WRF Webcast
Coronavirus Disease 2019 (COVID-19) Research Update

March 12, 2020

3:30 pm – 5:00 pm ET USA

Webcast Host

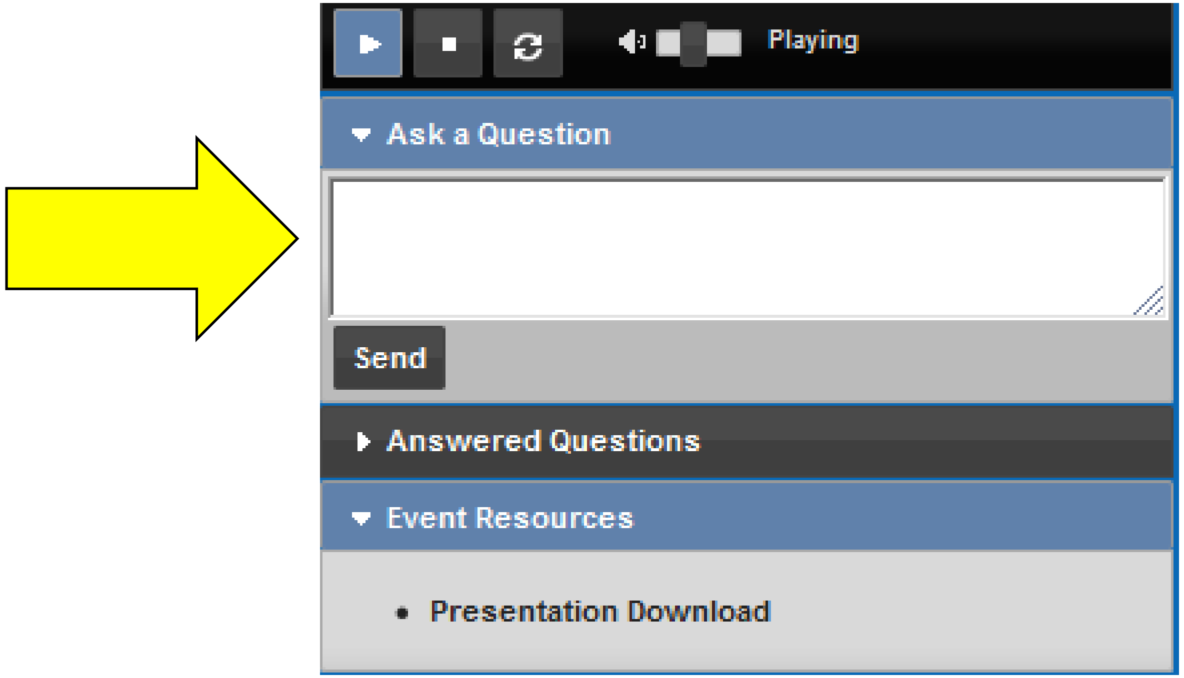
Lola Olabode, MPH, BCES

The science is rapidly moving, and the technical recommendations are changing!

Housekeeping Items

- Submit questions through the question box at any time! We will do a Q&A near the end of the webcast.
- Slides and a recording of the webcast will be available at www.waterrf.org.
- Send an email to Michelle Suazo at msuazo@waterrf.org for a PDH certificate.
- Survey at the end of the webcast.

Input your webcast questions here



Q&A at end of webcast

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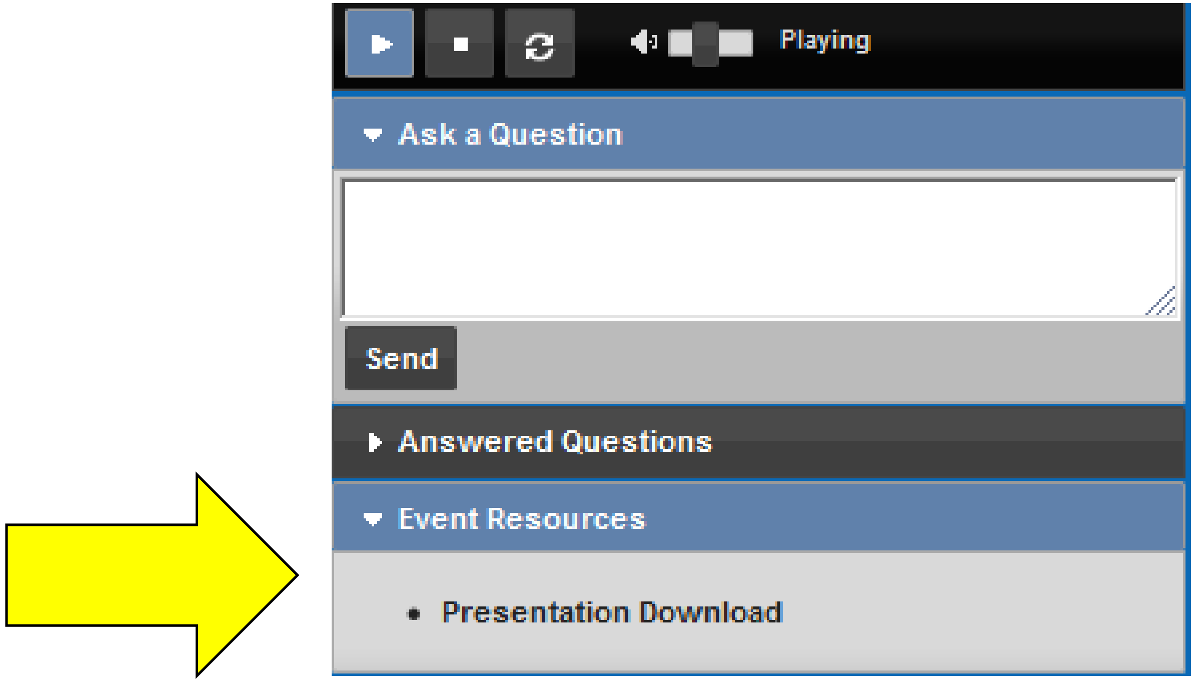


Slides and recording will be available to WRF subscribers within 24 hours after the webcast

Webcast Agenda

TIME	Content	Presenter
3:30 – 3:40p	WEBCAST Host – Introductions, Live Poll	Lola Olabode, MPH, BCES The Water Research Foundation
3:40 – 3:45p	WRF CEO Welcome	Dr. Peter Grevatt, CEO The Water Research Foundation
3:45 - 3:50p	Moderator and Purpose of Webcast	Dr. Charles Haas Drexel University, WRF Academic Council
3:50 – 4:00p	Centers for Disease Control and Prevention (CDC) Update	Jonathan Yoder Water Preparedness and Response at the Centers for Disease Control and Prevention
4:00 – 4:10p	Water Environment Federation (WEF) Disinfection & Public Health Committee Update	Dr. Rasha Maal-Bared EPCOR Water, WEF Waterborne Infectious Disease Outbreak Control (WIDOC) Working Group
4:10 – 4:20p	Technical Research Update and Lessons Learned from Ebola and other viruses	Dr. Mark Sobsey Gillings Schools of Global Public Health, University of North Carolina Chapel Hill Dr. Lisa Casanova Georgia State University
4:20 – 4:30p	Current and Ongoing Projects	Dr. Kyle Bibby University of Notre Dame
4:30 – 4:40p	Case Study – Australia	Dr. Dan Deere Water Quality Specialist at Water Futures, Australia
4:40 – 5:00p	Q&A	Dr. Haas and Lola Olabode

Live Poll #1: What geographical location are you calling in from today?

- Eastern US
- Midwest US
- Western US
- Canada
- Mexico
- Central America and the Caribbean
- South America
- Sub-Saharan Africa
- Middle East, North Africa and Greater Arabia
- Europe
- Asia
- Australia and Oceania

Live Poll #2: Please identify your affiliation:

- Academia
- Utilities
- Government
- Media
- Consultant/Industry
- Non-profit or Non government organization
- Health care
- Private citizen

Live Poll #3: Why are you interested in today's webcast? (Multiple Choices Allowed)

- I want the most up-to-date research on COVID-19 to remain informed.
- I want to know what measures exist to protect both workers and public health in general.
- We have cases in my area.
- I am a first-line responder and I'm not sure what to do.
- I travel often and worried about safety.
- I want to know the latest public health recommendations as of March 12, 2020 (today).
- I want to know more about containing and combating community spread.

WRF CEO Welcome

Peter Grevatt, PhD

Moderator and Purpose of Webcast

Dr. Charles Haas
Drexel University, WRF Academic Council

The science is rapidly moving, and the technical recommendations are changing!

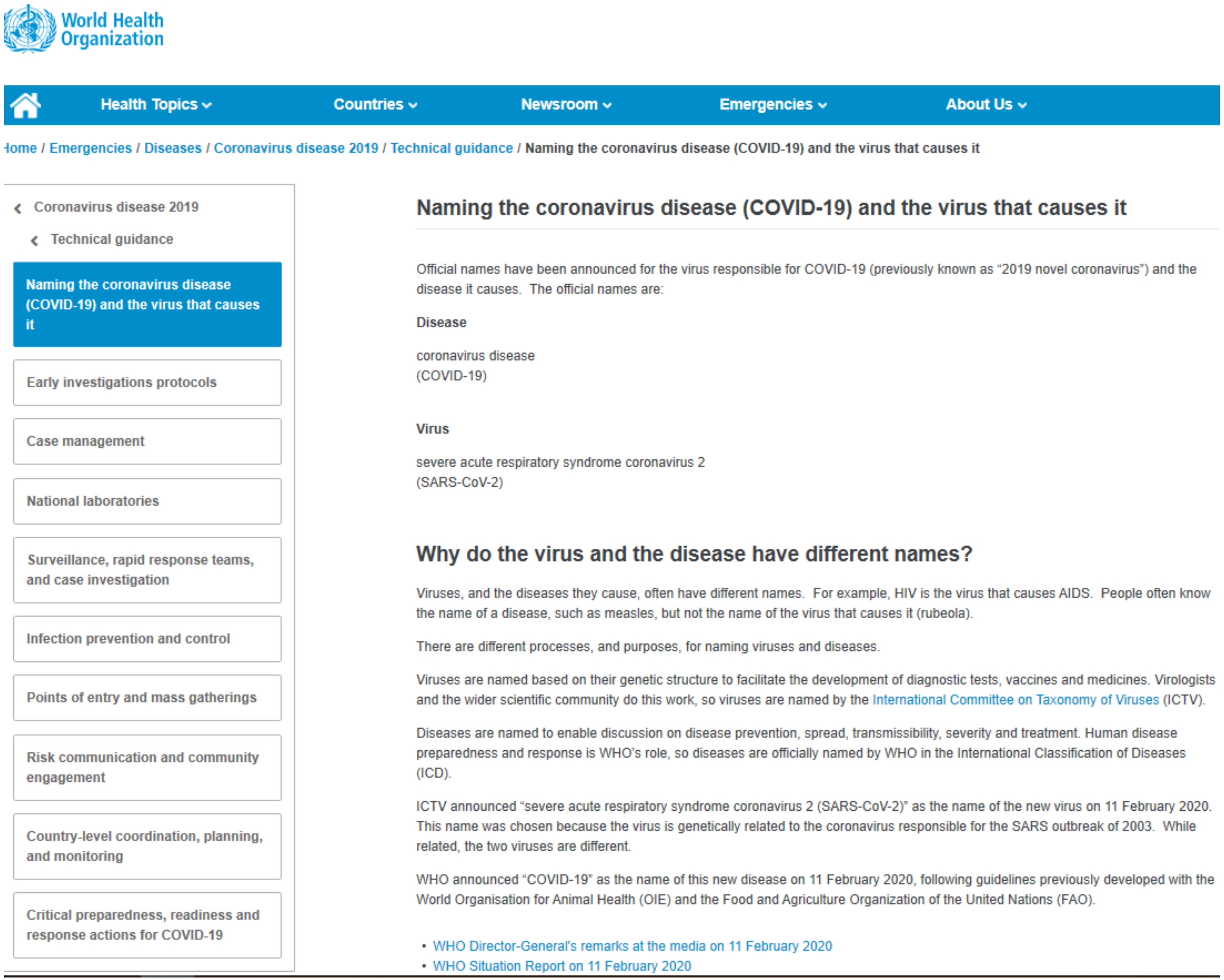
Nomenclature

COVID-19

- COVID-19 refers to the disease

SARS-CoV-2
2019-nCoV and COVID-19 virus

- All refer to the virus that results in COVID-19



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Home / Emergencies / Diseases / Coronavirus disease 2019 / Technical guidance / Naming the coronavirus disease (COVID-19) and the virus that causes it

- Coronavirus disease 2019
- Technical guidance
- Naming the coronavirus disease (COVID-19) and the virus that causes it
- Early investigations protocols
- Case management
- National laboratories
- Surveillance, rapid response teams, and case investigation
- Infection prevention and control
- Points of entry and mass gatherings
- Risk communication and community engagement
- Country-level coordination, planning, and monitoring
- Critical preparedness, readiness and response actions for COVID-19

Naming the coronavirus disease (COVID-19) and the virus that causes it

Official names have been announced for the virus responsible for COVID-19 (previously known as "2019 novel coronavirus") and the disease it causes. The official names are:

Disease

coronavirus disease
(COVID-19)

Virus

severe acute respiratory syndrome coronavirus 2
(SARS-CoV-2)

Why do the virus and the disease have different names?

Viruses, and the diseases they cause, often have different names. For example, HIV is the virus that causes AIDS. People often know the name of a disease, such as measles, but not the name of the virus that causes it (rubeola).

There are different processes, and purposes, for naming viruses and diseases.

Viruses are named based on their genetic structure to facilitate the development of diagnostic tests, vaccines and medicines. Virologists and the wider scientific community do this work, so viruses are named by the International Committee on Taxonomy of Viruses (ICTV).

Diseases are named to enable discussion on disease prevention, spread, transmissibility, severity and treatment. Human disease preparedness and response is WHO's role, so diseases are officially named by WHO in the International Classification of Diseases (ICD).

ICTV announced "severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)" as the name of the new virus on 11 February 2020. This name was chosen because the virus is genetically related to the coronavirus responsible for the SARS outbreak of 2003. While related, the two viruses are different.

WHO announced "COVID-19" as the name of this new disease on 11 February 2020, following guidelines previously developed with the World Organisation for Animal Health (OIE) and the Food and Agriculture Organization of the United Nations (FAO).

- WHO Director-General's remarks at the media on 11 February 2020
- WHO Situation Report on 11 February 2020

https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it

World Health Organization

unicef

Water, sanitation, hygiene and waste management for the COVID-19 virus

Technical brief
3 March 2020

1. Introduction and background

In late 2019, an acute respiratory disease emerged, known as novel coronavirus disease 2019 (COVID-19). The pathogen responsible for COVID-19 is severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2, also referred to as the COVID-19 virus), a member of the coronavirus family. In response to the growing spread of COVID-19, WHO has published a number of technical guidance documents on specific topics, including infection prevention and control (IPC). These documents are available at https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/infection-prevention-and-control.

This technical brief supplement the IPC documents by referencing and summarizing the WHO guidance on water, sanitation and health care waste that is relevant to viruses, including coronaviruses. This technical brief is written, in particular, for water and sanitation practitioners and providers. It is also for health care providers who want to know more about water, sanitation and hygiene (WASH) risks and practices.

The provision of safe water, sanitation and hygienic conditions is essential to protecting human health during all infectious disease outbreaks, including the COVID-19 outbreak. Ensuring good and consistently applied WASH and waste management practices in communities, homes, schools, marketplaces and health care facilities will further help to prevent human-to-human transmission of the COVID-19 virus.

The most important information concerning WASH and the COVID-19 virus is summarized here.

