



DHS SCIENCE AND TECHNOLOGY

Master Question List for COVID-19 (caused by SARS-CoV-2)

Weekly Report

20 October 2020

For comments or questions related to the contents of this document, please contact the DHS S&T Hazard Awareness & Characterization Technology Center at HACTechnologyCenter@hq.dhs.gov.



**Homeland
Security**

Science and Technology

DHS Science and Technology Directorate | MOBILIZING INNOVATION FOR A SECURE WORLD

CLEARED FOR PUBLIC RELEASE

FOREWORD

The Department of Homeland Security (DHS) is paying close attention to the evolving Coronavirus Infectious Disease (COVID-19) situation in order to protect our nation. DHS is working very closely with the Centers for Disease Control and Prevention (CDC), other federal agencies, and public health officials to implement public health control measures related to travelers and materials crossing our borders from the affected regions.

Based on the response to a similar product generated in 2014 in response to the Ebolavirus outbreak in West Africa, the DHS Science and Technology Directorate (DHS S&T) developed the following “master question list” that quickly summarizes what is known, what additional information is needed, and who may be working to address such fundamental questions as, “What is the infectious dose?” and “How long does the virus persist in the environment?” The Master Question List (MQL) is intended to quickly present the current state of available information to government decision makers in the operational response to COVID-19 and allow structured and scientifically guided discussions across the federal government without burdening them with the need to review scientific reports, and to prevent duplication of efforts by highlighting and coordinating research.

The information contained in the following table has been assembled and evaluated by experts from publicly available sources to include reports and articles found in scientific and technical journals, selected sources on the internet, and various media reports. It is intended to serve as a “quick reference” tool and should not be regarded as comprehensive source of information, nor as necessarily representing the official policies, either expressed or implied, of the DHS or the U.S. Government. DHS does not endorse any products or commercial services mentioned in this document. All sources of the information provided are cited so that individual users of this document may independently evaluate the source of that information and its suitability for any particular use. This document is a “living document” that will be updated as needed when new information becomes available.

The Department of Homeland Security Science and Technology Directorate is committed to providing access to our web pages for individuals with disabilities, both members of the public and federal employees. If the format of any elements or content within this document interferes with your ability to access the information, as defined in the Rehabilitation Act, please contact the Hazard Awareness & Characterization Technology Center for assistance by emailing HACTechnologyCenter@hq.dhs.gov. A member of our team will contact you within 5 business days. To enable us to respond in a manner most helpful to you, please indicate the nature of your accessibility problem, the preferred format in which to receive the material, the web address (<https://www.dhs.gov/publication/st-master-question-list-covid-19>) or name of the document of the material (Master Question List for COVID-19) with which you are having difficulty, and your contact information.

Table of Contents

Infectious Dose – How much agent will make a healthy individual ill?	3
The human infectious dose of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is unknown by all exposure routes. Studies from other animal models are used as surrogates for humans. Based on primate and rodent models, the inhalation median infectious dose (ID ₅₀) in humans is likely less than 10,000 PFU, and possibly less than 1,000 PFU. We need to know the infectious dose for humans by all possible exposure routes in order to inform models, develop diagnostics and countermeasures, and inform disinfection efforts.	
Transmissibility – How does it spread from one host to another? How easily is it spread?	4
SARS-CoV-2 is passed easily between humans ($R_0 = 2.2-3.1$, $k = 0.2-0.5$), through close contact and aerosol transmission. ^{37, 90, 249, 442} Vertical transmission from mother to fetus is possible ^{483, 632} but rare. ⁶⁰³ Individuals can transmit SARS-CoV-2 to others while asymptomatic or pre-symptomatic. Clusters of cases arising from social settings are larger than those occurring in households. ¹⁹ Super-spreading events (SSEs) appear common in SARS-CoV-2 transmission and may be crucial for controlling spread. Rates of transmission on public transport are unclear but appear low. ²³⁵ The role of children in disease transmission is not well-understood, but confirmed pediatric cases in the US are increasing. ¹⁴ Undetected cases play a major role in transmission, and most cases are not reported. ⁷⁰⁰ Individuals who have recovered clinically, but test positive, appear unable to transmit COVID-19. ³¹⁸ We need to know the relative contribution of different routes of transmission (e.g., fomites, aerosols, droplets).	
Host Range – How many species does it infect? Can it transfer from species to species?	5
SARS-CoV-2 is closely related to other coronaviruses circulating in bats in Southeast Asia. Previous coronaviruses have passed through an intermediate mammal host before infecting humans, but the presence or identity of the SARS-CoV-2 intermediate host is unknown. ^{377, 388, 390} Current evidence suggests a direct jump from bats to humans is plausible. ⁸⁰ SARS-CoV-2 uses the same receptor for cell entry as the SARS-CoV-1 coronavirus that circulated in 2002/2003. Animals can transmit SARS-CoV-2 to humans. Several animal species are susceptible to SARS-CoV-2 infection. We need to know the best animal model for replicating human infection by various exposure routes.	
Incubation Period – How long after infection do symptoms appear? Are people infectious during this time?	6
On average, symptoms develop 5 days after exposure with a range of 2-14 days. Incubating individuals can transmit disease for several days before symptom onset. Some individuals never develop symptoms but can still transmit disease. It is estimated that most individuals are no longer infectious beyond 10 days after symptom onset. The average time between symptom onset in successive cases (i.e., the serial interval) is approximately 5 days. Individuals can shed virus for several weeks, though it is not necessarily infectious. We need to know the incubation duration and length of infectivity in different patient populations.	
Clinical Presentation – What are the signs and symptoms of an infected person?	7
Most symptomatic cases are mild, but severe disease can be found in any age group. ⁹ Older individuals and those with underlying conditions are at higher risk of serious illness and death, as are men. ⁴⁷⁴ Fever is most often the first symptom. Between 16% and 58% of cases are asymptomatic throughout the course of their infection. ^{93, 97, 358, 366, 437, 458, 472, 593, 609} The case fatality rate is unknown, but individuals >60 and those with comorbidities are at elevated risk of death. ^{602, 714} Minority populations are disproportionately affected by COVID-19. ⁴⁴¹ Children are susceptible to COVID-19, ¹⁷⁰ though generally show milder ^{125, 403} or no symptoms. We need to know the true case fatality rate, as well as the duration and prevalence of debilitating symptoms that inhibit an individual's ability to function.	
Protective Immunity – How long does the immune response provide protection from reinfection?	8
Infected patients show productive immune responses, but the duration of any protection is unknown. Reinfection is possible. The longevity of antibody responses and T-cell responses is unknown but appears to be at least several months. Reinfection with SARS-CoV-2 is possible, but the frequency of reinfection is unknown. The strength and duration of any immunity after initial COVID-19 infection is unknown. ^{33, 662} The contribution of historical coronavirus exposure to SARS-CoV-2 immunity is unknown. Immune responses appear to differ by sex and age, and may contribute to differences in symptom severity. We need to know the frequency and severity of reinfection, as well as the protective effects of immune components.	
Clinical Diagnosis – Are there tools to diagnose infected individuals? When during infection are they effective?	9
Diagnosis of COVID-19 is based on symptoms consistent with COVID-19, PCR-based testing of active cases, and/or the presence of SARS-CoV-2 antibodies in individuals. Confirmed cases are still underreported. ²⁷⁰ Validated serological (antibody) assays are being used to help determine who has been exposed to SARS-CoV-2. We need to identify additional factors that affect the accuracy of serological or PCR-based diagnostic tests.	
Medical Treatments – Are there effective treatments?	10

There is no universally effective treatment for COVID-19, but some treatments reduce disease severity and mortality. Remdesivir may reduce symptom duration in hospitalized patients, but there is no evidence that it reduces mortality. Hydroxychloroquine is associated with risk of cardiac arrhythmias and provides limited to no clinical benefit.¹⁹⁹ Corticosteroids may significantly reduce mortality in severely ill and ventilated patients. Convalescent plasma treatment is safe and appears to be effective when administered early, though evidence is mixed.⁴⁹³ Anticoagulants may reduce COVID-19 mortality in hospitalized patients. Other pharmaceutical interventions are being investigated but results from large clinical trials are needed. We need clear, randomized trials for treatment efficacy in patients with both severe and mild/moderate illness.

Vaccines – Are there effective vaccines?11

Work is ongoing to develop and produce a SARS-CoV-2 vaccine (e.g., Operation Warp Speed).^{62, 260, 265-267, 455} Early results are being released, but evidence should be considered preliminary until larger Phase III trials are completed.⁶⁶¹ Globally, there are 5 vaccine candidates that have received broad use approval or Emergency Use Authorization. We need published results from Phase I-III trials in humans to assess vaccine efficacy and safety, and length of immunity.

Non-pharmaceutical Interventions – Are public health control measures effective at reducing spread?12

Broad-scale control measures such as stay-at-home orders and widespread face mask use effectively reduce transmission and are more impactful when implemented simultaneously. Public health notifications increase adherence to policies.²⁰⁵ Research is needed to plan the path to SARS-CoV-2 elimination via pharmaceutical and non-pharmaceutical interventions. We need to understand measures that will limit spread in the winter, particularly in indoor environments.

Environmental Stability – How long does the agent live in the environment?13

SARS-CoV-2 can persist on surfaces for at least 3 days and on the surface of a surgical mask for up to 7 days depending on conditions. SARS-CoV-2 is stable for at least several hours as an aerosol but is inactivated rapidly with sunlight and heat. SARS-CoV-2 survival on surfaces is highly dependent on the presence of UV light and temperature. SARS-CoV-2 survival in the air is highly dependent on the presence of UV light and temperature. The International Commission on Microbiological Specifications for Foods (ICMSF) believes that it is highly unlikely that ingestion of SARS-CoV-2 will result in illness. We need to quantify the duration of SARS-CoV-2 infectivity on surfaces, not simply the presence of RNA.

Decontamination – What are effective methods to kill the agent in the environment?14

Soap and water, as well as common alcohol and chlorine-based cleaners, hand sanitizers, and disinfectants are effective at inactivating SARS-CoV-2 on hands and surfaces. Several methods exist for decontaminating N95 respirators.⁴⁶³ We need additional SARS-CoV-2 decontamination studies, particularly with regard to PPE and other items in short supply.

PPE – What PPE is effective, and who should be using it?15

Face masks appear effective at reducing infections from SARS-CoV-2. Healthcare workers are at high risk of acquiring COVID-19, even with recommended PPE. We need to continue assessing PPE effectiveness with specific regard to SARS-CoV-2 instead of surrogates.

Forensics – Natural vs intentional use? Tests to be used for attribution.16

All current evidence supports the natural emergence of SARS-CoV-2 via a bat and possible intermediate mammal species. We need to know whether there was an intermediate host species between bats and humans.

Genomics – How does the disease agent compare to previous strains?17

Current evidence suggests that SARS-CoV-2 accumulates mutations at a similar rate as other coronaviruses. At least one mutation has been associated with greater viral transmission, but virulence appears unchanged. Associations between human blood type and COVID-19 severity are unclear. We need to link genotypes to phenotypes (e.g., disease severity) in infected patients.

Forecasting – What forecasting models and methods exist?18

We need to know how different forecasting methods have fared when compared to real data and develop an understanding of which model features contribute most to accurate and inaccurate forecasts.

Infectious Dose – How much agent will make a healthy individual ill?
What do we know?
<p>The human infectious dose of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is unknown by all exposure routes. Studies from other animal models are used as surrogates for humans. Based on primate and rodent models, the inhalation median infectious dose (ID₅₀) in humans is likely less than 10,000 PFU, and possibly less than 1,000 PFU.</p>
<ul style="list-style-type: none"> • The UK plans to conduct human exposure trials in January 2021 to identify the infectious dose of SARS-CoV-2.⁸⁰
<p><i>Non-human primates</i></p>
<ul style="list-style-type: none"> • A total dose of approximately 700,000 plaque-forming units (PFU) of the novel coronavirus SARS-CoV-2 infected cynomolgus macaques via combination intranasal and intratracheal exposure (10⁶ TCID₅₀ total dose).⁵⁴² Macaques did not exhibit clinical symptoms, but shed virus from the nose and throat.⁵⁴² • Rhesus and cynomolgus macaques showed mild to moderate clinical infections at doses of 4.75x10⁶ PFU (delivered through several routes), while marmosets developed mild infections when exposed to 1x10⁶ PFU intranasally.⁴⁰³ • Rhesus macaques are effectively infected with SARS-CoV-2 via the ocular conjunctival and intratracheal route at a dose of ~700,000 PFU (10⁶ TCID₅₀).¹⁵⁹ Rhesus macaques infected with 2,600,000 TCID₅₀ of SARS-CoV-2 by the intranasal, intratracheal, oral and ocular routes combined recapitulate moderate human disease.⁴⁴⁸ A small study infected Rhesus macaques via ocular inoculation (1x10⁶ TCID₅₀), resulting in mild infection; however, gastric inoculation did not result in infection (same dose), suggesting a limited role of gastric transmission. Interpretation is limited due to the small scale.¹⁵⁸ • African green monkeys replicate aspects of human disease, including severe pathological symptoms (exposed to 500,000 PFU via intranasal and intratracheal routes),⁶⁷⁵ mild clinical symptoms (aerosol exposures between 5,000 and 16,000 PFU),²⁶⁸ and acute respiratory distress syndrome (ARDS), with small particle aerosol exposure doses as low as 2,000 PFU.⁷⁶ • Aerosol exposure of three primate species (African green monkeys, cynomolgus macaques, and rhesus macaques) via a Collison nebulizer resulted in mild clinical disease in all animals with doses between 28,700 and 48,600 PFU.³⁰⁷ • Rhesus macaques have been suggested as the best non-human primate model of human COVID-19.⁴⁰²
<p><i>Rodents and other animal models</i></p>
<ul style="list-style-type: none"> • Low-dose intranasal inoculation of ferrets (2,000 PFU) and Golden Syrian hamsters (1,800 PFU) with SARS-CoV-2 resulted in mild clinical symptoms, the production of infectious virus, and seroconversion.⁴⁴⁰ • Golden Syrian hamsters exposed to 80,000 TCID₅₀ (~56,000 PFU) via the intranasal route developed clinical symptoms reminiscent of mild human infections (all hamsters infected).⁵⁷² In a separate study, immunosuppressed Golden Syrian hamsters showed severe clinical symptoms (including death) after exposure to 100-10,000 PFU via intranasal challenge.⁸⁸ • Golden Syrian hamsters infected with 100,000 PFU intranasally exhibited mild clinical symptoms and developed neutralizing antibodies,¹²⁰ and were also capable of infecting individuals in separate cages. In another study, older hamsters had more severe symptoms and developed fewer neutralizing antibodies than younger hamsters.⁴⁷⁷ • Mice genetically modified to express the human ACE2 receptor (transgenic hACE2 mice) were inoculated intranasally with 100,000 TCID₅₀ (~70,000 PFU), and all mice developed pathological symptoms consistent with COVID-19.⁵⁵ • Transgenic (hACE2) mice became infected after timed aerosol exposure (36 TCID₅₀/minute) to between 900 and 1080 TCID₅₀ (~630-756 PFU). All mice (4/4) exposed for 25-30 minutes became infected, while no mice (0/8) became infected after exposure for 0-20 minutes (up to 720 TCID₅₀, ~504 PFU).⁵⁶ This paper has methodological caveats (e.g., particle size). • Transgenic (hACE2) mice exposed intranasally to 400,000 PFU of SARS-CoV-2 develop typical human symptoms.⁵⁹² • Ferrets infected with 316,000 TCID₅₀³²⁶ or 600,000 TCID₅₀⁵³⁵ of SARS-CoV-2 by the intranasal route show similar symptoms to human disease.^{326, 535} Uninfected ferrets in direct contact with infected ferrets test positive and show disease as early as 2 days post-contact.³²⁶ In one study, direct contact was required to transfer infection between ferrets,³²⁶ however, transmission without direct contact was found in another study.⁵³⁵ In a separate ferret study, 1 in 6 individuals exposed to 10² PFU via the intranasal route became infected, while 12 out of 12 individuals exposed to >10⁴ PFU became infected.⁵⁵¹ • Domestic cats exposed to 100,000 PFU of SARS-CoV-2 via the intranasal route developed severe pathological symptoms including lesions in the nose, throat, and lungs.⁵⁷⁰ In a separate study, infected cats showed no clinical signs, but were able to shed virus and transmit to other cats.⁸¹
<p><i>Related Coronaviruses</i></p>
<ul style="list-style-type: none"> • The infectious dose for severe acute respiratory syndrome coronavirus 1 (SARS-CoV-1) in mice is estimated to be between 67-540 PFU (average 240 PFU, intranasal route).^{151, 153} • Genetically modified mice exposed intranasally to Middle East respiratory syndrome coronavirus (MERS-CoV) between 100-500,000 PFU show signs of infection. Infection with higher doses result in severe syndromes.^{25, 139, 371, 711}
What do we need to know?
<p>We need to know the infectious dose for humans by all possible exposure routes in order to inform models, develop diagnostics and countermeasures, and inform disinfection efforts.</p>
<ul style="list-style-type: none"> • Human infectious dose by aerosol, surface contact (fomite), fecal-oral routes, and other potential routes of exposure • Most appropriate animal model(s) to estimate the human infectious dose for SARS-CoV-2 • Does exposure dose determine disease severity?

Transmissibility – How does it spread from one host to another? How easily is it spread?		
What do we know?		
<p>SARS-CoV-2 is passed easily between humans ($R_0 = 2.2-3.1$, $k = 0.2-0.5$), through close contact and aerosol transmission.^{36, 89, 248, 443} Vertical transmission from mother to fetus is possible^{182, 634} but rare.⁶⁰⁵</p> <ul style="list-style-type: none"> As of 10/20/2020, pandemic COVID-19 has caused at least 40,485,384 infections and 1,119,545 deaths globally.³⁰³ In the US, there have been 8,216,723 confirmed COVID-19 cases and 220,150 confirmed deaths,³⁰³ though both cases³⁴ and fatalities are underestimates.^{468, 674} Initial high-quality estimates of human transmissibility (R_0) range from 2.2 to 3.1^{412, 488, 539, 683, 710} and possibly higher.⁵⁵⁴ The US CDC (as of 10/5/2020) and WHO (as of 7/9/2020) acknowledge that SARS-CoV-2 can spread via aerosol or “airborne” transmission beyond 6 ft in certain situations⁶⁶⁸ such as enclosed indoor spaces with inadequate ventilation.¹¹⁰ The CDC advises that most SARS-CoV-2 transmission, however, is by larger respiratory droplets, not by small-particle aerosols.¹¹⁰ Infectious virus has been found in patient rooms,⁵⁵⁷ up to 16 feet away from COVID-19 patient beds,³⁶² at concentrations of 6 to 74 TCID₅₀/L.³⁶² Aerosol infection risk may be highest in crowded, indoor environments.⁹³ Based on cycle threshold values of viral load in the upper respiratory tract, it is estimated that exhaled breath may emit between 100,000-10,000,000 genome copies per person per hour,⁴⁰⁸ the amount of infectious virus remains unknown. In the US, younger individuals comprised a larger proportion of new cases in June-August (compared to January-May), and contributed to community transmission and subsequent infections in older adults.⁷⁷ <p>Individuals can transmit SARS-CoV-2 to others while asymptomatic or pre-symptomatic.</p> <ul style="list-style-type: none"> Individuals may be infectious for 1-3 days prior to symptom onset.^{45, 653} Pre-symptomatic^{78, 332, 580, 589, 689, 714} or asymptomatic^{54, 284, 407} patients can transmit SARS-CoV-2.³⁹⁶ At least 12% of all cases are estimated to be due to asymptomatic transmission.¹⁷³ Approximately 40%⁵³² (between 15-56%) of infections may be caused by pre-symptomatic transmission.^{101, 271, 392, 709} Individuals are most infectious before symptoms begin and within 5 days of symptom onset.¹²⁷ Asymptomatic individuals can transmit disease as soon as 2 days after infection.⁵⁸⁸ There is some evidence that asymptomatic individuals transmit SARS-CoV-2 less often than symptomatic individuals.^{92, 599} <p>Clusters of cases arising from social settings are larger than those occurring in households.¹⁹</p> <ul style="list-style-type: none"> Attack rates of the virus are higher within households than casual contacts.^{95, 568} Meta-analysis indicates that approximately 18% of household contacts of infected index patients acquire SARS-CoV-2 (i.e., the “attack rate”), with higher attack rates for symptomatic index cases, spouses of index cases, and adults.³³⁰ Adults represent 67% of household index cases.⁴¹⁵ SARS-CoV-2 may be spread by conversation and exhalation^{13, 369, 558, 582} in indoor areas such as restaurants;³⁷⁸ positive SARS-CoV-2 patients were twice as likely as negative patients to report that they had recently eaten in restaurants.²⁰⁵ Clusters are often associated with large indoor gatherings,^{361, 489} including bars, restaurants, and music festivals.⁷⁰⁰ <p>Super-spreading events (SSEs) appear common in SARS-CoV-2 transmission and may be crucial for controlling spread.</p> <ul style="list-style-type: none"> The majority of new infections come from relatively few infectious individuals (overdispersion parameter $k = 0.2-0.5$).^{18, 178, 356, 359, 643} Phylogenetics shows the importance of SSEs early in the COVID-19 outbreak.⁶⁴³ <p>Rates of transmission on public transport are unclear but appear low.²³⁴</p> <ul style="list-style-type: none"> Several studies have identified plausible transmission on airplanes.^{53, 133, 274, 322} Fluorescent tracer research on commercial airplanes suggests a low risk of aerosol or surface transmission during flights, though key parameters such as the emission rate (infectious particles per hour) remain uncertain, and results are sensitive to the assumed infectious dose.⁵⁷³ Testing for this study assumes that mask wearing is continuous, the number of infected passengers is low, and passengers only face forward. The testing does not consider passenger movement, passenger conversations, or infected flight attendants.⁵⁷³ On trains in China, transmission rates were high for those in the same row as an infectious individual (1.5-3.5% attack rate), though low for non-neighboring passengers.²⁸⁰ Infection risk increased with co-habitation time.²⁸⁰ The US CDC has issued a strong recommendation for face mask mandates on public transportation.⁵⁶⁹ <p>The role of children in disease transmission is not well-understood, but confirmed pediatric cases in the US are increasing.¹⁴</p> <ul style="list-style-type: none"> A large meta-analysis estimates that children are 44% less susceptible to COVID-19 than adults,⁶³² though modeling suggests that susceptibility does not differ substantially by age.⁴⁶⁹ During April to May 2020 in the US, adults who worked in childcare centers acquired COVID-19 at rates similar to those without childcare exposure, suggesting limited transmission from children to adults in childcare settings during a period of time where substantial mitigation measures were in place.²³⁰ Extensive contact tracing in India suggests that children readily transmit SARS-CoV-2 to other children.³⁵⁹ In a Georgia summer camp, 260 of 344 tested attendees (campers and staff) tested positive for SARS-CoV-2 RNA.⁵⁹⁴ <p>Undetected cases play a major role in transmission, and most cases are not reported.⁷⁰²</p> <ul style="list-style-type: none"> Models suggest up to 86% of early COVID-19 cases in China were undetected, and these infections were the source for 79% of reported cases.³⁷⁴ Models estimate that the true number of cases may be approximately 5 to 10 times greater than the reported number of cases in the US,^{306, 549, 574} though underreporting rates vary substantially among locations.²⁷⁸ <p>Individuals who have recovered clinically, but test positive, appear unable to transmit COVID-19.³¹⁷</p> <tr> <th>What do we need to know?</th></tr> <tr> <td> <p>We need to know the relative contribution of different routes of transmission (e.g., fomites, aerosols, droplets).</p> <ul style="list-style-type: none"> How common is transmission from bodily fluids like semen,³⁷⁰ urine,⁵⁹⁰ and feces?⁶²² How infectious are young children compared to adults? </td></tr>	What do we need to know?	<p>We need to know the relative contribution of different routes of transmission (e.g., fomites, aerosols, droplets).</p> <ul style="list-style-type: none"> How common is transmission from bodily fluids like semen,³⁷⁰ urine,⁵⁹⁰ and feces?⁶²² How infectious are young children compared to adults?
What do we need to know?		
<p>We need to know the relative contribution of different routes of transmission (e.g., fomites, aerosols, droplets).</p> <ul style="list-style-type: none"> How common is transmission from bodily fluids like semen,³⁷⁰ urine,⁵⁹⁰ and feces?⁶²² How infectious are young children compared to adults? 		

Host Range – How many species does it infect? Can it transfer from species to species?
What do we know?
<p>SARS-CoV-2 is closely related to other coronaviruses circulating in bats in Southeast Asia. Previous coronaviruses have passed through an intermediate mammal host before infecting humans, but the presence or identity of the SARS-CoV-2 intermediate host is unknown.^{377, 388, 390} Current evidence suggests a direct jump from bats to humans is plausible.⁷⁹</p> <ul style="list-style-type: none"> • Early genomic analysis indicates similarity to SARS-CoV-1,⁷¹⁸ with a suggested bat origin.^{140, 718} • Positive samples from the South China Seafood Market strongly suggests a wildlife source,¹¹⁴ though it is possible that the virus was circulating in humans before the disease was associated with the seafood market.^{62, 141, 687, 699} • Viruses similar to SARS-CoV-2 were present in pangolin samples collected several years ago,³⁴⁹ and pangolins positive for coronaviruses related to SARS-CoV-2 exhibited clinical symptoms such as cough and shortness of breath.³⁷⁶ However, a survey of 334 pangolins did not identify coronavirus nucleic acid in 'upstream' market chain samples, suggesting that positive samples from pangolins may be the result of exposure to infected humans, wildlife or other animals within the wildlife trade network. These data suggest that pangolins are incidental hosts of coronaviruses.³⁶⁴ <p>SARS-CoV-2 uses the same receptor for cell entry as the SARS-CoV-1 coronavirus that circulated in 2002/2003.</p> <ul style="list-style-type: none"> • Experiments show that SARS-CoV-2 Spike (S) receptor-binding domain binds the human cell receptor (ACE2) stronger than SARS-CoV-1,⁶⁷⁸ potentially explaining its high transmissibility. The same work suggests that differences between SARS-CoV-2 and SARS-CoV-1 Spike proteins may limit the therapeutic ability of SARS antibody treatments.⁶⁷⁸ • Changes in proteolytic cleavage of the Spike protein can also affect cell entry and animal host range, in addition to receptor binding.⁴²⁸ • Modeling suggests a wide range of animal hosts for SARS-CoV-2, though experimental studies are still needed.¹⁴⁸ <p>Animals can transmit SARS-CoV-2 to humans.</p> <ul style="list-style-type: none"> • Infected mink have been linked to human infections in workers at mink farms.⁴⁷⁹ <p>Several animal species are susceptible to SARS-CoV-2 infection.</p> <ul style="list-style-type: none"> • Animal model studies suggest that Golden Syrian hamsters, primates, and ferrets may be susceptible to infection.^{120, 326} In the Netherlands, farmed mink developed breathing and gastrointestinal issues, which was diagnosed as SARS-CoV-2 infection.¹ It is thought that an infected mink has transmitted SARS-CoV-2 to a human.³⁴³ Golden Syrian hamsters are able to infect other hamsters via direct contact and close quarters aerosol transmission.⁵⁷² Similarly, raccoon dogs (mammals related to foxes) are susceptible to COVID-19 (10⁵ intranasal exposure dose) and were shown to transmit infection to other raccoon dogs in neighboring enclosures.²¹⁵ • Domestic cats are susceptible to infection with SARS-CoV-2 (100,000-520,000 PFU via the intranasal route⁵⁷⁰ or a combination of routes²⁵⁷), and can transmit the virus to other cats via droplet or short-distance aerosol.⁵⁷⁰ Dogs exposed to SARS-CoV-2 produced anti-SARS-CoV-2 antibodies⁸² but exhibited no clinical symptoms.^{570, 578} • Deer mice can be experimentally infected with SARS-CoV-2 via intranasal exposure (10⁴ or 10⁵ TCID₅₀)¹⁸³ and are able to transmit virus to uninfected deer mice through direct contact.²⁴⁴ Their capacity as a reservoir species is unknown. • Wild cats (tigers and lions)⁶⁵¹ can be infected with SARS-CoV-2, although their ability to spread to humans is unknown.^{414, 706} Studies have confirmed that human keepers transmitted SARS-CoV-2 to tigers and lions at the Bronx Zoo.⁶⁰ Two cases of SARS-CoV-2 infection have been confirmed in pet domestic cats.¹⁰⁶ • Ducks, chickens, and pigs remained uninfected after experimental SARS-CoV-2 exposure (30,000 CFU for ducks and chickens⁵⁷⁰, 100,000 PFU for pigs⁵⁷⁰, ~70,000 PFU for pigs and chickens⁵⁵⁹ all via intranasal route).⁵⁷⁰ When pigs were inoculated by the oronasal route (10⁶ PFU), minimal to no signs of clinical disease were noted, suggesting limited transmission concerns.⁵⁰⁴ • Chicken, turkey, duck, quail, and geese were not susceptible to SARS-CoV-2 after experimental exposures.⁵⁸⁷ • Rabbits do not exhibit clinical symptoms after exposure to SARS-CoV-2, but do seroconvert.⁴⁵⁰ • Cattle exposed to SARS-CoV-2 showed no clinical disease but exhibited low levels of viral shedding in the nose, which could be residual virus from the exposure dose.⁶¹⁶
What do we need to know?
<p>We need to know the best animal model for replicating human infection by various exposure routes.</p> <ul style="list-style-type: none"> • What is the intermediate host(s) (if any)? • Which animal species can transmit SARS-CoV-2 to humans? • Can SARS-CoV-2 circulate in animal reservoir populations, potentially leading to future spillover events?

Incubation Period – How long after infection do symptoms appear? Are people infectious during this time?
What do we know?
<p>On average, symptoms develop 5 days after exposure with a range of 2-14 days. Incubating individuals can transmit disease for several days before symptom onset. Some individuals never develop symptoms but can still transmit disease.</p>
<ul style="list-style-type: none"> • By general consensus, the incubation period of COVID-19 is between 5³⁵⁷ and 6⁶⁵⁴ days.⁶⁹² Fewer than 2.5% of infected individuals show symptoms sooner than 2 days after exposure.³⁵⁷ However, more recent estimates using different models calculate a longer incubation period, between 7 and 8 days.⁵¹⁴ This could mean that 5-10% of individuals undergoing a 14-day quarantine are still infectious at the end.⁵¹⁴ • There is evidence that younger (<14) and older (>75) individuals have longer COVID-19 incubation periods, creating a U-shaped relationship between incubation period length and patient age³³³ while adolescent and young adult populations (15-24 years old) have been estimated at ~2 days.³⁸¹ • Individuals can test positive for COVID-19 even if they lack clinical symptoms.^{54, 119, 249, 604, 714} • Individuals can be infectious while asymptomatic,^{111, 546, 604, 714} and asymptomatic and pre-symptomatic individuals have similar amounts of virus in the nose and throat compared to symptomatic patients.^{45, 324, 723} • Peak infectiousness may be during the incubation period, one day before symptoms develop.²⁷¹ Infectious virus has been cultured in patients up to 6 days before the development of symptoms.⁴⁵
<p>It is estimated that most individuals are no longer infectious beyond 10 days after symptom onset.</p>
<ul style="list-style-type: none"> • While the amount of virus needed to infect another individual is unknown, mild-moderate COVID-19 cases appear to be infectious for no longer than 10 days after symptom onset, while severely ill or immunocompromised patients may be infectious for 20 days after symptom onset; individuals can also transmit infection before symptoms appear.⁶³⁷ • Asymptomatic individuals are estimated to be infectious for a median of 9.5 days.²⁸²
<p>The average time between symptom onset in successive cases (i.e., the serial interval) is approximately 5 days.</p>
<ul style="list-style-type: none"> • On average, there are approximately 4¹⁷³ to 7.5³⁷² days between symptom onset in successive cases of a single transmission chain (i.e., the serial interval). Based on data from 339 transmission chains in China and additional meta-analysis, the mean serial interval is between 4.4 and 6.0 days.^{172, 519, 692} • The serial interval of COVID-19 has declined substantially over time as a result of increased case isolation,³⁰ meaning individuals tend to transmit virus for less time.
<p>Individuals can shed virus for several weeks, though it is not necessarily infectious.</p>
<ul style="list-style-type: none"> • Children are estimated to shed virus for 15 days on average, with asymptomatic individuals shedding virus for less time (11 days) than symptomatic individuals (17 days).⁴⁰⁶ • Asymptomatic and mildly ill patients who test positive for SARS-CoV-2 take less time to test negative than severely ill patients.³⁶⁶ • Patients infected by asymptomatic or young (<20 years old) individuals may take longer to develop symptoms than those infected by other groups of individuals.⁶⁵⁴ • Viral RNA loads in the upper respiratory tract tend to peak within a few days of symptom onset and become undetectable approximately two weeks after symptoms begin.⁶³⁶ The duration of the infectious period is unknown,⁶³⁶ though patients can test positive for SARS-CoV-2 viral RNA for extended periods of time, particularly in stool samples.⁶³⁶
What do we need to know?
<p>We need to know the incubation duration and length of infectivity in different patient populations.</p>
<ul style="list-style-type: none"> • What is the average infectious period during which individuals can transmit the disease? • How soon can asymptomatic patients transmit infection after exposure? • Does the incubation period correlate with disease severity or exposure dose?

Clinical Presentation – What are the signs and symptoms of an infected person?
What do we know?
<p>Most symptomatic cases are mild, but severe disease can be found in any age group.⁹ Older individuals and those with underlying conditions are at higher risk of serious illness and death, as are men.⁴⁷⁵ Fever is most often the first symptom.</p> <ul style="list-style-type: none"> • COVID-19 generally begins with fever, then cough and malaise, with gastrointestinal symptoms developing later.³⁵¹ In 49 children with COVID-19 (0-22 years), however, only 51% developed fever.⁶⁹⁶ Temperature-only screening may miss active infections, as only 20% of emergency department patients testing positive for COVID-19 had fevers >100°F.⁶³¹ • Most symptomatic COVID-19 cases are mild (81%, n=44,000 cases).^{604, 669} Initial COVID-19 symptoms include fever (87.9%, only 44-52% present with fever initially),^{43, 249} cough (67.7%),²⁴⁹ fatigue, shortness of breath, headache, and reduced lymphocyte count.^{112, 123, 283} Initial cough without fever may precede mild/moderate illness.³⁷⁹ Chills, muscle pain, headache, sore throat, and loss of taste or smell^{116, 496, 690} are also possible COVID-19 symptoms.¹¹² GI symptoms are present in approximately 9% of patients.⁵⁴⁴ Neurological symptoms are observed in up to 82% of individuals hospitalized with COVID-19.³⁸⁴ Ocular issues⁶⁸⁵ such as conjunctivitis (~10%)²⁵³ and skin lesions²¹⁹ may also be symptoms of COVID-19.⁸³ • Complications include acute respiratory distress syndrome (ARDS, 17-29% of hospitalized patients),^{125, 283, 639} pneumonia,⁴⁸³ cardiac injury (20%),⁵⁷¹ secondary infection, kidney damage,^{44, 586} pancreatitis,³³ arrhythmia, sepsis, stroke (1.6% of hospitalized patients),⁴³⁰ other respiratory complications,⁶¹⁹ and shock.^{249, 283, 639, 716} • SARS-CoV-2 may attack blood vessels in the lung, leading to clotting complications and ARDS.^{17, 625} Clotting affects multiple human organ systems⁵²³ and is present in 15-27% of cases.⁴⁰⁵ • Approximately 15% of hospitalized patients are classified as severe,^{249, 604} and approximately 5% of patients are admitted to the ICU.^{249, 604} Higher SARS-CoV-2 RNA loads on admission have been associated with greater risk of death.^{410, 659} • COVID-19 symptoms like fatigue and shortness of breath commonly persist for weeks⁶⁰³ to months¹⁰⁰ after initial onset. Most (88%) individuals infected with COVID-19 (n=86) showed evidence of lung damage six weeks after clinical recovery.²⁵⁰ • COVID-19 associated hyperinflammatory syndrome can lead to increased disease severity and mortality.⁶⁵² Adults can also experience a multisystem inflammatory response (MIS-A) similar to that seen in children.⁴⁴⁶ • In 206 adults hospitalized with COVID-19 in Iran, those with vitamin D deficiency die at higher rates than those with sufficient vitamin D levels.⁴⁰⁹ Additional study on the role of vitamin D is warranted.⁴²⁷ <p>Between 16% and 58% of cases are asymptomatic throughout the course of their infection.^{92, 96, 358, 366, 438, 459, 473, 595, 611}</p> <p>The case fatality rate is unknown, but individuals >60 and those with comorbidities are at elevated risk of death.^{604, 716}</p> <ul style="list-style-type: none"> • Cardiovascular disease, obesity,^{20, 503} hypertension,⁷⁰⁴ diabetes, and respiratory conditions all increase the CFR.^{604, 716} • The CFR increases with age (data from China and Italy): 0-19 years < 0.2%; 20-29 years = 0-0.2%, 30-39 years = 0.2-0.3%, 40-49 years = 0.4%, 50-59 years 1.0-1.3%, 60-69 years = 3.5-3.6%, 70-79 years = 8.0-12.8%, >80 years = 14.8-20.2%.⁴⁷¹ • In Iceland, the overall case fatality rate has been estimated at 0.3-0.6% but increases to ~4% in those over 70 years old.²⁵¹ An estimated overall infection fatality rate for Indiana was calculated as 0.26%, increasing to 1.71% for those >65 years old.⁷⁵ • Smoking appears to be statistically associated with a higher likelihood of COVID-19 progressing to more severe disease.⁴⁹³ <p>Minority populations are disproportionately affected by COVID-19.⁴⁴²</p> <ul style="list-style-type: none"> • Black, Asian, and Minority Ethnic populations acquire SARS-CoV-2 infection at higher rates than other groups^{209, 242, 482, 511} and are hospitalized^{223, 513} and die disproportionately.^{276, 432} Hispanic and Black COVID-19 patients tend to die at younger ages than white patients.⁶⁷⁷ Hispanic, Black, and American Indian children account for 78% of US pediatric deaths (n=121).⁷⁴ • Pregnant women with COVID-19 appear to require ICU care more often than non-pregnant women,⁵⁰⁷ have higher rates of preterm delivery and are less likely to present with fever and myalgia.³¹ Severity in pregnant women may be associated with underlying conditions such as obesity.³¹ Preterm births are more likely in symptomatic patients.¹⁵⁵ Approximately 25% of pregnant COVID-19 patients had symptoms for at least 8 weeks.²³ <p>Children are susceptible to COVID-19,¹⁶⁹ though generally show milder^{124, 404} or no symptoms.</p> <ul style="list-style-type: none"> • Between 21-28% of children (<19 years old) may be asymptomatic.^{404, 491, 515} Most symptomatic children present with mild or moderate symptoms,^{241, 491} with few exhibiting severe or clinical illness.⁶⁸² In the US, 33% of children hospitalized with COVID-19 required ICU care, though the case fatality rate was low (1.8%).³²³ Severe symptoms in children³⁹¹ and infants^{91, 404} are possible, and more likely in those with complex medical histories.⁵⁶⁷ Pediatric mortality from SARS-CoV-2 follows national trends in neonatal mortality, rather than following trends of SARS-CoV-2 death rates in adults.²³⁶ • WHO⁶⁶⁷ and US CDC³⁰¹ have issued definitions for a rare condition in children (Pediatric Multi-System Inflammatory Syndrome, MIS-C)²³² linked to COVID-19 infection.⁵⁴⁰ The prevalence of this condition is unknown. Children with both severe and moderate initial symptoms can progress to MIS-C,²³¹ though it may be more likely to be preceded by fever.⁶⁹⁶ • Lymphopenia and blood cell abnormalities are less common in children than adults, except for children with MIS-C.³⁴⁰
What do we need to know?
<p>We need to know the true case fatality rate, as well as the duration and prevalence of debilitating symptoms that inhibit an individual's ability to function.</p> <ul style="list-style-type: none"> • How does the asymptomatic fraction vary across age groups? • How long, on average, are affected individuals unable to perform normal jobs and responsibilities?

Protective Immunity – How long does the immune response provide protection from reinfection?
What do we know?
<p>Infected patients show productive immune responses, but the duration of any protection is unknown. Reinfection is possible. The longevity of antibody responses and T-cell responses is unknown but appears to be at least several months.</p> <ul style="list-style-type: none"> In 1,215 infected individuals from Iceland, 91% developed antibody responses that persisted for at least 4 months.²⁵¹ In 880 patients from Northern Ireland, SARS-CoV-2 antibodies were still detectable at 20 weeks post-infection.⁵⁴¹ Mild COVID-19 infections can induce detectable immune responses for at least 3 months.⁵⁴³ In a study of 285 COVID-19 patients, 100% developed antiviral IgG within 19 days of symptom onset,³⁹⁵ and antibody levels have been correlated with neutralizing ability in <i>in vitro</i> studies.⁶⁰⁹ In a smaller study of 44 patients, plasma from 91% demonstrated SARS-CoV-2 neutralizing ability, appearing ~8 days after symptom onset.⁵⁹³ The antibody IgM appears to contribute substantially to SARS-CoV-2 neutralizing ability, with IgG also contributing to a lesser extent.²²⁵ In a study of 221 COVID-19 patients, levels of two types of antibodies (IgM and IgG) were not associated with the severity of symptoms.²⁸¹ However, in a smaller study, patients with severe disease showed stronger antibody responses than those with non-severe symptoms.⁶⁰⁹ Severely ill individuals develop higher levels of neutralizing antibodies³⁸⁶ and greater T-cell response frequencies⁵⁶³ than mildly symptomatic or asymptomatic individuals. <p>Reinfection with SARS-CoV-2 is possible, but the frequency of reinfection is unknown.</p> <ul style="list-style-type: none"> Researchers in Hong Kong³³⁹ and the US⁶⁰⁸ have identified COVID-19 reinfections. Reinfections have been either less³³⁹ or more severe⁶⁰⁸ than the initial infection. The infectiousness of re-infected individuals is unknown. Two studies suggest limited reinfection potential in macaques, with re-challenge 28 days¹⁶⁰ or 35 days¹²² after initial exposure resulting in no clinical symptoms. Ferrets infected with 10² – 10⁴ PFU were protected from acute lung injury following secondary challenge with SARS-CoV-2 28 days after initial exposure, but they did exhibit clinical symptoms such as lethargy and ruffled fur.⁵⁵¹ Cats exposed to SARS-CoV-2 after initial recovery did not shed virus.⁸² <p>The strength and duration of any immunity after initial COVID-19 infection is unknown.^{32, 664}</p> <ul style="list-style-type: none"> In a small study (n=65), 95% of patients developed neutralizing antibodies within 8 days of symptom onset,⁵⁶⁴ but neutralizing antibody titers declined substantially when assayed after 60 days.⁵⁶⁴ Individuals with more severe infections developed higher neutralizing antibody levels that persisted longer than those with asymptomatic or mild infections.⁵⁶⁴ Neutralizing antibodies develop in 50-70% of patients.^{39, 496, 680} In an outbreak on a fishing vessel where 85% of the crew became infected, three individuals who had high levels of neutralizing antibodies from previous SARS-CoV-2 exposure were protected from the on-board outbreak.²¹ Some patients do not develop detectable antibody responses,^{600, 680} and their future protection is unknown. A small study (n=4) identified that children (<3 years) can seroconvert after asymptomatic infection, but level of protection is unknown.³¹⁶ In a 35-year study of 10 men, immunity to seasonal coronaviruses waned after one year.¹⁷⁵ Reinfection was observed between one and three years after initial infection.¹⁷⁵ Previous studies on coronavirus immunity suggest that neutralizing antibodies may wane after several years.^{97, 684} <p>The contribution of historical coronavirus exposure to SARS-CoV-2 immunity is unknown.</p> <ul style="list-style-type: none"> Cross-reactivity in T-cell responses between other human coronaviruses and SARS-CoV-2 may explain variation in symptom severity among patients.⁴¹⁷ Key components of the human immune response (memory B cells) are activated by SARS-CoV-2, and may persist for decades to offset any waning antibody immunity.⁴⁵⁴ Cross-reactivity from seasonal coronaviruses also enhances the immune response toward the S2 unit of the SARS-CoV-2 Spike protein.⁴⁵⁴ Two studies identified key components of the adaptive immune system (CD4⁺ T cells) in the majority of recovered COVID-19 patients, and these cells reacted to SARS-CoV-2 Spike protein.^{86, 246} These studies also identified Spike protein responses in CD4⁺ T cells of ~30-40% of unexposed patients,²⁴⁶ suggesting some cross-reactivity between other circulating human coronaviruses and SARS-CoV-2.^{86, 246} Long-lasting T-cell responses have been seen in SARS-CoV-1 patients, and T-cell cross-reactivity between other coronaviruses and SARS-CoV-2 suggest additional immune protection.³⁶⁰ Children do not appear to be protected from SARS-CoV-2 infection by historical exposure to seasonal coronaviruses.⁵⁶⁵ Serum from patients exposed to seasonal coronaviruses did not neutralize SARS-CoV-2.⁵¹⁰ <p>Immune responses appear to differ by sex and age, and may contribute to differences in symptom severity.</p> <ul style="list-style-type: none"> In 39 patients, the immune responses of females differed from males, namely through a stronger T-cell response and lower levels of some inflammatory cytokines,⁵⁹⁷ which may help to explain increased disease severity in males. In 159 patients, antibody levels differed between males and females, supporting the notion that greater inflammatory responses in males contribute to their elevated disease severity.³³⁹ Symptom severity in adults does not appear to be due to a lack of an adaptive immune response; rather, early action of the innate immune response may affect disease severity in both adult and pediatric/adolescent cases.⁵⁰⁵
What do we need to know?
<p>We need to know the frequency and severity of reinfection, as well as the protective effects of immune components.</p> <ul style="list-style-type: none"> How do different components of the immune response contribute to long-term protection? How does initial disease severity affect the type, magnitude, and timing of any protective immune response?

Clinical Diagnosis – Are there tools to diagnose infected individuals? When during infection are they effective?
What do we know?
<p>Diagnosis of COVID-19 is based on symptoms consistent with COVID-19, PCR-based testing of active cases, and/or the presence of SARS-CoV-2 antibodies in individuals. Confirmed cases are still underreported.²⁶⁹</p> <ul style="list-style-type: none"> • The US CDC recommends that anyone, including those without symptoms, who has been in contact with a positive COVID-19 case should be tested (as of 9/18/2020).¹¹⁷ The CDC advises that recovered patients need not be tested for SARS-CoV-2 again within 3 months of recovery unless symptoms re-develop; this advice does not imply protection from re-infection.¹¹³ • The timing of diagnostic PCR tests impacts results. The false-negative rate for RT-PCR tests is lowest between 7 and 9 days after exposure, and PCR tests are more likely to give false-negative results before symptoms begin (within 4 days of exposure) and more than 14 days after exposure.³⁴⁶ Low viral loads can lead to false negative RT-PCR tests,³⁸⁷ and viral loads are lower in late stage infections as well as at the end of a given day. The role of temporal changes in immunological response and variation of diagnostic test results based on symptom severity warrants additional studies.³³⁴ • Nasal and pharyngeal swabs may be less effective as diagnostic specimens than sputum and bronchoalveolar lavage fluid,⁶⁴⁵ although evidence is mixed.⁶⁷¹ Combination RT-PCR and serology (antibody) testing may increase the ability to diagnose patients with mild symptoms, or identify patients at higher risk of severe disease.⁷¹² Assays targeting antibodies against the nucleocapsid protein (N) instead of the Spike protein (S) of SARS-CoV-2 may improve detection.⁹⁴ The US FDA has issued an Emergency Use Authorization for a saliva-based diagnostic assay.¹⁸⁴ • Diagnostic test results from at-home, mid-nasal swabs were comparable to clinician-conducted nasopharyngeal swabs, though false-negatives were observed in individuals with low viral titer.⁴¹⁸ • Asymptomatic individuals have a higher likelihood of testing negative for a specific antibody (IgG) compared to symptomatic patients, potentially due to lower viral loads (as measured by RT-PCR).⁶⁵⁸ • Tests from the US CDC are available to states.^{104, 111} Rapid test kits have been produced by universities and industry.^{66, 72, 147, 191, 629} Home tests are being developed, though they cannot yet be used for diagnosis.^{449, 451, 487} • The CRISPR-Cas12a system is being used to develop fluorescence-based COVID-19 diagnostic tests.^{167, 286} India has approved a rapid CRISPR-based test paper capable of generating results with 96% sensitivity and 98% specificity within an hour of nasopharyngeal swab.⁴ • Low-sensitivity tests (like lateral flow assays) may be beneficial despite lower accuracy, because they reduce the time necessary to identify and subsequently contain potential outbreaks.⁴³³ • Immunological indicators^{51, 177, 222, 270, 285, 506, 591, 640} fasting blood glucose levels,⁶⁴⁴ and oxygen levels³²⁹ may help differentiate between severe and non-severe cases,¹³⁴ and decision-support tools for diagnosing severe infections exist.^{419, 576, 681} • Preliminary work has demonstrated the feasibility of nanoparticle-based breath samplers for detecting COVID-19, though additional validation work is necessary on larger sample sizes.⁵⁶⁶ • As of 20 October, the FDA has approved 281 tests under EUAs, including 219 molecular, 56 antibody, and 6 antigen tests.²¹² • Pooling samples and conducting RT-PCR tests may expand testing capability.⁴³⁵ • Detection dogs are being used at airports to recommend individuals for subsequent SARS-CoV-2 PCR testing.⁵¹² • High-throughput diagnostic platforms based on loop-mediated isothermal amplification (LamPORE) are comparable in sensitivity and specificity to PCR, and may increase sampling speed.⁵⁰² A high-throughput diagnostic assay for screening asymptomatic individuals has received US Emergency Use Authorization.^{84, 213}
Validated serological (antibody) assays are being used to help determine who has been exposed to SARS-CoV-2.
<ul style="list-style-type: none"> • Repeated serological testing is necessary to identify asymptomatic⁵⁰⁹ and other undetected patients.⁵⁵⁵ Exclusively testing symptomatic healthcare workers is likely to exclude a large fraction of COVID-19 positive personnel.⁵⁸⁵ • Research has shown high variability in the ability of tests (ELISA⁴⁶⁷ and lateral flow assays) by different manufacturers to accurately detect positive and negative cases (sensitivity and specificity, respectively).^{353, 660} The FDA has excluded several dozen serological diagnostic assays based on failure to conform to updated regulatory requirements.¹⁸⁹ Researchers have designed a standardized ELISA procedure for SARS-CoV-2 serology samples.³²⁸ • Meta-analysis suggests that lateral flow assays (LFIA) are less accurate than ELISA or chemiluminescent methods (CLIA), but that the target of serological studies (e.g., IgG or IgM) does not affect accuracy.³⁸⁵ • Serological assay false positive rates may account for a substantial portion of reported exposures.⁶⁵ The Infectious Disease Society of America advises against using serology to determine exposure within two weeks of symptom onset.²⁶¹ • SARS-CoV-2 RNA is likely to persist long enough in untreated wastewater to permit reliable detection for COVID-19 surveillance,²⁶ and can warn of SARS-CoV-2 cases ahead of positive PCR tests and hospital admissions.⁴⁹⁷ • As of July 2020, approximately 9% of the US population had serological evidence of SARS-CoV-2 exposure, with proportions varying substantially across different locations (e.g., 33.6% in New York, 3.8% in California).³⁴
What do we need to know?
<p>We need to identify additional factors that affect the accuracy of serological or PCR-based diagnostic tests.</p> <ul style="list-style-type: none"> • How long do antibody targets of serological assays persist, and after what point are they not informative for prevalence? • What is the relationship between disease severity and the timing of positive serological assays?

