### What do we know?

- The human infectious dose for novel Wuhan coronavirus (SARS-CoV-2), which causes coronavirus disease 19 (COVID-19) is currently unknown via all exposure routes. Severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS) coronaviruses (CoV) are used as surrogates.
- The infectious dose for SARS in mice is estimated to be between 67-540 PFU (average 240 PFU, intranasal route).50-51
- Genetically modified mice exposed intranasally to doses of MERS virus (as of 3/4/2020).68
- There are 153 SARS-CoV-2 cases across 15 US states, with 11 deaths. (as of 3/4/2020).48
- Sustained transmission may have occurred in the US (Seattle) for up to 5 or 6 weeks.14
- SARS-CoV-2 transmission has occurred in hospitals inside and outside of China,33 including the US.17
- Pre-symptomatic10 or asymptomatic patients in China can transmit SARS-CoV-2; the degree of asymptomatic transmission is still unknown.
- SARS-CoV-2 is believed to spread through close contact and droplet transmission.39
- Viable SARS-CoV-2 has been isolated from human feces; fecal-oral transmission is possible.104
- Transmission via fomites has not been confirmed for SARS-CoV-2, but occurred in prior SARS40,121 and MERS99 outbreaks
- SARS-CoV-2 is consistently present in infected patient saliva104
- Infants have been diagnosed with COVID-19, but no evidence exists for vertical transmission via intrauterine infection or through breastmilk.38,109
- China reports no evidence of super-spreading events (SSSEs) within hospital patients or staff.101

### Transmissibility – How does it spread from one host to another? How easily is it spread?

- The WHO has declared SARS-CoV-2 a Public Health Emergency of International Concern116 with 95,124 cases and 3,254 deaths49 in 75 countries (as of 3/4/2020).22,96,114
- High-quality estimates of human transmissibility (R0) range from 2.2 to 3.1,96,91,120,118
- Large outbreaks are occurring in Japan, Italy, Iran, South Korea, Germany, France, and Spain.110
- There are 153 SARS-CoV-2 cases across 15 US states, with 11 deaths. (as of 3/4/2020).48
- Sustained transmission may have occurred in the US (Seattle) for up to 5 or 6 weeks.14
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### Host range – How many species does it infect? Can it transfer from species to species?

- Early genomic analysis indicates similarity to SARS132 with a suggested bat origin.54,132
- Analysis of SARS-CoV-2 genomes suggests that a non-bat intermediate species is responsible for the beginning of the outbreak.92
- Although the identity of the intermediate species remains unconfirmed, pangolins may be a natural host of related viruses possibly including SARS-CoV-2.76-77
- Positive samples from the South China Seafood Market strongly suggests a wildlife source,12 though it is possible that the virus was circulating in humans before the disease was associated with the seafood market.15,43,122,126
- Experiments suggest that SARS-CoV-2 Spike (S) receptor-binding domain binds the human cell receptor (ACE2) stronger than SARS,113 potentially explaining its high transmissibility; the same work suggests that differences between SARS-CoV-2 and SARS-CoV Spike proteins may limit the therapeutic ability of SARS antibody treatments.119
- Modeling between SARS-CoV-2 Spike and ACE2 proteins suggests that SARS-CoV-2 can bind and infect human, bat, civet, monkey and swine cells.107

### Incubation period – How long after infection do symptoms appear? Are people infectious during this time?

- A study of 1,099 COVID-19 patients found a median incubation period of 3 days, with a range from 0 to 24 days.37
- Earlier estimates of the incubation period from confirmed cases were higher; 5.8 days with a range from 1.3 to 11.3 days,6 and 5.2 days with an upper bound of 9.2-18 days.75
- CDC estimates that the incubation period is between 2 and 14 days27,31
- Asymptomatic infection has been documented, where individuals do not present with clinical symptoms but are found positive via diagnostic assay.10,34,57,101,130
- Individuals can be infectious while asymptomatic,30,91,101,130 and asymptomatic individuals have about the same amount of virus in their nose and throat as symptomatic individuals.133
- Infectious period is unknown, but possibly up to 10-14 days4,96
- On average, there are 7.5 days between symptom onset in successive cases of a single transmission chain (i.e., the serial interval).75
- The average time for individuals to first seek medical care decreased from 5.8 days after symptom onset to 4.6 days before and after January 1st, 2020, respectively, indicating an increase in seeking care behavior.75
- China recommends 14 quarantine for recovered patients due to positive genetic tests days after leaving the hospital, raising the possibility of continued transmission after symptoms subside.104
### What do we need to know?

