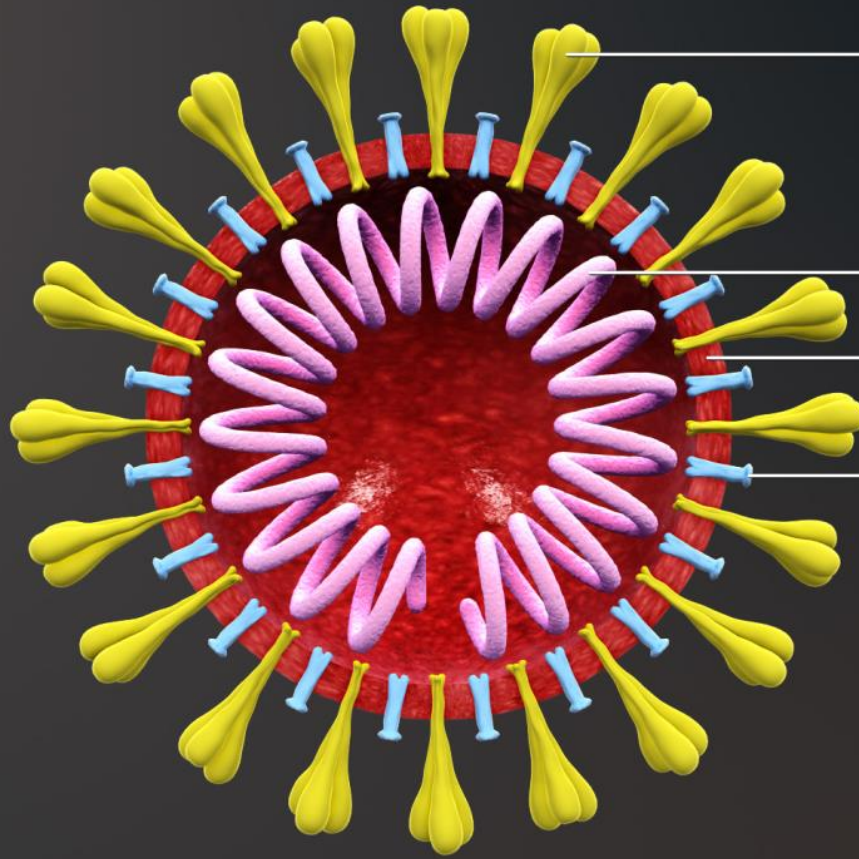
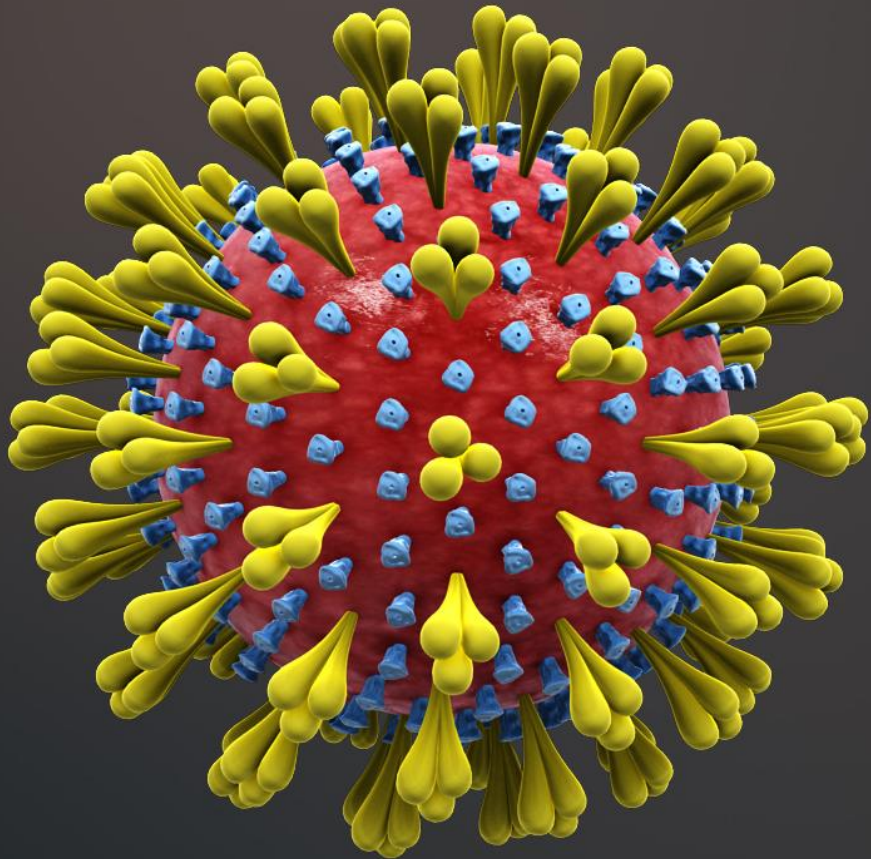




KEMRI



In Search of Better Health



Spike Glycoprotein (S)

RNA and N protein

Envelope

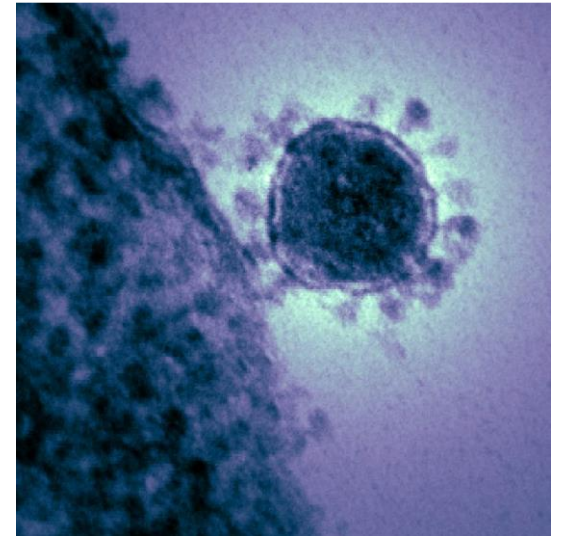
Hemagglutinin-esterase dimer (HE)

Overview of Presentation

- Background
- Biology of Corona Virus,
- Characteristics and history of emergence in humans
- Human Coronaviruses (HCoVs)
- Other Coronaviruses (SARs & MERs)
- Novel Coronaviruses SARS COV - 2

Corona Viruses :Background

- Large family of viruses that cause respiratory illness
 - Belongs to Coronaviridae family
- Named for the crown-like spikes on surface
- 4 subgroupings (α , β , γ & δ)
- Enveloped positive strand RNA viruses
- Largest genome among RNA viruses; ~30 kb
- High frequency of recombination
- First isolated in the 1960s
- Circulates among animals, avian species, most notably bats and humans (zoonotic)



Coronaviruses (CoV): Biology

Coronavirus:

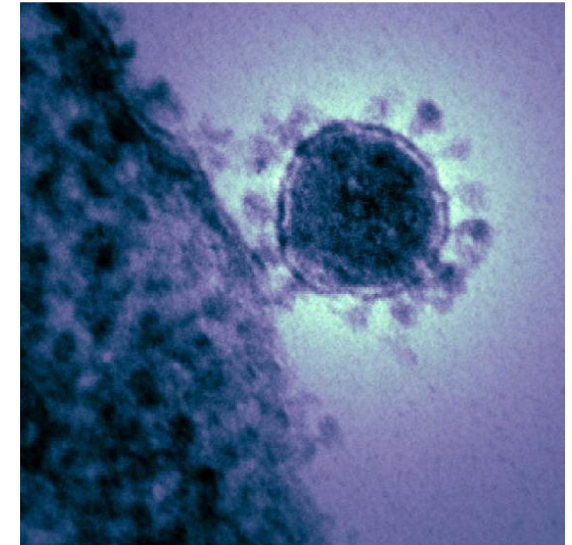
- Family *Coronaviridae*; sub family Coronavirinae; Genus Nidovirales
- Enveloped and spherical (100-160 nm), genome RNA SS (+)
- Wide range of hosts: mammals and birds
- Human: respiratory, gastrointestinal, liver, and neurologic diseases.

Four genera : *Alphacoronavirus*, *Betacoronavirus*, *Gammacoronavirus*
and *Deltacoronavirus*