- Frequent and proper hand hygiene is one of the most important measures that can be used to prevent infection with the COVID-19 virus. WASH practitioners should work to enable more frequent and regular hand hygiene by improving facilities and using proven behaviour change techniques.
- WHO guidance on the safe management of drinking-water and sanitation services applies to the COVID-19 outbreak. Extra measures are not needed. In particular, disinfection will facilitate more rapid die-off of the COVID-19 virus.
- Many co-benefits will be realized by safely managing water and sanitation services and applying good hygiene practices. Such efforts will prevent many other infectious diseases, which cause millions of deaths each year.

Revised WHO guidance

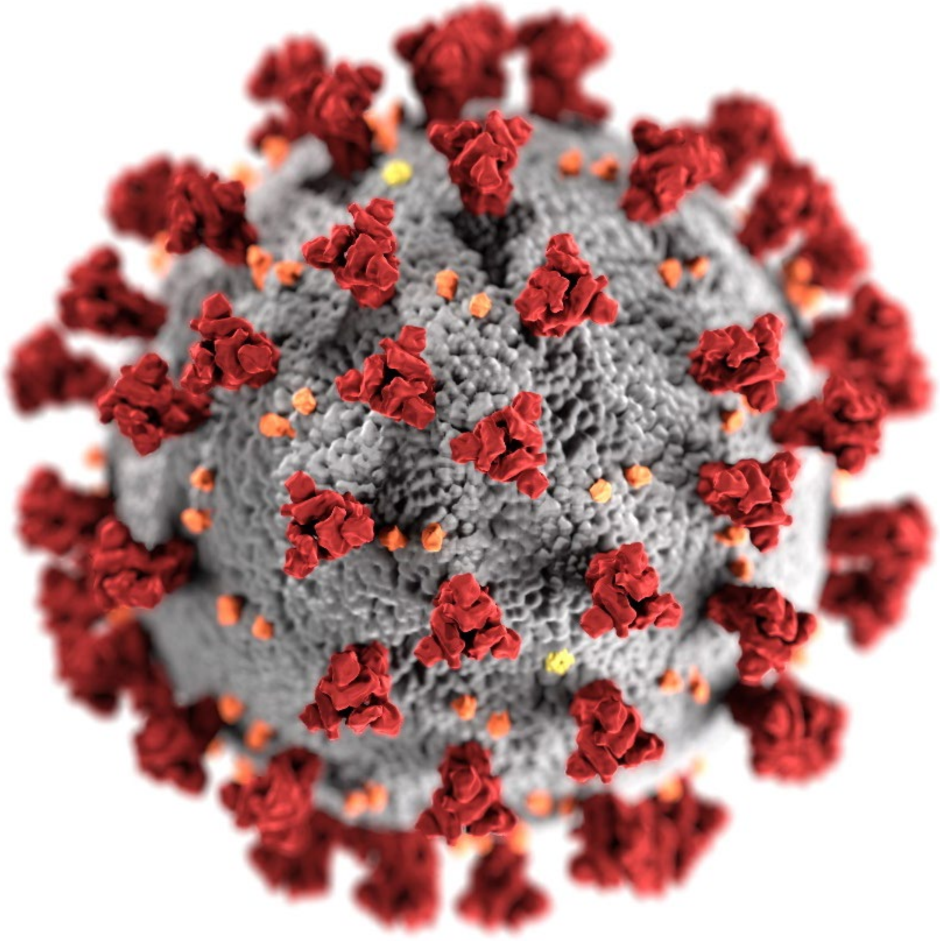
as of March 3, 2020

Centers for Disease Control and Prevention (CDC) Update

Jonathan Yoder
Water Preparedness and Response at the
Centers for Disease Control and Prevention

COVID 19
CORONAVIRUS DISEASE

COVID-19: Updates from CDC



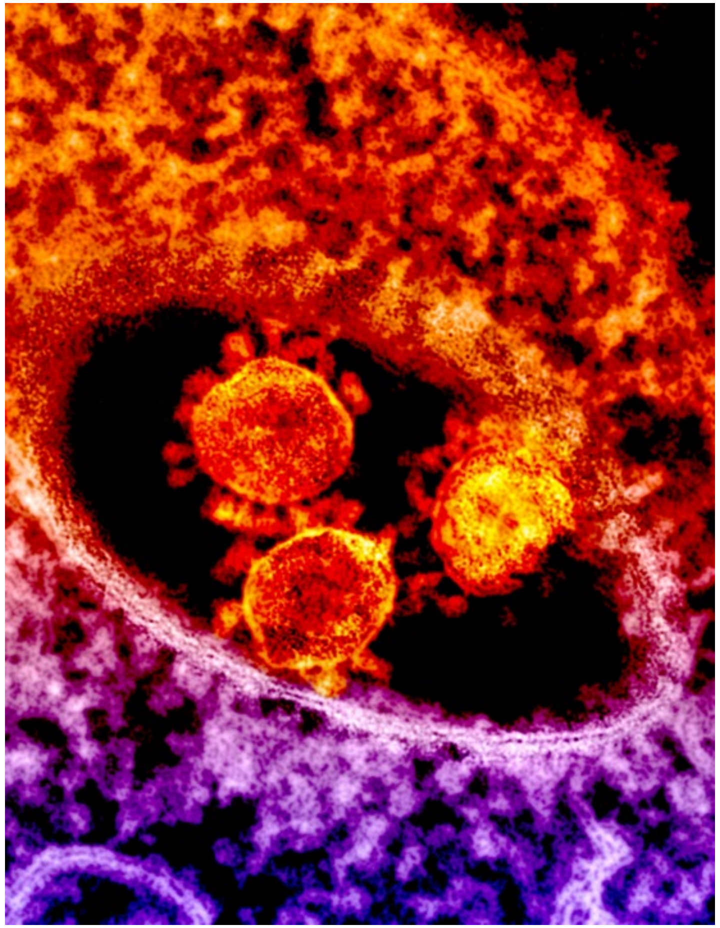
For more information: **www.cdc.gov/COVID19**

Overview of Presentation

- Coronavirus Disease 2019 (COVID-19)
- CDC Guidance
  - Hand Hygiene
  - Surface cleaning
  - Waste water, drinking water, recreational water

Coronavirus (CoV) Background

- Large family of viruses that cause respiratory illness
  - Belongs to *Coronaviridae* family
- First isolated in the 1960s
- Named for the crown-like spikes on surface
  - 4 subgroupings (alpha, beta, gamma, delta)
- Some can spread between among animals and people (zoonotic)

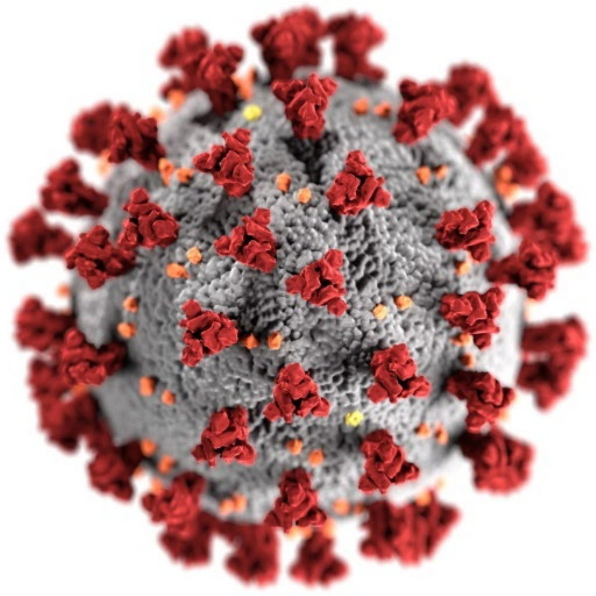


Coronavirus Disease 2019 (COVID-19)

COVID-19: Emergence

- Identified in Wuhan, China in December 2019
- Caused by the virus SARS-CoV-2
- Early on, many patients were reported to have a link to a large seafood and live animal market
- Later patients did not have exposure to animal markets
  - Indicated person-to-person spread
- Travel-related exportation of cases reported
  - First US case: January 21, 2020
- CDC is reporting confirmed COVID-19 cases in the US online at www.cdc.gov/coronavirus/2019-ncov/cases-in-us.html

How It Spreads



- Investigations are ongoing to better understand spread
- Largely based on what is known from other coronaviruses
  - Presumed to occur primarily through close person-to-person contact
    - May occur when respiratory droplets are produced when an infected person coughs or sneezes
  - Possibly by touching a surface or object that has the virus on it and then touching the mouth, nose, or eyes

COVID-19: Symptoms & Complications

Symptoms may include

- Fever
- Cough
- Shortness of breath

Wide range of illness severity has been reported

- Mild to severe illness
- Can result in death

Estimated incubation period

- 2 to 14 days

Complications may include

- Pneumonia
- Respiratory failure
- Multisystem organ failure

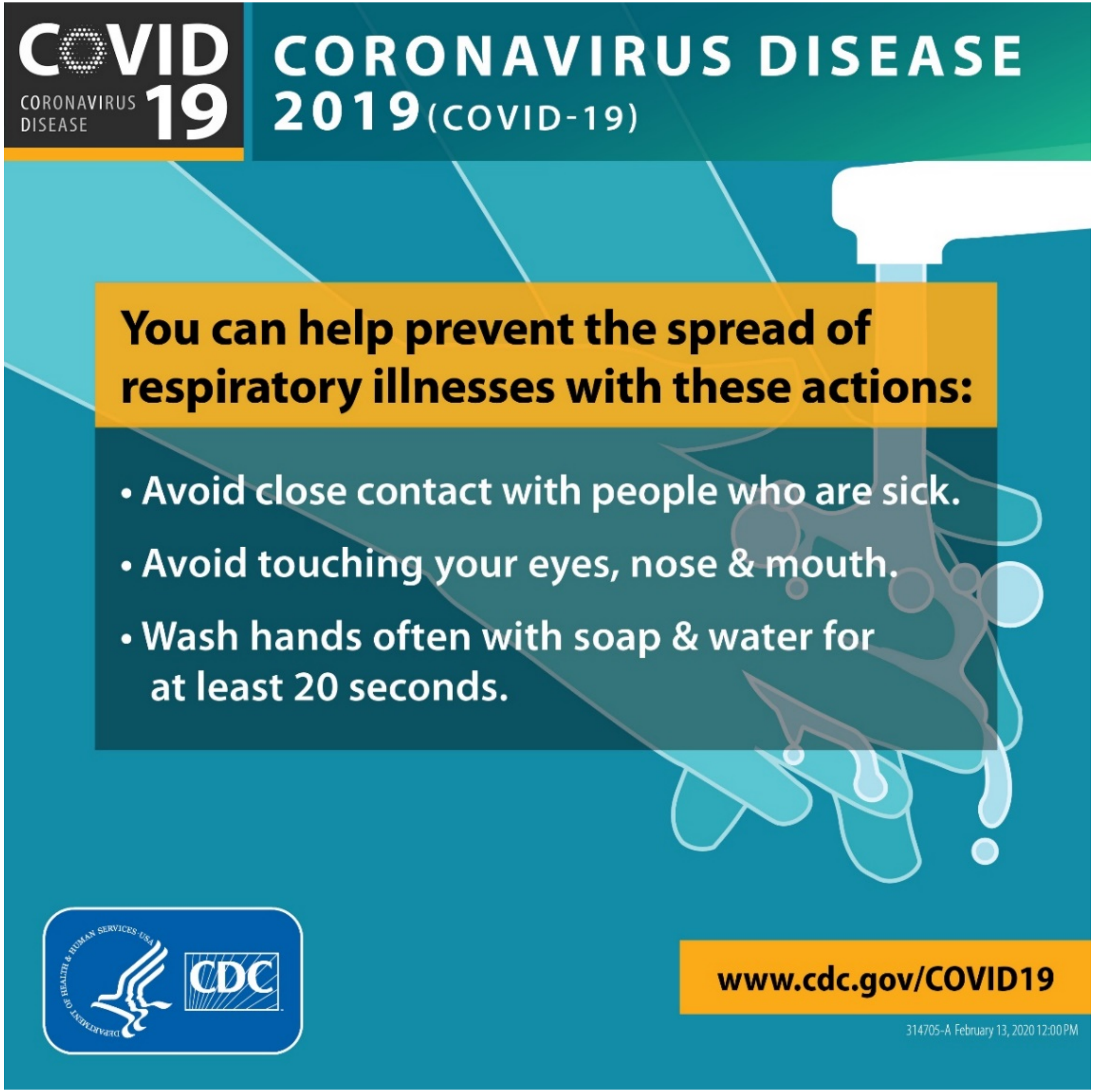
COVID-19: Prevention & Treatment

Everyday preventive actions for respiratory illnesses

- Avoid touching your eyes, nose, and mouth with unwashed hands
- Avoid close contact with people who are sick
- Stay home when you are sick
- Cover your cough or sneeze with a tissue, then throw it away
- Clean and disinfect frequently touched objects and surfaces
- Wash your hands often with soap and water for at least 20 seconds
  - Use an alcohol-based hand sanitizer with at least 60% alcohol if soap and water are not readily available

Treatment

- No specific antiviral treatment licensed for COVID-19
- Supportive care to
  - Relieve symptoms
  - Manage pneumonia and respiratory failure



COVID 19
CORONAVIRUS DISEASE
CORONAVIRUS DISEASE 2019 (COVID-19)
You can help prevent the spread of respiratory illnesses with these actions:
• Avoid close contact with people who are sick.
• Avoid touching your eyes, nose & mouth.
• Wash hands often with soap & water for at least 20 seconds.
CDC
www.cdc.gov/COVID19
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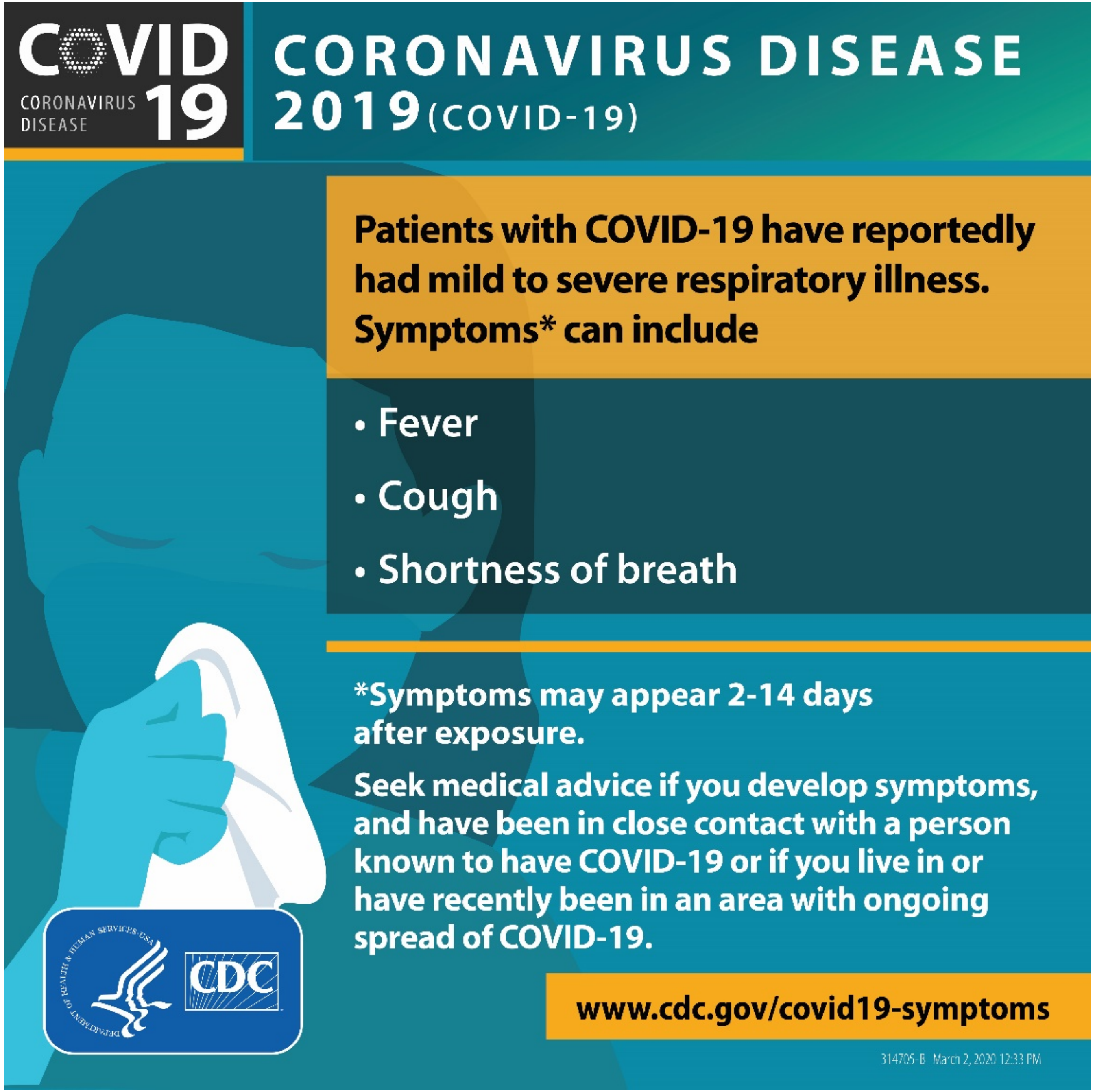
COVID 19 CORONAVIRUS DISEASE
CORONAVIRUS DISEASE 2019 (COVID-19)
Patients with COVID-19 have reportedly had mild to severe respiratory illness. Symptoms* can include
• Fever
• Cough
• Shortness of breath
*Symptoms may appear 2-14 days after exposure.
Seek medical advice if you develop symptoms, and have been in close contact with a person known to have COVID-19 or if you live in or have recently been in an area with ongoing spread of COVID-19.
CDC
www.cdc.gov/covid19-symptoms
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COVID-19: What You Should Do

