COVID-19: Viral transmission and hospital planning

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Cornell University
March 20, 2020
Disclaimer

- This is a rapidly changing situation and the information presented here is only current as of March 20, 2020. Further guidance may be available through the CDC, WHO, AVMA, NYSVMS, FDA, etc.

- For individual questions, contact your local physician or department of health.
COVID-19: The big picture
Coronaviruses: Microscopic view
Transmission
Creating a plan for your own practice
As a member of the veterinary medical profession, I solemnly swear that I will use my scientific knowledge and skills for the benefit of society. I will strive to promote animal health and welfare, relieve animal suffering, protect the health of the public and environment, and advance comparative medical knowledge.
Cleveland Clinic, UH postponing non-essential surgeries

Posted: 9:10 PM, Mar 17, 2020  Updated: 9:10 PM, Mar 17, 2020

By: Courtney Shaw

The ADA is recommending that dentists nationwide postpone elective procedures in response to the spread of the coronavirus disease, COVID-19, across the country.

Every month, frontline health responders around the world need these supplies (and more) to protect themselves and others from #COVID19

- 89 million masks
- 30 million gowns
- 1.59 million goggles
- 76 million gloves
- 2.9 million liters hand sanitizer

#COVID19
#coronavirus
What is the current situation?
Symptoms of COVID-19

Data shows the disease is mild in 80 percent of patients, severe in 13 percent, and critical in 6 percent.

Most common symptoms:
- Fever
- Fatigue
- Dry cough

Some patients may also have:
- Aches and pains
- Runny nose
- Sore throat
- Shortness of breath
- Diarrhoea

In critical cases, COVID-19 can cause severe pneumonia or a multiple-organ failure and can lead to death.

Risk factors and comorbidities

- **Risk factors**
  - Increasing age
  - Male

- **Comorbidities**
  - Cardiovascular disease
  - Hypertension
  - Diabetes
  - Chronic obstructive pulmonary disease (COPD)

*(Jain & Yuan, 2020)*
What are coronaviruses?

- Single-stranded, positive-sense, enveloped RNA virus

What happens at the cellular level?
SARS-CoV-2 uses the SARS-CoV receptor ACE2 for host cell entry.

The spike protein of SARS-CoV-2 is primed by TMPRSS2.
Porcine epidemic diarrhea virus

Feline infectious peritonitis virus (FIPV)

Equine coronavirus

Bovine coronavirus

Orange ... bat RaTG13
Red ... hCoV-19 2019-2020
Cyan ... pangolin CoV
Blue ... SARS CoV
Purple ... MERS CoV
Green ... common cold CoV
What about the origin?

Image source: Timothy Sheahan, University of North Carolina | https://www.wsj.com/articles/what-we-know-about-the-wuhan-virus-11579716128
How does the virus spread?

- Droplet transmission
- Fomite transmission
- Other possible transmission routes (significance?)
  - Urine
  - Feces
  - Blood
  - (Peng et al, 2020)
When is the virus spread?
What is droplet transmission?

What about aerosol spread?

Aerodynamic Characteristics and RNA Concentration of SARS-CoV-2 Aerosol in Wuhan Hospitals during COVID-19 Outbreak

Yuan Liu, Ph.D.,\textsuperscript{1,\dagger}, Zhi Ning, Ph.D.,\textsuperscript{2,\dagger,∗}, Yu Chen, Ph.D.,\textsuperscript{1,\dagger,∗}, Ming Guo, Ph.D.,\textsuperscript{1,\dagger}, Yingle Liu, Ph.D.,\textsuperscript{1}, Nirmal Kumar Gali, Ph.D.,\textsuperscript{2}, Li Sun, M.Sc.,\textsuperscript{2}, Yusen Duan, M.Sc.,\textsuperscript{3}, Jing Cai, Ph.D.,\textsuperscript{4}, Dane Westerdahl\textsuperscript{2}, D.Env.,\textsuperscript{2}, Xinjin Liu, M.Sc.,\textsuperscript{1}, Kin-fai Ho, Ph.D.,\textsuperscript{5,∗}, Haidong Kan, Ph.D.,\textsuperscript{4,∗}, Qingyan Fu, Ph.D.,\textsuperscript{3,∗}, Ke Lan, MD, PhD,\textsuperscript{1,∗}

