YABA COLLEGE OF TECHNOLOGY

DEPARTMENT OF COMPUTER TECHNOLOGY

MULTIMEDIA (COM 410)

EPIDERMIC DISEASES

(CASE STUDY: CORONAVIRUS)

COMPUTER SCIENCE HND II

GROUP 3

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EPIDEMICS DISEASES

CORONA VIRUS

1.0 EPIDEMIC DISEASES

An epidemic occurs when an infectious disease spreads rapidly to many people. For example, in 2003, the severe acute respiratory syndrome (SARS) epidemic took the lives of nearly 800 people worldwide.

A disease outbreak happens when a disease occurs in greater numbers than expected in a community or region or during a season. An outbreak may occur in one community or even extend to several countries. It can last from days to years.

Sometimes a single case of a contagious disease is considered an outbreak. This may be true if it is an unknown disease, is new to a community, or has been absent from a population for a long time.

Figure 1.1: Epidemic virus

2.0 WHAT IS THE CORONAVIRUS

Coronaviruses are a family of hundreds of viruses that can cause fever, respiratory problems, and sometimes gastrointestinal symptoms too. The 2019 novel coronavirus is one of seven members of this family known to infect humans, and the third in the past three decades to jump from animals to humans. Since emerging in China in December, this new coronavirus has caused a global health emergency, sickening almost 100,000 people worldwide, and so far killing more than 3,000. As of March 3, about 100 cases had been reported in the US, and six people have died.

The virus is now known as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The disease it causes is called coronavirus disease 2019 (COVID-19).

Cases of COVID-19 have been reported in a growing number of countries, including the U.S. Public health groups, such as the World Health Organization (WHO) and the U.S. Centers for Disease Control and Prevention (CDC), are monitoring the situation and posting updates on their websites. These groups have also issued recommendations for preventing and treating the illness.

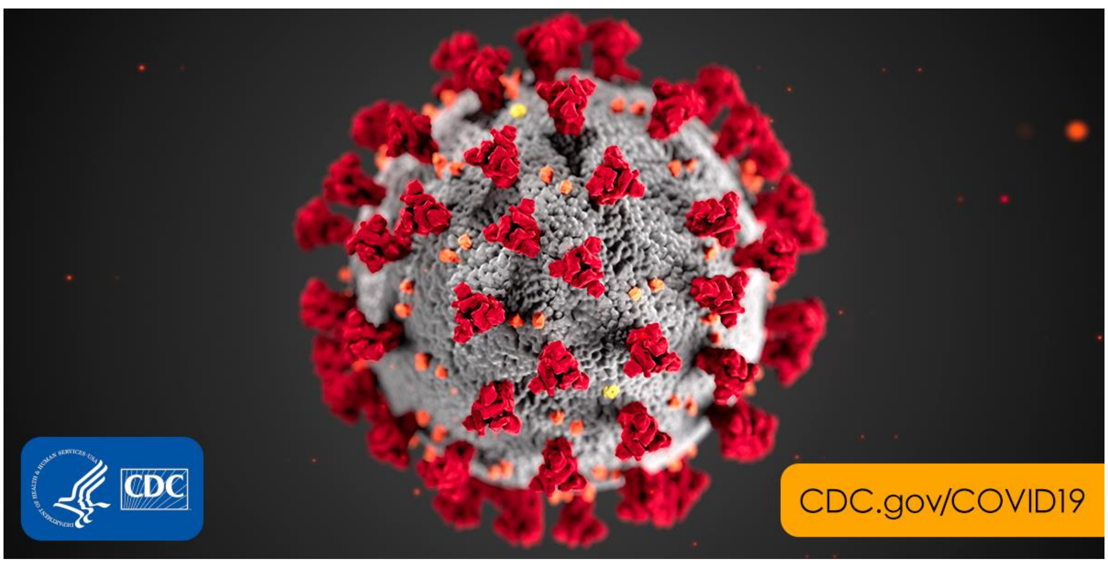

Figure 2.1: Covid-19

3.0 HOW DID IT GET ITS OFFICIAL NAME?

The international committee tasked with classifying viruses has named the new one SARS-CoV-2, because of its close genetic ties to another coronavirus, the one that causes SARS. However, the disease *caused by* SARS-CoV-2—remember, that is the disease characterized by coughing, fever, and respiratory distress—is called Covid-19. It is the name officially bestowed upon the ailment by the World Health Organization. WHO's task was to find a name that didn't demonize a particular place, animal, individual, or group of people and which was also pronounceable. It's pronounced just like it sounds: Co-Vid-Nine-teen (Covid-19).