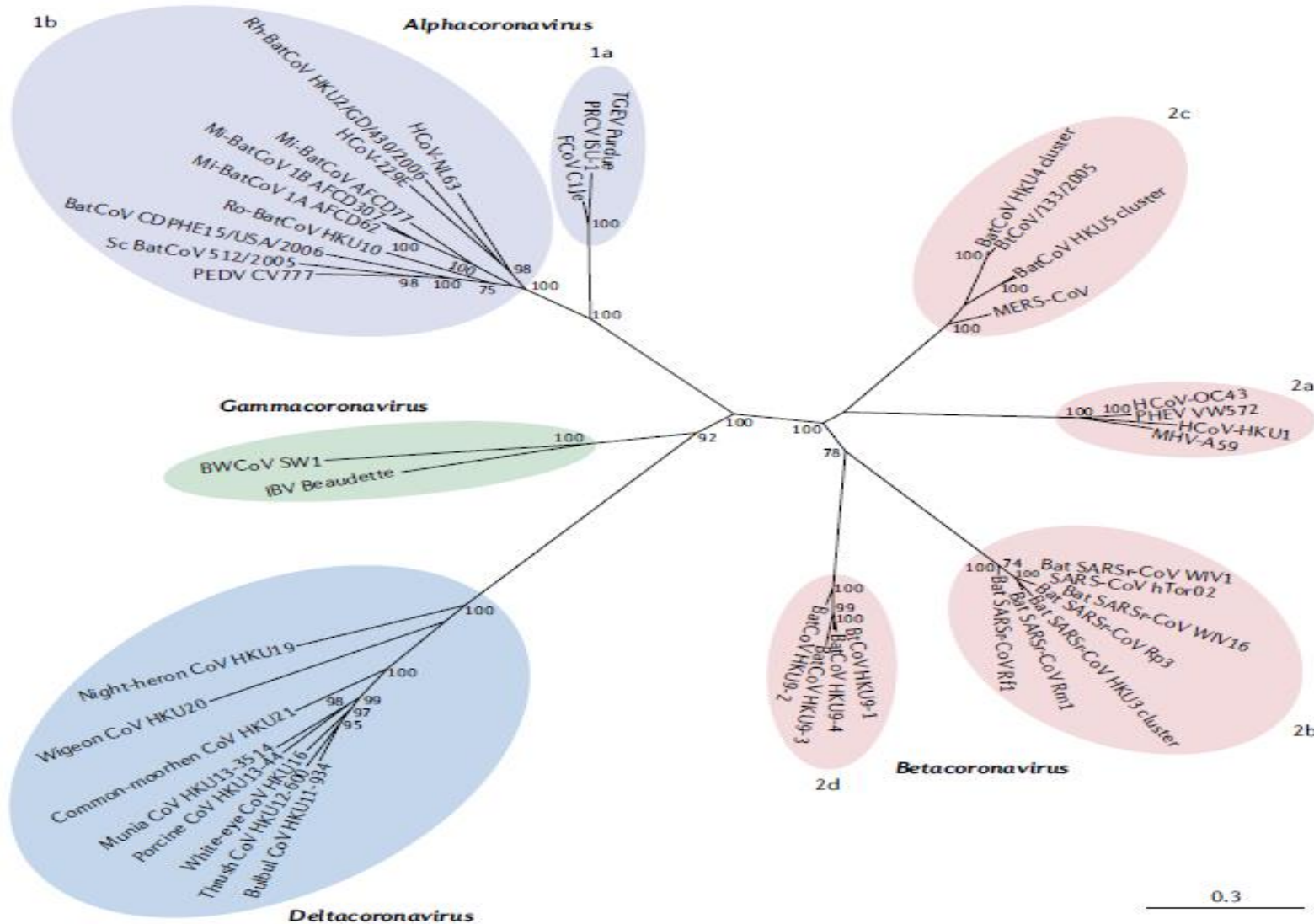
- Alphacoronavirus : HCoV-229E, HCoV-NL63; Pig, dog, and cat CoVs
- Betacoronavirus : HCoV - OC43, HCoV - HKU1, HCoV-SARS, MERS-CoV, SARS CoV-2, rodent pig, bats and cattle CoVs
- Gamma and Delta : Birds and some mammals

Corona Viruses that Infect Humans

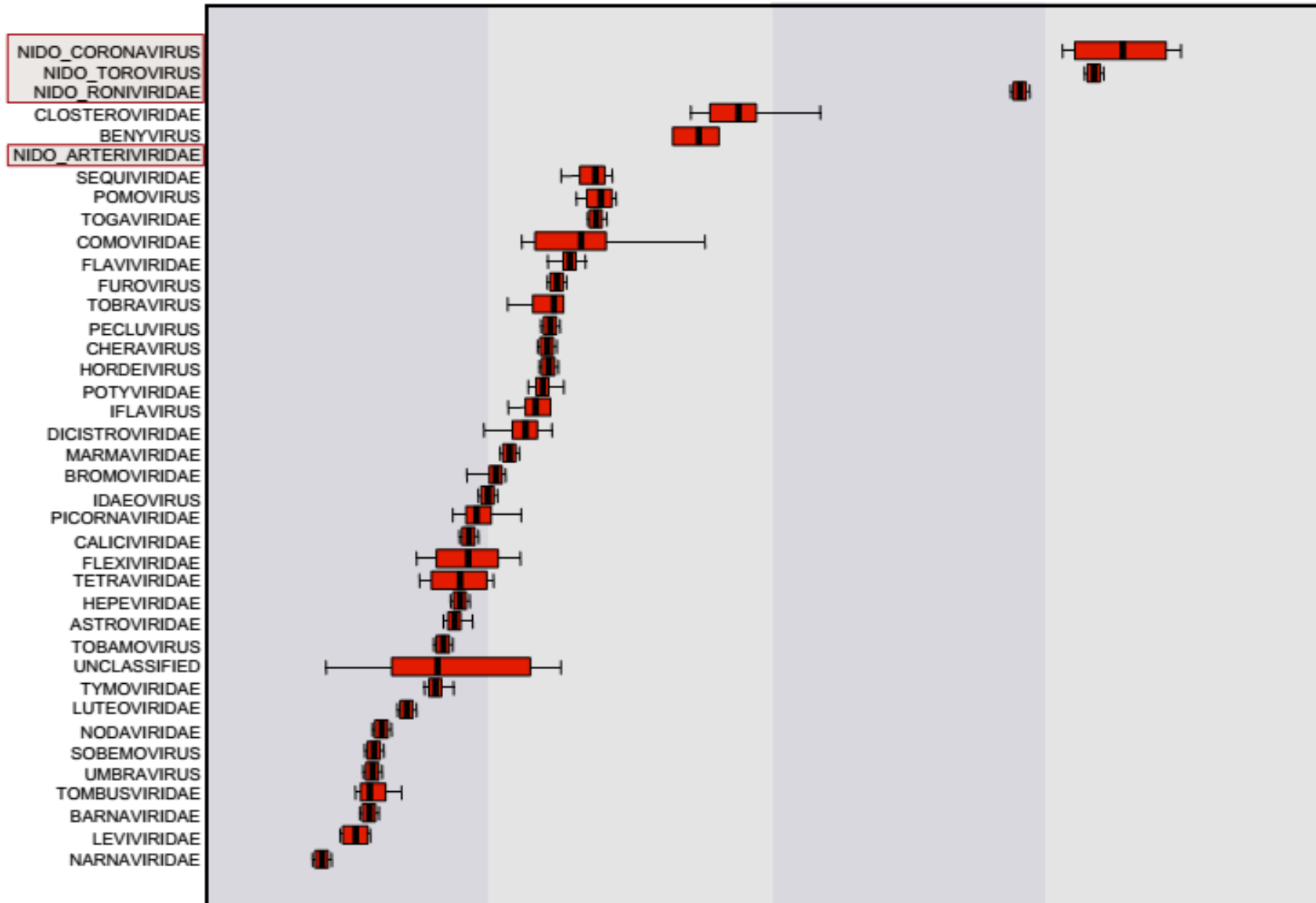
- Seven coronaviruses that can infect humans
- Common HCoV-associated with mild illness:
 - HCoV-229E (alpha)
 - HCoV-OC43 (alpha)
 - HCoV-NL63 (beta)
 - HCoV-HKU1 (beta)
- Other CoVs- highly pathogenic:
 - SARS-CoV (beta)
 - MERS-CoV (beta)
 - SARS CoV-2* (beta) [***2019 Novel Coronavirus**]
- Identified in Wuhan, China in 2019
- Initial case reported had association with an animal/seafood market exposure
- Travel-related exportation of cases reported
- Investigations ongoing



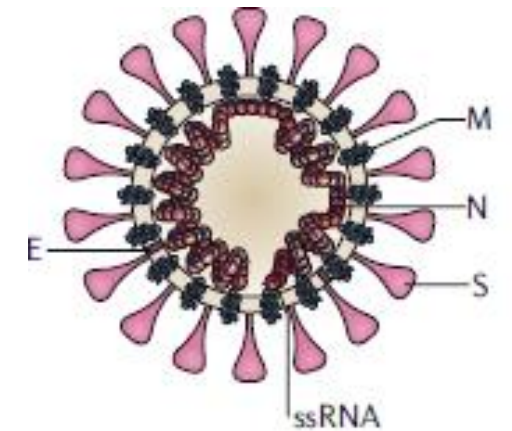
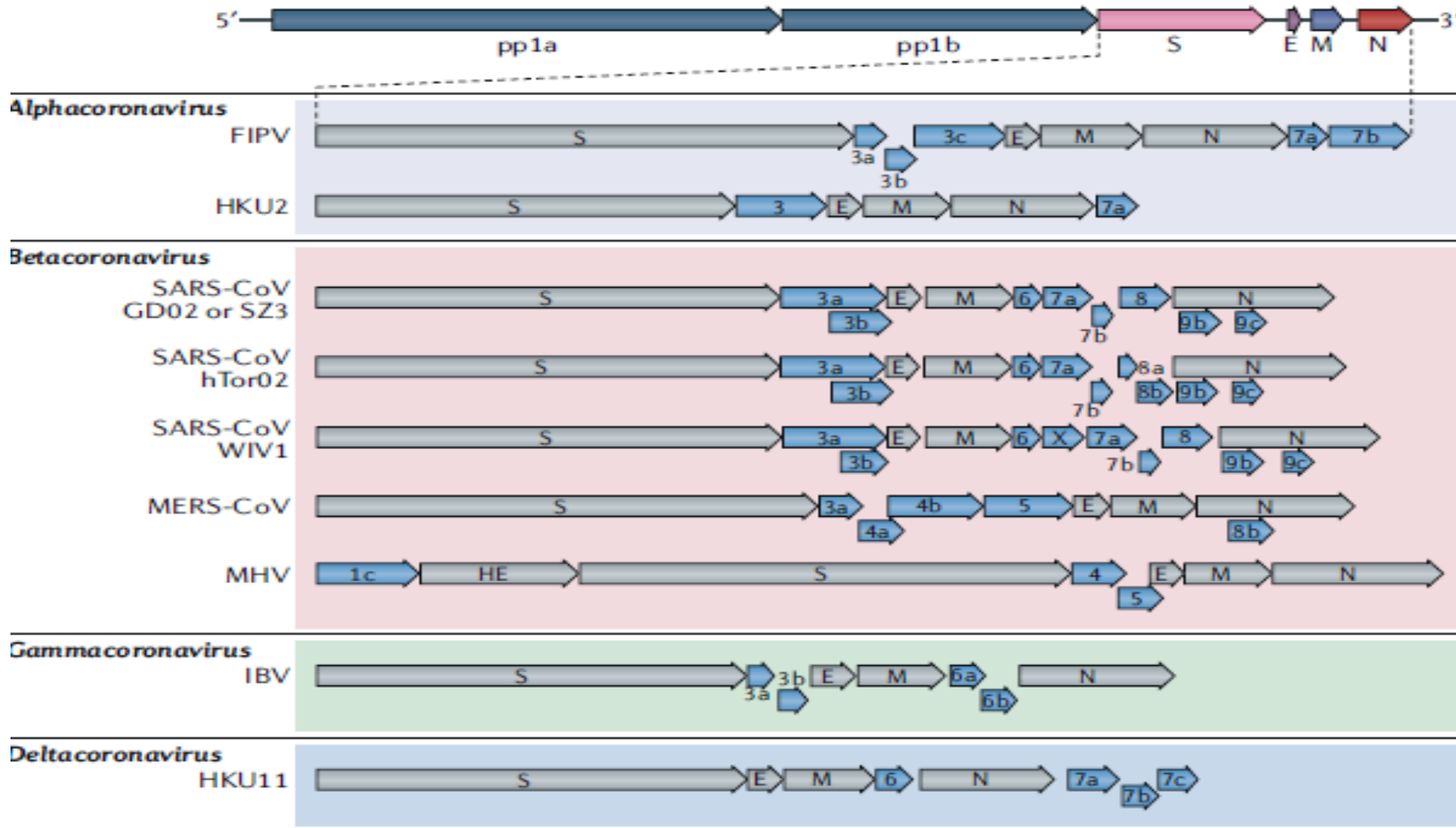
Coronaviruses (CoV): Characteristics