Aerosol and surface stability of HCoV-19 (SARS-CoV-2) compared to SARS-CoV-1

Neeltje van Doremalen\textsuperscript{1∗}, Trenton Bushmaker\textsuperscript{1∗}, Dylan H. Morris\textsuperscript{2∗}, Myndi G. Holbrook\textsuperscript{1}, Amandine Gamble\textsuperscript{3}, Brandi N. Williamson\textsuperscript{1}, Azaibi Tamin\textsuperscript{4}, Jennifer L. Harcourt\textsuperscript{4}, Natalie J. Thomburg\textsuperscript{4}, Susan I. Gerber\textsuperscript{4}, James O. Lloyd-Smith\textsuperscript{3,5}, Emmie de Wit\textsuperscript{1}, Vincent J. Munster\textsuperscript{1}

Both papers are accessible on BioRXiv.org
Aerosol stability

Source: Doremalen et al, 2020 | https://www.medrxiv.org/content/10.1101/2020.03.09.20033217v2
Are pets able to spread the virus?

What about that dog in Hong Kong that tested positive for the COVID-19 virus?

The dog was owned by an infected person and had a series of positive tests. That’s pretty convincing evidence that it was infected. However, the tests were reportedly “weak positives” and no detectable antibody response was detected in the dog (at least not yet), supporting that this was a pretty low grade infection.

*Infected vs infectious* is the big question. An individual can be infected but not infectious, if they’re not producing much virus and therefore unlikely to pass the infection along. The hope is that dogs are not a great host for the virus and if infected, that they’re not infected enough to pose a risk to others.

What about cats?

Cats are still a bigger concern in this scenario because they were able to be infected by the SARS virus and could infect other cats with SARS, and this virus is similar enough that it’s reasonable to be concerned that it could infect cats as well. However there has been little testing (in fact none that we know of) of cats so far, though undoubtedly many cats have been exposed through their infected owners. Time will tell based on field study (hopefully) and probably experimental work.

Should I be worried about catching COVID-19 from my dog or cat?

No. As a disease that is at least predominantly if not purely transmitted by people, pets are going to get it from people, not the other way around. If your dog/cat is infected, it probably got it from you or one of your close contacts, and the infected person poses more of a risk to you than the dog/cat.

So, what should we think about with pets and COVID-19?

Common sense. If you’re infected, stay away from people and pets. If you’re infected and you’ve been with your pet, keep it away from others. If we keep pets from getting exposed and keep exposed pets away from people, then we reduce the risks – if there are in fact any – even further.

What about survival on fomites?

Table 1. Duration of survival of severe acute respiratory syndrome coronavirus (SARS-CoV) on paper, a disposable gown, and a cotton gown.

<table>
<thead>
<tr>
<th>Inoculation, TCID_{50}/mL</th>
<th>Time taken to inactivate SARS-CoV, by surface</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Paper</td>
</tr>
<tr>
<td>10^8</td>
<td>24 h</td>
</tr>
<tr>
<td>10^5</td>
<td>3 h</td>
</tr>
<tr>
<td>10^4</td>
<td>&lt;5 min</td>
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Source: Lai et al., 2005
RECENT INTERNATIONAL TRAVEL OF OWNERS, KNOWN REGIONAL COMMUNITY TRANSMISSION, OR KNOWN CONTACT WITH AN INFECTED HUMAN?

YES

Does the owner have recent history* of respiratory disease?

YES

Is presentation an emergency?

YES

Admit animal from vehicle

NO

Reschedule

NO

Notify clinic infection control personnel and, if possible, wait for further recommendations.