Medical Treatments – Are there effective treatments?
What do we know?
<p>There is no universally effective treatment for COVID-19, but some treatments reduce disease severity and mortality. Remdesivir may reduce symptom duration in hospitalized patients, but there is no evidence that it reduces mortality.</p>
<ul style="list-style-type: none"> • Remdesivir may reduce the duration of symptoms in infected individuals, from 15 days to 10 days on average.⁶⁴ Remdesivir received an Emergency Use Authorization from the FDA^{186, 457} and is recommended for use in the EU.⁶⁷⁰ Remdesivir in combination with anti-coronavirus immunoglobulin (ITAC) is also being investigated in clinical trial.⁴⁵⁸ • A large clinical trial (SOLIDARITY, n=2,750 treated patients) found no benefit of remdesivir for patient mortality, regardless of ventilation status or treatment severity.⁴⁸⁴ An abbreviated clinical trial of remdesivir (n=237) found no significant benefits.⁶⁴⁹
<p>Hydroxychloroquine is associated with risk of cardiac arrhythmias and provides limited to no clinical benefit.¹⁹⁸</p>
<ul style="list-style-type: none"> • Hydroxychloroquine does not prevent infection as either pre-^{16, 228, 520} or post-exposure prophylaxis,^{85, 436} does not benefit mild-moderate COVID-19 cases,¹⁰³ was associated with adverse cardiac events in severely ill patients,³²⁰ does not reduce mortality,² and increases mortality when combined with azithromycin.¹⁹⁸ The FDA revoked its EUA on 6/15/20.¹⁸⁵ • Benefits of hydroxychloroquine⁴⁶ and azithromycin²²⁷ have been called into question,³⁶⁵ as studies lack key methodological details or¹²⁶ do not specify their study populations.⁶⁹⁸
<p>Corticosteroids may significantly reduce mortality in severely ill and ventilated patients.</p>
<ul style="list-style-type: none"> • Dexamethasone is associated with substantial reductions in mortality for patients receiving mechanical ventilation, smaller benefits for those receiving supplemental oxygen,²⁷⁷ and no benefits in patients who did not need oxygen or ventilation.²⁷⁷ • A large meta-analysis found that 28-day mortality in critically ill patients was reduced in patients (n=678) who received systemic corticosteroids.⁵⁸⁴ Four separate, smaller trials of corticosteroids (n<152) were stopped early.^{39, 162, 373, 610} • The benefits of glucocorticoids may depend heavily on patient inflammation.³¹⁹ For instance, methylprednisolone reduced mortality in older patients with high CRP levels, but the effect was not seen in the general study population.³⁰²
<p>Convalescent plasma treatment is safe and appears to be effective when administered early, though evidence is mixed.⁴⁹⁵</p>
<ul style="list-style-type: none"> • A large trial of plasma therapy (>25,000 patients) shows that treatment is safe, with some evidence that it can reduce 7-day mortality.³¹⁰ Plasma therapy shows larger reductions in mortality when administered within 44 hours of hospital admission,⁵⁵³ and donor plasma with higher antibody levels appears more effective.^{311, 416, 524} A clinical trial of high-titer convalescent plasma showed benefits when administered early (shorter hospital stays and lower mortality).²⁸⁸ • On 8/24/2020, the US FDA approved an Emergency Use Authorization for convalescent plasma therapy.¹⁹⁴
<p>Anticoagulants may reduce COVID-19 mortality in hospitalized patients</p>
<ul style="list-style-type: none"> • Both therapeutic and prophylactic use of anticoagulants has been associated with significant (~50%) reduction in mortality in hospitalized COVID-19 patients.⁴⁵² Anticoagulant use was associated with lower mortality in the severely ill.⁴⁸⁶ A small Phase II clinical trial found that enoxaparin significantly reduced the need for mechanical ventilation when used therapeutically.³⁶⁷ • Anticoagulants appear more effective in severely ill patients, but the correct dose is critical to avoid complications.²⁹⁴
<p>Other pharmaceutical interventions are being investigated but results from large clinical trials are needed.</p>
<ul style="list-style-type: none"> • Acalabrutinib may improve patient oxygenation,⁵⁴⁵ and is being included in large clinical trials (SOLIDARITY).³⁴⁷ • Vitamin D (with vitamin B12 and magnesium) may reduce the need for ventilation in COVID-19 patients (n=17).⁵⁹⁸ • Several interferon-based treatments show promise, including interferon beta-1b,^{287, 518} interferon beta-1a,¹⁵⁰ interferon alpha-2b,⁵⁰⁰ and interferon kappa,²¹⁶ though results from the SOLIDARITY trial found no benefit of interferon beta-1a.⁴⁸⁴ • Tocilizumab appears to show a 12% reduction in mortality in treated patients, though randomized clinical trials are needed due to inconsistencies in existing tocilizumab study designs.⁴¹³ • There is no clinical benefit from combination ritonavir/lopinavir.^{98, 221, 245, 380} The kinase inhibitor ruxolitinib may help to reduce symptom duration and mortality.⁹⁹ Anakinra has shown some evidence of clinical benefit in small observational studies.^{102, 137} Favipiravir may reduce the duration of clinical symptoms¹⁶⁸ and reduce the time for viral clearance.²¹⁷ Bromhexine may reduce rates of mechanical ventilation and mortality.⁴¹ • Regeneron's REGN-COV2 monoclonal antibody is being tested as part of the RECOVERY trial,³¹⁸ and has been associated with reductions in symptom duration when administered early in infection.⁵²⁸ Eli Lilly has reported reduced hospitalization rates in patients given their monoclonal antibody (LY-CoV555), though full results have not been published.³⁸³ Both Eli Lilly³⁹⁴ and Regeneron⁵²⁷ have applied for Emergency Use Authorization for their therapies. Eli Lilly has paused a Phase III trial of its monoclonal therapy.³⁹⁹ Other antibody products are being tested in human trials and appear safe.⁶³⁵ • Bradykinin inhibitors are being investigated as COVID-19 treatments,⁶²⁰ due to the potential role of bradykinins in disease.²²⁴ • Statins are safe to use in patients with COVID-19 and might reduce the need for mechanical ventilation.⁵⁸¹ • Androgen levels have been suggested as a factor in disease severity in men,^{239, 441, 638} and a human trial for dutasteride, an anti-androgen treatment, is ongoing.²⁴⁰ • Whole-lung radiation may be a treatment option for severely ill patients, though larger studies are needed.²⁷³
What do we need to know?
<p>We need clear, randomized trials for treatment efficacy in patients with both severe and mild/moderate illness.</p>
<ul style="list-style-type: none"> • Does time to viral clearance correlate with symptom severity or time to symptom resolution?

Vaccines – Are there effective vaccines?
What do we know?
<p>Work is ongoing to develop and produce a SARS-CoV-2 vaccine (e.g., Operation Warp Speed).^{61, 259, 264-266, 456} Early results are being released, but evidence should be considered preliminary until larger Phase III trials are completed.⁶⁶³</p> <p><i>Phase III Trials (testing for efficacy):</i></p> <ul style="list-style-type: none"> Moderna has begun Phase III trials of its mRNA COVID-19 vaccine (mRNA-1273), which will target 30,000 participants.⁴³⁹ University of Oxford and AstraZeneca's adenovirus candidate (now called AZD1222) has begun Phase II/III human trials.⁴⁸⁰ On 9/6/2020, a possible adverse event in one patient halted the trial, but it has since resumed in the UK and other countries.⁷²² Sinovac has begun Phase III trials of its CoronaVac inactivated vaccine candidate in healthcare professionals.⁵⁷⁷ Sinopharm has begun Phase III trials of two of its inactivated SARS-CoV-2 vaccine candidates, one by the Wuhan Institute of Biological Products and the other by Beijing Institute of Biological Products.⁵⁹ BioNTech and Pfizer are recruiting for a combination Phase I/II/III trial of their mRNA vaccine candidates BNT162b1 and BNT162b2.⁷⁰ The Phase III trial has increased the trial size from 30,000 to 40,000 to include more diverse participants.⁷²² Janssen, with Johnson and Johnson, has registered a Phase III clinical trial with 60,000 participants for their adenovirus Ad26.COV2.S candidate.²⁹⁹ This trial was paused on 10/12/2020 due to a potential adverse event.²⁷² Russia's Gamaleya will begin a Phase III clinical trial for its adenovirus-based vaccine candidate (COVID-Vac-Lyo).^{220, 526} CanSino's Ad5-nCoV adenovirus vaccine is undergoing Phase III clinical trials.⁷¹⁹ Novavax will begin a Phase III trial of its subunit vaccine candidate NVX-CoV2373 on 10,000 patients in the UK, with plans for US trials beginning in October 2020.⁴⁶¹ Baharat will begin a Phase III trial of its inactivated rabies virus platform (Covaxin) in India.⁶⁰² <p><i>Phase II Trials (initial testing for efficacy, continued testing for safety, continued dose-finding):</i></p> <ul style="list-style-type: none"> Inovio has begun a Phase II trial of their INO-4800 DNA vaccine candidate.²⁹² Imperial College London has begun Phase I/II trials of their RNA vaccine candidate, LNP-nCoVsnRNA.⁴⁶³ Phase I/II trials have begun for vaccine candidates from Zydus Cadila (ZyCoV-D, DNA plasmid)⁷²⁴ and Baharat (Covaxin, inactivated rabies virus used as carrier for SARS-CoV-2 proteins).¹⁸¹ Anhui Zhifei has registered a Phase II clinical trial for their RBD-Dimer vaccine candidate.⁴⁰ Novavax has begun Phase II tests of its NVX-CoV2373 recombinant subunit vaccine candidate.⁶ CureVac has begun a Phase II trial of their mRNA candidate CVnCoV.¹⁴⁶ Based on unpublished Phase I/II results, Russia has approved a second COVID-19 vaccine, EpiVacCorona.¹³⁸ <p><i>Phase I Trials (initial testing for safety):</i></p> <ul style="list-style-type: none"> mRNA vaccines: Chinese Academy of Military Sciences (ARCoV),¹⁵⁶ Arcturus (ARCT-021),⁴² and Thailand's Chula Vaccine Research Center (ChulaCov19).¹³⁶ Adenovirus-based vaccines: ReiThera (GRAd-COV2),⁵³⁰ Vaxart (oral vaccine, VXA-CoV2-1),⁶²⁶ and ImmunityBio (hAd5).²⁹¹ Inactivated vaccines: Chinese Academy of Medical Sciences,⁵⁶² Immunitor LLC (V-Sars),⁴²⁵ Kazakhstan's Research Institute for Biological Safety Programs (QazCOVID),⁵³³ Shenzhen Kangtai,³¹³ and Russia's Chumakov Center.⁶⁰¹ Recombinant subunit vaccines: Vaxine Pty (Covax-19),⁶²⁷ Clover Biopharmaceuticals (SCB-2019),⁴²⁴ the Chinese Academy of Sciences (RBD-Dimer),³⁹⁸ Medigen Vaccine Biologics (MVC-COV1901),⁴²⁶ the University of Queensland (UQ),⁵¹⁶ the Finlay Vaccine Institute (Soverana 01),⁴⁷⁰ Sichuan University,⁶⁸⁸ Sanofi Pasteur,⁵⁵⁶ and the Jiangsu Province CDC with the West China Hospital (Sf9).³⁰⁴ DNA vaccines: Genexine (GX-19)²²⁹ and AnGes (AG0301-COVID19).³⁸ Other vaccine platforms: lentiviral vectors (LV-SMENP-DC),⁴²² oral bacTRL-Spike candidates,⁴²¹ dendritic cells (DC-ATA by Aivita),⁴²³ plant-derived virus-like particles (Medicago⁴²⁰ and Kentucky BioProcessing⁷¹), measles vectors,^{429, 492} baculovirus vectors,²² mixed protein/peptide candidates,⁶²⁸ influenza virus vector vaccine nasal spray (DeINS1-2019-nCoV-RBD-OPT1),⁶⁵⁰ peptide based vaccines (UB-612¹⁴⁴ and pVAC⁶¹³), and vaccinia virus vectors (MVA-SARS-2-S).²⁵⁸ <p>Globally, there are 5 vaccine candidates that have received broad use approval or Emergency Use Authorization.</p> <ul style="list-style-type: none"> CanSino's Ad5-nCoV vaccine has been approved for use in the Chinese military,⁵⁸³ Gamelaya's vaccine has been given conditional approval in Russia,⁸ SinoVac's CoronaVac candidate has been approved in China for limited emergency use,¹⁰ and two of Sinopharm's inactivated vaccine candidates have been approved for use in the United Arab Emirates.¹⁵⁷ <p><i>Other vaccine information:</i></p> <ul style="list-style-type: none"> A retrospective review found no evidence that prior influenza vaccination negatively impacts COVID-19 progression.⁵³⁴ The US FDA issued formal guidance for vaccine sponsors regarding the data needed to support Emergency Use Authorization.¹⁹⁰
What do we need to know?
<p>We need published results from Phase I-III trials in humans to assess vaccine efficacy and safety, and length of immunity.</p> <ul style="list-style-type: none"> Safety and efficacy of vaccine candidates in humans, particularly from Phase III trials.

Non-pharmaceutical Interventions – Are public health control measures effective at reducing spread?
What do we know?
<p>Broad-scale control measures such as stay-at-home orders and widespread face mask use effectively reduce transmission and are more impactful when implemented simultaneously. Public health notifications increase adherence to policies.²⁰⁴</p> <ul style="list-style-type: none"> • Social distancing and other policies are estimated to have reduced COVID-19 spread by 44% in Hong Kong¹⁴⁵ and reduced spread throughout China,^{341, 345, 348, 400, 411, 642} Europe,^{226, 315} and the US.³³⁷ Restrictive lockdowns in China are estimated to have reduced disease transmission within only a few days⁷²¹ by reducing contacts.⁷⁰³ In China, modeling suggests that a one-day delay in implementing control measures increased the time needed to curtail an outbreak by 2.4 days.¹⁷¹ In the US, each day of delay in emergency declarations and school closures was associated with a 5-6% increase in mortality.⁶⁹⁵ • In the US, shelter-in-place orders (SIPOs) and restaurant and bar closures were associated with large reductions in exponential growth rate of cases.¹⁴² School closures and cancellation of large gatherings had smaller effects.¹⁴² Similarly, researchers found that a larger number of public health interventions in place was strongly associated with lower COVID-19 growth rates in the next week.³¹² Adherence to social distancing policies depends on income.⁶⁵⁵ • Individual behaviors such as wearing face coverings and practicing social distancing have been associated with reduced risk of COVID-19 infection.⁴⁹⁶ Always wearing masks, maintaining physical distance >1m, and frequently washing hands were all associated with reduced risk of COVID-19 infection in individuals who had direct contact with infected individuals.¹⁷⁰ • An observational study in the US found that face mask use was more common in sub- and urban areas, in women, and in older individuals. Also, mask use rose across the board in June and July 2020.²⁵⁶ • Mobility^{207, 352} and physical contact rates³⁰⁰ decline after public health control measures are implemented. Mobility reductions in the US have been associated with significant reductions in COVID-19 case growth.^{52, 267} Social distancing and reductions in both non-essential visits to stores and overall movement distance led to lower transmission rates.⁴⁴⁵ • A combination of school closures, work restrictions, and other measures are likely required to effectively limit transmission.^{197, 335} School closures alone appear insufficient.^{297, 348} • In South Korea, early implementation of rapid contact tracing, testing, and quarantine was able to reduce the transmission rate of COVID-19.⁵⁸⁹ Contact tracing combined with high levels of testing and physical distancing³⁴⁴ may limit COVID-19 resurgence.^{28, 199} Widespread face mask use can also significantly reduce transmission at the population level.³¹⁴ • Modeling suggests that widespread use of facemasks is effective at reducing transmission⁴⁵³ even when individual mask efficiency is low,¹⁷⁶ though their benefits are maximized when most of the population wears masks.²⁰⁶ • Adolescents and young adults (15-24) may require different messaging to improve adherence to non-pharmaceutical interventions and public health policies; targeted messaging campaigns are suggested to reduce transmission.²⁵⁴ In the US, increasing SARS-CoV-2 prevalence in 18-24 year-old individuals precedes cases and hospitalizations in older adults; limiting transmission in younger populations is crucial for reducing hospitalizations and mortality.⁴⁷⁶ <p>Research is needed to plan the path to SARS-CoV-2 elimination via pharmaceutical and non-pharmaceutical interventions.</p> <ul style="list-style-type: none"> • Retrospective contact tracing may help identify the source of large clusters of cases, and should be implemented due to the overdispersion or heterogeneity in secondary transmission arising from each primary COVID-19 case.¹¹⁸ • Premature relaxation of public health control measures may facilitate rapid increases in prevalence at the state level.²¹⁸ • Modeling suggests that optimal control policies involve quickly quarantining infected individuals, and that periods of social distancing or lock-down may be effective in reducing overall exposure from asymptomatic or unconfirmed cases.⁶¹² Testing is critical to balancing public health and economic costs.⁶¹² Rolling interventions may be necessary.⁶⁹³ Undetected cases can lead to elevated risk of re-emergence after restrictions are lifted, highlighting the need for robust testing strategies.²⁶² • Modeling in the UK suggests that testing of between 59% and 87% of symptomatic individuals, alongside robust contact tracing and quarantine, is necessary to safely reopen schools without creating a second, winter pandemic wave.⁴⁸⁵ Regularly testing high-risk groups like healthcare workers may provide benefits to transmission reduction.²⁴³ • Modeling in the US shows that contact tracing and testing are necessary to reduce the likelihood of COVID-19 resurgence after initial movement restrictions are lifted.²⁹ Quarantining whole households may increase the efficiency of testing.²⁹ • Synchronizing public health interventions and lockdowns across US state lines may reduce the total number of interventions necessary to eliminate transmission as COVID-19 cases continue to resurge.⁵⁴⁷ • Modeling indicates that COVID-19 is likely to become endemic in the US population, with regular, periodic outbreaks, and that additional social or physical distancing measures may be required for several years to keep cases below critical care capacity in absence of a vaccine or effective therapeutic.³²⁷ Results depend on the duration of immunity after exposure.³²⁷ • In the US, statistical modeling suggests that early school closures resulted in lower mortality, though school closures were often implemented in conjunction with other non-pharmaceutical interventions.⁴⁹
What do we need to know?
<p>We need to understand measures that will limit spread in the winter, particularly in indoor environments.</p> <ul style="list-style-type: none"> • What constitutes a high-risk contact time for interactions with COVID-19 patients?³⁰⁸ • How effective are school closures when COVID-19 prevalence in the community is high? Low? • How will holiday travel from colleges and universities impact COVID-19 case growth?

Environmental Stability – How long does the agent live in the environment?	
What do we know?	
<p>SARS-CoV-2 can persist on surfaces for at least 3 days and on the surface of a surgical mask for up to 7 days depending on conditions. SARS-CoV-2 is stable for at least several hours as an aerosol but is inactivated rapidly with sunlight and heat.</p> <p>SARS-CoV-2 survival on surfaces is highly dependent on the presence of UV light and temperature.</p> <ul style="list-style-type: none"> • In simulated saliva on stainless steel surfaces, SARS-CoV-2 exhibits negligible decay over 60 minutes in darkness, but loses 90% of infectivity every 6.8-12.8 minutes, depending on the intensity of simulated UVB radiation levels.⁵²⁵ • SARS-CoV-2 can persist on plastic and metal surfaces between 3 days (21-23°C, 40% RH)⁶²³ and 7 days (22°C, 65% RH). Infectious virus can be recovered from a surgical mask after 7 days (22°C, 65% RH).¹³² • The Department of Homeland Security (DHS) developed a data-based model for SARS-CoV-2 decay on inert surfaces (stainless steel, ABS plastic and nitrile rubber) at varying temperature and relative humidity without sunlight.¹⁶⁵ • SARS-CoV-2 persists for less than 3 days within the pages of library books, and for less than 1 day on book and DVD covers.⁷ • Approximately 0.1-1% of initial SARS-CoV-2 inoculated on plastic, stainless steel, glass, ceramics, wood, latex gloves, cotton, paper, and surgical masks remained after 48 hours.³⁹³ • At room temperature (22°C), SARS-CoV-2 remains detectable (via plaque assay) on paper currency for up to 24 hours, on clothing for up to 4 hours, and on skin for up to 96 hours.²⁶³ Persistence is reduced with warmer temperatures (37°C), and enhanced at colder temperatures (4°C).²⁶³ • Both temperature and humidity contribute to SARS-CoV-2 survival on nonporous surfaces, with cooler, less humid environments facilitating survival (stainless steel, ABS plastic, and nitrile rubber; indoors only; simulated saliva matrix).⁷³ • SARS-CoV-2 is susceptible to heat treatment (70°C) but can persist for at least two weeks at refrigerated temperatures (4°C).^{132, 522} SARS-CoV-2 maintains infectivity for at least 21 days when inoculated on frozen foods and stored below -20°C.²⁰³ • Researchers found SARS-CoV-2 to be stable at room temperature across pH 3–10, and tested its stability on several surfaces.¹³¹ After 3 hours (22°C, RH 65%), no infectious virus was detected on printing and tissue papers; on day 2, none was found on treated wood and cloth; on day 4, none was found on glass or banknote; on day 7, none was found on stainless steel or plastic. Detectable levels (~0.1% or original inoculum) were found on a surgical mask on day 7.¹³¹ • In the absence of sunlight, infectious SARS-CoV-2 can remain on non-porous (e.g., glass, vinyl) surfaces for at least 28 days at 20°C and 50% RH; higher temperatures greatly reduce the environmental stability of SARS-CoV-2.⁵³⁸ This value is longer than other stability estimates,^{132, 538, 623} potentially due to a fluid matrix with more protein to simulate human respiratory fluid, a higher inoculation dose, and the absence of sunlight.⁵³⁸ • SARS-CoV-2 genetic material (RNA) was detected in symptomatic and asymptomatic cruise ship passenger rooms up to 17 days after cabins were vacated. The infectiousness of this material is not known.⁴⁴⁴ <p>SARS-CoV-2 survival in the air is highly dependent on the presence of UV light and temperature.</p> <ul style="list-style-type: none"> • SARS-CoV-2 has an aerosol half-life of 2.7 hours (without sunlight, particles <5 µm, tested at 21-23°C and 65% RH),⁶²³ retaining infectivity for up to 16 hours in appropriate conditions (23°C, 53% RH, no sunlight).¹⁹⁵ • Experimental studies using SARS-CoV-2 aerosols (1.78-1.96 µm mass median aerodynamic diameter in artificial saliva matrix) found that simulated sunlight rapidly inactivates the virus, with 90% reductions in infectious concentration after 6 minutes in high-intensity sunlight (similar to mid-June) and 19 minutes in low-intensity sunlight (similar to early March or October).⁵⁶¹ In dark conditions, the half-life of aerosolized SARS-CoV-2 is approximately 86 minutes in simulated saliva matrix.⁵⁶¹ Humidity had no significant impact on aerosolized virus survival.⁵⁶¹ • DHS has also developed a tool for estimating the decay of airborne SARS-CoV-2 in different environmental conditions.¹⁶⁴ • RNA in clinical samples collected in viral transport medium is stable at 18-25°C or 2-8°C for up to 21 days without impacting real-time RT-PCR results.⁵⁷⁹ RNA in clinical samples is also stable at 4°C for up to 4 weeks with regard to quantitative RT-PCR testing (given that the sample contains 5,000 copies/mL). Separately, storage of RNA in phosphate buffered saline (PBS) at room temperature (18-25°C) resulted in unstable sample concentrations.⁴⁹⁹ • Due to inefficiencies in end-to-end sampling techniques, it is estimated that at least 1,000 viral particles per 25 cm² are needed to detect SARS-CoV-2 RNA on surfaces.⁴⁹⁰ • Modeling suggests that hot, dry conditions increase the number of SARS-CoV-2 particles, whereas cold, humid conditions facilitate the spread of droplets.⁷¹³ <p>The International Commission on Microbiological Specifications for Foods (ICMSF) believes that it is highly unlikely that ingestion of SARS-CoV-2 will result in illness.</p> <ul style="list-style-type: none"> • There is no documented evidence that food, food packaging, or food handling is a significant source of COVID-19 infections,²⁹³ though several outbreaks have a hypothesized food origin.²⁶⁰ 	
What do we need to know?	
<p>We need to quantify the duration of SARS-CoV-2 infectivity on surfaces, not simply the presence of RNA.</p> <ul style="list-style-type: none"> • Duration of SARS-CoV-2 infectivity via fomites and surfaces (contact hazard) • Stability of SARS-CoV-2 on PPE (e.g., Tyvek) • Stability of SARS-CoV-2 in food (to date, no known infections from contaminated food)⁶⁶¹ • Is there a link between fine-sediment particulate matter and COVID-19 in industrialized cities?⁷⁵⁷ 	

Decontamination – What are effective methods to kill the agent in the environment?
What do we know?
<p>Soap and water, as well as common alcohol and chlorine-based cleaners, hand sanitizers, and disinfectants are effective at inactivating SARS-CoV-2 on hands and surfaces.</p> <ul style="list-style-type: none"> Alcohol-based hand rubs are effective at inactivating SARS-CoV-2.³⁴² Chlorine bleach (1%, 2%), 70% ethanol and 0.05% chlorhexidine are effective against live virus in lab tests.¹³⁰ Twice-daily cleaning with sodium dichloroisocyanurate decontaminated surfaces in COVID-19 patient hospital rooms.⁴⁷² EPA has released a list of SARS-CoV-2 disinfectants, but not all solutions have been tested on SARS-CoV-2.²⁴ Several solutions have been tested against SARS-CoV-2 and found to be effective (EPA list N), including those based on para-chloro-meta-xyleneol, salicylic acid, sodium hypochlorite, glycolic acid, and quaternary ammonium compounds.¹⁷⁹ Oral antiseptic rinses used in pre-procedural rinses for dentistry containing povidone-iodine (PVP-I) are effective decontaminants of SARS-CoV-2, completely inactivating SARS-CoV-2 at concentrations above 0.5% in lab tests (for 15-30 s).⁶⁸ Regular disinfection of hospital rooms (with benzalkonium wipes) can reduce the presence of SARS-CoV-2 on surfaces, though contamination is widespread without regular cleaning.³²⁵ Holder pasteurization of donor breast milk spiked with SARS-CoV-2 rendered the virus inactive, demonstrating that standard decontamination procedures are effective at reducing risk of COVID-19 risk in infants via donor breast milk.⁶¹⁷ Efforts are ongoing to create paint-on surfaces that can rapidly inactivate SARS-CoV-2.⁶³ Under an emergency exemption, the US EPA permitted Texas and American Airlines to use a product manufactured by Applied BioScience as a surface coating capable of inactivating SARS-CoV-2 within 2 hours, for up to 7 days.¹⁸⁰ Pulsed xenon ultraviolet light was able to decontaminate SARS-CoV-2 on respirators with 1-5 minute exposures.⁵⁷⁵ Addition of surfactant agents to common sanitizing liquids was shown to increase evaporation time and viricidal efficiency when sprayed on a PVC surface coated with a SARS-CoV-2 virus suspension.²⁹⁸ Iodine-based antiseptics may be able to decontaminate nasal passages, though any influence on transmission is unknown.²¹⁴ A mouth-spray previously investigated for the cold-causing coronavirus 229E (ColdZyme®) effectively inactivated SARS-CoV-2 <i>in vitro</i>; additional tests are necessary to determine any clinical benefit.²⁵² Chlorhexidine digluconate, commonly used in hospitals, may be ineffective at disinfecting SARS-CoV-2 on surfaces.⁴⁸ Indoor air filters based on non-thermal plasma or reactive oxygen species may be effective at reducing circulating SARS-CoV-2 concentrations, estimated by reductions in surrogate virus, though additional testing on live SARS-CoV-2 virus is needed.⁵⁵² Indoor air filtration devices based on hydroxyl radical cascades, which do not emit ozone, are being trialed at 4 UK hospitals due to their efficacy in reducing concentrations of a surrogate virus (M2 phage).^{27, 614} <p>Several methods exist for decontaminating N95 respirators.⁴⁶⁴</p> <ul style="list-style-type: none"> Researchers have identified four methods capable of decontaminating N95 respirators while maintaining physical integrity (fit factor): UV radiation, heating to 70°C, and vaporized hydrogen peroxide (VHP).²⁰² Ethanol (70%) was associated with loss of physical integrity.²⁰² Dry heat and UV decontamination can also be used under certain conditions.²⁰¹ Hydrogen peroxide vapor (VHP) can repeatedly decontaminate N95 respirators.⁵³⁶ Devices capable of decontaminating 80,000 masks per day have been granted Emergency Use Authorization from the FDA.¹⁸⁷ The FDA has issued an Emergency Use Authorization for a system capable of decontaminating ten N95 masks at a time using devices already present in many US hospitals.⁸⁷ However, a cohort study suggested fit failure after 1-5 decontamination cycles with this method, depending on mask type.³⁸² Respirator decontamination methods such as VHP appear to maintain filtration efficiency after repeated decontamination cycles.⁴⁹⁸ Several decontamination methods, including VHP, moist heat, and UVC, are capable of decontaminating N95 respirators for 10-20 cycles without loss of fit or filtration efficiency.¹² Stacking respirators may increase decontamination rates without compromising efficiency.⁵⁵⁰ Peracetic acid may be effective in combination with VHP.³⁰⁵ Wet heat (65°C for 30 minutes) in a multicooker can decontaminate N95 respirators inoculated with SARS-CoV-2.¹⁶⁶ Methylene blue (in combination with visible light) is being investigated for decontamination of N95 respirators.⁶¹⁸ Researchers have developed a thermal inactivation model for SARS-CoV-2, providing estimates of infectivity reduction based on time and temperature in the environment and under decontamination strategies.⁶⁹⁴ Heat treatment (56°C) is sufficient to kill coronaviruses (not SARS-CoV-2 explicitly),^{517, 715} though effectiveness depends partly on protein in the sample.⁵¹⁷ Coronaviruses may be resistant to heat inactivation for up to 7 days when stabilized in stool.⁶⁰⁶⁻⁶⁰⁷ Coronaviruses are more stable in matrixes such as respiratory sputum.¹⁷⁴ Dry heat (100°C, 5% RH for 50 minutes) was able to decontaminate N95 respirators inoculated with several viruses without compromising fit, but has not been tested on SARS-CoV-2.⁴⁶⁶
What do we need to know?
<p>We need additional SARS-CoV-2 decontamination studies, particularly with regard to PPE and other items in short supply.</p> <ul style="list-style-type: none"> Does contamination with human fluids/waste alter disinfectant efficacy profiles? How effective is air filtration at reducing transmission in healthcare, airplanes, and public spaces?

PPE – What PPE is effective, and who should be using it?	
What do we know?	
<p>Face masks appear effective at reducing infections from SARS-CoV-2. Healthcare workers are at high risk of acquiring COVID-19, even with recommended PPE.</p> <ul style="list-style-type: none"> Healthcare worker illnesses⁶⁰⁴ demonstrates human-to-human transmission despite isolation, PPE, and infection control.⁵⁶⁰ Risk of transmission to healthcare workers is high.⁵³¹ Contacts with healthcare workers tend to transmit COVID-19 more often than other casual contacts.⁶⁴⁷ Hospital-acquired infection rates fell after introduction of comprehensive infection control measures, including expanded testing and use of PPE for all patient contacts.⁵³⁷ Universal masking policies also reduced the rate of new healthcare worker infections.^{646, 720} A modeling study suggests that healthcare workers are primarily at risk from droplet and inhalation exposure (compared to contact with fomites), with greater risk while in closer proximity to patients.³⁰⁹ Even among healthcare personnel reporting adequate PPE early in the pandemic (March - April), rates of infection were 3.4 times higher in healthcare personnel than the general population.⁴⁵⁵ Four percent of healthcare workers in Denmark tested positive for SARS-CoV-2; higher rates are observed in those with direct contact with COVID-19 patients.²⁹⁶ "Healthcare personnel entering the room [of SARS-CoV-2 patients] should use standard precautions, contact precautions, airborne precautions, and use eye protection (e.g., goggles or a face shield)."¹⁰⁸ WHO indicates healthcare workers should wear clean long-sleeve gowns as well as gloves.⁶⁶⁵ PPE that covers all skin may reduce exposure to pathogens.^{196, 657} Respirators (NIOSH-certified N95, EUFP2 or equivalent) are recommended for those working with potential aerosols.⁶⁶⁶ Additional protection (Powered Air Purifying Respirator (PAPR) with hood), should be considered for high-risk procedures.⁹⁰ A small observational study found no COVID-19 cases in 25 healthcare workers exposed to an infected patient while conducting aerosol-generating procedures, despite differences in the mask types (N95 respirator vs. 3-ply surgical mask) worn by the workers.³³⁸ There is still insufficient evidence to recommend surgical masks as alternatives to N95s. KN95 respirators are, under certain conditions, approved for use under FDA Emergency Use Authorization.¹⁸⁸ On May 7, the FDA rescinded a number of KN95 models that no longer meet the EUA criteria and are no longer authorized.¹⁹³ A study suggests that P100 respirators with removable filter cartridges have similar filtration efficiency compared to N95 respirators and could plausibly be used if N95 respirators were in short supply.⁴⁹⁴ Particular care should be taken with "duckbill" N95 respirators, which may fail fit tests after repeated doffing.¹⁵⁴ Dome-shaped N95 respirators also failed fit tests after extended use.¹⁵⁴ The US FDA cautions healthcare facilities using passive protective barrier enclosures without negative pressure, and has withdrawn a prior Emergency Use Authorization for the devices.¹⁹² <p>Non-medical masks may be effective at slowing transmission, though data specific to SARS-CoV-2 are sparse.^{5, 11}</p> <ul style="list-style-type: none"> On 4/3/2020, the US CDC recommended wearing cloth face masks in public where social distancing measures are difficult to maintain.¹⁰⁹ The CDC recommends masks without exhalation vents or valves,¹⁰⁵ as masks with valves can allow particles to pass through unfiltered.⁶³⁰ The WHO recommends that the general population wear non-medical masks when in public settings and when physical distancing is difficult, and that vulnerable populations (e.g., elderly) wear medical masks when close contact is likely.⁶⁶² Infected individuals wearing facemasks in the home before the onset of symptoms was associated with a reduction in household transmission.⁶⁴⁸ A meta-analysis of SARS-CoV-1, MERS, and COVID-19 transmission events found evidence that wearing face masks and eye protection were each associated with lower risk of transmission.¹³⁵ N95 respirators were associated with a larger reduction in transmission risk compared to surgical face masks.¹³⁵ In a separate meta-analysis, N95 respirators were found to be beneficial for reducing the occurrence of respiratory illness in health care professionals including influenza, though surgical masks were similarly effective for influenza.⁴⁶⁵ N95 respirators were associated with up to 80% reductions in SARS-CoV-1 infections.⁴⁶⁵ Surgical face masks, respirators and homemade face masks may prevent transmission of coronaviruses from infectious individuals (with or without symptoms) to other individuals.^{149, 368, 621} Surgical masks were associated with a significant reduction in the amount of seasonal coronavirus (not SARS-CoV-2) expressed as aerosol particles (<5 µm).³⁶⁸ Homemade masks generally reduce overall flow from breathing and coughing (63-86% reduction) but also generate leakage jets facing downward and backward from the wearer's face.⁶³³ Some non-standard materials (e.g., cotton, cotton hybrids) may be able to filter out >90% of simulant particles >0.3µm,³³¹ while other materials (e.g., T-shirt, vacuum cleaner bag, towels) appear to have lower filtration efficacy (~35-62%).⁶⁴¹ Of 42 homemade materials tested, the three with the greatest filtration efficiencies were layered cotton with raised visible fibers.⁷⁰¹ Neck fleeces commonly worn by runners may increase the frequency of small aerosol particles, compared to wearing no mask at all.²⁰⁰ Masks made of cotton T-shirt material appear ineffective at reducing emitted particles when individuals talk, breathe, sneeze, or cough, with those made of single layers actually increasing emitted particles during these activities.⁴⁷ 	
What do we need to know?	
<p>We need to continue assessing PPE effectiveness with specific regard to SARS-CoV-2 instead of surrogates.</p> <ul style="list-style-type: none"> When and how do N95 respirators and other face coverings fail? How effective are homemade masks at reducing SARS-CoV-2 transmission? 	

Forensics – Natural vs intentional use? Tests to be used for attribution.
What do we know?
<p>All current evidence supports the natural emergence of SARS-CoV-2 via a bat and possible intermediate mammal species.</p> <ul style="list-style-type: none"> • New analysis of SARS-CoV-2 and related SARS-like coronaviruses suggests that SARS-CoV-2 jumped directly from bats to humans, without the influence of an intermediate 'mixing' host.⁷⁹ Pangolin coronaviruses were shown to be more divergent and split off from bat coronaviruses earlier than SARS-CoV-2.⁷⁹ Current sampling of pangolin viruses does not implicate them as an intermediate to human SARS-CoV-2.⁷⁹ These data suggest SARS-CoV-2 emerged from circulating bat coronaviruses in SE China/SE Asia and additional zoonotic emergence of novel coronaviruses could occur. • Based on phylogenetic analysis, SARS-CoV-2 most likely emerged from <i>Rhinolophus</i> (horseshoe) bats living in China, Laos, Myanmar, Vietnam, or another Southeast Asian country,³⁵⁴ though historical recombination with pangolin coronaviruses may explain some features of the SARS-CoV-2 genome.²¹⁰ • Genomic analysis suggests that SARS-CoV-2 is a natural variant and is unlikely to be human-derived or otherwise created by "recombination" with other circulating strains of coronavirus.^{35, 718} • Comparing genomes of multiple coronaviruses using machine-learning has identified key genomic signatures shared among high case fatality rate coronaviruses (SARS-CoV-1, SARS-CoV-2, MERS) and animal counterparts.²⁵⁵ These data further suggest that SARS-CoV-2 emergence is the result of natural emergence and that there is a potential for future zoonotic transmission of additional pathogenic strains to humans.²⁵⁵ • Deletion mutants were identified at low levels in human clinical samples, suggesting that the PRRA furin cleavage site alone is not fully responsible for human infection, but does confer a fitness advantage in the human host.⁶⁷³ Additional whole-genome sequencing in humans would help to confirm this finding. • Genomic data support at least two plausible origins of SARS-CoV-2: "(i) natural selection in a non-human animal host prior to zoonotic transfer, and (ii) natural selection in humans following zoonotic transfer."³⁵ Both scenarios are consistent with the observed genetic changes found in all known SARS-CoV-2 isolates. • Some SARS-CoV-2 genomic evidence indicates a close relationship with pangolin coronaviruses,⁶⁷² and data suggest that pangolins may be a natural host for beta-coronaviruses.^{388, 390} Genomic evidence suggests a plausible recombination event between a circulating coronavirus in pangolins and bats could be the source of SARS-CoV-2.^{375, 686} Emerging studies are showing that bats are not the only reservoir of SARS-like coronaviruses.⁷⁰⁷ Additional research is needed. • There are multiple studies showing that the SARS-CoV-2 S protein receptor binding domain, the portion of the protein responsible for binding the human receptor ACE2, was acquired through recombination between coronaviruses from pangolins and bats.^{35, 375, 389, 707} These studies suggest that pangolins may have played an intermediate role in the adaptation of SARS-CoV-2 to be able to bind to the human ACE2 receptor. Additional research is needed. • A novel bat coronavirus (RmYN02) has been identified in China with an insertion between the S1/S2 cleavage site of the Spike protein. While distinct from the furin cleavage site insertion in SARS-CoV-2, this evidence shows that such insertions can occur naturally.⁷¹⁷ • Additionally, "[...] SARS-CoV-2 is not derived from any previously used virus backbone," reducing the likelihood of laboratory origination,³⁵ and "[...] genomic evidence does not support the idea that SARS-CoV-2 is a laboratory construct, [though] it is currently impossible to prove or disprove the other theories of its origin."³⁵ • Work with other coronaviruses has indicated that heparan sulfate dependence can be an indicator of prior cell passage, due to a mutation in the previous furin enzyme recognition motif.¹⁵² • A report claiming a laboratory origin of SARS-CoV-2⁶⁹¹ has been heavily disputed by scientists at Johns Hopkins University.³
What do we need to know?
<p>We need to know whether there was an intermediate host species between bats and humans.</p> <ul style="list-style-type: none"> • What tests for attribution exist for coronavirus emergence? • What is the identity of the intermediate species? • Are there closely related circulating coronaviruses in bats or other animals with the novel PRRA cleavage site found in SARS-CoV-2?

Genomics – How does the disease agent compare to previous strains?
What do we know?
<p>Current evidence suggests that SARS-CoV-2 accumulates mutations at a similar rate as other coronaviruses.</p>
<ul style="list-style-type: none"> • There have been no documented cases of SARS-CoV-2 prior to December 2019. Preliminary genomic analyses, however, suggest that the first human cases of SARS-CoV-2 emerged between 10/19/2019 – 12/17/2019.^{37, 62, 521} • Analysis of more than 7,000 SARS-CoV-2 genome samples provides an estimated mutation rate of 6×10^{-4} nucleotides per genome per year.⁶²⁴ The same analysis estimates the emergence of SARS-CoV-2 in humans between October and December 2019.⁶²⁴ This aligns with the first known human cases in China in early December 2019, in Europe in late December 2019,¹⁶³ circulation in the US (Washington State) in February 2020,⁶⁷⁶ and circulation in Mexico in March 2020.⁵⁹⁶ In both California¹⁶¹ and New York City,²³⁷ evidence supports multiple introductions of SARS-CoV-2 from inside and outside the US. • SARS-CoV-2 is acquiring nucleotide changes at a rate that suggests the virus is undergoing purifying selection (that the genome is stabilizing toward a common genome).⁶⁷⁹ Low genetic diversity early in the epidemic suggests that SARS-CoV-2 was capable of jumping to human and other mammalian hosts,⁶⁷⁹ and that additional jumps into humans from reservoir species may occur. • In 94 COVID-19 patients, there was no association between viral genotype and clinical severity.⁷⁰⁸ However, a 382 base pair deletion in the SARS-CoV-2 genome has been linked to milder clinical illness (n=39),⁶⁹⁷ though caveats in sample size, time of sampling, and patient selection are warranted. • Recent analysis of >16,000 genomes of SARS-CoV-2 suggests two major introductions in the US, one associated with the West coast and one with the Eastern portion of the US.⁴⁴⁷
<p>At least one mutation has been associated with greater viral transmission, but virulence appears unchanged.</p>
<ul style="list-style-type: none"> • Phylogenetic and clinical analysis suggests the D614G mutation in the Spike protein is associated with higher rates of SARS-CoV-2 transmission, but no change in clinical severity in infected patients.³³⁶ However, it is difficult to determine whether this mutation is overrepresented due to founder effects, or whether it truly spreads more rapidly than other isolates. Preliminary experimental evidence suggests that this mutation increases infectivity in cell lines.⁷⁰⁵ • The D614G mutation increased viral loads in experimentally infected hamsters in the nose and throat,⁵⁰⁸ and hastened transmission (evidence of spread between hamsters after 2 days for D614G mutants vs. 4 days for wild-type virus).²⁷⁹ The D614G mutation showed a competitive advantage within hamster hosts, meaning it increased in frequency <i>in vitro</i> compared to wild-type virus.⁵⁰⁸ The mutation did increase viral replication in human cell lines.⁵⁰⁸ • The SARS-CoV-2 Spike protein mutation D614G appears to make the virus more susceptible to neutralization by monoclonal antibodies or by convalescent patient plasma.⁶⁵⁶ Antibodies induced by the D614G mutation or wild-type virus are able to neutralize each other.³⁶³ • Ongoing study of SARS-CoV-2 sequences reveals the continued spread and increased presence of sequences with the D614G mutation in subsequent waves of virus infection in Texas.³⁹⁷
<p>Associations between human blood type and COVID-19 severity are unclear.</p>
<ul style="list-style-type: none"> • Several human genomic regions have been associated with increased risk of COVID-19 infection and severe disease. Some of these are linked to human blood type,²³³ where there is evidence of slightly increased prevalence⁵⁸ and moderately increased severity in those with type A blood,²⁷⁵ though early evidence was mixed.³⁵⁵ Other regions associated with severe disease include locus 3p21.31, where certain alleles are found more often in patients with respiratory distress requiring ventilation,²³³ as well as those with severe disease.⁴⁸¹ • A meta-analysis of 7,503 SARS-CoV-2 positive cases and 2,962,160 controls across 13 population subgroups found that positive individuals were more likely to have type A blood, and less likely to have type O blood.²³⁵ • Phylogenetics suggest that SARS-CoV-2 is of bat origin, but is closely related to coronaviruses found in pangolins.^{388, 390} The SARS-CoV-2 Spike protein, which mediates entry into host cells and is the major determinant of host range, is very similar to the SARS-CoV-1 Spike protein.⁴⁰¹ The rest of the genome is more closely related to two separate bat coronaviruses⁴⁰¹ and coronaviruses found in pangolins.³⁹⁰ • Structural modeling suggests that observed changes in the genetic sequence of the SARS-CoV-2 Spike protein may enhance binding of the virus to human ACE2 receptors.⁴⁷⁴ More specifically, changes to two residues (Q493 and N501) are linked with improving the stability of the virus-receptor binding complex.⁴⁷⁴ Additionally, structural modeling identified several existing mutations that may enhance the stability of the receptor binding domain, potentially increasing binding efficacy.⁴⁷⁸ Infectivity assays are needed to validate the potential phenotypic results identified in these studies. • A key difference between SARS-CoV-2 and other beta-coronaviruses is the presence of a polybasic furin cleavage site in the Spike protein (insertion of a PRRA amino acid sequence between S1 and S2).¹⁴³
What do we need to know?
<p>We need to link genotypes to phenotypes (e.g., disease severity) in infected patients.</p>
<ul style="list-style-type: none"> • Are there similar genomic differences in the progression of coronavirus strains from bat to intermediate species to human? • Are there different strains or clades of circulating virus? If so, do they differ in virulence? • What are the mutations in SARS-CoV-2 that allowed human infection and transmission? • How do viral mutations affect the long-term efficacy of specific vaccines?

Forecasting – What forecasting models and methods exist?
What do we know?
<p>The US CDC provides ensemble forecasts based on the arithmetic mean of participating groups.¹⁰⁷</p> <ul style="list-style-type: none"> • Columbia University Model: Spatially-explicit SEIR model incorporating contact rate reductions due to social distancing. Estimates total cases and risk of healthcare overrun.⁵⁴⁸ • Imperial College London: Week-ahead forecasts of cases, deaths, and transmissibility (R_0) at the country-level. Transmissibility estimates used to forecast incidence based on Poisson renewal process.⁶⁷ • Institute of Health Metrics and Evaluation (IHME): Mechanistic SEIR model combined with curve-fitting techniques to forecast cases, hospital resource use, and deaths at the state and country level.²⁸⁹ Also provides global forecasts.²⁹⁰ • Los Alamos National Laboratory: Forecasts of state-level cases and deaths based on statistical growth model fit to reported data. Implicitly accounts for effects of social distancing and other control measures.³⁵⁰ • Massachusetts Institute of Technology: Mechanistic SEIR model that forecasts cases, hospitalizations, and deaths. Also includes estimates of intervention measures, allows users to project based on different intervention scenarios (e.g., social distancing lasting for 3 vs. 4 weeks).⁴³⁴ • Northeastern University: Spatially explicit, agent-based epidemic model used to forecast fatalities, hospital resource use, and the cumulative attack rate (proportion of the population infected) for unmitigated and mitigated scenarios.⁴⁶⁰ • Notre Dame University: Agent-based model forecasting cases and deaths for Midwest states. Includes effectiveness of control measures like social distancing.⁵⁰¹ • University of California, Los Angeles: Mechanistic SIR model with statistical optimization to find best-fitting parameter values. Estimates confirmed and active cases, fatalities, and transmission rates at the national and state levels.⁶¹⁵ • University of Chicago: Age-structured SEIR model that accounts for asymptomatic individuals and the effectiveness of social distancing policies. Forecasts only for Illinois.¹²⁹ • University of Geneva: Country-level forecasts of cases, deaths, and transmissibility (R_0). Uses statistical models fit to reported data, not mechanistic models.²⁰⁸ • University of Massachusetts, Amherst: Aggregation of state and national forecasts to create ensemble model.⁵²⁹ • University of Texas, Austin: Machine learning model aimed at identifying links between social distancing measures and changes in death rates. Forecasts fatalities at the state, metropolitan area, and national level. Cannot be used to make projections beyond initial infection wave.⁴³¹ • Youyang Gu: Mechanistic SEIR model coupled with machine learning algorithms to minimize error between predicted and observed values. Forecasts deaths and infections at the state and national level, including 60 non-US countries. Includes effects of public health control efforts.²⁴⁷ • Auquan: SEIR model used to forecast deaths and illnesses at the country and state level.⁵⁰ • CovidSim: SEIR model allow users to simulate effects of future intervention policies at state and national levels (US only).¹²⁸ • Google/Harvard University: Time-series machine learning model that makes assumptions about which non-pharmaceutical interventions will be in place in the future.²³⁸ <p>Other forecasting efforts:</p> <ul style="list-style-type: none"> • The WHO COVID-19 modeling parameter working group has released updated parameter ranges for several key COVID-19 parameters, including the reproduction number (R_0), serial interval, generation time, and fatality rate.⁶⁹ • University of Georgia: Statistical models used to estimate the current number of symptomatic and incubating individuals, beyond what is reported (e.g., “nowcasts”). Available at the state and national level for the US.¹¹⁵ • Hospital IQ has a dashboard that forecasts hospital and ICU admissions for each county in the US. Relies in part on IHME forecasts.²⁹⁵ • COVID Act Now: State and county-level dashboard focused on re-opening strategies, showing trends in four metrics related to COVID-19 risk (change in cases, total testing capacity, fraction of positive tests, and availability of ICU beds). Fundamentally uses an SEIR model fit to observed data.⁴⁶² • Researchers use a rolling window analysis incorporating uncertainty in the generation time distribution to estimate time-varying transmission rates in US states (the effective reproduction number, R_{eff} or R_t).¹⁵ • Georgia Tech Applied Bioinformatics Laboratory: Tool providing probability of at least one infected individual attending an event, accounting for event size and county/state COVID-19 prevalence.¹²¹ • MITRE: Dashboards for COVID-19 forecasts and decision support tools, including regional comparisons and intervention planning. Uses combinations of SEIR models and curve-fitting approaches.⁴³⁷ • Covasim: Agent-based model for testing effects of intervention measures, also available as Python library.³²¹ • Florez and Singh: Global and country-level forecasts of cases and fatalities, simple statistical projection of future growth.²¹¹
What do we need to know?
<p>We need to know how different forecasting methods have fared when compared to real data and develop an understanding of which model features contribute most to accurate and inaccurate forecasts.</p>

Table 1. Definitions of commonly-used acronyms

Acronym/Term	Definition	Description
ACE2	Angiotensin-converting enzyme 2	Acts as a receptor for SARS-CoV and SARS-CoV-2, allowing entry into human cells
Airborne transmission	Aerosolization of infectious particles	Aerosolized particles can spread for long distances (e.g., between hospital rooms via HVAC systems). Particles generally <5 µm.
ARDS	Acute respiratory distress syndrome	Leakage of fluid into the lungs which inhibits respiration and leads to death
Attack rate	Proportion of “at-risk” individuals who develop infection	Defined in terms of “at-risk” population such as schools or households, defines the proportion of individuals in those populations who become infected after contact with an infectious individual
CCV	Canine coronavirus	Canine coronavirus
CFR	Case Fatality Rate	Number of deaths divided by confirmed patients
CoV	Coronavirus	Virus typified by crown-like structures when viewed under electron microscope
COVID-19	Coronavirus disease 19	Official name for the disease caused by the SARS-CoV-2 virus.
Droplet transmission	Sneezing, coughing	Transmission via droplets requires relatively close contact (e.g., within 6 feet)
ELISA	Enzyme-linked immunosorbent assay	Method for serological testing of antibodies
Fomite	Inanimate vector of disease	Surfaces such as hospital beds, doorknobs, healthcare worker gowns, faucets, etc.
HCW	Healthcare worker	Doctors, nurses, technicians dealing with patients or samples
Incubation period	Time between infection and symptom onset	Time between infection and onset of symptoms typically establishes guidelines for isolating patients before transmission is possible
Infectious period	Length of time an individual can transmit infection to others	Reducing the infectious period is a key method of reducing overall transmission; hospitalization, isolation, and quarantine are all effective methods
Intranasal	Agent deposited into external nares of subject	Simulates inhalation exposure by depositing liquid solution of pathogen/virus into the nose of a test animal, where it is then taken up by the respiratory system.
MERS	Middle-East Respiratory Syndrome	Coronavirus with over 2,000 cases in regional outbreak since 2012
MHV	Mouse hepatitis virus	Coronavirus surrogate
Nosocomial	Healthcare- or hospital-associated infections	Characteristic of SARS and MERS outbreaks, lead to refinement of infection control procedures
PCR	Polymerase chain reaction	PCR (or real-time [RT] or quantitative [Q] PCR) is a method of increasing the amount of genetic material in a sample, which is then used for diagnostic testing to confirm the presence of SARS-CoV-2
PFU	Plaque forming unit	Measurement of the number of infectious virus particles as determined by plaque forming assay. A measurement of sample infectivity.
PPE	Personal protective equipment	Gowns, masks, gloves, and any other measures used to prevent spread between individuals

Acronym/Term	Definition	Description
R_0	Basic reproduction number	A measure of transmissibility. Specifically, the average number of new infections caused by a typical infectious individual in a wholly susceptible population.
SARS	Severe Acute Respiratory Syndrome	Coronavirus with over 8,000 cases in global 2002-2003 outbreak
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2	Official name for the virus previously known as 2019-nCoV.
SEIR	Susceptible (S), exposed (E), infected (I), and resistant (R)	A type of modeling that incorporates the flow of people between the following states: susceptible (S), exposed (E), infected (I), and resistant (R), and is being used for SARS-CoV-2 forecasting
Serial interval	Length of time between symptom onset of successive cases in a transmission chain	The serial interval can be used to estimate R_0 , and is useful for estimating the rate of outbreak spread
SIR	Susceptible (S), infected (I), and resistant (R)	A type of modeling that incorporates the flow of people between the following states: susceptible (S), infected (I), and resistant (R), and is being used for SARS-CoV-2 forecasting
TCID50	50% Tissue Culture Infectious Dose	The number of infectious units which will infect 50% of tissue culture monolayers. A measurement of sample infectivity.
Transgenic	Genetically modified	In this case, animal models modified to be more susceptible to MERS and/or SARS by adding proteins or receptors necessary for infection
Vertical transmission	Transmission from mother to fetus	Generally understood as intrauterine transmission via blood or placenta. Not the same as transmission during or after birth.