Coronaviruses (CoV): Characteristics

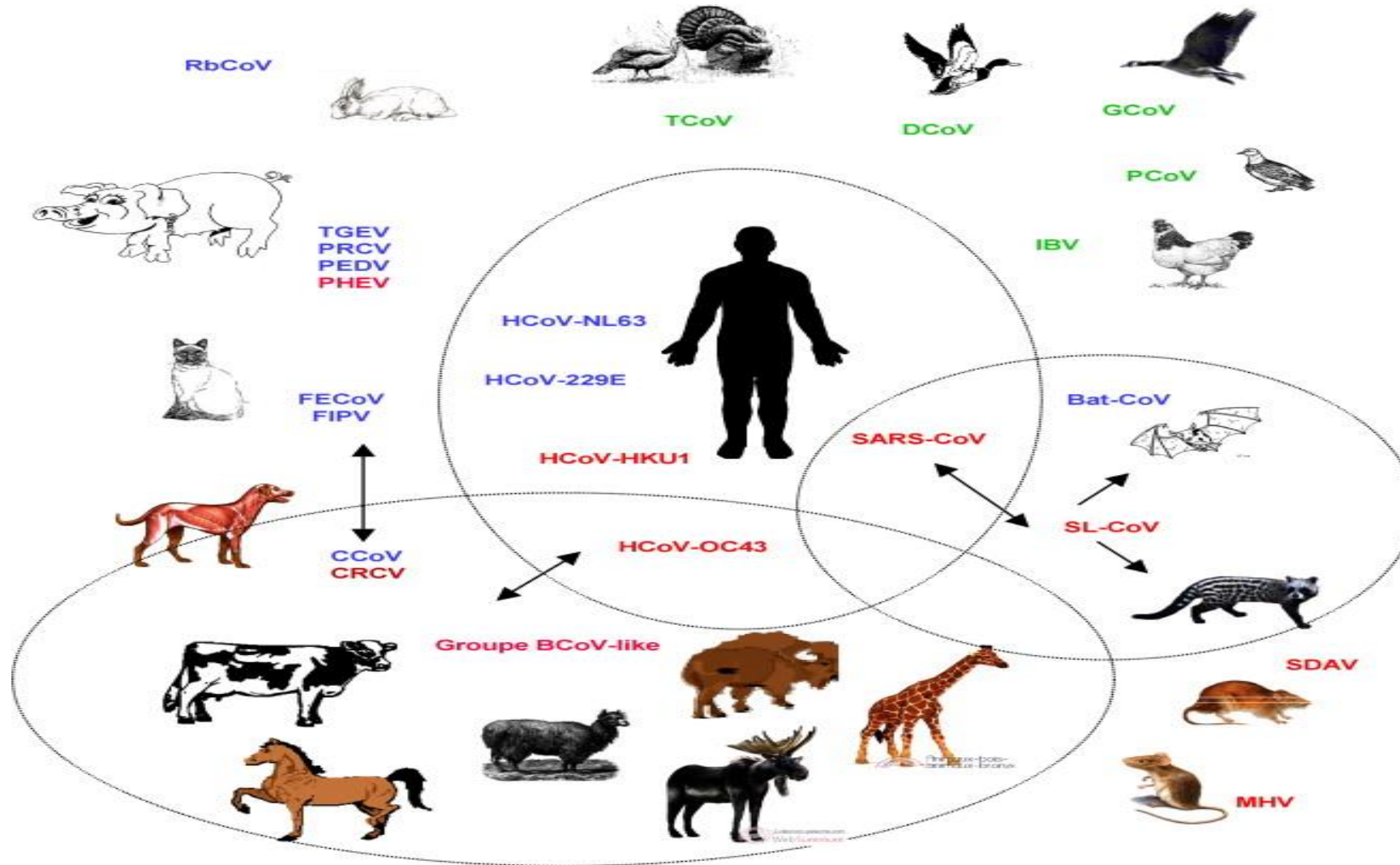


Coronaviruses (CoV): Characteristics

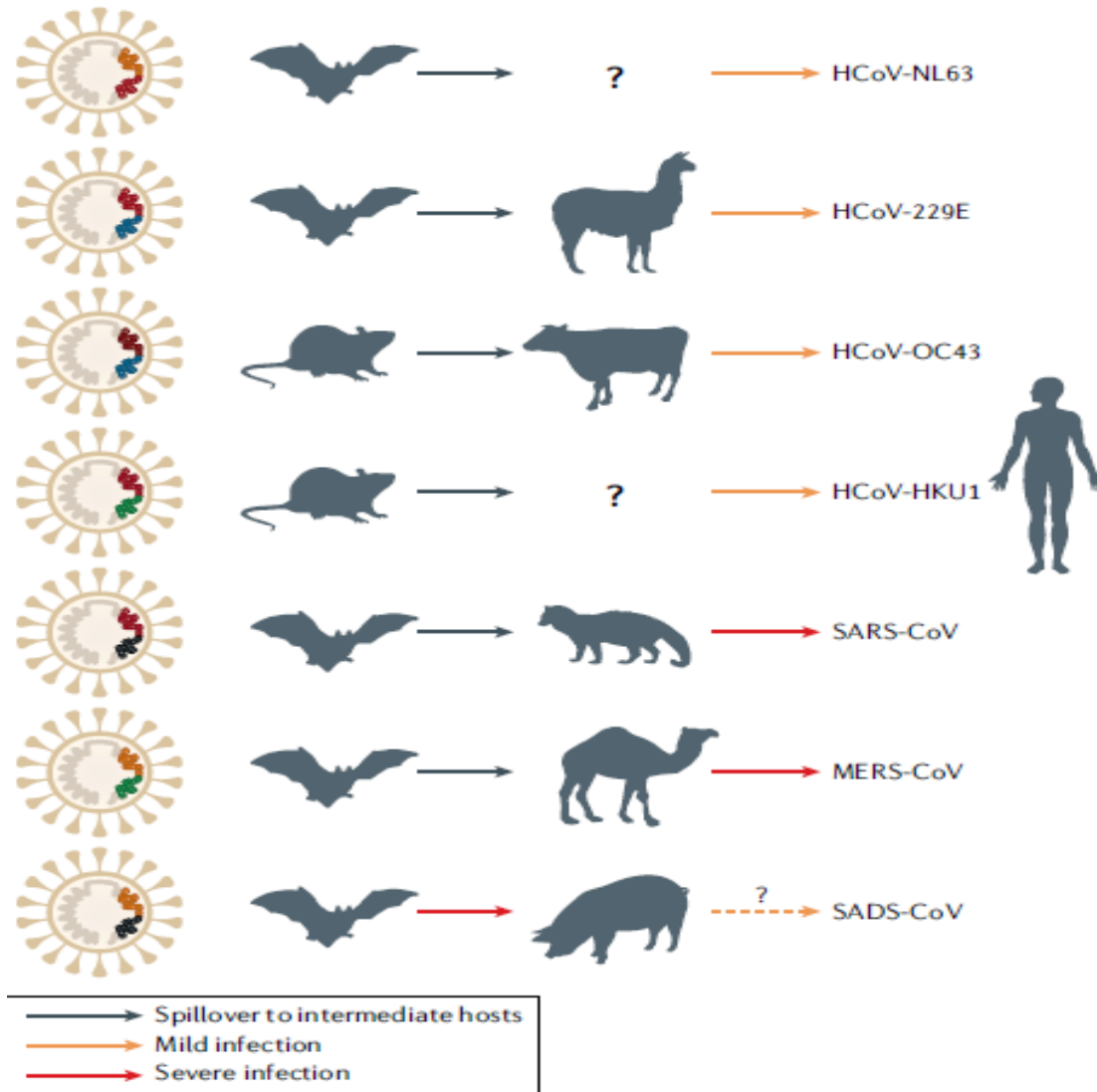


Coronaviruses (CoV): Emergence

Probable origin of human adapted coronaviruses

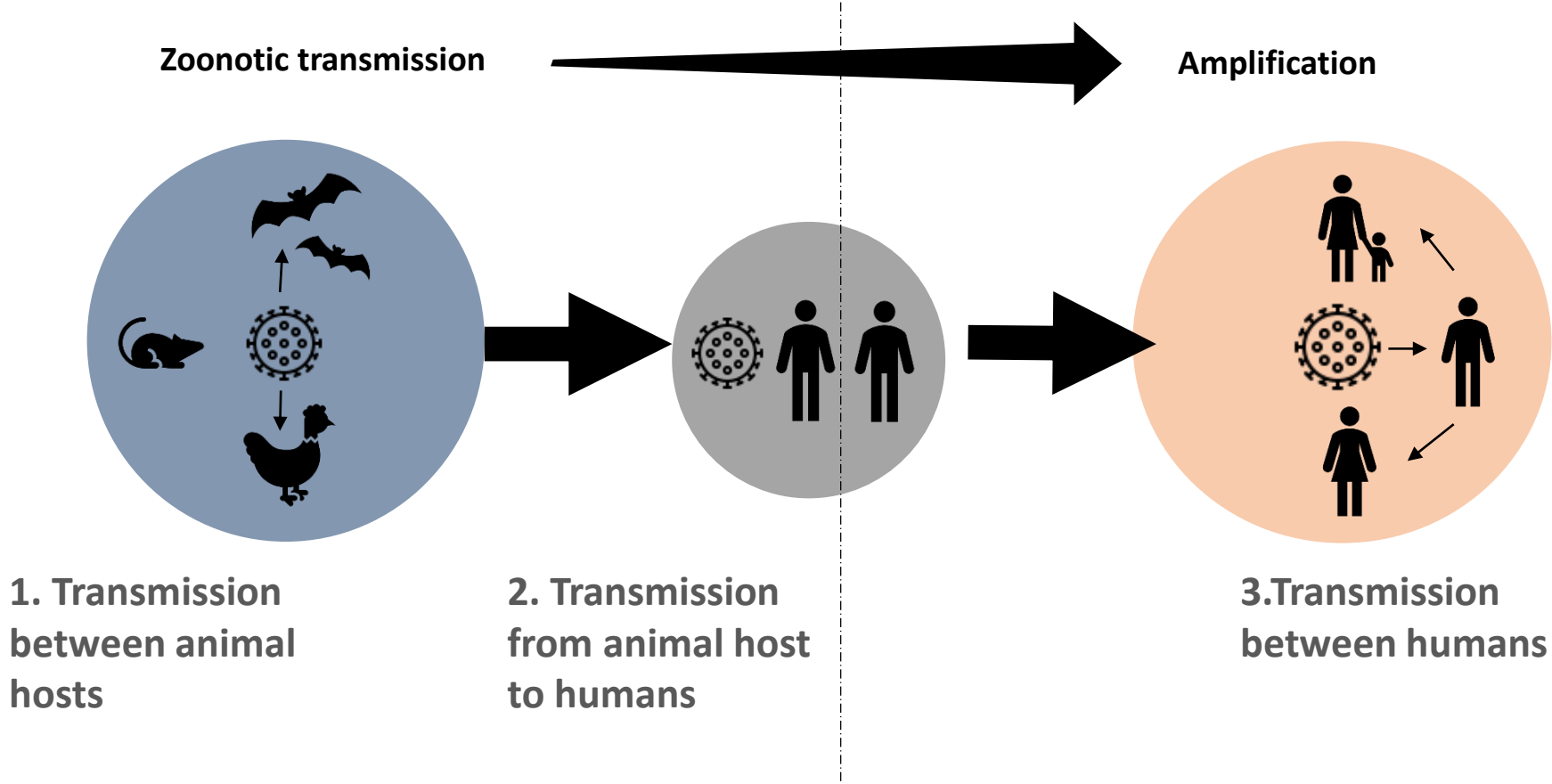


Coronaviruses (CoV): Emergences in human



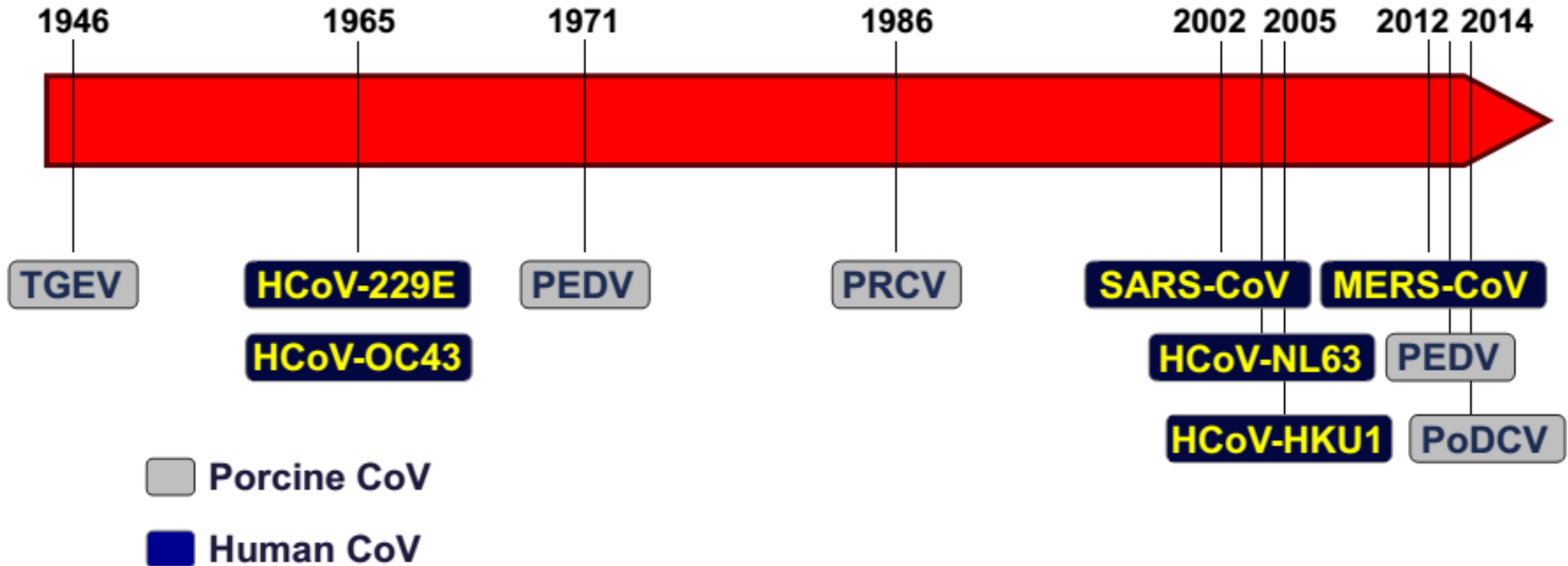
Animal origin of human coronaviruses

Zoonotic diseases and human spread



20/03/2020

Coronaviruses (CoV): Emergence in human



Transmission:229E, NL-63, OC-43, HKU1

- Worldwide
- Seasonality: Winter and spring in temperate climates
- Exposure common in early childhood
- Transmission likely to be droplet, direct and indirect contact
- Most commonly spread from an infected person to others through:
 - The air by coughing or sneezing
 - Close personal contact, such as touching or shaking hands
 - Touching an infected object or surface
- Commonly occurs in fall and winter, but can occur year-round
- Young children are most likely to get infected
- Most people will get infected in their lifetime

Clinical Spectrum of Illness: 229E, NL-63, OC-43, HKU1