If you're confused, think about HIV/AIDS. Human-immunodeficiency virus infects people. If left untreated, HIV can lead to autoimmune deficiency syndrome, or AIDS. Some people might get infected with SARS-CoV-2 and not get sick at all. Others will come down with symptoms of the disease Covid-19.

4.0 HOW CORONA VIRUS SPREAD

Coronaviruses are divided into four groups called genera: alpha, beta, gamma, and delta. These little invaders are zoonotic, meaning they can spread between animals and humans; gamma and delta coronaviruses mostly infect birds, while alpha and beta mostly reside in mammals.

Researchers' first isolated human coronaviruses in the 1960s, and for a long time they were considered pretty mild. Mostly, if you got a coronavirus, you'd end up with a cold. But the most famous coronaviruses are the ones that jumped from animals to humans.

Coronaviruses are made up of one strip of RNA, and that genetic material is surrounded by a membrane studded with little spike proteins. (Under a microscope, those proteins stick up in a ring around the top of the virus, giving it its name—"corona" is Latin for "crown.") When the virus gets into the body, those spike proteins attach to host cells, and the virus injects that RNA into the cell's nucleus, hijacking the replication machinery there to make more virus. Infection ensues.

The severity of that infection depends on a couple of factors. One is what part of the body the virus tends to latch onto. Less serious types of coronavirus, like the ones that cause the common cold, tend to attach to cells higher up in the respiratory tract—places like your nose or throat. But their more gnarly relatives attach in the lungs and bronchial tubes, causing more serious infections. The MERS virus, for example, binds to a protein found in the lower respiratory tract and the gastrointestinal tract, so that, in addition to causing respiratory problems, the virus often causes kidney failure.

The other thing that contributes to the severity of the infection is the proteins the virus produces. Different genes mean different proteins; more virulent coronaviruses may have spike proteins that are better at latching onto human cells. Some coronaviruses produce proteins that can fend off the immune system, and when patients have to mount even larger immune responses, they get sicker.

