COVID 19
HISTORY, EPIDEMIOLOGY, VIROLOGY

Dr. Abdurezak Ahmed
Internist & Endocrinologist
Addis Ababa University
COVID 19 TRAINING OF TRAINER
Organized by: ORHB, Universities in Oromia, ORHB AC, OPA, IOHPA, EEHA, EEA
25/4/20
Outline

- HISTORY
- EPIDEMIOLOGY
- VIROLOGY
History of Pandemic in humankind

- 430 B.C.: Peloponnesian war: Libya, Ethiopia and Egypt crossed the Athenians wall under the Spartans siege, 2/3 died, Athenians defeated by Spartans, Typhoid fever
- 165 A.D.: Antoine Plaque; claimed Emperor Marcus Aurelius
- 1350: the Black Death: 1/3 of world population
- 1492: the Columbian Exchange
- 1665: the great Plaque of London
- 1817: First cholera pandemic
- 1855: the third plague pandemic
- 1875: Fiji Measles pandemic
- 1889: Russian Flu
- 1918: Spanish Flu
- 1957: Asian Flu
- 1981: HIV/AIDS
- 2003: SARS
- 2012: MERS
- 2019: COVID-19
History of Corona Virus

• It was identified in animals
• Human coronaviruses, first characterized in the 1960s (1)
• Since 2003, at least 5 new human coronaviruses have been identified, including the SARS corona virus, which caused significant morbidity and mortality (1)
• MERS was another Corona virus epidemic that has caused significant mortality and morbidity in Middle east

1. Kahn, Jeffrey S. MD, PhD; McIntosh, Kenneth MDThe Pediatric Infectious Disease Journal: History and Recent Advances in Coronavirus Discovery November 2005 - Volume 24 - Issue 11 - p S223-S227 doi: 10.1097/01.inf.0000188166.17324.60
Group of coronavirus particles, negatively stained with phosphotungstic acid (PTA). Some variation in size is seen, but shape is relatively uniform. Magnification 144,000x.

During the 2002–2003 outbreak, SARS infection was reported in 29 countries in North America, South America, Europe and Asia.

Overall 8098 infected individuals were identified, with 774 SARS-related fatalities

Case fatality ratio 9.6%

2. WHO, Emergencies preparedness, response, SARS
MERS

• MERS: First reported in Saudi Arabia in 2012
• Since then spread to several Other countries including USA
• 2494 confirmed cases of MERS
• 858 MERS-Cov associated deaths since October 2012 (case fatality rate 34.4%)
• Majority from KSA (2102 Cases, 780 deaths with a case fatality rate of 37.1%)
• 27 countries reported MERS-Cov
Total Confirmed: 2,719,522

Confirmed Cases by Country/Region/Sovereignty:
- 869,172 US
- 213,024 Spain
- 189,973 Italy
- 159,467 France
- 153,129 Germany
- 139,246 United Kingdom

New York US: 695,920 tested
California US: 482,097 tested
Florida US: 301,147 tested

Deaths:
- 25,549 deaths in Italy
- 22,157 deaths in Spain
- 21,856 deaths in France
- 18,738 deaths

Lead by JHU CSSE. Automation Support: Esri Living Atlas team and JHU.
<table>
<thead>
<tr>
<th>Location</th>
<th>Confirmed</th>
<th>Recovered</th>
<th>Deaths</th>
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<tr>
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<td>890K</td>
<td>82,843</td>
<td>50,372</td>
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<td>Spain</td>
<td>213K</td>
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<td>United Kingdom</td>
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<td>Iran</td>
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<td>China</td>
<td>84,302</td>
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Updated less than 20 mins ago · Source: Wikipedia · About this data
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Update: 24/04/2020 10:07
Africa CDC Dashboard

Cases 27,427
Deaths 1,298
Recoveries 7,474
COVID-19 Ethiopia

• Confirmed cases: 117
• Recovered: 25
• Death: 3

World

• Confirmed: 2.71 M
• Recovered: 743 k
• Death: 191 k
How It All Started

• In December 2019, an outbreak of COVID-19, caused by a novel coronavirus SARS-CoV-2, began in Wuhan, China
• The disease spread widely in China then to the rest of the world
• Severe cases of pneumonia, ARDS, and death reported
• Person-to-person transmission has been widely documented
## Distribution of cases by severity