- Most often associated with upper respiratory tract infections in children
 - 2nd only to Rhinovirus as cause of common cold
- Pneumonia and lower tract infections
 - immunocompromised individuals; elderly
- Association with hospitalization and severe illness in children not clearly defined
- May play a role in exacerbations of underlying respiratory diseases
- Symptoms and viral loads high first few days of illness
- Incubation period 2-5 days

Clinical Spectrum of Illness: 229E, NL-63, OC-43, HKU1

Symptoms

Usually cause mild to moderate upper-respiratory tract illnesses, like the common cold

- Runny nose
- Headache
- Cough
- Sore throat
- Fever
- General unwell feeling
- Pneumonia or bronchitis*

Other CORONA VIRUSES - 1

SARS-CoV (Severe Acute Respiratory Syndrome Coronavirus Viral respiratory illness)

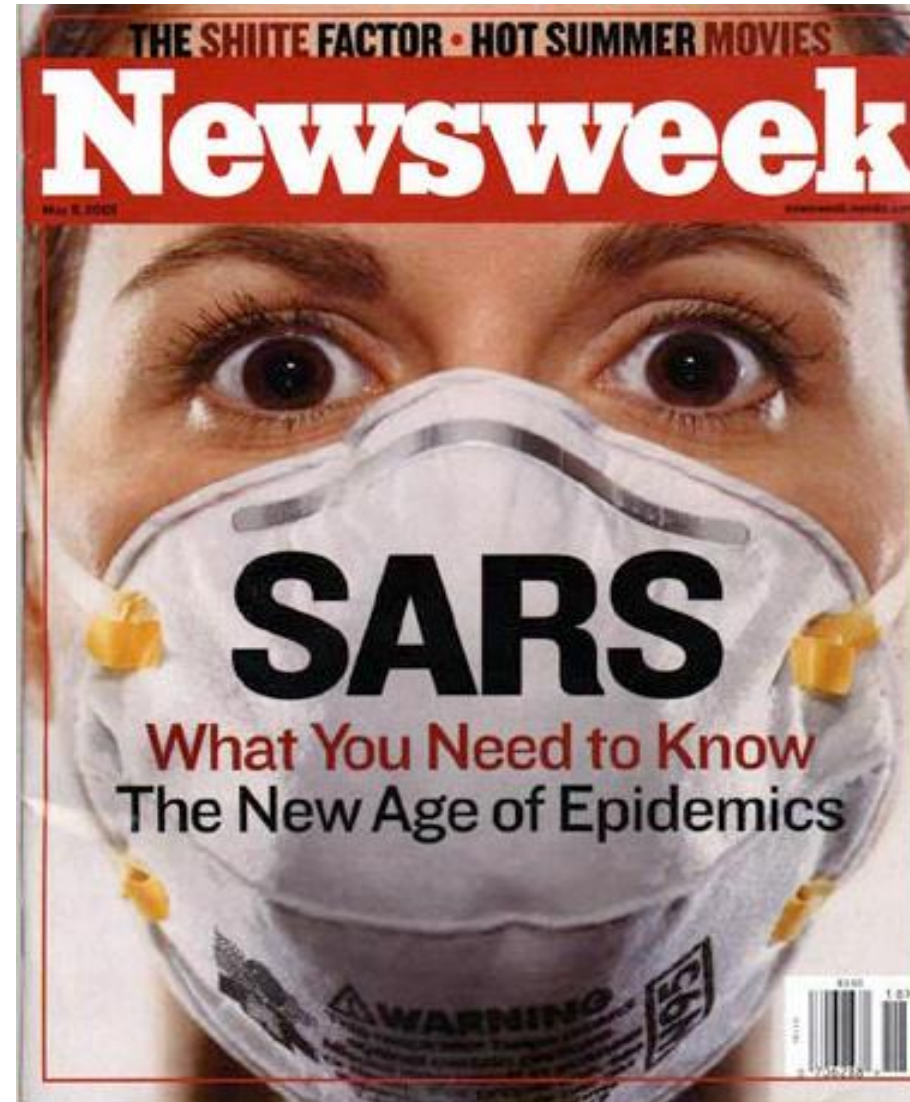
- First recognized in November 2002 in China
- 2002-2003 global outbreak – 8,098 probable cases
 - 774 deaths
- No known human cases since 2004
- Spread by close person-to-person contact
- Symptoms often include:
 - Fever, chills, and body aches progressing to pneumonia