<table>
<thead>
<tr>
<th>SARS-CoV-2 (COVID-19)</th>
<th>Infectious dose – how much agent will make a normal individual ill?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Human infectious dose by aerosol route</td>
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<td></td>
<td>• Human infectious dose by surface contact (fomite)</td>
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<tr>
<td></td>
<td>• Human infectious dose by fecal-oral route</td>
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<td></td>
<td>• Where does SARS-CoV-2 replicate in the respiratory tract?</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Transmissibility – How does it spread from one host to another? How easily is it spread?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Capability of SARS-CoV-2 to be transmitted by contact with fomites (doorknobs, surfaces, clothing, etc.) – see also Experimental Stability</td>
</tr>
<tr>
<td>• Superspreading capacity needs to be refined</td>
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<tr>
<td>• Updated person to person transmission rates (e.g., R0) as control measures take effect</td>
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<tr>
<td>• Tendency for ill individuals to seek medical care due to symptoms</td>
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<tr>
<td>• What is the underreporting rate?</td>
</tr>
<tr>
<td>• Can individuals become re-infected with SARS-CoV-2?</td>
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<tr>
<td>• What is the difference in transmissibility among countries?</td>
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<tr>
<td>• Is the R0 estimate higher in healthcare or long-term care facilities?</td>
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<tr>
<td>• How effective are social distancing measures at reducing spread?</td>
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</tbody>
</table>

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<tr>
<th>Host range – how many species does it infect? Can it transfer from species to species?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• What is the intermediate host(s)?</td>
</tr>
<tr>
<td>• What are the mutations in SARS-CoV-2 that allowed human infection and transmission?</td>
</tr>
<tr>
<td>• What animals can SARS-CoV-2 infect (e.g., pet dogs, potential wildlife reservoirs)?</td>
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</tbody>
</table>

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<th>Incubation period – how long after infection do symptoms appear? Are people infectious during this time?</th>
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<tr>
<td>• How early does asymptomatic transmission begin?</td>
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<tr>
<td>• What is the average infectious period during which individuals can transmit the disease?</td>
</tr>
<tr>
<td>• How long do patients continue to shed infectious virus after physical recovery?</td>
</tr>
<tr>
<td>• Can individuals become re-infected after recovery? If so, how long after?</td>
</tr>
</tbody>
</table>

### Who is doing experiments/has capabilities in this area?

<table>
<thead>
<tr>
<th>Capability of performing work</th>
</tr>
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<tbody>
<tr>
<td>- DHS National Biodefense Analysis and Countermeasures Center (NBACC)</td>
</tr>
<tr>
<td>- Capable of performing work:</td>
</tr>
<tr>
<td>- Christian Althaus (Bern)</td>
</tr>
<tr>
<td>- Neil Ferguson (MRC)</td>
</tr>
<tr>
<td>- Gabriel Leung, Joseph Wu (University of Hong Kong)</td>
</tr>
<tr>
<td>- Sara Del Valle (Los Alamos)</td>
</tr>
<tr>
<td>- Maimuna Majumder (Boston Children’s Hospital)</td>
</tr>
<tr>
<td>- Trevor Bedford (Fred Hutchinson Cancer Center)</td>
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<td>- Sang Woo Park (Princeton)</td>
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<tr>
<th>Performing work:</th>
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<tbody>
<tr>
<td>- Matthew Frieman (University of Maryland Baltimore)</td>
</tr>
<tr>
<td>- Ralph Baric (University of North Carolina)</td>
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<tr>
<td>- Stanley Perlman (University of Iowa)</td>
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<tr>
<td>- Susan Baker (Loyola University Chicago)</td>
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<tr>
<td>- Mark Denison (Vanderbilt University)</td>
</tr>
<tr>
<td>- Vineet Menachery (University of Texas Medical Branch)</td>
</tr>
<tr>
<td>- Jason McLellan, Daniel Wrapp, Nianshuang Wang (University of Texas)</td>
</tr>
<tr>
<td>- David O’Conner (U. Wisconsin, Madison)</td>
</tr>
<tr>
<td>- Chaolin Huang (Jin Yin-tan Hospital, Wuhan, China)</td>
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<tr>
<td>- The Novel Coronavirus Pneumonia Emergency Response Epidemiology Team</td>
</tr>
</tbody>
</table>