Literature Cited:

1. Coronavirus diagnosed at mink farms in North Brabant. NOS 2020. <https://nos.nl/artikel/2331784-coronavirus-vastgesteld-bij-nertsenfokkerijen-in-noord-brabant.html>
2. Effect of Hydroxychloroquine in Hospitalized Patients with Covid-19. *New England Journal of Medicine* 2020. <https://www.nejm.org/doi/full/10.1056/NEJMoa2022926>
3. In Response: Yan et al. Preprint Examinations of the Origin of SARS-CoV-2; Johns Hopkins Bloomberg School of Public Health, Center for Health Security: 2020. https://www.centerforhealthsecurity.org/our-work/pubs_archive/pubs-pdfs/2020/200921-in-response-yan.pdf
4. India's new paper Covid-19 test could be a 'game changer'. BBC 2020. <https://www.bbc.com/news/world-asia-india-54338864>
5. Masks for Prevention of Respiratory Virus Infections, Including SARS-CoV-2, in Health Care and Community Settings. *Annals of Internal Medicine* 0 (0), null. <https://www.acpjournals.org/doi/abs/10.7326/M20-3213>
6. Novavax begins Phase II part of Covid-19 vaccine trial. *Clinical Trials Arena* 2020. <https://www.clinicaltrialsarena.com/news/novavax-covid-vaccine-phaseii/>
7. Research Shows Virus Undetectable on Five Highly Circulated Library Materials After Three Days. Institute for Library and Museum Services: 2020. <https://www.ims.gov/news/research-shows-virus-undetectable-five-highly-circulated-library-materials-after-three-days>
8. Russia Approves First COVID-19 Vaccine. *FDA News* 2020. <https://www.fdanews.com/articles/198492-russia-approves-first-covid-19-vaccine>
9. Severe Outcomes Among Patients with Coronavirus Disease 2019 (COVID-19) — United States, February 12–March 16, 2020. . *MMWR* 2020. https://www.cdc.gov/mmwr/volumes/69/wr/mm6912e2.htm?s_cid=mm6912e2_w#suggestedcitation
10. Sinovac's Covid-19 vaccine gets emergency use approval in China. *Pharmaceutical Technology* 2020. <https://www.pharmaceutical-technology.com/news/sinovac-vaccine-emergency-use/>
11. Update Alert: Masks for Prevention of Respiratory Virus Infections, Including SARS-CoV-2, in Health Care and Community Settings. *Annals of Internal Medicine* 0 (0), null. <https://www.acpjournals.org/doi/abs/10.7326/L20-0948>
12. 3M, Decontamination of 3M Filtering Facepiece Respirators, such as N95 Respirators, in the United States - Considerations; 3M: 2020. <https://multimedia.3m.com/mws/media/18248690/decontamination-methods-for-3m-filtering-facepiece-respirators-technical-bulletin.pdf>
13. AAAS, You may be able to spread coronavirus just by breathing, new report finds. *Science* 2 April, 2020. <https://www.sciencemag.org/news/2020/04/you-may-be-able-spread-coronavirus-just-breathing-new-report-finds>
14. AAP, Children and COVID-19: State-Level Data Report. <https://services.aap.org/en/pages/2019-novel-coronavirus-covid-19-infections/children-and-covid-19-state-level-data-report/> (accessed 8/31/2020).
15. Abbott, S.; Hellewell, J.; Thompson, R.; Sherratt, K.; Gibbs, H.; Bosse, N.; Munday, J.; Meakin, S.; Doughty, E.; Chun, J.; Chan, Y.; Finger, F.; Campbell, P.; Endo, A.; Pearson, C.; Gimma, A.; Russell, T.; null, n.; Flasche, S.; Kucharski, A.; Eggo, R.; Funk, S., Estimating the time-varying reproduction number of SARS-CoV-2 using national and subnational case counts [version 1; peer review: awaiting peer review]. *Wellcome Open Research* 2020, 5 (112). <https://wellcomeopenresearch.org/articles/5-112/v1>
16. Abella, B. S.; Jolkovsky, E. L.; Biney, B. T.; Uspal, J. E.; Hyman, M. C.; Frank, I.; Hensley, S. E.; Gill, S.; Vogl, D. T.; Maillard, I.; Babushok, D. V.; Huang, A. C.; Nasta, S. D.; Walsh, J. C.; Wiletyo, E. P.; Gimotty, P. A.; Milone, M. C.; Amaravadi, R. K., Efficacy and Safety of Hydroxychloroquine vs Placebo for Pre-exposure SARS-CoV-2 Prophylaxis Among Health Care Workers: A Randomized Clinical Trial. *JAMA Intern Med* 2020.

17. Ackermann, M.; Verleden, S. E.; Kuehnel, M.; Haverich, A.; Welte, T.; Laenger, F.; Vanstapel, A.; Werlein, C.; Stark, H.; Tzankov, A.; Li, W. W.; Li, V. W.; Mentzer, S. J.; Jonigk, D., Pulmonary Vascular Endothelialitis, Thrombosis, and Angiogenesis in Covid-19. *New England Journal of Medicine* **2020**. <https://www.nejm.org/doi/full/10.1056/NEJMoa2015432>
18. Adam, D.; Wu, P.; Wong, J.; Lau, E.; Tsang, T.; Cauchemez, S.; Leung, G.; Cowling, B., Clustering and superspreading potential of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infections in Hong Kong. **2020**.
19. Adam, D. C.; Wu, P.; Wong, J. Y.; Lau, E. H. Y.; Tsang, T. K.; Cauchemez, S.; Leung, G. M.; Cowling, B. J., Clustering and superspreading potential of SARS-CoV-2 infections in Hong Kong. *Nature Medicine* **2020**. <https://doi.org/10.1038/s41591-020-1092-0>
20. Adams, M.; Katz, D.; Grandpre, J., Updated Estimates of Chronic Conditions Affecting Risk for Complications from Coronavirus Disease, United States. *Emerging Infectious Disease journal* **2020**, 26 (9). https://wwwnc.cdc.gov/eid/article/26/9/20-2117_article
21. Addetia, A.; Crawford, K. H. D.; Dings, A.; Zhu, H.; Roychoudhury, P.; Huang, M.-L.; Jerome, K. R.; Bloom, J. D.; Greninger, A. L., Neutralizing antibodies correlate with protection from SARS-CoV-2 in humans during a fishery vessel outbreak with high attack rate. *Journal of Clinical Microbiology* **2020**, JCM.02107-20. <https://jcm.asm.org/content/jcm/early/2020/08/21/JCM.02107-20.full.pdf>
22. Adimmune, A Study to Evaluate the Safety and Immunogenicity of AdimrSC-2f Vaccine. <https://clinicaltrials.gov/ct2/show/NCT04522089>.
23. Afshar, Y.; Gaw, S. L.; Flaherman, V. J.; Chambers, B. D.; Krakow, D.; Berghella, V.; Shamshirsaz, A. A.; Boatin, A. A.; Aldrovandi, G.; Greiner, A.; Riley, L.; Boscardin, W. J.; Jamieson, D. J.; Jacoby, V. L., Clinical Presentation of Coronavirus Disease 2019 (COVID-19) in Pregnant and Recently Pregnant People. *Obstetrics & Gynecology* **9900**, Latest Articles, 10.1097/AOG.0000000000004178. https://journals.lww.com/greenjournal/Fulltext/9900/Clinical_Presentation_of_Coronavirus_Disease_2019.2.aspx
24. Agency, U. S. E. P., EPA's Registered Antimicrobial Products for Use Against Novel Coronavirus SARS-CoV-2, the Cause of COVID-19. <https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2>.
25. Agrawal, A. S.; Garron, T.; Tao, X.; Peng, B. H.; Wakamiya, M.; Chan, T. S.; Couch, R. B.; Tseng, C. T., Generation of a transgenic mouse model of Middle East respiratory syndrome coronavirus infection and disease. *J Virol* **2015**, 89 (7), 3659-70. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4403411/pdf/zjv3659.pdf>
26. Ahmed, W.; Bertsch, P. M.; Bibby, K.; Haramoto, E.; Hewitt, J.; Huygens, F.; Gyawali, P.; Korajkic, A.; Riddell, S.; Sherchan, S. P.; Simpson, S. L.; Sirikanchana, K.; Symonds, E. M.; Verhagen, R.; Vasan, S. S.; Kitajima, M.; Bivins, A., Decay of SARS-CoV-2 and surrogate murine hepatitis virus RNA in untreated wastewater to inform application in wastewater-based epidemiology. *Environmental Research* **2020**, 110092. <http://www.sciencedirect.com/science/article/pii/S0013935120309890>
27. Airora, The development, testing and verification of Airora's patented biocidal technology. <https://www.airora.com/verification.html> (accessed 19 Oct 2020).
28. Aleta, A.; Martin-Corral, D.; Pastore y Piontti, A.; Ajelli, M.; Litvinova, M.; Chinazzi, M.; Dean, N.; Halloran, M. E.; Longini, I.; Merler, S.; Pentland, A.; Vespignani, A.; Moro, E.; Moreno, Y., Modeling the impact of social distancing, testing, contact tracing and household quarantine on second-wave scenarios of the COVID-19 epidemic. *Preprint* **2020**. https://www.mobs-lab.org/uploads/6/7/8/7/6787877/tracing_main_may4.pdf
29. Aleta, A.; Martín-Corral, D.; Pastore y Piontti, A.; Ajelli, M.; Litvinova, M.; Chinazzi, M.; Dean, N. E.; Halloran, M. E.; Longini Jr, I. M.; Merler, S.; Pentland, A.; Vespignani, A.; Moro, E.; Moreno, Y., Modelling the impact of testing, contact tracing and household quarantine on second waves of COVID-19. *Nature Human Behaviour* **2020**. <https://doi.org/10.1038/s41562-020-0931-9>

30. Ali, S. T.; Wang, L.; Lau, E. H. Y.; Xu, X.-K.; Du, Z.; Wu, Y.; Leung, G. M.; Cowling, B. J., Serial interval of SARS-CoV-2 was shortened over time by nonpharmaceutical interventions. *Science* **2020**, eabc9004. <https://science.sciencemag.org/content/sci/early/2020/07/20/science.abc9004.full.pdf>
31. Allotey, J.; Stallings, E.; Bonet, M.; Yap, M.; Chatterjee, S.; Kew, T.; Debenham, L.; Llavall, A. C.; Dixit, A.; Zhou, D.; Balaji, R.; Lee, S. I.; Qiu, X.; Yuan, M.; Coomaraswamy, D.; van Wely, M.; van Leeuwen, E.; Kostova, E.; Kunst, H.; Khalil, A.; Tiberi, S.; Brizuela, V.; Broutet, N.; Kara, E.; Kim, C. R.; Thorson, A.; Oladapo, O. T.; Mofenson, L.; Zamora, J.; Thangaratinam, S., Clinical manifestations, risk factors, and maternal and perinatal outcomes of coronavirus disease 2019 in pregnancy: living systematic review and meta-analysis. *BMJ* **2020**, 370, m3320. <https://www.bmj.com/content/bmj/370/bmj.m3320.full.pdf>
32. Altmann, D. M.; Douek, D. C.; Boyton, R. J., What policy makers need to know about COVID-19 protective immunity. *The Lancet* **2020**. [https://doi.org/10.1016/S0140-6736\(20\)30985-5](https://doi.org/10.1016/S0140-6736(20)30985-5)
33. Alves, A. M.; Yvamoto, E. Y.; Marzinotto, M. A. N.; Teixeira, A. C. d. S.; Carrilho, F. J., SARS-CoV-2 leading to acute pancreatitis: an unusual presentation. *The Brazilian Journal of Infectious Diseases* **2020**. <http://www.sciencedirect.com/science/article/pii/S1413867020301392>
34. Anand, S.; Montez-Rath, M.; Han, J.; Bozeman, J.; Kerschmann, R.; Beyer, P.; Parsonnet, J.; Chertow, G. M., Prevalence of SARS-CoV-2 antibodies in a large nationwide sample of patients on dialysis in the USA: a cross-sectional study. *The Lancet* **2020**. [https://doi.org/10.1016/S0140-6736\(20\)32009-2](https://doi.org/10.1016/S0140-6736(20)32009-2)
35. Andersen, K. G.; Rambaut, A.; Lipkin, W. I.; Holmes, E. C.; Garry, R. F., The proximal origin of SARS-CoV-2. *Nature Medicine* **2020**. <https://doi.org/10.1038/s41591-020-0820-9>
36. Anderson, E. L.; Turnham, P.; Griffin, J. R.; Clarke, C. C., Consideration of the Aerosol Transmission for COVID-19 and Public Health. *Risk Analysis* **2020**, 40 (5), 902-907. <https://onlinelibrary.wiley.com/doi/abs/10.1111/risa.13500>
37. Anderson, K., Estimates of the clock and TMRCA for 2019-nCoV based on 27 genomes. <http://virological.org/t/clock-and-tmrca-based-on-27-genomes/347> (accessed 01/26/2020).
38. AnGes, Study of COVID-19 DNA Vaccine (AG0301-COVID19). <https://clinicaltrials.gov/ct2/show/NCT04463472?term=NCT04463472&draw=2&rank=1>.
39. Angus, D. C.; Derde, L.; Al-Beidh, F.; Annane, D.; Arabi, Y.; Beane, A.; van Bentum-Puijk, W.; Berry, L.; Bhimani, Z.; Bonten, M.; Bradbury, C.; Brunkhorst, F.; Buxton, M.; Buzgau, A.; Cheng, A. C.; de Jong, M.; Detry, M.; Estcourt, L.; Fitzgerald, M.; Goossens, H.; Green, C.; Haniffa, R.; Higgins, A. M.; Horvat, C.; Hulleger, S. J.; Kruger, P.; Lamontagne, F.; Lawler, P. R.; Linstrum, K.; Litton, E.; Lorenzi, E.; Marshall, J.; McAuley, D.; McGlothlin, A.; McGuinness, S.; McVerry, B.; Montgomery, S.; Mouncey, P.; Murthy, S.; Nichol, A.; Parke, R.; Parker, J.; Rowan, K.; Sanil, A.; Santos, M.; Saunders, C.; Seymour, C.; Turner, A.; van de Veerdonk, F.; Venkatesh, B.; Zarychanski, R.; Berry, S.; Lewis, R. J.; McArthur, C.; Webb, S. A.; Gordon, A. C., Effect of Hydrocortisone on Mortality and Organ Support in Patients With Severe COVID-19: The REMAP-CAP COVID-19 Corticosteroid Domain Randomized Clinical Trial. *Jama* **2020**. <https://jamanetwork.com/journals/jama/fullarticle/2770278>
40. Anhui, Clinical Study of Recombinant Novel Coronavirus Vaccine. <https://clinicaltrials.gov/ct2/show/NCT04466085>.
41. Ansarin, K.; Tolouian, R.; Ardalan, M.; Taghizadieh, A.; Varshochi, M.; Teimouri, S.; Vaezi, T.; Valizadeh, H.; Saleh, P.; Safiri, S.; Chapman, K. R., Effect of bromhexine on clinical outcomes and mortality in COVID-19 patients: A randomized clinical trial. *Bioimpacts* **2020**, 10 (4), 209-215.
42. Arcturus, Phase 1/2 Ascending Dose Study of Investigational SARS-CoV-2 Vaccine ARCT-021 in Healthy Adult Subjects. <https://clinicaltrials.gov/ct2/show/NCT04480957?term=vaccine&cond=covid-19&draw=10>.
43. Arentz, M.; Yim, E.; Klaff, L.; Lokhandwala, S.; Riedo, F. X.; Chong, M.; Lee, M., Characteristics and Outcomes of 21 Critically Ill Patients With COVID-19 in Washington State. *JAMA* **2020**. <https://doi.org/10.1001/jama.2020.4326>

44. Argenziano, M. G.; Bruce, S. L.; Slater, C. L.; Tiao, J. R.; Baldwin, M. R.; Barr, R. G.; Chang, B. P.; Chau, K. H.; Choi, J. J.; Gavin, N.; Goyal, P.; Mills, A. M.; Patel, A. A.; Romney, M.-L. S.; Safford, M. M.; Schluger, N. W.; Sengupta, S.; Sobieszczyk, M. E.; Zucker, J. E.; Asadourian, P. A.; Bell, F. M.; Boyd, R.; Cohen, M. F.; Colquhoun, M. I.; Colville, L. A.; de Jonge, J. H.; Dershowitz, L. B.; Dey, S. A.; Eiseman, K. A.; Girvin, Z. P.; Goni, D. T.; Harb, A. A.; Herzik, N.; Householder, S.; Karaaslan, L. E.; Lee, H.; Lieberman, E.; Ling, A.; Lu, R.; Shou, A. Y.; Sisti, A. C.; Snow, Z. E.; Sperring, C. P.; Xiong, Y.; Zhou, H. W.; Natarajan, K.; Hripcsak, G.; Chen, R., Characterization and Clinical Course of 1000 Patients with COVID-19 in New York: retrospective case series. *medRxiv* **2020**, 2020.04.20.20072116.
<https://www.medrxiv.org/content/medrxiv/early/2020/04/22/2020.04.20.20072116.full.pdf>
45. Arons, M. M.; Hatfield, K. M.; Reddy, S. C.; Kimball, A.; James, A.; Jacobs, J. R.; Taylor, J.; Spicer, K.; Bardossy, A. C.; Oakley, L. P.; Tanwar, S.; Dyal, J. W.; Harney, J.; Chisty, Z.; Bell, J. M.; Methner, M.; Paul, P.; Carlson, C. M.; McLaughlin, H. P.; Thornburg, N.; Tong, S.; Tamin, A.; Tao, Y.; Uehara, A.; Harcourt, J.; Clark, S.; Brostrom-Smith, C.; Page, L. C.; Kay, M.; Lewis, J.; Montgomery, P.; Stone, N. D.; Clark, T. A.; Honein, M. A.; Duchin, J. S.; Jernigan, J. A., Presymptomatic SARS-CoV-2 Infections and Transmission in a Skilled Nursing Facility. *New England Journal of Medicine* **2020**.
<https://www.nejm.org/doi/full/10.1056/NEJMoa2008457>
46. Arshad, S.; Kilgore, P.; Chaudhry, Z. S.; Jacobsen, G.; Wang, D. D.; Huitsing, K.; Brar, I.; Alangaden, G. J.; Ramesh, M. S.; McKinnon, J. E.; O'Neill, W.; Zervos, M.; Nauriyal, V.; Hamed, A. A.; Nadeem, O.; Swiderek, J.; Godfrey, A.; Jennings, J.; Gardner-Gray, J.; Ackerman, A. M.; Lezotte, J.; Ruhala, J.; Fadel, R.; Vahia, A.; Gudipati, S.; Parraga, T.; Shallal, A.; Maki, G.; Tariq, Z.; Suleyman, G.; Yared, N.; Herc, E.; Williams, J.; Lanfranco, O. A.; Bhargava, P.; Reyes, K.; Chen, A., Treatment with Hydroxychloroquine, Azithromycin, and Combination in Patients Hospitalized with COVID-19. *International Journal of Infectious Diseases* **2020**. <https://doi.org/10.1016/j.ijid.2020.06.099>
47. Asadi, S.; Cappa, C. D.; Barreda, S.; Wexler, A. S.; Bouvier, N. M.; Ristenpart, W. D., Efficacy of masks and face coverings in controlling outward aerosol particle emission from expiratory activities. *Scientific Reports* **2020**, 10 (1), 15665. <https://doi.org/10.1038/s41598-020-72798-7>
48. Assis, M. S.; Araújo, R.; Lopes, A. M. M., Safety alert for hospital environments and health professional: chlorhexidine is ineffective for coronavirus. *Rev Assoc Med Bras (1992)* **2020**, 66Suppl 2 (Suppl 2), 124-129.
49. Auger, K. A.; Shah, S. S.; Richardson, T.; Hartley, D.; Hall, M.; Warniment, A.; Timmons, K.; Bosse, D.; Ferris, S. A.; Brady, P. W.; Schondelmeyer, A. C.; Thomson, J. E., Association Between Statewide School Closure and COVID-19 Incidence and Mortality in the US. *JAMA* **2020**.
<https://doi.org/10.1001/jama.2020.14348>
50. Auquan, COVID-19 Dashboard. <https://covid19-infection-model.auquan.com/>.
51. Aziz, M.; Fatima, R.; Assaly, R., Elevated Interleukin-6 and Severe COVID-19: A Meta-Analysis. *J Med Virol* **2020**.
52. Badr, H. S.; Du, H.; Marshall, M.; Dong, E.; Squire, M. M.; Gardner, L. M., Association between mobility patterns and COVID-19 transmission in the USA: a mathematical modelling study. *The Lancet Infectious Diseases* **2020**. [https://doi.org/10.1016/S1473-3099\(20\)30553-3](https://doi.org/10.1016/S1473-3099(20)30553-3)
53. Bae, S. H.; Shin, H.; Koo, H.-Y.; Lee, S. W.; Yang, J. M.; Yon, D. K., Asymptomatic Transmission of SARS-CoV-2 on Evacuation Flight. *Emerging Infectious Disease journal* **2020**, 26 (11).
https://wwwnc.cdc.gov/eid/article/26/11/20-3353_article
54. Bai, Y.; Yao, L.; Wei, T.; Tian, F.; Jin, D.-Y.; Chen, L.; Wang, M., Presumed Asymptomatic Carrier Transmission of COVID-19. *JAMA*.
55. Bao, L.; Deng, W.; Huang, B.; Gao, H.; Liu, J.; Ren, L.; Wei, Q.; Yu, P.; Xu, Y.; Qi, F.; Qu, Y.; Li, F.; Lv, Q.; Wang, W.; Xue, J.; Gong, S.; Liu, M.; Wang, G.; Wang, S.; Song, Z.; Zhao, L.; Liu, P.; Zhao, L.; Ye, F.; Wang, H.; Zhou, W.; Zhu, N.; Zhen, W.; Yu, H.; Zhang, X.; Guo, L.; Chen, L.; Wang, C.; Wang, Y.; Wang, X.; Xiao,

- Y.; Sun, Q.; Liu, H.; Zhu, F.; Ma, C.; Yan, L.; Yang, M.; Han, J.; Xu, W.; Tan, W.; Peng, X.; Jin, Q.; Wu, G.; Qin, C., The pathogenicity of SARS-CoV-2 in hACE2 transgenic mice. *Nature* **2020**.
56. Bao, L.; Gao, H.; Deng, W.; Lv, Q.; Yu, H.; Liu, M.; Yu, P.; Liu, J.; Qu, Y.; Gong, S.; Lin, K.; Qi, F.; Xu, Y.; Li, F.; Xiao, C.; Xue, J.; Song, Z.; Xiang, Z.; Wang, G.; Wang, S.; Liu, X.; Zhao, W.; Han, Y.; Wei, Q.; Qin, C., Transmission of SARS-CoV-2 via close contact and respiratory droplets among hACE2 mice. *The Journal of Infectious Diseases* **2020**. <https://doi.org/10.1093/infdis/jiaa281>
57. Barakat, T.; Muylkens, B.; Su, B.-L., Is Particulate Matter of Air Pollution a Vector of Covid-19 Pandemic? *Matter* **2020**, 3 (4), 977-980.
<http://www.sciencedirect.com/science/article/pii/S2590238520305129>
58. Barnkob, M. B.; Pottegård, A.; Støvring, H.; Haunstrup, T. M.; Homburg, K.; Larsen, R.; Hansen, M. B.; Titlestad, K.; Aagaard, B.; Møller, B. K.; Barington, T., Reduced prevalence of SARS-CoV-2 infection in ABO blood group O. *Blood Advances* **2020**, 4 (20), 4990-4993.
<https://doi.org/10.1182/bloodadvances.2020002657>
59. Barrington, L.; Cornwell, A., China's Sinopharm begins late stage trial of COVID-19 vaccine in UAE. <https://www.reuters.com/article/us-health-coronavirus-emirates-vaccine/chinas-sinopharm-begins-late-stage-trial-of-covid-19-vaccine-in-abu-dhabi-idUSKCN24H14T>.
60. Bartlett, S. L.; Diel, D. G.; Wang, L.; Zec, S.; Laverack, M.; Martins, M.; Caserta, L. C.; Killian, M. L.; Terio, K.; Olmstead, C.; Delaney, M. A.; Stokol, T.; Ivančić, M.; Jenkins-Moore, M.; Ingerman, K.; Teegan, T.; McCann, C.; Thomas, P.; McAloose, D.; Sykes, J. M.; Calle, P. P., SARS-CoV-2 Infection And Longitudinal Fecal Screening In Malayan Tigers (*Panthera tigris jacksoni*), Amur Tigers (*Panthera tigris altaica*), And African Lions (*Panthera leo krugeri*) At The Bronx Zoo, New York, USA. *bioRxiv* **2020**, 2020.08.14.250928.
<https://www.biorxiv.org/content/biorxiv/early/2020/08/14/2020.08.14.250928.full.pdf>
61. BBCNews, Coronavirus: AstraZeneca to begin making potential vaccine.
<https://www.bbc.com/news/business-52917118>.
62. Bedford, T.; Neher, R., Genomic epidemiology of novel coronavirus (nCoV) using data from GISAID.
<https://nextstrain.org/ncov>.
63. Behzadinasab, S.; Chin, A.; Hosseini, M.; Poon, L. L. M.; Ducker, W. A., A Surface Coating that Rapidly Inactivates SARS-CoV-2. *ACS Applied Materials & Interfaces* **2020**.
<https://doi.org/10.1021/acsami.0c11425>
64. Beigel, J. H.; Tomashek, K. M.; Dodd, L. E.; Mehta, A. K.; Zingman, B. S.; Kalil, A. C.; Hohmann, E.; Chu, H. Y.; Luetkemeyer, A.; Kline, S.; Lopez de Castilla, D.; Finberg, R. W.; Dierberg, K.; Tapson, V.; Hsieh, L.; Patterson, T. F.; Paredes, R.; Sweeney, D. A.; Short, W. R.; Touloumi, G.; Lye, D. C.; Ohmagari, N.; Oh, M.-d.; Ruiz-Palacios, G. M.; Benfield, T.; Fätkenheuer, G.; Kortepeter, M. G.; Atmar, R. L.; Creech, C. B.; Lundgren, J.; Babiker, A. G.; Pett, S.; Neaton, J. D.; Burgess, T. H.; Bonnett, T.; Green, M.; Makowski, M.; Osinusi, A.; Nayak, S.; Lane, H. C., Remdesivir for the Treatment of Covid-19 — Final Report. *New England Journal of Medicine* **2020**. <https://doi.org/10.1056/NEJMoa2007764>
65. Bendavid, E.; Mulaney, B.; Sood, N.; Shah, S.; Ling, E.; Bromley-Dulfano, R.; Lai, C.; Weissberg, Z.; Saavedra, R.; Tedrow, J.; Tversky, D.; Bogan, A.; Kupiec, T.; Eichner, D.; Gupta, R.; Ioannidis, J.; Bhattacharya, J., COVID-19 Antibody Seroprevalence in Santa Clara County, California. *medRxiv* **2020**, 2020.04.14.20062463.
<https://www.medrxiv.org/content/medrxiv/early/2020/04/17/2020.04.14.20062463.full.pdf>
66. BGI, BGI Responds to Novel Coronavirus with Real-Time Detection Kits, Deploys Emergency Team to Wuhan. 2020. <https://www.bgi.com/global/company/news/bgi-responds-to-novel-coronavirus-with-real-time-detection-kits-deploys-emergency-team-to-wuhan/>
67. Bhatia, S.; al., e., Short-term forecasts of COVID-19 deaths in multiple countries. <https://mrc-ide.github.io/covid19-short-term-forecasts/index.html#introduction>.

68. Bidra, A. S.; Pelletier, J. S.; Westover, J. B.; Frank, S.; Brown, S. M.; Tessema, B., Rapid In-Vitro Inactivation of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Using Povidone-Iodine Oral Antiseptic Rinse. *Journal of Prosthodontics* **2020**, n/a (n/a).
<https://onlinelibrary.wiley.com/doi/abs/10.1111/jopr.13209>
69. Biggerstaff, M.; Cowling, B.; Cucunubá, Z.; Dinh, L.; Ferguson, N.; Gao, H.; Hill, V.; Imai, N.; Johansson, M.; Kada, S.; Morgan, O.; Pastore y Piontti, A.; Polonsky, J.; Prasad, P. V.; Quandelacy, T.; Rambaut, A.; Tappero, J.; Vandemaale, K.; Vespignani, A.; Warmbrod, K. L.; Wong, J., Early Insights from Statistical and Mathematical Modeling of Key Epidemiologic Parameters of COVID-19. *Emerging Infectious Disease journal* **2020**, 26 (11). https://wwwnc.cdc.gov/eid/article/26/11/20-1074_article
70. BioNTech, Study to Describe the Safety, Tolerability, Immunogenicity, and Efficacy of RNA Vaccine Candidates Against COVID-19 in Healthy Adults.
<https://clinicaltrials.gov/ct2/show/NCT04368728?term=BioNtech&draw=2&rank=12>.
71. BioProcessing, K., KBP-201 COVID-19 Vaccine Trial in Healthy Volunteers.
<https://clinicaltrials.gov/ct2/show/study/NCT04473690?term=vaccine&cond=covid-19&draw=3>.
72. Biotech, M., Mesa Biotech Receives Emergency Use Authorization from FDA for a 30 Minute Point of Care Molecular COVID-19 Test. Mesa Biotech: 2020.
<https://www.mesabiotech.com/news/euacoronavirus>
73. Biryukov, J.; Boydston, J. A.; Dunning, R. A.; Yeager, J. J.; Wood, S.; Reese, A. L.; Ferris, A.; Miller, D.; Weaver, W.; Zeitouni, N. E.; Phillips, A.; Freeburger, D.; Hooper, I.; Ratnesar-Shumate, S.; Yoltz, J.; Krause, M.; Williams, G.; Dawson, D. G.; Herzog, A.; Dabisch, P.; Wahl, V.; Hevey, M. C.; Altamura, L. A., Increasing Temperature and Relative Humidity Accelerates Inactivation of SARS-CoV-2 on Surfaces. *mSphere* **2020**, 5 (4), e00441-20. <https://msphere.asm.org/content/msph/5/4/e00441-20.full.pdf>
74. Bixler, D.; Miller, A. D.; Mattison, C. P.; al., e., SARS-CoV-2—Associated Deaths Among Persons Aged <21 Years — United States, February 12–July 31, 2020. *Morbidity and Mortality Weekly Report* **2020**, 2020 (69), 1324-1329. <https://www.cdc.gov/mmwr/volumes/69/wr/mm6937e4.htm>
75. Blackburn, J.; Yiannoutsos, C. T.; Carroll, A. E.; Halverson, P. K.; Menachemi, N., Infection Fatality Ratios for COVID-19 Among Noninstitutionalized Persons 12 and Older: Results of a Random-Sample Prevalence Study. *Annals of Internal Medicine* **2020**, 0 (0), null.
<https://www.acpjournals.org/doi/abs/10.7326/M20-5352>
76. Blair, R. V.; Vaccari, M.; Doyle-Meyers, L. A.; Roy, C. J.; Russell-Lodrigue, K.; Fahlberg, M.; Monjure, C. J.; Beddingfield, B.; Plante, K. S.; Plante, J. A.; Weaver, S. C.; Qin, X.; Midkiff, C. C.; Lehmicke, G.; Golden, N.; Threeton, B.; Penney, T.; Allers, C.; Barnes, M. B.; Pattison, M.; Datta, P. K.; Maness, N. J.; Birnbaum, A.; Bohm, R. P.; Rappaport, J., ARDS and Cytokine Storm in SARS-CoV-2 Infected Caribbean Vervets. *bioRxiv* **2020**, 2020.06.18.157933.
<http://biorxiv.org/content/early/2020/06/19/2020.06.18.157933.abstract>
77. Boehmer, T. K.; DeVies, J.; Caruso, E.; al., e., Changing Age Distribution of the COVID-19 Pandemic — United States, May–August 2020. *Morbidity and Mortality Weekly Report* **2020**, 2020 (69), 1404-1409.
https://www.cdc.gov/mmwr/volumes/69/wr/mm6939e1.htm?s_cid=mm6939e1_w
78. Böhmer, M. M.; Buchholz, U.; Corman, V. M.; Hoch, M.; Katz, K.; Marosevic, D. V.; Böhm, S.; Woudenberg, T.; Ackermann, N.; Konrad, R.; Eberle, U.; Treis, B.; Dangel, A.; Bengs, K.; Fingerle, V.; Berger, A.; Hörmansdorfer, S.; Ippisch, S.; Wicklein, B.; Grahl, A.; Pörtner, K.; Müller, N.; Zeitlmann, N.; Boender, T. S.; Cai, W.; Reich, A.; An der Heiden, M.; Rexroth, U.; Hamouda, O.; Schneider, J.; Veith, T.; Mühlemann, B.; Wölfel, R.; Antwerpen, M.; Walter, M.; Protzer, U.; Liebl, B.; Haas, W.; Sing, A.; Drosten, C.; Zapf, A., Investigation of a COVID-19 outbreak in Germany resulting from a single travel-associated primary case: a case series. *The Lancet. Infectious diseases* **2020**, S1473-3099(20)30314-5.
<https://pubmed.ncbi.nlm.nih.gov/32422201>
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7228725/>

79. Boni, M. F.; Lemey, P.; Jiang, X.; Lam, T. T.-Y.; Perry, B. W.; Castoe, T. A.; Rambaut, A.; Robertson, D. L., Evolutionary origins of the SARS-CoV-2 sarbecovirus lineage responsible for the COVID-19 pandemic. *Nature Microbiology* **2020**. <https://doi.org/10.1038/s41564-020-0771-4>
80. Booth, W.; Johnson, C. Y., Britain to infect healthy volunteers with coronavirus in vaccine challenge trials. *Washington Post* 2020. https://www.washingtonpost.com/world/europe/covid-challenge-trials-uk/2020/10/20/00a31136-026c-11eb-b92e-029676f9ebec_story.html
81. Bosco-Lauth, A. M.; Hartwig, A. E.; Porter, S. M.; Gordy, P. W.; Nehring, M.; Byas, A. D.; VandeWoude, S.; Ragan, I. K.; Maison, R. M.; Bowen, R. A., Experimental infection of domestic dogs and cats with SARS-CoV-2: Pathogenesis, transmission, and response to reexposure in cats. *Proceedings of the National Academy of Sciences* **2020**, 202013102. <http://www.pnas.org/content/early/2020/09/28/2013102117.abstract>
82. Bosco-Lauth, A. M.; Hartwig, A. E.; Porter, S. M.; Gordy, P. W.; Nehring, M.; Byas, A. D.; VandeWoude, S.; Ragan, I. K.; Maison, R. M.; Bowen, R. A., Pathogenesis, transmission and response to re-exposure of SARS-CoV-2 in domestic cats. *bioRxiv* **2020**, 2020.05.28.120998. <http://biorxiv.org/content/early/2020/05/29/2020.05.28.120998.abstract>
83. Bouaziz, J.; Duong, T.; Jachiet, M.; Velter, C.; Lestang, P.; Cassius, C.; Arsouze, A.; Domergue Than Trong, E.; Bagot, M.; Begon, E.; Sulimovic, L.; Rybojad, M., Vascular skin symptoms in COVID-19: a french observational study. *Journal of the European Academy of Dermatology and Venereology* n/a (n/a). <https://onlinelibrary.wiley.com/doi/abs/10.1111/jdv.16544>
84. Boukli, N.; Le Mene, M.; Schnuriger, A.; Cuervo, N. S.; Laroche, C.; Morand-Joubert, L.; Gozlan, J., High incidence of false positive results in patients with other acute infections, using the LIAISON® SARS-CoV-2 commercial chemiluminescent micro-particle immunoassay for detection of IgG anti SARS-CoV-2 antibodies. *Journal of Clinical Microbiology* **2020**, JCM.01352-20. <https://jcm.asm.org/content/jcm/early/2020/08/25/JCM.01352-20.full.pdf>
85. Boulware, D. R.; Pullen, M. F.; Bangdiwala, A. S.; Pastick, K. A.; Lofgren, S. M.; Okafor, E. C.; Skipper, C. P.; Nascene, A. A.; Nicol, M. R.; Abassi, M.; Engen, N. W.; Cheng, M. P.; LaBar, D.; Lothar, S. A.; MacKenzie, L. J.; Drobot, G.; Marten, N.; Zarychanski, R.; Kelly, L. E.; Schwartz, I. S.; McDonald, E. G.; Rajasingham, R.; Lee, T. C.; Hullsiek, K. H., A Randomized Trial of Hydroxychloroquine as Postexposure Prophylaxis for Covid-19. *New England Journal of Medicine* **2020**. <https://www.nejm.org/doi/full/10.1056/NEJMoa2016638>
86. Braun, J.; Loyal, L.; Frentsch, M.; Wendisch, D.; Georg, P.; Kurth, F.; Hippenstiel, S.; Dingeldey, M.; Kruse, B.; Fauchere, F.; Baysal, E.; Mangold, M.; Henze, L.; Lauster, R.; Mall, M.; Beyer, K.; Roehmel, J.; Schmitz, J.; Miltenyi, S.; Mueller, M. A.; Witzernath, M.; Suttorp, N.; Kern, F.; Reimer, U.; Wenschuh, H.; Drosten, C.; Corman, V. M.; Giesecke-Thiel, C.; Sander, L.-E.; Thiel, A., Presence of SARS-CoV-2 reactive T cells in COVID-19 patients and healthy donors. *medRxiv* **2020**, 2020.04.17.20061440. <https://www.medrxiv.org/content/medrxiv/early/2020/04/22/2020.04.17.20061440.full.pdf>
87. Brennan, Z., FDA issues 2nd EUA for decontamination system for N95 masks. *Regulatory Focus* 2020. <https://www.raps.org/news-and-articles/news-articles/2020/4/fda-issues-2nd-eua-for-decontamination-system-for>
88. Brocato, R.; Principe, L.; Kim, R.; Zeng, X.; Williams, J.; Liu, Y.; Li, R.; Smith, J.; Golden, J.; Gangemi, D.; Youssef, S.; Wang, Z.; Glanville, J.; Hooper, J., Disruption of Adaptive Immunity Enhances Disease in SARS-CoV-2 Infected Syrian Hamsters. *bioRxiv* **2020**, 2020.06.19.161612. <http://biorxiv.org/content/early/2020/06/19/2020.06.19.161612.abstract>
89. Brosseau, L. M., COMMENTARY: COVID-19 transmission messages should hinge on science. <http://www.cidrap.umn.edu/news-perspective/2020/03/commentary-covid-19-transmission-messages-should-hinge-science>.

90. Brosseau, L. M.; Jones, R., Commentary: Protecting health workers from airborne MERS-CoV - learning from SARS. <http://www.cidrap.umn.edu/news-perspective/2014/05/commentary-protecting-health-workers-airborne-mers-cov-learning-sars>.
91. Bryner, J., First US infant death linked to COVID-19 reported in Illinois. *LiveScience* 2020. <https://www.livescience.com/us-infant-dies-coronavirus.html>
92. Buitrago-Garcia, D.; Egli-Gany, D.; Counotte, M. J.; Hossmann, S.; Imeri, H.; Ipekci, A. M.; Salanti, G.; Low, N., Occurrence and transmission potential of asymptomatic and presymptomatic SARS-CoV-2 infections: A living systematic review and meta-analysis. *PLOS Medicine* **2020**, 17 (9), e1003346. <https://doi.org/10.1371/journal.pmed.1003346>
93. Buonanno, G.; Morawska, L.; Stabile, L., Quantitative assessment of the risk of airborne transmission of SARS-CoV-2 infection: Prospective and retrospective applications. *Environment International* **2020**, 145, 106112. <http://www.sciencedirect.com/science/article/pii/S0160412020320675>
94. Burbelo, P. D.; Riedo, F. X.; Morishima, C.; Rawlings, S.; Smith, D.; Das, S.; Strich, J. R.; Chertow, D. S.; Davey, R. T.; Cohen, J. I., Detection of Nucleocapsid Antibody to SARS-CoV-2 is More Sensitive than Antibody to Spike Protein in COVID-19 Patients. *J Infect Dis* **2020**.
95. Burke, R. M., Active monitoring of persons exposed to patients with confirmed COVID-19—United States, January–February 2020. *MMWR. Morbidity and mortality weekly report* **2020**, 69.
96. Byambasuren, O.; Cardona, M.; Bell, K.; Clark, J.; McLaws, M.-L.; Glasziou, P., Estimating the extent of true asymptomatic COVID-19 and its potential for community transmission: systematic review and meta-analysis. *Available at SSRN 3586675* **2020**.
97. Callow, K.; Parry, H.; Sergeant, M.; Tyrrell, D., The time course of the immune response to experimental coronavirus infection of man. *Epidemiology & Infection* **1990**, 105 (2), 435-446.
98. Cao, B.; Wang, Y.; Wen, D.; Liu, W.; Wang, J.; Fan, G.; Ruan, L.; Song, B.; Cai, Y.; Wei, M.; Li, X.; Xia, J.; Chen, N.; Xiang, J.; Yu, T.; Bai, T.; Xie, X.; Zhang, L.; Li, C.; Yuan, Y.; Chen, H.; Li, H.; Huang, H.; Tu, S.; Gong, F.; Liu, Y.; Wei, Y.; Dong, C.; Zhou, F.; Gu, X.; Xu, J.; Liu, Z.; Zhang, Y.; Li, H.; Shang, L.; Wang, K.; Li, K.; Zhou, X.; Dong, X.; Qu, Z.; Lu, S.; Hu, X.; Ruan, S.; Luo, S.; Wu, J.; Peng, L.; Cheng, F.; Pan, L.; Zou, J.; Jia, C.; Wang, J.; Liu, X.; Wang, S.; Wu, X.; Ge, Q.; He, J.; Zhan, H.; Qiu, F.; Guo, L.; Huang, C.; Jaki, T.; Hayden, F. G.; Horby, P. W.; Zhang, D.; Wang, C., A Trial of Lopinavir–Ritonavir in Adults Hospitalized with Severe Covid-19. *New England Journal of Medicine* **2020**. <https://www.nejm.org/doi/full/10.1056/NEJMoa2001282>
99. Cao, Y.; Wei, J.; Zou, L.; Jiang, T.; Wang, G.; Chen, L.; Huang, L.; Meng, F.; Huang, L.; Wang, N.; Zhou, X.; Luo, H.; Mao, Z.; Chen, X.; Xie, J.; Liu, J.; Cheng, H.; Zhao, J.; Huang, G.; Wang, W.; Zhou, J., Ruxolitinib in treatment of severe coronavirus disease 2019 (COVID-19): A multicenter, single-blind, randomized controlled trial. *Journal of Allergy and Clinical Immunology* **2020**. <http://www.sciencedirect.com/science/article/pii/S0091674920307387>
100. Carfi, A.; Bernabei, R.; Landi, F.; Group, f. t. G. A. C.-P.-A. C. S., Persistent Symptoms in Patients After Acute COVID-19. *JAMA* **2020**. <https://doi.org/10.1001/jama.2020.12603>
101. Casey, M.; Griffin, J.; McAloon, C. G.; Byrne, A. W.; Madden, J. M.; McEvoy, D.; Collins, A. B.; Hunt, K.; Barber, A.; Butler, F.; Lane, E. A.; O'Brien, K.; Wall, P.; Walsh, K. A.; More, S. J., Estimating pre-symptomatic transmission of COVID-19: a secondary analysis using published data. *medRxiv* **2020**, 2020.05.08.20094870. <https://www.medrxiv.org/content/medrxiv/early/2020/05/11/2020.05.08.20094870.full.pdf>
102. Cauchois, R.; Koubi, M.; Delarbre, D.; Manet, C.; Carvelli, J.; Blasco, V. B.; Jean, R.; Fouche, L.; Bornet, C.; Pauly, V.; Mazodier, K.; Pestre, V.; Jarrot, P.-A.; Dinarello, C. A.; Kaplanski, G., Early IL-1 receptor blockade in severe inflammatory respiratory failure complicating COVID-19. *Proceedings of the National Academy of Sciences* **2020**, 202009017. <http://www.pnas.org/content/early/2020/07/21/2009017117.abstract>

103. Cavalcanti, A. B.; Zampieri, F. G.; Rosa, R. G.; Azevedo, L. C. P.; Veiga, V. C.; Avezum, A.; Damiani, L. P.; Marcadenti, A.; Kawano-Dourado, L.; Lisboa, T.; Junqueira, D. L. M.; de Barros e Silva, P. G. M.; Tramuja, L.; Abreu-Silva, E. O.; Laranjeira, L. N.; Soares, A. T.; Echenique, L. S.; Pereira, A. J.; Freitas, F. G. R.; Gebara, O. C. E.; Dantas, V. C. S.; Furtado, R. H. M.; Milan, E. P.; Golin, N. A.; Cardoso, F. F.; Maia, I. S.; Hoffmann Filho, C. R.; Kormann, A. P. M.; Amazonas, R. B.; Bocchi de Oliveira, M. F.; Serpa-Neto, A.; Falavigna, M.; Lopes, R. D.; Machado, F. R.; Berwanger, O., Hydroxychloroquine with or without Azithromycin in Mild-to-Moderate Covid-19. *New England Journal of Medicine* **2020**.
<https://www.nejm.org/doi/full/10.1056/NEJMoa2019014>
104. CDC, 2019 Novel Coronavirus RT-PCR Identification Protocols.
<https://www.cdc.gov/coronavirus/2019-ncov/lab/rt-pcr-detection-instructions.html>.
105. CDC, About Masks. <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/about-face-coverings.html>.
106. CDC, Confirmation of COVID-19 in Two Pet Cats in New York. Centers for Disease Control and Prevention: 2020. <https://www.cdc.gov/media/releases/2020/s0422-covid-19-cats-NYC.html>
107. CDC, COVID-19 Forecasts. <https://www.cdc.gov/coronavirus/2019-ncov/covid-data/forecasting-us.html>.
108. CDC, Interim healthcare infection prevention and control recommendations for patients under investigation for 2019 novel coronavirus. <https://www.cdc.gov/coronavirus/2019-ncov/infection-control.html>.
109. CDC, Recommendation Regarding the Use of Cloth Face Coverings, Especially in Areas of Significant Community-Based Transmission. **2020**. <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/cloth-face-cover.html>
110. CDC, Scientific Brief: SARS-CoV-2 and Potential Airborne Transmission.
<https://www.cdc.gov/coronavirus/2019-ncov/more/scientific-brief-sars-cov-2.html>.
111. CDC, Situation summary. <https://www.cdc.gov/coronavirus/2019-nCoV/summary.html>.
112. CDC, Symptoms of Coronavirus. <https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html>.
113. CDC, Updated Isolation Guidance Does Not Imply Immunity to COVID-19.
<https://www.cdc.gov/media/releases/2020/s0814-updated-isolation-guidance.html>.
114. CDC, C., China's CDC detects a large number of new coronaviruses in the South China seafood market in Wuhan http://www.chinacdc.cn/yw_9324/202001/t20200127_211469.html (accessed 01/27/2020).
115. CEID, Nowcasts for the US, states, and territories. <http://2019-coronavirus-tracker.com/nowcast.html>.
116. Centers for Disease Control and Prevention (CDC), Coronaviruses Disease 2019 (COVID-19) 2020 Interim Case Definition, Approved August 5 2020. <https://wwwn.cdc.gov/nndss/conditions/coronavirus-disease-2019-covid-19/case-definition/2020/08/05/> (accessed 21 Sept 2020).
117. Centers for Disease Control and Prevention (CDC), Overview of Testing for SARS-CoV-2 (COVID-19). <https://www.cdc.gov/coronavirus/2019-ncov/hcp/testing-overview.html> (accessed 22 September 2020).
118. Cevik, M.; Marcus, J.; Buckee, C.; Smith, T., SARS-CoV-2 transmission dynamics should inform policy. *Available at SSRN 3692807* **2020**.
119. Chan, J. F.-W.; Yuan, S.; Kok, K.-H.; To, K. K.-W.; Chu, H.; Yang, J.; Xing, F.; Liu, J.; Yip, C. C.-Y.; Poon, R. W.-S.; Tsoi, H.-W.; Lo, S. K.-F.; Chan, K.-H.; Poon, V. K.-M.; Chan, W.-M.; Ip, J. D.; Cai, J.-P.; Cheng, V. C.-C.; Chen, H.; Hui, C. K.-M.; Yuen, K.-Y., A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. *The Lancet* **2020**.
<https://www.sciencedirect.com/science/article/pii/S0140673620301549>
120. Chan, J. F.; Zhang, A. J.; Yuan, S.; Poon, V. K.; Chan, C. C.; Lee, A. C.; Chan, W. M.; Fan, Z.; Tsoi, H. W.; Wen, L.; Liang, R.; Cao, J.; Chen, Y.; Tang, K.; Luo, C.; Cai, J. P.; Kok, K. H.; Chu, H.; Chan, K. H.; Sridhar, S.;

- Chen, Z.; Chen, H.; To, K. K.; Yuen, K. Y., Simulation of the clinical and pathological manifestations of Coronavirus Disease 2019 (COVID-19) in golden Syrian hamster model: implications for disease pathogenesis and transmissibility. *Clin Infect Dis* **2020**.
<https://www.ncbi.nlm.nih.gov/pubmed/32215622>
121. Chande, A. T.; Gussler, W.; Harris, M.; Lee, S.; Rishishwar, L.; Jordan, I. K.; Andris, C. M.; Weitz, J. S., Interactive COVID-19 Event Risk Assessment Planning Tool. <http://covid19risk.biosci.gatech.edu/>.
122. Chandrashekar, A.; Liu, J.; Martinot, A. J.; McMahan, K.; Mercado, N. B.; Peter, L.; Tostanoski, L. H.; Yu, J.; Maliga, Z.; Nekorchuk, M.; Busman-Sahay, K.; Terry, M.; Wrijil, L. M.; Ducat, S.; Martinez, D. R.; Atyeo, C.; Fischinger, S.; Burke, J. S.; Slein, M. D.; Pessaint, L.; Van Ry, A.; Greenhouse, J.; Taylor, T.; Blade, K.; Cook, A.; Finneyfrock, B.; Brown, R.; Teow, E.; Velasco, J.; Zahn, R.; Wegmann, F.; Abbink, P.; Bondzie, E. A.; Dagotto, G.; Gebre, M. S.; He, X.; Jacob-Dolan, C.; Kordana, N.; Li, Z.; Lifton, M. A.; Mahrokhian, S. H.; Maxfield, L. F.; Nityanandam, R.; Nkolola, J. P.; Schmidt, A. G.; Miller, A. D.; Baric, R. S.; Alter, G.; Sorger, P. K.; Estes, J. D.; Andersen, H.; Lewis, M. G.; Barouch, D. H., SARS-CoV-2 infection protects against rechallenge in rhesus macaques. *Science* **2020**, eabc4776.
<https://science.sciencemag.org/content/sci/early/2020/05/19/science.abc4776.full.pdf>
123. Changzheng, L. J. L., Experts in the medical treatment team: Wuhan's unexplained viral pneumonia patients can be controlled more. <https://www.cn-healthcare.com/article/20200110/content-528579.html>.
124. Chen, C.; Cao, M.; Peng, L.; Guo, X.; Yang, F.; Wu, W.; Chen, L.; Yang, Y.; Liu, Y.; Wang, F., Coronavirus Disease-19 Among Children Outside Wuhan, China. *SSRN* **2020**.
https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3546071
125. Chen, N.; Zhou, M.; Dong, X.; Qu, J.; Gong, F.; Han, Y.; Qiu, Y.; Wang, J.; Liu, Y.; Wei, Y.; Xia, J.; Yu, T.; Zhang, X.; Zhang, L., Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet* **2020**.
<https://www.ncbi.nlm.nih.gov/pubmed/32007143>
126. Chen, Z.; Hu, J.; Zhang, Z.; Jiang, S.; Han, S.; Yan, D.; Zhuang, R.; Hu, B.; Zhang, Z., Efficacy of hydroxychloroquine in patients with COVID-19: results of a randomized clinical trial. *medRxiv* **2020**, 2020.03.22.20040758.
<https://www.medrxiv.org/content/medrxiv/early/2020/04/10/2020.03.22.20040758.full.pdf>
127. Cheng, H.-Y.; Jian, S.-W.; Liu, D.-P.; Ng, T.-C.; Huang, W.-T.; Lin, H.-H.; Team, f. t. T. C.-O. I., Contact Tracing Assessment of COVID-19 Transmission Dynamics in Taiwan and Risk at Different Exposure Periods Before and After Symptom Onset. *JAMA Internal Medicine* **2020**.
<https://doi.org/10.1001/jamainternmed.2020.2020>
128. Chhatwal, J.; Ayer, T.; Linas, B. P. D., O. O.; Mueller, P.; Adey, M.; Ladd, M. A.; Xiao, J. Y. X., COVID-19. <https://www.covid19sim.org/>.
129. Chicago, Forecasting for Illinois SARS-CoV-2 model.
https://github.com/cobeylab/covid_IL/tree/master/Forecasting.
130. Chin, A.; Chu, J.; Perera, M.; Hui, K.; Yen, H.-L.; Chan, M.; Peiris, M.; Poon, L., Stability of SARS-CoV-2 in different environmental conditions. *medRxiv* **2020**, 2020.03.15.20036673.
<https://www.medrxiv.org/content/medrxiv/early/2020/03/27/2020.03.15.20036673.full.pdf>
131. Chin, A. W. H.; Chu, J. T. S.; Perera, M. R. A.; Hui, K. P. Y.; Yen, H.-L.; Chan, M. C. W.; Peiris, M.; Poon, L. L. M., Stability of SARS-CoV-2 in different environmental conditions. *The Lancet Microbe* **2020**, 1 (1), e10. [https://doi.org/10.1016/S2666-5247\(20\)30003-3](https://doi.org/10.1016/S2666-5247(20)30003-3)
132. Chin, A. W. H.; Chu, J. T. S.; Perera, M. R. A.; Hui, K. P. Y.; Yen, H.-L.; Chan, M. C. W.; Peiris, M.; Poon, L. L. M., Stability of SARS-CoV-2 in different environmental conditions. *The Lancet Microbe*.
[https://doi.org/10.1016/S2666-5247\(20\)30003-3](https://doi.org/10.1016/S2666-5247(20)30003-3)