Coronaviruses (CoV): SARS-CoV episode

The coronavirus family: from common cold to Severe acute respiratory syndrome (SARS)

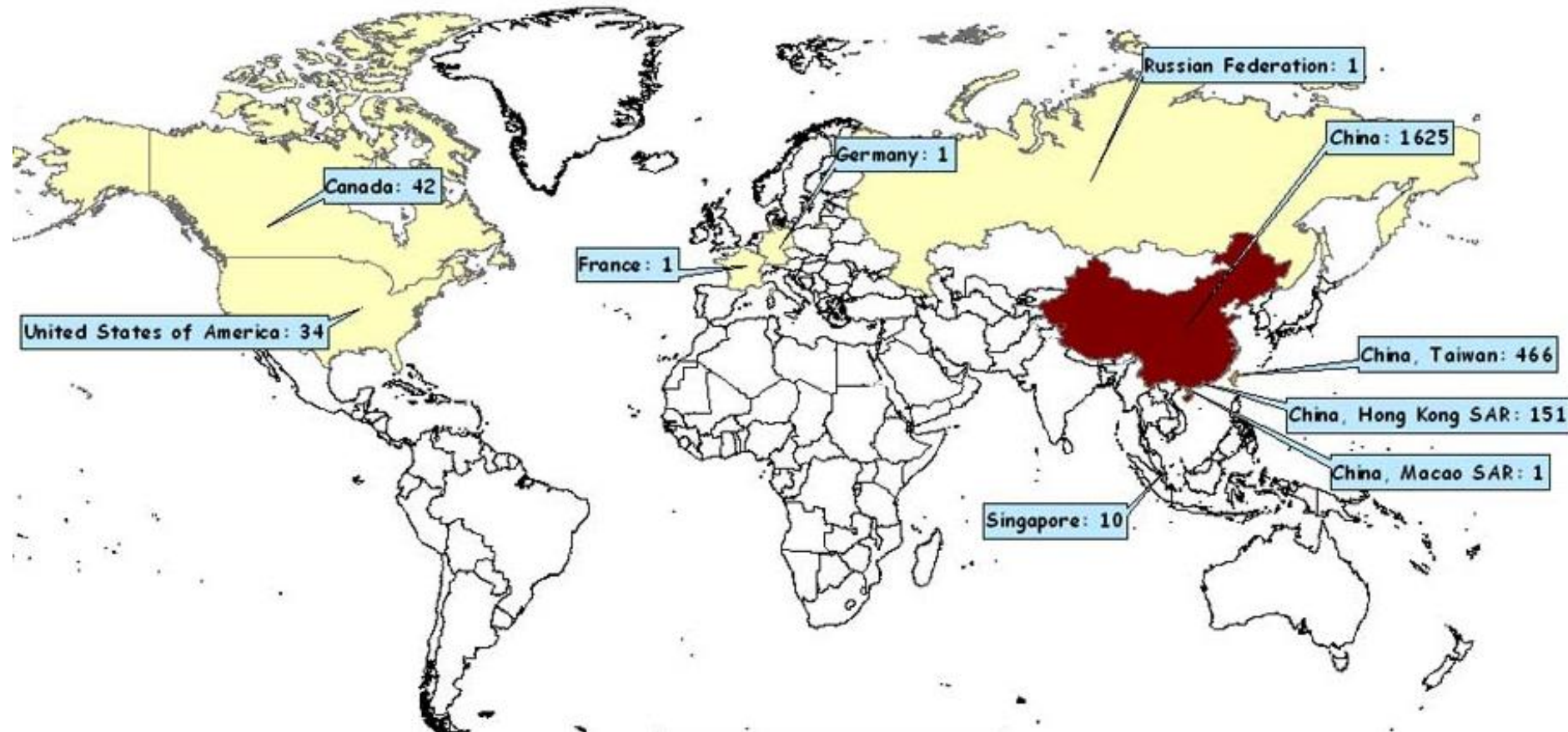
Outbreak in March 2003
(mid-November 2002)

- >8422 infections
- 916 death reported in 29 countries

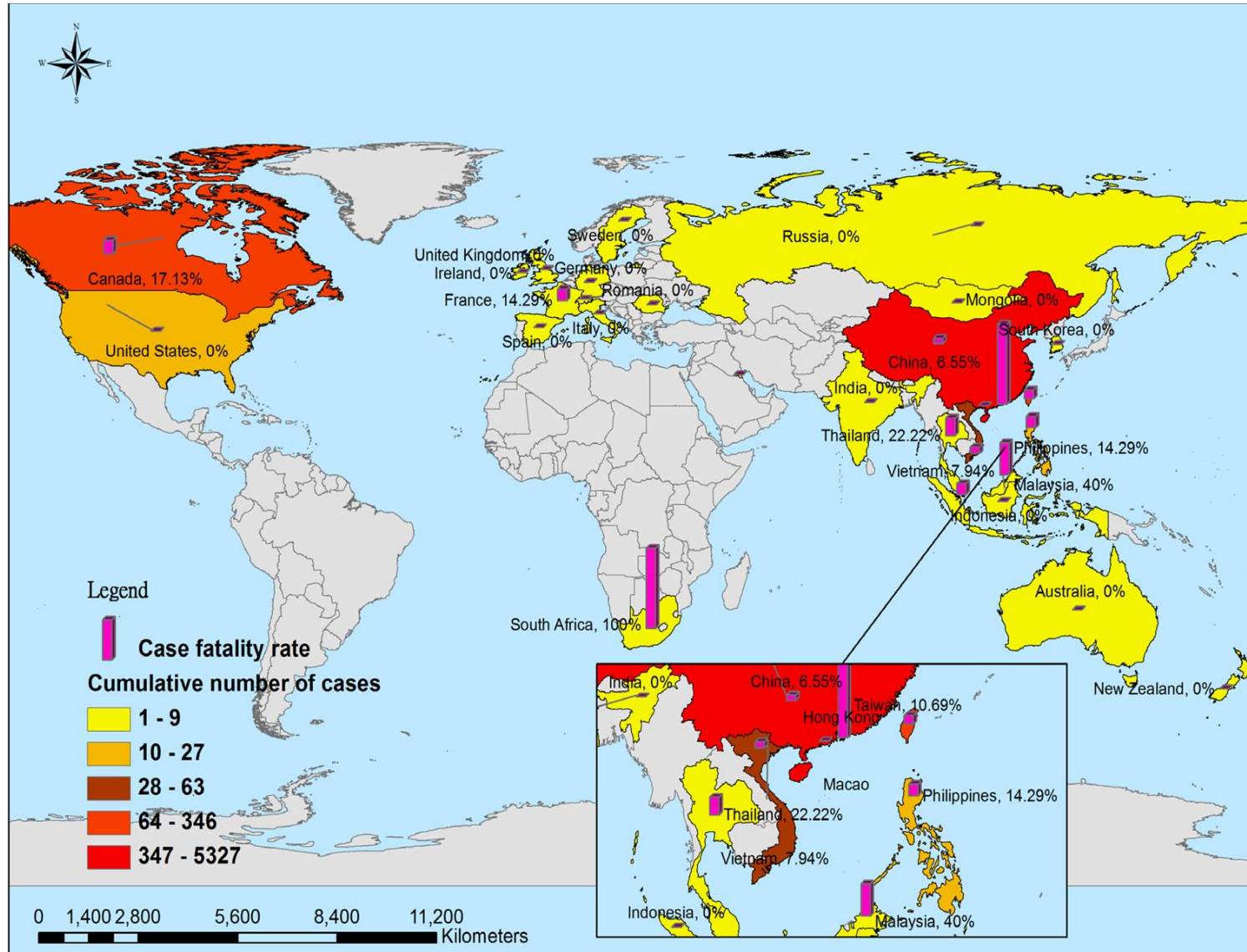


Coronaviruses (CoV): SARS-CoV episode

SARS: Number of Current Probable Cases as of 31 May 2003, 14:00 GMT+2



Coronaviruses (CoV): SARS-CoV episode



1 case reported in Africa

Other CORONA VIRUSES - 2

MERS-CoV [Middle East Respiratory Syndrome Coronavirus (MERS)]

