Covid 19

Clearly explain how chosen topic relates to unit (2 marks per unit)
Introduction and summary are interesting

10-15 slides

- Relates to all 5 units
    - Bio Chem
    - Metabolic Process
    - Molecular Genetics
    - Homeostasis
    - Pop Dyn
- Bullet points
-

For example, if your topic was COVID-19, you could discuss the properties of the virus that allow it to enter cells for biochemistry, how PCR is used to test for the virus for genetics, how the virus effects the body for the homeostasis, and how and why it became a pandemic for population dynamics.
Other possible topics include: specific disease/disorder, specific medication, specific vaccine, specific drug, etc...

Intro

INTRO SLIDE

W: Welcome back to Covid - Nineteen News, or CNN as we like to call it, I'm your host David Walji and today, we have a special guest joining us. I'm joined here today on call with Dr. Dhrumil Patel, one of the leading global researchers in the field of all things Covid-19. Hello Dr. Patel, thank you for joining us today.

SWITCH SLIDE

P: No problem, David. Thank you for having me, and please, call me Dhrumil; Dr. Patel was my father.

W: Haha, very well Dhrumil. Well then let's get right into it, shall we? So what exactly is Covid-19 and how did we get into this situation?

SWITCH SLIDE

P: Well, the Covid-19 outbreak originated in the Hubei province of China in Wuhan City, and by December 2019, we were already seeing Covid-19 spreading between humans

W: Ah yes, but all the cases prior to January 1st, 2020 were linked to the Huanan Seafood Wholesale Market, isn't that correct?

P: Yes, that's correct, and in fact, it was only until mid-January that we saw the first case of **SARS-CoV-2** outside of China in Thailand.

W: Ah interesting. And just to clarify for our listeners, SARS-CoV-2 is the scientific classification name for Covid-19, named "2' because this is the 2nd wave we've seen in recent years, the first one having mysteriously disappeared after causing a similar smaller effect in 2003.

P: By the end of January, the number of confirmed cases rose to 2000+, infecting over 18 countries. It was at this point that the W.H.O. declared Covid-19 a Public Health Emergency of International Concern

W: And who could forget about March of 2020 when over 150 countries reported outbreaks, with over 6000 deaths worldwide.

P: First it was China who saw a massive spike in their cases, then there was Italy, Spain, Brazil and the United States; a real pandemic.

W: It is indeed, but before we get to current cases and the road to 10 million, if you don't mind, I'd like to jump right into **how** Covid-19 is such an effective virus.

SWITCH SLIDE

Biochemistry

P: Well SARS-CoV-2 is a non-segmented, enveloped and single-stranded RNA virus which infects the respiratory system of the host. A model of the virus is being depicted on the top picture on the screen. The virus itself is identifiable by 4 key factors, **highlighted in the black square**: the spike denoted by S, the envelope denoted E, the protein membrane denoted by M and the nucleocapsid denoted by N.

W: Ah so from what I can tell, the diagram shows the early life cycle of the virus. First the spike S protein binds to the host's cell and then enters the cell. From there, the genetic material from the RNA is released and then the late stage of the life cycle starts.

P: Well that's essentially correct. The one thing I will add is that the virus can enter the cell through 1 of 2 ways. The first way being receptor-mediated endocytosis with the help of an

enzyme called furin and the second way being a process called direct fusion once again mediated by furin.

W: Ah, so then the virus goes on to replicate the RNA, synthesize the viral protein, waits for maturation, assembles more of itself and finally causes the cell to burst through lysis.

P: Yes, exactly. Interesting fact, the N protein in the viral RNA is replicated in the cytoplasm of the cell whereas the E, M and S proteins are biosynthesized in the endoplasmic reticulum. After being transported to the Golgi apparatus, all the proteins are combined and await exocytosis.

W: Oh man that's so interesting!! So what else can you tell us about the metabolic processes of the virus?