Stay informed

- Latest COVID-19 information for the public (www.cdc.gov/COVID19)
- CDC's travel health notices (wwwnc.cdc.gov/travel/notices)

Take everyday preventive actions

- These are always recommended to prevent the spread of respiratory viruses

Call your medical provider if you

- Feel sick with fever, cough, or difficulty breathing

AND

- Have been in close contact with a person known to have COVID-19 or if you live in or have recently been in an area with ongoing spread of COVID-19.

CDC Resources for COVID-19

Preventing COVID-19 in Communities

Preventing COVID-19 in common community settings

- Homes
- Schools and childcare programs
- Colleges and Universities
- Workplaces
- Community and faith-based organizations
- Community event and mass gatherings

https://www.cdc.gov/coronavirus/2019-ncov/community/index.html

COVID-19: Cleaning and Disinfection in Community Settings

- Practice routine cleaning of frequently touched surfaces
  - Including tables, doorknobs, light switches, handles, desks, toilets, faucets, sinks
- Use household cleaners and EPA-registered disinfectants that are appropriate for the surface, following label instructions
- Additional guidance available for cleaning and disinfection of households with people isolated at home with COVID-19

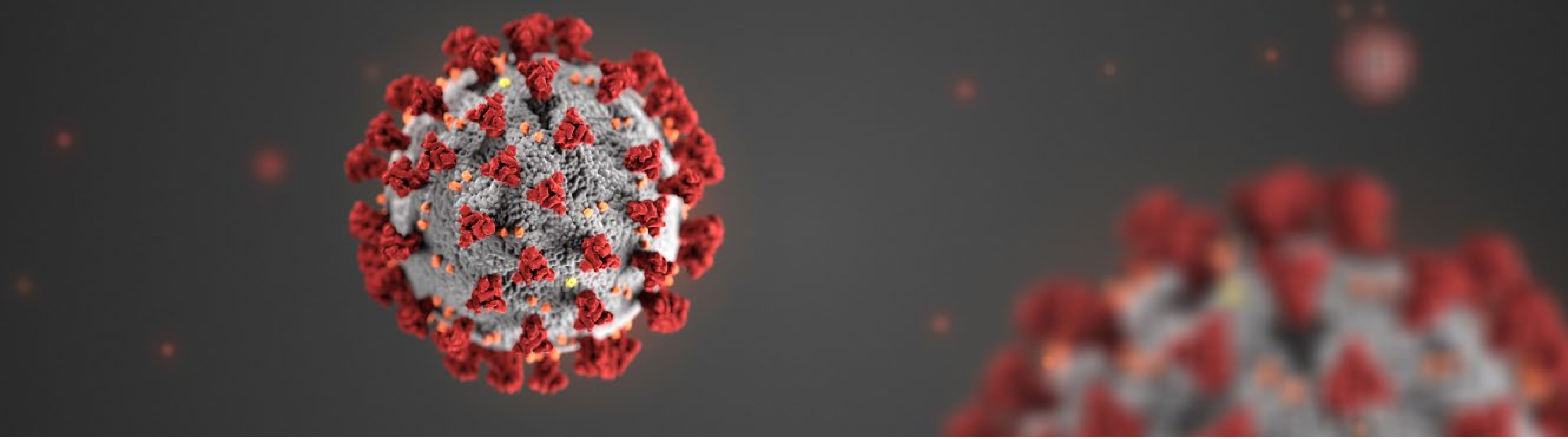
  www.cdc.gov/coronavirus/2019-ncov/community/home/cleaning-disinfection.html

COVID-19: Products to Use for Surface Disinfection

- Most common EPA-registered household disinfectants should be effective
- Bleach solutions (0.1% - 0.5%) and 70% alcohol have shown effectiveness against similar coronaviruses
- Products with EPA-approved emerging viral pathogens claims
  - www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2

COVID-19: Wastewater, Drinking Water, Recreational Water

- Virus is susceptible to disinfectants used in treatment
- Wastewater and sewage workers should:
  - Use standard practices
    - Basic hygiene precautions
    - Wear PPE as prescribed for current work tasks
- There is no evidence to suggest that employees of wastewater plants need any additional protections in relation to COVID-19
- New guidance on wastewater, drinking water, recreational water https://www.cdc.gov/coronavirus/2019-ncov/php/water.html



For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov

Water Environment Federation (WEF) Disinfection & Public Committee Update

Dr. Rasha Maal-Bared
EPCOR Water, WEF Waterborne Infectious Disease Outbreak Control (WIDOC) Working Group

The Water Professional's Guide to COVID-19: Preparedness, not Panic

Rasha Maal-Bared, PhD
Senior Microbiologist, EPCOR Water Canada
WEF DPHC WIDOC Working Group

Behind the webpage

- The authors
  - WEF Disinfection and Public Health Committee (DPHC)
    - Waterborne Infectious Disease Outbreak Control (WIDOC) Working Group
- The data synthesis and review process
  - WEF Internal Process – WIDOC & DPHC
  - External review process – CDC, OSHA and EPA
- Considering the many unknowns, can we make evidence-based recommendations to help the water sector control the spread of the COVID-19 virus?

What we know from health care

Most resistant to environmental conditions and disinfection

Prions (e.g., Creutzfeldt-Jacob Disease)

Bacterial Spores (e.g., *Bacillus anthracis*)

Coccidia (e.g., *Cryptosporidium*)

Mycobacteria (e.g., *Mycobacterium avium* complex)

Non-enveloped viruses (e.g., Ebola, Norovirus)

Fungi (e.g., *Aspergillus*)

Vegetative Bacteria (e.g., *E. coli, Pseudomonas, etc.*)

COVID-19 Virus

Enveloped viruses (e.g., COVID-19, SARS, Hepatitis)

Most susceptible

CDC. Guideline for Disinfection and Sterilization in Healthcare Facilities (2017). Adapted from: Favero & Bond (2001); Russel (1998).

What we know about COVID-19 Virus

- RNA was found in anal and oral swabs and blood (Zhang et al., 2020a), in feces (Holshue et al., 2020; Xiao et al., 2020; Ong et al., 2020) and on surfaces and PPE (Ong et al., 2020).
- Live virus was isolated from feces (Zhang et al., 2020b), saliva (To et al., 2020), respiratory secretions (Peng et al., 2020), surfaces and aerosols (In press).
- Has not yet been isolated from surface water, groundwater or wastewater (WW).

Most resistant to environmental conditions and disinfection

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Enveloped viruses (e.g., COVID-19, SARS, Hepatitis)

Most susceptible

- While fecal-oral transmission may be possible, likelihood of catching COVID-19 from feces seems low.
- Surfaces that come in contact with infected individuals or untreated WW could be contaminated with the COVID-19 virus.
- Airborne transmission in the form of droplets and aerosols is possible.

COVID-19 Virus

What we know about other coronaviruses

Human coronaviruses

- **SARS-CoV** (Wang et al., 2005a; Wang et al., 2005b; Rabenau et al., 2005)
- **Human coronavirus 229E** (HCoV-229E) (Gundy et al., 2009; Sizun et al., 2000; Sattar et al., 1989)

Most resistant to environmental conditions and disinfection

Prions (e.g., Creutzfeldt-Jacob Disease)

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Enveloped viruses (e.g., COVID-19, SARS, Hepatitis)

Most susceptible

Animal coronaviruses

- **Transmissible gastroenteritis virus** (TGEV) (Casanova et al., 2009)
- **Feline infectious peritonitis virus** (FIPV) (Gundy et al., 2009)
- **Mouse hepatitis virus (MHV)** (Casanova et al., 2009; Dellano et al., 2009)

- Coronaviruses are not more resistant to disinfection than *E. coli*, phages, or poliovirus (Gundy et al., 2009).
- Surrogate survival in the aquatic environment is impacted by environmental conditions, especially temperature.
- SARS-CoV RNA - but not live virus - was isolated from hospital wastewater (Wang et al., 2005b).
- Chlorination and superchlorination can be effective.

What we know about non-enveloped viruses

- **Poliovirus** (Gundy et al., 2009)
- **Ebolavirus** in WW (Bibby et al., 2017; Bibby et al., 2015; Haas et al., 2017)
- **Ebolavirus** on fomites (Smither, 2018)
- **Norovirus GI and GII** in secondary effluent (Dunkin et al., 2017)
- **Adenovirus, enterovirus and murine norovirus** (Cromeans et al., 2009)

Most resistant to environmental conditions and disinfection

Prions (e.g., Creutzfeldt-Jacob Disease)

Bacterial Spores (e.g., *Bacillus anthracis*)

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Non-enveloped viruses (e.g., Ebola, Norovirus)

Fungi (e.g., *Aspergillus*)

Vegetative Bacteria (e.g., *E. coli, Pseudomonas, etc.*)

Enveloped viruses (e.g., COVID-19, SARS, Hepatitis)

Most susceptible

- Chlorination and superchlorination are effective at inactivating these non-enveloped viruses, which are more resistant than COVID-19 virus.
- PPE and good hygiene practices are protective.
- Free chlorine residual is a good indicator of process efficacy.
- Surfaces in frequent contact with untreated wastewater should be disinfected.

What do we know about water treatment

- Disinfection requirements based on inactivation of pathogens more or equally resistant to disinfection.
- Every stage of treatment, retention or dilution controls additional microorganisms.
- Conventional oxidation (e.g., hypochlorite, chloramine, PAA) and UV irradiation should be effective at inactivating the COVID-19 virus.
- Monitoring traditional performance parameters is predictive of process efficacy and safety.

What utilities can do

People

- Do not panic!
- Stay informed.
- Communicate why we make the decisions we make internally and externally.
- Encourage wearing PPE and good hygiene practices.

Processes

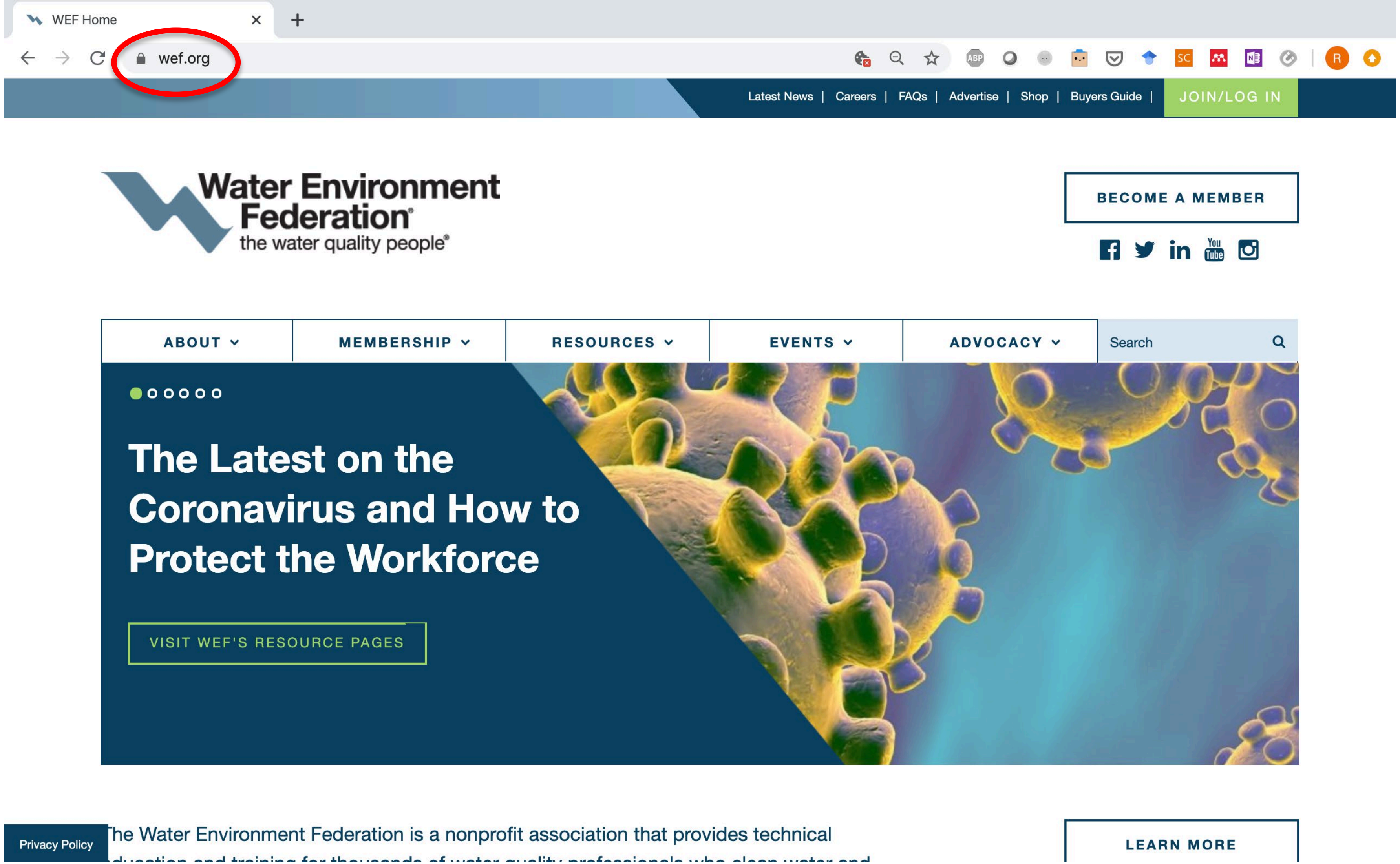
- Business as usual
  - Current disinfection practices are expected to be sufficient.
  - Monitoring plant performance (e.g., free chlorine, fecal indicator bacteria, UVT).
- Supply chain management is crucial (e.g., parts, equipment, PPE, chemicals).

