



UKWIR Briefing Note on risks posed to the water industry by the newly emergent 2019 novel Coronavirus (2019-nCoV)

Produced on the 12th February 2020

Summary

The recent outbreak of a newly emergent coronavirus in China has prompted concerns of the risks it poses to water industry operations. Information available so far has indicated that person to person transmission through contact with respiratory droplets is the predominant route of infection. Limited evidence suggests the virus can be shed in the faeces although it does not appear a significant feature of infection. The virus may be present, therefore, in sewage although it is expected to be considerably dispersed and pose little additional risk to wastewater operations. Following good hygiene practice for working in contact with sewage would be sufficiently protective to minimise any potential for exposure to the virus. The occurrence of more widespread and sustained transmission in the UK, could pose a risk to water company staff (e.g. samplers, domestic water efficiency auditors, byelaw's inspectors, plumbers) visiting customer properties. As a precautionary measure, water companies should provide guidance for managing this particular risk. The virus does not appear to survive well in the environment and can be eliminated very effectively by water treatment, especially chlorination, and would pose a very minimal risk through drinking water.

1.0 Introduction

In December, 2019, a series of pneumonia cases of unknown cause emerged in Wuhan, Hubei, China, with clinical presentations greatly resembling viral pneumonia. Genome sequencing of viruses present in the respiratory tract of infected individuals indicated the causative agent to be a novel coronavirus, which was named 2019 novel coronavirus (2019-nCoV). Subsequently (11th February 2020), the disease was renamed by the World Health Organization (WHO) as Covid-19.

Early on, individuals working at a seafood and wild-animal market were suspected of being first infected by the virus. Subsequently, person to person transmission has been shown to occur. So far (11th February 2020), 43,108 confirmed cases of infection have been reported, of which 42,644 were within mainland China. While the proportion of infections that progress to acute respiratory disease remains unclear, the total number of deaths currently stands at 1,018 individuals. Over 95% of all deaths have occurred in Hubei province in the Wuhan region of China.

All statements contained in this document are made without responsibility on the part of UK Water Industry Research Limited and its Contractors, and are not to be relied upon as statements or representations of facts; and UK Water Industry Research Limited does not make or give, nor has any person authority on its behalf to make or give, any representation or warranty whatever in relation to the contents of this document or any associated software.



It is highly likely that the transmissibility of 2019-nCoV is sufficient to support sustained human transmission, depending on the extent of control measures being implemented by international and national health authorities. On January 30th, 2020, the International Health Regulations Emergency Committee of the World Health Organization declared the outbreak a “public health emergency of international concern.

In the UK, the incidence or transmission of novel Coronavirus has been declared to constitute a serious and imminent threat to public health. Consequently, the Health Protection (Coronavirus) Regulations 2020 have been introduced and came into force immediately after they were made, although they apply only to England. The measures outlined in these regulations were considered as an effective means of delaying or preventing further transmission of the virus.

The objective of this Briefing Note is to provide water companies with an assessment of the risks posed by the 2019-nCoV to their operations. This note summarises the information publically available (as of 12/02/2020) on the causal agent of this disease, symptoms of illness and fate and behaviour of the virus in the environment, including susceptible to disinfection. Consideration has been given to the occupational risk posed to water industry workers and a qualitative assessment of the risk has been performed

It is likely that more information will emerge on the virus and the infection rate may increase in the UK. Consequently, it may become necessary to revise this risk assessment and further updates of this briefing note will be produced as appropriate.

2.0 Description of the virus

Coronaviruses (CoVs) are large, enveloped, positive-strand RNA viruses that can be divided into 4 genera: alpha, beta, delta and gamma, of which only alpha and beta CoVs are known to infect humans. Human coronaviruses (HCoV-229E, HCoV-OC43, HCoV-NL63 and HCoV-HKU1) are endemic globally and account for around 10% to 30% of upper respiratory tract infections in adults.

The two other strains of human coronaviruses are Severe Acute Respiratory Syndrome coronavirus (SARS-CoV) and Middle East Respiratory Syndrome coronavirus (MERS-CoV). SARS-CoV was the causal agent of the severe acute respiratory syndrome outbreaks in 2002 and 2003 in Guangdong Province, China that subsequently spread to several other countries around the world. MERS-CoV was the virus responsible for severe respiratory disease outbreaks in 2012 in the Middle East. The later virus continues to circulate but cases appear confined to the Arabian Peninsula. The natural reservoir of MERS-CoV is presumed to be bats, yet human transmission has primarily been attributed to an intermediate host, the dromedary camel.