Switch slide

Metabolic Processes

As you explained, the proteins for assembling SARS-CoV-2 are produced inside the cells. The virus tricks a ribosome into manufacturing a protein that can read the virus from the 3' end to the 5' end and produces parts of the virus like the membrane and spike proteins to be assembled. These processes are anabolic processes.

Burst cells release tons of pro-inflammatory proteins like cytokines, which cause the blood vessel to expand and become more permeable. Plasma from your blood starts leaking into both the space between the vessel and the alveoli and into the alveoli. Specific immune cells like neutrophils arrive and lead to pus forming inside the alveoli. Other cells like fibroblasts cause fibrosis, making the alveolus rigid and unable to stretch to pull in oxygen. These factors work to prevent gas exchange.

However, to achieve some gas exchange, the body expands blood vessels further, delivering more plasma and immune cells to the alveoli, adding even more fluid to impede gas exchange.

The infection of cells in your alveoli is pneumonia and the fluid buildup is Acute Respiratory Distress Syndrome and is why covid-19 patients feel like they're drowning when they are dying.

Switch slide

Molecular Genetics

- Hm that's very interesting

- Before you continue, I'm just going to briefly talk about how testing for coronavirus is done
- As most of our viewers already know, Polymerase chain reaction, or PCR, is a very common and simple technique used to detect or amplify RNA and DNA sequences
- While traditional methods take days to clone the DNA, PCR allows for this to happen in a matter of hours.

SWITCH SLIDE

- Now why do I bring this technique up, you may ask? Well a version of PCR, known as Reverse Transcription PCR, or RT-PCR, is currently one of the most common testing methods currently being used to test for Covid-19
- While regular PCR focuses mainly on denaturing and cloning **DNA**, RT-PCR, is a technique focused on using **RNA** as it's template
- Now this is specifically effective against Covid-19 as the virus itself tends to set its sights on manipulating our RNA - you may have heard about how covid-19 affects messenger RNA - this process exploits that to test for it
- So after swabbing either the throat or nose of a patient, scientists then reverse transcribe the RNA to DNA
- And after adding selective samples of complementary DNA fragments, the virus will attempt to replicate itself.
- Scientists then inject the sample with a certain type of fluorescent dye which attaches itself to specific markers set up in the added DNA fragments
- Now, like standard PCR, through heating and cooling, creating the necessary conditions for specific reactions to take place, the DNA will copy itself, along with the virus.
- If the amount of fluorescent dye reaches above a certain threshold, then the patient is diagnosed with Covid-19

- Now one thing that should be noted is that testing with RT-PCR is not in fact the most effective way to test for Covid-19
- A study was done in February of 2020 comparing the efficacy and consistency of testing for Covid-19 in chest CTs and RT-PCR
- Of roughly 1000 patients examined, around 400 tested negative with RT-PCR. However, when those same 400 patients had chest CTs, 308 of them resulted with positive results. Accounting for both false-positive and false-negative results, 206 of them actually had Covid-19. This essentially tells us that Chest CTs are far more sensitive for diagnosis.
- In terms of speed, Chest CTs are also quicker if access to one is available, taking around 5.1 days to get test results back, in comparison to RT-PCR which takes around 6.9 days.
- Now the reason that RT-PCR is so much more common is because getting access to a CT machine is much more difficult than swabbing someone's nose or throat.
- But if access is available, it is best to go for the CT scan.

Switch slide

Homeostasis

- how the virus affects the body for homeostasis

Inflammatory proteins like the cytokines we discussed for metabolic processes can also jump into the blood and cause “Systemic Inflammation”, which is inflammation across the entire body.