Admit animal from vehicle directly to isolation, ideally through a side entrance

Notify clinic infection control personnel, when applicable

NO

Notify clinic infection control personnel and, if possible, wait for further recommendations.

Admit animal from vehicle directly to isolation, ideally through a side entrance, while using respiratory PPE

If PPE is unavailable, consider referral to tertiary facility that has PPE

NO

Admit animal from vehicle using standard precautions (e.g., laboratory coat)

Keep 3-4 feet (1-1.2 m) distance from owner

Ideally, assess animal in examination room near clinic entrance

NO

Normal admission

Can someone else bring the animal?

YES

Admit animal from vehicle while using respiratory PPE

Keep 3-6 feet (1.2 m) distance from owner

NO

Reschedule

Can someone else bring the animal?

YES

Admit animal from vehicle

NO

Reschedule

PPE = personal protective equipment

*Within the past 2 weeks.
RECENT INTERNATIONAL TRAVEL OF OWNERS, KNOWN REGIONAL COMMUNITY TRANSMISSION, OR KNOWN CONTACT WITH AN INFECTED HUMAN?

YES

NO
Big picture approach

HACCP

- Hazard
- Analysis
- Points
- Control
- Critical

Hazards

- Waiting rooms
- Overlapping appointments
- Close contacts during restraint
- Exam tables, reception desk, benches
- Computer keyboards, computer mouse, light switches, door handles
- Microscopes
- Paper records, paper money, checks
- Pens, pencils, stethoscopes
- Supply chain disruptions
- Limited PPE
- PPE needed by healthcare providers
Avoid this!

Analysis

Image source: Bertolini | A doctor’s waiting room can be an interesting and scary place | https://www.mirror.co.uk/lifestyle/health/doctors-waiting-room-can-interesting-12786392
Controlling

- Minimize congregations
  - Close the waiting rooms – take away the chairs?
  - Retrieve pets from the parking lot
  - Utilize telemedicine
  - Think about staffing

- Minimize traffic in the hospital
  - Add extra time between appointments
  - No walk-ins
  - No sales reps
  - No unnecessary remodeling by outside individuals
  - Designate certain hours for at risk populations?
  - Put a halt to training classes or other visitors

- Control the fomites and contact areas
  - Clean, clean, clean
  - Hand sanitizers available
  - How are payments being processed?
  - Minimize the community magazines, coffee makers, etc.
  - Can a door be propped open to avoid being touched?

Minimizing congregations
What about owners staying in their cars?

Image source: Singh | Most dirty, germiest places in your car! How to avoid the unknown health hazards | https://www.financialexpress.com/auto/car-news/most-dirty-germiest-places-in-your-car-how-to-avoid-unknown-health-hazards/1606476/
Implementing car-side to vet-side

- Communicate, communicate, communicate
  - Let your clients know what your procedures are
  - Post on practice website, Facebook, etc.
  - Explain procedure when providing reminder phone call
  - Post a sign on the front door with your procedure
Implementing car-side to vet-side

1. Owner arrives in parking lot with pet. Have owner call that they are there.
2. Technician will go over the history on the phone with the owner.
3. Technician retrieves pet
   - Owner waits in car or near car?
   - Cat in a carrier – designated spot to set?
   - Bring a slip lead for dogs; owner holds onto their leash if possible
Implementing car-side to vet-side

- 4. Pet comes into the hospital with technician. (Good point for tech to wash hands/use hand sanitizer?).
- 5. Normal physical exam. Veterinarian calls owner to report findings and discuss plan.
- 6. Plan implemented
- 7. Pet is returned, in the opposite fashion of above
- 8. Reception calls to process payment (if credit card)
  - If paying with cash/check – consider an envelope?
  - Consider online payments?
Consider a designated pet areas?