Plants and collection systems

- Examine administrative controls (e.g., safe work plans, hazard assessments and registries, and risk assessments).
- Identify critical staff and their backups.
- Review engineering controls in high risk areas (e.g., pump stations, headwaters, aeration basins, etc.) and high risk tasks (e.g., high splash activities).

Other guidance documents related to wastewater

Topic	WEF guidance	OSHA/CDC guidance	WHO guidance	Water Research Australia	Stantec whitepaper
Waterborne transmission	Possible				
Worker safety	Standard PPE and hygiene practices				
Wastewater treatment	Standard				Depends on design
Surface or fomite survival	Yes				N/A
Patient waste	Class B	Class B	Class A	N/A	N/A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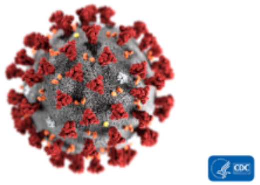

The 2019 Novel Coronavirus (officially named SARS-CoV-2) is the cause of a respiratory illness called Coronavirus disease (COVID-19). It was identified as the cause of an outbreak first detected in Wuhan, China on Dec. 12, 2019. The disease has spread worldwide. This means it is important for water sector professionals to keep informed on the attributes of the virus's spread and illness as well as any measures needed to protect both workers and public health.

This page will be updated periodically with limited general information, specific water sector technical information, WEF policies and decisions, and links to trusted sites for the most up-to-date official information.

WATER-SECTOR SPECIFIC INFORMATION

WEF EVENTS UPDATE

Privacy Policy

Coronavirus Field Guide

wef.org/news-hub/wef-news/the-water-professionals-guide-to-the-2019-novel-coronavirus/

Water Environment Federation
the water quality people®

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The Water Professional's Guide to COVID-19

February 11, 2020

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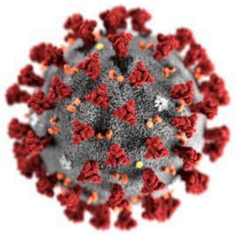
The 2019 Novel Coronavirus was identified as the cause of an outbreak of respiratory illness, referred to as COVID-19. It was first detected in Wuhan, China on Dec. 12, 2019. Because this disease already has begun to spread worldwide, it is important that water sector professionals keep informed on the attributions of this virus and any measures needed to protect both workers and public health, in general.

Disclaimer: The information posted here is a summary of current knowledge about this emerging viral pathogen. The state of knowledge will evolve as additional investigation and research is conducted, so continuous review of reputable sources and websites is advised.



CDC

Extent of the 2019 Novel Coronavirus Outbreak

Wastewater Treatment and COVID-19

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Coronavirus Field Guide

wef.org/news-hub/wef-news/the-water-professionals-guide-to-the-2019-novel-coronavirus/

Authors & Acknowledgements

More Resources on Coronavirus

Authors & Acknowledgements

This article was prepared by the **WEF Disinfection and Public Health Committee's (DPHC) Waterborne Infectious Disease Outbreak Control (WIDOC) Working Group**.

- **Rasha Maal-Bared** is the Senior Microbiologist at EPCOR Water Services Inc. (Edmonton, Canada) and the current chair of the Waterborne Infection Disease Outbreak Control Working Group.
- **Robert Bastian** is a senior environmental scientist at the U.S. Environmental Protection Agency.
- **Kyle Bibby** is an Associate Professor and the Wanzek Collegiate Chair in the Department of Civil and Environmental Engineering and Earth Sciences at the University of Notre Dame (Notre Dame, Ind.).
- **Kari Brisolara** is the Associate Dean for Academic Affairs and an Associate Professor of Environmental and Occupational Health Sciences at the Louisiana State University Health Sciences Center (New Orleans, La.) and Vice Chair of the WEF Disinfection and Public Health Committee.
- **Lee Gary** is an Adjunct Professor at Tulane University, an instructor with the Basic Academy at the FEMA/Emergency Management Institute (Emmitsburg, Md.) and the owner and CEO of Strategic Management Services (New Orleans).
- **Chuck Gerba** is a professor of epidemiology and biostatistics in the Dept of Environmental Science at the University of Arizona and a supporting member of the WIDOC working group.
- **Lola Olabode** is a Program Director at the Water Research Foundation and an expert in risk management during outbreaks (Washington, D.C.).
- **Naoko Munakata** is a Supervising Engineer at the Los Angeles County Sanitation Districts.
- **Robert S. Reimers** is a Professor Emeritus at Tulane University's School of Public Health and Tropical Medicine, the Director of Asepticys Inc. (New Orleans, La.).
- **Albert Rubin** is a professor emeritus at North Carolina State University in the Dept of Biological and Agricultural Engineering.
- **Scott Schaefer** is the Wastewater Practice Leader with AE2S (Saint Joseph, Minn.) and the Chair of the WEF Disinfection and Public Health Committee.
- **Samendra Sherchan** is an Assistant Professor at the Tulane School of Public Health and Tropical Medicine (New Orleans, La.).
- **Jay Swift** is a Principal Engineer with Gray and Osborne (Seattle, Wash.).

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Privacy Policy

Going viral: working towards virus risk management in wastewater treatment systems

May 7, 2020 1:00-2:30 PM (EST)

Speakers: Charles Gerba, Kyle Bibby, Sharon Nappier and Thomas Worley-Morse

Moderator: Naoko Munakata

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Technical Research Update and Lessons Learned from Ebola and other viruses

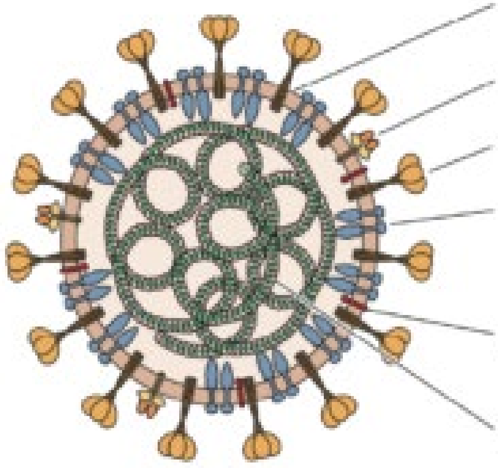
Dr. Mark Sobsey
Gillings Schools of Global Public Health
University of North Carolina Chapel Hill

Dr. Lisa Casanova
Georgia State University

COVID-19 Virus: Technical Research Update and Lessons Learned from SARS, Ebola and Other Viruses

Mark D. Sobsey
University of North Carolina
Lisa Casanova
Georgia State University

COVID-19 Virus:



- Lipid envelope
- Zoonotic
- Typical respiratory infection
  - most cases (~80%) are mild,
  - some cases (~20%) are severe and require hospitalization
  - Asymptomatic infection occurs
- Some develop gastrointestinal illness
  - Limited evidence of enteric infection, but plausible
- Respiratory secretions, blood and sometimes fecal matter; shedding can occur before illness appears
  - Duration of shedding is days to possibly weeks

Exposure and Transmission: Known Sources

Major: Respiratory Secretions

- Person-to person direct contact
- Airborne droplets (within a few feet)
- Concentrations in respiratory secretions (as nucleic acid)

Less certain but documented:

- Secretions and other deposits on inanimate surfaces
- Indirect contact
- touch surfaces
- other fomites (toilets)

Ong et al Air, Surface Environmental, and Personal Protective Equipment Contamination by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) From a Symptomatic Patient. JAMA. March 4, 2020. doi:10.1001/jama.2020.3227

Exposure/Transmission(?): Less Known

Feces

- Presence, concentrations and infectivity:
- Virus nucleic acid and virions detected in patient feces
- Histopathological evidence of enteric infection
- Fecal shedding of viral nucleic acid for ~4 weeks
- Cell culture detection in fecal samples (China)

Uncertain/Unknown:

- Infectious virus concentrations in feces
- Feces as a potential transmission source?
  - Extent of fecal transmission?
- Airborne exposure and spread from bioaerosols
  - Concentrations in indoor and outdoor air?

1. (Xiao F, Tang M, Zheng X, Liu Y, Li X, Shan H, Evidence for gastrointestinal infection of SARS-CoV-2, Gastroenterology (2020), doi: https://doi.org/10.1053/j.gastro.2020.02.055.)
2. http://weekly.chinacdc.cn/en/article/id/ffa97a96-db2a-4715-9dfb-ef662660e89d

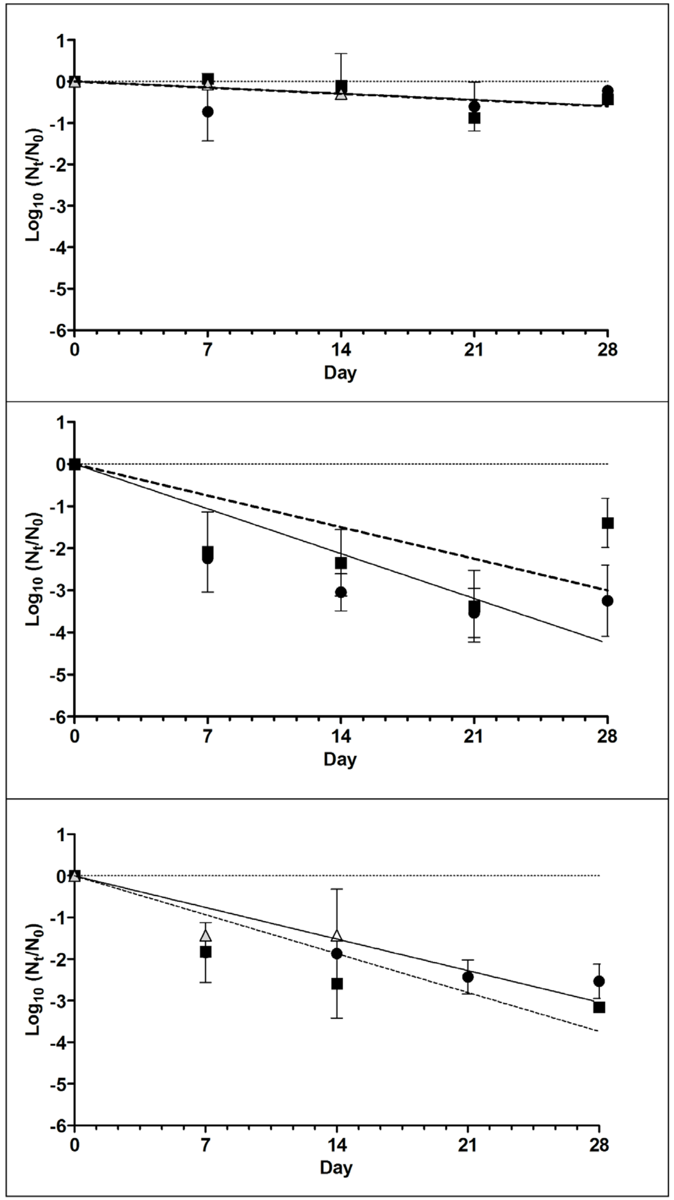
Presence and Survival in the Environment

Known

- Concentrations of other CoVs in some environmental samples
- Survival of other CoVs in some media
    - sewage, water, surfaces and some foods.

Unknown

- concentrations in feces, sewage or water
- if other CoVs are predictive of concentrations
- survival in feces, sewage, water and other media
- if survival of other CoVs is predictive



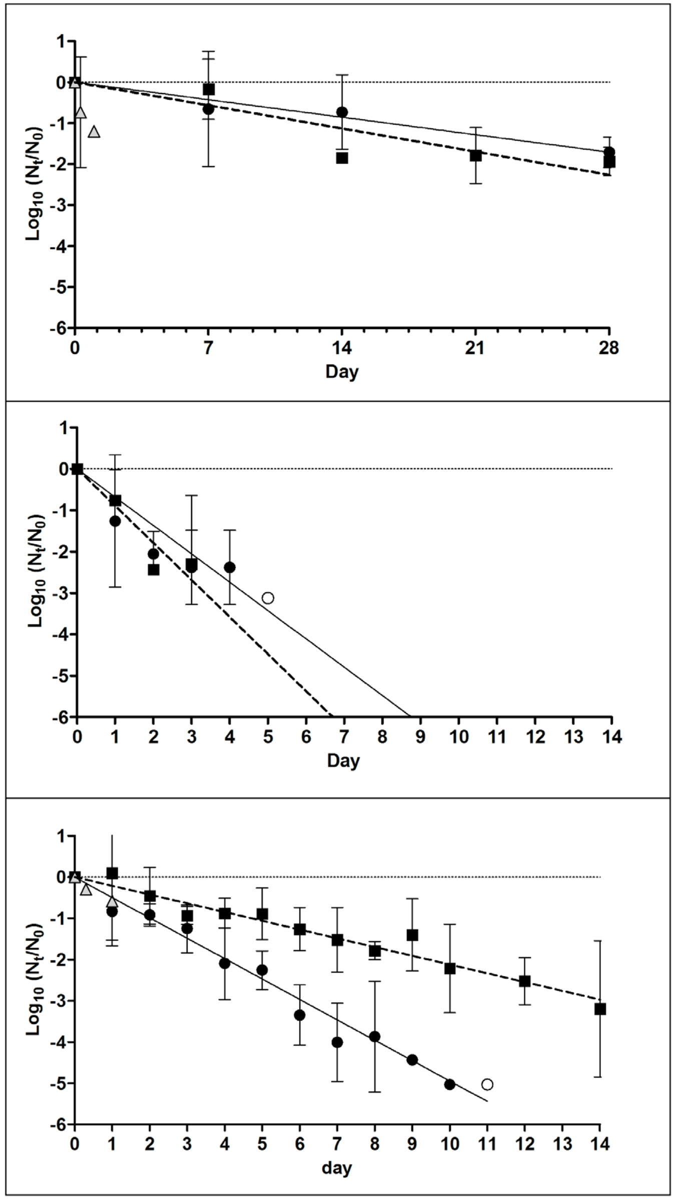
4°C 20% RH 25°C

greater at
lower temp
and
lower RH

4°C 50% RH 25°C

CoV Survival on Surfaces

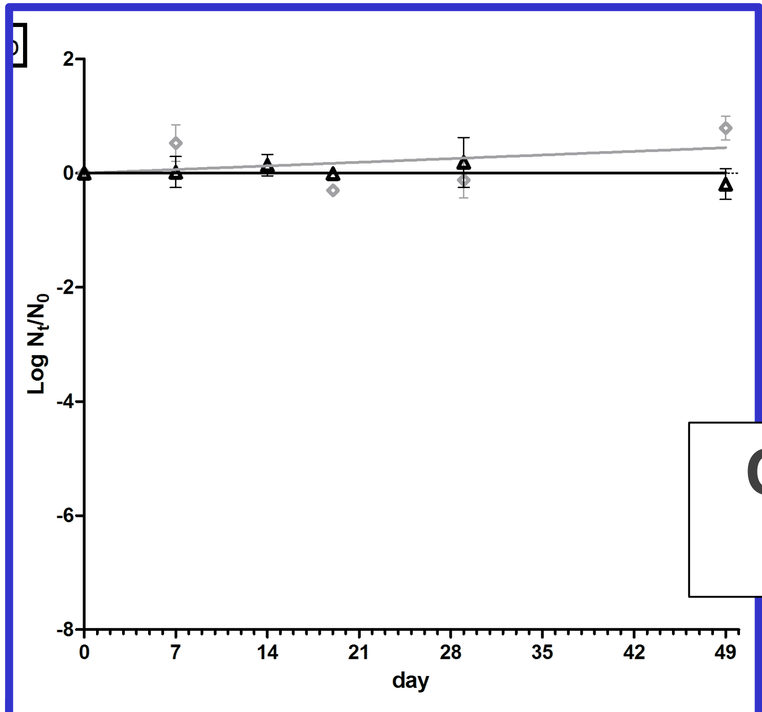
4°C 80% RH 25°C

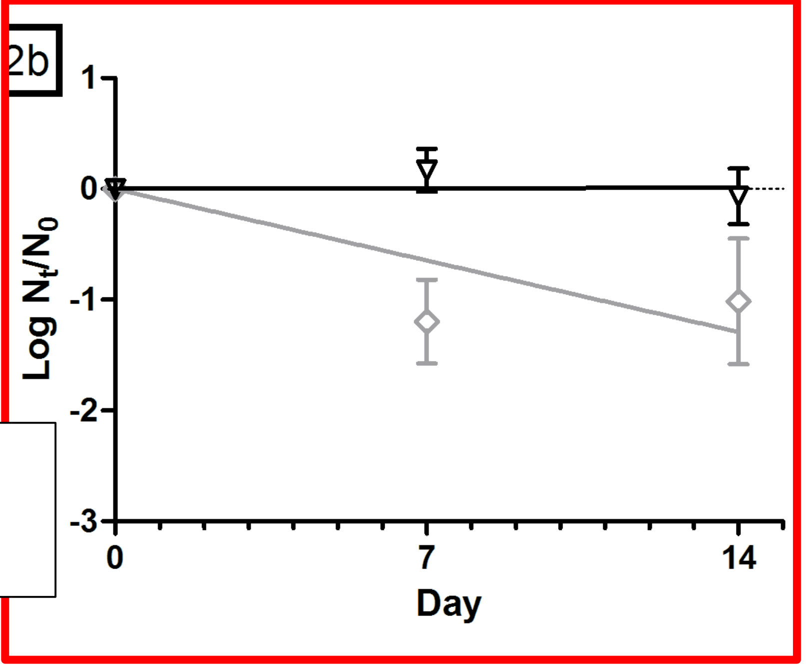


Casanova LM, Jeon S, Rutala WA, Weber DJ, Sobsey MD. (2010) Effects of air temperature and relative humidity on coronavirus survival on surfaces. Appl Environ Microbiol. 2010 May;76(9):2712-7.