In one study about the SARS-CoV, Chinese scientists found that patients 12 years after infection had some metabolic abnormalities like hyperinsulinemia (more insulin in your blood than there should be), insulin resistance, hyperglycaemia, type 1 diabetes or T2D

Some of these inflammatory proteins also make their way to the hypothalamus in the brain, which controls body temperature. They signal to the brain to keep pushing the body temperature up (past 37 C to 40, 42 C) in an effort to try and denature the proteins of the virus. However, in increasing the body temperature as part of a fever, our own proteins can also denature, preventing them from performing their original purpose

There are also other conditions that arise from a covid-19 infection like diarrhea, nausea, or anorexia. There are also cases of people losing their sense of smell or taste when proteins from the Sars-Cov-2 disrupt the supporting cells responsible for clearing out metabolic waste, providing metabolic products, and renewing dead cells near your olfactory sensory neurons. The supporting cells can no longer maintain homeostasis around these neurons and patients lose their sense of smell and taste.

SIRS, or Systemic Inflammatory Response Syndrome, is when things go from bad to worse: Inflammation occurs all across the body. Tissues won’t receive the oxygen they need to live, organs will go into failure, the patient will go into severe sepsis, then septic shock, and finally, death.
Switch slide

Population Dynamics

- Thank you Dhrumil for that in depth analysis of the effects of covid-19 on the human body
- Now that we know **how** it affects us, I think that is a great segue into **who** is most at risk

SWITCH SLIDE

- As we've already touched upon, covid-19 spread rapidly from Wuhan, China, starting as an endemic and morphing into a pandemic
- Probably one of the most sought after questions is concerning the effectivity of the virus relating to specific demographics
- From a study done in August of 2020, the CDC found that since June, overall, Asian non-hispanic persons showed the least amount of increase in cases, hospitalizations and deaths (as highlighted in Green)

- Whereas American Indian and Alaskan native non hispanic persons showed the **highest** increase (as highlighted in Red)
    - Keep in mind, these are american statistics
- Numerous studies have also shown that, while it was originally thought that younger people were thought to be relatively unaffected by this virus, this was not the case.
- While cases found in those of older age were more likely to die, it was found that there was no correlation between age and the risk of contracting the virus
- This basically means that everyone spreads it relatively the same, and that everyone needs to follow the safety measures put in place by governments in order to keep safe.

- Now to briefly touch on vaccines and herd immunity, herd immunity is what happens when enough of a given population is no longer affected by the virus.
- According to the University of Colorado Health, herd immunity for Covid-19 is estimated at roughly 66%.
- Now if we look at the number of current variant strands of SARS-CoV-2 (as highlighted in orange) and if we take into consideration the speed of the virus being able to mutate and the limits of the global health system, herd immunity will not be possible without a vaccine.

- And probably, one of the only pieces of good news the world has received in a very long time; Pfizer and Biontech recently announced that one of their vaccines has completed phase 3 trials at a 90% effectivity rate.
- But it comes with a catch, since there has never been an approved coronavirus vaccine before (like with MERS or Sars-CoV-1), it's unclear how permanent this vaccine will be and how often revaccinations will need to be
- Regarding side effects, there are already reports of mild short-term side effects such as fever, headaches, muscle aches, and injection-site reactions
- Finally, long-term side effects will not be known until further testing.

Conclusion

W: Well that's it for our Covid-19 news for today. Thank you so much, Dr. Dhrumil Patel for joining us and sharing your insight on all things pandemic.

D: Thank you for having me, before I go though, I do want to share one video with everyone about the case count development up until June 27th.

PLAY VIDEO

Sources

- A. (2017, June 27). Parkinson's Associated Protein Linked to Human Upper GI Tract Infections. Retrieved November 15, 2020, from https://debuglies.com/2017/06/28/parkinsons-associated-protein-linked-to-human-upper-gi-tract-infections/

Ai*, T., Author Affiliations From the Departments of Radiology (T.A., C, H., Et Al., Organization, W., National Health Commission of the People's Republic of China, . . . Inui, S. (2020, February 26). Correlation of Chest CT and RT-PCR Testing for Coronavirus Disease 2019 (COVID-19) in China: A Report of 1014 Cases. Retrieved November 15, 2020, from https://pubs.rsna.org/doi/full/10.1148/radiol.2020200642