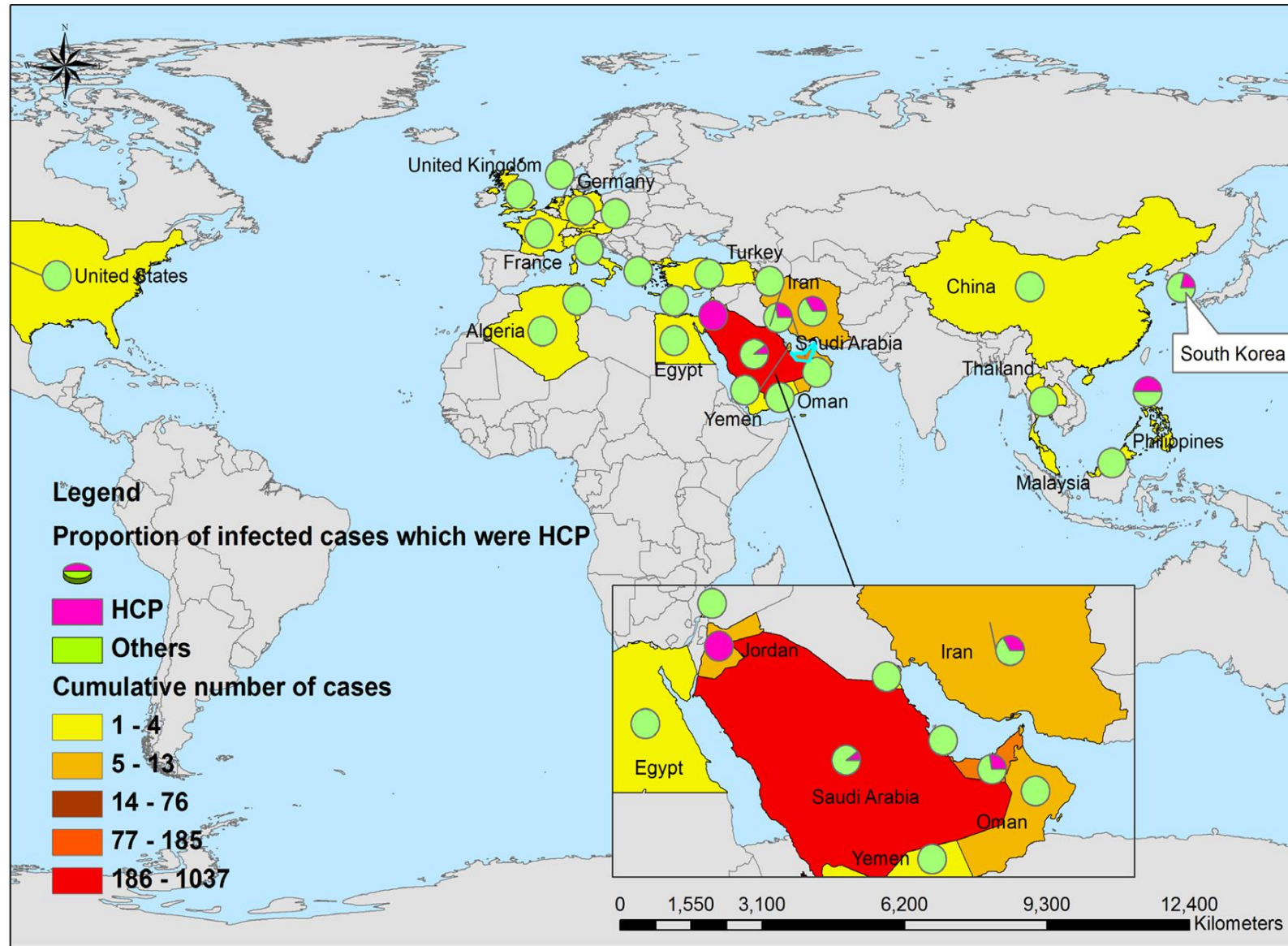
- Viral respiratory illness
- First reported in 2012 in Saudi Arabia
 - Human illnesses in dozens of countries (in or near Arabian Peninsula)
- As of October 3, 2019
 - >2400 lab-confirmed cases
 - >850 deaths

Coronaviruses (CoV): MERS-CoV episode



-June 2012; Jeddah, (Saudi Arabia): 2220 laboratory-confirmed
-cases resulting in at least 790 deaths, 27 countries

Coronaviruses (CoV): MERS-CoV episode



4 human cases in Africa

Coronaviruses (CoV): Case Management

- No specific therapy for SARS-CoV, MERS-CoV and the other HCoVs infection
- Symptomatic treatment
- Antiviral: ribavirin (most used), IFNs and lopinavir.
- Drug and vaccine discovery research for SARS and MERS: Spike and proteases as main targets

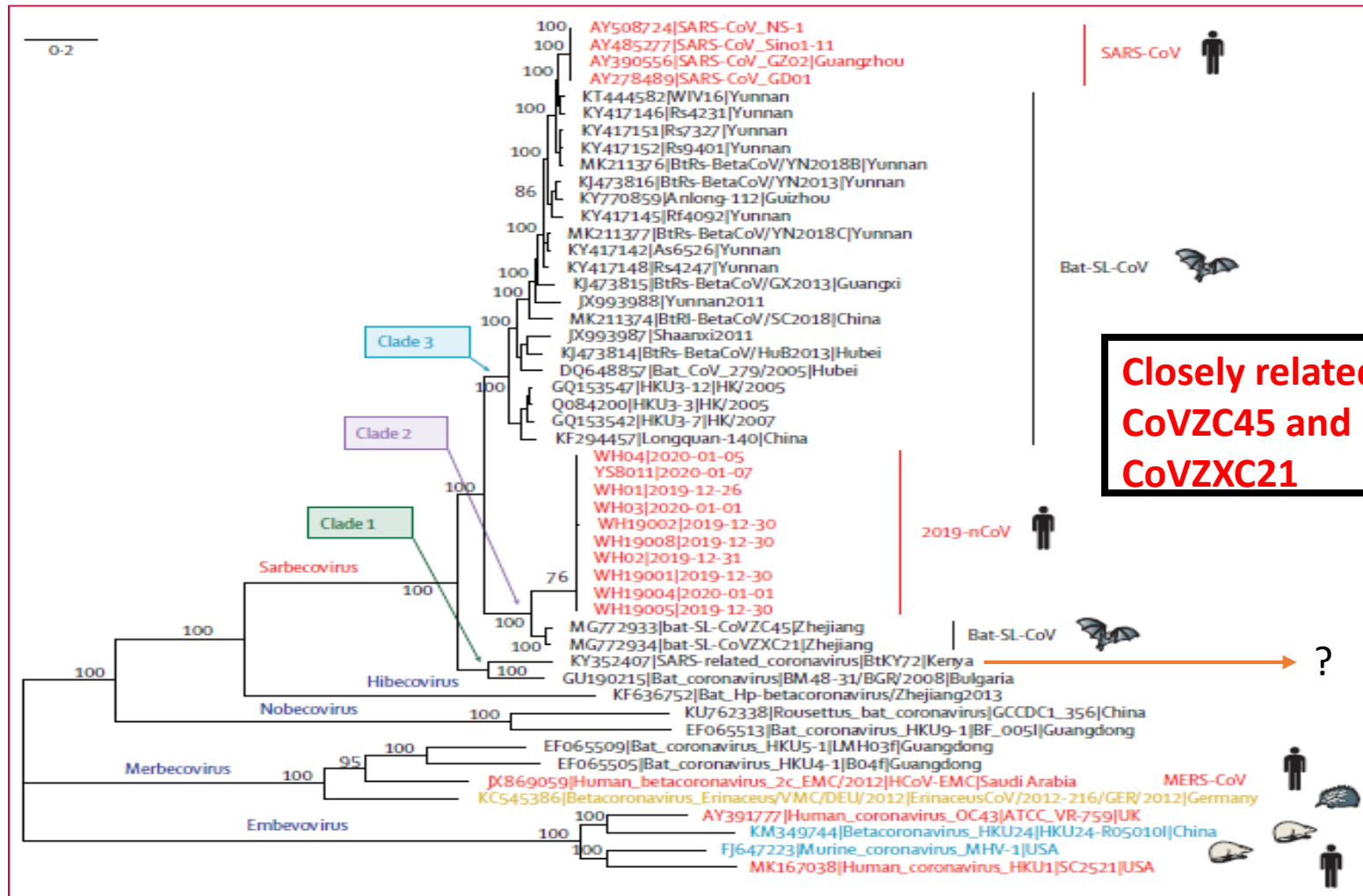
SARS COV -2

- Identified in Wuhan, China in 2019
- Initial cases all linked to Huanan Seafood Market in Wuhan City, China. The Market was closed 01.01.20 for environmental sanitation and disinfection
- On 10 January, WHO launched a website with updated general and travel guidance <https://www.who.int/health-topics/coronavirus>
- On 11 January, China shared the genetic sequence of nCoV enabling the rapid development of diagnostic tests
- The cases in Thailand, Japan and Republic of Korea were all travelers from Wuhan City
- Travel-related exportation of cases reported
- Investigations ongoing

