COVID-19 Education Module Update

• These slides are being shared in order to provide a discussion on variants of COVID-19 as well as information pertaining to “COVID-19 Booster” vaccines.

• Please remember, references to articles and literature sources used in constructing these slides can be found by clicking on any text in these modules that are underlined and are blue in color.

• By the end of this presentation, the learner should be able:
  • To obtain a better understanding of the science behind variants
  • To better understand new relevant data on booster vaccines
  • To recognize the importance vaccines and preventive measures have in controlling and improving health
Waves during a pandemic

• As early as April 30, 2020, additional waves of this disease were observed.

• Consistent with previous pandemics, multiple waves occurred as demonstrated in this summary slide from Center for Evidence Based Medicine.

• An article in Nature predicts SARS-CoV-2 will become the 5th circulating Coronavirus... but may be after more waves occur.
  • Four present “seasonal” coronaviruses have been circulating in humans for decades.

<table>
<thead>
<tr>
<th>Years</th>
<th>Spread</th>
<th>Season of onset</th>
<th>Possible origin</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1889-92</td>
<td>Global</td>
<td>Spring</td>
<td>Russia*</td>
<td>Two phases, later more severe</td>
</tr>
<tr>
<td>1898-1901</td>
<td>Europe, America, Australia</td>
<td>Unknown</td>
<td>Unknown*</td>
<td>Mild</td>
</tr>
<tr>
<td>1918-20</td>
<td>Global</td>
<td>Spring</td>
<td>USA or China</td>
<td>Two phases, later more severe</td>
</tr>
<tr>
<td>1946-48</td>
<td>Global</td>
<td>Unknown</td>
<td>Australia or China</td>
<td>Mild</td>
</tr>
<tr>
<td>1957-58</td>
<td>Global</td>
<td>Spring</td>
<td>China</td>
<td>Two phases equally severe</td>
</tr>
<tr>
<td>1968-69</td>
<td>Global</td>
<td>Summer</td>
<td>China</td>
<td>Slow spread, relatively mild</td>
</tr>
<tr>
<td>1977-78</td>
<td>Global</td>
<td>Spring</td>
<td>China</td>
<td>Unclear because of co-circulation of other influenza viruses</td>
</tr>
<tr>
<td>2002-2003</td>
<td>South East Asia, Canada</td>
<td>Autumn</td>
<td>China</td>
<td>Several phases</td>
</tr>
<tr>
<td>2009-10</td>
<td>Global</td>
<td>Spring</td>
<td>Mexico</td>
<td>Mild, two phases</td>
</tr>
<tr>
<td>2019-current</td>
<td>Global</td>
<td>Winter</td>
<td>China</td>
<td>Underway</td>
</tr>
</tbody>
</table>

Key: * = causality by influenza viruses was inferred by serological studies in survivors;

Why do we have waves?

• There can be a combination of reasons although the exact causes are unknown.
  • Reactions: when numbers increase, behavior changes. Even if only slight variations, it does not take much to alter the spread. Being more consistent with masks, hand-washing, increased vaccines, et cetera
  
  • Broad social networks: waves can occur based on general group gatherings in society, various social events taking place, and many other reasons that broaden a social network
  
  • Winter months: As seen with the flu, many viruses are more prevalent in winter months. We still saw an increase of COVID-19 infections in the summer months, which is not uncommon during a pandemic (due to the other reasons discussed)
  
  • Immunity: cases of infection decline when immunity builds up (due to receiving a vaccine or obtaining natural immunity). This leads to “dips” in the wave occurring in the incidence of the virus
  
  • There are various other reasons (i.e. testing availability) that are difficult to study which lead to waves occurring
Why does the data change so much?

• Great question! Many answers:

• Worldwide travel, in today’s time, is easier than ever before. Airline flights leave and enter the US and many other countries hundreds of times each day. There are thousands of people traveling the globe and interacting with each other on a daily basis. These factors lead to a spread between individuals from all over the globe with subsequent changes and variants that occur.
  • It only takes a few contacts to cause a tremendous spread.
Why does the data change so much? (cont)

- Data will lag behind when there is a new variant
  - First is discovery of the variant, then testing for the variant. It takes time to determine immune status to a new variant and if present vaccines are effective against the particular variant.

- There is a lag time between...
  - When people may be exposed
  - Do they show symptoms
  - Do they test positive
  - How many show symptoms
  - How severe their symptoms become
  - How many patients are hospitalized
  - How many patients who are hospitalized are moved to an ICU
  - How many patients die from this disease
Why does the data change so much? (cont)

• Articles normally go through a peer-review process and are rarely distributed in the public until this process has been completed. Significant changes can come from this peer-reviewed process.