Contact: PANTHR@HQ.DHS.GOV

DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited.
What do we know?

- The majority of COVID-19 cases are mild (81%, N = 44,000 cases).
- Initial COVID-19 symptoms include fever (87.9% overall, but only 43.8% present with fever initially), cough (67.7%), fatigue, shortness of breath, headache, reduced lymphocyte count.
- Complications include acute respiratory distress (ARDS) observed in 17-29% of hospitalized patients, which leads to death in 4-15% of cases.
- Other complications include pneumonia (characteristic ground glass opacities), acute cardiac injury, secondary infection, kidney failure, arrhythmia, and shock.
- Approximately 15% of hospitalized patients were classified as severe, and severe cases were older and more likely to have underlying disorders.
- Approximately 5% of patients were admitted to the ICU.
- Between 23-32% of cases include pneumonia required intensive respiratory support.
- Overactive immune cells may contribute to symptom severity.
- The case fatality rate (CFR) depends on patient comorbidities; no comorbidities = 0.9%, cardiovascular disease = 10.5%, diabetes = 7.3%, chronic respiratory disease = 6.3%, hypertension = 6.0%, cancer = 5.6%.
- The CFR is age-dependent; 280 years old = 14.8%, 70-79 = 8.0%, 60-69 = 3.6%, 50-59 = 1.3%, 40-49 = 0.4%, 10-39 = 0.2%, 0-9 = 0.1%.
- Approximately 1% of hospitalizations occur in children < 19 years old.
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- 63.8% of confirmed fatalities have been male.
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- 63.8% of confirmed fatalities have been male.

Clinical diagnosis – are there tools to diagnose infected individuals? When during infection are they effective?

- Updated tests from the US CDC are available to states.
- The FDA released an Emergency Use Authorization describing an accelerated policy enabling laboratories to develop and use tests in-house for patient diagnosis.
- The US has relaxed criteria for testing patients, no longer requires travel history or close contact with known cases.
- US CDC has expanded patient testing criteria to include symptomatic patients at Clinician discretion.
- RT-PCR assays have been developed to detect SARS-CoV-2 in humans.
- PCR protocols and primers have been widely shared among international researchers.
- Several rapid or real-time test kits have been produced by universities and industry, including the Wuhan Institute of Virology, BGI, and Cepheid.
- RT-PCR tests are able to identify asymptomatic cases; SARS-CoV-2 infection was identified in 2/114 individuals previously cleared by in-house for patient diagnosis.

Medical treatment – are there effective treatments? Vaccines?

- Treatment for COVID-19 is primarily supportive care including oxygen and mechanical ventilation, though China has released a treatment plan, over 80 clinical trials are set to run on various treatments in China.
- Efficacy antivirals (lopinavir, ritonavir, ribavirin, oseltamivir) is unknown; however, several therapeutics [Remdesivir and chloroquine] inhibit SARS-CoV-2 infection in human cells in vitro and are undergoing clinical trials in China and the US.
- Multiple entities are working to produce a SARS-CoV-2 vaccine, including NIH/NIAID, Moderna, and Sanofi with HHS.
- The hospitalized case-fatality rate in China has decreased from 14.4% to 0.8% as of between December, 2019 and February, 2020, suggesting improved treatment or increased capacity.
- Approximately 38% of COVID-19 patients in China received oxygen therapy, 6.1% received mechanical ventilation, though China suggested that corticosteroids should be considered for severe patients to prevent ARDS.
- A clinical report (one patient) suggested that corticosteroids should be considered for severe patients to prevent ARDS.
- The aerosol survival of related human coronaviruses (HCoV-229E) was relatively high, and SARS-CoV-2 may be more stable than alpha-coronaviruses (HCoV-229E).
- No strong evidence for reduction in transmission with seasonal increase in temperature and humidity.
- Survival of SARS-CoV-2 specifically is unknown, and surrogate coronavirus data need to be used at this time.
- One hour after aerosolization, approximately 63% of airborne MERS virus remained viable in a simulated office environment (25°C, 75% RH).
- The aerosol survival of related human coronavirus (229E) was relatively high, (half-life of ~67 hours at 20°C and 50% RH), indicating ~20% of infectious virus remained after 6 days. Both higher and lower RH reduced HCoV-229E survival; lower temperatures improved survival.

