Coronaviruses

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Coronaviruses

- From the Latin corona (crown / halo)
- Enveloped RNA viruses
 - Genomic size 26 32 kilobases, the largest for an RNA virus
 - RNA viruses have very high mutation rates correlated with enhanced virulence and evolvability*
- Can cause diseases in mammals & birds:
 - In humans, usually mild respiratory infections (e.g. about 20% of common colds) but rarer forms (SARS, MERS) can be lethal
 - In cows and pigs may cause diarrhoea
 - In chickens can cause upper respiratory disease
- No vaccines or antiviral drugs approved for prevention or treatment.

*Duffy S (2018) Why are RNA virus mutation rates so damn high? PLoS Biol 16(8): e3000003. https://doi.org/10.1371/journal.pbio.3000003

Novel Coronaviruses

- SARS coronavirus (SARS-CoV).
 - Cause of Severe Acute Respiratory Syndrome (SARS) (2003-4)
 - Over 8,000 people were infected, worldwide (CFR ca. 10%)
- Middle East respiratory syndrome coronavirus (MERS-CoV).
 - As of 18/12/2019: 2,497 cases with 898 deaths (CFR ca. 36%) in 27 countries
- NL63/NL/New Haven Coronavirus & HKU1.
 - Newly described, affect humans but do not cause serious disease
- Wuhan pneumonia (2019 nCoV)
 - As of 11/01/2020: 41 confirmed cases, 1 death

Coronaviruses

- Zoonoses
 - SARS-CoV horseshoe bats, civet cats
 - MERS-CoV (possibly bats), dromedary camels
 - Several known coronaviruses circulating in animals but have not yet infected humans
- Common signs of infection in humans include:
 - respiratory symptoms
 - fever
 - cough
 - shortness of breath
 - breathing difficulties
- In more severe cases:
 - pneumonia,
 - severe acute respiratory syndrome
 - kidney failure
 - death

SARS (Severe Acute Respiratory Syndrome) The pandemic that was halted

- An acute respiratory disease
- Transmission: droplet & on hands
- First case 45Y male in Guandong, China, 16/11/2002
 - First cases in Hong Kong Feb 2003
 - Hanoi index case 26/02/2003
 - Singapore index case 01/03/2003
 - Canada index case 05/03/2003
 - Taiwan index case 14/03/2003
- Virus identified 22/03/2003
- Last pandemic cases July 2003
- 37 countries involved
- 8,422 cases & 916 deaths worldwide (CFR = 10.9%)
- No cases reported since 2004







- A novel Coronavirus (SARS coronavirus SARS CoV)
- Genetically traced to a colony of horseshoe bats (*Rhinolophus* sp.) in Yunnan province
- Isolated from:
 - Palm civets (*Paradoxurus hermaphroditus*)

Controlling the epidemic

Infection only transmitted from clinically ill individuals

- Epidemiological investigation & surveillance
 - International co-operation
 - Case definitions
 - Defined responsibilities
- Identification of the cause
 - International co-operation between laboratories
- Treatment of cases
 - International sharing of results
- Quarantine of suspect and confirmed cases
- Advice against un-necessary travel & screening air travellers
- Reduction of social interaction in affected areas
 - e.g. closure of schools



Middle East Respiratory Syndrome Coronavirus (MERS-CoV)

MERS CoV

- Also called SARS-like virus, novel coronavirus or 'Saudi SARS'
 - First known cases spring 2012
 - 2,506 lab-confirmed cases including 862 deaths (to 15/01/2020: [WHO] CFR 35.7%)
 - Most cases male (86% in Jun Nov 2019)
 - Age 9/12 94 Y (median 56Y in Jun-Nov 2019)

Cases world-wide



- 27 countries have reported cases
- Initial (& most ca. 80%) cases in Saudi Arabia (2,102 confirmed cases, 780 deaths - to end Nov 2019)
- Concern about risks associated with Hajj pilgrimage

MERS-CoV – the disease

- Severe disease in:
 - elderly,
 - immunocompromised,
 - those with chronic diseases

(e.g. cancer, chronic lung disease, diabetes)

- All have respiratory disease
- Symptoms vary from mild to severe pneumonia
- Renal failure may occur
- Atypical symptoms can occur in immunocompromised
- Supportive care is life saving
- No approved virus-specific therapy

Epidemiology

- Transmission generally requires close contact
- Humans probably infected by direct or indirect contact with dromedary camels**
- Limited ability to transmit between humans.
 - So far, observed non-sustained human-to-human transmission has occurred mainly in health care settings**
- Taphozous perforatus (Egyptian tomb bat) may be the original source of the virus





- 7th coronavirus known to infect people
- like SARS-CoV, member of subgenus Sarbecovirus (Beta-CoV lineage B)
 - genetically distinct from other coronaviruses that infect humans



Origin & Phylogenetics

- "Comparisons of the genetic sequences of this virus and other virus samples have shown similarities to SARS-CoV (79.5%) and bat coronaviruses (96%), indicating that an origin in bats is likely".*
- Our phylogenetic analysis of 2019-nCoV showed that the virus belongs to the subgenus Sarbecovirus. 2019-nCoV was more similar to two bat-derived coronavirus strains, than to known human-infecting coronaviruses, including the virus that caused the SARS outbreak of 2003**.

*Zhou, Peng; Yang, Xing-Lou; Wang, Xian-Guang; Hu, Ben; Zhang, Lei; Zhang, Wei; Si, Hao-Rui (23 January 2020). "*Discovery of a novel coronavirus associated with the recent pneumonia outbreak in humans and its potential bat origin*". *bioRxiv*: 2020.01.22.914952. doi:10.1101/2020.01.22.914952– via www.biorxiv.org

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Published: January 30, 2020 DOI: https://doi.org/10.1016/S0140-6736(20)30251-8 🛛 🦲 Check for updates





- Associated with a food market in Wuhan in China
- Seafood and many other types of animals, many alive at the market

Epidemiology

- First detected in Wuhan, China, mid-Dec 2019
 - phylogenetic study suggests that transmission was likely from a single infected animal
- Spread to all provinces of China & 26 other countries
- Human-to-human spread confirmed in several countries
 - Basic reproduction number (R_0) is 1.4 5 (most estimates <3.8)
- Designated as a PHEIC by WHO on 30/01/2020
 - Not yet considered a pandemic
- First cases outside China:
 - people who had travelled from Wuhan
 - people who had been in contact with a traveller from the area
- As of 06/02/2020
 - 28,289 confirmed cases (28,063 in China) with 565 deaths
 - 26 countries with confirmed cases

Wash your hands

Wash your hands with soap and running water when hands are visibly dirty



If your hands are not visibly dirty, frequently clean them by using alcohol-based hand rub or soap and water

World Health Organization

Protect yourself and others from getting sick Wash your hands

- after coughing or sneezing
 - when caring for the sick
 - before, during and after you prepare food
 - before eating
 - after toilet use
 - when hands are visibly dirty
 - after handling animals or animal waste

Protect others from getting sick

When coughing and sneezing cover mouth and nose with flexed elbow or tissue



World Health Organization



Throw tissue into closed bin immediately after use

Clean hands with alcohol-based hand rub or soap and water after coughing or sneezing and when caring for the sick



World Health Organization

Protect others from getting sick



Avoid close contact when you are experiencing cough and fever



Avoid spitting in public



World Health Organization

If you have fever, cough and difficulty breathing seek medical care early and share previous travel history with your health care provider