133. Choi, E.; Chu, D. K. W.; Cheng, P. K. C.; Tsang, D. N. C.; Peiris, M.; Bausch, D.; Poon, L. L. M.; Watson-Jones, D., In-Flight Transmission of Severe Acute Respiratory Syndrome Coronavirus 2. *Emerging Infectious Disease Journal* **2020**, 26 (11). https://wwwnc.cdc.gov/eid/article/26/11/20-3254_article
134. Christensen, B.; Favaloro, E. J.; Lippi, G.; Van Cott, E. M., Hematology Laboratory Abnormalities in Patients with Coronavirus Disease 2019 (COVID-19). *Semin Thromb Hemost* **2020**, (EFirst).
135. Chu, D. K.; Akl, E. A.; Duda, S.; Solo, K.; Yaacoub, S.; Schünemann, H. J.; Chu, D. K.; Akl, E. A.; El-harakeh, A.; Bognanni, A.; Lotfi, T.; Loeb, M.; Hajizadeh, A.; Bak, A.; Izcovich, A.; Cuello-Garcia, C. A.; Chen, C.; Harris, D. J.; Borowiack, E.; Chamseddine, F.; Schünemann, F.; Morgano, G. P.; Muti Schünemann, G. E. U.; Chen, G.; Zhao, H.; Neumann, I.; Chan, J.; Khabisa, J.; Hneiny, L.; Harrison, L.; Smith, M.; Rizk, N.; Giorgi Rossi, P.; AbiHanna, P.; El-khoury, R.; Stalteri, R.; Baldeh, T.; Piggott, T.; Zhang, Y.; Saad, Z.; Khamis, A.; Reinap, M.; Duda, S.; Solo, K.; Yaacoub, S.; Schünemann, H. J., Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. *The Lancet* **2020**. [https://doi.org/10.1016/S0140-6736\(20\)31142-9](https://doi.org/10.1016/S0140-6736(20)31142-9)
136. Chulalongkorn, ChulaCov19 mRNA Vaccine in Healthy Adults. <https://clinicaltrials.gov/ct2/show/NCT04566276>.
137. Clark, K. E. N.; Collas, O.; Lachmann, H.; Singh, A.; Buckley, J.; Bhagani, S., Safety of intravenous Anakinra in COVID-19 with evidence of hyperinflammation, a case series. *Rheumatology Advances in Practice* **2020**. <https://doi.org/10.1093/rap/rkaa040>
138. CNBC, Russia approves second Covid-19 vaccine after preliminary trials. <https://www.cnbc.com/2020/10/14/russia-approves-second-covid-19-vaccine-after-preliminary-trials.html>.
139. Cockrell, A. S.; Yount, B. L.; Scobey, T.; Jensen, K.; Douglas, M.; Beall, A.; Tang, X.-C.; Marasco, W. A.; Heise, M. T.; Baric, R. S., A mouse model for MERS coronavirus-induced acute respiratory distress syndrome. *Nature microbiology* **2016**, 2 (2), 1-11.
140. Cohen, J., Mining coronavirus genomes for clues to the outbreak's origins. *Science* **2020**. <https://www.sciencemag.org/news/2020/01/mining-coronavirus-genomes-clues-outbreak-s-origins>
141. Cohen, J., Wuhan seafood market may not be source of novel virus spreading globally. <https://www.sciencemag.org/news/2020/01/wuhan-seafood-market-may-not-be-source-novel-virus-spreading-globally> (accessed 01/27/2020).
142. Courtemanche, C.; Garuccio, J.; Le, A.; Pinkston, J.; Yelowitz, A., Strong Social Distancing Measures In The United States Reduced The COVID-19 Growth Rate. *Health Affairs* **2020**, 10.1377/hlthaff.2020.00608. <https://doi.org/10.1377/hlthaff.2020.00608>
143. Coutard, B.; Valle, C.; de Lamballerie, X.; Canard, B.; Seidah, N.; Decroly, E., The spike glycoprotein of the new coronavirus 2019-nCoV contains a furin-like cleavage site absent in CoV of the same clade. *Antiviral research* **2020**, 176, 104742.
144. Covaxx, A Study to Evaluate the Safety, Tolerability, and Immunogenicity of UB-612 COVID-19 Vaccine. <https://clinicaltrials.gov/ct2/show/NCT04545749>.
145. Cowling, B. J.; Ali, S. T.; Ng, T. W. Y.; Tsang, T. K.; Li, J. C. M.; Fong, M. W.; Liao, Q.; Kwan, M. Y.; Lee, S. L.; Chiu, S. S.; Wu, J. T.; Wu, P.; Leung, G. M., Impact assessment of non-pharmaceutical interventions against COVID-19 and influenza in Hong Kong: an observational study. *medRxiv* **2020**, 2020.03.12.20034660. <https://www.medrxiv.org/content/medrxiv/early/2020/03/16/2020.03.12.20034660.full.pdf>
146. CureVax, A Dose-Confirmation Study to Evaluate the Safety, Reactogenicity and Immunogenicity of Vaccine CVnCoV in Healthy Adults. <https://clinicaltrials.gov/ct2/show/NCT04515147>.
147. Daily, H., Wuhan Institute of Virology, Chinese Academy of Sciences and others have found that 3 drugs have a good inhibitory effect on new coronavirus. Chen, L., Ed. **2020**. http://news.cnhubei.com/content/2020-01/28/content_12656365.html

148. Damas, J.; Hughes, G. M.; Keough, K. C.; Painter, C. A.; Persky, N. S.; Corbo, M.; Hiller, M.; Koepfli, K.-P.; Pfenning, A. R.; Zhao, H.; Genereux, D. P.; Swofford, R.; Pollard, K. S.; Ryder, O. A.; Nweeia, M. T.; Lindblad-Toh, K.; Teeling, E. C.; Karlsson, E. K.; Lewin, H. A., Broad host range of SARS-CoV-2 predicted by comparative and structural analysis of ACE2 in vertebrates. *Proceedings of the National Academy of Sciences* **2020**, 202010146. <https://www.pnas.org/content/pnas/early/2020/08/20/2010146117.full.pdf>
149. Davies, A.; Thompson, K. A.; Giri, K.; Kafatos, G.; Walker, J.; Bennett, A., Testing the efficacy of homemade masks: would they protect in an influenza pandemic? *Disaster Med Public Health Prep* **2013**, 7 (4), 413-8. <https://www.ncbi.nlm.nih.gov/pubmed/24229526>
150. Davoudi-Monfared, E.; Rahmani, H.; Khalili, H.; Hajiabdolbaghi, M.; Salehi, M.; Abbasian, L.; Kazemzadeh, H.; Yekaninejad, M. S., Efficacy and safety of interferon beta-1a in treatment of severe COVID-19: A randomized clinical trial. *medRxiv* **2020**, 2020.05.28.20116467. <https://www.medrxiv.org/content/medrxiv/early/2020/05/30/2020.05.28.20116467.full.pdf>
151. De Albuquerque, N.; Baig, E.; Ma, X.; Zhang, J.; He, W.; Rowe, A.; Habal, M.; Liu, M.; Shalev, I.; Downey, G. P.; Gorczynski, R.; Butany, J.; Leibowitz, J.; Weiss, S. R.; McGilvray, I. D.; Phillips, M. J.; Fish, E. N.; Levy, G. A., Murine hepatitis virus strain 1 produces a clinically relevant model of severe acute respiratory syndrome in A/J mice. *J Virol* **2006**, 80 (21), 10382-94. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1641767/pdf/0747-06.pdf>
152. de Haan, C. A. M.; Haijema, B. J.; Schellen, P.; Schreur, P. W.; te Lintelo, E.; Vennema, H.; Rottier, P. J. M., Cleavage of Group 1 Coronavirus Spike Proteins: How Furin Cleavage Is Traded Off against Heparan Sulfate Binding upon Cell Culture Adaptation. *Journal of Virology* **2008**, 82 (12), 6078-6083. <https://jvi.asm.org/content/jvi/82/12/6078.full.pdf>
153. Dediego, M. L.; Pewe, L.; Alvarez, E.; Rojas, M. T.; Perlman, S.; Enjuanes, L., Pathogenicity of severe acute respiratory coronavirus deletion mutants in hACE-2 transgenic mice. *Virology* **2008**, 376 (2), 379-389. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2810402/>
154. Degesys, N. F.; Wang, R. C.; Kwan, E.; Fahimi, J.; Noble, J. A.; Raven, M. C., Correlation Between N95 Extended Use and Reuse and Fit Failure in an Emergency Department. *JAMA* **2020**. <https://doi.org/10.1001/jama.2020.9843>
155. Delahoy, M. J.; Whitaker, M.; O'Halloran, A.; al., e., Characteristics and Maternal and Birth Outcomes of Hospitalized Pregnant Women with Laboratory-Confirmed COVID-19 — COVID-NET, 13 States, March 1–August 22, 2020. *Morbidity and Mortality Weekly Report* **2020**, ePub: 16 September 2020. https://www.cdc.gov/mmwr/volumes/69/wr/mm6938e1.htm?s_cid=mm6938e1_w
156. Deng, C., China to Fast-Track Coronavirus Vaccine Trial Based on Advanced Genetics Technology <https://www.wsj.com/articles/china-to-fast-track-coronavirus-vaccine-trial-based-on-advanced-genetics-technology-11593180841>.
157. Deng, C.; Jones, R., In Global Covid-19 Vaccine Race, Chinese Shot Receives First Foreign Approval. *Wall Street Journal* 2020. <https://www.wsj.com/articles/in-global-covid-19-vaccine-race-chinese-shot-receives-first-foreign-approval-11600171149>
158. Deng, W.; Bao, L.; Gao, H.; Xiang, Z.; Qu, Y.; Song, Z.; Gong, S.; Liu, J.; Liu, J.; Yu, P.; Qi, F.; Xu, Y.; Li, F.; Xiao, C.; Lv, Q.; Xue, J.; Wei, Q.; Liu, M.; Wang, G.; Wang, S.; Yu, H.; Chen, T.; Liu, X.; Zhao, W.; Han, Y.; Qin, C., Ocular conjunctival inoculation of SARS-CoV-2 can cause mild COVID-19 in rhesus macaques. *Nature Communications* **2020**, 11 (1), 4400. <https://doi.org/10.1038/s41467-020-18149-6>
159. Deng, W.; Bao, L.; Gao, H.; Xiang, Z.; Qu, Y.; Song, Z.; Gong, S.; Liu, J.; Liu, J.; Yu, P.; Qi, F.; Xu, Y.; Li, F.; Xiao, C.; Lv, Q.; Xue, J.; Wei, Q.; Liu, M.; Wang, G.; Wang, S.; Yu, H.; Liu, X.; Zhao, W.; Han, Y.; Qin, C., Ocular conjunctival inoculation of SARS-CoV-2 can cause mild COVID-19 in Rhesus macaques. *bioRxiv* **2020**.
160. Deng, W.; Bao, L.; Liu, J.; Xiao, C.; Liu, J.; Xue, J.; Lv, Q.; Qi, F.; Gao, H.; Yu, P.; Xu, Y.; Qu, Y.; Li, F.; Xiang, Z.; Yu, H.; Gong, S.; Liu, M.; Wang, G.; Wang, S.; Song, Z.; Liu, Y.; Zhao, W.; Han, Y.; Zhao, L.; Liu, X.; Wei, Q.; Qin, C., Primary exposure to SARS-CoV-2 protects against reinfection in rhesus macaques.

Science **2020**, eabc5343.

<https://science.sciencemag.org/content/sci/early/2020/07/01/science.abc5343.full.pdf>

161. Deng, X.; Gu, W.; Federman, S.; du Plessis, L.; Pybus, O. G.; Faria, N.; Wang, C.; Yu, G.; Bushnell, B.; Pan, C.-Y.; Guevara, H.; Sotomayor-Gonzalez, A.; Zorn, K.; Gopez, A.; Servellita, V.; Hsu, E.; Miller, S.; Bedford, T.; Greninger, A. L.; Roychoudhury, P.; Starita, L. M.; Famulare, M.; Chu, H. Y.; Shendure, J.; Jerome, K. R.; Anderson, C.; Gangavarapu, K.; Zeller, M.; Spencer, E.; Andersen, K. G.; MacCannell, D.; Paden, C. R.; Li, Y.; Zhang, J.; Tong, S.; Armstrong, G.; Morrow, S.; Willis, M.; Matyas, B. T.; Mase, S.; Kasirye, O.; Park, M.; Masinde, G.; Chan, C.; Yu, A. T.; Chai, S. J.; Villarino, E.; Bonin, B.; Wadford, D. A.; Chiu, C. Y., Genomic surveillance reveals multiple introductions of SARS-CoV-2 into Northern California. *Science* **2020**, eabb9263.

<https://science.sciencemag.org/content/sci/early/2020/06/05/science.abb9263.full.pdf>

162. Dequin, P. F.; Heming, N.; Meziani, F.; Plantefève, G.; Voiriot, G.; Badié, J.; François, B.; Aubron, C.; Ricard, J. D.; Ehrmann, S.; Jouan, Y.; Guillon, A.; Leclerc, M.; Coffre, C.; Bourgoin, H.; Lengellé, C.; Caille-Fénérol, C.; Tavernier, E.; Zohar, S.; Giraudeau, B.; Annane, D.; Le Gouge, A., Effect of Hydrocortisone on 21-Day Mortality or Respiratory Support Among Critically Ill Patients With COVID-19: A Randomized Clinical Trial. *Jama* **2020**. <https://jamanetwork.com/journals/jama/fullarticle/2770276>

163. Deslandes, A.; Berti, V.; Tandjaoui-Lambotte, Y.; Alloui, C.; Carbonnelle, E.; Zahar, J. R.; Brichler, S.; Cohen, Y., SARS-CoV-2 was already spreading in France in late December 2019. *International Journal of Antimicrobial Agents* **2020**, 106006.

<http://www.sciencedirect.com/science/article/pii/S0924857920301643>

164. DHS, Estimated Airborne Decay of SARS-CoV-2. <https://www.dhs.gov/science-and-technology/sars-airborne-calculator>.

165. DHS, Estimated Natural Decay of SARS-CoV-2 (virus that causes COVID-19) on surfaces under a range of temperatures and relative humidity. <https://www.dhs.gov/science-and-technology/sars-calculator>.

166. DHS, *Low-Cost Decontamination of N95 Respirators*; Department of Homeland Security Science & Technology Directorate: 2020.

https://www.dhs.gov/sites/default/files/publications/multicooker_n95_decontamination_factsheet_v9_2020_06_15.pdf

167. Ding, X.; Yin, K.; Li, Z.; Lalla, R. V.; Ballesteros, E.; Sfeir, M. M.; Liu, C., Ultrasensitive and visual detection of SARS-CoV-2 using all-in-one dual CRISPR-Cas12a assay. *Nature Communications* **2020**, *11* (1), 4711. <https://doi.org/10.1038/s41467-020-18575-6>

168. Doi, Y.; Hibino, M.; Hase, R.; Yamamoto, M.; Kasamatsu, Y.; Hirose, M.; Mutoh, Y.; Homma, Y.; Terada, M.; Ogawa, T.; Kashizaki, F.; Yokoyama, T.; Koba, H.; Kasahara, H.; Yokota, K.; Kato, H.; Yoshida, J.; Kita, T.; Kato, Y.; Kamio, T.; Kodama, N.; Uchida, Y.; Ikeda, N.; Shinoda, M.; Nakagawa, A.; Nakatsumi, H.; Horiguchi, T.; Iwata, M.; Matsuyama, A.; Banno, S.; Koseki, T.; Teramachi, M.; Miyata, M.; Tajima, S.; Maeki, T.; Nakayama, E.; Taniguchi, S.; Lim, C. K.; Saijo, M.; Imai, T.; Yoshida, H.; Kabata, D.; Shintani, A.; Yuzawa, Y.; Kondo, M., A prospective, randomized, open-label trial of early versus late favipiravir in hospitalized patients with COVID-19. *Antimicrob Agents Chemother* **2020**.

169. Dong, Y.; Mo, X.; Hu, Y.; Qi, X.; Jiang, F.; Jiang, Z.; Tong, S., Epidemiological Characteristics of 2143 Pediatric Patients With 2019 Coronavirus Disease in China. *Pediatrics* **2020**, e20200702.

<https://pediatrics.aappublications.org/content/pediatrics/early/2020/03/16/peds.2020-0702.full.pdf>

170. Doung-Ngern, P.; Suphanchaimat, R.; Panjangampatthana, A.; Janekrongtham, C.; Ruampoom, D.; Daochaeng, N.; Eungkanit, N.; Pisitpayat, N.; Srisong, N.; Yasopa, O.; Plernprom, P.; Promduangsi, P.; Kumphon, P.; Suangtho, P.; Watakulsin, P.; Chaiya, S.; Kripattanapong, S.; Chantian, T.; Bloss, E.; Namwat, C.; Limmathurotsakul, D., Case-Control Study of Use of Personal Protective Measures and Risk for Severe Acute Respiratory Syndrome Coronavirus 2 Infection, Thailand. *Emerg Infect Dis* **2020**, *26* (11).

171. Du, Z.; Xu, X.; Wang, L.; Fox, S. J.; Cowling, B. J.; Galvani, A. P.; Meyers, L. A., Effects of Proactive Social Distancing on COVID-19 Outbreaks in 58 Cities, China. *Emerg Infect Dis* **2020**, 26 (9).
172. Du, Z.; Xu, x.; Wu, Y.; Wang, L.; Cowling, B. J.; Meyers, L. A., COVID-19 serial interval estimates based on confirmed cases in public reports from 86 Chinese cities. *medRxiv* **2020**, 2020.04.23.20075796. <https://www.medrxiv.org/content/medrxiv/early/2020/04/27/2020.04.23.20075796.full.pdf>
173. Du, Z.; Xu, X.; Wu, Y.; Wang, L.; Cowling, B. J.; Meyers, L. A., The serial interval of COVID-19 from publicly reported confirmed cases. *medRxiv* **2020**, 2020.02.19.20025452. <https://www.medrxiv.org/content/medrxiv/early/2020/03/13/2020.02.19.20025452.full.pdf>
174. Duan, S.; Zhao, X.; Wen, R.; Huang, J.-j.; Pi, G.; Zhang, S.; Han, J.; Bi, S.; Ruan, L.; Dong, X.-p., Stability of SARS coronavirus in human specimens and environment and its sensitivity to heating and UV irradiation. *Biomedical and environmental sciences: BES* **2003**, 16 (3), 246-255.
175. Edridge, A. W. D.; Kaczorowska, J.; Hoste, A. C. R.; Bakker, M.; Klein, M.; Jebbink, M. F.; Matser, A.; Kinsella, C. M.; Rueda, P.; Prins, M.; Sastre, P.; Deijis, M.; Hoek, L. v. d., Coronavirus protective immunity is short-lasting *Pre-print* **2020**. <https://www.medrxiv.org/content/10.1101/2020.05.11.20086439v2.full.pdf>
176. Eikenberry, S. E.; Mancuso, M.; Iboi, E.; Phan, T.; Eikenberry, K.; Kuang, Y.; Kostelich, E.; Gumel, A. B., To mask or not to mask: Modeling the potential for face mask use by the general public to curtail the COVID-19 pandemic. *Infectious Disease Modelling* **2020**.
177. Endeman, H.; van der Zee, P.; van Genderen, M. E.; van den Akker, J. P. C.; Gommers, D., Progressive respiratory failure in COVID-19: a hypothesis. *The Lancet Infectious Diseases* **2020**. [https://doi.org/10.1016/S1473-3099\(20\)30366-2](https://doi.org/10.1016/S1473-3099(20)30366-2)
178. Endo, A.; Abbott, S.; Kucharski, A.; Funk, S., Estimating the overdispersion in COVID-19 transmission using outbreak sizes outside China [version 1; peer review: 1 approved, 1 approved with reservations]. *Wellcome Open Research* **2020**, 5 (67). <https://wellcomeopenresearch.org/articles/5-67/v1>
179. Environmental Protection Agency (EPA), List N: Disinfectants for Use Against SARS-CoV-2 (COVID-19). <https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2-covid-19> (accessed 21 Sept 2020).
180. Environmental Protection Agency (EPA), Section 18 Emergency Exemption Requests and Coronavirus (COVID-19). <https://www.epa.gov/pesticide-registration/section-18-emergency-exemption-requests-and-coronavirus-covid-19> (accessed 31 August 2020).
181. ExpressPharma, Bharat Biotech starts human trials for Covaxin, India's first COVID-19 vaccine. <https://www.expresspharma.in/latest-updates/bharat-biotech-starts-human-trials-for-covaxin-indias-first-covid-19-vaccine/>.
182. Facchetti, F.; Bugatti, M.; Drera, E.; Tripodo, C.; Sartori, E.; Cancila, V.; Papaccio, M.; Castellani, R.; Casola, S.; Boniotti, M. B.; Cavadini, P.; Lavazza, A., SARS-CoV2 vertical transmission with adverse effects on the newborn revealed through integrated immunohistochemical, electron microscopy and molecular analyses of Placenta. *EBioMedicine* **2020**, 59. <https://doi.org/10.1016/j.ebiom.2020.102951>
183. Fagre, A.; Lewis, J.; Eckley, M.; Zhan, S.; Rocha, S. M.; Sexton, N. R.; Burke, B.; Geiss, B. J.; Peersen, O.; Kading, R.; Rovnak, J.; Ebel, G. D.; Tjalkens, R. B.; Aboellail, T.; Schountz, T., SARS-CoV-2 infection, neuropathogenesis and transmission among deer mice: Implications for reverse zoonosis to New World rodents. *bioRxiv* **2020**, 2020.08.07.241810. <http://biorxiv.org/content/early/2020/08/07/2020.08.07.241810.abstract>
184. FDA, Coronavirus (COVID-19) Update: FDA Issues Emergency Use Authorization to Yale School of Public Health for SalivaDirect, Which Uses a New Method of Saliva Sample Processing. US Food and Drug Administration: 2020. <https://www.fda.gov/news-events/press-announcements/coronavirus-covid-19-update-fda-issues-emergency-use-authorization-yale-school-public-health>
185. FDA, Coronavirus (COVID-19) Update: FDA Revokes Emergency Use Authorization for Chloroquine and Hydroxychloroquine. U.S. Food and Drug Administration: 2020. <https://www.fda.gov/news->

[events/press-announcements/coronavirus-covid-19-update-fda-revokes-emergency-use-authorization-chloroquine-and](#)

186. FDA, COVID-19 Update: FDA Broadens Emergency Use Authorization for Veklury (remdesivir) to Include All Hospitalized Patients for Treatment of COVID-19. Food and Drug Administration: 2020.

<https://www.fda.gov/news-events/press-announcements/covid-19-update-fda-broadens-emergency-use-authorization-veklury-remdesivir-include-all-hospitalized>

187. FDA, *Emergency Use Authorization*; Food and Drug Administration: 2020.

<https://www.fda.gov/media/136529/download>

188. FDA, FAQs on Shortages of Surgical Masks and Gowns. <https://www.fda.gov/medical-devices/personal-protective-equipment-infection-control/faqs-shortages-surgical-masks-and-gowns#kn95>.

189. FDA, FAQs on Testing for SARS-CoV-2. <https://www.fda.gov/medical-devices/emergency-situations-medical-devices/faqs-testing-sars-cov-2#nolonger>.

190. FDA, FDA In Brief: FDA Issues Guidance on Emergency Use Authorization for COVID-19 Vaccines.

<https://www.fda.gov/news-events/fda-brief/fda-brief-fda-issues-guidance-emergency-use-authorization-covid-19-vaccines>.

191. FDA, *ID NOW COVID-19*; Food and Drug Administration: 2020.

<https://www.fda.gov/media/136525/download>

192. FDA, Protective Barrier Enclosures Without Negative Pressure Used During the COVID-19 Pandemic May Increase Risk to Patients and Health Care Providers - Letter to Health Care Providers. Food and Drug Administration: 2020. <https://www.fda.gov/medical-devices/letters-health-care-providers/protective-barrier-enclosures-without-negative-pressure-used-during-covid-19-pandemic-may-increase>

193. FDA, Respirator Models Removed from Appendix A.

<https://www.fda.gov/media/137928/download> (accessed 05/15/2020).

194. FDA, U. S., FDA Issues Emergency Use Authorization for Convalescent Plasma as Potential Promising COVID-19 Treatment, Another Achievement in Administration's Fight Against Pandemic. 2020.

<https://www.fda.gov/news-events/press-announcements/fda-issues-emergency-use-authorization-convalescent-plasma-potential-promising-covid-19-treatment>

195. Fears, A.; Klimstra, W.; Duprex, P.; Hartman, A.; Weaver, S.; Plante, K.; Mirchandani, D.; Plante, J. A.; Aguilar, P.; Fernández, D.; Nalca, A.; Totura, A.; Dyer, D.; Kearney, B.; Lackemeyer, M.; Bohannon, J. K.; Johnson, R.; Garry, R.; Reed, D.; Roy, C., Persistence of Severe Acute Respiratory Syndrome Coronavirus 2 in Aerosol Suspensions. *Emerging Infectious Disease journal* **2020**, 26 (9).

https://wwwnc.cdc.gov/eid/article/26/9/20-1806_article

196. Feldman, O.; Meir, M.; Shavit, D.; Idelman, R.; Shavit, I., Exposure to a Surrogate Measure of Contamination From Simulated Patients by Emergency Department Personnel Wearing Personal Protective Equipment. *JAMA* **2020**. <https://doi.org/10.1001/jama.2020.6633>

197. Ferguson, N.; Laydon, D.; Nedjati-Gilani, G.; Imai, N.; Ainslie, K.; Baguelin, M.; Bhatia, S.; Boonyasiri, A.; Cucunuba, Z.; Cuomo-Dannenburg, G.; Dighe, A.; Dorigatti, I.; Fu, H.; Gaythorpe, K.; Green, W.; Hamlet, A.; Hinsley, W.; Okell, L.; van Elsland, S.; Thompson, H.; Verity, R.; Volz, E.; Wang, H.; Wang, Y.; Walker, P.; Walters, C.; Winskill, P.; Whittaker, C.; Donnelly, C.; Riley, S.; Ghani, A., *Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand*; 2020.

<https://www.imperial.ac.uk/media/imperial-college/medicine/sph/ide/gida-fellowships/Imperial-College-COVID19-NPI-modelling-16-03-2020.pdf>

198. Fiolet, T.; Guihur, A.; Rebeaud, M.; Mulot, M.; Peiffer-Smadja, N.; Mahamat-Saleh, Y., Effect of hydroxychloroquine with or without azithromycin on the mortality of COVID-19 patients: a systematic review and meta-analysis. *Clinical Microbiology and Infection* **2020**.

<http://www.sciencedirect.com/science/article/pii/S1198743X2030505X>

199. Firth, J. A.; Hellewell, J.; Klepac, P.; Kissler, S. M.; Group, C. C.-W.; Kucharski, A. J.; Spurgin, L. G., Combining fine-scale social contact data with epidemic modelling reveals interactions between contact tracing, quarantine, testing and physical distancing for controlling COVID-19. *Preprint* **2020**. https://cmmid.github.io/topics/covid19/reports/2020_05_25_firth_et_al_manuscript.pdf
200. Fischer, E. P.; Fischer, M. C.; Grass, D.; Henrion, I.; Warren, W. S.; Westman, E., Low-cost measurement of facemask efficacy for filtering expelled droplets during speech. *Science Advances* **2020**, 07 August 2020.
201. Fischer, R.; Morris, D.; van Doremalen, N.; Sarchette, S.; Matson, M. J.; Bushmaker, T.; Yinda, C. K.; Seifert, S.; Gamble, A.; Williamson, B.; Judson, S.; de Wit, E.; Lloyd-Smith, J.; Munster, V., Effectiveness of N95 Respirator Decontamination and Reuse against SARS-CoV-2 Virus. *Emerging Infectious Disease journal* **2020**, 26 (9), 2253. https://wwwnc.cdc.gov/eid/article/26/9/20-1524_article
202. Fischer, R.; Morris, D. H.; van Doremalen, N.; Sarchette, S.; Matson, J.; Bushmaker, T.; Yinda, C. K.; Seifert, S.; Gamble, A.; Williamson, B.; Judson, S.; de Wit, E.; Lloyd-Smith, J.; Munster, V., Assessment of N95 respirator decontamination and re-use for SARS-CoV-2. *medRxiv* **2020**, 2020.04.11.20062018. <https://www.medrxiv.org/content/medrxiv/early/2020/04/24/2020.04.11.20062018.full.pdf>
203. Fisher, D.; Reilly, A.; Zheng, A. K. E.; Cook, A. R.; Anderson, D. E., Seeding of outbreaks of COVID-19 by contaminated fresh and frozen food. *bioRxiv* **2020**, 2020.08.17.255166. <https://www.biorxiv.org/content/biorxiv/early/2020/08/18/2020.08.17.255166.full.pdf>
204. Fisher, K. A., Factors associated with cloth face covering use among adults during the COVID-19 pandemic—United States, April and May 2020. *MMWR. Morbidity and Mortality Weekly Report* **2020**, 69.
205. Fisher, K. A.; Tenforde, M. W.; Feldstein, L. R.; al., e., Community and Close Contact Exposures Associated with COVID-19 Among Symptomatic Adults ≥18 Years in 11 Outpatient Health Care Facilities — United States, July 2020. *Morbidity and Mortality Weekly Report* **2020**, 2020 (69), 1258-1264. <https://www.cdc.gov/mmwr/volumes/69/wr/mm6936a5.htm>
206. Fisman, D. N.; Greer, A. L.; Tuite, A. R., Bidirectional impact of imperfect mask use on reproduction number of COVID-19: A next generation matrix approach. *Infectious Disease Modelling* **2020**, 5, 405-408. <http://www.sciencedirect.com/science/article/pii/S2468042720300191>
207. Fitzpatrick, J.; DeSalvo, K., Helping public health officials combat COVID-19. Google: 2020. <https://www.blog.google/technology/health/covid-19-community-mobility-reports?hl=en>
208. Flahault, A.; Manetti, E.; Simonson, T.; Lee, G.; Choirat, C., COVID-19 Forecasting. https://renkulab.shinyapps.io/COVID-19-Epidemic-Forecasting/_w_e0463e1e/#shiny-tab-about.
209. Flannery, D. D.; Gouma, S.; Dhudasia, M. B.; Mukhopadhyay, S.; Pfeifer, M. R.; Woodford, E. C.; Gerber, J. S.; Arevalo, C. P.; Bolton, M. J.; Weirick, M. E.; Goodwin, E. C.; Anderson, E. M.; Greenplate, A. R.; Kim, J.; Han, N.; Pattekar, A.; Dougherty, J.; Kuthuru, O.; Mathew, D.; Baxter, A. E.; Vella, L. A.; Weaver, J.; Verma, A.; Leite, R.; Morris, J. S.; Rader, D. J.; Elovitz, M. A.; Wherry, E. J.; Puopolo, K. M.; Hensley, S. E., SARS-CoV-2 seroprevalence among parturient women in Philadelphia. *Science Immunology* **2020**, 5 (49), eabd5709. <https://immunology.sciencemag.org/content/immunology/5/49/eabd5709.full.pdf>
210. Flores-Alanis, A.; Sandner-Miranda, L.; Delgado, G.; Cravioto, A.; Morales-Espinosa, R., The receptor binding domain of SARS-CoV-2 spike protein is the result of an ancestral recombination between the bat-CoV RaTG13 and the pangolin-CoV MP789. *BMC Research Notes* **2020**, 13 (1), 398. <https://doi.org/10.1186/s13104-020-05242-8>
211. Florez, H.; Singh, S., Online dashboard and data analysis approach for assessing COVID-19 case and death data [version 1; peer review: 2 approved, 1 approved with reservations]. *F1000Research* **2020**, 9 (570). <http://openr.es/kke>

212. Food and Drug Administration (FDA), Coronavirus (COVID-19) Update: Daily Roundup October 15, 2020. <https://www.fda.gov/news-events/press-announcements/coronavirus-covid-19-update-daily-roundup-october-15-2020> (accessed 16 Oct 2020).
213. Food and Drug Administration (FDA), SARS-CoV-2 Reference Panel Comparative Data. <https://www.fda.gov/medical-devices/coronavirus-covid-19-and-medical-devices/sars-cov-2-reference-panel-comparative-data> (accessed 28 Sept 2020).
214. Frank, S.; Brown, S. M.; Capriotti, J. A.; Westover, J. B.; Pelletier, J. S.; Tessema, B., In Vitro Efficacy of a Povidone-Iodine Nasal Antiseptic for Rapid Inactivation of SARS-CoV-2. *JAMA Otolaryngology–Head & Neck Surgery* **2020**. <https://doi.org/10.1001/jamaoto.2020.3053>
215. Freuling, C. M.; Breithaupt, A.; Müller, T.; Sehl, J.; Balkema-Buschmann, A.; Rissmann, M.; Klein, A.; Wylezich, C.; Höper, D.; Wernike, K.; Aebischer, A.; Hoffmann, D.; Friedrichs, V.; Dorhoi, A.; Groschup, M. H.; Beer, M.; Mettenleiter, T. C., Susceptibility of raccoon dogs for experimental SARS-CoV-2 infection. *bioRxiv* **2020**, 2020.08.19.256800. <http://biorxiv.org/content/early/2020/08/20/2020.08.19.256800.abstract>
216. Fu, W.; Liu, Y.; Liu, L.; Hu, H.; Cheng, X.; Liu, P.; Song, Z.; Zha, L.; Bai, S.; Xu, T.; Yuan, S.; Lu, F.; Shang, Z.; Zhao, Y.; Wang, J.; Zhao, J.; Ding, L.; Chen, J.; Zhang, L.; Zhu, T.; Zhang, X.; Lu, H.; Xu, J., An open-label, randomized trial of the combination of IFN- κ plus TFF2 with standard care in the treatment of patients with moderate COVID-19. *EClinicalMedicine* **2020**, 100547.
217. FUJIFILM Toyama Chemical Co., L., Anti-influenza drug Avigan® Tablet Meets Primary Endpoint in Phase III Clinical Trial in Japan for COVID-19 patients. Fujifilm, 2020. <https://www.fujifilm.com/news/n200923.html>
218. Gallaway, M. S.; Rigler, J.; Robinson, S.; al., e., Trends in COVID-19 Incidence After Implementation of Mitigation Measures — Arizona, January 22–August 7, 2020. *Morbidity and Mortality Weekly Report* **2020**, 2020 (69), 1460–1463.
219. Galván Casas, C.; Català, A.; Carretero Hernández, G.; Rodríguez-Jiménez, P.; Fernández-Nieto, D.; Rodríguez-Villa Lario, A.; Navarro Fernández, I.; Ruiz-Villaverde, R.; Falkenhain-López, D.; Llamas Velasco, M.; García-Gavín, J.; Baniandrés, O.; González-Cruz, C.; Morillas-Lahuerta, V.; Cubiró, X.; Figueras Nart, I.; Selda-Enriquez, G.; Romaní, J.; Fustà-Novell, X.; Melian-Olivera, A.; Roncero Riesco, M.; Burgos-Blasco, P.; Sola Ortigosa, J.; Feito Rodriguez, M.; García-Doval, I., Classification of the cutaneous manifestations of COVID-19: a rapid prospective nationwide consensus study in Spain with 375 cases. *British Journal of Dermatology* **2020**, 183 (1), 71–77. <https://onlinelibrary.wiley.com/doi/abs/10.1111/bjd.19163>
220. Gamaleya, Clinical Trial of Efficacy, Safety, and Immunogenicity of Gam-COVID-Vac Vaccine Against COVID-19 (RESIST). <https://clinicaltrials.gov/ct2/show/NCT04530396?term=vaccine&recrs=abdf&cond=COVID-19&phase=0123&sort=nwst&draw=2&rank=2>.
221. Gao, G.; Wang, A.; Wang, S.; Qian, F.; Chen, M.; Yu, F.; Zhang, J.; Wang, X.; Ma, X.; Zhao, T.; Zhang, F.; Chen, Z., A retrospective evaluation on the efficacy of Lopinavir/ritonavir and chloroquine to treat non-severe COVID-19 patients. *J Acquir Immune Defic Syndr* **2020**.
222. Garg, M.; Sharma, A. L.; Singh, S., Advancement in biosensors for inflammatory biomarkers of SARS-CoV-2 during 2019–2020. *Biosensors and Bioelectronics* **2021**, 171, 112703. <http://www.sciencedirect.com/science/article/pii/S0956566320306928>
223. Garg, S., Hospitalization Rates and Characteristics of Patients Hospitalized with Laboratory-Confirmed Coronavirus Disease 2019—COVID-NET, 14 States, March 1–30, 2020. *MMWR. Morbidity and Mortality Weekly Report* **2020**, 69.
224. Garvin, M. R.; Alvarez, C.; Miller, J. I.; Prates, E. T.; Walker, A. M.; Amos, B. K.; Mast, A. E.; Justice, A.; Aronow, B.; Jacobson, D., A mechanistic model and therapeutic interventions for COVID-19 involving a RAS-mediated bradykinin storm. *eLife* **2020**, 9, e59177. <https://doi.org/10.7554/eLife.59177>

225. Gasser, R.; Cloutier, M.; Prévost, J.; Fink, C.; Ducas, É.; Ding, S.; Dussault, N.; Landry, P.; Tremblay, T.; Laforce-Lavoie, A.; Lewin, A.; Beaudoin-Bussi res, G.; Laumaea, A.; Medjahed, H.; Larochelle, C.; Richard, J.; Dekaban, G. A.; Dikeakos, J. D.; Bazin, R.; Finzi, A., Major role of IgM in the neutralizing activity of convalescent plasma against SARS-CoV-2. *bioRxiv* **2020**, 2020.10.09.333278.
<https://www.biorxiv.org/content/biorxiv/early/2020/10/09/2020.10.09.333278.full.pdf>
226. Gatto, M.; Bertuzzo, E.; Mari, L.; Miccoli, S.; Carraro, L.; Casagrandi, R.; Rinaldo, A., Spread and dynamics of the COVID-19 epidemic in Italy: Effects of emergency containment measures. *Proceedings of the National Academy of Sciences* **2020**, 202004978.
<https://www.pnas.org/content/pnas/early/2020/04/22/2004978117.full.pdf>
227. Gautret, P.; Lagier, J.-C.; Parola, P.; Meddeb, L.; Mailhe, M.; Doudier, B.; Courjon, J.; Giordanengo, V.; Vieira, V. E.; Dupont, H. T., Hydroxychloroquine and azithromycin as a treatment of COVID-19: results of an open-label non-randomized clinical trial. *International Journal of Antimicrobial Agents* **2020**, 105949.
228. Gendelman, O.; Amital, H.; Bragazzi, N. L.; Watad, A.; Chodick, G., Continuous hydroxychloroquine or colchicine therapy does not prevent infection with SARS-CoV-2: Insights from a large healthcare database analysis. *Autoimmunity Reviews* **2020**, 102566.
<http://www.sciencedirect.com/science/article/pii/S1568997220301282>
229. Genexine, Safety and Immunogenicity Study of GX-19, a COVID-19 Preventive DNA Vaccine in Healthy Adults. <https://clinicaltrials.gov/ct2/show/NCT04445389?term=vaccine&cond=covid-19&draw=3>.
230. Gilliam, W. S.; Malik, A. A.; Shafiq, M.; Klotz, M.; Reyes, C.; Humphries, J. E.; Murray, T.; Elharake, J. A.; Wilkinson, D.; Omer, S. B., COVID-19 Transmission in US Child Care Programs. *Pediatrics* **2020**, e2020031971. <https://pediatrics.aappublications.org/content/pediatrics/early/2020/10/12/peds.2020-031971.full.pdf>
231. Godfred-Cato, S.; Bryant, B.; Leung, J.; Oster, M. E.; Conklin, L.; Abrams, J.; Roguski, K.; Wallace, B.; Prezzato, E.; Koumans, E. H.; Lee, E. H.; Geevarughese, A.; Lash, M. K.; Reilly, K. H.; Pulver, W. P.; Thomas, D.; Feder, K. A.; Hsu, K. K.; Plipat, N.; Richardson, G.; Reid, H.; Lim, S.; Schmitz, A.; Pierce, T.; Hrapcak, S.; Datta, D.; Morris, S. B.; Clarke, K.; Belay, E.; Team, C. M.-C. R., COVID-19—Associated Multisystem Inflammatory Syndrome in Children — United States, March–July 2020.
https://www.cdc.gov/mmwr/volumes/69/wr/mm6932e2.htm?s_cid=mm6932e2_w.
232. Godoy, M., Mystery Inflammatory Syndrome In Kids And Teens Likely Linked To COVID-19. *NPR* 2020. <https://www.npr.org/sections/health-shots/2020/05/07/851725443/mystery-inflammatory-syndrome-in-kids-and-teens-likely-linked-to-covid-19>
233. Gold, J. A.; Rossen, L. M.; Ahmad, F. B.; al., e., Race, Ethnicity, and Age Trends in Persons Who Died from COVID-19 — United States, May–August 2020. *Morbidity and Mortality Weekly Report* **2020**, ePub: 16 October 2020. <https://www.cdc.gov/mmwr/volumes/69/wr/mm6942e1.htm>
234. Goldbaum, C., Is the Subway Risky? It May Be Safer Than You Think. *The New York Times* 2020. <https://www.nytimes.com/2020/08/02/nyregion/nyc-subway-coronavirus-safety.html>
235. Golinelli, D.; Boetto, E.; Maietti, E.; Fantini, M. P., The association between ABO blood group and SARS-CoV-2 infection: A meta-analysis. *PLOS ONE* **2020**, 15 (9), e0239508.
<https://doi.org/10.1371/journal.pone.0239508>
236. González-García, N.; Miranda-Lora, A. L.; Gardu o-Espinosa, J.; Granados-River n, J. T.; M endez-Galv n, J. F.; Nieto-Zerme o, J.; Castilla-Pe n, M. F., COVID-19 pediatric mortality rates are heterogeneous between countries *Pre-print* **2020**.
<https://www.medrxiv.org/content/10.1101/2020.09.17.20196832v2.full.pdf>
237. Gonzalez-Reiche, A. S.; Hernandez, M. M.; Sullivan, M. J.; Ciferri, B.; Alshammari, H.; Obla, A.; Fabre, S.; Kleiner, G.; Polanco, J.; Khan, Z.; Alburquerque, B.; van de Guchte, A.; Dutta, J.; Francoeur, N.; Melo, B. S.; Oussenko, I.; Deikus, G.; Soto, J.; Sridhar, S. H.; Wang, Y.-C.; Twyman, K.; Kasarskis, A.;

- Altman, D. R.; Smith, M.; Sebra, R.; Aberg, J.; Krammer, F.; García-Sastre, A.; Luksza, M.; Patel, G.; Paniz-Mondolfi, A.; Gitman, M.; Sordillo, E. M.; Simon, V.; van Bakel, H., Introductions and early spread of SARS-CoV-2 in the New York City area. *Science* **2020**, eabc1917.
<https://science.sciencemag.org/content/sci/early/2020/05/28/science.abc1917.full.pdf>
238. Google, U.S. COVID-19 Public Forecasts. <https://datastudio.google.com/reporting/52f6e744-66c6-47aa-83db-f74201a7c4df/page/EfwUB?s=ou-b6M0HXag>.
239. Goren, A.; Vaño-Galván, S.; Wambier, C. G.; McCoy, J.; Gomez-Zubiaur, A.; Moreno-Arrones, O. M.; Shapiro, J.; Sinclair, R. D.; Gold, M. H.; Kovacevic, M.; Mesinkovska, N. A.; Goldust, M.; Washenik, K., A preliminary observation: Male pattern hair loss among hospitalized COVID-19 patients in Spain – A potential clue to the role of androgens in COVID-19 severity. *Journal of Cosmetic Dermatology* n/a (n/a).
<https://onlinelibrary.wiley.com/doi/abs/10.1111/jocd.13443>
240. Goren, A.; Wambier, C. G.; Herrera, S.; McCoy, J.; Vaño-Galván, S.; Gioia, F.; Comeche, B.; Ron, R.; Serrano-Villar, S.; Ramos, P. M.; Cadegiani, F. A.; Kovacevic, M.; Tosti, A.; Shapiro, J.; Sinclair, R., Anti-androgens may protect against severe COVID-19 outcomes: results from a prospective cohort study of 77 hospitalized men. *J Eur Acad Dermatol Venereol* **2020**.
241. Götzinger, F.; Santiago-García, B.; Noguera-Julián, A.; al., e., COVID-19 in children and adolescents in Europe: a multinational, multicentre cohort study. *The Lancet Child & Adolescent Health* **2020**.
[https://doi.org/10.1016/S2352-4642\(20\)30177-2](https://doi.org/10.1016/S2352-4642(20)30177-2)
242. Goyal, M. K.; Simpson, J. N.; Boyle, M. D.; Badolato, G. M.; Delaney, M.; McCarter, R.; Cora-Bramble, D., Racial/Ethnic and Socioeconomic Disparities of SARS-CoV-2 Infection Among Children. *Pediatrics* **2020**, e2020009951.
<https://pediatrics.aappublications.org/content/pediatrics/early/2020/08/03/peds.2020-009951.full.pdf>
243. Grassly, N. C.; Pons-Salort, M.; Parker, E. P. K.; White, P. J.; Ferguson, N. M.; Ainslie, K.; Baguelin, M.; Bhatt, S.; Boonyasiri, A.; Brazeau, N.; Cattarino, L.; Coupland, H.; Cucunuba, Z.; Cuomo-Dannenburg, G.; Dighe, A.; Donnelly, C.; van Elsland, S. L.; FitzJohn, R.; Flaxman, S.; Fraser, K.; Gaythorpe, K.; Green, W.; Hamlet, A.; Hinsley, W.; Imai, N.; Knock, E.; Laydon, D.; Mellan, T.; Mishra, S.; Nedjati-Gilani, G.; Nouvellet, P.; Okell, L.; Ragonnet-Cronin, M.; Thompson, H. A.; Unwin, H. J. T.; Vollmer, M.; Volz, E.; Walters, C.; Wang, Y.; Watson, O. J.; Whittaker, C.; Whittles, L.; Xi, X., Comparison of molecular testing strategies for COVID-19 control: a mathematical modelling study. *The Lancet Infectious Diseases* **2020**.
[https://doi.org/10.1016/S1473-3099\(20\)30630-7](https://doi.org/10.1016/S1473-3099(20)30630-7)
244. Griffin, B. D.; Chan, M.; Tabor, N.; Mendoza, E. J.; Leung, A.; Warner, B. M.; Duggan, A. T.; Moffat, E.; He, S.; Garnett, L.; Tran, K. N.; Banadyga, L.; Albietz, A.; Tierney, K.; Audet, J.; Bello, A.; Vendramelli, R.; Boese, A. S.; Fernando, L.; Lindsay, L. R.; Jardine, C. M.; Wood, H.; Poliquin, G.; Strong, J. E.; Drebot, M.; Safronetz, D.; Embury-Hyatt, C.; Kobasa, D., North American deer mice are susceptible to SARS-CoV-2. *bioRxiv* **2020**, 2020.07.25.221291.
<http://biorxiv.org/content/early/2020/07/26/2020.07.25.221291.abstract>
245. Griffin, S., Covid-19: Lopinavir-ritonavir does not benefit hospitalised patients, UK trial finds. *BMJ* **2020**, 370, m2650. <http://www.bmj.com/content/370/bmj.m2650.abstract>
246. Grifoni, A.; Weiskopf, D.; Ramirez, S. I.; Mateus, J.; Dan, J. M.; Moderbacher, C. R.; Rawlings, S. A.; Sutherland, A.; Premkumar, L.; Jodi, R. S., Targets of T cell responses to SARS-CoV-2 coronavirus in humans with COVID-19 disease and unexposed individuals. *Cell* **2020**.
247. Gu, Y., COVID-19 Projections Using Machine Learning. <https://covid19-projections.com/#view-projections>.
248. Guan, L.; Zhou, L.; Zhang, J.; Peng, W.; Chen, R., More awareness is needed for severe acute respiratory syndrome coronavirus 2019 transmission through exhaled air during non-invasive respiratory support: experience from China. *European Respiratory Journal* **2020**, 55 (3), 2000352.
<https://erj.ersjournals.com/content/erj/55/3/2000352.full.pdf>

249. Guan, W.-j.; Ni, Z.-y.; Hu, Y.; Liang, W.-h.; Ou, C.-q.; He, J.-x.; Liu, L.; Shan, H.; Lei, C.-l.; Hui, D. S. C.; Du, B.; Li, L.-j.; Zeng, G.; Yuen, K.-Y.; Chen, R.-c.; Tang, C.-l.; Wang, T.; Chen, P.-y.; Xiang, J.; Li, S.-y.; Wang, J.-l.; Liang, Z.-j.; Peng, Y.-x.; Wei, L.; Liu, Y.; Hu, Y.-h.; Peng, P.; Wang, J.-m.; Liu, J.-y.; Chen, Z.; Li, G.; Zheng, Z.-j.; Qiu, S.-q.; Luo, J.; Ye, C.-j.; Zhu, S.-y.; Zhong, N.-s., Clinical Characteristics of Coronavirus Disease 2019 in China. *New England Journal of Medicine* **2020**, *382*, 1708-1720.
https://www.nejm.org/doi/full/10.1056/NEJMoa2002032?query=recirc_artType_railA_article
250. Guardian, Covid patients have lung damage 'weeks after leaving hospital'. *The Guardian* 2020.
<https://www.theguardian.com/world/2020/sep/06/covid-patients-have-lung-damage-weeks-after-leaving-hospital>
251. Gudbjartsson, D. F.; Norddahl, G. L.; Melsted, P.; Gunnarsdottir, K.; Holm, H.; Eythorsson, E.; Arnthorsson, A. O.; Helgason, D.; Bjarnadottir, K.; Ingvarsson, R. F.; Thorsteinsdottir, B.; Kristjansdottir, S.; Birgisdottir, K.; Kristinsdottir, A. M.; Sigurdsson, M. I.; Arnadottir, G. A.; Ivarsdottir, E. V.; Andresdottir, M.; Jonsson, F.; Agustsdottir, A. B.; Berglund, J.; Eiriksdottir, B.; Fridriksdottir, R.; Gardarsdottir, E. E.; Gottfredsson, M.; Gretarsdottir, O. S.; Gudmundsdottir, S.; Gudmundsson, K. R.; Gunnarsdottir, T. R.; Gylfason, A.; Helgason, A.; Jensson, B. O.; Jonasdottir, A.; Jonsson, H.; Kristjansson, T.; Kristinsson, K. G.; Magnusdottir, D. N.; Magnusson, O. T.; Olafsdottir, L. B.; Rognvaldsson, S.; le Roux, L.; Sigmundsdottir, G.; Sigurdsson, A.; Sveinbjornsson, G.; Sveinsdottir, K. E.; Sveinsdottir, M.; Thorarensen, E. A.; Thorbjornsson, B.; Thordardottir, M.; Saemundsdottir, J.; Kristjansson, S. H.; Josefsdottir, K. S.; Masson, G.; Georgsson, G.; Kristjansson, M.; Moller, A.; Palsson, R.; Gudnason, T.; Thorsteinsdottir, U.; Jonsdottir, I.; Sulem, P.; Stefansson, K., Humoral Immune Response to SARS-CoV-2 in Iceland. *New England Journal of Medicine* **2020**.
<https://www.nejm.org/doi/full/10.1056/NEJMoa2026116>
252. Gudmundsdottir, Á.; Scheving, R.; Lindberg, F.; Stefansson, B., Inactivation of SARS-CoV-2 and HCoV-229E in vitro by ColdZyme® a medical device mouth spray against common cold. *Journal of Medical Virology* n/a (n/a). <https://onlinelibrary.wiley.com/doi/abs/10.1002/jmv.26554>
253. Güemes-Villahoz, N.; Burgos-Blasco, B.; García-Feijoó, J.; Sáenz-Francés, F.; Arriola-Villalobos, P.; Martinez-de-la-Casa, J. M.; Benítez-del-Castillo, J. M.; Herrera de la Muela, M., Conjunctivitis in COVID-19 patients: frequency and clinical presentation. *Graefe's Archive for Clinical and Experimental Ophthalmology* **2020**. <https://doi.org/10.1007/s00417-020-04916-0>
254. Guillo-Ramos, V.; Benzekri, A.; Thimm-Kaiser, M.; Hidalgo, A.; Perlman, D. C., Reconsidering assumptions of adolescent and young adult SARS-CoV-2 transmission dynamics. *Clinical Infectious Diseases* **2020**. <https://doi.org/10.1093/cid/ciaa1348>
255. Gussow, A. B.; Auslander, N.; Faure, G.; Wolf, Y. I.; Zhang, F.; Koonin, E. V., Genomic determinants of pathogenicity in SARS-CoV-2 and other human coronaviruses. *Proceedings of the National Academy of Sciences* **2020**, 202008176. <https://www.pnas.org/content/pnas/early/2020/06/09/2008176117.full.pdf>
256. Haischer, M. H.; Beilfuss, R.; Hart, M. R.; Opielinski, L.; Wrucke, D.; Zirgaitis, G.; Uhrich, T. D.; Hunter, S. K., Who is wearing a mask? Gender-, age-, and location-related differences during the COVID-19 pandemic. *PLOS ONE* **2020**, *15* (10), e0240785. <https://doi.org/10.1371/journal.pone.0240785>
257. Halfmann, P. J.; Hatta, M.; Chiba, S.; Maemura, T.; Fan, S.; Takeda, M.; Kinoshita, N.; Hattori, S. I.; Sakai-Tagawa, Y.; Iwatsuki-Horimoto, K.; Imai, M.; Kawaoka, Y., Transmission of SARS-CoV-2 in Domestic Cats. *N Engl J Med* **2020**.
258. Hamburg-Eppendorf, U., Safety, Tolerability and Immunogenicity of the Candidate Vaccine MVA-SARS-2-S Against COVID-19. <https://clinicaltrials.gov/ct2/show/NCT04569383>.
259. Hamilton, I. A., Bill Gates is funding new factories for potential coronavirus vaccines. <https://www.weforum.org/agenda/2020/04/bill-gates-7-potential-coronavirus-vaccines>.
260. Han, J.; Zhang, X.; He, S.; Jia, P., Can the coronavirus disease be transmitted from food? A review of evidence, risks, policies and knowledge gaps. *Environmental Chemistry Letters* **2020**.
<https://doi.org/10.1007/s10311-020-01101-x>

261. Hanson, K. E.; Caliendo, A. M.; Arias, C. F.; Englund, J. A.; Hayden, M. K.; Lee, M. J.; Loeb, M.; Patel, R.; Altayar, O.; El Alayli, A.; Sultan, S.; Falck-Ytter, Y.; Lavergne, V.; Morgan, R. L.; Murad, M. H.; Bhimraj, A.; Mustafa, R. A., *Infectious Diseases Society of America Guidelines on the Diagnosis of COVID-19: Serologic Testing*; Infectious Disease Society of America: 2020. <https://www.idsociety.org/practice-guideline/covid-19-guideline-serology/>
262. Hao, X.; Cheng, S.; Wu, D.; Wu, T.; Lin, X.; Wang, C., Reconstruction of the full transmission dynamics of COVID-19 in Wuhan. *Nature* **2020**. <https://doi.org/10.1038/s41586-020-2554-8>
263. Harbourt, D.; Haddow, A.; Piper, A.; Bloomfield, H.; Kearney, B.; Gibson, K.; Minogue, T., Modeling the Stability of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) on Skin, Currency, and Clothing. *medRxiv* **2020**, 2020.07.01.20144253. <https://www.medrxiv.org/content/medrxiv/early/2020/07/03/2020.07.01.20144253.full.pdf>
264. Hargreaves, B., Catalent takes on manufacture of J&J's coronavirus vaccine. <https://www.biopharma-reporter.com/Article/2020/04/30/Catalent-to-manufacture-Janssen-coronavirus-vaccine>.
265. Hargreaves, B., Lonza and Moderna shoot for billion COVID-19 doses. <https://www.biopharma-reporter.com/Article/2020/05/05/Lonza-and-Moderna-partner-for-COVID-19-vaccine>.
266. Hargreaves, B., Pfizer and BioNTech work to scale up COVID-19 vaccine production. <https://www.biopharma-reporter.com/Article/2020/05/11/Pfizer-scales-up-COVID-vaccine-production>.
267. Harris, J. E., Data from the COVID-19 epidemic in Florida suggest that younger cohorts have been transmitting their infections to less socially mobile older adults. *Review of Economics of the Household* **2020**. <https://doi.org/10.1007/s11150-020-09496-w>
268. Hartman, A. L.; Nambulli, S.; McMillen, C. M.; White, A. G.; Tilston-Lunel, N.; Albe, J. R.; Cottle, E. L.; Dunn, M. D.; Frye, L. J.; Gilliland, T. H.; Olsen, E. L.; Malley, K. J.; Schwarz, M. M.; Tomko, J. A.; Walker, R. C.; Xia, M.; Hartman, M. S.; Klein, E.; Scanga, C.; Flynn, J. L.; Klimstra, W. B.; McElroy, A. K.; Reed, D. S.; Duprex, W. P., SARS-CoV-2 infection of African green monkeys results in mild respiratory disease discernible by PET/CT imaging and prolonged shedding of infectious virus from both respiratory and gastrointestinal tracts. *bioRxiv* **2020**, 2020.06.20.137687. <http://biorxiv.org/content/early/2020/06/21/2020.06.20.137687.abstract>
269. Havers, F. P.; Reed, C.; Lim, T.; Montgomery, J. M.; Klena, J. D.; Hall, A. J.; Fry, A. M.; Cannon, D. L.; Chiang, C.-F.; Gibbons, A.; Krapivunaya, I.; Morales-Betoulle, M.; Roguski, K.; Rasheed, M. A. U.; Freeman, B.; Lester, S.; Mills, L.; Carroll, D. S.; Owen, S. M.; Johnson, J. A.; Semenova, V.; Blackmore, C.; Blog, D.; Chai, S. J.; Dunn, A.; Hand, J.; Jain, S.; Lindquist, S.; Lynfield, R.; Pritchard, S.; Sokol, T.; Sosa, L.; Turabelidze, G.; Watkins, S. M.; Wiesman, J.; Williams, R. W.; Yendell, S.; Schiffer, J.; Thornburg, N. J., Seroprevalence of Antibodies to SARS-CoV-2 in 10 Sites in the United States, March 23-May 12, 2020. *JAMA Internal Medicine* **2020**. <https://doi.org/10.1001/jamainternmed.2020.4130>
270. He, R.; Lu, Z.; Zhang, L.; Fan, T.; Xiong, R.; Shen, X.; Feng, H.; Meng, H.; Lin, W.; Jiang, W.; Geng, Q., The clinical course and its correlated immune status in COVID-19 pneumonia. *Journal of Clinical Virology* **2020**, 127, 104361. <http://www.sciencedirect.com/science/article/pii/S1386653220301037>
271. He, X.; Lau, E. H. Y.; Wu, P.; Deng, X.; Wang, J.; Hao, X.; Lau, Y. C.; Wong, J. Y.; Guan, Y.; Tan, X.; Mo, X.; Chen, Y.; Liao, B.; Chen, W.; Hu, F.; Zhang, Q.; Zhong, M.; Wu, Y.; Zhao, L.; Zhang, F.; Cowling, B. J.; Li, F.; Leung, G. M., Temporal dynamics in viral shedding and transmissibility of COVID-19. *Nature Medicine* **2020**. <https://doi.org/10.1038/s41591-020-0869-5>
272. Herper, M., Johnson & Johnson Covid-19 vaccine study paused due to unexplained illness in participant. *Stat* **2020**. <https://www.statnews.com/2020/10/12/johnson-johnson-covid-19-vaccine-study-paused-due-to-unexplained-illness-in-participant/>
273. Hess, C. B.; Buchwald, Z. S.; Stokes, W.; Nasti, T. H.; Switchenko, J. M.; Weinberg, B. D.; Steinberg, J. P.; Godette, K. D.; Murphy, D.; Ahmed, R.; Curran, W. J., Jr.; Khan, M. K., Low-dose whole-lung radiation for COVID-19 pneumonia: Planned day 7 interim analysis of a registered clinical trial. *Cancer* **2020**.