• A large quantity of data pours in and this needs to be vetted to determine what is truly the most accurate information.
More Data!!!

- [https://www.youtube.com/watch?v=uR3LCB1scdk](https://www.youtube.com/watch?v=uR3LCB1scdk)

- An “Eye-opening” statistic…
  - Essentially, in over 70 years of reporting in PubMed, diseases and conditions have had 3,000 – 10,000 studies conducted on them. (hypertension, heart failure, breast neoplasms, HIV, depression, obesity)

- Since 2020, there have been over 78,000 studies conducted so far, on COVID-19
Variants (not just Omicron)

• All RNA viruses will change over time in order to survive. Viruses are not independently living organisms (they must have a “host”...people)
  • Flu viruses change often which is why there is a new flu vaccine every year

• To put it in simple terms, the virus wants to live, so it will tend to mutate in order to be more transmissible (more people with the virus increases the chance the virus lives) and more infectious (if more of the virus stays in your body, the higher the likelihood it will survive)
  • This takes place all the time and in different areas, which is why we have variants from across the world. It’s nearly impossible to stop a complete spread across the entire world (i.e. cannot completely close off travel for everyone from everywhere.)
The omicron variant is, on average, causing less severe disease than previous variants of the virus, a new Centers for Disease Control and Prevention (CDC) study found.

The ratio of hospital admissions to cases and the ratio of deaths to cases were lower during the omicron wave than during the delta variant peak last year or the winter of 2020-2021, according to this CDC study.
Omicron Variant

“Despite Omicron seeing the highest reported numbers of COVID-19 cases and hospitalizations during the pandemic, disease severity indicators, including length of stay, ICU admission, and death, were lower than during previous pandemic peaks,” the study stated.

“Although disease severity appears lower with the Omicron variant, the high volume of hospitalizations can strain local health care systems and the average daily number of deaths remains substantial,” it added.
The omicron variant caused 27 hospital admissions per 1,000 cases, the study found, lower than 68 per 1,000 cases in the winter of 2020-2021 or 78 per 1,000 during the delta wave.

Similarly, the nine deaths per 1,000 cases during omicron was less than the 16 per 1,000 cases last winter or the 13 per 1,000 during the delta surge.

This Centers for Disease Control and Prevention (CDC) study found that omicron's decreased severity, compared to previous surges, was due multiple factors including: increased immunity from higher rates of vaccination, more immunity from previous infections that happened during previous waves, as well as the fact that the omicron variant inherently causes less severe illness.
Omnicron Variant

- It is clear that there is a higher rate of hospitalizations in the unvaccinated and CDC Data from NY shows a clear difference with unvaccinated in cases, hospitalizations and deaths
  - Most recent data (New York CDC Data)
Will we have more variants?

• **Almost certainly** (many are already out there)

• Viruses will change genetic code when infecting a person. With millions of people being infected around the world, there will be plenty of opportunity for mutations. Some will be changes that will have less transmissibility and some with more (i.e. Delta & Omicron)

• The hope is that there will be a variant that is mild and will not alter, but there is still risk of changes in the future.
  • Like Polio, Chickenpox, Measles and Mumps, creating immunity through vaccines is the best way to fight the changes in the virus
Vaccines continue to be the best protection!

- Recent CDC data continues to show the importance of Booster vaccines on COVID-19 associated hospitalizations:

  In December, compared to fully vaccinated persons in each group shown below, the monthly rates of COVID-19-associated hospitalizations were:

  - **16x** Higher in Unvaccinated Adults Ages 18 Years and Older
  - **9x** Higher in Unvaccinated Adolescents Ages 12-17 Years
  - **12x** Higher in Unvaccinated Adults Ages 18-49 years
  - **17x** Higher in Unvaccinated Adults Ages 50-64 years
  - **17x** Higher in Unvaccinated Adults Ages 65 Years and Older
However, booster doses protect even more!

Rates of COVID-19-Associated Hospitalizations by Vaccination and Additional or Booster Dose Status

In December, compared to fully vaccinated persons with additional or booster doses in each age group shown below, the monthly rates of COVID-19-associated hospitalizations were:

44x Higher
in Unvaccinated Adults
Ages 50-64 years

49x Higher
in Unvaccinated Adults
Ages 65 Years and Older
Recent **CDC Data** shows the benefit of booster vaccines.
Booster Vaccines

• Simply put…vaccines work

• Commonwealth Fund Brief suggested in November 2021: 1.1 million fewer deaths and 10.3 million fewer hospitalizations (in the US alone) can be attributed to the COVID-19 vaccines

