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

- NIDO_CORONAVIRUS
- NIDO_TOROVIRUS
- NIDO_RONIVIRIDAE
- CLOSTEROVIRIDAE
- BENNYVIRUS
- NIDO_ARTERIVIRIDAE
- SEQUIVIRIDAE
- POMOVIRUS
- TOSASVIRIDAE
- COMOVIRIDAE
- FLAVIVIRIDAE
- FUROVIRUS
- TOBRAVIRUS
- PECLUVIRUS
- QHEAVIRUS
- HORDEVRUS
- POTYVIRIDAE
- IFAVIRUS
- DICISTOVIRIDAE
- MARNAVIRIDAE
- BROMOVIRIDAE
- IDAEOVIRIDAE
- PICORNAVIRIDAE
- CALICIVIRIDAE
- FLEXIVIRIDAE
- TETRAVIRIDAE
- HEPEVIRIDAE
- ASTROVIRIDAE
- TOSAMOVIRUS
- UNCLASSIFIED
- TYMOVIRIDAE
- LUTEOVIRIDAE
- NOAVIRIDAE
- SOBEMOVIRUS
- UMBRAVIRUS
- TOMBUSVIRIDAE
- BARNAVIRIDAE
- LEVIVIRIDAE
- NARNAVIRIDAE

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Coronaviruses (CoV): Characteristics

<table>
<thead>
<tr>
<th>Alphacoronavirus</th>
<th>Betacoronavirus</th>
<th>Gammaronavirus</th>
<th>Deltacoronavirus</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIPV</td>
<td>SARS-CoV GD02 or SZ3</td>
<td>IBV</td>
<td>HKU11</td>
</tr>
<tr>
<td>HKU2</td>
<td>SARS-CoV hTor02</td>
<td></td>
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<tr>
<td></td>
<td>SARS-CoV WIV1</td>
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<td></td>
<td>MERS-CoV</td>
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<td></td>
<td>MHV</td>
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</tr>
</tbody>
</table>

- **S**: Spike protein
- **E**: Envelope protein
- **M**: Membrane protein
- **N**: Nucleocapsid protein

Diagram showing the genomic organization of different coronaviruses, including the locations of the pp1a and pp1b protease genes.
Coronaviruses (CoV): Emergence

Probable origin of human adapted coronaviruses
Coronaviruses (CoV): Emergences in human.
Zoonotic diseases and human spread

1. Transmission between animal hosts
2. Transmission from animal host to humans
3. Transmission between humans
Coronaviruses (CoV): Emergence in human


TGEV  HCoV-229E  PEDV  PRCV  SARS-CoV  MERS-CoV  HCoV-NL63  PEDV  HCoV-HKU1  PoDCV

Porcine CoV
Human CoV
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](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.

Closely related to bat-SL-CoVZC45 and bat-SL-CoVZXC21
Timeline of the outbreak

Officially reported data as of 22.01.2020 09:00 CET

- China reports to WHO a total of 59 patients with pneumonia of unknown etiology
- Japan reports 1 case
- Thailand reports a second case
- A second death reported in China
- 1st case December 12
- Cases linked to a Seafood Market in Wuhan City China
- Diagnostic test developed & confirms 41 cases in China
- Thailand reports 1 case
- 1 death reported in China
- Total of 440 confirmed cases in China, 4 in Thailand, 1 in Japan, 1 in Republic of Korea, 1 in the United States of America
- A total of 6 deaths reported
- Of the 440 cases, 16 are health care workers
- Of the 440 cases 51 are severe cases
- Some human to human transmission is occurring
The Current COVID-19 Cases Globally

Total Confirmed: 98,387
Total Deaths: 3,383
Total Recovered: 55,444

Coronavirus COVID-19 Global Cases by Johns Hopkins CSSE

Latest Update: 3/6/2020, 10:53:03 AM

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The Current COVID-19 Cases Globally – Epi Curve
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.

Source: Chinese CDC, March 02 - 2020
## Estimated Influenza Disease Burden, by Season United States, 2010-11 through 2017-18 Influenza Seasons

<table>
<thead>
<tr>
<th>Season</th>
<th>Symptomatic Illnesses</th>
<th>Medical Visits</th>
<th>Hospitalizations</th>
<th>Deaths</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>95% Cr I</td>
<td>Estimate</td>
<td>95% Cr I</td>
</tr>
<tr>
<td>2010-2011</td>
<td>21,000,000</td>
<td>(20,000,000 – 25,000,000)</td>
<td>10,000,000</td>
<td>(9,300,000 – 12,000,000)</td>
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<tr>
<td>2011-2012</td>
<td>9,300,000</td>
<td>(8,700,000 – 12,000,000)</td>
<td>4,300,000</td>
<td>(4,000,000 – 5,600,000)</td>
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<tr>
<td>2012-2013</td>
<td>34,000,000</td>
<td>(32,000,000 – 38,000,000)</td>
<td>16,000,000</td>
<td>(15,000,000 – 18,000,000)</td>
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<td>2013-2014</td>
<td>30,000,000</td>
<td>(28,000,000 – 33,000,000)</td>
<td>13,000,000</td>
<td>(12,000,000 – 15,000,000)</td>
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<tr>
<td>2014-2015</td>
<td>30,000,000</td>
<td>(29,000,000 – 33,000,000)</td>
<td>14,000,000</td>
<td>(13,000,000 – 16,000,000)</td>
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<tr>
<td>2015-2016</td>
<td>24,000,000</td>
<td>(20,000,000 – 33,000,000)</td>
<td>11,000,000</td>
<td>(9,000,000 – 15,000,000)</td>
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<tr>
<td>2016-2017</td>
<td>29,000,000</td>
<td>(25,000,000 – 45,000,000)</td>
<td>14,000,000</td>
<td>(11,000,000 – 23,000,000)</td>
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**Preliminary estimates**

<table>
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<tr>
<th>Season</th>
<th>Estimate</th>
<th>95% UI</th>
<th>Estimate</th>
<th>95% UI</th>
<th>Estimate</th>
<th>95% UI</th>
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</thead>
<tbody>
<tr>
<td>2017-2018</td>
<td>45,000,000</td>
<td>(39,000,000 – 58,000,000)</td>
<td>21,000,000</td>
<td>(18,000,000 – 27,000,000)</td>
<td>810,000</td>
<td>(620,000 – 1,400,000)</td>
</tr>
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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.
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