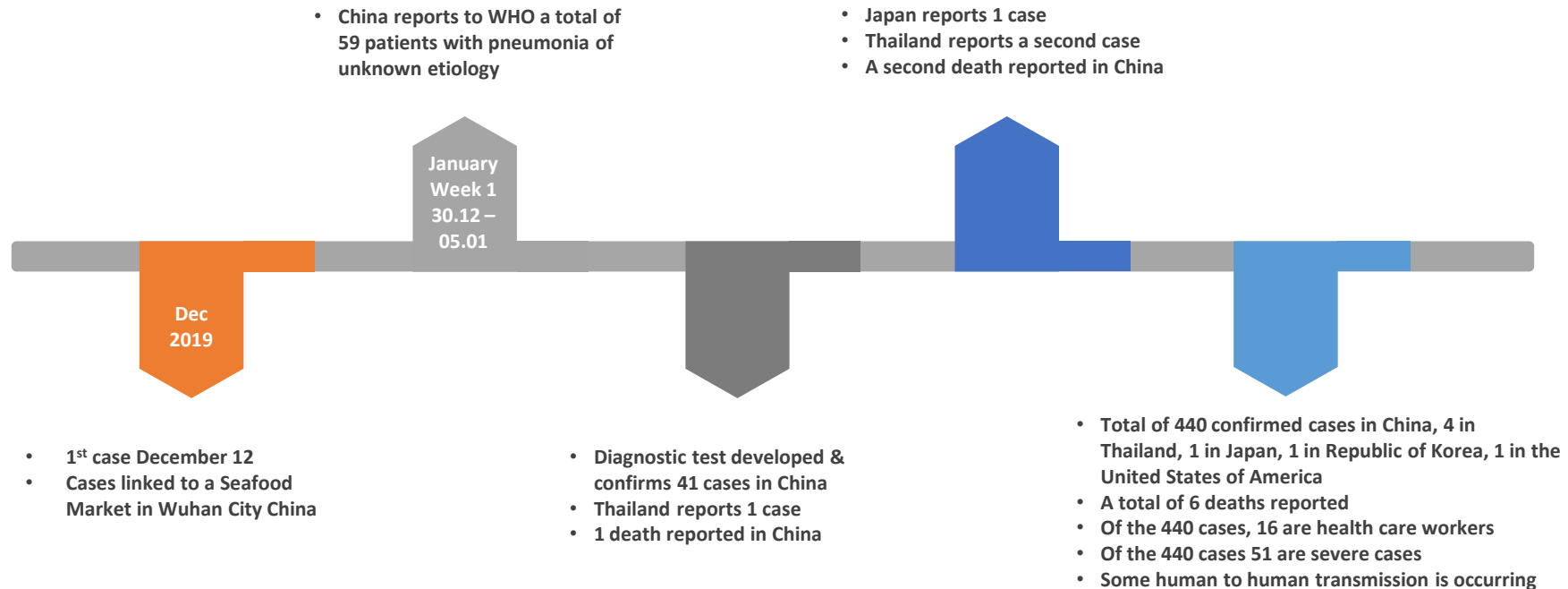


Coronaviruses (CoV): The Wuhan coronavirus (SARS COV –2)

Wuhan virus origin? Cases linked to Wuhan South China Seafood City (chickens, cats, marmots, other wild animals, and seafood.



Timeline of the outbreak



Officially reported data as of 22.01.2020 09:00 CET

The Current COVID-19 Cases Globally

Coronavirus COVID-19 Global Cases by Johns Hopkins CSSE

Total Confirmed

98,387

Confirmed Cases by Country/Region

- 80,555 Mainland China
- 6,284 South Korea
- 3,858 Italy
- 3,513 Iran
- 696 Others
- 545 Germany
- 423 France
- 360 Japan
- 282 Spain
- 233 US
- 119 Switzerland
- 117 Singapore
- 116 UK
- 105 Hong Kong
- 94 Sweden
- 91 Norway
- 82 Netherlands
- 60 Australia
- 58 Kuwait



Cumulative Confirmed Cases Active Cases

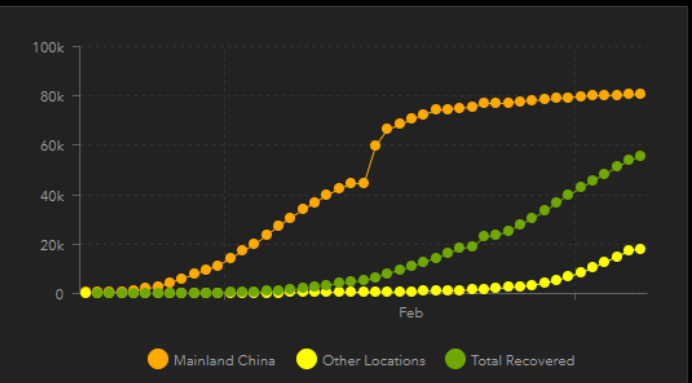
Lancet Inf Dis Article: [Here](#). Mobile Version: [Here](#). Visualization: JHU CSSE. Automation Support: [Esri Living Atlas team](#) and [JHU APL](#).
 Data sources: WHO, CDC, ECDC, NHC and DXY. Read more in this [blog](#). [Contact US](#).
 Downloadable database: [GitHub](#): [Here](#). Feature layer: [Here](#).
 Point level: City level - US, Canada and Australia; Province level - China; Country level - other countries. All points shown on the map are based on geographic centroids, and are not representative of a specific address, building or any location at a spatial scale finer than a city.

Total Deaths
3,383

- 2,931 deaths Hubei Mainland China
- 148 deaths Italy
- 107 deaths Iran
- 40 deaths South Korea
- 22 deaths Henan Mainland China
- 13 deaths Heilongjiang Mainland China
- 10 deaths King County, WA US
- 8 deaths Beijing Mainland China
- 7 deaths France
- 7 deaths

Total Recovered
55,444

- 41,966 recovered Hubei Mainland China
- 1,242 recovered Henan Mainland China
- 1,210 recovered Guangdong Mainland China
- 1,142 recovered Zhejiang Mainland China
- 979 recovered Anhui Mainland China
- 954 recovered Hunan Mainland China
- 908 recovered Jiangxi Mainland China
- 739 recovered Iran
- 617 recovered Shandong Mainland China
- 588 recovered

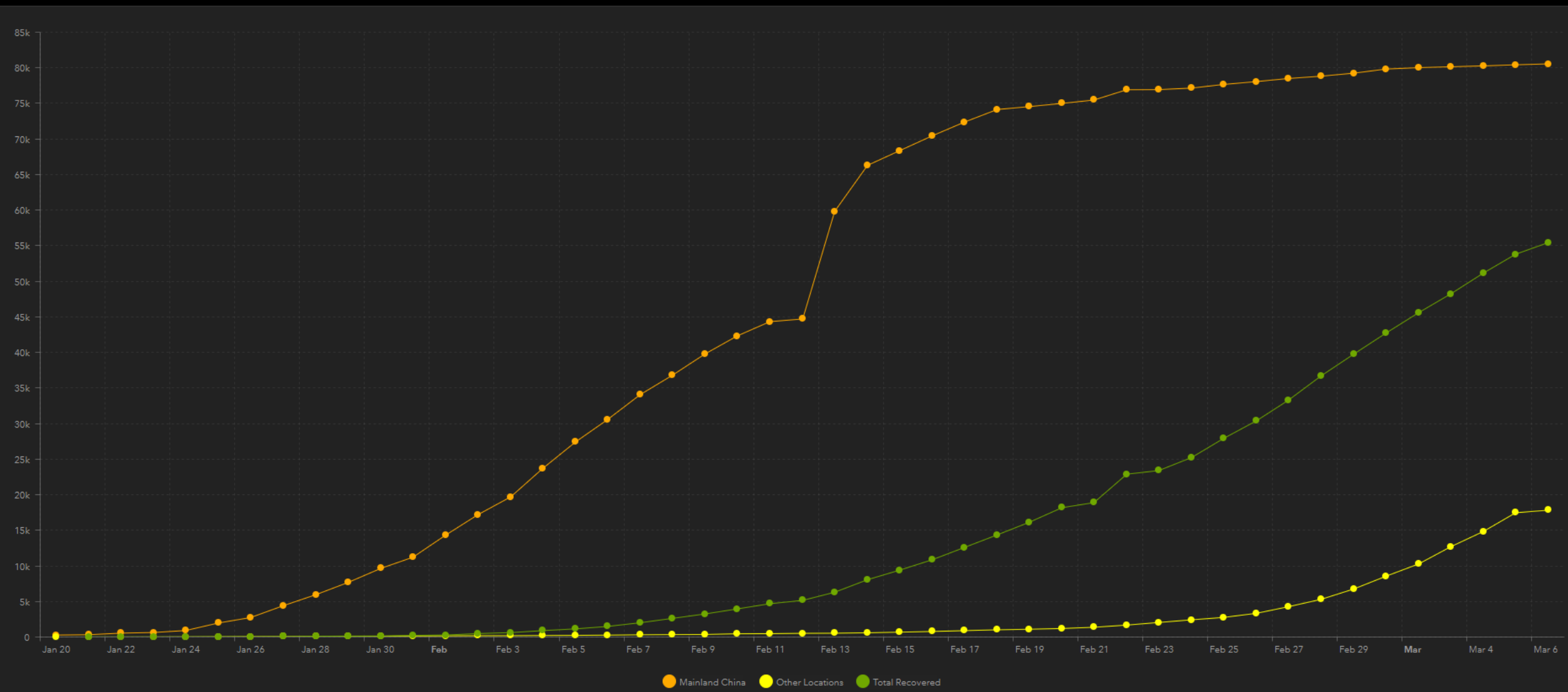


Actual Logarithmic Daily Cases

Last Updated at (M/D/YYYY)
3/6/2020, 10:53:03 AM

The Current COVID-19 Cases Globally – Epi Curve

Coronavirus COVID-19 Global Cases by Johns Hopkins CSSE



Coronaviruses (CoV): The Wuhan coronavirus (SARS COV -2)