Environmental stability – how long does the agent live in the environment?

- No information yet exists regarding the environmental stability of SARS-CoV-2; SARS and MERS coronaviruses are used as surrogates instead.
- Studies suggest that coronavirus can survive on non-porous surfaces up to 9-10 days (MHV, SARS-CoV) and porous surfaces for up to 3-5 days (SARS-CoV) in air conditioned environments (20-25°C, 40-50% RH).
- Coronavirus survival tends to be higher at lower temperatures and lower relative humidity (RH).
- SARS can persist with trace infectivity for up to 28 days at refrigerated temperatures (4°C) on surfaces.
- Beta-coronaviruses (e.g., SARS-CoV) may be more stable than alpha-coronaviruses (HCoV-229E).
- No strong evidence for reduction in transmission with seasonal increase in temperature and humidity.
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### SARS-CoV-2 (COVID-19)

**Clinical presentation – what are the signs and symptoms of an infected person?**
- How long does it take for infected individuals to recover outside of a healthcare setting?
- How does the CFR vary between countries?
- Is the reduction in CFR through time an indication of better treatment, less overcrowding, or both?

**Clinical diagnosis – are there tools to diagnose infected individuals? When during infection are they effective?**
- False positive/negative rates for tests
- Eclipse phase of infection (time between infection and detectable disease) in an individual

**Medical treatment – are there effective treatments? Vaccines?**
- Is GS-5734 (remdesivir) effective in vivo (already used in clinical trials under Emergency Use Authorization)?
- Is the GLS-5000 MERS vaccine cross-reactive against SARS-CoV-2?
- Efficacy of antibody treatments developed for SARS and MERS
- What is the efficacy of various MERS and SARS Phase I/II vaccines and other therapeutics?
- Are viral replicate inhibitors such as beta-D-N4-hydroxycytidine effective against SARS-CoV-2?

**Environmental stability – how long does the agent live in the environment?**
- Stability of SARS-CoV-2 in aerosol, droplets, and other matrices (mucus/sputum, feces)
- "Hang time" of the virus in air (Aerosol decay rate)
- Particle size distribution (e.g., droplet, large droplet and true aerosol distribution)
- Duration of SARS-CoV-2 infectivity via fomites and surface (contact hazard)?
- Stability of SARS-CoV-2 on PPE (e.g., Tyvek, nitrile, etc.)

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**Who is doing experiments/has capabilities in this area?**
- Jin Yin-tan Hospital, Wuhan, China
- China-Japan Friendship Hospital, Beijing, China
- Peking Union Medical College, Beijing, China
- Capital Medical University, Beijing, China
- Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China
- Huazhong University of Science and Technology, Wuhan, China
- The Central Hospital of Wuhan, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China
- Tsinghua University School of Medicine, Beijing, China
- Zhongnan Hospital of Wuhan University, Wuhan, China
- Peking University First Hospital, Beijing, China
- Peking University People's Hospital, Beijing, China
- Tsinghua University-Peking University Joint Center for Life Sciences, Beijing, China
- The Fifth Medical Center of PLA General Hospital, Beijing, China
- Performing work:
  - CDC
  - Wuhan Institute of Virology
  - Public Health Agency of Canada
  - Doherty Institute of Australia
  - Cepheid
  - BGI