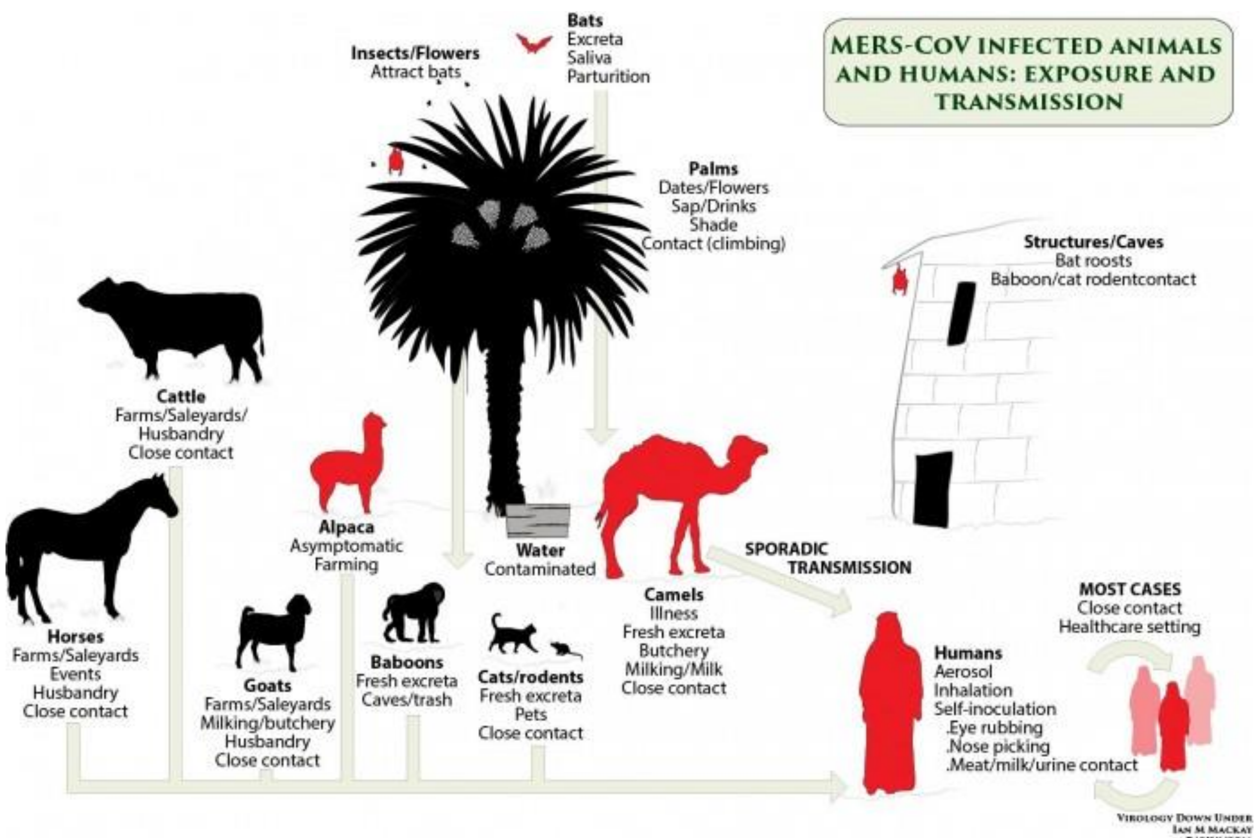

Figure 4.1: Covid-19 Transmission

5.0 CAUSES OF CORONA VIRUS

It's unclear exactly how contagious the new coronavirus is. It appears to be spreading from person to person among those in close contact. It may be spread by respiratory droplets released when someone with the virus coughs or sneezes.

The first cases were identified at the tail end of 2019 in Wuhan, the capital city of China's Hubei province, when hospitals started seeing patients with severe pneumonia. Like the viruses that cause MERS and SARS, the new coronavirus appears to have originated in bats, but it's not clear how the virus jumped from bats to humans or where the first infections occurred. Often, pathogens journey through an intermediary "animal reservoir"—bats infect the animals, and humans come into contact with some product from that animal. That could be milk or undercooked meat, or even mucus, urine, or feces. For example, MERS moved to humans through camels, and SARS came through civet cats sold at a live animal market in Guangzhou, China.

Scientists don't know why some coronaviruses have made that jump while others haven't. It may be that the viruses haven't made it to animals that humans interact with, or that the viruses don't have the right spike proteins, so they can't attach to our cells. It's also possible that these jumps happen more often than anyone realizes, but they go unnoticed because they don't cause serious reactions.

6.0 SYMPTOMS OF COVID-19

Signs and symptoms of COVID-19 may appear within 2 to 14 days after exposure. In the confirmed cases so far, most people get:

- Fever
- Cough
- Shortness of breath or difficulty breathing
- sore throat
- headache

Figure 6.1: Covid-19 Symptoms

The severity of COVID-19 symptoms can range from very mild to severe. People who are older or have existing medical conditions, such as heart disease, may be at higher risk of serious illness. This is similar to what is seen with other respiratory illnesses, such as influenza.

7.0 HOW TO AVOID CATCHING THE CORONAVIRUS

Although there is no vaccine available to prevent infection from the new coronavirus, you can take steps to reduce your risk of infection. WHO and CDC recommend following the standard precautions for avoiding respiratory viruses:

- Wash your hands often with soap and water, or use an alcohol-based hand sanitizer.
- Cover your mouth and nose with your elbow or tissue when you cough or sneeze.
- Avoid touching your eyes, nose and mouth if your hands aren't clean.
- Avoid close contact with anyone who is sick.
- Avoid sharing dishes, glasses, bedding and other household items if you're sick.
- Clean and disinfect surfaces you often touch.
- Stay home from work, school and public areas if you're sick.

Figure 7.1: How to Avoid Covid-19 Infection

CDC doesn't recommend that healthy people wear a facemask to protect themselves from respiratory illnesses, including COVID-19. Only wear a mask if a health care provider tells you to do so.

WHO also recommends that you:

- Avoid eating raw or undercooked meat or animal organs.
- Avoid contact with live animals and surfaces they may have touched if you're visiting live markets in areas that have recently had new coronavirus cases.