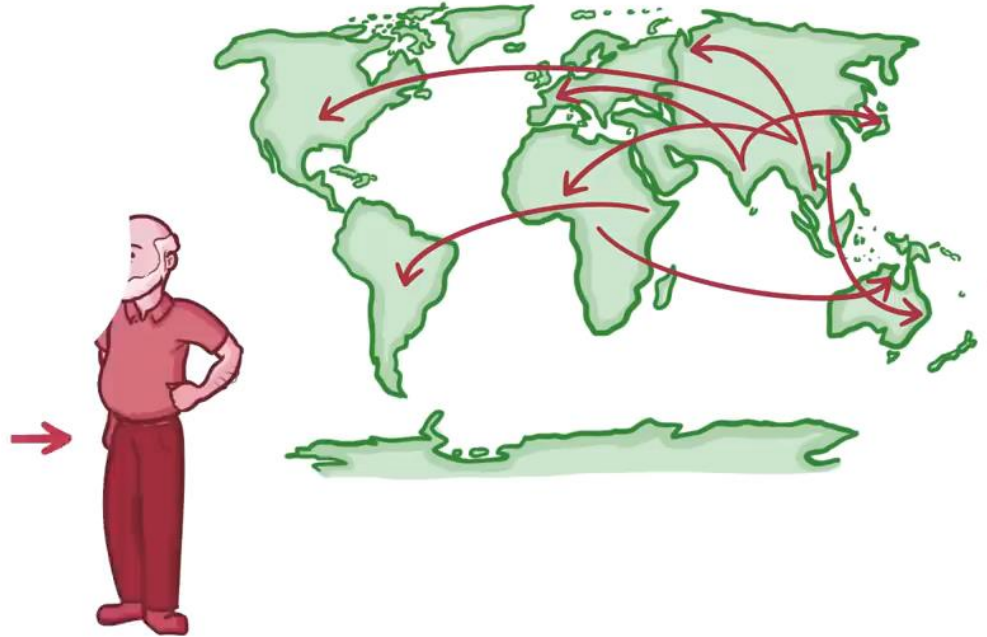
- An emerging coronavirus causing pneumonia outbreak in Wuhan, China, 31 December 2019
- Symptoms: fever, malaise, dry cough, and dyspnea
- Incubation period: two days to up to two weeks following exposure.
- Infections with variable severity: severity of illness has tended to be mild
 - Severe cases (especially in patients with underlying medical conditions)
 - Mild,
 - Asymptomatic

Transmission of SARS-CoV 2

- Efficient human-to-human transmission?
- Transmission may occur during the early symptomatic phase
 - Potentially before both fever and respiratory symptoms develop
- Patients with mild symptoms may more easily spread the virus due to not seeking medical attention.

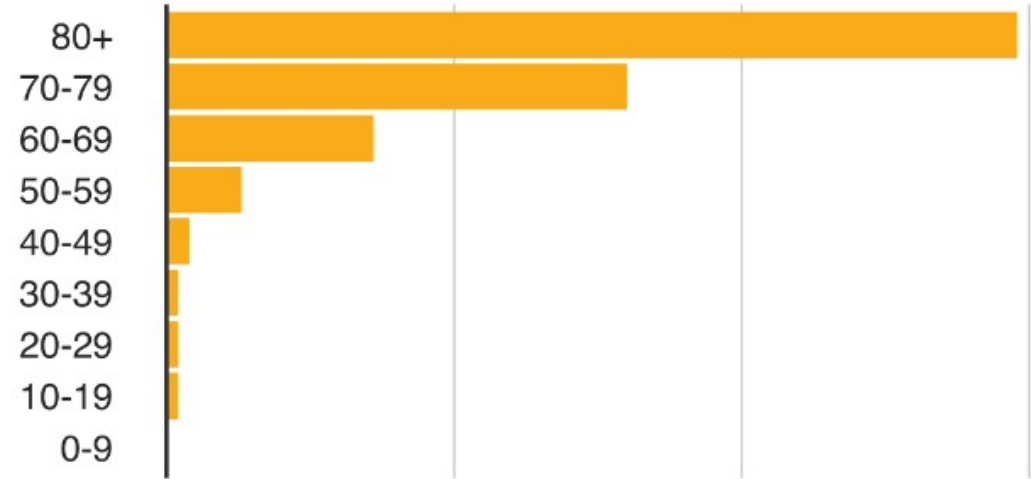
Psychological Impacts of SARS-CoV2 Virus

COMPARATIVE CASE FATALITY RATES

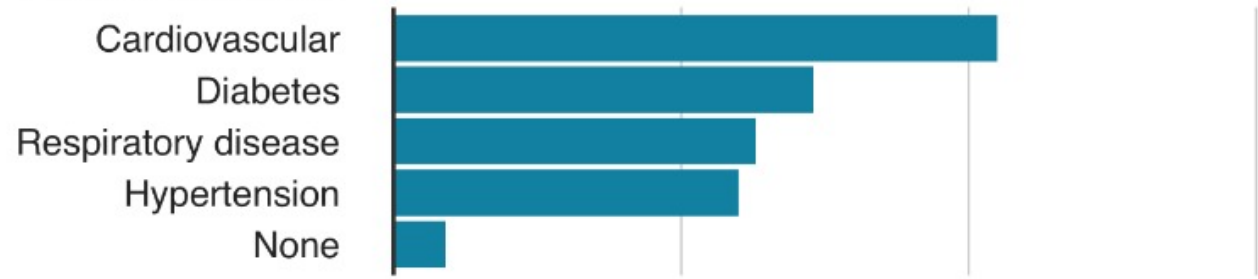


COVID - 19 CFR by Age, Sex and Underlying health conditions.

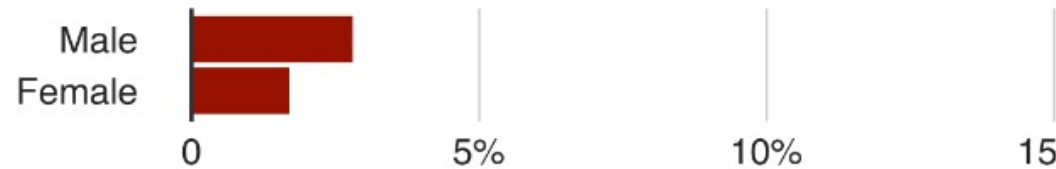
Age



Health condition



Sex



Source: Chinese CDC, March 02 - 2020

Estimated Influenza Disease Burden, by Season

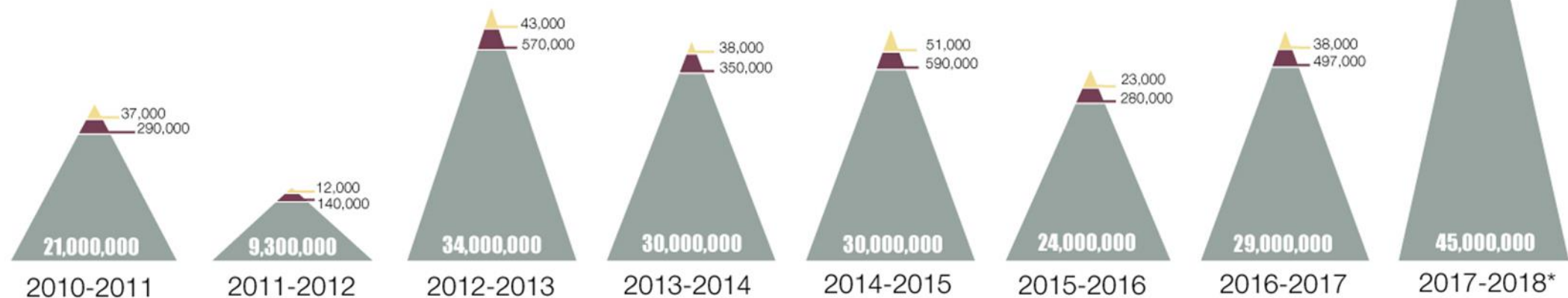
United States, 2010-11 through 2017-18 Influenza Seasons

Season	Symptomatic Illnesses		Medical Visits		Hospitalizations		Deaths	
	Estimate	95% Cr I	Estimate	95% Cr I	Estimate	95% Cr I	Estimate	95% Cr I
2010-2011	21,000,000	(20,000,000 – 25,000,000)	10,000,000	(9,300,000 – 12,000,000)	290,000	(270,000 – 350,000)	37,000	(32,000 – 51,000)
2011-2012	9,300,000	(8,700,000 – 12,000,000)	4,300,000	(4,000,000 – 5,600,000)	140,000	(130,000 – 190,000)	12,000	(11,000 – 23,000)
2012-2013	34,000,000	(32,000,000 – 38,000,000)	16,000,000	(15,000,000 – 18,000,000)	570,000	(530,000 – 680,000)	43,000	(37,000 – 57,000)
2013-2014	30,000,000	(28,000,000 – 33,000,000)	13,000,000	(12,000,000 – 15,000,000)	350,000	(320,000 – 390,000)	38,000	(33,000 – 50,000)
2014-2015	30,000,000	(29,000,000 – 33,000,000)	14,000,000	(13,000,000 – 16,000,000)	590,000	(540,000 – 680,000)	51,000	(44,000 – 64,000)
2015-2016	24,000,000	(20,000,000 – 33,000,000)	11,000,000	(9,000,000 – 15,000,000)	280,000	(220,000 – 480,000)	23,000	(17,000 – 35,000)
2016-2017	29,000,000	(25,000,000 – 45,000,000)	14,000,000	(11,000,000 – 23,000,000)	500,000	(380,000 – 860,000)	38,000	(29,000 – 61,000)
Preliminary estimates *	Estimate	95% UI	Estimate	95% UI	Estimate	95% UI	Estimate	95% UI
2017-2018 *	45,000,000	(39,000,000 – 58,000,000)	21,000,000	(18,000,000 – 27,000,000)	810,000	(620,000 – 1,400,000)	61,000	(46,000 – 95,000)

Estimated Influenza Disease Burden, by Season United States, 2010-11 through 2017-18 Influenza Seasons

- Deaths
- Hospitalizations
- Illnesses

Estimated U.S. Influenza Burden, By Season
(2010 - 2019)



*Estimates for these seasons are preliminary and may change as data are finalized.

Estimated Range of Annual Burden of Flu United States, 2010-11 through 2017-18 Influenza Seasons

The burden of influenza disease in the United States can vary widely and is determined by a number of factors including the characteristics of circulating viruses, the timing of the season, how well the vaccine is working to protect against illness, and how many people got vaccinated. While the impact of flu varies, it places a substantial burden on the health of people in the United States each year.

CDC estimates that influenza has resulted in between 9 million – 45 million illnesses, between 140,000 – 810,000 hospitalizations and between 12,000 – 61,000 deaths annually since 2010.



*The top range of these burden estimates are from the 2017-2018 flu season. These are preliminary and may change as data are finalized.

<https://www.cdc.gov/flu/about/burden/index.html>

Pending questions about this new coronavirus SARS COV - 2

- Natural animal reservoir
- Intermediate animal host
- Susceptible population