- Performing work:
  - Peter Doherty Institute for Infection and Immunity
  - Academy of Military Medical Sciences, Beijing, China
  - Tim Sheahan (University of North Carolina)
  - Ralph Baric (University of North Carolina)
  - Matthew Frieman (University of Maryland Baltimore)
  - Sanofi, with BARDA
  - Janssen Pharma and BARDA

**Capable of performing work:**
- Mark Sobsey (University of North Carolina)
- DHS National Biodefense Analysis and Countermeasures Center (NBACC)
- Defence Science and Technology Laboratory (Dstl)
- Public Health Agency of Canada
- CDC
- EPA
- NIH

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**Funded work:**
- CEPI ($12 million to three groups):
  - Moderna and NIAID for mRNA platform vaccine
  - Inovio preparing DNA vaccine (for MERS)
  - University of Queensland, Australia NIAID/NIH:
    - Moderna and Kaiser Permanente for mRNA vaccine Phase I trial
    - University of Nebraska Medical Center Trial (multiple therapeutics including Gilead’s Remdesivir).2
SARS-CoV-2 (COVID-19)

What do we know?

- No decontamination data for SARS-CoV-2 have been identified. SARS-CoV provides a plausible surrogate, as it is a close genetic relative of SARS-CoV-2 in the beta-coronavirus clade.
- Chlorine-based113 and ethanol-based49 solutions recommended, and the European CDC has released disinfectant guidelines for non-healthcare facilities.55
- "The virus [SARS-CoV-2] has relatively weak viability in vitro and can be inactivated at 56 °C for 30 minutes. Chlorine-containing disinfectants and 75% ethanol can effectively inactivate the virus."131
- Heat treatment at 56°C is sufficient to kill coronaviruses,10 though effectiveness depends in part on amount of protein in contaminated media.
- 70% ethanol, 50% isopropanol, sodium hypochlorite [bleach, 200 ppm], and UV radiation are effective at inactivating several coronaviruses (MHV and CCV).84
- Ethanol-based biocides (including ethanol-containing gels) are effective disinfectants against coronaviruses dried on surfaces, including ethanol containing gels similar to hand sanitizer.65, 117
- Surface spray disinfectants such as Mikrobac, Dismozon, and Korsolex are effective at reducing infectivity of the closely related SARS-CoV after 30 minutes of contact.85
- Coronaviruses may be resistant to thermal inactivation for up to 7 days when stabilized in stool.102-105
- Additionally, coronaviruses are more stable in matrices such as respiratory sputum.53

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

- PPE effectiveness for SARS-CoV-2 is currently unknown; SARS is used as a surrogate.
- US CDC does not recommend the use of face masks for healthy people. Face masks should be used by people showing symptoms to reduce the risk of others getting infected. The use of face masks is crucial for healthcare workers and people in close contact with infected patients (at home or in a health care facility).21
- "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)"46
- WHO indicates healthcare workers should wear clean, non-sterile, long-sleeve gowns as well as gloves.112
- Respirators (NIOSH-certified N95, EUPF2P or equivalent) are recommended for those dealing with possible aerosols.
- Additional protection, such as a Powered Air Purifying Respirator (PAPR) with a full hood, should be considered for high-risk procedures (i.e., intubation, ventilation).106
- Healthcare worker illnesses (over 1,000111) demonstrates human-to-human transmission despite isolation, PPE, and infection control.95
- Porous hospital materials, including paper and cotton cloth, maintain infectious SARS-CoV for a shorter time than non-porous material.95
- CDC recommends face masks for individuals attempting to prevent spread of SARS-CoV-2 in the home.26
- Genomic analysis places SARS-CoV-2 into the beta-coronavirus clade, with close relationship to bat viruses. The SARS-CoV-2 virus is distinct from SARS and MERS viruses.52
- Genomic analysis suggest that SARS-CoV-2 is a natural variant, and is therefore unlikely to be human-derived or otherwise created by "recombination" with other circulating strains of coronavirus.6, 132
- Some genomic evidence indicates a close relationship with pangolin coronaviruses116; data suggests that pangolins may be a natural host for beta-coronaviruses.66, 76. Additional research is needed.
- Genomic data support at least two plausible origins of SARS-CoV-2: (i) natural selection in non-human animal host prior to zoonotic transfer, and (ii) natural selection in humans which mediates entry into host cells.110, 111
- Additional laboratory studies suggest that SARS-CoV-2 originated from bats.85
- Pangolin coronaviruses are closely related to both SARS-CoV-2 and the closely related Bat coronavirus (RaTG13) isolated from Yunnan Province, China; suggesting that SARS-CoV-2 originated from bats.85
- The Spike protein of SARS-CoV-2, which mediates entry into host cells and is the major determinant of host range, is very similar to the Spike protein of SARS-CoV.78 The rest of the genome is more closely related to two separate bat79 and pangolin77 coronaviruses.
- Protein modeling and preliminary laboratory studies suggest that SARS-CoV-2 binds to the human ACE2 receptor,97, 118 the same cellular entry receptor used by SARS and other beta-coronaviruses.