Sequence analysis of the genome of the 2019-nCoV places the virus in the subgenus Sarbecovirus of the Betacoronavirus genus. Analysis of the genomes of this virus, obtained from several different patient sources, has indicated a sequence similarity greater than 99%. No evidence of viral mutation has been found so far.

The 2019-nCoV has been shown to be closely related (with 88% similarity) to two bat-derived severe acute respiratory syndrome (SARS)-like coronaviruses, bat-SL-CoVZC45 and bat-SL-CoVZXC21, collected in 2018 in Zhoushan, eastern China. The 2019-nCoV has been shown to be sufficiently divergent from SARS-CoV (about 79% similarity) and MERS-CoV (about 50% similarity) to be considered a new human-infecting species.

Whilst 2019-nCoV has a high similarity with coronaviruses from bats, there have been suggestions that transmission to humans has occurred through an intermediate host. The most likely candidate appears to be pangolins as genome sequences of their coronaviruses have been shown to be 99% identical to 2019-nCoV from patients.

3.0 Clinical Manifestations

There are a limited number of reports that describe the clinical presentation of symptoms in patients with confirmed 2019-nCoV infection and most of these have been derived from examination of hospitalised patients with pneumonia. The 2019-nCoV seems to have relatively low pathogenicity and moderate transmissibility. Modelling estimates of the case fatality rate (CFR) for 2019-nCoV based on the number of confirmed cases have been put at between 4% and 8% based on the preliminary data available. This CFR is lower than for SARS-CoV and considerably lower than for MERS-CoV.

Current evidence estimates a typical incubation period of five to six days although symptoms of 2019-nCoV may appear in as few as 2 days or as long as 12 days after exposure to the virus.

Clinical presentation among reported cases of 2019-nCoV infection varies in severity from asymptomatic infection or mild illness to severe or fatal illness. Some reports have suggested the potential for clinical deterioration during the second week of illness. The whole population is generally susceptible to the virus. The elderly and those with underlying diseases, however, show more serious conditions after infection and children and infants can also become infected by the 2019-nCoV.

The fever course among patients with 2019-nCoV infection is not fully understood; it may be prolonged and intermittent. Frequently reported signs and symptoms include fever (83–98%), cough (76%–82%), and myalgia or fatigue (11–44%) at illness onset. Sore throat has also been reported in some patients early in the clinical

course. Less commonly reported symptoms include sputum production, headache, haemoptysis (coughing up blood) and diarrhoea.

Risk factors for severe illness are not yet clear, although older patients and those with underlying chronic medical conditions may be at higher risk for severe illness. Nearly all reported cases have occurred in adults (median age 59 years). In one study of 425 patients with pneumonia and confirmed 2019-nCoV infection, 57% were male. Approximately one-third to one-half of reported patients had underlying medical comorbidities, including diabetes, hypertension, and cardiovascular disease.

Acute respiratory distress syndrome (ARDS) developed in 17–29% of hospitalized patients, and secondary infection developed in 10%. Between 23–32% of hospitalized patients with 2019-nCoV infection required intensive care for respiratory support. Among hospitalized patients with pneumonia, the case fatality proportion has been reported as high as 11–15%. However, as this estimate includes only hospitalized patients, and therefore may be higher than for the general population.

No specific treatment for 2019-nCoV infection is currently available. Clinical management includes prompt implementation of recommended infection prevention and control measures and supportive management of complications, including advanced organ support if indicated. From current knowledge of the cases, most patients have a good prognosis, the symptoms of children are relatively mild, and few patients are in critical condition.

Currently, the approach to this disease is to control the source of infection; use of personal protection as a precaution to reduce the risk of transmission; and early diagnosis, isolation, and supportive treatments for affected patients.

A number of resources are available that provide guidance on minimising exposure to the virus from infected individuals and cleaning areas potentially contaminated by the virus. These resources are primarily intended for healthcare personnel who are likely to face greater exposure to the virus. Individuals suspecting themselves of being infected have been advised to self-isolate for 14 days to reduce the likelihood of further transmitting the virus¹.

4.0 Disease Transmission

The predominant route of transmission appears to be through exposure to respiratory secretions from close contact (less than 2m) with an infected individual. This can occur directly through large droplets produced by coughing or sneezing. It has been proposed that infection can also be acquired indirectly through hand transfer to the nose, eyes or mouth after touching contaminated inanimate objects or skin. Typically, with most respiratory viruses, individuals are considered to be most contagious when they are most symptomatic, although there is some evidence

indicating spread of the virus from individuals during the incubation period before the development of visible symptoms.