274. Hoehl, S.; Karaca, O.; Kohmer, N.; Westhaus, S.; Graf, J.; Goetsch, U.; Ciesek, S., Assessment of SARS-CoV-2 Transmission on an International Flight and Among a Tourist Group. *JAMA Network Open* **2020**, 3 (8), e2018044-e2018044. <https://doi.org/10.1001/jamanetworkopen.2020.18044>
275. Hoiland, R. L.; Fergusson, N. A.; Mitra, A. R.; Griesdale, D. E. G.; Devine, D. V.; Stukas, S.; Cooper, J.; Thiara, S.; Foster, D.; Chen, L. Y. C.; Lee, A. Y. Y.; Conway, E. M.; Wellington, C. L.; Sekhon, M. S., The association of ABO blood group with indices of disease severity and multiorgan dysfunction in COVID-19. *Blood Advances* **2020**, 4 (20), 4981-4989. <https://doi.org/10.1182/bloodadvances.2020002623>
276. Holmes, L.; Enwere, M.; Williams, J.; Ogundele, B.; Chavan, P.; Piccoli, T.; Chinacherem, C.; Comeaux, C.; Pelaez, L.; Okundaye, O.; Stalnaker, L.; Kalle, F.; Deepika, K.; Philipicien, G.; Poleon, M.; Ogungbade, G.; Elmi, H.; John, V.; Dabney, K. W., Black-White Risk Differentials in COVID-19 (SARS-COV2) Transmission, Mortality and Case Fatality in the United States: Translational Epidemiologic Perspective and Challenges. *International Journal of Environmental Research and Public Health* **2020**, 17 (12), 4322. <https://www.mdpi.com/1660-4601/17/12/4322>
277. Horby, P.; Lim, W. S.; Emberson, J.; Mafham, M.; Bell, J.; Linsell, L.; Staplin, N.; Brightling, C.; Ustianowski, A.; Elmahi, E.; Prudon, B.; Green, C.; Felton, T.; Chadwick, D.; Rege, K.; Fegan, C.; Chappell, L. C.; Faust, S. N.; Jaki, T.; Jeffery, K.; Montgomery, A.; Rowan, K.; Juszczak, E.; Baillie, J. K.; Haynes, R.; Landray, M. J., Effect of Dexamethasone in Hospitalized Patients with COVID-19: Preliminary Report. *medRxiv* **2020**, 2020.06.22.20137273. <https://www.medrxiv.org/content/medrxiv/early/2020/06/22/2020.06.22.20137273.full.pdf>
278. Hortaçsu, A.; Liu, J.; Schwiag, T., Estimating the fraction of unreported infections in epidemics with a known epicenter: An application to COVID-19. *Journal of Econometrics* **2020**. <http://www.sciencedirect.com/science/article/pii/S030440762030302X>
279. Hou, Y. J.; Chiba, S.; Halfmann, P.; Ehre, C.; Kuroda, M.; Dinnon, K. H.; Leist, S. R.; Schäfer, A.; Nakajima, N.; Takahashi, K.; Lee, R. E.; Mascenik, T. M.; Edwards, C. E.; Tse, L. V.; Boucher, R. C.; Randell, S. H.; Suzuki, T.; Gralinski, L. E.; Kawaoka, Y.; Baric, R. S., SARS-CoV-2 D614G Variant Exhibits Enhanced Replication & ex vivo and Earlier Transmission & in vivo. *bioRxiv* **2020**, 2020.09.28.317685. <http://biorxiv.org/content/early/2020/09/29/2020.09.28.317685.abstract>
280. Hu, M.; Lin, H.; Wang, J.; Xu, C.; Tatem, A. J.; Meng, B.; Zhang, X.; Liu, Y.; Wang, P.; Wu, G.; Xie, H.; Lai, S., The risk of COVID-19 transmission in train passengers: an epidemiological and modelling study. *Clinical Infectious Diseases* **2020**. <https://doi.org/10.1093/cid/ciaa1057>
281. Hu, Q.; Cui, X.; Liu, X.; Peng, B.; Jiang, J.; Wang, X.; Li, Y.; Hu, W.; Ao, Z.; Duan, J.; Wang, X.; Zhu, L.; Guo, S.; Wu, G., The production of antibodies for SARS-CoV-2 and its clinical implication. *medRxiv* **2020**, 2020.04.20.20065953. <https://www.medrxiv.org/content/medrxiv/early/2020/04/24/2020.04.20.20065953.full.pdf>
282. Hu, Z.; Song, C.; Xu, C.; Jin, G.; Chen, Y.; Xu, X.; Ma, H.; Chen, W.; Lin, Y.; Zheng, Y.; Wang, J.; Hu, Z.; Yi, Y.; Shen, H., Clinical characteristics of 24 asymptomatic infections with COVID-19 screened among close contacts in Nanjing, China. *Science China Life Sciences* **2020**. <https://doi.org/10.1007/s11427-020-1661-4>
283. Huang, C.; Wang, Y.; Li, X.; Ren, L.; Zhao, J.; Hu, Y.; Zhang, L.; Fan, G.; Xu, J.; Gu, X.; Cheng, Z.; Yu, T.; Xia, J.; Wei, Y.; Wu, W.; Xie, X.; Yin, W.; Li, H.; Liu, M.; Xiao, Y.; Gao, H.; Guo, L.; Xie, J.; Wang, G.; Jiang, R.; Gao, Z.; Jin, Q.; Wang, J.; Cao, B., Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *The Lancet* **2020**. [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(20\)30183-5/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)30183-5/fulltext)
284. Huang, R.; Xia, J.; Chen, Y.; Shan, C.; Wu, C., A family cluster of SARS-CoV-2 infection involving 11 patients in Nanjing, China. *The Lancet Infectious Diseases* **2020**, 20 (5), 534-535. [https://doi.org/10.1016/S1473-3099\(20\)30147-X](https://doi.org/10.1016/S1473-3099(20)30147-X)

285. Huang, Y.; Lyu, X.; Li, D.; Wang, Y.; Wang, L.; Zou, W.; Wei, Y.; Wu, X., A cohort study of 223 patients explores the clinical risk factors for the severity diagnosis of COVID-19. *medRxiv* **2020**, 2020.04.18.20070656.
<https://www.medrxiv.org/content/medrxiv/early/2020/04/24/2020.04.18.20070656.full.pdf>
286. Huang, Z.; Tian, D.; Liu, Y.; Lin, Z.; Lyon, C. J.; Lai, W.; Fusco, D.; Drouin, A.; Yin, X.; Hu, T.; Ning, B., Ultra-sensitive and high-throughput CRISPR-powered COVID-19 diagnosis. *Biosensors and Bioelectronics* **2020**, 164, 112316. <http://www.sciencedirect.com/science/article/pii/S0956566320303110>
287. Hung, I. F.-N.; Lung, K.-C.; Tso, E. Y.-K.; Liu, R.; Chung, T. W.-H.; Chu, M.-Y.; Ng, Y.-Y.; Lo, J.; Chan, J.; Tam, A. R.; Shum, H.-P.; Chan, V.; Wu, A. K.-L.; Sin, K.-M.; Leung, W.-S.; Law, W.-L.; Lung, D. C.; Sin, S.; Yeung, P.; Yip, C. C.-Y.; Zhang, R. R.; Fung, A. Y.-F.; Yan, E. Y.-W.; Leung, K.-H.; Ip, J. D.; Chu, A. W.-H.; Chan, W.-M.; Ng, A. C.-K.; Lee, R.; Fung, K.; Yeung, A.; Wu, T.-C.; Chan, J. W.-M.; Yan, W.-W.; Chan, W.-M.; Chan, J. F.-W.; Lie, A. K.-W.; Tsang, O. T.-Y.; Cheng, V. C.-C.; Que, T.-L.; Lau, C.-S.; Chan, K.-H.; To, K. K.-W.; Yuen, K.-Y., Triple combination of interferon beta-1b, lopinavir–ritonavir, and ribavirin in the treatment of patients admitted to hospital with COVID-19: an open-label, randomised, phase 2 trial. *The Lancet* **2020**. [https://doi.org/10.1016/S0140-6736\(20\)31042-4](https://doi.org/10.1016/S0140-6736(20)31042-4)
288. Ibrahim, D.; Dulipsingh, L.; Zaparka, L.; Eadie, R.; Crowell, R.; Williams, K.; Wakefield, D. B.; Cook, L.; Puff, J.; Hussain, S. A., Factors Associated with Good Patient Outcomes Following Convalescent Plasma in COVID-19: A Prospective Phase II Clinical Trial. *Infect Dis Ther* **2020**, 1-14.
289. IHME, COVID-19 Projections. <https://covid19.healthdata.org/united-states-of-america>.
290. IHME, First COVID-19 Global Forecast: IHME Projects Three-Quarters of a Million Lives Could be Saved by January 1. Institute for Health Metrics and Evaluation: 2020.
<https://www.prnewswire.com/il/news-releases/first-covid-19-global-forecast-ihme-projects-three-quarters-of-a-million-lives-could-be-saved-by-january-1-807013447.html>
291. ImmunityBio, Study of the Safety of Prophylactic Vaccination With 2nd Generation E1/E2B/E3-Deleted Adenoviral-COVID-19 in Normal Healthy Volunteers.
<https://clinicaltrials.gov/ct2/show/NCT04591717?term=immunitybio&draw=2&rank=1>.
292. Inovio, Safety, Tolerability and Immunogenicity of INO-4800 Followed by Electroporation in Healthy Volunteers for COVID19.
<https://clinicaltrials.gov/ct2/show/NCT04447781?term=NCT04447781&draw=2&rank=1>.
293. International Commission on Microbiological Specifications for Foods (ICMSF), ICMSF opinion on SARS-CoV-2 and its relationship to food safety. https://www.icmsf.org/wp-content/uploads/2020/09/ICMSF2020-Letterhead-COVID-19-opinion-final-03-Sept-2020.BF_.pdf (accessed 08 Sept 2020).
294. Ionescu, F.; Jaiyesimi, I.; Petrescu, I.; Lawler, P. R.; Castillo, E.; Munoz-Maldonado, Y.; Imam, Z.; Narasimhan, M.; Abbas, A. E.; Konde, A.; Nair, G. B., Association of Anticoagulation Dose and Survival in Hospitalized COVID-19 Patients: A Retrospective Propensity Score Weighted Analysis. *Eur J Haematol* **2020**.
295. IQ, H., COVID-19 Forecast for United States. <https://app.hospiq.com/covid19?region=>.
296. Iversen, K.; Bundgaard, H.; Hasselbalch, R. B.; Kristensen, J. H.; Nielsen, P. B.; Pries-Heje, M.; Knudsen, A. D.; Christensen, C. E.; Fogh, K.; Norsk, J. B.; Andersen, O.; Fischer, T. K.; Jensen, C. A. J.; Larsen, M.; Torp-Pedersen, C.; Rungby, J.; Ditlev, S. B.; Hageman, I.; Møgelvang, R.; Hother, C. E.; Gybel-Brask, M.; Sørensen, E.; Harritshøj, L.; Folke, F.; Sten, C.; Benfield, T.; Nielsen, S. D.; Ullum, H., Risk of COVID-19 in health-care workers in Denmark: an observational cohort study. *The Lancet Infectious Diseases* **2020**. [https://doi.org/10.1016/S1473-3099\(20\)30589-2](https://doi.org/10.1016/S1473-3099(20)30589-2)
297. Iwata, K.; Doi, A.; Miyakoshi, C., Was School Closure Effective in Mitigating Coronavirus Disease 2019 (COVID-19)? Time Series Analysis Using Bayesian Inference. **2020**.

298. Jahromi, R.; Mogharab, V.; Jahromi, H.; Avazpour, A., Synergistic effects of anionic surfactants on coronavirus (SARS-CoV-2) virucidal efficiency of sanitizing fluids to fight COVID-19. *Food and Chemical Toxicology* **2020**, *145*, 111702. <http://www.sciencedirect.com/science/article/pii/S0278691520305925>
299. Janssen, A Study of Ad26.COV2.S for the Prevention of SARS-CoV-2-Mediated COVID-19 in Adult Participants (ENSEMBLE). <https://clinicaltrials.gov/ct2/show/NCT04505722>.
300. Jarvis, C. I.; Van Zandvoort, K.; Gimma, A.; Prem, K.; Klepac, P.; Rubin, G. J.; Edmunds, W. J., Quantifying the impact of physical distance measures on the transmission of COVID-19 in the UK. *BMC Med* **2020**, *18* (1), 124.
301. Jenco, M., CDC details COVID-19-related inflammatory syndrome in children. *AAP News* 2020. <https://www.aappublications.org/news/2020/05/14/covid19inflammatory051420>
302. Jeronimo, C. M. P.; Farias, M. E. L.; Val, F. F. A.; Sampaio, V. S.; Alexandre, M. A. A.; Melo, G. C.; Safe, I. P.; Borba, M. G. S.; Abreu-Netto, R. L.; Maciel, A. B. S.; Neto, J. R. S.; Oliveira, L. B.; Figueiredo, E. F. G.; Dinelly, K. M. O.; Rodrigues, M. G. d. A.; Brito, M.; Mourão, M. P. G.; Pivoto João, G. A.; Hajjar, L. A.; Bassat, Q.; Romero, G. A. S.; Naveca, F. G.; Vasconcelos, H. L.; Tavares, M. d. A.; Brito-Sousa, J. D.; Costa, F. T. M.; Nogueira, M. L.; Baía-da-Silva, D.; Xavier, M. S.; Monteiro, W. M.; Lacerda, M. V. G.; Team, f. the M., Methylprednisolone as Adjunctive Therapy for Patients Hospitalized With COVID-19 (Metcovid): A Randomised, Double-Blind, Phase IIb, Placebo-Controlled Trial. *Clinical Infectious Diseases* **2020**. <https://doi.org/10.1093/cid/ciaa1177>
303. JHU, Coronavirus COVID-19 Global Cases by Johns Hopkins CSSE. <https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6>.
304. Jiangsu, Phase I Trial of a Recombinant SARS-CoV-2 Vaccine (Sf9 Cell). <https://clinicaltrials.gov/ct2/show/NCT04530656>.
305. John, A. R.; Raju, S.; Cadnum, J. L.; Lee, K.; McClellan, P.; Akkus, O.; Miller, S. K.; Jennings, W. D.; Buehler, J. A.; Li, D. F.; Redmond, S. N.; Braskie, M.; Huyen, C. K.; Donskey, C. J., Scalable In-hospital Decontamination of N95 Filtering Facepiece Respirator with a Peracetic Acid Room Disinfection System. *Infection Control & Hospital Epidemiology* **2020**, 1-26. <https://www.cambridge.org/core/article/scalable-inhospital-decontamination-of-n95-filtering-facepiece-respirator-with-a-peracetic-acid-room-disinfection-system/4B56043CF6D905CA6E8EF07B19FCF054>
306. Johndrow, J. E.; Lum, K.; Ball, P., Estimating SARS-CoV-2-positive Americans using deaths-only data. *arXiv preprint arXiv:2004.02605* **2020**.
307. Johnston, S. C.; Jay, A.; Raymond, J. L.; Rossi, F.; Zeng, X.; Scruggs, J.; Dyer, D.; Frick, O.; Moore, J.; Berrier, K.; Esham, H.; Shamblin, J.; Sifford, W.; Fiallos, J.; Klosterman, L.; Stevens, S.; White, L.; Bowling, P.; Garcia, T.; Jensen, C.; Ghering, J.; Nyakiti, D.; Bellanca, S.; Kearney, B.; Giles, W.; Alli, N.; Paz, F.; Akers, K.; Danner, D.; Barth, J.; Johnson, J. A.; Durant, M.; Kim, R.; Pitt, M. L. M.; Nalca, A., Development of a Coronavirus Disease 2019 Nonhuman Primate Model Using Airborne Exposure. *bioRxiv* **2020**, 2020.06.26.174128. <http://biorxiv.org/content/early/2020/06/26/2020.06.26.174128.abstract>
308. Jones, N. R.; Qureshi, Z. U.; Temple, R. J.; Larwood, J. P. J.; Greenhalgh, T.; Bourouiba, L., Two metres or one: what is the evidence for physical distancing in covid-19? *BMJ* **2020**, *370*, m3223. <https://www.bmj.com/content/bmj/370/bmj.m3223.full.pdf>
309. Jones, R. M., Relative contributions of transmission routes for COVID-19 among healthcare personnel providing patient care. *Journal of Occupational and Environmental Hygiene* **2020**, 1-8. <https://doi.org/10.1080/15459624.2020.1784427>
310. Joyner, M. J.; Bruno, K. A.; Klassen, S. A.; Kunze, K. L.; Johnson, P. W.; Lesser, E. R.; Wiggins, C. C.; Senefeld, J. W.; Klompas, A. M.; Hodge, D. O.; Shepherd, J. R. A.; Rea, R. F.; Whelan, E. R.; Clayburn, A. J.; Spiegel, M. R.; Baker, S. E.; Larson, K. F.; Ripoll, J. G.; Andersen, K. J.; Buras, M. R.; Vogt, M. N. P.; Herasevich, V.; Dennis, J. J.; Regimbal, R. J.; Bauer, P. R.; Blair, J. E.; Van Buskirk, C. M.; Winters, J. L.; Stubbs, J. R.; van Helmond, N.; Butterfield, B. P.; Sexton, M. A.; Diaz Soto, J. C.; Paneth, N. S.; Verdun, N.

- C.; Marks, P.; Casadevall, A.; Fairweather, D.; Carter, R. E.; Wright, R. S., Safety Update: COVID-19 Convalescent Plasma in 20,000 Hospitalized Patients. *Mayo Clinic Proceedings* **2020**.
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7368917/>
311. Joyner, M. J.; Senefeld, J. W.; Klassen, S. A.; Mills, J. R.; Johnson, P. W.; Theel, E. S.; Wiggins, C. C.; Bruno, K. A.; Klompas, A. M.; Lesser, E. R.; Kunze, K. L.; Sexton, M. A.; Diaz Soto, J. C.; Baker, S. E.; Shepherd, J. R. A.; van Helmond, N.; van Buskirk, C. M.; Winters, J. L.; Stubbs, J. R.; Rea, R. F.; Hodge, D. O.; Herasevich, V.; Whelan, E. R.; Clayburn, A. J.; Larson, K. F.; Ripoll, J. G.; Andersen, K. J.; Buras, M. R.; Vogt, M. N. P.; Dennis, J. J.; Regimbal, R. J.; Bauer, P. R.; Blair, J. E.; Paneth, N. S.; Fairweather, D.; Wright, R. S.; Carter, R. E.; Casadevall, A., Effect of Convalescent Plasma on Mortality among Hospitalized Patients with COVID-19: Initial Three-Month Experience. *medRxiv* **2020**, 2020.08.12.20169359.
<http://medrxiv.org/content/early/2020/08/12/2020.08.12.20169359.abstract>
312. Jüni, P.; Rothenbühler, M.; Bobos, P.; Thorpe, K. E.; da Costa, B. R.; Fisman, D. N.; Slutsky, A. S.; Gesink, D., Impact of climate and public health interventions on the COVID-19 pandemic: A prospective cohort study. *Canadian Medical Association Journal* **2020**, cmaj.200920.
<https://www.cmaj.ca/content/cmaj/early/2020/05/08/cmaj.200920.full.pdf>
313. Kangtai, A phase I clinical trial for inactivated SARS-CoV-2 Vaccine(Vero Cells).
<http://www.chictr.org.cn/showproj.aspx?proj=62350>.
314. Karaivanov, A.; Lu, S. E.; Shigeoka, H.; Chen, C.; Pamplona, S., *Face Masks, Public Policies and Slowing the Spread of COVID-19: Evidence from Canada*; 27891; National Bureau of Economic Research: 2020.
https://www.nber.org/papers/w27891?utm_campaign=ntwh&utm_medium=email&utm_source=ntwg6&utm_source
315. Karnakov, P.; Arampatzis, G.; Kičić, I.; Wermelinger, F.; Wälchli, D.; Papadimitriou, C.; Koumoutsakos, P., Data driven inference of the reproduction number (R0) for COVID-19 before and after interventions for 51 European countries. **2020**.
316. Kawamura, Y.; Higashimoto, Y.; Miura, H.; Ihira, M.; Inaba, M.; Ito, R.; Kozawa, K.; Yoshikawa, T., Immune response against SARS-CoV-2 in pediatric patients including young infants. *Journal of Medical Virology* **2020**, n/a (n/a). <https://onlinelibrary.wiley.com/doi/abs/10.1002/jmv.26493>
317. KCDC, Findings from investigation and analysis of re-positive cases. Korean Centers for Disease Control and Prevention: 2020. <https://www.cdc.go.kr/board/board.es?mid=a30402000000&bid=0030>
318. Kellend, K., Regeneron's antibody drug added to UK Recovery trial of COVID treatments. *Reuters* 2020. https://www.reuters.com/article/us-health-coronavirus-regeneron-antibody/regenerons-antibody-drug-added-to-uk-recovery-trial-of-covid-treatments-idUSKBN2651N0?utm_source
319. Keller, M. J.; Kitsis, E. A.; Arora, S.; Chen, J. T.; Agarwal, S.; Ross, M. J.; Tomer, Y.; Southern, W., Effect of Systemic Glucocorticoids on Mortality or Mechanical Ventilation in Patients With COVID-19. *Journal of Hospital Medicine* **2020**, Online First, July 22nd, 2020.
320. Kelly, M.; O'Connor, R.; Townsend, L.; Coghlan, M.; Relihan, E.; Moriarty, M.; Carr, B.; Melanophy, G.; Doyle, C.; Bannan, C.; O'Riordan, R.; Merry, C.; Clarke, S.; Bergin, C., Clinical outcomes and adverse events in patients hospitalised with COVID -19, treated with off- label hydroxychloroquine and azithromycin. *Br J Clin Pharmacol* **2020**.
321. Kerr, C. C.; Stuart, R. M.; Mistry, D.; Abeyasuriya, R. G.; Hart, G.; Rosenfeld, K.; Selvaraj, P.; Nunez, R. C.; Hagedorn, B.; George, L.; Izzo, A.; Palmer, A.; Delport, D.; Bennette, C.; Wagner, B.; Chang, S.; Cohen, J. A.; Panovska-Griffiths, J.; Jastrzebski, M.; Oron, A. P.; Wenger, E.; Famulare, M.; Klein, D. J., Covasim: an agent-based model of COVID-19 dynamics and interventions. *medRxiv* **2020**, 2020.05.10.20097469.
<https://www.medrxiv.org/content/medrxiv/early/2020/05/15/2020.05.10.20097469.full.pdf>
322. Khanh, N. C.; Thai, P. Q.; Quach, H.-L.; Thi, N.-A. H.; Dinh, P. C.; Duong, T. N.; Mai, L. T. Q.; Nghia, N. D.; Tu, T. A.; Quang, L. N.; Quang, T. D.; Nguyen, T.-T.; Vogt, F.; Anh, D. D., Transmission of Severe Acute

- Respiratory Syndrome Coronavirus 2 During Long Flight. *Emerging Infectious Disease journal* **2020**, 26 (11). https://wwwnc.cdc.gov/eid/article/26/11/20-3299_article
323. Kim, L.; Whitaker, M.; O'Halloran, A.; al., e., Hospitalization Rates and Characteristics of Children Aged <18 Years Hospitalized with Laboratory-Confirmed COVID-19 - COVID-NET, 14 States, March 1-July 25, 2020. *Morbidity and Mortality Weekly Report* **2020**, ePub: 7 August 2020. <https://www.cdc.gov/mmwr/volumes/69/wr/mm6932e3.htm?s>
324. Kim, S. E.; Jeong, H. S.; Yu, Y.; Shin, S. U.; Kim, S.; Oh, T. H.; Kim, U. J.; Kang, S. J.; Jang, H. C.; Jung, S. I.; Park, K. H., Viral kinetics of SARS-CoV-2 in asymptomatic carriers and presymptomatic patients. *Int J Infect Dis* **2020**.
325. Kim, U. J.; Lee, S. Y.; Lee, J. Y.; Lee, A.; Kim, S. E.; Choi, O.-J.; Lee, J. S.; Kee, S.-J.; Jang, H.-C., Air and Environmental Contamination Caused by COVID-19 Patients: a Multi-Center Study. *J Korean Med Sci* **2020**, 35 (37). <https://doi.org/10.3346/jkms.2020.35.e332>
326. Kim, Y.-I.; Kim, S.-G.; Kim, S.-M.; Kim, E.-H.; Park, S.-J.; Yu, K.-M.; Chang, J.-H.; Kim, E. J.; Lee, S.; Casel, M. A. B.; Um, J.; Song, M.-S.; Jeong, H. W.; Lai, V. D.; Kim, Y.; Chin, B. S.; Park, J.-S.; Chung, K.-H.; Foo, S.-S.; Poo, H.; Mo, I.-P.; Lee, O.-J.; Webby, R. J.; Jung, J. U.; Choi, Y. K., Infection and Rapid Transmission of SARS-CoV-2 in Ferrets. *Cell Host & Microbe* **2020**. <http://www.sciencedirect.com/science/article/pii/S1931312820301876>
327. Kissler, S. M.; Tedijanto, C.; Goldstein, E.; Grad, Y. H.; Lipsitch, M., Projecting the transmission dynamics of SARS-CoV-2 through the postpandemic period. *Science* **2020**, eabb5793. <https://science.sciencemag.org/content/sci/early/2020/04/14/science.abb5793.full.pdf>
328. Klumpp-Thomas, C.; Kalish, H.; Drew, M.; Hunsberger, S.; Snead, K.; Fay, M. P.; Mehalko, J.; Shunmugavel, A.; Wall, V.; Frank, P.; Denson, J.-P.; Hong, M.; Gulten, G.; Messing, S.; Hicks, J.; Michael, S.; Gilette, W.; Hall, M. D.; Memoli, M.; Esposito, D.; Sadtler, K., Standardization of enzyme-linked immunosorbent assays for serosurveys of the SARS-CoV-2 pandemic using clinical and at-home blood sampling. *medRxiv* **2020**, 2020.05.21.20109280. <https://www.medrxiv.org/content/medrxiv/early/2020/05/25/2020.05.21.20109280.full.pdf>
329. Knight, S. R.; Ho, A.; Pius, R.; Buchan, I.; Carson, G.; Drake, T. M.; Dunning, J.; Fairfield, C. J.; Gamble, C.; Green, C. A.; Gupta, R.; Halpin, S.; Hardwick, H. E.; Holden, K. A.; Horby, P. W.; Jackson, C.; Mclean, K. A.; Merson, L.; Nguyen-Van-Tam, J. S.; Norman, L.; Noursadeghi, M.; Olliaro, P. L.; Pritchard, M. G.; Russell, C. D.; Shaw, C. A.; Sheikh, A.; Solomon, T.; Sudlow, C.; Swann, O. V.; Turtle, L. C.; Openshaw, P. J.; Baillie, J. K.; Semple, M. G.; Docherty, A. B.; Harrison, E. M., Risk stratification of patients admitted to hospital with covid-19 using the ISARIC WHO Clinical Characterisation Protocol: development and validation of the 4C Mortality Score. *BMJ* **2020**, 370, m3339. <https://www.bmj.com/content/bmj/370/bmj.m3339.full.pdf>
330. Koh, W. C.; Naing, L.; Chaw, L.; Rosledzana, M. A.; Alikhan, M. F.; Jamaludin, S. A.; Amin, F.; Omar, A.; Shazli, A.; Griffith, M.; Pastore, R.; Wong, J., What do we know about SARS-CoV-2 transmission? A systematic review and meta-analysis of the secondary attack rate and associated risk factors. *PLOS ONE* **2020**, 15 (10), e0240205. <https://doi.org/10.1371/journal.pone.0240205>
331. Konda, A.; Prakash, A.; Moss, G. A.; Schmoldt, M.; Grant, G. D.; Guha, S., Aerosol Filtration Efficiency of Common Fabrics Used in Respiratory Cloth Masks. *ACS Nano* **2020**. <https://www.ncbi.nlm.nih.gov/pubmed/32329337>
332. Kong, D.; Zheng, Y.; Wu, H.; Pan, H.; Wagner, A. L.; Zheng, Y.; Gong, X.; Zhu, Y.; Jin, B.; Xiao, W.; Mao, S.; Lin, S.; Han, R.; Yu, X.; Cui, P.; Jiang, C.; Fang, Q.; Lu, Y.; Fu, C., Pre-symptomatic transmission of novel coronavirus in community settings. *Influenza and Other Respiratory Viruses* **2020**, n/a (n/a). <https://onlinelibrary.wiley.com/doi/abs/10.1111/irv.12773>
333. Kong, T.-k., Longer incubation period of coronavirus disease 2019 (COVID-19) in older adults. *AGING MEDICINE* **2020**, 3 (2), 102-109. <https://onlinelibrary.wiley.com/doi/abs/10.1002/agm2.12114>

334. Kong, W.-H.; Zhao, R.; Zhou, J.-B.; Wang, F.; Kong, D.-G.; Sun, J.-B.; Ruan, Q.-F.; Liu, M.-Q., Serologic Response to SARS-CoV-2 in COVID-19 Patients with Different Severity. *Virologica Sinica* **2020**.
<https://doi.org/10.1007/s12250-020-00270-x>
335. Koo, J. R.; Cook, A. R.; Park, M.; Sun, Y.; Sun, H.; Lim, J. T.; Tam, C.; Dickens, B. L., Interventions to mitigate early spread of SARS-CoV-2 in Singapore: a modelling study. *The Lancet Infectious Diseases* **2020**, 20 (6), 678-688. [https://doi.org/10.1016/S1473-3099\(20\)30162-6](https://doi.org/10.1016/S1473-3099(20)30162-6)
336. Korber, B.; Fischer, W. M.; Gnanakaran, S.; Yoon, H.; Theiler, J.; Abfalterer, W.; Hengartner, N.; Giorgi, E. E.; Bhattacharya, T.; Foley, B.; Hastie, K. M.; Parker, M. D.; Partridge, D. G.; Evans, C. M.; Freeman, T. M.; de Silva, T. I.; McDanal, C.; Perez, L. G.; Tang, H.; Moon-Walker, A.; Whelan, S. P.; LaBranche, C. C.; Saphire, E. O.; Montefiori, D. C.; Angyal, A.; Brown, R. L.; Carrilero, L.; Green, L. R.; Groves, D. C.; Johnson, K. J.; Keeley, A. J.; Lindsey, B. B.; Parsons, P. J.; Raza, M.; Rowland-Jones, S.; Smith, N.; Tucker, R. M.; Wang, D.; Wyles, M. D., Tracking changes in SARS-CoV-2 Spike: evidence that D614G increases infectivity of the COVID-19 virus. *Cell* **2020**. <https://doi.org/10.1016/j.cell.2020.06.043>
337. Korevaar, H. M.; Becker, A. D.; Miller, I. F.; Grenfell, B. T.; Metcalf, C. J. E.; Mina, M. J., Quantifying the impact of US state non-pharmaceutical interventions on COVID-19 transmission. *medRxiv* **2020**, 2020.06.30.20142877.
<https://www.medrxiv.org/content/medrxiv/early/2020/07/01/2020.06.30.20142877.full.pdf>
338. Kori, N.; Periyasamy, P.; Ng, B. H.; Satariah Ali, U. K.; Zainol Rashid, N. Z., Aerosolised COVID-19 Transmission Risk: Surgical or N95 Masks? *Infection Control & Hospital Epidemiology* **2020**, 1-8.
<https://www.cambridge.org/core/article/aerosolised-covid19-transmission-risk-surgical-or-n95-masks/C9589405A1F76BF0FC469FB04776279C>
339. Korte, W.; Buljan, M.; Rösslein, M.; Wick, P.; Golubov, V.; Jentsch, J.; Reut, M.; Peier, K.; Nohynek, B.; Fischer, A.; Stolz, R.; Cettuzzi, M.; Nolte, O., SARS-CoV-2 IgG and IgA antibody response is gender dependent; and IgG antibodies rapidly decline early on. *Journal of Infection* **2020**.
<https://doi.org/10.1016/j.jinf.2020.08.032>
340. Kosmeri, C.; Koumpis, E.; Tsabouri, S.; Siomou, E.; Makis, A., Hematological manifestations of SARS-CoV-2 in children. *Pediatric Blood & Cancer* n/a (n/a), e28745.
<https://onlinelibrary.wiley.com/doi/abs/10.1002/pbc.28745>
341. Kraemer, M. U. G.; Yang, C.-H.; Gutierrez, B.; Wu, C.-H.; Klein, B.; Pigott, D. M.; du Plessis, L.; Faria, N. R.; Li, R.; Hanage, W. P.; Brownstein, J. S.; Layan, M.; Vespignani, A.; Tian, H.; Dye, C.; Pybus, O. G.; Scarpino, S. V., The effect of human mobility and control measures on the COVID-19 epidemic in China. *Science* **2020**, eabb4218.
<https://science.sciencemag.org/content/sci/early/2020/03/25/science.abb4218.full.pdf>
342. Kratzel, A.; Todt, D.; V'kovski, P.; Steiner, S.; Gultom, M. L.; Thao, T. T. N.; Ebert, N.; Holwerda, M.; Steinmann, J.; Niemeyer, D.; Dijkman, R.; Kampf, G.; Drosten, C.; Steinmann, E.; Thiel, V.; Pfaender, S., Efficient inactivation of SARS-CoV-2 by WHO-recommended hand rub formulations and alcohols. *bioRxiv* **2020**, 2020.03.10.986711.
<https://www.biorxiv.org/content/biorxiv/early/2020/03/17/2020.03.10.986711.full.pdf>
343. Krever, M.; Picheta, R., A mink may have infected a human with Covid-19, Dutch authorities believe. *CNN* **2020**. <https://edition.cnn.com/2020/05/20/europe/coronavirus-mink-netherlands-testing-intl/index.html>
344. Kucharski, A. J.; Klepac, P.; Conlan, A. J. K.; Kissler, S. M.; Tang, M. L.; Fry, H.; Gog, J. R.; Edmunds, W. J., Effectiveness of isolation, testing, contact tracing, and physical distancing on reducing transmission of SARS-CoV-2 in different settings: a mathematical modelling study. *Lancet Infect Dis* **2020**.
345. Kucharski, A. J.; Russell, T. W.; Diamond, C.; Liu, Y.; Edmunds, J.; Funk, S.; Eggo, R. M.; Sun, F.; Jit, M.; Munday, J. D., Early dynamics of transmission and control of COVID-19: a mathematical modelling study. *The lancet infectious diseases* **2020**.

346. Kucirka, L. M.; Lauer, S. A.; Laeyendecker, O.; Boon, D., Variation in False-Negative Rate of Reverse Transcriptase Polymerase Chain Reaction–Based SARS-CoV-2 Tests by Time Since Exposure. *Annals of Internal Medicine* **2020**, 0 (0), null. <https://www.acpjournals.org/doi/abs/10.7326/M20-1495>
347. Kupferschmidt, K., Remdesivir and interferon fall flat in WHO's megastudy of COVID-19 treatments. *Science Magazine* **2020**, 1. <https://www.sciencemag.org/news/2020/10/remdesivir-and-interferon-fall-flat-who-s-megastudy-covid-19-treatments>
348. Lai, S.; Ruktanonchai, N. W.; Zhou, L.; Prosper, O.; Luo, W.; Floyd, J. R.; Wesolowski, A.; Santillana, M.; Zhang, C.; Du, X.; Yu, H.; Tatem, A. J., Effect of non-pharmaceutical interventions to contain COVID-19 in China. *Nature* **2020**. <https://doi.org/10.1038/s41586-020-2293-x>
349. Lam, T. T.-Y.; Shum, M. H.-H.; Zhu, H.-C.; Tong, Y.-G.; Ni, X.-B.; Liao, Y.-S.; Wei, W.; Cheung, W. Y.-M.; Li, W.-J.; Li, L.-F.; Leung, G. M.; Holmes, E. C.; Hu, Y.-L.; Guan, Y., Identifying SARS-CoV-2 related coronaviruses in Malayan pangolins. *Nature* **2020**. <https://doi.org/10.1038/s41586-020-2169-0>
350. LANL, COVID-19 Confirmed and Forecasted Case Data. <https://covid-19.bsvgateway.org/>.
351. Larsen, J. R.; Martin, M. R.; Martin, J. D.; Kuhn, P.; Hicks, J. B., Modeling the Onset of Symptoms of COVID-19. *Frontiers in Public Health* **2020**, 8 (473). <https://www.frontiersin.org/article/10.3389/fpubh.2020.00473>
352. Lasry, A.; Kidder, D.; Hast, M.; Poovey, J.; Sunshine, G.; Zviedrite, N.; Ahmed, F.; Ethier, K. A., Timing of community mitigation and changes in reported COVID-19 and community mobility—four US metropolitan areas, February 26–April 1, 2020. *morbidity and Mortality Weekly Report* **2020**, 69, 451-457. <https://www.cdc.gov/mmwr/volumes/69/wr/mm6915e2.htm>
353. Lassaunière, R.; Frische, A.; Harboe, Z. B.; Nielsen, A. C.; Fomsgaard, A.; Krogfelt, K. A.; Jørgensen, C. S., Evaluation of nine commercial SARS-CoV-2 immunoassays. *medRxiv* **2020**, 2020.04.09.20056325. <https://www.medrxiv.org/content/medrxiv/early/2020/04/10/2020.04.09.20056325.full.pdf>
354. Latinne, A.; Hu, B.; Olival, K. J.; Zhu, G.; Zhang, L.; Li, H.; Chmura, A. A.; Field, H. E.; Zambrana-Torrel, C.; Epstein, J. H.; Li, B.; Zhang, W.; Wang, L.-F.; Shi, Z.-L.; Daszak, P., Origin and cross-species transmission of bat coronaviruses in China. *Nature Communications* **2020**, 11 (1), 4235. <https://doi.org/10.1038/s41467-020-17687-3>
355. Latz, C. A.; DeCarlo, C.; Boitano, L.; Png, C. Y. M.; Patell, R.; Conrad, M. F.; Eagleton, M.; Dua, A., Blood type and outcomes in patients with COVID-19. *Annals of Hematology* **2020**. <https://doi.org/10.1007/s00277-020-04169-1>
356. Lau, M. S. Y.; Grenfell, B.; Thomas, M.; Bryan, M.; Nelson, K.; Lopman, B., Characterizing superspreading events and age-specific infectiousness of SARS-CoV-2 transmission in Georgia, USA. *Proceedings of the National Academy of Sciences* **2020**, 202011802. <https://www.pnas.org/content/pnas/early/2020/08/19/2011802117.full.pdf>
357. Lauer, S. A.; Grantz, K. H.; Bi, Q.; Jones, F. K.; Zheng, Q.; Meredith, H. R.; Azman, A. S.; Reich, N. G.; Lessler, J., The Incubation Period of Coronavirus Disease 2019 (COVID-19) From Publicly Reported Confirmed Cases: Estimation and Application. *Annals of Internal Medicine* **2020**. <https://doi.org/10.7326/M20-0504>
358. Lavezzo, E.; Franchin, E.; Ciavarella, C.; Cuomo-Dannenburg, G.; Barzon, L.; Del Vecchio, C.; Rossi, L.; Manganelli, R.; Loregian, A.; Navarin, N.; Abate, D.; Sciro, M.; Merigliano, S.; De Canale, E.; Vanuzzo, M. C.; Besutti, V.; Saluzzo, F.; Onelia, F.; Pacenti, M.; Parisi, S.; Carretta, G.; Donato, D.; Flor, L.; Cocchio, S.; Masi, G.; Sperduti, A.; Cattarino, L.; Salvador, R.; Nicoletti, M.; Caldart, F.; Castelli, G.; Nieddu, E.; Labella, B.; Fava, L.; Drigo, M.; Gaythorpe, K. A. M.; Ainslie, K. E. C.; Baguelin, M.; Bhatt, S.; Boonyasiri, A.; Boyd, O.; Cattarino, L.; Ciavarella, C.; Coupland, H. L.; Cucunubá, Z.; Cuomo-Dannenburg, G.; Djafaara, B. A.; Donnelly, C. A.; Dorigatti, I.; van Elsland, S. L.; FitzJohn, R.; Flaxman, S.; Gaythorpe, K. A. M.; Green, W. D.; Hallett, T.; Hamlet, A.; Haw, D.; Imai, N.; Jeffrey, B.; Knock, E.; Laydon, D. J.; Mellan, T.; Mishra, S.; Nedjati-Gilani, G.; Nouvellet, P.; Okell, L. C.; Parag, K. V.; Riley, S.; Thompson, H. A.; Unwin, H. J. T.; Verity, R.; Vollmer, M. A. C.; Walker, P. G. T.; Walters, C. E.; Wang, H.; Wang, Y.; Watson, O. J.;

- Whittaker, C.; Whittles, L. K.; Xi, X.; Ferguson, N. M.; Brazzale, A. R.; Toppo, S.; Trevisan, M.; Baldo, V.; Donnelly, C. A.; Ferguson, N. M.; Dorigatti, I.; Crisanti, A.; Imperial College, C.-R. T., Suppression of a SARS-CoV-2 outbreak in the Italian municipality of Vo'. *Nature* **2020**. <https://doi.org/10.1038/s41586-020-2488-1>
359. Laxminarayan, R.; Wahl, B.; Dudala, S. R.; Gopal, K.; Mohan, C.; Neelima, S.; Jawahar Reddy, K. S.; Radhakrishnan, J.; Lewnard, J. A., Epidemiology and transmission dynamics of COVID-19 in two Indian states. *Science* **2020**, eabd7672.
<https://science.sciencemag.org/content/sci/early/2020/09/29/science.abd7672.full.pdf>
360. Le Bert, N.; Tan, A. T.; Kunasegaran, K.; Tham, C. Y. L.; Hafezi, M.; Chia, A.; Chng, M. H. Y.; Lin, M.; Tan, N.; Linster, M.; Chia, W. N.; Chen, M. I. C.; Wang, L.-F.; Ooi, E. E.; Kalimuddin, S.; Tambyah, P. A.; Low, J. G.-H.; Tan, Y.-J.; Bertolotti, A., SARS-CoV-2-specific T cell immunity in cases of COVID-19 and SARS, and uninfected controls. *Nature* **2020**. <https://doi.org/10.1038/s41586-020-2550-z>
361. Leclerc, Q.; Fuller, N.; Knight, L.; null, n.; Funk, S.; Knight, G., What settings have been linked to SARS-CoV-2 transmission clusters? [version 2; peer review: 2 approved]. *Wellcome Open Research* **2020**, 5 (83). <https://wellcomeopenresearch.org/articles/5-83/v2>
362. Lednicky, J. A.; Lauzardo, M.; Fan, Z. H.; Jutla, A. S.; Tilly, T. B.; Gangwar, M.; Usmani, M.; Shankar, S. N.; Mohamed, K.; Eiguen-Fernandez, A.; Stephenson, C. J.; Alam, M. M.; Elbadry, M. A.; Loeb, J. C.; Subramaniam, K.; Waltzek, T. B.; Cherabuddi, K.; Morris, J. G.; Wu, C.-Y., Viable SARS-CoV-2 in the air of a hospital room with COVID-19 patients. *medRxiv* **2020**, 2020.08.03.20167395.
<https://www.medrxiv.org/content/medrxiv/early/2020/08/04/2020.08.03.20167395.full.pdf>
363. Lee, C. Y.-P.; Amrun, S. N.; Chee, R. S.-L.; Goh, Y. S.; Mak, T.-M.; Octavia, S.; Yeo, N. K.-W.; Chang, Z. W.; Tay, M. Z.; Torres-Ruesta, A.; Carissimo, G.; Poh, C. M.; Fong, S.-W.; Bei, W.; Lee, S.; Young, B. E.; Tan, S.-Y.; Leo, Y.-S.; Lye, D. C.; Lin, R. T. P.; Maurer-Stroh, S.; Lee, B.; Cheng-I, W.; Renia, L.; Ng, L. F. P., Neutralizing antibodies from early cases of SARS-CoV-2 infection offer cross-protection against the SARS-CoV-2 D614G variant. *bioRxiv* **2020**, 2020.10.08.332544.
<https://www.biorxiv.org/content/biorxiv/early/2020/10/09/2020.10.08.332544.full.pdf>
364. Lee, J.; Hughes, T.; Lee, M.-H.; Field, H.; Rovie-Ryan, J. J.; Sitam, F. T.; Sipangkui, S.; Nathan, S. K. S. S.; Ramirez, D.; Kumar, S. V.; Lasimbang, H.; Epstein, J. H.; Daszak, P., No evidence of coronaviruses or other potentially zoonotic viruses in Sunda pangolins (*Manis javanica*) entering the wildlife trade via Malaysia. *bioRxiv* **2020**, 2020.06.19.158717.
<https://www.biorxiv.org/content/biorxiv/early/2020/06/19/2020.06.19.158717.full.pdf>
365. Lee, T. C.; MacKenzie, L. J.; McDonald, E. G.; Tong, S. Y. C., An Observational Cohort Study of Hydroxychloroquine and Azithromycin for COVID-19: (Can't Get No) Satisfaction. *International Journal of Infectious Diseases* **2020**. <https://doi.org/10.1016/j.ijid.2020.06.095>
366. Lee, Y.-H.; Hong, C. M.; Kim, D. H.; Lee, T. H.; Lee, J., Clinical Course of Asymptomatic and Mildly Symptomatic Patients with Coronavirus Disease Admitted to Community Treatment Centers, South Korea. *Emerging Infectious Disease journal* **2020**, 26 (10). https://wwwnc.cdc.gov/eid/article/26/10/20-1620_article
367. Lemos, A. C. B.; do Espírito Santo, D. A.; Salvetti, M. C.; Gilio, R. N.; Agra, L. B.; Pazin-Filho, A.; Miranda, C. H., Therapeutic versus prophylactic anticoagulation for severe COVID-19: A randomized phase II clinical trial (HESACOVID). *Thrombosis Research* **2020**, 196, 359-366.
<http://www.sciencedirect.com/science/article/pii/S0049384820305302>
368. Leung, N. H. L.; Chu, D. K. W.; Shiu, E. Y. C.; Chan, K.-H.; McDevitt, J. J.; Hau, B. J. P.; Yen, H.-L.; Li, Y.; Ip, D. K. M.; Peiris, J. S. M.; Seto, W.-H.; Leung, G. M.; Milton, D. K.; Cowling, B. J., Respiratory virus shedding in exhaled breath and efficacy of face masks. *Nature Medicine* **2020**.
<https://doi.org/10.1038/s41591-020-0843-2>
369. Lewis, D., Is the coronavirus airborne? Experts can't agree. *Nature* **2020**. 10.1038/d41586-020-00974-w

370. Li, D.; Jin, M.; Bao, P.; Zhao, W.; Zhang, S., Clinical Characteristics and Results of Semen Tests Among Men With Coronavirus Disease 2019. *JAMA Network Open* **2020**, 3 (5), e208292-e208292. <https://doi.org/10.1001/jamanetworkopen.2020.8292>
371. Li, K.; Wohlford-Lenane, C.; Perlman, S.; Zhao, J.; Jewell, A. K.; Reznikov, L. R.; Gibson-Corley, K. N.; Meyerholz, D. K.; McCray, P. B., Jr., Middle East Respiratory Syndrome Coronavirus Causes Multiple Organ Damage and Lethal Disease in Mice Transgenic for Human Dipeptidyl Peptidase 4. *J Infect Dis* **2016**, 213 (5), 712-22. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4747621/pdf/jiv499.pdf>
372. Li, Q.; Guan, X.; Wu, P.; Wang, X.; Zhou, L.; Tong, Y.; Ren, R.; Leung, K. S. M.; Lau, E. H. Y.; Wong, J. Y.; Xing, X.; Xiang, N.; Wu, Y.; Li, C.; Chen, Q.; Li, D.; Liu, T.; Zhao, J.; Liu, M.; Tu, W.; Chen, C.; Jin, L.; Yang, R.; Wang, Q.; Zhou, S.; Wang, R.; Liu, H.; Luo, Y.; Liu, Y.; Shao, G.; Li, H.; Tao, Z.; Yang, Y.; Deng, Z.; Liu, B.; Ma, Z.; Zhang, Y.; Shi, G.; Lam, T. T. Y.; Wu, J. T.; Gao, G. F.; Cowling, B. J.; Yang, B.; Leung, G. M.; Feng, Z., Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus-Infected Pneumonia. *New England Journal of Medicine* **2020**. <https://www.nejm.org/doi/full/10.1056/NEJMoa2001316>
<https://www.nejm.org/doi/10.1056/NEJMoa2001316>
373. Li, Q.; Li, W.; Jin, Y.; Xu, W.; Huang, C.; Li, L.; Huang, Y.; Fu, Q.; Chen, L., Efficacy Evaluation of Early, Low-Dose, Short-Term Corticosteroids in Adults Hospitalized with Non-Severe COVID-19 Pneumonia: A Retrospective Cohort Study. *Infect Dis Ther* **2020**.
374. Li, R.; Pei, S.; Chen, B.; Song, Y.; Zhang, T.; Yang, W.; Shaman, J., Substantial undocumented infection facilitates the rapid dissemination of novel coronavirus (SARS-CoV2). *Science* **2020**, eabb3221. <https://science.sciencemag.org/content/sci/early/2020/03/13/science.abb3221.full.pdf>
375. Li, X.; Giorgi, E. E.; Marichannegowda, M. H.; Foley, B.; Xiao, C.; Kong, X.-P.; Chen, Y.; Gnanakaran, S.; Korber, B.; Gao, F., Emergence of SARS-CoV-2 through recombination and strong purifying selection. *Science Advances* **2020**, eabb9153. <https://advances.sciencemag.org/content/advances/early/2020/05/28/sciadv.abb9153.full.pdf>
376. Li, X.; Xiao, K.; Chen, X.; Liang, X.; Zhang, X.; Zhang, Z.; Zhai, J.; Wang, R.; Zhou, N.; Chen, Z.-J.; Su, R.; Zhou, F.; Holmes, E. C.; Irwin, D. M.; Chen, R.-A.; He, Q.; Wu, Y.-J.; Wang, C.; Du, X.-Q.; Peng, S.-M.; Xie, W.-J.; Shan, F.; Li, W.-P.; Dai, J.-W.; Shen, X.; Feng, Y.; Xiao, L.; Chen, W.; Shen, Y., Pathogenicity, tissue tropism and potential vertical transmission of SARS-CoV-2 in Malayan pangolins. *bioRxiv* **2020**, 2020.06.22.164442. <http://biorxiv.org/content/early/2020/06/22/2020.06.22.164442.abstract>
377. Li, X.; Zai, J.; Zhao, Q.; Nie, Q.; Li, Y.; Foley, B. T.; Chaillon, A., Evolutionary history, potential intermediate animal host, and cross-species analyses of SARS-CoV-2. *Journal of Medical Virology* **2020**, n/a (n/a). <https://onlinelibrary.wiley.com/doi/abs/10.1002/jmv.25731>
378. Li, Y.; Qian, H.; Hang, J.; Chen, X.; Hong, L.; Liang, P.; Li, J.; Xiao, S.; Wei, J.; Liu, L.; Kang, M., Evidence for probable aerosol transmission of SARS-CoV-2 in a poorly ventilated restaurant. *medRxiv* **2020**, 2020.04.16.20067728. <https://www.medrxiv.org/content/medrxiv/early/2020/04/22/2020.04.16.20067728.full.pdf>
379. Li, Y.; Shi, J.; Xia, J.; Duan, J.; Chen, L.; Yu, X.; Lan, W.; Ma, Q.; Wu, X.; Yuan, Y.; Gong, L.; Yang, X.; Gao, H.; Wu, C., Asymptomatic and Symptomatic Patients With Non-severe Coronavirus Disease (COVID-19) Have Similar Clinical Features and Virological Courses: A Retrospective Single Center Study. *Frontiers in Microbiology* **2020**, 11 (1570). <https://www.frontiersin.org/article/10.3389/fmicb.2020.01570>
380. Li, Y.; Xie, Z.; Lin, W.; Cai, W.; Wen, C.; Guan, Y.; Mo, X.; Wang, J.; Wang, Y.; Peng, P.; Chen, X.; Hong, W.; Xiao, G.; Liu, J.; Zhang, L.; Hu, F.; Li, F.; Zhang, F.; Deng, X.; Li, L., Efficacy and safety of lopinavir/ritonavir or arbidol in adult patients with mild/moderate COVID-19: an exploratory randomized controlled trial. *Med*. <https://doi.org/10.1016/j.medj.2020.04.001>
381. Liao, J.; Fan, S.; Chen, J.; Wu, J.; Xu, S.; Guo, Y.; Li, C.; Zhang, X.; Wu, C.; Mou, H., Epidemiological and clinical characteristics of COVID-19 in adolescents and young adults. *The Innovation* **2020**, 1 (1), 100001.