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

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

Genomics – how does the disease agent compare to previous strains?

What is SARS-CoV-2?

- 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 – 12/17/2019.7, 15, 90
- The mutation rate of SARS-CoV-2 is estimated to be similar to other RNA viruses (e.g., SARS, Ebola, Zika), and is currently calculated to be between 3.29 x 10-4 – 2.03 x 10-3 substitutions per site per year (median 1.07 x 10-1),7 though this estimate may change as more genomes are sequenced.
- Preliminary phylogenetic analysis identified a very close genetic similarity between SARS-CoV-2 and a Bat coronavirus (RaTG13) isolated from Yunnan Province, China; suggesting that SARS-CoV-2 originated from bats.85
- Pangolin coronaviruses are closely related to both SARS-CoV-2 and the closely related Bat coronavirus (RaTG13); phylogenetic analysis suggested that SARS-CoV-2 is of bat origin, but is closely related to pangolin coronavirus.77, 78
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### SARS-CoV-2 (COVID-19) - Required Information for Effective Infectious Disease Outbreak Response

#### What do we need to know?
- What is the minimal contact time for disinfectants?
- Are antiseptic wipes effective for cleaning hard, non-porous surfaces?
- Does contamination with human fluids/waste alter disinfectant efficacy profiles?
- How effective is air filtration at reducing transmission in healthcare, airplanes and public spaces?

#### Decontamination – what are effective methods to kill the agent in the environment?
- Mode of aerosol transmission?
- Effective distance of spread via droplet or aerosol?
- Is virus detectable in aerosol samples from patient rooms?
- How effective are barriers such as N95 respirators or surgical masks?
- What is the appropriate PPE for first responders?
- What are the proper procedures for reducing spread in medical facilities / transmission rate in medical settings?

#### PPE – what PPE is effective, and who should be using it?
- 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?

#### Forensics – natural vs intentional use?
- Natural vs intentional use?
- Tests to be used for attribution.

#### Genomics – how does the disease agent compare to previous strains?
- 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?

#### Who is doing experiments/has capabilities in this area?
- **Capable of performing work:**
  - DHS National Biodefense Analysis and Countermeasures Center (NBACC)