CoV Survival in Water

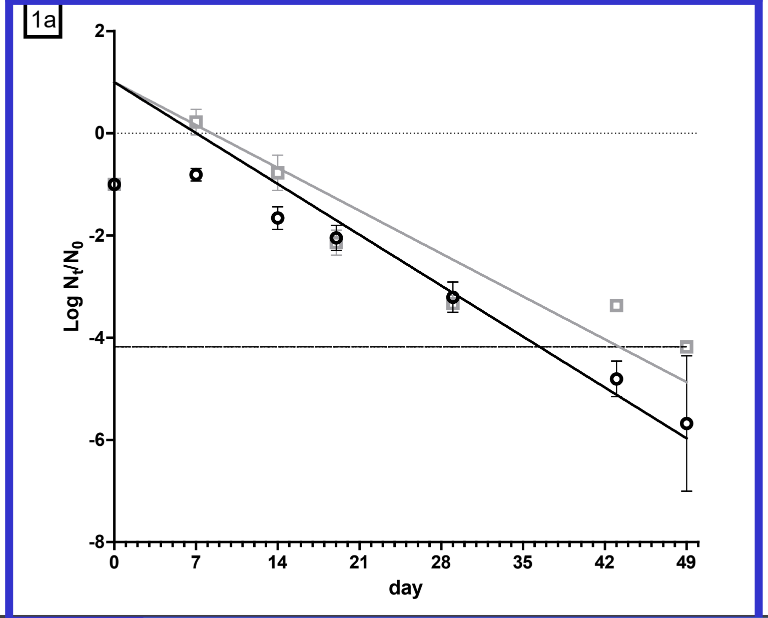
Reagent water
4°C
lake water

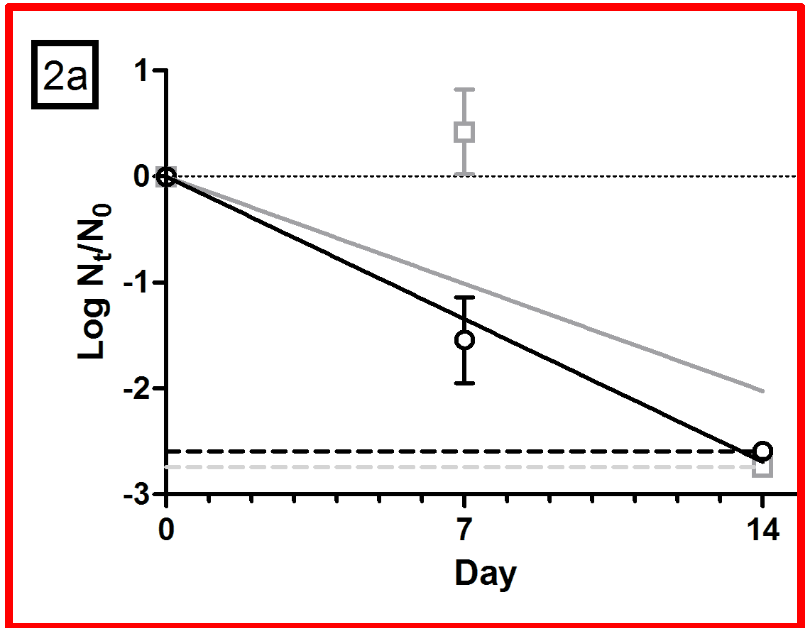




Survival:
long periods in reagent or lake water. Especially at lower temp

Reagent water
25°C
lake water





Casanova L, Rutala WA, Weber DJ, Sobsey, MD. 2009. Survival of surrogate coronaviruses in water. Water Res. 43(7): 893-8.

Expectations for COVID-19 Virus Survival in Environmental Media

- COVID-19 virus may be expected to survive for extended periods of time in environmental media
  - Inactivation is not immediate or very rapid
- Extensive declines of virus infectivity are expected over several days or weeks in aqueous media (sewage & water)
  - depends on temperature, matrix/medium and other environmental conditions
- On environmental surfaces, extensive declines of virus infectivity are expected in hours, days or weeks
  - depends on the matrix/medium, surface and environmental conditions (e.g., temperature and RH)

Disinfection

Other CoVs indicate susceptibility to range of chemical disinfectants and UV radiation (UVC)

Water

- Lime
- quaternary ammonium compounds
- peracetic & peroxyacetic acids
- chlorine dioxide
- Use at recommended concentrations or dilutions
- More sensitive than enteric viruses.
- Free chlorine is less effective with high organic load
- Conventional wastewater treatment systems likely to reduce at least as well as other human viruses

Surfaces

- Free chlorine
- ethanol (70%)
- quaternary ammonium compounds
- Glutaraldehydes
- peracetic and peroxyacetic acids
- chlorine dioxide
- phenolic compounds
- Available as EPA-certified formulations
- Use at recommended concentrations or dilutions

Recommendations and Guidance

WHO:

- Recommendations

World Health Organization

unicef

Water, sanitation, hygiene and waste management for the COVID-19 virus

Technical brief
3 March 2020

- https://www.who.int/publications-detail/water-sanitation-hygiene-and-waste-management-for-covid-19

WEF and OSHA

- All elements of WEF and OSHA guidance should be practiced
- https://www.osha.gov/SLTC/covid-19/controlprevention.html#solidwaste
- https://www.wef.org/news-hub/wef-news/the-water-professionals-guide-to-the-2019-novel-coronavirus

Recommendations: WHO

- Separate housing and sanitation facilities for cases
- Waste containment and storage for die-off over time
  - safe disposal.
  - Worker IPC
  - Sanitation Safety Plan
- Wastes can be transferred safely to effectively managed sanitation systems (on-site or central systems with disinfection).
  - Safe conveyance & worker IPC
- On-site waste disinfection for small systems is an option
  - Recommended: lime
  - Alternatives: peracetic acid, quaternary ammonium compounds or chlorine dioxide

Recommendations: WEF and OSHA

- WEF guidance on COVID-19 virus: adequate to minimize risks
- Handle solid waste with COVID-19 virus as Category B Medical Waste
- Workers in contact with fecal wastes
  - wear recommended PPE
  - follow recommendations for good hygiene (e.g., handwashing)
- Wastewater disinfection
  - free chlorine, peracetic acid or UV radiation is effective
  - use sufficient doses and contact times (CT values)
- Free chlorine dosed to achieve a free residual of 0.2 to 0.5 mg/L readily inactivates SARS CoV, other viruses and probably COVID-19 virus

Research Needs

- Develop data for survival of infectious COVID-19 virus and candidate surrogate viruses
  - human wastes and environmental media
- Compare survival of COVID-19 virus and surrogates
  - extrapolate or estimate COVID-19 virus survival based the survival of surrogates
  - range of matrices for a range of environmental conditions,
  - address waste treatment and disinfection processes.
- Candidate disinfectants
  - free chlorine, peracetic acids/peroxyacetic acids, quaternary ammonium compounds, chlorine dioxide, lime, gluteraldehydes

Closing words:

- Be sensible and take precautions
- Follow available guidance and recommendations
- Don't panic!
- Thank you!
- Questions?

http://aseanews.net/2020/02/12/editorial-the-straits-times-says-panic-and-fear-more-deadly-than-virus/

Current and Ongoing Projects

Dr. Kyle Bibby
University of Notre Dame

COVID-19 Virus
Relevance to Water and Wastewater

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Associate Professor and Wanzek Collegiate Chair
Civil and Environmental Engineering and Earth Sciences
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Kyle Bibby, PhD, PE

COLLEGE OF ENGINEERING

- Associate Professor at University of Notre Dame
  - Previously faculty at University of Pittsburgh
- Professional Engineer (Illinois)
- WEF Disinfection Committee
- Research on viruses in wastewater systems, including fate, detection, and improved indicators
- Previous research on Ebola virus in wastewater; current project on Lassa virus in wastewater

Collaborators

COLLEGE OF ENGINEERING

- Dr. Vincent Munster and Dr. Robert Fischer at NIH Rocky Mountain Labs
- Students include Nathalia Aquino (Pitt), Dr. Elyse Stachler (Pitt), Justin Greaves (ND)
- *Ebola work:* Leonard Casson at University of Pittsburgh
- *Ebola work:* Chuck Haas at Drexel University

Prior Work – Ebola Virus in WW

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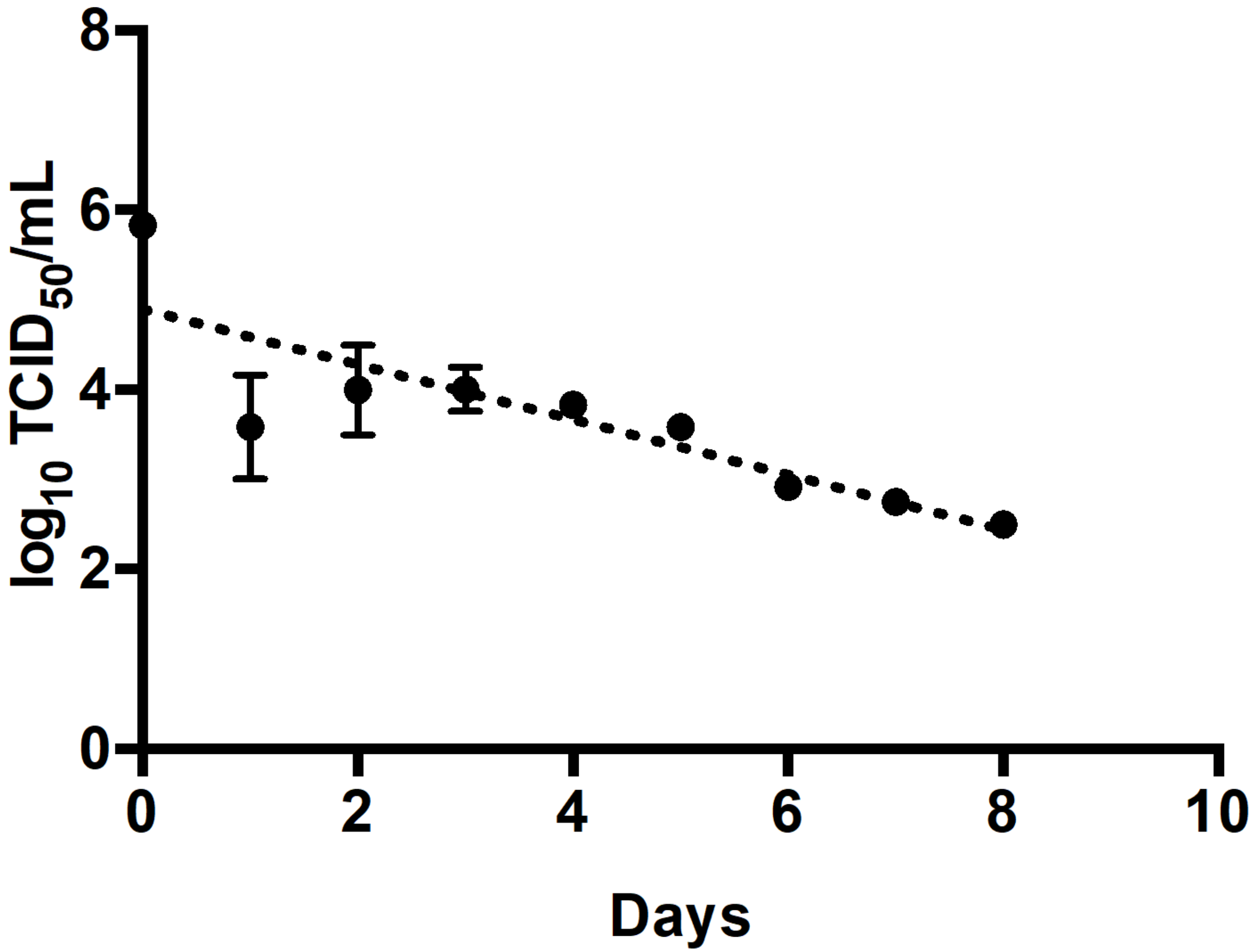

Bibby et al. *ES&T Letters* 2015

Lessons from the Ebola Virus Outbreak

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- Virus persisted longer than expected[1]
- Surrogates inadequate to fully describe[2]
- Disinfection highly effective[3]
- PPE significantly reduced risk in QMRA models[4]

1. Bibby, K.; Fischer, R. J.; Casson, L. W.; Stachler, E.; Haas, C. N.; Munster, V. J., Persistence of Ebola Virus in Sterilized Wastewater. *Environmental Science and Technology Letters* **2015,** *2*, (9), 245-249.
2. Aquino de Carvalho, N.; Stachler, E. N.; Cimabue, N.; Bibby, K., Evaluation of Phi6 Persistence and Suitability as an Enveloped Virus Surrogate. *Environmental Science & Technology* **2017,** *51*, (15), 8692-8700.
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4. Haas, C. N.; Rycroft, T.; Bibby, K.; Casson, L., Risks from Ebolavirus Discharge from Hospitals to Sewer Workers. *Water Environment Research* **2017,** *89*, (4), 357-368.

Isn't COVID-19 virus respiratory?

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- Recent reports have identified COVID-19 virus in the stool of an infected individual[1]
- Isolation of a culturable virus in the stool of an infected individual[2]
- Coronavirus receptor ACE2 is expressed in the small intestine and SARS-CoV replicates in the gastrointestinal tract[3]

1. Holshue, M. L.; DeBolt, C.; Lindquist, S.; Lofy, K. H.; Wiesman, J.; Bruce, H.; Spitters, C.; Ericson, K.; Wilkerson, S.; Tural, A., First Case of 2019 Novel Coronavirus in the United States. *New England Journal of Medicine* **2020**.
2. Yong, Z.; Cao, C.; Shuangli, Z.; Chang, S.; Dongyan, W.; Jingdong, S.; Yang, S.; Wei, Z.; Zijian, F.; Guizhen, W.; Jun, X.; Wenbo, X., Isolation of 2019-nCoV from a Stool Specimen of a Laboratory-Confirmed Case of the Coronavirus Disease 2019 (COVID-19). *China CDC Weekly* **2020,** *2*.
3. Leung, W. K.; To, K.-f.; Chan, P. K.; Chan, H. L.; Wu, A. K.; Lee, N.; Yuen, K. Y.; Sung, J. J., Enteric involvement of severe acute respiratory syndrome-associated coronavirus infection. *Gastroenterology* **2003,** *125*, (4), 1011-1017.