Booster Vaccines

• Omicron has been shown to be less affected by the 2-dose COVID-19 vaccines. However, the vaccines are still effective in that these vaccines initiate B-cell and T-cell formation. Although an individual may still contract the virus, their body’s defense is better prepared to fight it. That is because:
  • B-Cells create antibodies
  • T-Cells create a secondary defense to viruses

• Therefore, you can build T-cells (2\textsuperscript{nd} line of defense) from vaccines or from natural immunity
  • Although the primary defense may not be as effective, those who have been vaccinated or have natural immunity still have a good defense to keep from getting seriously ill (as seen in a \textcolor{blue}{preprinted study} on T-cells)
Booster Vaccines

• There is data to show that vaccines (without boosters) are leading to decreased efficacy. However, booster vaccines appear to increase the effectiveness. See the report from the UK Health Security Agency beside (black squares are Delta Variant and grey circles are Omicron)

• Two doses (Pfizer studied) = 30-40% effective
• Booster dose raised effectiveness to 70-80%

• So likely a better defense in antibodies with boosters
  • Antibodies attack a part of the Spike Protein
  • T-cells attack the whole Spike Protein
What about Natural Immunity!?

• We really do not know how long natural immunity will last

• Recent **Lancet study** using data on Coronaviruses like Sars-CoV-2
  • Natural immunity (protection gained after you have had COVID-19) is highly variable: Ranging from 3 months to possibly years
  • The recent Delta outbreak saw higher levels and spread (when studied in the UK) in locations where vaccine rates and previous infection rates were low

• This was seen again with Omicron in Vermont (high vaccination rate – 70%) and Michigan (high rate of previous natural immunity)
What is our recommendation?

- Get a booster vaccine. Continue to follow guidelines and actions to decrease risk

- Recent Systematic Review of studies of public health measures to reduce COVID-19 transmission
  - Handwashing, mask wearing (see WSJ graphic), and physical distancing
  - Unable to appropriately study: quarantine, isolation, lockdowns, and closure of schools, borders and workplaces
Vaccines...where are we today?

• Pediatrics: 8.6 million children 5-11 and 18.7 million aged 12-15 have received at least one dose of the vaccine
  • Of note, only 12 cases of myocarditis in 5-11 (265 in 12-15)
  • In most cases, more likely to get myocarditis from a COVID infection. As well, the cases seen with vaccines were milder compared to those with COVID infection.

• 4.73 Billion people have received at least one dose (3.97 Billion have had at least 2)
  • This is approximately the same number as the total world population in 1984
  • Presently the world population is roughly 7.9 Billion

• Current recommendation:
  • If received Pfizer: everyone 12 or older should have a booster
  • If received Moderna: Everyone 18 or older should have a booster
  • **mRNA vaccines are recommended over the J&J/Janssen vaccine (also recommending a booster for those over 18 years old)
Super Vaccine?

• A clinical trial for a “super vaccine” that would cover all coronaviruses (regardless of variant)

• Current vaccines help with antibody response that can wane and the virus can adapt to increase infectivity

• The focus would be to create antibodies that bind beyond the Spike Protein. A Science Study describes this concept

• Another being developed by Walter Reed will have multiple sets of nanoparticles that will create “instructions” for creating antibodies.
New Therapeutics for COVID-19!

• Even though vaccines are the best defense against COVID-19, there will still be breakthrough infections and those who are unable, or unwilling, to get the vaccine (or immune compromised)

• There are two antiviral medications that have been FDA authorized for use against COVID-19 in the United States:
  • Paxlovid (Nirmatrelvir) - Pfizer: Slows down the ability for the virus to replicate
    • Has shown 88% reduction in hospitalization compared to placebo in a high risk and unvaccinated population
  • Molnupiravir – Merck: inserts mutations when virus multiplies that weaken the virus
    • Modest results (30% reduction in hospitalization and death)
Other Therapeutics

- Remdesivir was the only FDA approved treatment for COVID-19
- Many other treatments that are widely used include:
  - Monoclonal Antibodies
  - Steroids
  - Supplemental oxygen
  - Mechanical ventilation
- Because viruses change rapidly, it is challenging to keep up with the many changes
- Antivirals for one virus are not often helpful for others (i.e. HIV meds do not help with influenza)
- If you do not eradicate the virus, but only weaken the virus, that could lead to more mutations
- The best option is prevention!
Excellent resources

• Consider subscribing to Your Local Epidemiologist (search for Your Local Epidemiologist or [this link](#))
  • This is an evidence-based set of emailed updates that have links to numerous reports and was beneficial in making this discussion.

• [Nature journal. Virus variants over time](#)
  • This article is worthwhile to read to gain additional knowledge.