382. Lieu, A.; Mah, J.; Zanicelli, V.; Exantus, R. C.; Longtin, Y., Impact of Extended Use and Decontamination with Vaporized Hydrogen Peroxide on N95 Respirator Fit. *American Journal of Infection Control* **2020**. <https://doi.org/10.1016/j.ajic.2020.08.010>
383. Lilly, E., Lilly announces proof of concept data for neutralizing antibody LY-CoV555 in the COVID-19 outpatient setting. Eli Lilly and Company: <https://investor.lilly.com/news-releases/news-release-details/lilly-announces-proof-concept-data-neutralizing-antibody-ly>, 2020; p 2.
<https://investor.lilly.com/news-releases/news-release-details/lilly-announces-proof-concept-data-neutralizing-antibody-ly>
384. Liotta, E. M.; Batra, A.; Clark, J. R.; Shlobin, N. A.; Hoffman, S. C.; Orban, Z. S.; Korolnik, I. J., Frequent neurologic manifestations and encephalopathy-associated morbidity in Covid-19 patients. *Annals of Clinical and Translational Neurology* **2020**, n/a (n/a).
<https://onlinelibrary.wiley.com/doi/abs/10.1002/acn3.51210>
385. Lisboa Bastos, M.; Tavaziva, G.; Abidi, S. K.; Campbell, J. R.; Haraoui, L.-P.; Johnston, J. C.; Lan, Z.; Law, S.; MacLean, E.; Trajman, A.; Menzies, D.; Benedetti, A.; Ahmad Khan, F., Diagnostic accuracy of serological tests for covid-19: systematic review and meta-analysis. *BMJ* **2020**, 370, m2516.
<https://www.bmj.com/content/bmj/370/bmj.m2516.full.pdf>
386. Liu, L.; To, K. K.-W.; Chan, K.-H.; Wong, Y.-C.; Zhou, R.; Kwan, K.-Y.; Fong, C. H.-Y.; Chen, L.-L.; Choi, C. Y.-K.; Lu, L.; Tsang, O. T.-Y.; Leung, W.-S.; To, W.-K.; Hung, I. F.-N.; Yuen, K.-Y.; Chen, Z., High neutralizing antibody titer in intensive care unit patients with COVID-19. *Emerging Microbes & Infections* **2020**, 1-30. <https://doi.org/10.1080/22221751.2020.1791738>
387. Liu, M.; Li, Q.; Zhou, J.; Ai, W.; Zheng, X.; Zeng, J.; Liu, Y.; Xiang, X.; Guo, R.; Li, X.; Wu, X.; Xu, H.; Jiang, L.; Zhang, H.; Chen, J.; Tian, L.; Luo, J.; Luo, C., Value of swab types and collection time on SARS-CoV-2 detection using RT-PCR assay. *Journal of Virological Methods* **2020**, 286, 113974.
<http://www.sciencedirect.com/science/article/pii/S0166093420302263>
388. Liu, P.; Chen, W.; Chen, J.-P., Viral Metagenomics Revealed Sendai Virus and Coronavirus Infection of Malayan Pangolins (*Manis javanica*). *Viruses* **2019**, 11 (11), 979. <https://www.mdpi.com/1999-4915/11/11/979>
389. Liu, P.; Jiang, J.-Z.; Wan, X.-F.; Hua, Y.; Li, L.; Zhou, J.; Wang, X.; Hou, F.; Chen, J.; Zou, J.; Chen, J., Are pangolins the intermediate host of the 2019 novel coronavirus (SARS-CoV-2)? *PLOS Pathogens* **2020**, 16 (5), e1008421. <https://doi.org/10.1371/journal.ppat.1008421>
390. Liu, P.; Jiang, J.-Z.; Wan, X.-F.; Hua, Y.; Wang, X.; Hou, F.; Chen, J.; Zou, J.; Chen, J., Are pangolins the intermediate host of the 2019 novel coronavirus (2019-nCoV) ? *bioRxiv* **2020**, 2020.02.18.954628.
<http://biorxiv.org/content/early/2020/02/20/2020.02.18.954628.abstract>
391. Liu, W.; Zhang, Q.; Chen, J.; Xiang, R.; Song, H.; Shu, S.; Chen, L.; Liang, L.; Zhou, J.; You, L.; Wu, P.; Zhang, B.; Lu, Y.; Xia, L.; Huang, L.; Yang, Y.; Liu, F.; Semple, M. G.; Cowling, B. J.; Lan, K.; Sun, Z.; Yu, H.; Liu, Y., Detection of Covid-19 in Children in Early January 2020 in Wuhan, China. *New England Journal of Medicine* **2020**. <https://www.nejm.org/doi/full/10.1056/NEJMc2003717>
392. Liu, Y.; Funk, S.; Flasche, S., *The Contribution of Pre-symptomatic Transmission to the COVID-19 Outbreak*; London School of Hygiene and Tropical Medicine: 2020.
<https://cmmid.github.io/topics/covid19/control-measures/pre-symptomatic-transmission.html>
393. Liu, Y.; Li, T.; Deng, Y.; Liu, S.; Zhang, D.; Li, H.; Wang, X.; Jia, L.; Han, J.; Bei, Z.; Zhou, Y.; Li, L.; Li, J., Stability of SARS-CoV-2 on environmental surfaces and in human excreta. *medRxiv* **2020**, 2020.05.07.20094805.
<https://www.medrxiv.org/content/medrxiv/early/2020/05/12/2020.05.07.20094805.full.pdf>
394. Loftus, P., Eli Lilly Asks FDA to Authorize Covid-19 Antibody Drug. *Wall Street Journal* 2020.
https://www.wsj.com/articles/eli-lilly-asks-fda-to-authorize-covid-19-antibody-drug-11602074998?mod=hp_lead_pos3

395. Long, Q.-X.; Liu, B.-Z.; Deng, H.-J.; Wu, G.-C.; Deng, K.; Chen, Y.-K.; Liao, P.; Qiu, J.-F.; Lin, Y.; Cai, X.-F.; Wang, D.-Q.; Hu, Y.; Ren, J.-H.; Tang, N.; Xu, Y.-Y.; Yu, L.-H.; Mo, Z.; Gong, F.; Zhang, X.-L.; Tian, W.-G.; Hu, L.; Zhang, X.-X.; Xiang, J.-L.; Du, H.-X.; Liu, H.-W.; Lang, C.-H.; Luo, X.-H.; Wu, S.-B.; Cui, X.-P.; Zhou, Z.; Zhu, M.-M.; Wang, J.; Xue, C.-J.; Li, X.-F.; Wang, L.; Li, Z.-J.; Wang, K.; Niu, C.-C.; Yang, Q.-J.; Tang, X.-J.; Zhang, Y.; Liu, X.-M.; Li, J.-J.; Zhang, D.-C.; Zhang, F.; Liu, P.; Yuan, J.; Li, Q.; Hu, J.-L.; Chen, J.; Huang, A.-L., Antibody responses to SARS-CoV-2 in patients with COVID-19. *Nature Medicine* **2020**.
<https://doi.org/10.1038/s41591-020-0897-1>
396. Long, Q.-X.; Tang, X.-J.; Shi, Q.-L.; Li, Q.; Deng, H.-J.; Yuan, J.; Hu, J.-L.; Xu, W.; Zhang, Y.; Lv, F.-J.; Su, K.; Zhang, F.; Gong, J.; Wu, B.; Liu, X.-M.; Li, J.-J.; Qiu, J.-F.; Chen, J.; Huang, A.-L., Clinical and immunological assessment of asymptomatic SARS-CoV-2 infections. *Nature Medicine* **2020**.
<https://doi.org/10.1038/s41591-020-0965-6>
397. Long, S. W.; Olsen, R. J.; Christensen, P. A.; Bernard, D. W.; Davis, J. J.; Shukla, M.; Nguyen, M.; Saavedra, M. O.; Yerramilli, P.; Pruitt, L.; Subedi, S.; Kuo, H.-C.; Hendrickson, H.; Eskandari, G.; Nguyen, H. A. T.; Long, J. H.; Kumaraswami, M.; Goike, J.; Boutz, D.; Gollihar, J.; McLellan, J. S.; Chou, C.-W.; Javanmardi, K.; Finkelstein, I. J.; Musser, J., Molecular Architecture of Early Dissemination and Massive Second Wave of the SARS-CoV-2 Virus in a Major Metropolitan Area. *medRxiv* **2020**, 2020.09.22.20199125. <http://medrxiv.org/content/early/2020/09/25/2020.09.22.20199125.abstract>
398. Longcom, A. Z., Phase I Clinical Study of Recombinant Novel Coronavirus Vaccine.
<https://clinicaltrials.gov/ct2/show/NCT04445194?term=NCT04445194&draw=2&rank=1>.
399. Lovelace, B.; Farr, C., U.S. pauses Eli Lilly's trial of a coronavirus antibody treatment over safety concerns. *CNBC* **2020**.
400. Lu, J.; Plessis, L. d.; Liu, Z.; Hill, V.; Kang, M.; Lin, H.; Sun, J.; Francois, S.; Kraemer, M. U. G.; Faria, N. R.; McCrone, J. T.; Peng, J.; Xiong, Q.; Yuan, R.; Zeng, L.; Zhou, P.; Liang, C.; Yi, L.; Liu, J.; Xiao, J.; Hu, J.; Liu, T.; Ma, W.; Li, W.; Su, J.; Zheng, H.; Peng, B.; Fang, S.; Su, W.; Li, K.; Sun, R.; Bai, R.; Tang, X.; Liang, M.; Quick, J.; Song, T.; Rambaut, A.; Loman, N.; Raghwani, J.; Pybus, O.; Ke, C., Genomic epidemiology of SARS-CoV-2 in Guangdong Province, China. *medRxiv* **2020**, 2020.04.01.20047076.
<https://www.medrxiv.org/content/medrxiv/early/2020/04/04/2020.04.01.20047076.full.pdf>
401. Lu, R.; Zhao, X.; Li, J.; Niu, P.; Yang, B.; Wu, H.; Wang, W.; Song, H.; Huang, B.; Zhu, N.; Bi, Y.; Ma, X.; Zhan, F.; Wang, L.; Hu, T.; Zhou, H.; Hu, Z.; Zhou, W.; Zhao, L.; Chen, J.; Meng, Y.; Wang, J.; Lin, Y.; Yuan, J.; Xie, Z.; Ma, J.; Liu, W. J.; Wang, D.; Xu, W.; Holmes, E. C.; Gao, G. F.; Wu, G.; Chen, W.; Shi, W.; Tan, W., Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. *The Lancet* **2020**. [https://doi.org/10.1016/S0140-6736\(20\)30251-8](https://doi.org/10.1016/S0140-6736(20)30251-8)
402. Lu, S.; Zhao, Y.; Yu, W.; Yang, Y.; Gao, J.; Wang, J.; Kuang, D.; Yang, M.; Yang, J.; Ma, C.; Xu, J.; Qian, X.; Li, H.; Zhao, S.; Li, J.; Wang, H.; Long, H.; Zhou, J.; Luo, F.; Ding, K.; Wu, D.; Zhang, Y.; Dong, Y.; Liu, Y.; Zheng, Y.; Lin, X.; Jiao, L.; Zheng, H.; Dai, Q.; Sun, Q.; Hu, Y.; Ke, C.; Liu, H.; Peng, X., Comparison of nonhuman primates identified the suitable model for COVID-19. *Signal Transduction and Targeted Therapy* **2020**, 5 (1), 157. <https://doi.org/10.1038/s41392-020-00269-6>
403. Lu, S.; Zhao, Y.; Yu, W.; Yang, Y.; Gao, J.; Wang, J.; Kuang, D.; Yang, M.; Yang, J.; Ma, C.; Xu, J.; Qian, X.; Li, H.; Zhao, S.; Li, J.; Wang, H.; Long, H.; Zhou, J.; Luo, F.; Ding, K.; Wu, D.; Zhang, Y.; Dong, Y.; Liu, Y.; Zheng, Y.; Lin, X.; Jiao, L.; Zheng, H.; Dai, Q.; Sun, Q.; Hu, Y.; Ke, C.; Liu, H.; Peng, X., Comparison of SARS-CoV-2 infections among 3 species of non-human primates. *bioRxiv* **2020**, 2020.04.08.031807.
<https://www.biorxiv.org/content/biorxiv/early/2020/04/12/2020.04.08.031807.full.pdf>
404. Lu, X.; Zhang, L.; Du, H.; Zhang, J.; Li, Y. Y.; Qu, J.; Zhang, W.; Wang, Y.; Bao, S.; Li, Y.; Wu, C.; Liu, H.; Liu, D.; Shao, J.; Peng, X.; Yang, Y.; Liu, Z.; Xiang, Y.; Zhang, F.; Silva, R. M.; Pinkerton, K. E.; Shen, K.; Xiao, H.; Xu, S.; Wong, G. W. K., SARS-CoV-2 Infection in Children. *New England Journal of Medicine* **2020**.
<https://www.nejm.org/doi/full/10.1056/NEJMc2005073>

405. Lu, Y.-f.; Pan, L.-y.; Zhang, W.-W.; Cheng, F.; Hu, S.-S.; Zhang, X.; Jiang, H.-y., A meta-analysis of the incidence of venous thromboembolic events and impact of anticoagulation on mortality in patients with COVID-19. *International Journal of Infectious Diseases* **2020**. <https://doi.org/10.1016/j.ijid.2020.08.023>
406. Lu, Y.; Li, Y.; Deng, W.; Liu, M.; He, Y.; Huang, L.; Lv, M.; Li, J.; Du, H., Symptomatic Infection is Associated with Prolonged Duration of Viral Shedding in Mild Coronavirus Disease 2019: A Retrospective Study of 110 Children in Wuhan. *Pediatr Infect Dis J* **2020**.
407. Luo, Y.; Trevathan, E.; Qian, Z.; Li, Y.; Li, J.; Xiao, W.; Tu, N.; Zeng, Z.; Mo, P.; Xiong, Y.; Ye, G., Asymptomatic SARS-CoV-2 Infection in Household Contacts of a Healthcare Provider, Wuhan, China. *Emerging Infectious Disease journal* **2020**, 26 (8). https://wwwnc.cdc.gov/eid/article/26/8/20-1016_article
408. Ma, J.; Qi, X.; Chen, H.; Li, X.; Zhang, Z.; Wang, H.; Sun, L.; Zhang, L.; Guo, J.; Morawska, L.; Grinshpun, S. A.; Biswas, P.; Flagan, R. C.; Yao, M., COVID-19 patients in earlier stages exhaled millions of SARS-CoV-2 per hour. *Clinical Infectious Diseases* **2020**. <https://doi.org/10.1093/cid/ciaa1283>
409. Maghbooli, Z.; Sahraian, M. A.; Ebrahimi, M.; Pazoki, M.; Kafan, S.; Tabriz, H. M.; Hadadi, A.; Montazeri, M.; Nasiri, M.; Shirvani, A.; Holick, M. F., Vitamin D sufficiency, a serum 25-hydroxyvitamin D at least 30 ng/mL reduced risk for adverse clinical outcomes in patients with COVID-19 infection. *PLOS ONE* **2020**, 15 (9), e0239799. <https://doi.org/10.1371/journal.pone.0239799>
410. Magleby, R.; Westblade, L. F.; Trzebucki, A.; Simon, M. S.; Rajan, M.; Park, J.; Goyal, P.; Safford, M. M.; Satlin, M. J., Impact of SARS-CoV-2 Viral Load on Risk of Intubation and Mortality Among Hospitalized Patients with Coronavirus Disease 2019. *Clinical Infectious Diseases* **2020**. <https://doi.org/10.1093/cid/ciaa851>
411. Maier, B. F.; Brockmann, D., Effective containment explains subexponential growth in recent confirmed COVID-19 cases in China. *Science* **2020**, 368 (6492), 742-746. <https://science.sciencemag.org/content/sci/368/6492/742.full.pdf>
412. Majumder, M.; Mandl, K., Early transmissibility assessment of a novel coronavirus in Wuhan, China. *SSRN* **2020**. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3524675
413. Malgie, J.; Schoones, J. W.; Pijls, B. G., Decreased mortality in COVID-19 patients treated with Tocilizumab: a rapid systematic review and meta-analysis of observational studies. *Clin Infect Dis* **2020**.
414. Mallapaty, S., Coronavirus can infect cats — dogs, not so much. *Nature* **2020**. <https://www.nature.com/articles/d41586-020-00984-8>
415. Maltezou, H. C.; Magaziotou, I.; Dedoukou, X.; Eleftheriou, E.; Raftopoulos, V.; Michos, A.; Lourida, A.; Panopoulou, M.; Stamoulis, K.; Papaevangelou, V.; Petinaki, E.; Mentis, A.; Papa, A.; Tsakris, A.; Roilides, E.; Syrogiannopoulos, G. A.; Tsolia, M.; Children, f. G. S. G. o. S.-C.-I. i., Children and Adolescents With SARS-CoV-2 Infection: Epidemiology, Clinical Course and Viral Loads. *The Pediatric Infectious Disease Journal* **9000**, Online First. https://journals.lww.com/pidj/Fulltext/9000/Children_and_Adolescents_With_SARS_CoV_2.96009.aspx
416. Maor, Y.; Cohen, D.; Paran, N.; Israely, T.; Ezra, V.; Axelrod, O.; Shinar, E.; Izak, M.; Rahav, G.; Rahimi-Levene, N.; Bazofin, B. M.; Gelman, R.; Dicker, D.; Brosh-Nissimov, T.; Megged, O.; Dahan, D.; Benov, A.; Paz, A.; Edward, K.; Moran, A.; Rogowski, O.; Sorkine, P.; Mayo, A.; Zimhony, O.; Chen, J., Compassionate use of convalescent plasma for treatment of moderate and severe pneumonia in COVID-19 patients and association with IgG antibody levels in donated plasma. *EClinicalMedicine* **2020**, 100525.
417. Mateus, J.; Grifoni, A.; Tarke, A.; Sidney, J.; Ramirez, S. I.; Dan, J. M.; Burger, Z. C.; Rawlings, S. A.; Smith, D. M.; Phillips, E.; Mallal, S.; Lammers, M.; Rubiro, P.; Quiambao, L.; Sutherland, A.; Yu, E. D.; da Silva Antunes, R.; Greenbaum, J.; Frazier, A.; Markmann, A. J.; Premkumar, L.; de Silva, A.; Peters, B.; Crotty, S.; Sette, A.; Weiskopf, D., Selective and cross-reactive SARS-CoV-2 T cell epitopes in unexposed humans. *Science* **2020**, eabd3871. <https://science.sciencemag.org/content/sci/early/2020/08/04/science.abd3871.full.pdf>

418. McCulloch, D. J.; Kim, A. E.; Wilcox, N. C.; Logue, J. K.; Greninger, A. L.; Englund, J. A.; Chu, H. Y., Comparison of Unsupervised Home Self-collected Midnasal Swabs With Clinician-Collected Nasopharyngeal Swabs for Detection of SARS-CoV-2 Infection. *JAMA Network Open* **2020**, 3 (7), e2016382-e2016382. <https://doi.org/10.1001/jamanetworkopen.2020.16382>
419. McElvaney, O. J.; Hobbs, B. D.; Qiao, D.; McElvaney, O. F.; Moll, M.; McEvoy, N. L.; Clarke, J.; O'Connor, E.; Walsh, S.; Cho, M. H.; Curley, G. F.; McElvaney, N. G., A linear prognostic score based on the ratio of interleukin-6 to interleukin-10 predicts outcomes in COVID-19. *EBioMedicine* **2020**, 61, 103026. <http://www.sciencedirect.com/science/article/pii/S2352396420304023>
420. Medicago, Safety, Tolerability and Immunogenicity of a Coronavirus-Like Particle COVID-19 Vaccine in Adults Aged 18-55 Years. <https://clinicaltrials.gov/ct2/show/NCT04450004?term=NCT04450004&draw=2&rank=1>.
421. Medicine, U. S. N. L. o., Evaluating the Safety, Tolerability and Immunogenicity of bacTRL-Spike Vaccine for Prevention of COVID-19. <https://clinicaltrials.gov/ct2/show/NCT04334980>.
422. Medicine, U. S. N. L. o., Immunity and Safety of Covid-19 Synthetic Minigene Vaccine. ClinicalTrials.gov: 2020. <https://clinicaltrials.gov/ct2/show/NCT04276896>
423. Medicine, U. S. N. L. o., Phase Ib-II Trial of Dendritic Cell Vaccine to Prevent COVID-19 in Frontline Healthcare Workers and First Responders. <https://clinicaltrials.gov/ct2/show/NCT04386252?term=Aivita+Biomedical&draw=2&rank=1>.
424. Medicine, U. S. N. L. o., SCB-2019 as COVID-19 Vaccine. <https://clinicaltrials.gov/ct2/show/NCT04405908?term=SCB-2019&draw=2&rank=1>.
425. Medicine, U. S. N. L. o., Tableted COVID-19 Therapeutic Vaccine (COVID-19). <https://clinicaltrials.gov/ct2/show/NCT04380532?term=immunitor&draw=2&rank=11>.
426. Medigen, A Phase I, Prospective, Open-Labelled Study to Evaluate the Safety and Immunogenicity of MVC-COV1901. <https://clinicaltrials.gov/ct2/show/study/NCT04487210?term=vaccine&cond=covid-19&draw=7>.
427. Meltzer, D. O.; Best, T. J.; Zhang, H.; Vokes, T.; Arora, V.; Solway, J., Association of Vitamin D Status and Other Clinical Characteristics With COVID-19 Test Results. *JAMA Network Open* **2020**, 3 (9), e2019722-e2019722. <https://doi.org/10.1001/jamanetworkopen.2020.19722>
428. Menachery, V. D.; Dinno, K. H.; Yount, B. L.; McAnarney, E. T.; Gralinski, L. E.; Hale, A.; Graham, R. L.; Scobey, T.; Anthony, S. J.; Wang, L.; Graham, B.; Randell, S. H.; Lipkin, W. I.; Baric, R. S., Trypsin Treatment Unlocks Barrier for Zoonotic Bat Coronavirus Infection. *Journal of Virology* **2020**, 94 (5), e01774-19. <https://jvi.asm.org/content/jvi/94/5/e01774-19.full.pdf>
429. Merck, A Study to Assess Safety, Tolerability, and Immunogenicity of V591 (COVID-19 Vaccine) in Healthy Participants (V591-001). <https://clinicaltrials.gov/ct2/show/NCT04498247>.
430. Merkler, A. E.; Parikh, N. S.; Mir, S.; Gupta, A.; Kamel, H.; Lin, E.; Lantos, J.; Schenck, E. J.; Goyal, P.; Bruce, S. S.; Kahan, J.; Lansdale, K. N.; LeMoss, N. M.; Murthy, S. B.; Stieg, P. E.; Fink, M. E.; Iadecola, C.; Segal, A. Z.; Cusick, M.; Campion, T. R., Jr; Diaz, I.; Zhang, C.; Navi, B. B., Risk of Ischemic Stroke in Patients With Coronavirus Disease 2019 (COVID-19) vs Patients With Influenza. *JAMA Neurology* **2020**. <https://doi.org/10.1001/jamaneurol.2020.2730>
431. Meyers, L. A., COVID-19 Mortality Projections for US States and Metropolitan Areas. <https://covid-19.tacc.utexas.edu/projections/>.
432. Millett, G. A.; Jones, A. T.; Benkeser, D.; Baral, S.; Mercer, L.; Beyrer, C.; Honermann, B.; Lankiewicz, E.; Mena, L.; Crowley, J. S.; Sherwood, J.; Sullivan, P., Assessing Differential Impacts of COVID-19 on Black Communities. *Annals of Epidemiology* **2020**. <http://www.sciencedirect.com/science/article/pii/S1047279720301769>
433. Mina, M. J.; Parker, R.; Larremore, D. B., Rethinking Covid-19 Test Sensitivity — A Strategy for Containment. *New England Journal of Medicine* **2020**. <https://www.nejm.org/doi/full/10.1056/NEJMp2025631>

434. MIT, DELPHI Epidemiological Case Predictions. <https://www.covidanalytics.io/projections>.
435. Mitchell, S. L.; Ventura, S. E., Evaluation and Comparison of the Hologic Aptima SARS-CoV-2 and the CDC 2019 nCoV real-time RT-PCR Diagnostic Panel using a Four-Sample Pooling Approach. *Journal of Clinical Microbiology* **2020**, JCM.02241-20.
<https://jcm.asm.org/content/jcm/early/2020/09/17/JCM.02241-20.full.pdf>
436. Mitja, O.; Ubals, M.; Corbacho, M.; Alemany, A.; Suner, C.; Tebe, C.; Tobias, A.; Penafiel, J.; Ballana, E.; Perez, C. A.; Admella, P.; Riera-Marti, N.; Laporte, P.; Mitja, J.; Clua, M.; Bertran, L.; Gavilan, S.; Ara, J.; Sarquella, M.; Argimon, J. M.; Cuatrecasas, G.; Canadas, P.; Elizalde-Torrent, A.; Fabregat, R.; Farre, M.; Forcada, A.; Flores-Mateo, G.; Lopez, C.; Muntada, E.; Nadal, N.; Narejos, S.; Gil-Ortega, A. N.; Prat, N.; Puig, J.; Quinones, C.; Ramirez-Viaplana, F.; Reyes-Uruena, J.; Riveira-Munoz, E.; Ruiz, L.; Sanz, S.; Sentis, A.; Sierra, A.; Velasco, C.; Vivanco-Hidalgo, R. M.; Zamora, J.; Casabona, J.; Vall-Mayans, M.; G-Beiras, C.; Clotet, B., A Cluster-Randomized Trial of Hydroxychloroquine as Prevention of Covid-19 Transmission and Disease. *medRxiv* **2020**, 2020.07.20.20157651.
<http://medrxiv.org/content/early/2020/07/26/2020.07.20.20157651.abstract>
437. MITRE, COVID-19 Dashboard and Tools. <https://dashboards.c19hcc.org/>.
438. Mizumoto, K.; Kagaya, K.; Zarebski, A.; Chowell, G., Estimating the asymptomatic proportion of coronavirus disease 2019 (COVID-19) cases on board the Diamond Princess cruise ship, Yokohama, Japan, 2020. *Eurosurveillance* **2020**, 25 (10), 2000180.
<https://www.eurosurveillance.org/content/10.2807/1560-7917.ES.2020.25.10.2000180>
439. Moderna, A Study to Evaluate Efficacy, Safety, and Immunogenicity of mRNA-1273 Vaccine in Adults Aged 18 Years and Older to Prevent COVID-19.
<https://clinicaltrials.gov/ct2/show/NCT04470427?term=moderna&cond=covid&draw=2&rank=1>.
440. Monchatre-Leroy, E.; Lesellier, S.; Wasniewski, M.; Picard-Meyer, E.; Richomme, C.; Boué, F.; Lacôte, S.; Murri, S.; Pulido, C.; Vulin, J.; Salguero, F. J.; Gouilh, M. A.; Servat, A.; Marianneau, P., Hamster and ferret experimental infection with intranasal low dose of a single strain of SARS-CoV-2. *bioRxiv* **2020**, 2020.09.24.311977.
<http://biorxiv.org/content/early/2020/09/24/2020.09.24.311977.abstract>
441. Montopoli, M.; Zumerle, S.; Vettor, R.; Rugge, M.; Zorzi, M.; Catapano, C. V.; Carbone, G.; Cavalli, A.; Pagano, F.; Ragazzi, E., Androgen-deprivation therapies for prostate cancer and risk of infection by SARS-CoV-2: a population-based study (n= 4532). *Annals of Oncology* **2020**.
442. Moore, J. T.; Ricaldi, J. N.; Rose, C. E.; al., e., Disparities in Incidence of COVID-19 Among Underrepresented Racial/Ethnic Groups in Counties Identified as Hotspots During June 5–18, 2020 — 22 States, February–June 2020. *Morbidity and Mortality Weekly Report* **2020**, ePub: 14 August 2020.
443. Morawska, L.; Milton, D. K., It is Time to Address Airborne Transmission of COVID-19. *Clinical Infectious Diseases* **2020**. <https://doi.org/10.1093/cid/ciaa939>
444. Moriarty, L. F.; Plucinski, M. M.; Marston, B. J. e. a., Public Health Responses fo COVID-19 Outbreaks on Cruise Ships - Worldwide, February - March 2020. *MMWR* **2020**, (ePub: 23 March 2020).
<https://www.cdc.gov/mmwr/volumes/69/wr/mm6912e3.htm>
445. Morley, C. P.; Anderson, K. B.; Shaw, J.; Stewart, T.; Thomas, S. J.; Wang, D., Social Distancing Metrics and Estimates of SARS-CoV-2 Transmission Rates: Associations Between Mobile Telephone Data Tracking and R. *Journal of Public Health Management and Practice* **9000**, Publish Ahead of Print.
https://journals.lww.com/jphmp/Fulltext/9000/Social_Distancing_Metrics_and_Estimates_of.99258.aspx
x
446. Morris, S. B.; Schwartz, N. G.; Patel, P.; al., e., Case Series of Multisystem Inflammatory Syndrome in Adults Associated with SARS-CoV-2 Infection — United Kingdom and United States, March–August 2020. *Morbidity and Mortality Weekly Report* **2020**, 2 October 2020.
<https://www.cdc.gov/mmwr/volumes/69/wr/mm6940e1.htm>

447. Moustafa, A. M.; Planet, P. J., Rapid whole genome sequence typing reveals multiple waves of SARS-CoV-2 spread. *bioRxiv* **2020**, 2020.06.08.139055.
<https://www.biorxiv.org/content/biorxiv/early/2020/06/09/2020.06.08.139055.full.pdf>
448. Munster, V. J.; Feldmann, F.; Williamson, B. N.; van Doremalen, N.; Pérez-Pérez, L.; Schulz, J.; Meade-White, K.; Okumura, A.; Callison, J.; Brumbaugh, B.; Avanzato, V. A.; Rosenke, R.; Hanley, P. W.; Saturday, G.; Scott, D.; Fischer, E. R.; de Wit, E., Respiratory disease and virus shedding in rhesus macaques inoculated with SARS-CoV-2. *bioRxiv* **2020**, 2020.03.21.001628.
<https://www.biorxiv.org/content/biorxiv/early/2020/03/21/2020.03.21.001628.full.pdf>
449. Muoio, D., Scanwell Health, myLAB Box unveil more at-home COVID-19 testing services. *MobiHealthNews* 20 March, 2020. <https://www.mobihealthnews.com/news/scanwell-health-mylab-box-unveil-more-home-covid-19-testing-services>
450. Mykytyn, A. Z.; Lamers, M. M.; Okba, N. M. A.; Breugem, T. I.; Schipper, D.; van den Doel, P. B.; van Run, P.; van Amerongen, G.; de Waal, L.; Koopmans, M.; Stittelaar, K. J.; van den Brand, J.; Haagmans, B. L., Susceptibility of rabbits to SARS-CoV-2. *bioRxiv* **2020**, 2020.08.27.263988.
<http://biorxiv.org/content/early/2020/08/27/2020.08.27.263988.abstract>
451. Nadi, A., An at-home fingerprick blood test may help detect your exposure to coronavirus. *NBC NEWS* 04 April, 2020. <https://www.nbcnews.com/health/health-news/home-fingerprick-blood-test-may-help-detect-your-exposure-coronavirus-n1176086>
452. Nadkarni, G. N.; Lala, A.; Bagiella, E.; Chang, H. L.; Moreno, P.; Pujadas, E.; Arvind, V.; Bose, S.; Charney, A. W.; Chen, M. D.; Cordon-Cardo, C.; Dunn, A. S.; Farkouh, M. E.; Glicksberg, B.; Kia, A.; Kohli-Seth, R.; Levin, M. A.; Timsina, P.; Zhao, S.; Fayad, Z. A.; Fuster, V., Anticoagulation, Mortality, Bleeding and Pathology Among Patients Hospitalized with COVID-19: A Single Health System Study. *Journal of the American College of Cardiology* **2020**, 27631.
<https://www.onlinejacc.org/content/accj/early/2020/08/24/j.jacc.2020.08.041.full.pdf>
453. Ngonghala, C. N.; Iboi, E.; Eikenberry, S.; Scotch, M.; MacIntyre, C. R.; Bonds, M. H.; Gumel, A. B., Mathematical assessment of the impact of non-pharmaceutical interventions on curtailing the 2019 novel Coronavirus. *Mathematical Biosciences* **2020**, 325, 108364.
<http://www.sciencedirect.com/science/article/pii/S0025556420300560>
454. Nguyen-Contant, P.; Embong, A. K.; Kanagaiah, P.; Chaves, F. A.; Yang, H.; Branche, A. R.; Topham, D. J.; Sangster, M. Y., S Protein-Reactive IgG and Memory B Cell Production after Human SARS-CoV-2 Infection Includes Broad Reactivity to the S2 Subunit. *mBio* **2020**, 11 (5), e01991-20.
<https://mbio.asm.org/content/mbio/11/5/e01991-20.full.pdf>
455. Nguyen, L. H.; Drew, D. A.; Graham, M. S.; Joshi, A. D.; Guo, C.-G.; Ma, W.; Mehta, R. S.; Warner, E. T.; Sikavi, D. R.; Lo, C.-H.; Kwon, S.; Song, M.; Mucci, L. A.; Stampfer, M. J.; Willett, W. C.; Eliassen, A. H.; Hart, J. E.; Chavarro, J. E.; Rich-Edwards, J. W.; Davies, R.; Capdevila, J.; Lee, K. A.; Lochlainn, M. N.; Varsavsky, T.; Sudre, C. H.; Cardoso, M. J.; Wolf, J.; Spector, T. D.; Ourselin, S.; Steves, C. J.; Chan, A. T., Risk of COVID-19 among front-line health-care workers and the general community: a prospective cohort study. *Lancet Public Health* **2020**. <http://www.thelancet-press.com/embargo/hcwcovid.pdf>
456. NIH, Accelerating COVID-19 Therapeutic Interventions and Vaccines (ACTIV).
<https://www.nih.gov/research-training/medical-research-initiatives/activ>.
457. NIH, *Fact Sheet for Patients And Parent/Caregivers - Emergency Use Authorization (EUA) Of Remdesivir For Coronavirus Disease 2019 (COVID-19)*; National Institutes of Health: 2020.
<https://www.fda.gov/media/137565/download>
458. NIH, NIH clinical trial testing hyperimmune intravenous immunoglobulin plus remdesivir to treat COVID-19 Begins. National Institutes of Health: 2020. <https://www.nih.gov/news-events/news-releases/nih-clinical-trial-testing-hyperimmune-intravenous-immunoglobulin-plus-remdesivir-treat-covid-19-begins>

459. Nishiura, H.; Kobayashi, T.; Miyama, T.; Suzuki, A.; Jung, S.-m.; Hayashi, K.; Kinoshita, R.; Yang, Y.; Yuan, B.; Akhmetzhanov, A. R.; Linton, N. M., Estimation of the asymptomatic ratio of novel coronavirus infections (COVID-19). *International Journal of Infectious Diseases* **2020**, *94*, 154-155.
<http://www.sciencedirect.com/science/article/pii/S1201971220301399>
460. Northeastern, Modeling of COVID-19 epidemic in the United States.
<https://covid19.gleamproject.org/#icubedproj>.
461. Novavax, Novavax Initiates Phase 3 Efficacy Trial of COVID-19 Vaccine in the United Kingdom.
<https://ir.novavax.com/news-releases/news-release-details/novavax-initiates-phase-3-efficacy-trial-covid-19-vaccine-united>.
462. Now, C. A., America's COVID warning system. <https://covidactnow.org/?s=38532>.
463. O'Hare, R.; Wighton, K., Imperial to begin first human trials of new COVID-19 vaccine.
<https://www.imperial.ac.uk/news/198314/imperial-begin-first-human-trials-covid-19/>.
464. O'Hearn, K.; Gertsman, S.; Webster, R.; Tsampalieros, A.; Ng, R.; Gibson, J.; Sampson, M.; Sikora, L.; McNally, J. D., Efficacy and Safety of Disinfectants for Decontamination of N95 and SN95 Filtering Facepiece Respirators: A Systematic Review. *Journal of Hospital Infection*.
<https://doi.org/10.1016/j.jhin.2020.08.005>
465. Offeddu, V.; Yung, C. F.; Low, M. S. F.; Tam, C. C., Effectiveness of Masks and Respirators Against Respiratory Infections in Healthcare Workers: A Systematic Review and Meta-Analysis. *Clin Infect Dis* **2017**, *65* (11), 1934-1942. <https://www.ncbi.nlm.nih.gov/pubmed/29140516>
466. Oh, C.; Araud, E.; Puthussery, J. V.; Bai, H.; Clark, G. G.; Wang, L.; Verma, V.; Nguyen, T. H., Dry Heat as a Decontamination Method for N95 Respirator Reuse. *Environmental Science & Technology Letters* **2020**. <https://doi.org/10.1021/acs.estlett.0c00534>
467. Okba, N.; Müller, M.; Li, W.; Wang, C.; GeurtsvanKessel, C.; Corman, V.; Lamers, M.; Sikkema, R.; de Bruin, E.; Chandler, F., Severe Acute Respiratory Syndrome Coronavirus 2-Specific Antibody Responses in Coronavirus Disease 2019 Patients. *Emerging infectious diseases* **2020**, *26* (7).
468. Olson, D. R.; Huynh, M.; Fine, A.; Baumgartner, J.; Castro, A.; Chan, H. T.; Daskalakis, D.; Devinney, K.; Guerra, K.; Harper, S.; Kennedy, J.; Konty, K.; Li, W.; McGibbon, E.; Shaff, J.; Thompson, C.; Vora, N. M.; Van Wye, G., Preliminary Estimate of Excess Mortality During the COVID-19 Outbreak — New York City, March 11–May 2, 2020. *Morbidity and Mortality Weekly Report* **2020**, (ePub: 11 May 2020).
https://www.cdc.gov/mmwr/volumes/69/wr/mm6919e5.htm?s_cid=mm6919e5_w
469. Omori, R.; Matsuyama, R.; Nakata, Y., The age distribution of mortality from novel coronavirus disease (COVID-19) suggests no large difference of susceptibility by age. *Scientific Reports* **2020**, *10* (1), 16642. <https://doi.org/10.1038/s41598-020-73777-8>
470. OnCubaNews, Cuba to start clinical trials of its own vaccine against new coronavirus.
<https://oncubanews.com/en/cuba/cuba-to-start-clinical-trials-of-its-own-vaccine-against-new-coronavirus/>.
471. Onder, G.; Rezza, G.; Brusaferro, S., Case-Fatality Rate and Characteristics of Patients Dying in Relation to COVID-19 in Italy. *JAMA* **2020**. <https://doi.org/10.1001/jama.2020.4683>
472. Ong, S. W. X.; Tan, Y. K.; Chia, P. Y.; Lee, T. H.; Ng, O. T.; Wong, M. S. Y.; Marimuthu, K., Air, Surface Environmental, and Personal Protective Equipment Contamination by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) From a Symptomatic Patient. *Jama* **2020**.
https://jamanetwork.com/journals/jama/articlepdf/2762692/jama_ong_2020_id_200016.pdf
473. Oran, D. P.; Topol, E. J., Prevalence of Asymptomatic SARS-CoV-2 Infection. *Annals of Internal Medicine* **2020**, *0* (0), null. <https://www.acpjournals.org/doi/abs/10.7326/M20-3012>
474. Ortega, J. T.; Serrano, M. L.; Pujol, F. H.; Rangel, H. R., Role of changes in SARS-CoV-2 spike protein in the interaction with the human ACE2 receptor: An in silico analysis. *EXCLI journal* **2020**, *19*, 410-417.
<https://pubmed.ncbi.nlm.nih.gov/32210742>
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7081066/>

475. Ortolan, A.; Lorenzin, M.; Felicetti, M.; Doria, A.; Ramonda, R., Does gender influence clinical expression and disease outcomes in COVID-19? A systematic review and meta-analysis. *International Journal of Infectious Diseases* **2020**. <https://doi.org/10.1016/j.ijid.2020.07.076>
476. Oster, A. M.; Caruso, E.; DeVies, J.; Hartnett, K. P.; Boehmer, T. K., Transmission Dynamics by Age Group in COVID-19 Hotspot Counties — United States, April–September 2020. *Morbidity and Mortality Weekly Report* **2020**, ePub (9 October 2020).
<https://www.cdc.gov/mmwr/volumes/69/wr/mm6941e1.htm>
477. Osterrieder, N.; Bertzbach, L. D.; Dietert, K.; Abdelgawad, A.; Vladimirova, D.; Kunec, D.; Hoffmann, D.; Beer, M.; Gruber, A. D.; Trimpert, J., Age-Dependent Progression of SARS-CoV-2 Infection in Syrian Hamsters. *Viruses* **2020**, 12 (7).
478. Ou, J.; Zhou, Z.; Dai, R.; Zhang, J.; Lan, W.; Zhao, S.; Wu, J.; Seto, D.; Cui, L.; Zhang, G.; Zhang, Q., Emergence of RBD mutations in circulating SARS-CoV-2 strains enhancing the structural stability and human ACE2 receptor affinity of the spike protein. *bioRxiv* **2020**, 2020.03.15.991844.
<https://www.biorxiv.org/content/biorxiv/early/2020/04/20/2020.03.15.991844.full.pdf>
479. Oude Munnink, B. B.; Sikkema, R. S.; Nieuwenhuijse, D. F.; Molenaar, R. J.; Munger, E.; Molenkamp, R.; van der Spek, A.; Tolsma, P.; Rietveld, A.; Brouwer, M.; Bouwmeester-Vincken, N.; Harders, F.; der Honing, R. H.-v.; Wegdam-Blans, M. C. A.; Bouwstra, R. J.; GeurtsvanKessel, C.; van der Eijk, A. A.; Velkers, F. C.; Smit, L. A. M.; Stegeman, A.; van der Poel, W. H. M.; Koopmans, M. P. G., Jumping back and forth: anthroozoonotic and zoonotic transmission of SARS-CoV-2 on mink farms. *bioRxiv* **2020**, 2020.09.01.277152.
<https://www.biorxiv.org/content/biorxiv/early/2020/09/01/2020.09.01.277152.full.pdf>
480. Oxford, Oxford COVID-19 vaccine to begin phase II/III human trials. University of Oxford: 2020.
<http://www.ox.ac.uk/news/2020-05-22-oxford-covid-19-vaccine-begin-phase-iii-human-trials>
481. Pairo-Castineira, E.; Clohisey, S.; Klaric, L.; Bretherick, A.; Rawlik, K.; Parkinson, N.; Pasko, D.; Walker, S.; Richmond, A.; Head Fourman, M.; Law, A.; Furniss, J.; Gountouna, E.; Wrobel, N.; Russell, C. D.; Moutsianas, L.; Wang, B.; Meynert, A.; Yang, Z.; Zhai, R.; Zheng, C.; Griffith, F.; Oosthuizen, W.; Shih, B.; Keating, S.; Zechner, M.; Haley, C.; Porteous, D. J.; Hayward, C.; Knight, J.; Summers, C.; Shankar-Hari, M.; Turtle, L.; Ho, A.; Hinds, C.; Horby, P.; Nichol, A.; Maslove, D.; Ling, L.; Klenerman, P.; McAuley, D.; Montgomery, H.; Walsh, T.; Shen, X.; Rowan, K.; Fawkes, A.; Murphy, L.; Ponting, C. P.; Tenesa, A.; Caulfield, M.; Scott, R.; Openshaw, P. J. M.; Semple, M. G.; Vitart, V.; Wilson, J. F.; Baillie, J. K., Genetic mechanisms of critical illness in Covid-19. *medRxiv* **2020**, 2020.09.24.20200048.
<http://medrxiv.org/content/early/2020/09/25/2020.09.24.20200048.1.abstract>
482. Pan, D.; Sze, S.; Minhas, J. S.; Bangash, M. N.; Pareek, N.; Divall, P.; Williams, C. M. L.; Oggioni, M. R.; Squire, I. B.; Nellums, L. B.; Hanif, W.; Khunti, K.; Pareek, M., The impact of ethnicity on clinical outcomes in COVID-19: A systematic review. *EClinicalMedicine*.
<https://doi.org/10.1016/j.eclinm.2020.100404>
483. Pan, F.; Ye, T.; Sun, P.; Gui, S.; Liang, B.; Li, L.; Zheng, D.; Wang, J.; Hesketh, R. L.; Yang, L.; Zheng, C., Time Course of Lung Changes On Chest CT During Recovery From 2019 Novel Coronavirus (COVID-19) Pneumonia. *Radiology* **0** (0), 200370. <https://pubs.rsna.org/doi/abs/10.1148/radiol.2020200370>
484. Pan, H.; Peto, R.; Abdool Karim, Q.; Alejandria, M.; Henao Restrepo, A. M.; Hernandez Garcia, C.; Kieny, M. P.; Malekzadeh, R.; Murthy, S.; Preziosi, M.-P.; Reddy, S.; Roses, M.; Sathiyamoorthy, V.; Rottingen, J.-A.; Swaminathan, S., Repurposed antiviral drugs for COVID-19; interim WHO SOLIDARITY trial results. *medRxiv* **2020**, 2020.10.15.20209817.
<https://www.medrxiv.org/content/medrxiv/early/2020/10/15/2020.10.15.20209817.full.pdf>
485. Panovska-Griffiths, J.; Kerr, C. C.; Stuart, R. M.; Mistry, D.; Klein, D. J.; Viner, R. M.; Bonell, C., Determining the optimal strategy for reopening schools, the impact of test and trace interventions, and the risk of occurrence of a second COVID-19 epidemic wave in the UK: a modelling study. *The Lancet Child & Adolescent Health* **2020**. [https://doi.org/10.1016/S2352-4642\(20\)30250-9](https://doi.org/10.1016/S2352-4642(20)30250-9)

486. Paranjpe, I.; Fuster, V.; Lala, A.; Russak, A.; Glicksberg, B. S.; Levin, M. A.; Charney, A. W.; Narula, J.; Fayad, Z. A.; Bagiella, E.; Zhao, S.; Nadkarni, G. N., Association of Treatment Dose Anticoagulation with In-Hospital Survival Among Hospitalized Patients with COVID-19. *Journal of the American College of Cardiology* **2020**, 27327.
<http://www.onlinejacc.org/content/accj/early/2020/05/05/j.jacc.2020.05.001.full.pdf>
487. Park, A., An At-Home Coronavirus Test May Be on the Way in the U.S. *TIME* 25 March, 2020.
<https://time.com/5809753/at-home-coronavirus-test/>
488. Park, S. W.; Champredon, D.; Earn, D. J. D.; Li, M.; Weitz, J. S.; Grenfell, B. T.; Dushoff, J., Reconciling early-outbreak preliminary estimates of the basic reproductive number and its uncertainty: a new framework and applications to the novel coronavirus (2019-nCoV) outbreak. **2020**, 1-13.
489. Park, S. Y.; Kim, Y.-M.; Yi, S.; Lee, S.; Na, B.-J.; Kim, C. B.; Kim, J.-i.; Kim, H. S.; Kim, Y. B.; Park, Y.; Huh, I. S.; Kim, H. K.; Yoon, H. J.; Jang, H.; Kim, K.; Chang, Y.; Kim, I.; Lee, H.; Gwack, J.; Kim, S. S.; Kim, M.; Kweon, S.; Choe, Y. J.; Park, O.; Park, Y. J.; Jeong, E. K., Coronavirus Disease Outbreak in Call Center, South Korea. *Emerging Infectious Disease journal* **2020**, 26 (8), 1666.
https://wwwnc.cdc.gov/eid/article/26/8/20-1274_article
490. Parker, C. W.; Singh, N.; Tighe, S.; Blachowicz, A.; Wood, J. M.; Seuylemezian, A.; Vaishampayan, P.; Urbaniak, C.; Hendrickson, R.; Laaguiby, P.; Clark, K.; Clement, B. G.; O'Hara, N. B.; Couto-Rodriguez, M.; Bezdan, D.; Mason, C. E.; Venkateswaran, K., End-to-End Protocol for the Detection of SARS-CoV-2 from Built Environments. *mSystems* **2020**, 5 (5), e00771-20.
<https://msystems.asm.org/content/msys/5/5/e00771-20.full.pdf>
491. Parri, N.; Lenge, M.; Buonsenso, D., Children with Covid-19 in Pediatric Emergency Departments in Italy. *New England Journal of Medicine* **2020**. <https://www.nejm.org/doi/full/10.1056/NEJMc2007617>
492. Pasteur, I., Clinical Trial to Evaluate the Safety and Immunogenicity of the COVID-19 Vaccine (COVID-19-101). <https://clinicaltrials.gov/ct2/show/NCT04497298>.
493. Patanavanich, R.; Glantz, S. A., Smoking Is Associated With COVID-19 Progression: A Meta-analysis. *Nicotine Tob Res* **2020**, 22 (9), 1653-1656.
494. Patolia, H.; Pan, J.; Harb, C.; Marr, L. C.; Baffoe-Bonnie, A., Filtration evaluation and clinical use of expired elastomeric P-100 filter cartridges during the COVID-19 pandemic. *Infection Control & Hospital Epidemiology* **2020**, 1-6. <https://www.cambridge.org/core/article/filtration-evaluation-and-clinical-use-of-expired-elastomeric-p100-filter-cartridges-during-the-covid19-pandemic/D5EFCC5EEF65FEA210E1070149CB9DEF>
495. Pau, A. K.; Aberg, J.; Baker, J.; Belperio, P. S.; Coopersmith, C. M.; Crew, P.; Glidden, D. V.; Grund, B.; Gulick, R. M.; Harrison, C.; Kim, A.; Lane, H. C.; Masur, H.; Sheikh, V.; Singh, K.; Yazdany, J.; Tebas, P., Convalescent Plasma for the Treatment of COVID-19: Perspectives of the National Institutes of Health COVID-19 Treatment Guidelines Panel. *Annals of Internal Medicine* **2020**, 0 (0), null.
<https://www.acpjournals.org/doi/abs/10.7326/M20-6448>
496. Payne, D. C., SARS-CoV-2 Infections and Serologic Responses from a Sample of US Navy Service Members—USS Theodore Roosevelt, April 2020. *MMWR. Morbidity and Mortality Weekly Report* **2020**, 69.
497. Peccia, J.; Zulli, A.; Brackney, D. E.; Grubaugh, N. D.; Kaplan, E. H.; Casanovas-Massana, A.; Ko, A. I.; Malik, A. A.; Wang, D.; Wang, M.; Warren, J. L.; Weinberger, D. M.; Arnold, W.; Omer, S. B., Measurement of SARS-CoV-2 RNA in wastewater tracks community infection dynamics. *Nature Biotechnology* **2020**. <https://doi.org/10.1038/s41587-020-0684-z>
498. Peltier, R. E.; Wang, J.; Hollenbeck, B. L.; Lanza, J.; Furtado, R. M.; Cyr, J.; Ellison, R.; Kobayashi, K. J., Addressing Decontaminated Respirators: Some Methods Appear to Damage Mask Integrity and Protective Function. *Infection Control & Hospital Epidemiology* **2020**, 1-9.
499. Perchetti, G. A.; Huang, M.-L.; Peddu, V.; Jerome, K. R.; Greninger, A. L., Stability of SARS-CoV-2 in PBS for Molecular Detection. *Journal of Clinical Microbiology* **2020**.