More recently, reports have emerged of the presence of the virus in faeces raising the potential for a faecal-oral route of transmission. The evidence suggests, however, that gastrointestinal illness is not a common feature (approximately 10% of individuals) of infection by 2019-nCoV. This observation has been derived from a limited number of case studies and may be subject to revision once more is known about the clinical course of infection. It has been recognised that squat latrines, common in China, lacking covers and hands that are not washed thoroughly with soap and water after use could be responsible for faecal-oral transmission.

5.0 Survival of the virus in the environment and inactivation

There is no data on the fate and behaviour specifically of 2019-nCoV in the environment. The virus is unable replicate outside living cells and cannot increase in number in the environment. As a virus possessing an outer envelope, however, it will not be tolerant of adverse environmental conditions and will be readily susceptible to inactivation by disinfectants.

A comparative review of the fate and behaviour of 2019-nCoV with other human coronaviruses has indicated that 2019-nCoV could remain infectious on inanimate (e.g. metal, glass or plastic) surfaces at room temperature for up to 9 days. At a temperature of 30°C or more the duration of persistence is shorter. Coronaviruses infecting bovines and felines are known to survive for 28 days under a similar temperature.

This review (Kampf 2020) also concluded that 2019-nCoV can be efficiently inactivated by surface disinfection procedures with 62-71% ethanol, 0.5% hydrogen peroxide or 0.1% sodium hypochlorite within 1 minute. Other biocidal agents, such as 0.05-0.2% benzalkonium chloride or 0.02% chlorhexidine digluconate, were less effective.

6.0 Implications for Wastewater and Drinking Water Treatment

The presence of 2019-nCoV in faeces of infected individuals raises the possibility of a faecal-oral route of transmission creating a potential occupational risk for wastewater workers. At this stage, there is a lack of evidence to establish the extent of this risk beyond a qualitative assessment. In the event of sustained transmission in the UK where the number of cases is considerably greater than at present, person to person transmission would be the major route of infection between individuals.

Currently, as only a small number of individuals in the UK are known to be infected with 2019-nCoV, it would be expected that infectious viruses shed in faeces would be considerably dispersed in a sewerage system and pose a negligible occupational



risk for wastewater workers. Following good hygiene practice when working on sewerage systems and at wastewater treatment works would provide effective protection against exposure to the virus.

The current strategy to quarantine suspected cases in dedicated facilities for 14 days may increase the virus burden in the sewerage system serving the facilities. The extent of this increase would depend on the number of individuals becoming infected and the proportion that shed infectious viruses in their faeces. Consequently, this may pose an elevated risk to occupational health although it is likely to be slight.

Regardless of the route of transmission, water samplers or other staff (e.g. plumbers, byelaw's inspectors, domestic water efficiency auditors) visiting customer properties may be at increased risk where individuals are or maybe infected. This risk is only likely to be significant where there is sustained transmission of the virus in this country. Under such circumstances, it would be essential that measures (e.g. disposable gloves and, if advised, face masks) are taken to prevent exposure to the viruses from contact with contaminated bodily secretions and inanimate surfaces or for staff to avoid entering the property unless absolutely necessary. As a precautionary measure, it would be prudent for water companies to prepare guidance for employees concerning visits to households.

Drinking water would pose a negligible risk for public health as the virus would be eliminated very effectively by water treatment, especially chlorination. Any virus, present in sewage, would be substantially removed by wastewater treatment and undergo deterioration and loss of infectivity in the environment.

Bibliography

Backer JA, Klinkenberg D, Wallinga J. The incubation period of 2019-nCoV infections among travellers from Wuhan. China [Internet]. *Infectious Diseases (except HIV/AIDS)*. medRxiv. 2020.

Ceraolo C, Giorgi FM. Genomic variance of the 2019-nCoV coronavirus. *bioRxiv*. 2020 Jan 1.

Chan JF, Yuan S, Kok KH, To KK, Chu H, Yang J, Xing F, Liu J, Yip CC, Poon RW, Tsoi HW. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. *The Lancet*. 2020 Jan 24.

Chan JF, Lau SK, To KK, Cheng VC, Woo PC, Yuen KY. Middle East respiratory syndrome coronavirus: another zoonotic betacoronavirus causing SARS-like disease. *Clinical microbiology reviews*. 2015 Apr 1;28(2):465-522.

Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, Qiu Y, Wang J, Liu Y, Wei Y, Yu T. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *The Lancet*. 2020 Jan 30.