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Percentage of patients</th>
<th>Death rate(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No symptoms</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>Mild/moderate</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>Severe symptoms</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>Critical symptoms</td>
<td>5</td>
<td>50</td>
</tr>
</tbody>
</table>
In critical care

- ICU: 5% of proven infections.
- Critical care will be an integral component of the global response to this emerging infection.
- Health systems can be challenged to provide adequate care: The rapid increase in the number of cases of COVID-19 in Wuhan.
- Case-fatality: 7-fold higher in Hubei Province compared with those outside of the region, 2.9% vs 0.4%.
- Emphasizing the importance of health system capacity.

Who are at risk for severe Disease?

- Older adults
- Group at higher risk for severe illness
- People with Asthma
- People with HIV

- Group at Higher risk for severe illness
  - Age >65
  - Nursing home or chronic care facility residents
  - Chronic lung diseases or moderate to severe asthma
  - Serious heart conditions
  - Conditions of immuno-compromized
    - Cancer, smoking, Bone marrow/ organ transplant, immunodeficiencies, poorly controlled HIV/AIDS, Prolonged use of corticosteroids or other immune weakening drugs,

- Severe obesity BMI ≥ 40
- CKD and on dialysis
- Liver diseases advanced
Virology of CORONA

• VIRUS: SARS COV-2
  • Part of corona virus 80% similarity with SARS-CoV 2002-2003
  • MERS 2012

• DISEASE: COVID-19
• Class of Nidovirales order, replicate using mRNA
• Corona virus subfamily: alpha, beta, delta, gamma
• Human: alpha (Hcov-229E, HCoV-NL63)
  Beta (HCoV-HKU1, HCOV-OC43, MERS CoV, SARS-CoV)
RNA sequences resemble SARS-CoV(79%) and MERS-CoV(50%)
SARS-CoV-2 had a similar receptor-binding domain structure to that of SARS-CoV, and can bind ACE-2 receptors in the lower respiratory tract of humans
Epidemiologic information implicates a bat-origin virus infecting unidentified animal species sold in China’s live animal market.
This allowed direct access to crowds of humans, increasing opportunities for host switching
Such live markets have also led to avian epizoonotics with fatal human spillover cases caused by Influenza H5N1 and H7N9
In 2002-2003, bat-coronavirus-derived SARS infected palm civets and raccoon dogs which in turn caused 8098 human infections and 774 deaths in 37 countries, costing the global economy $30-$100 billion
In 2012, bat-coronavirus MERS-CoV infected dromedary camels and was responsible for 2494 lab-confirmed infections with 858 fatalities (the majority in Saudi Arabia) [case fatality rate of 36%], including 38 deaths following a single introduction into South Korea
Model of coronavirus structure: A schematic diagram of virion structure


file://www.lww.com
Coronavirus replication

M: membrane protein required for virus budding; S: viral spike glycoprotein that has receptor binding and membrane fusion activities; E: small membrane protein that plays a role in coronavirus assembly; N: nucleocapsid phosphoprotein associated with viral RNA inside the virion.
Where does it come from?

- Bat Corona RaTG-13: 96.2% genetic similarity, potentially it may come from bat to humans.
- May have an intermediate host to get ability to infect, swabbing some genetic material leading to new virus formation. Homologous recombination.
- ??may be from lab
SARS-CoV-2 Types

S-type
- 30% infection
- Less severe smx
- Less aggressive
- Zoonotic connection

L-type
- 70% infections
- Increased severity
- More aggressive
- Evolved from the s-type
Virus dynamics

• **Ro:** Reproductive Ratio, ability to infect: 2-4  \( Ro = 3 \)

• **SI:** Series Interval, time to infect others = 4 days
  - In 12 days it can infect 40 individuals from one index case
  - \( Ro > 1 \) there is exponential rise in the total number of cases.

• **Route of Transmission:**
  - Respiratory droplets
  - Aerosolized pressure procedures
  - ?? Airborne
Thank you