Image sources: Mesa County | After Hours Drop Off | https://animalservices.mesacounty.us/lost-and-found-pets/after-hours-drop-off/
Cat Friendly Clinic | https://catfriendlyclinic.org/vets-nurses/the-waiting-room
What about just staying outside?

Goal is still to maintain 6 feet distance!
Last option

Social distance!

Solid opaque sight barrier between dog and cat area of waiting room

Image adapted from Cat Friendly Clinic | https://catfriendlyclinic.org/vets-nurses/the-waiting-room/
What about elderly/immuno-compromised clients?

- Can it wait?
- First appointment of the day?
- Can a friend or family member bring the pet?
Keeping personnel safe

- Minimizing the number of people present at any given time (consider shifting practice hours?)
- Create personnel groups
- Instruct sick employees to stay home, follow the recommendations of healthcare providers in regards to quarantines
- Make sure there is an emergency contact list in place
What can personnel do from home?

- Update your practice website, blog, or Facebook page
- Mailings
- Medical records
- Online dog training
- Online CE
- Create client handouts, adapt your current handouts
- Analyze practice trends
Veterinary healthcare team members who have symptoms of acute respiratory illness should stay at home and should not return to work until they are free of fever (fever is defined as a temperature of 100.4°F or higher, using an oral thermometer), signs of a fever, and any other symptoms for at least 24 hours without the use of fever-reducing or other symptom-altering medicine (e.g., cough suppressants). Communicate about COVID-19 with your team. Flexible sick leave policies are important and team members should be made aware of these policies. Team members who appear to have symptoms of acute respiratory illness upon arrival at work or who become sick during the day should be separated from other team members and sent home immediately.

If a team member is confirmed to have COVID-19, the veterinary practice owner should inform other team members of their possible exposure to COVID-19, but maintain confidentiality as required by law. Team members who are exposed to another employee with confirmed COVID-19 should contact their physician or local health department to determine how best to proceed.
Controlling the fomites
What can kill the virus in the environment?

- Sodium hypochlorite
- Ethanol 70%
- Quarternary ammonium
- Isopropanol
- Octanoic acid
- Hydrogen peroxide
- Phenolic
- L-lactic acid
- Peroxyacetic acid
- Glycolic acid
- Hydrochlorous acid
- Hydrochloric acid

* If a surface is suspected to be contaminated by SARS-CoV-2, PPE should be worn.
* Check concentrations and contact time at: https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2
Pesticide Registration

List N: Disinfectants for Use Against SARS-CoV-2

List N includes products that meet EPA's criteria for use against SARS-CoV-2, the cause of COVID-19.

When purchasing a product, check if its EPA registration number is included on this list. If it is, you have a match and the product can be used against SARS-CoV-2. You can find this number on the product label – just look for the EPA Reg. No. These products may be marketed and sold under different brand names, but if they have the same EPA registration number, they are the same product.

This list includes products with emerging viral pathogen claims and those with human coronavirus claims. If a product with an emerging viral pathogen claim is not available, use a product with a coronavirus claim. If the product is listed as “N” under the Emerging Viral Pathogen Claim column, then it has a human coronavirus claim.

- Frequently Asked Questions about List N: Disinfectants for Use Against SARS-CoV-2
- Emerging Viral Pathogen Claims for SARS-CoV-2: Submission Information for Registrants

Note: Inclusion on this list does not constitute an endorsement by EPA. There may be additional disinfectants that meet the criteria for use against SARS-CoV-2. EPA will update this list with additional products as needed.

Source: EPA | https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2
Doing our part

Donate spare supplies
If veterinary hospitals have supplies or other support they want to offer to the COVID-19 response:
Please refer any offers for assistance to: covid19assistance@exec.ny.gov

David Smith, DVM
Director, Division of Animal Industry
New York State Department of Agriculture and Markets
Take aways

- The situation is rapidly changing and we must all be prepared for changes
- Main transmission modes are droplet and fomite transmission
- Have a plan for your hospital – think about how to maintain social distancing and the surfaces that might harbor the virus
- If you have questions or concerns, make sure to reach out to local and state public health departments and state veterinarians.