8.0 PRACTICE EVERYDAY PREVENTION

As you touch people, surfaces and objects throughout the day, you accumulate germs on your hands. You can infect yourself with these germs by touching your eyes, nose or mouth.

To protect yourself, wash your hands often with soap and water for at least 20 seconds. If soap and water aren't available, use an alcohol-based hand sanitizer with at least 60% alcohol.

8.1 Travel

If you're planning to travel internationally, first check the CDC and WHO websites for updates and advice. Also look for any health advisories that may be in place where you plan to travel. You may also want to talk with your doctor if you have health conditions that make you more susceptible to respiratory infections and complications.

9.0 HOW DEADLY IS COVID-19 (Is Covid-19 more deadly than the flu?)

What remains to be seen, according to preliminary estimates from the Centers for Disease Control and Prevention, the 2019–2020 flu caused 19 million to 25 million illnesses and up to 25,000 deaths. The Covid-19 numbers are harder to calculate because it's not yet clear how many people are infected. The CDC calculates the death rate at about 2 percent, which is higher than the flu—but the real number might be a lot lower, because less-severe cases may not have been reported. People with more mild cases might not even go to the hospital, and health care workers might have mistaken cases for the flu or for pneumonia. If epidemiologists count only the most severe cases, the death rate will look higher because a higher proportion of those patients die, so that might not offer an accurate reflection of reality.

10.0 EVERYTHING YOU NEED TO KNOW ABOUT CORONAVIRUS VACCINES

10.1 WHAT IS IN A VACCINE

Vaccines all work on the same basic principle: Scientists try to make something that closely resembles a pathogen, and then expose a person's immune system to it through a small dose administered as an injection. Ideally, the immune system develops a strong memory of the pathogen, so that the next time the person is exposed, their body will mount an attack before the infection can take hold. The trick is to do this without making the person seriously ill from the vaccine itself. There are a few different methods for making vaccines, but they all must strike this delicate balance.

One way to make a vaccine is to weaken, or attenuate, the microorganism while still keeping it alive. The most common method for doing this is growing several generations of the pathogen in environments other than human cells, so that it evolves away from causing disease in humans. By repeatedly culturing live viruses or bacteria in animal cells, scientists can essentially create a bunch of mutants. Then it's a matter of selecting the mutant strains that can replicate in human cells but don't cause disease like their wild ancestor. The trick is that these imposters still have to look enough like the original virus to accurately train the immune system to fend it off. Examples of attenuated vaccines include those for measles, mumps, and tuberculosis.

Another type is called an inactivated vaccine, which is made from a dead version of the whole virus or bacteria after it's been killed with heat or chemicals. This type of vaccine can also be made using smaller pieces of the microbe, which by themselves are not considered alive.

One common approach is to locate the protein that a virus uses like a key to get into human cells, which is usually on its surface. Once scientists know the genetic code for this protein, they can paste it into bacteria or yeast and use these microbial factories to produce huge quantities of it to be used as the basis of the vaccine. The protein alone is often enough to be easily recognized by the immune system and to trigger a defense on subsequent exposure.

Alternately, sometimes scientists will genetically modify the virus instead, swapping bits of the disease-causing pathogen into a harmless virus shell. These types of inactivated vaccines almost always require multiple doses, because they're not as good at stimulating the immune system as a live microbe. But they come with a lower risk of severe reactions. Examples of inactivated vaccines include those for polio, rabies, and hepatitis A and B.

All the approved vaccines on the market use one of these two techniques. But newer methods still in development may get their debut with the Covid-19 outbreak. One such promising technology is nucleotide-based vaccines. Nucleotides are the chemical building blocks that make up genetic material, both DNA and RNA. The virus that causes Covid-19, known as SARS-CoV-2, consists of a strand of RNA enclosed in a spike-covered capsule. It uses these spikes to invade human lung cells. Vaccine makers can copy the genetic instructions for making these spikes and package them up into a shot. Once inside the body, human cells will make the viral proteins, which the immune system will then recognize as foreign. It will produce antibodies against them and learn how to attack any future invaders carrying these protein spikes.

Figure 2: Covid-19 Vaccine

10.2 WHO IS MAKING A COVID-19 VACCINE?

Almost everyone! Here’s a breakdown of the 30+ candidates in development (so far), starting with those that are making nucleotide-based vaccines.