- Bat coronavirus RaTG13, complete genome - Nucleotide - NCBI. (n.d.). Retrieved November 15, 2020, from https://www.ncbi.nlm.nih.gov/nuccore/MN996532
- Bhargava, H. (2020, September 23). Coronavirus: What Happens To People's Body If They Get Infected. Retrieved November 16, 2020, from https://www.webmd.com/lung/coronavirus-covid-19-affects-body
- Delano, Matthew & Ward, Peter. (2016). The immune system's role in sepsis progression, resolution, and long-term outcome. Immunological Reviews. 274. 330-353. 10.1111/imr.12499.
- Helmy, Y. A., Fawzy, M., Elaswad, A., Sobieh, A., Kenney, S. P., & Shehata, A. A. (2020). The COVID-19 Pandemic: A Comprehensive Review of Taxonomy, Genetics, Epidemiology, Diagnosis, Treatment, and Control. Journal of Clinical Medicine, 9(4), 1225. doi:10.3390/jcm9041225
- Homeostasis, Disease & Medicine News, Articles: The Scientist Magazine®. (n.d.). Retrieved November 16, 2020, from https://www.the-scientist.com/tag/homeostasis,disease-medicine
- How is the COVID-19 Virus Detected using Real Time RT-PCR? (2020, March 27). Retrieved November 15, 2020, from https://www.iaea.org/newscenter/news/how-is-the-covid-19-virus-detected-using-real-time-rt-pcr
- How to tell if you have a fever: Signs, symptoms, and treatment. (n.d.). Retrieved November 16, 2020, from https://www.medicalnewstoday.com/articles/326160
- Identifying the source of the outbreak. (n.d.). Retrieved November 15, 2020, from https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/about-epidemiology/identifying-source-outbreak.html
- Kane, S. V. (n.d.). Coronavirus disease 2019 (COVID-19): Issues related to gastrointestinal disease in adults. Retrieved November 16, 2020, from https://www.uptodate.com/contents/coronavirus-disease-2019-covid-19-issues-related-to-gastrointestinal-disease-in-adults
- Krieger, L. (2020, April 13). When coronavirus kills, it's like death by drowning - and doctors disagree on best treatment. Retrieved November 16, 2020, from https://www.mercurynews.com/2020/04/11/when-coronavirus-kills-its-like-death-by-drowning-and-doctors-disagree-on-best-treatment/
- Pfizer and BioNTech Announce Vaccine Candidate Against COVID-19 Achieved Success in First Interim Analysis from Phase 3 Study. (n.d.). Retrieved November 15, 2020, from https://www.pfizer.com/news/press-release/press-release-detail/pfizer-and-biontech-announce-vaccine-candidate-against
- Todd Neff, F. (2020, August 18). Coronavirus vaccines 101: What you need to know. Retrieved November 15, 2020, from https://www.uchealth.org/today/coronavirus-vaccines-101-what-you-need-to-know/