Coronavirus Fate Data in WW Limited

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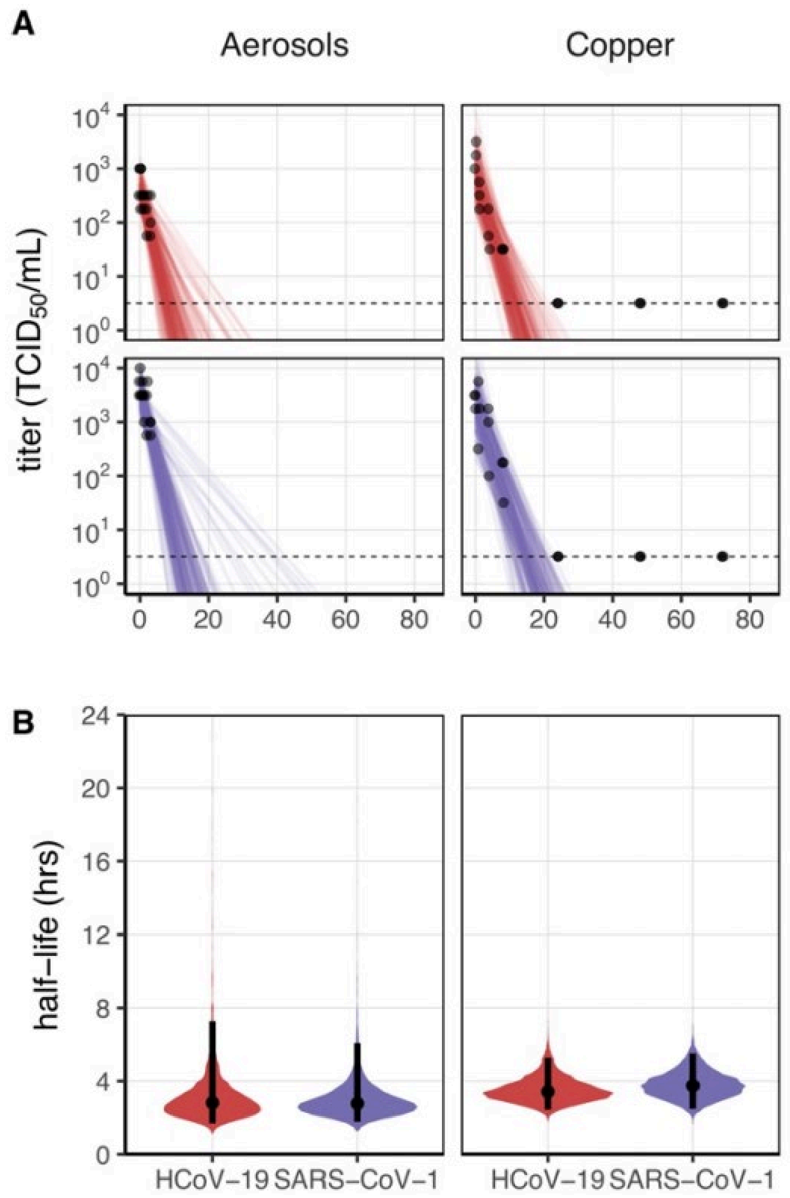
- SARS RNA detected in 10/10 wastewater samples and 3/10 following disinfection[1]
- "SARS-CoV persisted 2 days in hospital wastewater, domestic sewage and dechlorinated tap water… at 4 °C, the SARS-CoV could persist for 14 days in wastewater and at least 17 days in feces or urine" [2]
- "SARS-CoV persisted 14 days in sewage at 4°C, 2 days at 20°C, and its RNA can be detected for 8 days though the virus had been inactivated." [3]

1. Wang, X.-W.; Li, J.-S.; Guo, T.-K.; Zhen, B.; Kong, Q.-X.; Yi, B.; Li, Z.; Song, N.; Jin, M.; Wu, X.-M., Excretion and detection of SARS coronavirus and its nucleic acid from digestive system. *World Journal of Gastroenterology: WJG* **2005,** *11*, (28), 4390.
2. Wang, X.-W.; Li, J.-S.; Jin, M.; Zhen, B.; Kong, Q.-X.; Song, N.; Xiao, W.-J.; Yin, J.; Wei, W.; Wang, G.-J., Study on the resistance of severe acute respiratory syndrome-associated coronavirus. *Journal of virological methods* **2005,** *126*, (1-2), 171-177.
3. Wang, X.; Li, J.; Guo, T.; Zhen, B.; Kong, Q.; Yi, B.; Li, Z.; Song, N.; Jin, M.; Xiao, W., Concentration and detection of SARS coronavirus in sewage from Xiao Tang Shan Hospital and the 309th Hospital of the Chinese People's Liberation Army. *Water science and technology* **2005,** *52*, (8), 213-221.

Persistence in Aerosols and on Surfaces

- Surface and aerosol persistence generally comparable to COVID-19 virus [1]
- "Our results indicate that the greater transmissibility observed … is unlikely to be due to greater environmental viability of this virus compared to SARS-CoV-1."[1]



1. van Doremalen et al. "Aerosol and surface stability of HCoV-19 (SARS-CoV-2) compared to SARS-CoV-1". *MedRXiv*.

Key Uncertainties

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- ***Load* and *Viability* of the virus in stool and wastewater**

- *Persistence* of the virus in stool and wastewater

- *Disinfection* of the virus in stool and wastewater

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Case Study – Australia

Dr. Dan Deere
Water Quality Specialist at Water Futures, Australia

Australian water sector response to COVID-19

WATER SERVICES ASSOCIATION OF AUSTRALIA

10 YEARS Water Research AUSTRALIA

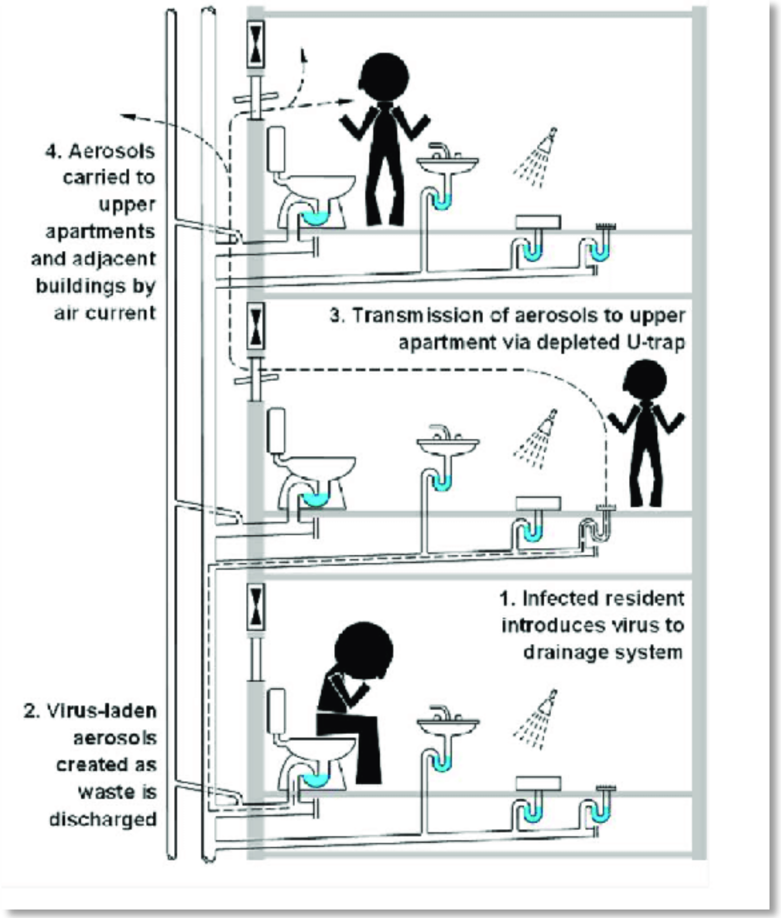
enHEALTH

Evolution of response
1. The Calm…(Dec-Jan)

- Not much action at first:
  - A. The COVID-19 virus was isolated to Wuhan so no special action in Australia
  - B. The COVID-19 virus was not a water and sanitation issue so no special action or interest from the Australian water sector
- Important Lesson #1: the world is interconnected – we all need to respond even if it starts off as "someone else's problem"

Evolution of response
2. The awakening…(Jan-Feb)

- Chinese Center for Disease Control and Prevention (CCDC) and Ministry of Construction (MoC) asked bilingual microbiologist from IDEXX (Xukun 'Kathy' Zhao) in Shanghai to get advice on **implications for water and wastewater** and on testing
- IDEXX Shanghai contacted Sydney Water (Dr Peter Beatson) for advice and support
- They were aware of the Amoy Gardens SARS transmission in Hong Kong

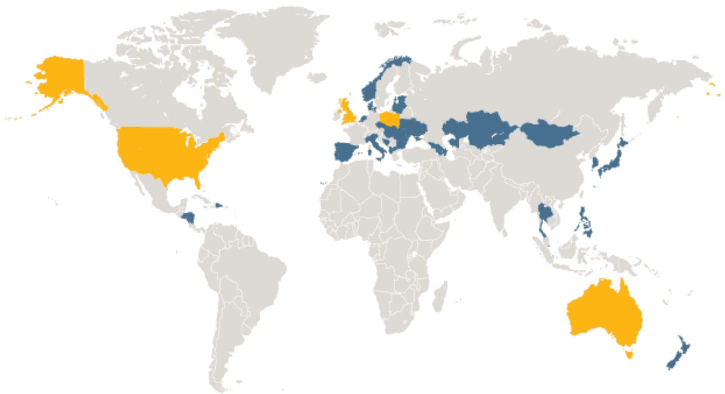


Evolution of response
2. The awakening…

- They needed urgent support
- We couldn't quickly organise a formal response
- Important Lesson #2 – Pandemics don't wait for 'due process' – <u>we need rapid response</u>
- We need to be on standby and set up to respond fast and our current bureaucratic processes aren't set up to do that …
  - a. Our scientific processes are set up for:
    - Grant application
    - Do the literature review and/or research
    - Peer review and publish
  - b. Our communication processes require lengthy formal approvals

Evolution of response
2. The awakening…

- Peter Beatson organised an informal 'coalition of the willing' peers to try to respond urgently but informally
  - (Christobel Ferguson, Dan Deere, Kaye Power, Chris Owens, Peter Cox, Greg Ryan, Sandi Kolbe, Adam Lovell, Paul Monis, Alex Keegan, Peter White, David Cunliffe, Suzie Sarkis, David Roser, Ken Rotert, Kelly Hill *et al*.)



Evolution of response
2. The awakening…

- Informal advice (Deere → Zhao → to CCDC and MoC):
  - no general immediate need to test for the virus in waters
  - conventional microbial indicators can still verify water quality
  - normal treatment (chlorine) is a reliable barrier to coronaviruses
  - just continue with conventional water/wastewater treatment
  - just continue with conventional wastewater safe work practices
- Advice shared with Chinese water/wastewater agencies
- Some raised chlorine setpoints (up another 0.2 mg/L)

Evolution of response
3. Problems started in Oz…(Feb)

- Sewer workers concerned for their safety
  - Particularly in areas with Chinese tourists and large Chinese populations
- Concerns about workers being stressed or even refusing to work
- Health agencies and utilities developed responses to ease minds
- Water Research Australia (Dr Kelly Hill) collated those thoughts and put out a formal 'fact sheet' to further put minds at ease:
  - https://www.waterra.com.au/_r9550/media/system/attrib/file/2200/WaterRA_FS_Coronavirus_V11.pdf

Factsheet

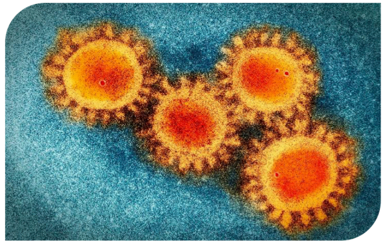
SARS-CoV-2 - Water and Sanitation

Water Research AUSTRALIA

This information sheet synthesises information currently available on SARS-CoV-2 [previously known as novel coronavirus (2019-nCOV)] — what is known about the virus, similar viruses, the related disease (COVID-19), and the management of viruses in terms of water and sanitation systems.

What is Coronavirus (CoV)?

Coronaviruses are a large and diverse family of enveloped[i] RNA[ii] viruses. These lipid-enveloped CoV viruses are generally considered more fragile than other viruses (both environmentally, and to disinfection), however are known to cause illness of variable severity in humans, including the common cold, severe acute respiratory syndrome (SARS-CoV), and Middle East Respiratory Syndrome (MERS-CoV). The name 'corona' comes from their round appearance and the spikes on their surface that can be likened to a solar corona, as shown in the image below.



The term HCoV is used to represent human coronaviruses, of which there are seven types currently described. Although most human coronavirus infections cause mild symptoms and may even go unnoticed[15], two coronaviruses: SARS-CoV[iii], and MERS-CoV[iv], emerged in 2002 and 2012, respectively, and resulted in epidemics, that infected thousands and caused hundreds of deaths.

Quick Facts

- Virus is enveloped, single stranded RNA
- Chlorine typically inactivates CoV[4,9]
- The virus can cause pneumonia[3,7]
- In many cases disease (COVID-19) is mild[15]

[i] The term 'enveloped' refers to the membrane envelope around the surface of the virus. Some viruses are 'naked' and have no such membrane envelope. This feature is relevant to understanding their resistance to disinfection as well as their environmental persistence and transmission.

SARS-CoV-2

Prior to late 2019 there were just six types of HCoV described. However, a cluster of patients suffering from pneumonia (a lung infection) was identified in the city of Wuhan, Hubei Province, China, on 21 December 2019. Testing of fluid from a patient's lungs resulted in the identification of the 7th HCoV on 3 January 2020. The patient was suffering from a disease now named COVID-19 and the virus causing the disease was formally named SARS-CoV-2 on 11 February 2020[8]. Whilst the initial cluster was believed to be spread from animals to humans, direct human to human transmission is now spreading the virus globally. As with other HCoV types, the principal transmission route is via droplets contaminated with the virus. These are spread via coughs, sneezes and nasal secretions that can then either be directly inhaled by a person nearby or transferred via indirect contact via surfaces that have become contaminated. Whilst it has yet to be studied in detail, the SARS-CoV-2 is likely to have similar properties to the SARS-COV due to its close genetic similarity[16].

SARS-CoV-2 is transmitted from person-to-person via the respiratory system through sneezing, coughing and secretions, both directly and indirectly via contaminated surfaces.

Like most infections, people with underlying medical conditions and the elderly are more susceptible.

SARS-CoV-2 and implications for water and sanitation systems and workers

Consideration of water and sanitation systems is not a first priority when seeking to monitor and manage the spread of HCoV since the viruses are not typically waterborne. However, there are factors that need to be understood where the spread of the SARS-CoV-2 might have implications for the continuity of supply.

Management of water and sanitation systems should remain business as usual.