500. Pereda, R.; González, D.; Rivero, H. B.; Rivero, J. C.; Pérez, A.; López, L. D. R.; Mezquia, N.; Venegas, R.; Betancourt, J. R.; Domínguez, R. E., Therapeutic Effectiveness of Interferon- α 2b Against COVID-19: The Cuban Experience. *J Interferon Cytokine Res* **2020**, *40* (9), 438-442.
501. Perkins, A.; Espana, G., NotreDame-FRED COVID-19 forecasts.
https://github.com/confunguido/covid19_ND_forecasting/blob/master/README.md.
502. Peto, L.; Rodger, G.; Carter, D. P.; Osman, K. L.; Yavuz, M.; Johnson, K.; Raza, M.; Parker, M. D.; Wyles, M. D.; Andersson, M.; Justice, A.; Vaughan, A.; Hoosdally, S.; Stoesser, N.; Matthews, P. C.; Eyre, D. W.; Peto, T. E.; Carroll, M. W.; de Silva, T. I.; Crook, D. W.; Evans, C. M.; Pullan, S. T., Diagnosis of SARS-CoV-2 infection with LamPORE, a high-throughput platform combining loop-mediated isothermal amplification and nanopore sequencing. *medRxiv* **2020**, 2020.09.18.20195370.
<https://www.medrxiv.org/content/medrxiv/early/2020/09/25/2020.09.18.20195370.full.pdf>
503. Petrakis, D.; Margină, D.; Tsarouhas, K.; Tekos, F.; Stan, M.; Nikitovic, D.; Kouretas, D.; Spandidos, D. A.; Tsatsakis, A., Obesity - a risk factor for increased COVID-19 prevalence, severity and lethality (Review). *Mol Med Rep* **2020**, *22* (1), 9-19. <https://doi.org/10.3892/mmr.2020.11127>
504. Pickering, B.; Smith, G.; Pinette, M.; Embury-Hyatt, C.; Moffat, E.; Marszal, P.; Lewis, C. E., Susceptibility of domestic swine to experimental infection with SARS-CoV-2. *bioRxiv* **2020**, 2020.09.10.288548. <http://biorxiv.org/content/early/2020/09/10/2020.09.10.288548.abstract>
505. Pierce, C. A.; Preston-Hurlburt, P.; Dai, Y.; Aschner, C. B.; Cheshenko, N.; Galen, B.; Garforth, S. J.; Herrera, N. G.; Jangra, R. K.; Morano, N. C.; Orner, E.; Sy, S.; Chandran, K.; Dziura, J.; Almo, S. C.; Ring, A.; Keller, M. J.; Herold, K. C.; Herold, B. C., Immune responses to SARS-CoV-2 infection in hospitalized pediatric and adult patients. *Science Translational Medicine* **2020**, *12* (564), eabd5487.
<https://stm.sciencemag.org/content/scitransmed/12/564/eabd5487.full.pdf>
506. Pigoga, J. L.; Friedman, A.; Broccoli, M.; Hirner, S.; Naidoo, A. V.; Singh, S.; Werner, K.; Wallis, L. A., Clinical and historical features associated with severe COVID-19 infection: a systematic review. *medRxiv* **2020**, 2020.04.23.20076653.
<https://www.medrxiv.org/content/medrxiv/early/2020/04/27/2020.04.23.20076653.full.pdf>
507. Pirjani, R.; Hosseini, R.; Soori, T.; Rabiei, M.; Hosseini, L.; Abiri, A.; Moini, A.; Shizarpour, A.; Razani, G.; Sepidarkish, M., Maternal and neonatal outcomes in COVID-19 infected pregnancies: a prospective cohort study. *Journal of Travel Medicine* **2020**. <https://doi.org/10.1093/jtm/taaa158>
508. Plante, J. A.; Liu, Y.; Liu, J.; Xia, H.; Johnson, B. A.; Lokugamage, K. G.; Zhang, X.; Muruato, A. E.; Zou, J.; Fontes-Garfias, C. R.; Mirchandani, D.; Scharton, D.; Bilello, J. P.; Ku, Z.; An, Z.; Kalveram, B.; Freiberg, A. N.; Menachery, V. D.; Xie, X.; Plante, K. S.; Weaver, S. C.; Shi, P.-Y., Spike mutation D614G alters SARS-CoV-2 fitness and neutralization susceptibility. *bioRxiv* **2020**, 2020.09.01.278689.
<http://biorxiv.org/content/early/2020/09/02/2020.09.01.278689.abstract>
509. Pollán, M.; Pérez-Gómez, B.; Pastor-Barriuso, R.; al., e., Prevalence of SARS-CoV-2 in Spain (ENE-COVID): a nationwide, population-based seroepidemiological study. *The Lancet* **2020**.
[https://doi.org/10.1016/S0140-6736\(20\)31483-5](https://doi.org/10.1016/S0140-6736(20)31483-5)
510. Poston, D.; Weisblum, Y.; Wise, H.; Templeton, K.; Jenks, S.; Hatzioannou, T.; Bieniasz, P. D., Absence of SARS-CoV-2 neutralizing activity in pre-pandemic sera from individuals with recent seasonal coronavirus infection. *medRxiv* **2020**, 2020.10.08.20209650.
<https://www.medrxiv.org/content/medrxiv/early/2020/10/11/2020.10.08.20209650.full.pdf>
511. Potter, D.; Riffon, M.; Kakamada, S.; Miller, R. S.; Komatsoulis, G. A., Disproportionate impact of COVID-19 disease among racial and ethnic minorities in the U.S. cancer population as seen in CancerLinQ Discovery data. *Journal of Clinical Oncology* **2020**, *38* (29_suppl), 84-84.
https://ascopubs.org/doi/abs/10.1200/JCO.2020.38.29_suppl.84
512. Press, A., Finland deploys coronavirus-sniffing dogs at main airport. <https://www.msn.com/en-us/news/world/finland-deploys-coronavirus-sniffing-dogs-at-main-airport/ar-BB19li6Z?li=BBnbca1> (accessed 23 SEP 2020).

513. Price-Haywood, E. G.; Burton, J.; Fort, D.; Seoane, L., Hospitalization and Mortality among Black Patients and White Patients with Covid-19. *New England Journal of Medicine* **2020**.
<https://www.nejm.org/doi/full/10.1056/NEJMsa2011686>
514. Qin, J.; You, C.; Lin, Q.; Hu, T.; Yu, S.; Zhou, X., Estimation of incubation period distribution of COVID-19 using disease onset forward time: a novel cross-sectional and forward follow-up study. *Science Advances* **2020**, 07 Aug 2020.
<https://advances.sciencemag.org/content/early/2020/08/07/sciadv.abc1202>
515. Qiu, H.; Wu, J.; Hong, L.; Luo, Y.; Song, Q.; Chen, D., Clinical and epidemiological features of 36 children with coronavirus disease 2019 (COVID-19) in Zhejiang, China: an observational cohort study. *The Lancet Infectious Diseases*. [https://doi.org/10.1016/S1473-3099\(20\)30198-5](https://doi.org/10.1016/S1473-3099(20)30198-5)
516. Queensland, U. o., An interventional study to evaluate the safety and immune response of a vaccine against Severe Acute Respiratory Syndrome coronavirus 2 (SARS-CoV-2, the virus that causes COVID-19 infection) when given to healthy adult participants. .
<https://www.anzctr.org.au/Trial/Registration/TrialReview.aspx?id=379861&isReview=true>.
517. Rabenau, H. F.; Cinatl, J.; Morgenstern, B.; Bauer, G.; Preiser, W.; Doerr, H. W., Stability and inactivation of SARS coronavirus. *Med Microbiol Immunol* **2005**, 194 (1-2), 1-6.
<https://link.springer.com/content/pdf/10.1007/s00430-004-0219-0.pdf>
518. Rahmani, H.; Davoudi-Monfared, E.; Nourian, A.; Khalili, H.; Hajizadeh, N.; Jalalabadi, N. Z.; Fazeli, M. R.; Ghazaeian, M.; Yekaninejad, M. S., Interferon β -1b in treatment of severe COVID-19: A randomized clinical trial. *Int Immunopharmacol* **2020**, 88, 106903.
519. Rai, B.; Shukla, A.; Dwivedi, L. K., Estimates of serial interval for COVID-19: A systematic review and meta-analysis. *Clinical Epidemiology and Global Health* **2020**.
<http://www.sciencedirect.com/science/article/pii/S2213398420301895>
520. Rajasingham, R.; Bangdiwala, A. S.; Nicol, M. R.; Skipper, C. P.; Pastick, K. A.; Axelrod, M. L.; Pullen, M. F.; Nascene, A. A.; Williams, D. A.; Engen, N. W.; Okafor, E. C.; Rini, B. I.; Mayer, I. A.; McDonald, E. G.; Lee, T. C.; Li, P.; MacKenzie, L. J.; Balko, J. M.; Dunlop, S. J.; Hullsiek, K. H.; Boulware, D. R.; Lofgren, S. M.; team, o. b. o. t. C. P., Hydroxychloroquine as pre-exposure prophylaxis for COVID-19 in healthcare workers: a randomized trial. *Clinical Infectious Diseases* **2020**. <https://doi.org/10.1093/cid/ciaa1571>
521. Rambaut, A., Phylodynamic analysis of nCoV-2019 genomes - 27-Jan-2020.
<http://virological.org/t/phylodynamic-analysis-of-ncov-2019-genomes-27-jan-2020/353>.
522. Rapid Expert Consultation, *Rapid Expert Consultation Update on SARS-CoV-2 Surface Stability and Incubation for the COVID-19 Pandemic (March 27, 2020)*. The National Academies Press: Washington, DC, 2020. <https://www.nap.edu/read/25763/chapter/1>
523. Rapkiewicz, A. V.; Mai, X.; Carsons, S. E.; Pittaluga, S.; Kleiner, D. E.; Berger, J. S.; Thomas, S.; Adler, N. M.; Charytan, D. M.; Gasmi, B.; Hochman, J. S.; Reynolds, H. R., Megakaryocytes and platelet-fibrin thrombi characterize multi-organ thrombosis at autopsy in COVID-19: A case series. *EClinicalMedicine* **2020**, 100434. <http://www.sciencedirect.com/science/article/pii/S2589537020301784>
524. Rasheed, A. M.; Fatak, D. F.; Hashim, H. A.; Maulood, M. F.; Kabah, K. K.; Almusawi, Y. A.; Abdulamir, A. S., The therapeutic potential of convalescent plasma therapy on treating critically-ill COVID-19 patients residing in respiratory care units in hospitals in Baghdad, Iraq. *Infez Med* **2020**, 28 (3), 357-366.
525. Ratnesar-Shumate, S.; Williams, G.; Green, B.; Krause, M.; Holland, B.; Wood, S.; Bohannon, J.; Boydston, J.; Freeburger, D.; Hooper, I.; Beck, K.; Yeager, J.; Altamura, L. A.; Biryukov, J.; Yolitz, J.; Schuit, M.; Wahl, V.; Hevey, M.; Dabisch, P., Simulated Sunlight Rapidly Inactivates SARS-CoV-2 on Surfaces. *The Journal of Infectious Diseases* **2020**. <https://doi.org/10.1093/infdis/jiaa274>
526. Reeve, P.; Salzman, S., Russia announces expanded trials for coronavirus vaccine approved 10 days ago. <https://abcnews.go.com/International/russia-announces-expanded-trials-coronavirus-vaccine-approved-10/story?id=72497297>.

527. Regeneron, Statement on REGN-COV2 Emergency Use Authorization Request. 2020.
<https://newsroom.regeneron.com/static-files/6feab76b-176d-402d-bf30-d40462e68b7b>
528. Regeneron Pharmaceuticals, I., REGENERON'S REGN-COV2 ANTIBODY COCKTAIL REDUCED VIRAL LEVELS AND IMPROVED SYMPTOMS IN NON-HOSPITALIZED COVID-19 PATIENTS. 2020; p 3.
<https://newsroom.regeneron.com/news-releases/news-release-details/regenerons-regn-cov2-antibody-cocktail-reduced-viral-levels-and>
529. Reich, N., Ensemble. <https://reichlab.io/>.
530. ReiThera, ReiThera, Laukocare, and Univercells announce Pan-European consortium for the fast-track development of a single-dose adenovirus-based Covid-19 vaccine.
<https://www.reither.com/2020/04/23/reither-leukocare-and-univercells-announce-pan-european-consortium-for-the-fast-track-development-of-a-single-dose-adenovirus-based-covid-19-vaccine/>.
531. Remuzzi, A.; Remuzzi, G., COVID-19 and Italy: what next? *The Lancet* **2020**.
[https://doi.org/10.1016/S0140-6736\(20\)30627-9](https://doi.org/10.1016/S0140-6736(20)30627-9)
532. Ren, X.; Li, Y.; Yang, X.; Li, Z.; Cui, J.; Zhu, A.; Zhao, H.; Yu, J.; Nie, T.; Ren, M.; Dong, S.; Cheng, Y.; Chen, Q.; Chang, Z.; Sun, J.; Wang, L.; Feng, L.; Gao, G. F.; Feng, Z.; Li, Z., Evidence for pre-symptomatic transmission of coronavirus disease 2019 (COVID-19) in China. *Influenza and Other Respiratory Viruses* **2020**, n/a (n/a). <https://onlinelibrary.wiley.com/doi/abs/10.1111/irv.12787>
533. RIBSP, Randomized, Blind, Placebo-controlled I/II Phase QAZCOVID-IN®- COVID-19 Inactivated Vaccine. <https://clinicaltrials.gov/ct2/show/NCT04530357?term=vaccine&recrs=adf&cond=COVID-19&phase=0123&sort=nwst&draw=2&rank=1>.
534. Riccio, M. D.; Lorini, C.; Bonaccorsi, G.; Paget, J.; Caini, S., The association between influenza vaccination and the risk of SARS-CoV-2 infection, severe illness, and death: a systematic review of the literature. **2020**. <https://www.medrxiv.org/content/10.1101/2020.09.25.20201350v1.full.pdf>
535. Richard, M.; Kok, A.; de Meulder, D.; Bestebroer, T. M.; Lamers, M. M.; Okba, N. M. A.; Fentener van Vlissingen, M.; Rockx, B.; Haagmans, B. L.; Koopmans, M. P. G.; Fouchier, R. A. M.; Herfst, S., SARS-CoV-2 is transmitted via contact and via the air between ferrets. *Nature Communications* **2020**, 11 (1), 3496. <https://doi.org/10.1038/s41467-020-17367-2>
536. Richter, W.; Hofacre, K.; Willenberg, Z., *Final Report for the Bioquell Hydrogen Peroxide Vapor (HPV) Decontamination for Reuse of N95 Respirators*; Battelle Memorial Institute: 2016.
<http://wayback.archive-it.org/7993/20170113034232/http://www.fda.gov/downloads/EmergencyPreparedness/Counterterrorism/MedicalCountermeasures/MCMRegulatoryScience/UCM516998.pdf>
537. Rickman, H. M.; Rampling, T.; Shaw, K.; Martinez-Garcia, G.; Hail, L.; Coen, P.; Shahmanesh, M.; Shin, G. Y.; Nastouli, E.; Houlihan, C. F., Nosocomial transmission of COVID-19: a retrospective study of 66 hospital-acquired cases in a London teaching hospital. *Clinical Infectious Diseases* **2020**.
<https://doi.org/10.1093/cid/ciaa816>
538. Riddell, S.; Goldie, S.; Hill, A.; Eagles, D.; Drew, T. W., The effect of temperature on persistence of SARS-CoV-2 on common surfaces. *Virology Journal* **2020**, 17 (1), 145. <https://doi.org/10.1186/s12985-020-01418-7>
539. Riou, J.; Althaus, C. L., Pattern of early human-to-human transmission of Wuhan 2019 novel coronavirus (2019-nCoV), December 2019 to January 2020. *Eurosurveillance* **2020**, 25 (4), 2000058.
<https://www.eurosurveillance.org/content/10.2807/1560-7917.ES.2020.25.4.2000058>
540. Riphagen, S.; Gomez, X.; Gonzalez-Martinez, C.; Wilkinson, N.; Theocharis, P., Hyperinflammatory shock in children during COVID-19 pandemic. *The Lancet*. [https://doi.org/10.1016/S0140-6736\(20\)31094-1](https://doi.org/10.1016/S0140-6736(20)31094-1)
541. Robertson, L. J.; Moore, J. S.; Blighe, K.; Ng, K. Y.; Quinn, N.; Jennings, F.; Warnock, G.; Sharpe, P.; Clarke, M.; Maguire, K.; Rainey, S.; Price, R.; Burns, W.; Kowalczyk, A.; Awuah, A.; McNamee, S.; Wallace, G.; Sager, S.; Chao Shern, C.; Nesbit, M. A.; McLaughlin, J.; Moore, T., SARS-CoV-2 antibody testing in a

- UK population: detectable IgG for up to 20 weeks post infection. *medRxiv* **2020**, 2020.09.29.20201509.
<https://www.medrxiv.org/content/medrxiv/early/2020/10/01/2020.09.29.20201509.full.pdf>
542. Rockx, B.; Kuiken, T.; Herfst, S.; Bestebroer, T.; Lamers, M. M.; Oude Munnink, B. B.; de Meulder, D.; van Amerongen, G.; van den Brand, J.; Okba, N. M. A.; Schipper, D.; van Run, P.; Leijten, L.; Sikkema, R.; Verschoor, E.; Verstrepen, B.; Bogers, W.; Langermans, J.; Drosten, C.; Fentener van Vlissingen, M.; Fouchier, R.; de Swart, R.; Koopmans, M.; Haagmans, B. L., Comparative pathogenesis of COVID-19, MERS, and SARS in a nonhuman primate model. *Science* **2020**, eabb7314.
<https://science.sciencemag.org/content/sci/early/2020/04/16/science.abb7314.full.pdf>
543. Rodda, L. B.; Netland, J.; Shehata, L.; Pruner, K. B.; Morawski, P. M.; Thouvenel, C.; Takehara, K. K.; Eggenberger, J.; Hemann, E. A.; Waterman, H. R.; Fahning, M. L.; Chen, Y.; Rathe, J.; Stokes, C.; Wrenn, S.; Fiala, B.; Carter, L. P.; Hamerman, J. A.; King, N. P.; Gale, M.; Campbell, D. J.; Rawlings, D.; Pepper, M., Functional SARS-CoV-2-specific immune memory persists after mild COVID-19. *medRxiv* **2020**, 2020.08.11.20171843.
<https://www.medrxiv.org/content/medrxiv/early/2020/08/15/2020.08.11.20171843.full.pdf>
544. Rokkas, T., Gastrointestinal involvement in COVID-19: a systematic review and meta-analysis. *Annals of Gastroenterology* **2020**, 33 (4), 355-365.
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7315709/>
545. Roschewski, M.; Lionakis, M. S.; Sharman, J. P.; Roswarski, J.; Goy, A.; Monticelli, M. A.; Roshon, M.; Wrzesinski, S. H.; Desai, J. V.; Zarakas, M. A.; Collen, J.; Rose, K.; Hamdy, A.; Izumi, R.; Wright, G. W.; Chung, K. K.; Baselga, J.; Staudt, L. M.; Wilson, W. H., Inhibition of Bruton tyrosine kinase in patients with severe COVID-19. *Science Immunology* **2020**, 5 (48), eabd0110.
<http://immunology.sciencemag.org/content/5/48/eabd0110.abstract>
546. Rothe, C.; Schunk, M.; Sothmann, P.; Bretzel, G.; Froeschl, G.; Wallrauch, C.; Zimmer, T.; Thiel, V.; Janke, C.; Guggemos, W.; Seilmaier, M.; Drosten, C.; Vollmar, P.; Zwirgmaier, K.; Zange, S.; Wölfel, R.; Hoelscher, M., Transmission of 2019-nCoV Infection from an Asymptomatic Contact in Germany. *New England Journal of Medicine* **2020**. <https://www.nejm.org/doi/full/10.1056/NEJMc2001468>
<https://www.nejm.org/doi/10.1056/NEJMc2001468>
547. Ruktanonchai, N. W.; Floyd, J. R.; Lai, S.; Ruktanonchai, C. W.; Sadilek, A.; Rente-Lourenco, P.; Ben, X.; Carioli, A.; Gwinn, J.; Steele, J. E.; Prosper, O.; Schneider, A.; Oplinger, A.; Eastham, P.; Tatem, A. J., Assessing the impact of coordinated COVID-19 exit strategies across Europe. *Science* **2020**, eabc5096.
<https://science.sciencemag.org/content/sci/early/2020/07/16/science.abc5096.full.pdf>
548. Rundle, A., Severe COVID-19 Risk Mapping.
<https://columbia.maps.arcgis.com/apps/webappviewer/index.html?id=ade6ba85450c4325a12a5b9c09ba796c>
549. Russell, T. W.; Hellewell, J.; Abbott, S.; Golding, N.; Gibbs, H.; Jarvis, C. I.; van Zandvoort, K.; group, C. n. w.; Flasche, S.; Eggo, R. M.; Edmunds, W. J.; Kucharski, A. J., Using a delay-adjusted case fatality ratio to estimate under-reporting. CMMID: 2020.
https://cmmid.github.io/topics/covid19/severity/global_cfr_estimates.html
550. RUSSO, R.; Levine, C.; Veilleux, C.; Peixoto, B.; McCormick-Ell, J.; Block, T.; Gresko, A.; Delmas, G.; Chitale, P.; Frees, A.; Ruiz, A.; Alland, D., Decontaminating N95 respirators during the Covid-19 pandemic: simple and practical approaches to increase decontamination capacity, speed, safety and ease of use. *medRxiv* **2020**, 2020.08.17.20177022.
<https://www.medrxiv.org/content/medrxiv/early/2020/08/21/2020.08.17.20177022.full.pdf>
551. Ryan, K. A.; Bewley, K. R.; Fotheringham, S. A.; Brown, P.; Hall, Y.; Marriott, A. C.; Tree, J. A.; Allen, L.; Aram, M. J.; Brunt, E.; Buttigieg, K. R.; Cavell, B. E.; Carter, D. P.; Cobb, R.; Coombes, N. S.; Godwin, K. J.; Gooch, K. E.; Gourié, J.; Halkerston, R.; Harris, D. J.; Humphries, H. E.; Hunter, L.; Ho, C. M. K.; Kennard, C. L.; Leung, S.; Ngabo, D.; Osman, K. L.; Paterson, J.; Penn, E. J.; Pullan, S. T.; Rayner, E.; Slack, G. S.; Steeds, K.; Taylor, I.; Tipton, T.; Thomas, S.; Wand, N. I.; Watson, R. J.; Wiblin, N. R.; Charlton, S.;

- Hallis, B.; Hiscox, J. A.; Funnell, S.; Dennis, M. J.; Whittaker, C. J.; Catton, M. G.; Druce, J.; Salguero, F. J.; Carroll, M. W., Dose-dependent response to infection with SARS-CoV-2 in the ferret model: evidence of protection to re-challenge. *bioRxiv* **2020**, 2020.05.29.123810.
<https://www.biorxiv.org/content/biorxiv/early/2020/05/29/2020.05.29.123810.full.pdf>
552. Safewell, SafeSpace. <https://www.safewellsolutions.co.uk/products/safespace/> (accessed 10 Oct 2020).
553. Salazar, E.; Christensen, P. A.; Graviss, E. A.; Ngyuen, D. T.; Castillo, B.; Chen, J.; Valdez Lopez, B.; Eager, T.; Yi, X.; Zhao, P.; Rogers, J.; Shehabeldin, A.; Joseph, D.; Masud, F.; Leveque, C.; Olsen, R. J.; Bernard, D. W.; Gollihar, J.; Musser, J. M., Early transfusion of a large cohort of COVID-19 patients with high titer anti-SARS-CoV-2 spike protein IgG convalescent plasma confirms a signal of significantly decreased mortality. *medRxiv* **2020**, 2020.10.02.20206029.
<http://medrxiv.org/content/early/2020/10/05/2020.10.02.20206029.abstract>
554. Sanche, S.; Lin, Y. T.; Xu, C.; Romero-Severson, E.; Hengartner, N. W.; Ke, R., The novel coronavirus, 2019-nCoV, is highly contagious and more infectious than initially estimated. *arXiv preprint arXiv:2002.03268* **2020**.
555. Sanchez, G. V.; Biedron, C.; Fink, L. R.; al., e., Initial and Repeated Point Prevalence Surveys to Inform SARS-CoV-2 Infection Prevention in 26 Skilled Nursing Facilities — Detroit, Michigan, March–May 2020. *Morbidity and Mortality Weekly Report* **2020**, *ePub*: 1 July 2020.
https://www.cdc.gov/mmwr/volumes/69/wr/mm6927e1.htm?s_cid=mm6927e1_w#suggestedcitation
556. Sanofi, Study of Recombinant Protein Vaccine Formulations Against COVID-19 in Healthy Adults 18 Years of Age and Older. <https://clinicaltrials.gov/ct2/show/NCT04537208>.
557. Santarpia, J. L.; Herrera, V. L.; Rivera, D. N.; Ratnesar-Shumate, S.; Reid, S. P.; Denton, P. W.; Martens, J. W. S.; Fang, Y.; Conoan, N.; Callahan, M. V.; Lawler, J. V.; Brett-Major, D. M.; Lowe, J. J., The Infectious Nature of Patient-Generated SARS-CoV-2 Aerosol. *medRxiv* **2020**, 2020.07.13.20041632.
<https://www.medrxiv.org/content/medrxiv/early/2020/07/21/2020.07.13.20041632.full.pdf>
558. Santarpia, J. L.; Rivera, D. N.; Herrera, V.; Morwitzer, M. J.; Creager, H.; Santarpia, G. W.; Crown, K. K.; Brett-Major, D.; Schnaubelt, E.; Broadhurst, M. J.; Lawler, J. V.; Reid, S. P.; Lowe, J. J., Transmission Potential of SARS-CoV-2 in Viral Shedding Observed at the University of Nebraska Medical Center. *medRxiv* **2020**, 2020.03.23.20039446.
<https://www.medrxiv.org/content/medrxiv/early/2020/03/26/2020.03.23.20039446.1.full.pdf>
559. Schlottau, K.; Rissmann, M.; Graaf, A.; Schön, J.; Sehl, J.; Wylezich, C.; Höper, D.; Mettenleiter, T. C.; Balkema-Buschmann, A.; Harder, T.; Grund, C.; Hoffmann, D.; Breithaupt, A.; Beer, M., SARS-CoV-2 in fruit bats, ferrets, pigs, and chickens: an experimental transmission study. *The Lancet Microbe* **2020**.
[https://doi.org/10.1016/S2666-5247\(20\)30089-6](https://doi.org/10.1016/S2666-5247(20)30089-6)
560. Schnirring, L., New coronavirus infects health workers, spreads to Korea.
<http://www.cidrap.umn.edu/news-perspective/2020/01/new-coronavirus-infects-health-workers-spreads-korea>.
561. Schuit, M.; Ratnesar-Shumate, S.; Yolitz, J.; Williams, G.; Weaver, W.; Green, B.; Miller, D.; Krause, M.; Beck, K.; Wood, S.; Holland, B.; Bohannon, J.; Freeburger, D.; Hooper, I.; Biryukov, J.; Altamura, L. A.; Wahl, V.; Hevey, M.; Dabisch, P., Airborne SARS-CoV-2 is Rapidly Inactivated by Simulated Sunlight. *The Journal of Infectious Diseases* **2020**. <https://doi.org/10.1093/infdis/jiaa334>
562. Sciences, C. A. o. M., Safety and Immunogenicity Study of an Inactivated SARS-CoV-2 Vaccine for Preventing Against COVID-19. Safety and Immunogenicity Study of an Inactivated SARS-CoV-2 Vaccine for Preventing Against COVID-19.
563. Sekine, T.; Perez-Potti, A.; Rivera-Ballesteros, O.; Strålin, K.; Gorin, J.-B.; Olsson, A.; Llewellyn-Lacey, S.; Kamal, H.; Bogdanovic, G.; Muschiol, S.; Wullimann, D. J.; Kammann, T.; Emgård, J.; Parrot, T.; Folkesson, E.; Rooyackers, O.; Eriksson, L. I.; Sönnernborg, A.; Allander, T.; Albert, J.; Nielsen, M.; Klingström, J.; Gredmark-Russ, S.; Björkström, N. K.; Sandberg, J. K.; Price, D. A.; Ljunggren, H.-G.;

- Aleman, S.; Buggert, M., Robust T cell immunity in convalescent individuals with asymptomatic or mild COVID-19. *bioRxiv* **2020**, 2020.06.29.174888.
<https://www.biorxiv.org/content/biorxiv/early/2020/06/29/2020.06.29.174888.full.pdf>
564. Seow, J.; Graham, C.; Merrick, B.; Acors, S.; Steel, K. J. A.; Hemmings, O.; O'Bryne, A.; Kouphou, N.; Pickering, S.; Galao, R.; Betancor, G.; Wilson, H. D.; Signell, A. W.; Winstone, H.; Kerridge, C.; Temperton, N.; Snell, L.; Bisnauthsing, K.; Moore, A.; Green, A.; Martinez, L.; Stokes, B.; Honey, J.; Izquierdo-Barras, A.; Arbane, G.; Patel, A.; O'Connell, L.; O'Hara, G.; MacMahon, E.; Douthwaite, S.; Nebbia, G.; Batra, R.; Martinez-Nunez, R.; Edgeworth, J. D.; Neil, S. J. D.; Malim, M. H.; Doores, K., Longitudinal evaluation and decline of antibody responses in SARS-CoV-2 infection. *medRxiv* **2020**, 2020.07.09.20148429.
<https://www.medrxiv.org/content/medrxiv/early/2020/07/11/2020.07.09.20148429.full.pdf>
565. sermet, i.; temmam, s.; huon, c.; behillil, s.; gadjos, v.; bigot, t.; lurier, t.; chretien, d.; backovick, m.; Moisan-Delaunay, A.; donati, f.; albert, m.; foucaud, e.; Mesplees, B.; benoist, g.; fayas, a.; duval-arnould, m.; cretolle, c.; charbit, m.; aubart, m.; Auriau, J.; lorrot, m.; Kariyawasam, D.; fertita, l.; Orliaguet, G.; pigneur, b.; Bader-Meunier, B.; briand, c.; toubiana, j.; Guillemot, T.; van der werf, s.; leruez-ville, m.; eloit, m., Prior infection by seasonal coronaviruses does not prevent SARS-CoV-2 infection and associated Multisystem Inflammatory Syndrome in children. *medRxiv* **2020**, 2020.06.29.20142596.
<https://www.medrxiv.org/content/medrxiv/early/2020/06/30/2020.06.29.20142596.full.pdf>
566. Shan, B.; Broza, Y. Y.; Li, W.; Wang, Y.; Wu, S.; Liu, Z.; Wang, J.; Gui, S.; Wang, L.; Zhang, Z.; Liu, W.; Zhou, S.; Jin, W.; Zhang, Q.; Hu, D.; Lin, L.; Zhang, Q.; Li, W.; Wang, J.; Liu, H.; Pan, Y.; Haick, H., Multiplexed Nanomaterial-Based Sensor Array for Detection of COVID-19 in Exhaled Breath. *ACS Nano* **2020**. <https://doi.org/10.1021/acsnano.0c05657>
567. Shekerdemian, L. S.; Mahmood, N. R.; Wolfe, K. K.; Riggs, B. J.; Ross, C. E.; McKiernan, C. A.; Heidemann, S. M.; Kleinman, L. C.; Sen, A. I.; Hall, M. W.; Priestley, M. A.; McGuire, J. K.; Boukas, K.; Sharron, M. P.; Burns, J. P.; Collaborative, f. t. I. C.-P., Characteristics and Outcomes of Children With Coronavirus Disease 2019 (COVID-19) Infection Admitted to US and Canadian Pediatric Intensive Care Units. *JAMA Pediatrics* **2020**. <https://doi.org/10.1001/jamapediatrics.2020.1948>
568. Shen, Y.; Xu, W.; Li, C.; Handel, A.; Martinez, L.; Ling, F.; Ebell, M.; Fu, X.; Pan, J.; Ren, J.; Gu, W.; Chen, E., A cluster of COVID-19 infections indicating person-to-person transmission among casual contacts from social gatherings: An outbreak case-contact investigation. *Open Forum Infectious Diseases* **2020**. <https://doi.org/10.1093/ofid/ofaa231>
569. Shepardson, D., U.S. CDC issues 'strong recommendation' for mask mandate on airplanes, trains. *Reuters* **2020**. <https://ca.reuters.com/article/instant-article/idUSL1N2HA24V>
570. Shi, J.; Wen, Z.; Zhong, G.; Yang, H.; Wang, C.; Huang, B.; Liu, R.; He, X.; Shuai, L.; Sun, Z.; Zhao, Y.; Liu, P.; Liang, L.; Cui, P.; Wang, J.; Zhang, X.; Guan, Y.; Tan, W.; Wu, G.; Chen, H.; Bu, Z., Susceptibility of ferrets, cats, dogs, and other domesticated animals to SARS-coronavirus 2. *Science* **2020**, eabb7015.
<https://science.sciencemag.org/content/sci/early/2020/04/07/science.abb7015.full.pdf>
571. Shi, S.; Qin, M.; Shen, B.; Cai, Y.; Liu, T.; Yang, F.; Gong, W.; Liu, X.; Liang, J.; Zhao, Q.; Huang, H.; Yang, B.; Huang, C., Association of Cardiac Injury With Mortality in Hospitalized Patients With COVID-19 in Wuhan, China. *JAMA Cardiology* **2020**. <https://doi.org/10.1001/jamacardio.2020.0950>
572. Sia, S. F.; Yan, L. M.; Chin, A. W. H.; Fung, K.; Choy, K. T.; Wong, A. Y. L.; Kaewpreedee, P.; Perera, R.; Poon, L. L. M.; Nicholls, J. M.; Peiris, M.; Yen, H. L., Pathogenesis and transmission of SARS-CoV-2 in golden hamsters. *Nature* **2020**.
573. Silcott, D.; Kinahan, S.; Santarpia, J.; Silcott, B.; Silcott, R.; Silcott, P.; Silcott, B.; Distelhorst, S.; Herrera, V.; Rivera, D.; Crown, K.; Lucero, G.; Bryden, W.; McLoughlin, M.; Cetta, M.; Accardi, R., TRANSCOM/AMC Commercial Aircraft Cabin Aerosol Dispersion Tests; USATRANSCOM and AMC: 2020.
<https://www.ustranscom.mil/cmd/docs/TRANSCOM%20Report%20Final.pdf>

574. Silverman, J. D.; Hupert, N.; Washburne, A. D., Using influenza surveillance networks to estimate state-specific prevalence of SARS-CoV-2 in the United States. *Science Translational Medicine* **2020**, eabc1126.
<https://stm.sciencemag.org/content/scitransmed/early/2020/06/22/scitransmed.abc1126.full.pdf>
575. Simmons, S.; Carrion, R.; Alfson, K.; Staples, H.; Jinadatha, C.; Jarvis, W.; Sampathkumar, P.; Chemaly, R. F.; Khawaja, F.; Povroznik, M.; Jackson, S.; Kaye, K. S.; Rodriguez, R. M.; Stibich, M., Deactivation of SARS-CoV-2 with Pulsed Xenon Ultraviolet: implications for environmental COVID-19 control. *Infection Control & Hospital Epidemiology* **2020**, 1-19.
<https://www.cambridge.org/core/article/deactivation-of-sarscov2-with-pulsed-xenon-ultraviolet-implications-for-environmental-covid19-control/AD5CF52419E27E86E0114059FBA78D4C>
576. Singh, K.; Mittal, S.; Gollapudi, S.; Butzmann, A.; Kumar, J.; Ohgami, R. S., A meta-analysis of SARS-CoV-2 patients identifies the combinatorial significance of D-dimer, C-reactive protein, lymphocyte, and neutrophil values as a predictor of disease severity. *International Journal of Laboratory Hematology n/a* (n/a). <https://onlinelibrary.wiley.com/doi/abs/10.1111/ijlh.13354>
577. Sinovac, Clinical Trial of Efficacy and Safety of Sinovac's Adsorbed COVID-19 (Inactivated) Vaccine in Healthcare Professionals (PROFISCOV).
<https://clinicaltrials.gov/ct2/show/NCT04456595?term=vaccine&cond=covid-19&draw=2&rank=1>.
578. Sit, T. H. C.; Brackman, C. J.; Ip, S. M.; Tam, K. W. S.; Law, P. Y. T.; To, E. M. W.; Yu, V. Y. T.; Sims, L. D.; Tsang, D. N. C.; Chu, D. K. W.; Perera, R.; Poon, L. L. M.; Peiris, M., Infection of dogs with SARS-CoV-2. *Nature* **2020**.
579. Skalina, K. A.; Goldstein, D. Y.; Sulail, J.; Hahm, E.; Narlieva, M.; Szymczak, W.; Fox, A. S., Extended Storage of SARS-CoV2 Nasopharyngeal Swabs Does Not Negatively Impact Results of Molecular-Based Testing. *medRxiv* **2020**, 2020.05.16.20104158.
<https://www.medrxiv.org/content/medrxiv/early/2020/05/20/2020.05.16.20104158.full.pdf>
580. Song, J.-Y.; Yun, J.-G.; Noh, J.-Y.; Cheong, H.-J.; Kim, W.-J., Covid-19 in South Korea — Challenges of Subclinical Manifestations. *New England Journal of Medicine* **2020**.
<https://www.nejm.org/doi/full/10.1056/NEJMc2001801>
581. Song, S. L.; Hays, S. B.; Panton, C. E.; Mylona, E. K.; Kalligeros, M.; Shehadeh, F.; Mylonakis, E., Statin Use Is Associated with Decreased Risk of Invasive Mechanical Ventilation in COVID-19 Patients: A Preliminary Study. *Pathogens* **2020**, 9 (9).
582. Stadnytskyi, V.; Bax, C. E.; Bax, A.; Anfinrud, P., The airborne lifetime of small speech droplets and their potential importance in SARS-CoV-2 transmission. *Proceedings of the National Academy of Sciences* **2020**, 202006874. <https://www.pnas.org/content/pnas/early/2020/05/12/2006874117.full.pdf>
583. Staff, CanSino's COVID-19 vaccine candidate approved for military use in China. *Reuters* **2020**.
<https://www.reuters.com/article/us-health-coronavirus-china-vaccine/cansinos-covid-19-vaccine-candidate-approved-for-military-use-in-china-idUSKBN2400DZ>
584. Sterne, J. A. C.; Murthy, S.; Diaz, J. V.; Slutsky, A. S.; Villar, J.; Angus, D. C.; Annane, D.; Azevedo, L. C. P.; Berwanger, O.; Cavalcanti, A. B.; Dequin, P. F.; Du, B.; Emberson, J.; Fisher, D.; Giraudeau, B.; Gordon, A. C.; Granholm, A.; Green, C.; Haynes, R.; Heming, N.; Higgins, J. P. T.; Horby, P.; Jüni, P.; Landray, M. J.; Le Gouge, A.; Leclerc, M.; Lim, W. S.; Machado, F. R.; McArthur, C.; Meziani, F.; Møller, M. H.; Perner, A.; Petersen, M. W.; Savovic, J.; Tomazini, B.; Veiga, V. C.; Webb, S.; Marshall, J. C., Association Between Administration of Systemic Corticosteroids and Mortality Among Critically Ill Patients With COVID-19: A Meta-analysis. *Jama* **2020**. <https://jamanetwork.com/journals/jama/fullarticle/2770279>
585. Stubblefield, W. B.; Talbot, H. K.; Feldstein, L.; Tenforde, M. W.; Rasheed, M. A. U.; Mills, L.; Lester, S. N.; Freeman, B.; Thornburg, N. J.; Jones, I. D.; Ward, M. J.; Lindsell, C. J.; Baughman, A.; Halasa, N.; Grijalva, C. G.; Rice, T. W.; Patel, M. M.; Self, W. H.; Investigators, I. V. E. i. t. C. I., Seroprevalence of SARS-CoV-2 Among Frontline Healthcare Personnel During the First Month of Caring for COVID-19 Patients — Nashville, Tennessee. *Clinical Infectious Diseases* **2020**. <https://doi.org/10.1093/cid/ciaa936>

586. Su, H.; Yang, M.; Wan, C.; Yi, L.-X.; Tang, F.; Zhu, H.-Y.; Yi, F.; Yang, H.-C.; Fogo, A. B.; Nie, X.; Zhang, C., Renal histopathological analysis of 26 postmortem findings of patients with COVID-19 in China. *Kidney International*. <https://doi.org/10.1016/j.kint.2020.04.003>
587. Suarez, D. L.; Pantin-Jackwood, M. J.; Swayne, D. E.; Lee, S. A.; DeBlois, S. M.; Spackman, E., Lack of susceptibility of poultry to SARS-CoV-2 and MERS-CoV. *bioRxiv* **2020**, 2020.06.16.154658. <http://biorxiv.org/content/early/2020/06/16/2020.06.16.154658.abstract>
588. Sugano, N.; Ando, W.; Fukushima, W., Cluster of SARS-CoV-2 infections linked to music clubs in Osaka, Japan: asymptotically infected persons can transmit the virus as soon as 2 days after infection. *The Journal of Infectious Diseases* **2020**. <https://doi.org/10.1093/infdis/jiaa542>
589. Sukhyun, R.; Seikh Taslim, A.; Cheolsun, J.; Baekjin, K.; Benjamin, J. C., Effect of Nonpharmaceutical Interventions on Transmission of Severe Acute Respiratory Syndrome Coronavirus 2, South Korea, 2020. *Emerging Infectious Disease journal* **2020**, 26 (10). https://wwwnc.cdc.gov/eid/article/26/10/20-1886_article
590. Sun, J.; Zhu, A.; Li, H.; Zheng, K.; Zhuang, Z.; Chen, Z.; Shi, Y.; Zhang, Z.; Chen, S. B.; Liu, X.; Dai, J.; Li, X.; Huang, S.; Huang, X.; Luo, L.; Wen, L.; Zhuo, J.; Li, Y.; Wang, Y.; Zhang, L.; Zhang, Y.; Li, F.; Feng, L.; Chen, X.; Zhong, N.; Yang, Z.; Huang, J.; Zhao, J.; Li, Y. M., Isolation of Infectious SARS-CoV-2 from Urine of a COVID-19 Patient. *Emerg Microbes Infect* **2020**, 1-8.
591. Sun, S.; Cai, X.; Wang, H.; He, G.; Lin, Y.; Lu, B.; Chen, C.; Pan, Y.; Hu, X., Abnormalities of peripheral blood system in patients with COVID-19 in Wenzhou, China. *Clinica Chimica Acta* **2020**, 507, 174-180. <http://www.sciencedirect.com/science/article/pii/S0009898120301790>
592. Sun, S. H.; Chen, Q.; Gu, H. J.; Yang, G.; Wang, Y. X.; Huang, X. Y.; Liu, S. S.; Zhang, N. N.; Li, X. F.; Xiong, R.; Guo, Y.; Deng, Y. Q.; Huang, W. J.; Liu, Q.; Liu, Q. M.; Shen, Y. L.; Zhou, Y.; Yang, X.; Zhao, T. Y.; Fan, C. F.; Zhou, Y. S.; Qin, C. F.; Wang, Y. C., A Mouse Model of SARS-CoV-2 Infection and Pathogenesis. *Cell Host Microbe* **2020**.
593. Suthar, M. S.; Zimmerman, M. G.; Kauffman, R. C.; Mantus, G.; Linderman, S. L.; Hudson, W. H.; Vanderheiden, A.; Nyhoff, L.; Davis, C. W.; Adekunle, S.; Affer, M.; Sherman, M.; Reynolds, S.; Verkerke, H. P.; Alter, D. N.; Guarner, J.; Bryksin, J.; Horwath, M.; Arthur, C. M.; Saakadze, N.; Smith, G. H.; Edupuganti, S.; Scherer, E. M.; Hellmeister, K.; Cheng, A.; Morales, J. A.; Neish, A. S.; Stowell, S. R.; Frank, F.; Ortlund, E.; Anderson, E.; Menachery, V. D.; Roupahel, N.; Mehta, A.; Stephens, D. S.; Ahmed, R.; Roback, J. D.; Wrammert, J., Rapid generation of neutralizing antibody responses in COVID-19 patients. *Cell Reports Medicine* **2020**. <https://doi.org/10.1016/j.xcrm.2020.100040>
594. Szablewski, C. M.; Chang, K. T.; Brown, M. M.; al., e., SARS-CoV-2 Transmission and Infection Among Attendees of an Overnight Camp — Georgia, June 2020. *Morbidity and Mortality Weekly Report* **2020**, ePub: 31 July 2020. <https://www.cdc.gov/mmwr/volumes/69/wr/mm6931e1.htm>
595. Tabata, S.; Imai, K.; Kawano, S.; Ikeda, M.; Kodama, T.; Miyoshi, K.; Obinata, H.; Mimura, S.; Kodaera, T.; Kitagaki, M.; Sato, M.; Suzuki, S.; Ito, T.; Uwabe, Y.; Tamura, K., Clinical characteristics of COVID-19 in 104 people with SARS-CoV-2 infection on the Diamond Princess cruise ship: a retrospective analysis. *The Lancet Infectious Diseases*. [https://doi.org/10.1016/S1473-3099\(20\)30482-5](https://doi.org/10.1016/S1473-3099(20)30482-5)
596. Taboada, B.; Vazquez-Perez, J. A.; Muñoz Medina, J. E.; Ramos Cervantes, P.; Escalera-Zamudio, M.; Boukadida, C.; Sanchez-Flores, A.; Isa, P.; Mendieta Condado, E.; Martínez-Orozco, J. A.; Becerril-Vargas, E.; Salas-Hernández, J.; Grande, R.; González-Torres, C.; Gaytán-Cervantes, F. J.; Vazquez, G.; Pulido, F.; Araiza Rodríguez, A.; Garcés Ayala, F.; González Bonilla, C. R.; Grajales Muñiz, C.; Borja Aburto, V. H.; Barrera Badillo, G.; López, S.; Hernández Rivas, L.; Perez-Padilla, R.; López Martínez, I.; Ávila-Ríos, S.; Ruiz-Palacios, G.; Ramírez-González, J. E.; Arias, C. F., Genomic Analysis of Early SARS-CoV-2 Variants Introduced in Mexico. *Journal of Virology* **2020**, JVI.01056-20. <https://jvi.asm.org/content/jvi/early/2020/07/02/JVI.01056-20.full.pdf>
597. Takahashi, T.; Ellingson, M. K.; Wong, P.; Israelow, B.; Lucas, C.; Klein, J.; Silva, J.; Mao, T.; Oh, J. E.; Tokuyama, M.; Lu, P.; Venkataraman, A.; Park, A.; Liu, F.; Meir, A.; Sun, J.; Wang, E. Y.; Casanovas-

- Massana, A.; Wyllie, A. L.; Vogels, C. B. F.; Earnest, R.; Lapidus, S.; Ott, I. M.; Moore, A. J.; Anastasio, K.; Askenase, M. H.; Batsu, M.; Beatty, H.; Bermejo, S.; Bickerton, S.; Brower, K.; Bucklin, M. L.; Cahill, S.; Campbell, M.; Cao, Y.; Courchaine, E.; Datta, R.; Deluliis, G.; Geng, B.; Glick, L.; Handoko, R.; Kalinich, C.; Khoury-Hanold, W.; Kim, D.; Knaggs, L.; Kuang, M.; Kudo, E.; Lim, J.; Linehan, M.; Lu-Culligan, A.; Malik, A. A.; Martin, A.; Matos, I.; McDonald, D.; Minasyan, M.; Mohanty, S.; Muenker, M. C.; Naushad, N.; Nelson, A.; Nouws, J.; Nunez-Smith, M.; Obaid, A.; Ott, I.; Park, H.-J.; Peng, X.; Petrone, M.; Prophet, S.; Rahming, H.; Rice, T.; Rose, K.-A.; Sewanan, L.; Sharma, L.; Shepard, D.; Silva, E.; Simonov, M.; Smolgovsky, M.; Song, E.; Sonnert, N.; Strong, Y.; Todeasa, C.; Valdez, J.; Velazquez, S.; Vijayakumar, P.; Wang, H.; Watkins, A.; White, E. B.; Yang, Y.; Shaw, A.; Fournier, J. B.; Odio, C. D.; Farhadian, S.; Dela Cruz, C.; Grubaugh, N. D.; Schulz, W. L.; Ring, A. M.; Ko, A. I.; Omer, S. B.; Iwasaki, A.; Yale, I. r. t., Sex differences in immune responses that underlie COVID-19 disease outcomes. *Nature* **2020**.
<https://doi.org/10.1038/s41586-020-2700-3>
598. Tan, C. W.; Ho, L. P.; Kalimuddin, S.; Cherng, B. P. Z.; Teh, Y. E.; Thien, S. Y.; Wong, H. M.; Tern, P. J. W.; Chandran, M.; Chay, J. W. M.; Nagarajan, C.; Sultana, R.; Low, J. G. H.; Ng, H. J., Cohort study to evaluate effect of vitamin D, magnesium, and vitamin B12 in combination on severe outcome progression in older patients with coronavirus (COVID-19). *Nutrition* **2020**, 79-80, 111017.
<http://www.sciencedirect.com/science/article/pii/S0899900720303002>
599. Tan, F.; Wang, K.; Liu, J.; Liu, D.; Luo, J.; Zhou, R., Viral Transmission and Clinical Features in Asymptomatic Carriers of SARS-CoV-2 in Wuhan, China. *Frontiers in Medicine* **2020**, 7 (547).
<https://www.frontiersin.org/article/10.3389/fmed.2020.00547>
600. Tan, W.; Lu, Y.; Zhang, J.; Wang, J.; Dan, Y.; Tan, Z.; He, X.; Qian, C.; Sun, Q.; Hu, Q.; Liu, H.; Ye, S.; Xiang, X.; Zhou, Y.; Zhang, W.; Guo, Y.; Wang, X.-H.; He, W.; Wan, X.; Sun, F.; Wei, Q.; Chen, C.; Pan, G.; Xia, J.; Mao, Q.; Chen, Y.; Deng, G., Viral Kinetics and Antibody Responses in Patients with COVID-19. *medRxiv* **2020**, 2020.03.24.20042382.
<https://www.medrxiv.org/content/medrxiv/early/2020/03/26/2020.03.24.20042382.full.pdf>
601. Tass, Russia's Chumakov Center begins clinical trials of its COVID-19 vaccine in St. Petersburg.
<https://tass.com/society/1213793>.
602. Team, D. W., 'Covaxin': Bharat Biotech to begin Phase-III trials of COVID-19 vaccine in UP from October. <https://www.dnaindia.com/india/report-covaxin-bharat-biotech-covid-19-vaccine-phase-3-trials-uttar-pradesh-october-2845194>.
603. Tenforde, M. W.; Kim, S. S.; Lindsell, C. J.; al., e., Symptom Duration and Risk Factors for Delayed Return to Usual Health Among Outpatients with COVID-19 in a Multistate Health Care Systems Network — United States, March–June 2020. *Morbidity and Mortality Weekly Report* **2020**, ePub: 24 July 2020.
604. The Novel Coronavirus Pneumonia Emergency Response Epidemiology, T., The Epidemiological Characteristics of an Outbreak of 2019 Novel Coronavirus Diseases (COVID-19) — China, 2020. *China CDC Weekly* **2020**, 2, 1-10. <http://weekly.chinacdc.cn//article/id/e53946e2-c6c4-41e9-9a9b-fea8db1a8f51>
605. Thomas, P.; Alexander, P. E.; Ahmed, U.; Elderhorst, E.; El-Khechen, H.; Mammen, M. J.; Debono, V. B.; Aponte Torres, Z.; Aryal, K.; Brocard, E.; Sagastuy, B.; Alhazzani, W., Vertical transmission risk of SARS-CoV-2 infection in the third trimester: a systematic scoping review. *The Journal of Maternal-Fetal & Neonatal Medicine* **2020**, 1-8. <https://doi.org/10.1080/14767058.2020.1786055>
606. Thomas, P. R.; Karriker, L. A.; Ramirez, A.; Zhang, J.; Ellingson, J. S.; Crawford, K. K.; Bates, J. L.; Hammen, K. J.; Holtkamp, D. J., Evaluation of time and temperature sufficient to inactivate porcine epidemic diarrhea virus in swine feces on metal surfaces. *Journal of Swine Health and Production* **2015**, 23 (2), 84.
607. Thomas, P. R.; Ramirez, A.; Zhang, J.; Ellingson, J. S.; Myers, J. N., Methods for inactivating PEDV in Hog Trailers. *Animal Industry Report* **2015**, 661 (1), 91.