#### Generating recommendations:
- WHO
- CDC
- Pan-American Health Organization

#### Performing genomic investigations:
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<table>
<thead>
<tr>
<th>Acronym/Term</th>
<th>Definition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SARS-CoV-2</td>
<td>Severe acute respiratory syndrome coronavirus 2</td>
<td>Official name for the virus previously known as 2019-nCoV.</td>
</tr>
<tr>
<td>COVID-19</td>
<td>Coronavirus disease 19</td>
<td>Official name for the disease caused by the SARS-CoV-2 virus.</td>
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<tr>
<td>CFR</td>
<td>Case Fatality Rate</td>
<td>Number of deaths divided by confirmed patients</td>
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<tr>
<td>PFU</td>
<td>Plaque forming unit</td>
<td>Measurement of the number of infectious virus particles as determined by plaque forming assay. A measurement of sample infectivity.</td>
</tr>
<tr>
<td>TCID₅₀</td>
<td>50% Tissue Culture Infectious Dose</td>
<td>The number of infectious units which will infect 50% of tissue culture monolayers. A measurement of sample infectivity.</td>
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<tr>
<td>HCW</td>
<td>Healthcare worker</td>
<td>Doctors, nurses, technicians dealing with patients or samples</td>
</tr>
<tr>
<td>SARS</td>
<td>Severe Acute Respiratory Syndrome</td>
<td>Coronavirus with over 8,000 cases in global 2002-2003 outbreak</td>
</tr>
<tr>
<td>MERS</td>
<td>Middle-East Respiratory Syndrome</td>
<td>Coronavirus with over 2,000 cases in regional outbreak since 2012</td>
</tr>
<tr>
<td>CoV</td>
<td>Coronavirus</td>
<td>Virus typified by crown-like structures when viewed under electron microscope</td>
</tr>
<tr>
<td>R₀</td>
<td>Basic reproduction number</td>
<td>A measure of transmissibility. Specifically, the average number of new infections caused by a typical infectious individual in a wholly susceptible population.</td>
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<tr>
<td>MHV</td>
<td>Mouse hepatitis virus</td>
<td>Coronavirus surrogate</td>
</tr>
<tr>
<td>CCV</td>
<td>Canine coronavirus</td>
<td>Canine coronavirus</td>
</tr>
<tr>
<td>Fomite</td>
<td>Inanimate vector of disease</td>
<td>Surfaces such as hospital beds, doorknobs, healthcare worker gowns, faucets, etc.</td>
</tr>
<tr>
<td>Transmission Type</td>
<td>Description</td>
<td>Notes</td>
</tr>
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<td>------------------------</td>
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<td>----------------------------------------------------------------------</td>
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<tr>
<td>Droplet transmission</td>
<td>Sneezing, coughing</td>
<td>Transmission via droplets requires relatively close contact (e.g., within 6 feet)</td>
</tr>
<tr>
<td>Airborne transmission</td>
<td>Aerosolization of infectious particles</td>
<td>Aerosolized particles can spread for long distances (e.g., between hospital rooms via HVAC systems)</td>
</tr>
<tr>
<td>Transgenic</td>
<td>Genetically modified</td>
<td>In this case, animal models modified to be more susceptible to MERS and/or SARS by adding proteins or receptors necessary for infection</td>
</tr>
<tr>
<td>Intranasal</td>
<td>Agent deposited into external nares of subject</td>
<td>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.</td>
</tr>
<tr>
<td>Incubation period</td>
<td>Time between infection and symptom onset</td>
<td>Time between infection and onset of symptoms typically establishes guidelines for isolating patients before transmission is possible</td>
</tr>
<tr>
<td>Infectious period</td>
<td>Length of time an individual can transmit infection to others</td>
<td>Reducing the infectious period is a key method of reducing overall transmission; hospitalization, isolation, and quarantine are all effective methods</td>
</tr>
<tr>
<td>Serial interval</td>
<td>Length of time between symptom onset of successive cases in a transmission chain</td>
<td>The serial interval can be used to estimate R₀, and is useful for estimating the rate of outbreak spread</td>
</tr>
<tr>
<td>Superspreading</td>
<td>One individual responsible for an abnormally large number of secondary infections</td>
<td>Superspreading can be caused by high variance in the distribution of secondary cases caused by a single individual; most individuals infect very few people, while some infect a large number, even with the same average number of secondary infections</td>
</tr>
<tr>
<td>Nosocomial</td>
<td>Healthcare- or hospital-associated infections</td>
<td>Characteristic of SARS and MERS outbreaks, lead to refinement of infection control procedures</td>
</tr>
<tr>
<td>ACE2</td>
<td>Angiotensin-converting enzyme 2</td>
<td>Acts as a receptor for SARS-CoV, allowing entry into human cells</td>
</tr>
<tr>
<td>ARDS</td>
<td>Acute respiratory distress syndrome</td>
<td>Leakage of fluid into the lungs which inhibits respiration and leads to death</td>
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<td>--------------</td>
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<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>PPE</td>
<td>Personal protective equipment</td>
<td>Gowns, masks, gloves, and any other measures used to prevent spread between individuals</td>
</tr>
</tbody>
</table>

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