Chinazzi M, Davis JT, Gioannini C, Litvinova M, Pastore y Piontti A, Rossi L. Preliminary assessment of the International Spreading Risk Associated with the 2019 novel Coronavirus (2019-nCoV) outbreak in Wuhan City.

Cui J, Li F, Shi ZL. Origin and evolution of pathogenic coronaviruses. *Nature reviews Microbiology*. 2019 Mar;17(3):181-92.

Dong N, Yang X, Ye L, Chen K, Chan EW, Yang M, Chen S. Genomic and protein structure modelling analysis depicts the origin and infectivity of 2019-nCoV, a new coronavirus which caused a pneumonia outbreak in Wuhan, China. bioRxiv. 2020 Jan 1.

Gao Y, Liu Q. The Epidemic Dynamics of 2019 Novel Coronavirus (2019-nCoV) Infections in China by 28 January. Available at SSRN 3529448. 2020.

Gralinski LE, Menachery VD. Return of the Coronavirus: 2019-nCoV. *Viruses*. 2020 Feb;12(2):135.

Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, Zhang L, Fan G, Xu J, Gu X, Cheng Z. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *The Lancet*. 2020 Jan 24.

Jung SM, Akhmetzhanov AR, Hayashi K, Linton NM, Yang Y, Yuan B, Kobayashi T, Kinoshita R, Nishiura H. Real time estimation of the risk of death from novel coronavirus (2019-nCoV) infection: Inference using exported cases. medRxiv. 2020 Jan 1.

Kampf G, Todt D, Pfaender S, Steinmann E. Persistence of coronaviruses on inanimate surfaces and its inactivation with biocidal agents. *Journal of Hospital Infection*. 2020 Feb 6.

Lauer SA, Grantz KH, Bi Q, Jones FK, Zheng Q, Meredith H, Azman AS, Reich NG, Lessler J. The incubation period of 2019-nCoV from publicly reported confirmed cases: estimation and application. medRxiv. 2020 Jan 1.

Li X, Zai J, Wang X, Li Y. Potential of large 'first generation' human-to-human transmission of 2019-nCoV. *Journal of Medical Virology*. 2020 Jan 30.

Liu Z, Magal P, Seydi O, Webb G. Understanding unreported cases in the 2019-nCov epidemic outbreak in Wuhan, China, and the importance of major public health interventions. China, and the Importance of Major Public Health Interventions (February 3, 2020). 2020 Feb 3.

Lu R, Zhao X, Li J, Niu P, Yang B, Wu H, Wang W, Song H, Huang B, Zhu N, Bi Y. Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. *The Lancet*. 2020 Jan 30.

Riou JY, Althaus C. Pattern of early human-to-human transmission of Wuhan 2019 novel coronavirus (2019-nCoV), December 2019 to January 2020. *Eurosurveillance*. 2020 Jan 30;25(4):pii-2000058.

Sun Z, Xu P, Liu X, Karuppiyah T, Kumar SS, He G. A Review on the Factors Contributing to 2019-nCoV Virus Outbreaks in Wuhan.

Wang W, Tang J, Wei F. Updated understanding of the outbreak of 2019 novel coronavirus (2019-nCoV) in Wuhan, China. *Journal of Medical Virology*. 2020 Jan 29.

Weiss SR, Navas-Martin S. Coronavirus pathogenesis and the emerging pathogen severe acute respiratory syndrome coronavirus. *Microbiol. Mol. Biol. Rev.*. 2005 Dec 1;69(4):635-64.

Wu P, Hao X, Lau EH, Wong JY, Leung KS, Wu JT, Cowling BJ, Leung GM. Real-time tentative assessment of the epidemiological characteristics of novel coronavirus infections in Wuhan, China, as at 22 January 2020. *Eurosurveillance*. 2020 Jan 23;25(3).

Zhang H, Kang Z, Gong H, Xu D, Wang J, Li Z, Cui X, Xiao J, Meng T, Zhou W, Liu J. The digestive system is a potential route of 2019-nCoV infection: a bioinformatics analysis based on single-cell transcriptomes. bioRxiv. 2020 Jan 1.

Zhang R, Liu H, Li F, Zhang B, Liu Q, Li X, Luo L. Transmission and epidemiological characteristics of Novel Coronavirus (2019-nCoV)-Infected Pneumonia (NCIP): preliminary evidence obtained in comparison with 2003-SARS. medRxiv. 2020 Jan 1.

ⁱ <https://www.gov.uk/government/publications/wuhan-novel-coronavirus-self-isolation-for-patients-undergoing-testing/advice-sheet-home-isolation>