608. TILLET, R.; SEVINSKY, J.; HARTLEY, P.; KERWIN, H.; CRAWFORD, N.; GORZALSKI, A.; LAVERDURE, C.; VERMA, S.; ROSSETTO, C.; FARRELL, M.; JACKSON, D.; Pandori, M.; VAN HOOSER, S., Genomic Evidence for a Case of Reinfection with SARS-CoV-2. *The Lancet* **2020**.
https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3681489
609. To, K. K.-W.; Tsang, O. T.-Y.; Leung, W.-S.; Tam, A. R.; Wu, T.-C.; Lung, D. C.; Yip, C. C.-Y.; Cai, J.-P.; Chan, J. M.-C.; Chik, T. S.-H., Temporal profiles of viral load in posterior oropharyngeal saliva samples and serum antibody responses during infection by SARS-CoV-2: an observational cohort study. *The Lancet Infectious Diseases* **2020**.
610. Tomazini, B. M.; Maia, I. S.; Cavalcanti, A. B.; Berwanger, O.; Rosa, R. G.; Veiga, V. C.; Avezum, A.; Lopes, R. D.; Bueno, F. R.; Silva, M.; Baldassare, F. P.; Costa, E. L. V.; Moura, R. A. B.; Honorato, M. O.; Costa, A. N.; Damiani, L. P.; Lisboa, T.; Kawano-Dourado, L.; Zampieri, F. G.; Olivato, G. B.; Righy, C.; Amendola, C. P.; Roepke, R. M. L.; Freitas, D. H. M.; Forte, D. N.; Freitas, F. G. R.; Fernandes, C. C. F.; Melro, L. M. G.; Junior, G. F. S.; Morais, D. C.; Zung, S.; Machado, F. R.; Azevedo, L. C. P., Effect of Dexamethasone on Days Alive and Ventilator-Free in Patients With Moderate or Severe Acute Respiratory Distress Syndrome and COVID-19: The CoDEX Randomized Clinical Trial. *Jama* **2020**.
<https://jamanetwork.com/journals/jama/fullarticle/2770277>
611. Treibel, T. A.; Manisty, C.; Burton, M.; McKnight, Á.; Lambourne, J.; Augusto, J. B.; Couto-Parada, X.; Cutino-Moguel, T.; Noursadeghi, M.; Moon, J. C., COVID-19: PCR screening of asymptomatic health-care workers at London hospital. *The Lancet*. [https://doi.org/10.1016/S0140-6736\(20\)31100-4](https://doi.org/10.1016/S0140-6736(20)31100-4)
612. Tsay, C.; Lejarza, F.; Stadtherr, M. A.; Baldea, M., Modeling, state estimation, and optimal control for the US COVID-19 outbreak. *Scientific Reports* **2020**, 10 (1), 10711. <https://doi.org/10.1038/s41598-020-67459-8>
613. Tuebingen, U. H., Safety and Immunogenicity Trial of Multi-peptide Vaccination to Prevent COVID-19 Infection in Adults (pVAC).
<https://clinicaltrials.gov/ct2/show/NCT04546841?term=vaccine&recrs=abdf&cond=COVID-19&phase=0123&sort=nwst&draw=2>.
614. Twin FM, NHS Trials "Unique" New Decontamination Tech to Reduce COVID Transmission Indoors.
<https://www.twinfm.com/article/nhs-trials-unique-new-decontamination-tech-to-reduce-covid-transmission-indoors> (accessed 19 Oct 2020).
615. UCLA, COVID-19 Cases in the United States. <https://covid19.uclaml.org/model.html>.
616. Ulrich, L.; Wernike, K.; Hoffmann, D.; Mettenleiter, T. C.; Beer, M., Experimental infection of cattle with SARS-CoV-2. *bioRxiv* **2020**, 2020.08.25.254474.
<http://biorxiv.org/content/early/2020/08/25/2020.08.25.254474.abstract>
617. Unger, S.; Christie-Holmes, N.; Guvenc, F.; Budykowski, P.; Mubareka, S.; Gray-Owen, S. D.; O'Connor, D. L., Holder pasteurization of donated human milk is effective in inactivating SARS-CoV-2. *Canadian Medical Association Journal* **2020**, cmaj.201309.
<https://www.cmaj.ca/content/cmaj/early/2020/07/09/cmaj.201309.1.full.pdf>
618. University of Washington Medicine, Researchers seek cost-effective way to decontaminate PPE.
<https://newsroom.uw.edu/postscript/researchers-seek-cost-effective-way-decontaminate-ppe> (accessed 05 Oct 2020).
619. Urigo, C.; Soin, S.; Sahu, A., Spontaneous pneumomediastinum as a complication of a COVID-19 related pneumonia: case report and review of literature. *Radiology Case Reports* **2020**, 15 (12), 2577-2581. <http://www.sciencedirect.com/science/article/pii/S1930043320305148>
620. van de Veerdonk, F. L.; Kooijzer, I. J. E.; de Nooijer, A. H.; van der Hoeven, H. G.; Maas, C.; Netea, M. G.; Brüggemann, R. J. M., Outcomes Associated With Use of a Kinin B2 Receptor Antagonist Among Patients With COVID-19. *JAMA Network Open* **2020**, 3 (8), e2017708-e2017708.
<https://doi.org/10.1001/jamanetworkopen.2020.17708>

621. van der Sande, M.; Teunis, P.; Sabel, R., Professional and Home-Made Face Masks Reduce Exposure to Respiratory Infections among the General Population. *Plos One* **2008**, 3 (7). <Go to ISI>://WOS:000264065800020
622. van Doorn, A. S.; Meijer, B.; Frampton, C. M. A.; Barclay, M. L.; de Boer, N. K. H., Systematic review with meta-analysis: SARS-CoV-2 stool testing and the potential for faecal-oral transmission. *Alimentary Pharmacology & Therapeutics* n/a (n/a). <https://onlinelibrary.wiley.com/doi/abs/10.1111/apt.16036>
623. van Doremalen, N.; Bushmaker, T.; Morris, D. H.; Holbrook, M. G.; Gamble, A.; Williamson, B. N.; Tamin, A.; Harcourt, J. L.; Thornburg, N. J.; Gerber, S. I.; Lloyd-Smith, J. O.; de Wit, E.; Munster, V. J., Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1. *New England Journal of Medicine* **2020**. <https://doi.org/10.1056/NEJMc2004973>
624. van Dorp, L.; Acman, M.; Richard, D.; Shaw, L. P.; Ford, C. E.; Ormond, L.; Owen, C. J.; Pang, J.; Tan, C. C. S.; Boshier, F. A. T.; Ortiz, A. T.; Balloux, F., Emergence of genomic diversity and recurrent mutations in SARS-CoV-2. *Infection, Genetics and Evolution* **2020**, 104351. <http://www.sciencedirect.com/science/article/pii/S1567134820301829>
625. Varga, Z.; Flammer, A. J.; Steiger, P.; Haberecker, M.; Andermatt, R.; Zinkernagel, A. S.; Mehra, M. R.; Schuepbach, R. A.; Ruschitzka, F.; Moch, H., Endothelial cell infection and endotheliitis in COVID-19. *The Lancet* **2020**, 395 (10234), 1417-1418. [https://doi.org/10.1016/S0140-6736\(20\)30937-5](https://doi.org/10.1016/S0140-6736(20)30937-5)
626. Vaxart, Safety and Immunogenicity Trial of an Oral SARS-CoV-2 Vaccine (VXA-CoV2-1) for Prevention of COVID-19 in Healthy Adults. <https://clinicaltrials.gov/ct2/show/NCT04563702>.
627. Vaxine, Monovalent Recombinant COVID19 Vaccine (COVAX19). <https://clinicaltrials.gov/ct2/show/NCT04453852?term=NCT04453852&draw=2&rank=1>.
628. Vector, Study of the Safety, Reactogenicity and Immunogenicity of "EpiVacCorona" Vaccine for the Prevention of COVID-19 (EpiVacCorona). <https://clinicaltrials.gov/ct2/show/NCT04527575>.
629. Verdict, Cepheid to develop automated molecular test for coronavirus. Verdict Medical Devices: 2020. <https://www.medicaldevice-network.com/news/cepheid-automated-test-coronavirus/>
630. Verma, S.; Dhanak, M.; Frankenfield, J., Visualizing droplet dispersal for face shields and masks with exhalation valves. *arXiv preprint arXiv:2008.00125* **2020**.
631. Vilke, G. M.; Brennan, J. J.; Cronin, A. O.; Castillo, E. M., Clinical features of covid-19 patients: is temperature screening useful? *The Journal of Emergency Medicine* **2020**. <http://www.sciencedirect.com/science/article/pii/S073646792030977X>
632. Viner, R. M.; Mytton, O. T.; Bonell, C.; Melendez-Torres, G. J.; Ward, J.; Hudson, L.; Waddington, C.; Thomas, J.; Russell, S.; van der Klis, F.; Koirala, A.; Ladhani, S.; Panovska-Griffiths, J.; Davies, N. G.; Booy, R.; Eggo, R. M., Susceptibility to SARS-CoV-2 Infection Among Children and Adolescents Compared With Adults: A Systematic Review and Meta-analysis. *JAMA Pediatrics* **2020**. <https://doi.org/10.1001/jamapediatrics.2020.4573>
633. Viola, I. M.; Peterson, B.; Pisetta, G.; Pavar, G.; Akhtar, H.; Menolascina, F.; Mangano, E.; Dunn, K.; Gabl, R.; Nila, A.; Molinari, E.; Cummins, C.; Thompson, G.; Lo, M.; Denison, F.; Digard, P.; Malik, O.; Dunn, M. J. G.; Mehendale, F., Face Coverings, Aerosol Dispersion and Mitigation of Virus Transmission Risk. *arXiv.org*: 2020.
634. Vivanti, A. J.; Vauloup-Fellous, C.; Prevot, S.; Zupan, V.; Suffee, C.; Do Cao, J.; Benachi, A.; De Luca, D., Transplacental transmission of SARS-CoV-2 infection. *Nature Communications* **2020**, 11 (1), 3572. <https://doi.org/10.1038/s41467-020-17436-6>
635. Vlaar, A. P. J.; de Bruin, S.; Busch, M.; Timmermans, S.; van Zeggeren, I. E.; Koning, R.; Ter Horst, L.; Bulle, E. B.; van Baarle, F.; van de Poll, M. C. G.; Kemper, E. M.; van der Horst, I. C. C.; Schultz, M. J.; Horn, J.; Paulus, F.; Bos, L. D.; Wiersinga, W. J.; Witzenrath, M.; Rueckinger, S.; Pilz, K.; Brouwer, M. C.; Guo, R. F.; Heunks, L.; van Paassen, P.; Riedemann, N. C.; van de Beek, D., Anti-C5a antibody IFX-1 (vilobelimab) treatment versus best supportive care for patients with severe COVID-19 (PANAMO): an exploratory, open-label, phase 2 randomised controlled trial. *Lancet Rheumatol* **2020**.

636. Walsh, K. A.; Jordan, K.; Clyne, B.; Rohde, D.; Drummond, L.; Byrne, P.; Ahern, S.; Carty, P. G.; O'Brien, K. K.; O'Murchu, E.; O'Neill, M.; Smith, S. M.; Ryan, M.; Harrington, P., SARS-CoV-2 Detection, Viral Load and Infectivity over the Course of an Infection: SARS-CoV-2 Detection, Viral Load and Infectivity. *The Journal of infection* **2020**, S0163-4453(20)30449-7.
<https://pubmed.ncbi.nlm.nih.gov/32615199>
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7323671/>
637. Walsh, K. A.; Spillane, S.; Comber, L.; Cardwell, K.; Harrington, P.; Connell, J.; Teljeur, C.; Broderick, N.; de Gascun, C. F.; Smith, S. M.; Ryan, M.; O'Neill, M., The duration of infectiousness of individuals infected with SARS-CoV-2. *Journal of Infection*. <https://doi.org/10.1016/j.jinf.2020.10.009>
638. Wambier, C. G.; Vaño-Galván, S.; McCoy, J.; Gomez-Zubiaur, A.; Herrera, S.; Hermosa-Gelbard, Á.; Moreno-Arrones, O. M.; Jiménez-Gómez, N.; González-Cantero, A.; Pascual, P. F.; Segurado-Miravalles, G.; Shapiro, J.; Pérez-García, B.; Goren, A., Androgenetic Alopecia Present in the Majority of Hospitalized COVID-19 Patients – the “Gabrin sign”. *Journal of the American Academy of Dermatology*. <https://doi.org/10.1016/j.jaad.2020.05.079>
639. Wang, D.; Hu, B.; Hu, C.; Zhu, F.; Liu, X.; Zhang, J.; Wang, B.; Xiang, H.; Cheng, Z.; Xiong, Y.; Zhao, Y.; Li, Y.; Wang, X.; Peng, Z., Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus–Infected Pneumonia in Wuhan, China. *JAMA* **2020**.
<https://doi.org/10.1001/jama.2020.1585>
https://jamanetwork.com/journals/jama/articlepdf/2761044/jama_wang_2020_oi_200019.pdf
640. Wang, D.; Li, R.; Wang, J.; Jiang, Q.; Gao, C.; Yang, J.; Ge, L.; Hu, Q., Correlation analysis between disease severity and clinical and biochemical characteristics of 143 cases of COVID-19 in Wuhan, China: a descriptive study. *BMC Infectious Diseases* **2020**, 20 (1), 519. <https://doi.org/10.1186/s12879-020-05242-w>
641. Wang, D.; You, Y.; Zhou, X.; Zong, Z.; Huang, H.; Zhang, H.; Yong, X.; Cheng, Y.; Yang, L.; Guo, Q.; Long, Y.; Liu, Y.; Huang, J.; Du, L., Selection of homemade mask materials for preventing transmission of COVID-19: a laboratory study. *medRxiv* **2020**.
642. Wang, K.; Zhao, S.; Li, H.; Song, Y.; Wang, L.; Wang, M. H.; Peng, Z.; Li, H.; He, D., Real-time estimation of the reproduction number of the novel coronavirus disease (COVID-19) in China in 2020 based on incidence data. *Annals of Translational Medicine* **2020**, 8 (11), 689.
<http://atm.amegroups.com/article/view/43447>
643. Wang, L.; Didelot, X.; Yang, J.; Wong, G.; Shi, Y.; Liu, W.; Gao, G. F.; Bi, Y., Inference of person-to-person transmission of COVID-19 reveals hidden super-spreading events during the early outbreak phase. *Nature Communications* **2020**, 11 (1), 5006. <https://doi.org/10.1038/s41467-020-18836-4>
644. Wang, S.; Ma, P.; Zhang, S.; Song, S.; Wang, Z.; Ma, Y.; Xu, J.; Wu, F.; Duan, L.; Yin, Z.; Luo, H.; Xiong, N.; Xu, M.; Zeng, T.; Jin, Y., Fasting blood glucose at admission is an independent predictor for 28-day mortality in patients with COVID-19 without previous diagnosis of diabetes: a multi-centre retrospective study. *Diabetologia* **2020**. <https://doi.org/10.1007/s00125-020-05209-1>
645. Wang, W.; Xu, Y.; Gao, R.; Lu, R.; Han, K.; Wu, G.; Tan, W., Detection of SARS-CoV-2 in Different Types of Clinical Specimens. *JAMA* **2020**. <https://doi.org/10.1001/jama.2020.3786>
646. Wang, X.; Ferro, E. G.; Zhou, G.; Hashimoto, D.; Bhatt, D. L., Association Between Universal Masking in a Health Care System and SARS-CoV-2 Positivity Among Health Care Workers. *JAMA* **2020**.
<https://doi.org/10.1001/jama.2020.12897>
647. Wang, X.; Pan, Y.; Zhang, D.; Chen, L.; Jia, L.; Li, X.; Yang, P.; Wang, Q.; Macintyre, C. R., Basic epidemiological parameter values from data of real-world in mega-cities: the characteristics of COVID-19 in Beijing, China. *BMC Infectious Diseases* **2020**, 20 (1), 526. <https://doi.org/10.1186/s12879-020-05251-9>
648. Wang, Y.; Tian, H.; Zhang, L.; Zhang, M.; Guo, D.; Wu, W.; Zhang, X.; Kan, G. L.; Jia, L.; Huo, D.; Liu, B.; Wang, X.; Sun, Y.; Wang, Q.; Yang, P.; MacIntyre, C. R., Reduction of secondary transmission of SARS-

CoV-2 in households by face mask use, disinfection and social distancing: a cohort study in Beijing, China. *BMJ Global Health* **2020**, 5 (5), e002794.

<https://gh.bmj.com/content/bmjgh/5/5/e002794.full.pdf>

649. Wang, Y.; Zhang, D.; Du, G.; Du, R.; Zhao, J.; Jin, Y.; Fu, S.; Gao, L.; Cheng, Z.; Lu, Q.; Hu, Y.; Luo, G.; Wang, K.; Lu, Y.; Li, H.; Wang, S.; Ruan, S.; Yang, C.; Mei, C.; Wang, Y.; Ding, D.; Wu, F.; Tang, X.; Ye, X.; Ye, Y.; Liu, B.; Yang, J.; Yin, W.; Wang, A.; Fan, G.; Zhou, F.; Liu, Z.; Gu, X.; Xu, J.; Shang, L.; Zhang, Y.; Cao, L.; Guo, T.; Wan, Y.; Qin, H.; Jiang, Y.; Jaki, T.; Hayden, F. G.; Horby, P. W.; Cao, B.; Wang, C., Remdesivir in adults with severe COVID-19: a randomised, double-blind, placebo-controlled, multicentre trial. *The Lancet* **2020**, 395 (10236), 1569-1578.

<http://www.sciencedirect.com/science/article/pii/S0140673620310229>

650. Wantai, B., A Phase I Clinical Trial of Influenza virus Vector COVID-19 Vaccine for intranasal Spray (DelNS1-2019-nCoV-RBD-OPT1). <http://www.chictr.org.cn/showprojen.aspx?proj=55421>.

651. WCS, A Tiger at Bronx Zoo Tests Positive for COVID-19; The Tiger and the Zoo's Other Cats Are Doing Well at This Time. [https://newsroom.wcs.org/News-](https://newsroom.wcs.org/News-Releases/articleType/ArticleView/articleId/14010/A-Tiger-at-Bronx-Zoo-Tests-Positive-for-COVID-19-The-Tiger-and-the-Zoos-Other-Cats-Are-Doing-Well-at-This-Time.aspx)

[Releases/articleType/ArticleView/articleId/14010/A-Tiger-at-Bronx-Zoo-Tests-Positive-for-COVID-19-The-Tiger-and-the-Zoos-Other-Cats-Are-Doing-Well-at-This-Time.aspx](https://newsroom.wcs.org/News-Releases/articleType/ArticleView/articleId/14010/A-Tiger-at-Bronx-Zoo-Tests-Positive-for-COVID-19-The-Tiger-and-the-Zoos-Other-Cats-Are-Doing-Well-at-This-Time.aspx) (accessed April 6, 2020).

652. Webb, B. J.; Peltan, I. D.; Jensen, P.; Hoda, D.; Hunter, B.; Silver, A.; Starr, N.; Buckel, W.; Grisel, N.; Hummel, E.; Snow, G.; Morris, D.; Stenehjem, E.; Srivastava, R.; Brown, S. M., Clinical criteria for COVID-19-associated hyperinflammatory syndrome: a cohort study. *The Lancet Rheumatology* **2020**.

<http://www.sciencedirect.com/science/article/pii/S266599132030343X>

653. Wei, W. E.; Li, Z.; Chiew, C. J.; Yong, S. E.; Toh, M. P.; Lee, V. J., Presymptomatic transmission of SARS-CoV-2 - Singapore, January 23 - March 16, 2020. *Morbidity and Mortality Weekly Report* **2020**, ePub (1 April 2020). <https://www.cdc.gov/mmwr/volumes/69/wr/mm6914e1.htm>

654. Wei, Y.; Wei, L.; Liu, Y.; Huang, L.; Shen, S.; Zhang, R.; Chen, J.; Zhao, Y.; Shen, H.; Chen, F., A systematic review and meta-analysis reveals long and dispersive incubation period of COVID-19. *medRxiv* **2020**, 2020.06.20.20134387.

<https://www.medrxiv.org/content/medrxiv/early/2020/06/22/2020.06.20.20134387.full.pdf>

655. Weill, J. A.; Stigler, M.; Deschenes, O.; Springborn, M. R., Social distancing responses to COVID-19 emergency declarations strongly differentiated by income. *Proceedings of the National Academy of Sciences* **2020**, 202009412. <https://www.pnas.org/content/pnas/early/2020/07/28/2009412117.full.pdf>

656. Weissman, D.; Alameh, M.-G.; Silva, T. d.; Collini, P.; Hornsby, H.; Brown, R.; LaBranche, C. C.; Edwards, R. J.; Sutherland, L.; Santra, S.; Mansouri, K.; Gobeil, S.; McDanal, C.; Pardi, N.; Hengartner, N.; Lin, P. J. C.; Tam, Y.; Shaw, P. A.; Lewis, M. G.; Boesler, C.; Şahin, U.; Acharya, P.; Haynes, B. F.; Korber, B.; Montefiori, D. C., D614G Spike Mutation Increases SARS CoV-2 Susceptibility to Neutralization.

<https://www.medrxiv.org/content/10.1101/2020.07.22.20159905v2.full.pdf>.

657. Weissman, D. N.; de Perio, M. A.; Radonovich, L. J., Jr, COVID-19 and Risks Posed to Personnel During Endotracheal Intubation. *JAMA* **2020**. <https://doi.org/10.1001/jama.2020.6627>

658. Wellinghausen, N.; Plonné, D.; Voss, M.; Ivanova, R.; Frodl, R.; Deininger, S., SARS-CoV-2-IgG response is different in COVID-19 outpatients and asymptomatic contact persons. *Journal of Clinical Virology* **2020**, 130, 104542. <http://www.sciencedirect.com/science/article/pii/S1386653220302845>

659. Westblade, L. F.; Brar, G.; Pinheiro, L. C.; Paidoussis, D.; Rajan, M.; Martin, P.; Goyal, P.; Sepulveda, J. L.; Zhang, L.; George, G.; Liu, D.; Whittier, S.; Plate, M.; Small, C. B.; Rand, J. H.; Cushing, M. M.; Walsh, T. J.; Cooke, J.; Safford, M. M.; Loda, M.; Satlin, M. J., SARS-CoV-2 Viral Load Predicts Mortality in Patients with and Without Cancer Who Are Hospitalized with COVID-19. *Cancer Cell* **2020**.

<http://www.sciencedirect.com/science/article/pii/S1535610820304815>

660. Whitman, J. D.; Hiatt, J.; Mowrey, C. T.; al., e., Test performance evaluation of SARS-CoV-2 serological assays. *Unpublished Preprint* **2020**. https://www.dropbox.com/s/cd1628cau09288a/SARS-CoV-2_Serology_Manuscript.pdf?dl=0

661. Whitworth, J., U.S. FDA 'aware' of China testing food for coronavirus.
<https://www.foodsafetynews.com/2020/06/u-s-fda-aware-of-china-testing-food-for-coronavirus/>
(accessed 06/22/2020).
662. WHO, *Advice on the use of masks on the context of COVID-19. Interim Guidance. 5 June 2020.*;
World Health Organization: 2020. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/when-and-how-to-use-masks>
663. WHO, Draft landscape of COVID-19 candidate vaccines.
<https://www.who.int/publications/m/item/draft-landscape-of-covid-19-candidate-vaccines> (accessed 9/22/2020).
664. WHO, "Immunity passports" in the context of COVID-19; World Health Organization: 2020.
<https://www.who.int/news-room/commentaries/detail/immunity-passports-in-the-context-of-covid-19>
665. WHO, *Infection prevention and control during health care when novel coronavirus (nCoV) infection is suspected*; 2020. <https://www.who.int/publications-detail/infection-prevention-and-control-during-health-care-when-novel-coronavirus-ncov-infection-is-suspected-20200125>
666. WHO, Laboratory testing for 2019 novel coronavirus (2019-nCoV) in suspected human cases.
667. WHO, Multisystem inflammatory syndrome in children and adolescents temporally related to COVID-19. World Health Organization: 2020. <https://www.who.int/news-room/commentaries/detail/multisystem-inflammatory-syndrome-in-children-and-adolescents-with-covid-19>
668. WHO, *Transmission of SARS-CoV-2: implications for infection prevention precautions*; World Health Organization: 2020. <https://www.who.int/news-room/commentaries/detail/transmission-of-sars-cov-2-implications-for-infection-prevention-precautions>
669. Wiersinga, W. J.; Rhodes, A.; Cheng, A. C.; Peacock, S. J.; Prescott, H. C., Pathophysiology, Transmission, Diagnosis, and Treatment of Coronavirus Disease 2019 (COVID-19): A Review. *JAMA* **2020**. <https://doi.org/10.1001/jama.2020.12839>
670. Wise, J., Covid-19: Remdesivir is recommended for authorisation by European Medicines Agency. *Bmj* **2020**, 369, m2610.
671. Wölfel, R.; Corman, V. M.; Guggemos, W.; Seilmaier, M.; Zange, S.; Müller, M. A.; Niemeyer, D.; Jones, T. C.; Vollmar, P.; Rothe, C.; Hoelscher, M.; Bleicker, T.; Brünink, S.; Schneider, J.; Ehmann, R.; Zwirgmaier, K.; Drosten, C.; Wendtner, C., Virological assessment of hospitalized patients with COVID-2019. *Nature* **2020**. <https://doi.org/10.1038/s41586-020-2196-x>
672. Wong, M. C.; Javornik Cregeen, S. J.; Ajami, N. J.; Petrosino, J. F., Evidence of recombination in coronaviruses implicating pangolin origins of nCoV-2019. *bioRxiv* **2020**, 2020.02.07.939207. <https://www.biorxiv.org/content/biorxiv/early/2020/02/13/2020.02.07.939207.full.pdf>
673. Wong, Y. C.; Lau, S. Y.; Wang To, K. K.; Mok, B. W. Y.; Li, X.; Wang, P.; Deng, S.; Woo, K. F.; Du, Z.; Li, C.; Zhou, J.; Woo Chan, J. F.; Yuen, K. Y.; Chen, H.; Chen, Z., Natural transmission of bat-like SARS-CoV-2 PRRA variants in COVID-19 patients. *Clinical Infectious Diseases* **2020**. <https://doi.org/10.1093/cid/ciaa953>
674. Woolf, S. H.; Chapman, D. A.; Sabo, R. T.; Weinberger, D. M.; Hill, L., Excess Deaths From COVID-19 and Other Causes, March-April 2020. *JAMA* **2020**. <https://doi.org/10.1001/jama.2020.11787>
675. Woolsey, C. B.; Borisevich, V.; Prasad, A. N.; Agans, K. N.; Deer, D. J.; Dobias, N. S.; Heymann, J. C.; Foster, S. L.; Levine, C. B.; Medina, L.; Melody, K.; Geisbert, J. B.; Fenton, K. A.; Geisbert, T. W.; Cross, R. W., Establishment of an African green monkey model for COVID-19. *bioRxiv* **2020**, 2020.05.17.100289. <http://biorxiv.org/content/early/2020/05/17/2020.05.17.100289.abstract>
676. Worobey, M.; Pekar, J.; Larsen, B. B.; Nelson, M. I.; Hill, V.; Joy, J. B.; Rambaut, A.; Suchard, M. A.; Wertheim, J. O.; Lemey, P., The emergence of SARS-CoV-2 in Europe and the US. *bioRxiv* **2020**, 2020.05.21.109322. <https://www.biorxiv.org/content/biorxiv/early/2020/05/23/2020.05.21.109322.full.pdf>

677. Worthham, J. M.; Lee, J. T.; Althomsons, S.; al., e., Characteristics of Persons Who Died with COVID-19 — United States, February 12–May 18, 2020. *Morbidity and Mortality Weekly Report* **2020**, ePub: July 10, 2020 (69). <https://www.cdc.gov/mmwr/volumes/69/wr/mm6928e1.htm>
678. Wrapp, D.; Wang, N.; Corbett, K. S.; Goldsmith, J. A.; Hsieh, C.-L.; Abiona, O.; Graham, B. S.; McLellan, J. S., Cryo-EM Structure of the 2019-nCoV Spike in the Prefusion Conformation. *bioRxiv* **2020**, 2020.02.11.944462.
<https://www.biorxiv.org/content/biorxiv/early/2020/02/15/2020.02.11.944462.full.pdf>
679. Wright, E. S.; Lakdawala, S. S.; Cooper, V. S., SARS-CoV-2 genome evolution exposes early human adaptations. *bioRxiv* **2020**, 2020.05.26.117069.
<https://www.biorxiv.org/content/biorxiv/early/2020/05/26/2020.05.26.117069.full.pdf>
680. Wu, F.; Wang, A.; Liu, M.; Wang, Q.; Chen, J.; Xia, S.; Ling, Y.; Zhang, Y.; Xun, J.; Lu, L.; Jiang, S.; Lu, H.; Wen, Y.; Huang, J., Neutralizing antibody responses to SARS-CoV-2 in a COVID-19 recovered patient cohort and their implications. *medRxiv* **2020**, 2020.03.30.20047365.
<https://www.medrxiv.org/content/medrxiv/early/2020/04/06/2020.03.30.20047365.full.pdf>
681. Wu, G.; Yang, P.; Xie, Y.; Woodruff, H. C.; Rao, X.; Guiot, J.; Frix, A.-N.; Louis, R.; Moutschen, M.; Li, J.; Li, J.; Yan, C.; Du, D.; Zhao, S.; Ding, Y.; Liu, B.; Sun, W.; Albarello, F.; D'Abramo, A.; Schininà, V.; Nicastri, E.; Occhipinti, M.; Barisione, G.; Barisione, E.; Halilaj, I.; Lovinfosse, P.; Wang, X.; Wu, J.; Lambin, P., Development of a Clinical Decision Support System for Severity Risk Prediction and Triage of COVID-19 Patients at Hospital Admission: an International Multicenter Study. *European Respiratory Journal* **2020**, 2001104. <https://erj.ersjournals.com/content/erj/early/2020/06/25/13993003.01104-2020.full.pdf>
682. Wu, H.; Zhu, H.; Yuan, C.; Yao, C.; Luo, W.; Shen, X.; Wang, J.; Shao, J.; Xiang, Y., Clinical and Immune Features of Hospitalized Pediatric Patients With Coronavirus Disease 2019 (COVID-19) in Wuhan, China. *JAMA Network Open* **2020**, 3 (6), e2010895-e2010895.
<https://doi.org/10.1001/jamanetworkopen.2020.10895>
683. Wu, J. T.; Leung, K.; Leung, G. M., Nowcasting and forecasting the potential domestic and international spread of the 2019-nCoV outbreak originating in Wuhan, China: a modelling study. *The Lancet* **2020**. [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(20\)30260-9/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)30260-9/fulltext)
684. Wu, L.-P.; Wang, N.-C.; Chang, Y.-H.; Tian, X.-Y.; Na, D.-Y.; Zhang, L.-Y.; Zheng, L.; Lan, T.; Wang, L.-F.; Liang, G.-D., Duration of antibody responses after severe acute respiratory syndrome. *Emerging infectious diseases* **2007**, 13 (10), 1562.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2851497/pdf/07-0576_finalD.pdf
685. Wu, P.; Duan, F.; Luo, C.; Liu, Q.; Qu, X.; Liang, L.; Wu, K., Characteristics of Ocular Findings of Patients With Coronavirus Disease 2019 (COVID-19) in Hubei Province, China. *JAMA Ophthalmology* **2020**. <https://doi.org/10.1001/jamaophthalmol.2020.1291>
686. Xiao, K.; Zhai, J.; Feng, Y.; Zhou, N.; Zhang, X.; Zou, J. J.; Li, N.; Guo, Y.; Li, X.; Shen, X.; Zhang, Z.; Shu, F.; Huang, W.; Li, Y.; Zhang, Z.; Chen, R. A.; Wu, Y. J.; Peng, S. M.; Huang, M.; Xie, W. J.; Cai, Q. H.; Hou, F. H.; Chen, W.; Xiao, L.; Shen, Y., Isolation of SARS-CoV-2-related coronavirus from Malayan pangolins. *Nature* **2020**.
687. Xinhua, China detects large quantity of novel coronavirus at Wuhan seafood market
http://www.xinhuanet.com/english/2020-01/27/c_138735677.htm.
688. Xinhua, COVID-19 vaccine candidate produced from insect cells to enter human trials.
http://en.nhc.gov.cn/2020-08/26/c_81483.htm.
689. Xu, X. K.; Liu, X. F.; Wu, Y.; Ali, S. T.; Du, Z.; Bosetti, P.; Lau, E. H. Y.; Cowling, B. J.; Wang, L., Reconstruction of Transmission Pairs for novel Coronavirus Disease 2019 (COVID-19) in mainland China: Estimation of Super-spreading Events, Serial Interval, and Hazard of Infection. *Clin Infect Dis* **2020**.

690. Yan, C. H.; Faraji, F.; Prajapati, D. P.; Boone, C. E.; DeConde, A. S., In *Association of chemosensory dysfunction and Covid-19 in patients presenting with influenza-like symptoms*, International Forum of Allergy & Rhinology, Wiley Online Library: 2020.
691. Yan, L.; Shu, K.; Guan, J.; Shanchang, H., Unusual Features of the SARS-CoV-2 Genome Suggesting Sophisticated Laboratory Modification Rather Than Natural Evolution and Delineation of Its Probable Synthetic Route. *Zenodo* **2020**. <https://zenodo.org/record/4028830#.X3JdatpKiUn>
692. Yang, L.; Dai, J.; Zhao, J.; Wang, Y.; Deng, P.; Wang, J., Estimation of incubation period and serial interval of COVID-19: analysis of 178 cases and 131 transmission chains in Hubei province, China. *Epidemiology and Infection* **2020**, 148, e117. <https://www.cambridge.org/core/article/estimation-of-incubation-period-and-serial-interval-of-covid19-analysis-of-178-cases-and-131-transmission-chains-in-hubei-province-china/C1B194C01268F005AAFB8D50CB5F945>
693. Yang, P.; Qi, J.; Zhang, S.; Bi, G.; Wang, X.; Yang, Y.; Sheng, B.; Mao, X., Feasibility of Controlling COVID-19 Outbreaks in the UK by Rolling Interventions. *medRxiv* **2020**, 2020.04.05.20054429. <https://www.medrxiv.org/content/medrxiv/early/2020/04/07/2020.04.05.20054429.full.pdf>
694. Yap, T. F.; Liu, Z.; Shveda, R. A.; Preston, D. J., A predictive model of the temperature-dependent inactivation of coronaviruses. *Applied Physics Letters* **2020**, 117 (6), 060601. <https://aip.scitation.org/doi/abs/10.1063/5.0020782>
695. Yehya, N.; Venkataramani, A.; Harhay, M. O., Statewide Interventions and Covid-19 Mortality in the United States: An Observational Study. *Clinical Infectious Diseases* **2020**. <https://doi.org/10.1093/cid/cia923>
696. Yonker, L. M.; Neilan, A. M.; Bartsch, Y.; Patel, A. B.; Regan, J.; Arya, P.; Gootkind, E.; Park, G.; Hardcastle, M.; St. John, A.; Appleman, L.; Chiu, M. L.; Fialkowski, A.; De la Flor, D.; Lima, R.; Bordt, E. A.; Yockey, L. J.; D'Avino, P.; Fischinger, S.; Shui, J. E.; Lerou, P. H.; Bonventre, J. V.; Yu, X. G.; Ryan, E. T.; Bassett, I. V.; Irimia, D.; Edlow, A. G.; Alter, G.; Li, J. Z.; Fasano, A., Pediatric SARS-CoV-2: Clinical Presentation, Infectivity, and Immune Responses. *The Journal of Pediatrics* **2020**. <https://doi.org/10.1016/j.jpeds.2020.08.037>
697. Young, B. E.; Fong, S.-W.; Chan, Y.-H.; Mak, T.-M.; Ang, L. W.; Anderson, D. E.; Lee, C. Y.-P.; Amrun, S. N.; Lee, B.; Goh, Y. S.; Su, Y. C. F.; Wei, W. E.; Kalimuddin, S.; Chai, L. Y. A.; Pada, S.; Tan, S. Y.; Sun, L.; Parthasarathy, P.; Chen, Y. Y. C.; Barkham, T.; Lin, R. T. P.; Maurer-Stroh, S.; Leo, Y.-S.; Wang, L.-F.; Renia, L.; Lee, V. J.; Smith, G. J. D.; Lye, D. C.; Ng, L. F. P., Effects of a major deletion in the SARS-CoV-2 genome on the severity of infection and the inflammatory response: an observational cohort study. *The Lancet* **2020**. [https://doi.org/10.1016/S0140-6736\(20\)31757-8](https://doi.org/10.1016/S0140-6736(20)31757-8)
698. Yu, B.; Li, C.; Chen, P.; Zhou, N.; Wang, L.; Li, J.; Jiang, H.; Wang, D. W., Low dose of hydroxychloroquine reduces fatality of critically ill patients with COVID-19. *Sci China Life Sci* **2020**, 1-7.
699. Yu, W.-B.; Tang, G.-D.; Zhang, L.; Corlett, R. T., Decoding evolution and transmissions of novel pneumonia coronavirus using the whole genomic data. *ChinaXiv* **2020**. <http://www.chinaxiv.org/abs/202002.00033>
700. Yuki, F.; Eiichiro, S.; Naho, T.; Reiko, M.; Ikkoh, Y.; Yura, K. K.; Mayuko, S.; Konosuke, M.; Takeaki, I.; Yugo, S.; Shohei, N.; Kazuaki, J.; Tadatsugu, I.; Tomimasa, S.; Motoi, S.; Hiroshi, N.; Hitoshi, O., Clusters of Coronavirus Disease in Communities, Japan, January–April 2020. *Emerging Infectious Disease journal* **2020**, 26 (9). https://wwwnc.cdc.gov/eid/article/26/9/20-2272_article
701. Zangmeister, C. D.; Radney, J. G.; Vicenzi, E. P.; Weaver, J. L., Filtration Efficiencies of Nanoscale Aerosol by Cloth Mask Materials Used to Slow the Spread of SARS CoV-2. *ACS Nano* **2020**. <https://doi.org/10.1021/acsnano.0c05025>
702. Zhan, C.; Chi, K. T.; Lai, Z.; Chen, X.; Mo, M., General Model for COVID-19 Spreading with Consideration of Intercity Migration, Insufficient Testing and Active Intervention: Application to Study of Pandemic Progression in Japan and USA. *medRxiv* **2020**.

703. Zhang, J.; Litvinova, M.; Liang, Y.; Wang, Y.; Wang, W.; Zhao, S.; Wu, Q.; Merler, S.; Viboud, C.; Vespignani, A.; Ajelli, M.; Yu, H., Changes in contact patterns shape the dynamics of the COVID-19 outbreak in China. *Science* **2020**, eabb8001.
<https://science.sciencemag.org/content/sci/early/2020/05/04/science.abb8001.full.pdf>
704. Zhang, J.; Wu, J.; Sun, X.; Xue, H.; Shao, J.; Cai, W.; Jing, Y.; Yue, M.; Dong, C., Associations of hypertension with the severity and fatality of SARS-CoV-2 infection: A meta-analysis. *Epidemiology and Infection* **2020**, 1-19. <https://www.cambridge.org/core/article/associations-of-hypertension-with-the-severity-and-fatality-of-sarscov2-infection-a-metaanalysis/4116FAD7D866737099F976E7E7FAEB15>
705. Zhang, L.; Jackson, C. B.; Mou, H.; Ojha, A.; Rangarajan, E. S.; Izard, T.; Farzan, M.; Choe, H., The D614G mutation in the SARS-CoV-2 spike protein reduces S1 shedding and increases infectivity. *bioRxiv* **2020**, 2020.06.12.148726. <http://biorxiv.org/content/early/2020/06/12/2020.06.12.148726.abstract>
706. Zhang, Q.; Zhang, H.; Huang, K.; Yang, Y.; Hui, X.; Gao, J.; He, X.; Li, C.; Gong, W.; Zhang, Y.; Peng, C.; Gao, X.; Chen, H.; Zou, Z.; Shi, Z.; Jin, M., SARS-CoV-2 neutralizing serum antibodies in cats: a serological investigation. *bioRxiv* **2020**, 2020.04.01.021196.
<http://biorxiv.org/content/early/2020/04/03/2020.04.01.021196.abstract>
707. Zhang, T.; Wu, Q.; Zhang, Z., Probable Pangolin Origin of SARS-CoV-2 Associated with the COVID-19 Outbreak. *Current Biology* **2020**, 30 (7), 1346-1351.e2.
<http://www.sciencedirect.com/science/article/pii/S0960982220303602>
708. Zhang, X.; Tan, Y.; Ling, Y.; Lu, G.; Liu, F.; Yi, Z.; Jia, X.; Wu, M.; Shi, B.; Xu, S.; Chen, J.; Wang, W.; Chen, B.; Jiang, L.; Yu, S.; Lu, J.; Wang, J.; Xu, M.; Yuan, Z.; Zhang, Q.; Zhang, X.; Zhao, G.; Wang, S.; Chen, S.; Lu, H., Viral and host factors related to the clinical outcome of COVID-19. *Nature* **2020**.
<https://doi.org/10.1038/s41586-020-2355-0>
709. Zhang, Y.; Muscatello, D.; Tian, Y.; Chen, Y.; Li, S.; Duan, W.; Ma, C.; Sun, Y.; Wu, S.; Ge, L.; Yang, P.; Jia, L.; Wang, Q.; MacIntyre, C. R., Role of presymptomatic transmission of COVID-19: evidence from Beijing, China. *Journal of Epidemiology and Community Health* **2020**, jech-2020-214635.
<https://jech.bmj.com/content/jech/early/2020/08/26/jech-2020-214635.full.pdf>
710. Zhao; Musa; Lin; Ran; Yang; Wang; Lou; Yang; Gao; He; Wang, Estimating the Unreported Number of Novel Coronavirus (2019-nCoV) Cases in China in the First Half of January 2020: A Data-Driven Modelling Analysis of the Early Outbreak. *Journal of Clinical Medicine* **2020**, 9 (2), 388.
711. Zhao, G.; Jiang, Y.; Qiu, H.; Gao, T.; Zeng, Y.; Guo, Y.; Yu, H.; Li, J.; Kou, Z.; Du, L.; Tan, W.; Jiang, S.; Sun, S.; Zhou, Y., Multi-Organ Damage in Human Dipeptidyl Peptidase 4 Transgenic Mice Infected with Middle East Respiratory Syndrome-Coronavirus. *PLoS One* **2015**, 10 (12), e0145561.
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4689477/pdf/pone.0145561.pdf>
712. Zhao, J.; Yuan, Q.; Wang, H.; Liu, W.; Liao, X.; Su, Y.; Wang, X.; Yuan, J.; Li, T.; Li, J.; Qian, S.; Hong, C.; Wang, F.; Liu, Y.; Wang, Z.; He, Q.; He, B.; Zhang, T.; Ge, S.; Liu, L.; Zhang, J.; Xia, N.; Zhang, Z., Antibody Responses to SARS-CoV-2 in Patients of Novel Coronavirus Disease 2019. *SSRN* **2020**.
https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3546052#
713. Zhao, L.; Qi, Y.; Luzzatto-Fegiz, P.; Cui, Y.; Zhu, Y., COVID-19: Effects of Environmental Conditions on the Propagation of Respiratory Droplets. *Nano Letters* **2020**, 20 (10), 7744-7750.
<https://doi.org/10.1021/acs.nanolett.0c03331>
714. Zhen-Dong, T.; An, T.; Ke-Feng, L.; Peng, L.; Hong-Ling, W.; Jing-Ping, Y.; Yong-Li, Z.; Jian-Bo, Y., Potential Presymptomatic Transmission of SARS-CoV-2, Zhejiang Province, China, 2020. *Emerging Infectious Disease journal* **2020**, 26 (5). https://wwwnc.cdc.gov/eid/article/26/5/20-0198_article
715. Zhongchu, L., The sixth press conference of "Prevention and Control of New Coronavirus Infected Pneumonia". Hubei Provincial Government: 2020.
http://www.hubei.gov.cn/hbfb/xwfbh/202001/t20200128_2015591.shtml
716. Zhou, F.; Yu, T.; Du, R.; Fan, G.; Liu, Y.; Liu, Z.; Xiang, J.; Wang, Y.; Song, B.; Gu, X.; Guan, L.; Wei, Y.; Li, H.; Wu, X.; Xu, J.; Tu, S.; Zhang, Y.; Chen, H.; Cao, B., Clinical course and risk factors for mortality of

adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. *The Lancet*.

[https://doi.org/10.1016/S0140-6736\(20\)30566-3](https://doi.org/10.1016/S0140-6736(20)30566-3)

717. Zhou, H.; Chen, X.; Hu, T.; Li, J.; Song, H.; Liu, Y.; Wang, P.; Liu, D.; Yang, J.; Holmes, E. C.; Hughes, A. C.; Bi, Y.; Shi, W., A novel bat coronavirus reveals natural insertions at the S1/S2 cleavage site of the Spike protein and a possible recombinant origin of HCoV-19. *bioRxiv* **2020**, 2020.03.02.974139.

<https://www.biorxiv.org/content/biorxiv/early/2020/03/11/2020.03.02.974139.full.pdf>

718. Zhou, P.; Yang, X.-L.; Wang, X.-G.; Hu, B.; Zhang, L.; Zhang, W.; Si, H.-R.; Zhu, Y.; Li, B.; Huang, C.-L.; Chen, H.-D.; Chen, J.; Luo, Y.; Guo, H.; Jiang, R.-D.; Liu, M.-Q.; Chen, Y.; Shen, X.-R.; Wang, X.; Zheng, X.-S.; Zhao, K.; Chen, Q.-J.; Deng, F.; Liu, L.-L.; Yan, B.; Zhan, F.-X.; Wang, Y.-Y.; Xiao, G.; Shi, Z.-L., Discovery of a novel coronavirus associated with the recent pneumonia outbreak in humans and its potential bat origin. *bioRxiv* **2020**, 2020.01.22.914952.

<https://www.biorxiv.org/content/biorxiv/early/2020/01/23/2020.01.22.914952.1.full.pdf>

719. Zhu, F.-C.; Guan, X.-H.; Li, Y.-H.; Huang, J.-Y.; Jiang, T.; Hou, L.-H.; Li, J.-X.; Yang, B.-F.; Wang, L.; Wang, W.-J.; Wu, S.-P.; Wang, Z.; Wu, X.-H.; Xu, J.-J.; Zhang, Z.; Jia, S.-Y.; Wang, B.-S.; Hu, Y.; Liu, J.-J.; Zhang, J.; Qian, X.-A.; Li, Q.; Pan, H.-X.; Jiang, H.-D.; Deng, P.; Gou, J.-B.; Wang, X.-W.; Wang, X.-H.; Chen, W., Immunogenicity and safety of a recombinant adenovirus type-5-vectored COVID-19 vaccine in healthy adults aged 18 years or older: a randomised, double-blind, placebo-controlled, phase 2 trial. *The Lancet* **2020**. [https://doi.org/10.1016/S0140-6736\(20\)31605-6](https://doi.org/10.1016/S0140-6736(20)31605-6)

720. Zhu, S.; Zong, Z., Why did so few healthcare workers in China get COVID-19 infection. *QJM: An International Journal of Medicine* **2020**.

721. Zhu, Y.; Chen, Y. Q., On a Statistical Transmission Model in Analysis of the Early Phase of COVID-19 Outbreak. *Statistics in Biosciences* **2020**, 1-17.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7113380/>

722. Zimmer, C.; Thomas, K.; Mueller, B., AstraZeneca Partly Resumes Coronavirus Vaccine Trial After Halting It for Safety. <https://www.nytimes.com/2020/09/12/health/astrazeneca-coronavirus-vaccine-trial-resumes.html>.

723. Zou, L.; Ruan, F.; Huang, M.; Liang, L.; Huang, H.; Hong, Z.; Yu, J.; Kang, M.; Song, Y.; Xia, J.; Guo, Q.; Song, T.; He, J.; Yen, H.-L.; Peiris, M.; Wu, J., SARS-CoV-2 Viral Load in Upper Respiratory Specimens of Infected Patients. *New England Journal of Medicine* **2020**.

<https://www.nejm.org/doi/full/10.1056/NEJMc2001737>

724. Zydus, Novel Corona Virus-2019-nCov vaccine by intradermal route in healthy subjects. .

<http://ctri.nic.in/Clinicaltrials/pmaindet2.php?trialid=45306&Enchid=&userName=vaccine>.