[ii] The term 'RNA' is shorthand for ribonucleic acid which makes up their genome. Some viruses have DNA, or deoxyribonucleic acid. This is relevant to their resistance to UV disinfection.
[iii] SARS: Severe Acute Respiratory Syndrome
[iv] MERS: Middle East Respiratory Syndrome

Factsheet

SARS-CoV-2 - Water and Sanitation

Water Research AUSTRALIA

Working around wastewater

Some coronaviruses can potentially survive in the gastrointestinal tract and be spread by the 'faecal-oral' route or via inhalation of contaminated wastewater droplets. There have not been reports of faecal-oral transmission of COVID-19 to date[12]. Two studies have reported detection of SARS-CoV-2 fragments in faecal matter of COVID-19 patients[13,14]. Whilst plausible, because it's newly discovered, it is not yet certain how well the virus is able to survive in water and wastewater. However, nasal secretions are found in wastewater (e.g. due to flushing of tissues) and most likely SARS-CoV-2 will enter wastewater systems. Furthermore, the most similar virus tested, SARS-CoV, was shown to be present in wastewater and to persist in faeces, urine, water and wastewater for periods up to 2 days at 20°C, at least 14 days at 4°C, and survive for 4 days in diarrheal stool samples with an alkaline pH at room temperature[9,11].

Based on this, it is possible that SARS-CoV-2 may be present in wastewater where COVID-19 infections are present. Importantly, the same is true for a wide variety of pathogens, such as other viruses, bacteria and protozoa. The controls already in place to protect persons working around wastewater are based on keeping workers safe from much more readily transmissible and established faecal-oral pathogens (such as norovirus, adenovirus, hepatitis A virus, *Cryptosporidium*, *Giardia* and *Campylobacter*). The key point is that existing, standard approaches, already used for working safely with wastewater, still apply, and no special or specific changes need to be made due to the SARS-CoV-2. The SARS-CoV-2 is just one of many pathogens including viruses potentially present in wastewater. Exposure to all pathogens in the workplace and in wastewater should be managed by 'business as usual' hygiene practices (see below).

'Business as usual' hygiene practices

- Wash your hands often with soap and water before and after eating as well as after attending the toilet. If soap and water are not available use an alcohol-based hand rub;
- Wear appropriate PPE when working in areas where exposure to untreated wastewater is possible – safety goggles, face shields (or masks), gloves, as well as increased hand hygiene;
- Avoid touching eyes, nose and mouth with unwashed hands;
- Avoid contact with others if they have cold and flu like symptoms;
- Clean and disinfect surfaces;
- Cough and sneeze into your elbow;
- Stay home if you are unwell.

Water utilities and their contractors should continue to provide safe working environments by following conventional precautions for working with wastewater. This involves providing the appropriate tools, equipment, work methods and procedures, personal protective equipment and sanitation for all workers. In addition, providing advice, such as this fact sheet, is important, to avoid unnecessary concern.

Disinfection of water and wastewater

The design and operation of processes used for the disinfection of water and wastewater is based on the most resistant pathogens present. Fortunately, coronaviruses are not among those most resistant to disinfection processes. That means that conventional disinfection methods, applied to inactivate the more resistant viruses, would be expected to readily inactivate SARS-COV-2.

For oxidant (chlorine, monochloramine and chlorine dioxide) disinfectants, the more resistant non-enveloped, protein capsid coated viruses, such as hepatitis A virus and coxsackieviruses, have historically been used to set the design and operational requirements for disinfection. The lipid-enveloped CoV viruses are typically more sensitive to these disinfectants. For instance, the virus most closely related to SARS-CoV-2, being SARS-CoV, was found to be very sensitive to chlorine and chlorine dioxide disinfection (as sensitive as *E. coli* and coliphage).[9]

For UV irradiation, double-stranded DNA viruses, such as adenoviruses, have historically been used to set the design and operational requirements for disinfection. The CoV viruses have large single-stranded RNA genomes and are considerably more sensitive to UV disinfection.

Given the above, it is considered that conventional disinfection of water and wastewater, designed and operated to meet current standards, guidelines and validation approaches, will be more than adequate to control transmission of SARS-CoV-2 via drinking water, recycled water and wastewater. No additional or modified treatment is required beyond the 'business as usual' treatment currently applied to manage such transmission risks.

Standard water and wastewater treatment and disinfection processes used to control pathogen transmission via water routes are expected to be effective on SARS-CoV-2. No changes are required.

The Australian Department of Health has published guidance for employers in response to COVID-19. The guidance refers to drinking water stating that "Drinking water in Australia is high quality and is well treated. It is not anticipated that drinking water will be affected by novel coronavirus"[5].

Factsheet

SARS-CoV-2 - Water and Sanitation

Drinking water in Australia is high quality and is well treated. It is not anticipated that currently safe drinking water will be affected and made unsafe by SARS-CoV-2 if COVID-19 becomes established in Australia[5].

Risks to continuity of supply and public concern

There are real risks that a COVID-19 outbreak could cause major impacts on water and wastewater services through disruption. For instance,

- Disruptions may arise in the supply of parts, equipment and chemicals that may have direct impacts on supply.
- Staff may be unable to attend work due to becoming ill, fear of becoming ill, or due to caring duties for family members that are ill or unable to attend work or school.
- Essential services workers may be concerned about undertaking their work for fear of becoming contaminated by wastewater, however, this fear is not supported by evidence.

In addition, WSAA has prepared a Fact Sheet that highlights that drinking water supplies are safe, and that bottled water need not be consumed in place of tap water, or stockpiled, due to fears from COVID-19.[10]

Monitoring and Research

Routine water quality monitoring

Routine water quality monitoring should continue as normal, that is monitoring microbial faecal indicators of wastewater that are already widely used and well understood. This includes monitoring *E. coli* in drinking water and waters potentially affected by wastewater as well as enterococci in natural bathing waters. This type of verification monitoring of water quality is already routinely used across the country. Routine monitoring for SARS-CoV-2 is not required.

Research priorities

In specialist facilities that are equipped with adequate containment to undertake research with SARS-CoV-2, research should occur for the following purposes:

- To better understand the environmental persistence and resistance of the SARS-CoV-2 to disinfection and treatment processes.
- Where a virus is being widely shed by infected people in an outbreak situation, wastewater monitoring can provide a simple means to find out what subtypes are present.

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- Jurisdictional health representatives
- Water Services Association of Australia

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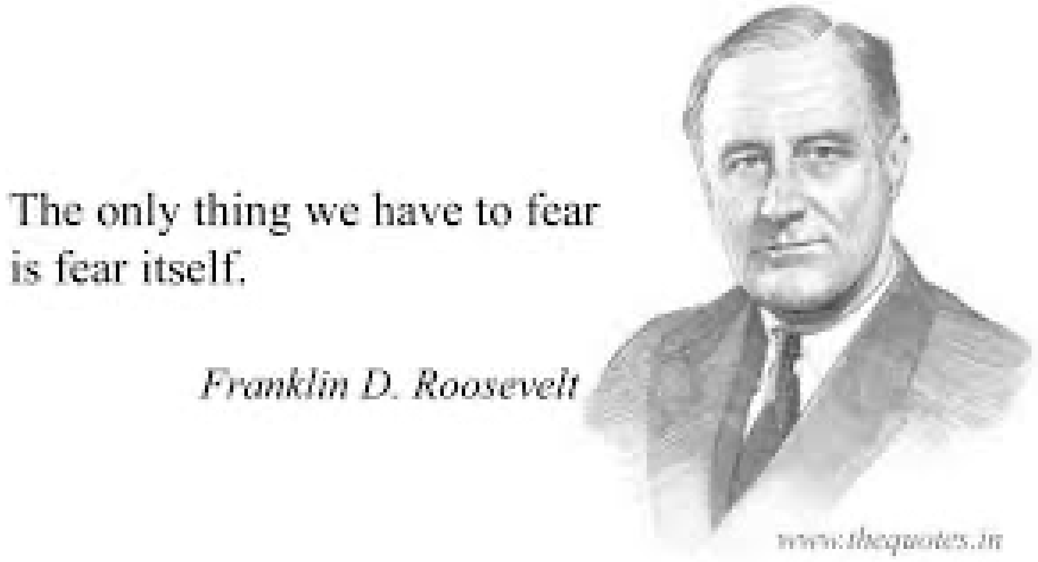
Evolution of response
3. The problems started in Oz…

- Important Lesson #3 – fear of virus a bigger problem than the virus



Evolution of response
4. Problems got worse…(March)

- People started stockpiling:
  - Bottled water
  - Toilet paper
  - Food
  - Sanitisers

Evolution of response
4. Problems got worse…

- Water and sanitation issues broadened with concerns such as:
  - public afraid drinking water wouldn't be safe and needed reassurance
  - 'wet wipes' etc. being flushed into sewers due to no toilet paper
  - excessive sanitisers flushed into sewers
- Water Research Australia updated their fact sheet
- Water Services Association of Australia (akin to AWWA) developed a fact sheet (assembled by Erin Cini, Sandi Kolbe and Greg Ryan in liaison with members)
  - https://www.wsaa.asn.au/sites/default/files/publication/download/COVID-19%20Fact%20Sheet.pdf

FACT SHEET: COVID-19

(official name: severe acute respiratory syndrome coronavirus 2)

Can I catch COVID-19 from drinking water?

There is no evidence that the COVID-19 virus is transmitted by drinking water. The current evidence is that the COVID-19 virus is most likely transmitted from person-to-person by sneezing and coughing.

Drinking water in Australia is high quality and is well treated. There is no evidence that drinking water will be affected by coronavirus.

Should I buy bottled water?

There is no need to buy bottled water for drinking. Safe, clean tap water will continue to be supplied directly to your home every day.

How are water utilities protecting the water supply?

Water utilities have stringent hygiene measures in place at water treatment plants. In addition, there is almost no human contact in the process of treating water for drinking.

Existing water treatment and disinfection processes, including use of chlorine, are effective in removing viruses from water supplies.

Water utilities are in contact with key government agencies to monitor and understand the health impact of COVID-19 as it develops and are well-connected internationally to stay updated on the latest information and evidence.

What if workers are quarantined at home, will water still be supplied?

Water is an essential service and water utilities are well prepared to manage their response to COVID-19. Water utilities have existing emergency response plans and are continuing to update them in response to the most current available information.

In general water treatment plants are secure, have back up power and require few staff to operate them and some water treatment plants can be operated remotely. Water utilities ensure that multiple staff are able to operate water treatment plants and water supply systems so that if one person is on leave for any reason drinking water can still be safely and reliably supplied.

Can COVID-19 be transmitted by the wastewater system?

There is no evidence that the COVID-19 virus can be transmitted via wastewater systems, with or without wastewater treatment. Current disinfection methods are expected to be sufficient to manage the COVID-19 virus.

Wastewater continues to be managed and treated properly and carefully by water utilities to protect public health and the environment.

Best practices for protecting the occupational health of workers at wastewater treatment plants continue to be maintained.

In general wastewater treatment plants are secure, have back up power and require few staff to operate them and some wastewater treatment plants can be operated remotely. Water utilities ensure that multiple staff are able to operate wastewater treatment plants and sewerage systems so that if one person is on leave for any reason wastewater can still be safely and reliably treated.

How to help prevent the spread of coronavirus?

The Australian Department of Health advises that practising good hand hygiene and sneeze/cough hygiene is the best defence against most viruses. Good practice is:

- wash your hands frequently with soap and water, before and after eating, and after going to the toilet
- cover coughs and sneezes, dispose of tissues, and use alcohol-based hand sanitiser
- and if unwell, avoid contact with others.

Drinking water quality in Australia

Urban water utilities supply safe, high quality drinking water to cities and regions across Australia. The Australian Drinking Water Guidelines developed by the National Health and Medical Research Council provide approximately 100 rigorous guideline values for water utilities to follow. In the most recent National Performance Report for the Australian water industry, which assesses compliance against the Guidelines, or licence conditions imposed on utilities, compliance with water supply quality remained high.

About WSAA

The Water Services Association of Australia (WSAA) is the peak industry body representing the urban water industry. Our members provide water and sewerage services to over 22 million customers in Australia and New Zealand and many of Australia's largest industrial and commercial enterprises.

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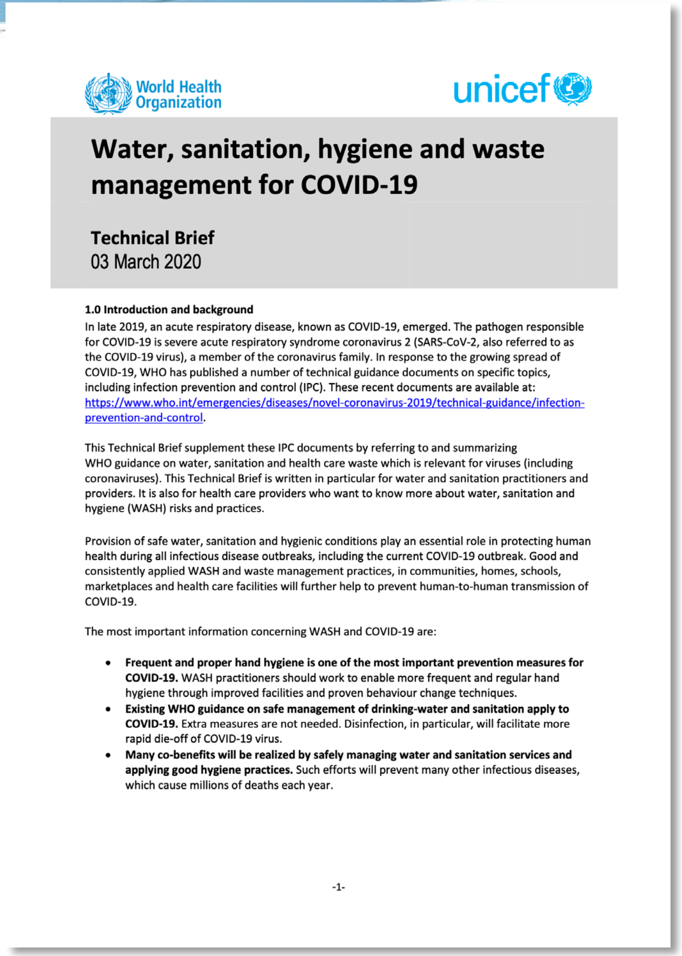
Evolution of response
4. Problems got worse…

- Important Lesson #4 – we need leadership, coordination and a reliable point of publicly shared truth

Evolution of response
5. Getting on top of it…(Mar)

- We now have a confident technical position
- Also collaborating globally
  - Liaise with:
    - Water Research Foundation
    - Global Water Research Coalition
    - WEF
    - WHO
  - WHO Technical Brief (David Cunliffe as committee chair)
    - https://www.who.int/publications-detail/water-sanitation-hygiene-and-waste-management-for-covid-19



World Health Organization | unicef

Water, sanitation, hygiene and waste management for COVID-19

Technical Brief
03 March 2020

1.0 Introduction and background

In late 2019, an acute respiratory disease, known as COVID-19, emerged. The pathogen responsible for COVID-19 is severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2, also referred to as the COVID-19 virus), a member of the coronavirus family. In response to the growing spread of COVID-19, WHO has published a number of technical guidance documents on specific topics, including infection prevention and control (IPC). These recent documents are available at: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/infection-prevention-and-control.

This Technical Brief supplement these IPC documents by referring to and summarizing WHO guidance on water, sanitation and health care waste which is relevant for viruses (including coronaviruses). This Technical Brief is written in particular for water and sanitation practitioners and providers. It is also for health care providers who want to know more about water, sanitation and hygiene (WASH) risks and practices.

Provision of safe water, sanitation and hygienic conditions play an essential role in protecting human health during all infectious disease outbreaks, including the current COVID-19 outbreak. Good and consistently applied WASH and waste management practices, in communities, homes, schools, marketplaces and health care facilities will further help to prevent human-to-human transmission of COVID-19.