Thanks!

Contact: aek68@cornell.edu
<table>
<thead>
<tr>
<th>Species</th>
<th>20</th>
<th>83</th>
<th>218</th>
<th>246</th>
<th>353</th>
<th>426</th>
<th>593</th>
<th>636</th>
<th>714</th>
<th>716</th>
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<td><em>Viverricta indica pallida</em> (Civet)</td>
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<td><em>Equus caballus</em> (horse)</td>
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<td><em>Homo sapiens</em> (human)</td>
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<td><em>Lynx canadensis</em> (lynx)</td>
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<td><em>Capra hircus</em> (goat)</td>
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<td><em>Pteropus alecto</em> (flying fox)</td>
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<td><em>Bubalus bubalis</em> (buffalo)</td>
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<td><em>Canis lupus dingo</em> (dog)</td>
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<td><em>Merops nubicus</em> (bee-eater)</td>
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<td><em>Egretta garzetta</em> (egret)</td>
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<td><em>Apaloderma vittatum</em> (cuckoo)</td>
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<td><em>Mus caroli</em> (field mouse)</td>
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Qui et al., 2020: doi:10.20944/preprints202003.0091.v1
A spokesman for the Agriculture, Fisheries and Conservation Department (AFCD) said today (March 19) that a pet dog sent to the AFCD has repeatedly tested positive for the COVID-19 virus. This is another infected case following an earlier case in which a 17-year-old Pomeranian dog tested weak positive during repeated tests for the virus.

The current case involves a German Shepherd dog that lived in a residence at Pok Fu Lam. When the owner was confirmed with COVID-19, the dog was sent for quarantine with another mixed breed dog from the same residence to the animal keeping facility at the Hong Kong Port of the Hong Kong-Zhuhai-Macao Bridge yesterday (March 18). No positive results were obtained from the mixed breed dog and neither dog has shown any signs of disease.

The Department will continue to closely monitor both dogs and conduct repeated tests on the animals.

The AFCD will continue to work together with the Department of Health in handling relevant cases. To ensure public and animal health, the Department strongly advises that mammalian pet animals including dogs and cats from households with persons confirmed as infected with COVID-19, or close contacts of COVID-19 infected persons, should be put under quarantine in AFCD facilities.

The spokesman reminded pet owners to adopt good hygiene practices (including hand washing before and after being around or handling animals, their food, or supplies, as well as avoiding kissing them) and to maintain a clean and hygienic household environment. People who are sick should restrict contact with animals. If there are any changes in the health condition of the pets, advice from a veterinarian should be sought as soon as possible.

The spokesman emphasised that there is currently no evidence that pet animals can be a source of COVID-19 for humans or that this virus can cause the disease in dogs. Pet owners should always maintain good hygiene practices and under no circumstances should they abandon their pets.

Ends/Thursday, March 19, 2020
Issued at HKT 20:15

https://www.info.gov.hk/gia/general/202003/19/P2020031900606.htm
Elevated exhaustion levels and reduced functional diversity of T cells in peripheral blood may predict severe progression in COVID-19 patients

Hong-Yi Zheng, Mi Zhang, Cui-Xian Yang, Nian Zhang, Xi-Cheng Wang, Xin-Ping Yang, Xing-Qi Dong and Yong-Tang Zheng

Cellular & Molecular Immunology

https://doi.org/10.1038/s41423-020-0401-3
Full genome trees of major subclades
2020-03-16 0700UTC

S clade
139 (+6)

G clade
142 (+7)

V clade
50 (+3)

Notable changes:
• S clade: 6 USA
• G clade: 1 Congo, 1 USA, 5 Finland
• V clade: 1 Canine (Hong Kong), 1 USA, 1 Finland

Other clades (None)

We gratefully acknowledge the Authors from Originating and Submitting laboratories of sequence data on which the analysis is based.