Archive

Intro

More than 73% of these cases have been reported in mainland China [69]. At this time, the number of global cases has shown a drastic increase within a short time, confirmed cases and deaths in China have not increased too much, while confirmed cases and deaths in other countries have drastically increased (Table 4). The number of confirmed cases increased from 2798 to 17,391 in one week (between 27 January and 3 February), and the number of infected countries doubled (from 12 to 24). Due to the rapid increase of the number of infected cases and infected countries, the WHO declared SARS-CoV-2 a pandemic on 11 March 2020 and on 13 March 2020, the WHO declared Europe to be the new center of the pandemic due to the massive increase of confirmed cases there [70]. On 23 March 2020, Italy reported the highest number of deaths (5560) followed by China (3276), Spain (1720), and Iran (1685). One week later (30 March 2020), the global map of COVID-19 had changed. For example, the highest number of cases was reported in the USA (122,653 cases; 2112 deaths) followed by Italy (97,689 cases; 10,781 deaths), China (82,447 cases; 3310 deaths), Spain (78,797 cases; 6528 deaths), Germany (57,298 cases; 455 deaths), France (39,642 cases; 2602 deaths), and Iran (38,309 cases; 2640 deaths). As of 6 April 2020, there were 1,210,956 confirmed cases of SARS-CoV-2 infection (most of the cases, 307,318, were in the USA) and 67,594 deaths (most of the deaths, 15,889, were in Italy). One week later (13 April 2020), the number of confirmed cases of SARS-CoV-2 increased 1.7 times (up to 524,514 confirmed cases), and the number of deaths increased 2.5 times (up to 20,444 deaths) in the USA alone. The number of confirmed cases, deaths, and infected countries are shown in Table 4.

Biochemistry

Molecular Processes

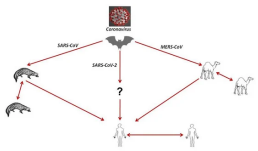
The assessment of genetic diversity among 86 complete or semi-complete genomes of SARS-CoV-2 viruses revealed three deletions in the genome of isolates from Japan, USA, and Australia in addition to many other substitution mutations. The deletion mutations were in the ORF1ab gene (3-nucleotide and 24-nucleotide deletion) and at the 3′ end of the genome (10-nucleotide deletion). Of the 93 substitution mutations, 42 changed the amino acid sequence of structural and non-structural proteins [65]. The 3- and 24-nucleotide deletions in ORF1ab are expected to reduce the protein sequence by 1 and 8 amino acid residues, respectively, without changing the reading frame, but the functional effects have yet to be investigated.

The alignment of SARS-CoV-2 reference S protein gene against all SARS-CoV-2 sequenced genomes from China, USA, Japan, Australia, and Taiwan revealed 99.97–100% identity, with 100% query coverage (also confirmed by our phylogenetic analysis, Figure 2), while the identity and coverage for SARS-CoV S protein gene were 74.5% and 91%, respectively. Also, the S protein gene from bat SARS and SARS-like coronavirus isolates shared 76.5–83% identity with that of SARS-CoV-2. This agrees with previous conclusions regarding the evolutionary analysis of SARS-CoV-2 [11,44]. In the phylogenetic analysis we performed, SARS-CoV-2 viruses were

in the same cluster regardless of the geographic region (Figure 2). These results strongly suggest the possibility of a recent common ancestor for all SARS-CoV-2 or the transmission of the same virus strain across countries.

Heres also some links that might help
https://www.ncbi.nlm.nih.gov/nuccore/MN996532
https://www.mdpi.com/2077-0383/9/4/1225/htm

Molecular Genetics



- testing for the virus for genetics

- Not most effective (what is?) but most efficient because of ability to test more people w/out having ppl take ct scan

Homeostasis

Pop Dyn

how and why it became a pandemic for population dynamics

- As we know antibiotics dont work against viral infections, only against bacterial infectiosn
- Timeline of vaccines
- Cnn → vac accessible by dec of 2020 to most americans
- Real question is, how many people will take the vaccine - vaccines wont cure covid, vaccinations will

Side effects
More than half of those receiving early COVID-19 vaccines reported mild, short-term side effects such as fever, headaches, muscle aches, and injection-site reactions.
Immunity
No one knows. On the plus side, the coronavirus mutates more slowly than flu viruses, whose viral-protein targets change so fast that annual flu shots are needed. So the coronavirus target isn't moving nearly as fast. But there's never been an approved coronavirus vaccine, so it's not clear either how well these vaccines will prevent COVID-19. Keep in mind, too, that immunity may be partial, as it is with the flu shot. Even those vaccinated could fall ill, but experience lesser – and less-dangerous – symptoms.