The most important information concerning WASH and COVID-19 are:

- **Frequent and proper hand hygiene is one of the most important prevention measures for COVID-19.** WASH practitioners should work to enable more frequent and regular hand hygiene through improved facilities and proven behaviour change techniques.
- **Existing WHO guidance on safe management of drinking-water and sanitation apply to COVID-19.** Extra measures are not needed. Disinfection, in particular, will facilitate more rapid die-off of COVID-19 virus.
- **Many co-benefits will be realized by safely managing water and sanitation services and applying good hygiene practices.** Such efforts will prevent many other infectious diseases, which cause millions of deaths each year.

-1-

Evolution of response
5. Getting on top of it…

- Important Lesson #5 – we need to extend that sharing and coordination globally [today's seminar is a critical part of that]

Evolution of response
6. Planning for indirect impacts

- Water and sanitation workers might be off work:
  - fear of infection at work
  - need to stay home to care for others
  - told to go into lock down
- Supply chain failures (power, chemicals, parts & fittings, PPE)
- Water and/or wastewater being blamed for, or possibly even being responsible for, some transmission events
- Economic impacts and implications for investment in water and sanitation
- Important lesson # 6 – it's not just direct impacts that need to be considered

Evolution of response
7. Research and monitoring

- Sewer monitoring to track and trace the pandemic over time
- Probably similar to other coronaviruses but good to be sure:
  - Survival studies in water, wastewater and aerosols to inform potential for water-related transmission:
    - drinking water, sewage, recycled water, seafood harvested near outfalls, recreational water, sewer workers, plumbers, swimming pools, stormwater…
  - Validation of inactivation and removal by disinfection and filtration
    - Currently seeking funding in Australia to complete this work
    - Building on previous studies on other viruses

Smart Water Fund

Final Report

Chlor(am)ine disinfection of human pathogenic viruses in recycled waters

Dr Alexandra Keegan, Dr Satiya Wati and Bret Robinson
Australian Water Quality Centre

SWF62M-2114

June 2012

Government of South Australia

SA Water

Smart Water Fund

Table 1E. Free available chlorine Ct values for CB5 virus calculated by determining the integral of residual chlorine vs time for WW of various turbidities and pHs at 10°C

pH	Log_{10} inactivation	Ct (mg.min/L) 0.2 NTU using 6.5 mg/L chlorine	Ct (mg.min/L) 2 NTU using 6.87 mg/L chlorine	Ct (mg.min/L) 5 NTU using 6.87 mg/L chlorine	Ct (mg.min/L) 20 NTU using 9 mg/L chlorine
7	1	2.05	2.13	2.24	2.55
	2	3.29	3.37	3.71	5.95
	3	4.41	4.75	4.88	16.47
	4	5.44	5.46	5.99	25.81
8	1	5.72	6.67	7.78	7.99
	2	9.6	10.32	13.16	15.09
	3	12.8	12.90	17.79	24.81
	4	15.49	15.68	21.94	34.52
9	1	8.25	8.94	9.66	13.70
	2	14.06	15.5	16.33	28.73
	3	19.10	20.88	22.03	41.32
	4	23.97	26	27.93	51.89

Table 2E. Preformed monochloramine Ct values for adenovirus 2 calculated by determining the integral of residual monochloramine vs time for WW of various turbidities and pHs at 10°C

pH	Log_{10} inactivation	Ct (mg.min/L) 2 NTU using 15 mg/L monochloramine	Ct (mg.min/L) 5 NTU using 15 mg/L monochloramine	Ct (mg.min/L) 20 NTU using 16 mg/L monochloramine
7	1	969	1204	1375
	2	1688	1903	2175
	3	2393	2638	2970
	4	3082	3337	3757
8	1	1482	1590	3148
	2	2326	2546	4070
	3	3160	3490	4904
	4	3949	4426	5900
9	1	2992	4364	6001
	2	4592	6032	8114
	3	5716	7511	9544
	4	6746	9096	10718

WaterVal

Streamlining Technology Validation

Chlorine disinfection

Validation protocol

9. Method to determine the LRV for each pathogen group

Table 1 can be used to determine the LRV by chlorination for viruses and bacteria for turbidity ranging from 0.2 to 5 NTU, pH ranging from 7 to 9 and temperature ranging from 5 °C to 25 °C.

The CT values at a temperature of 10 °C and a pH of 7, 8 or 9 are determined by linear regression, based on the experimental CT values in Keegan et al. (2012) and by rounding up to the next integer. The CT values for intermediate pH values are linearly interpolated. The CT values for temperatures other than 10 °C are based on the CT values at 10 °C adjusted for temperature, using the relationships described in Appendix C, Table C-7 of the US EPA *Disinfection profiling and benchmarking guidance manual* (US EPA 1999a). Using the US EPA data for pH 6 to 9 (validation protocol pH range is 7 to 9), a relationship with temperature can be established according to equation 4. This relationship can be applied to the CT values at 10 °C before rounding, assuming that the same relationship applies for all LRVs, and conservatively rounding up to the next integer.

$$CT(T) = A * e^{(-0.071*T)} \qquad \text{(equation 4)}$$

where $A = \frac{CT(10°C)}{e^{(-0.071*10)}}$

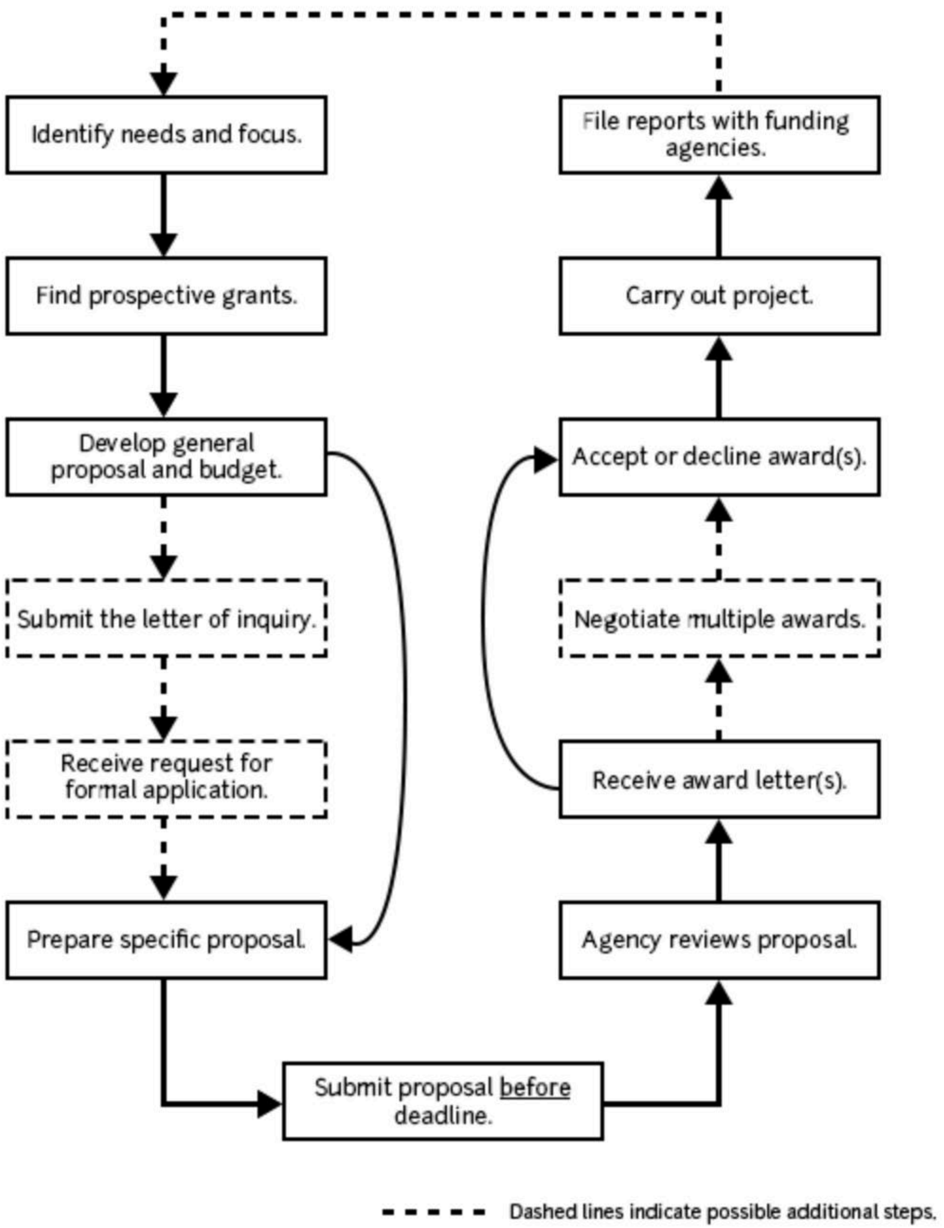
Table 1 CT values for 1 to 4 log reduction values of viruses at a range of turbidity, pH and temperature

pH	Log$_{10}$ inactivation	≤0.2 NTU					≤2 NTU					≤5 NTU				
		5 °C	10 °C	15 °C	20 °C	25 °C	5 °C	10 °C	15 °C	20 °C	25 °C	5 °C	10 °C	15 °C	20 °C	25 °C
≤7	1	4	3	2	2	1	4	3	2	2	1	4	3	2	2	1
	2	5	4	3	2	2	5	4	3	2	2	6	4	3	2	2
	3	7	5	4	3	2	7	5	4	3	2	7	5	4	3	2
	4	8	6	4	3	2	9	6	4	3	2	9	7	5	3	3
≤7.5	1	7	5	4	3	2	7	5	4	3	2	8	6	4	3	2
	2	10	7	5	4	3	10	7	5	4	3	13	9	6	5	4
	3	13	9	7	5	4	13	9	7	5	4	16	12	9	6	5
	4	16	11	8	6	4	16	11	8	6	4	21	15	11	7	6
≤8	1	9	7	5	3	3	10	7	5	4	3	12	9	6	4	3
	2	14	10	7	5	4	15	10	7	5	4	19	13	9	7	5
	3	18	13	9	7	5	19	13	10	7	5	25	18	13	9	7
	4	23	16	12	8	6	23	16	12	8	6	32	23	16	11	8
≤8.5	1	11	8	6	4	3	12	9	6	5	4	14	10	7	5	4
	2	17	12	9	6	5	19	13	9	7	5	21	15	11	8	6
	3	23	16	12	9	6	25	17	13	9	7	29	21	15	10	8
	4	29	21	15	10	8	31	22	16	11	8	37	26	18	13	9
≤9	1	13	9	6	5	3	14	10	7	5	4	15	10	7	5	4
	2	20	14	10	7	5	22	16	11	8	6	23	16	12	8	6
	3	28	19	14	10	7	30	21	15	11	8	32	23	16	11	8
	4	35	25	17	12	9	38	27	19	13	10	41	29	20	14	10

For systems that operate outside the values for pH, temperature and turbidity identified in the CT table, specific challenge testing must be undertaken to determine the log inactivation.

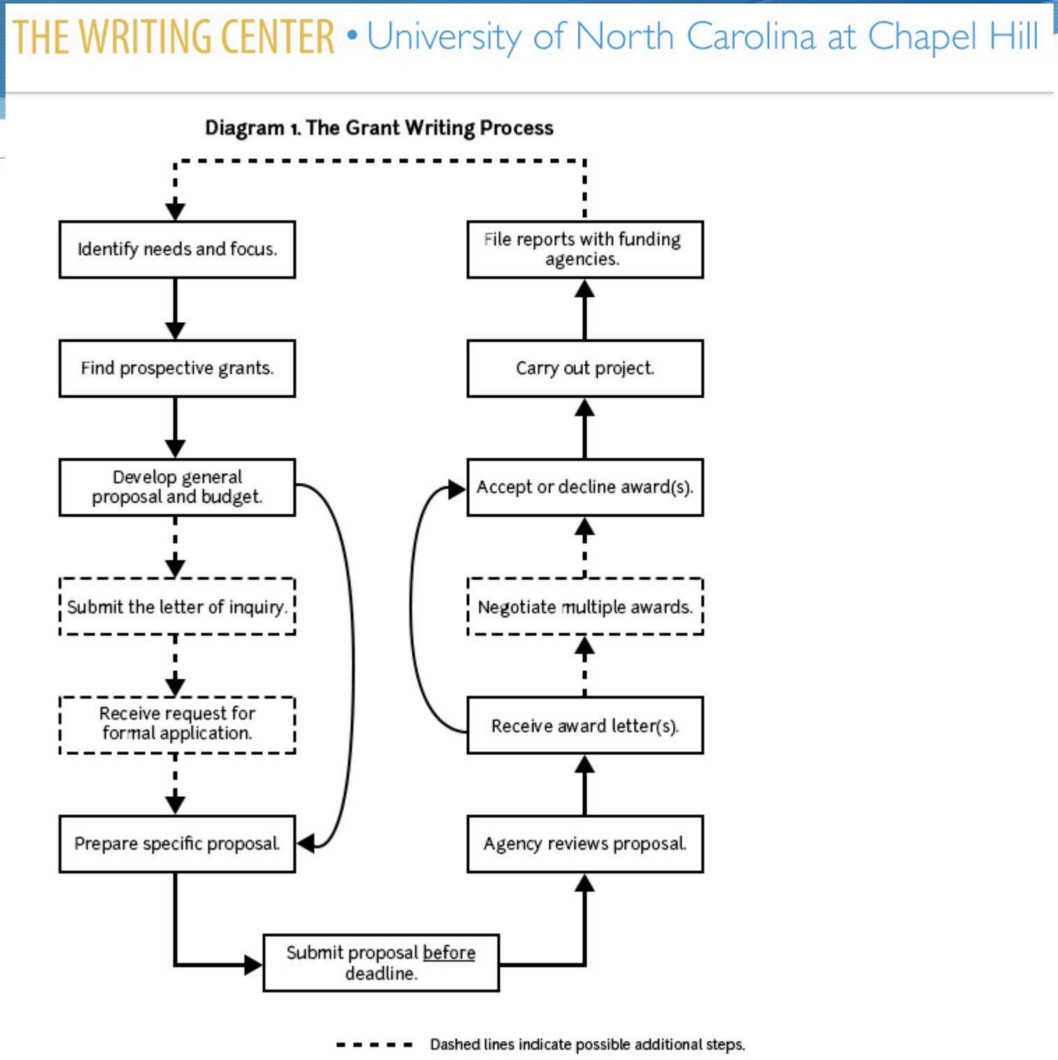
THE WRITING CENTER • University of North Carolina at Chapel Hill

Diagram 1. The Grant Writing Process



Evolution of response
7. Research and monitoring

- Important Lesson #7 – we need to a) get research funding quickly; and b) have research capacity ready for such situations
  - We have limited research capacity and it's hard to gear up fast
  - Research funding processes are slow



Evolution of response
8. Where to next

- For COVID-19
  - Continue collaborating to respond as well as we can this time
  - Work as a global community of practice in the public interest
  - Nucleate our work and thoughts around lead agencies (e.g. WRF)
  - Be proactive, consistent and non-contradictory in messaging
  - Do the research and publish it
- To get ready for next time
  - Learn and don’t lose the important lessons
  - Put in place mechanisms to help us respond better next time

Poll #4: What kind of research does the water sector need to be conducting immediately in response to the COVID-19 virus outbreak?

- Persistence and viability of the COVID-19 virus.
- Infective dose of the COVID-19 virus in wastewater and feces.
- Airborne exposure and spread from bioaerosols of COVID-19 virus.
- Disinfection efficacy of the COVID-19 virus.
- Disinfection and inactivation dynamics in municipal wastewater processes involving chloramine, peracetic acid (PAA) and other disinfectants?
- White paper on the state of science of infectious viruses in water.
- A synthesis of lessons-learned from past infectious disease outbreaks.
- Other

Q&A

Dr. Haas and Lola Olabode

The Water Research Foundation

Thank You

Comments or questions, please contact:
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For more information, visit

www.waterrf.org

Thursday, April 16th
3:30 - 5pm US ET