Figure 2: Covid-19 Vaccine Production

Moderna

Boston-based biotech unicorn Moderna is perhaps best known for working on personalized cancer vaccines. But the company has a history of responding to public health threats, including the 2015 Zika outbreak. In collaboration with scientists at the National Institutes of Allergy and Infectious Disease, and with funding from CEPI, Moderna has already produced an RNA-based vaccine which codes for a stabilized form of the SARS-CoV-2 spike protein. On February 24, the company shipped doses of its candidate, mRNA-1273, to the NIAID Vaccine Research Center, where a Phase I safety trial is set to begin as early as April.

CureVac

Like Moderna, crosstown rival CureVac uses lab-made mRNA to spur the production of coronavirus proteins, triggering immune cells to produce antibodies against it. And, like Moderna, it got a grant from CEPI to apply its technology to SARS-CoV-2. CureVac representatives have said the company expects to have a candidate ready for human testing within a few months.

Inovio

This Pennsylvania-based biotech uses a slightly different technology, using DNA instead of RNA to make medicines. It has also received funding from CEPI to develop a DNA-based vaccine against Covid-19. In January, the company started preclinical testing of its candidate, called INO-4800. It has so far produced 3,000 doses for trials to be conducted in patients in the US, China, and South Korea. The first of these is scheduled to begin in the US at the end of April.

Applied DNA Sciences / Takis Biotech

Applied DNA, a New York–based company, announced in March it is partnering with Rome, Italy–based Takis Biotech to deliver its own DNA-based vaccine candidates against Covid-19. The companies plan to have four versions available to test in mice by later this month.

Zydus Cadlia

India-based pharmaceutical firm Zydus Cadila announced in February it had initiated two approaches for developing a Covid-19 vaccine. Like Inovio and Applied DNA, the first involves using a ring of DNA designed to produce coronavirus protein once inside the human body. The second deals with genetically manipulating an attenuated recombinant measles virus so that it will induce antibodies against Covid-19. Company officials have not announced timelines for human testing.

Stermina Therapeutics

This is another mRNA vaccine project, based at Shanghai East Hospital of Tongji University. The CEO of Stermina told Chinese state media at the end of January that manufacturing has already begun, and doses could be ready for human testing sometime in March.

Imperial College London

A team of British scientists are currently testing their own DNA-based vaccine in mice at labs in Imperial College London. The researchers are looking for funding partners to advance the candidate into human testing later this year.

10.3 WHEN WILL A COVID-19 VACCINE BE READY

On Tuesday, National Institute of Allergy and Infectious Diseases director Anthony Fauci told US senators, “It will take at least a year and a half to have a vaccine we can use.” That might seem like an eternity for public health officials staring down a probable pandemic. But if true, it would actually set a record. Most vaccines take between five and 15 years to come to market, says Jon Andrus, an adjunct professor of global vaccinology and vaccine policy at the Milken Institute of Public Health at George Washington University.

The reason it usually takes so long comes down to a combination of factors. The first is getting a candidate vaccine that’s ready to test. This part of the vaccine development process, known as discovery, used to take years of careful benchtop biology. Scientists had to isolate and grow viruses in the lab. But now, with genetic sequencing, new protein-visualizing microscopes, and other technology advances, it’s possible to skip that step. Arriving at a vaccine candidate can sometimes be done in weeks.

All those advances, though, can’t speed up the time it takes to meticulously monitor how well these candidate vaccines work in people. Clinical trials, a prerequisite for bringing a vaccine to market, are the real bottleneck. Each happens in three stages. Phase 1 involves just a few dozen healthy volunteers, and is meant to evaluate whether the vaccine is safe.

That takes about three months. If the healthy volunteers don't suffer any adverse effects, it's on to Phase 2. This time, several hundred people will get the shot, ideally in an area experiencing a Covid-19 outbreak, so scientists can gather data on how well it spurs the production of antibodies and fends off the disease for these trial subjects. That's another six to eight months. If everything still looks good, Phase 3 is to recruit a few thousand people in an outbreak zone and repeat the experiment. That's another six to eight months—if you don't have any problems recruiting patients or with your vaccine supply. Then a regulatory agency, like the US Food and Drug Administration, has to review all the data before making a decision about whether to approve the vaccine. That can take months to a year.

If you've been doing the math, this means that, since vaccine candidates started being developed in January, a version approved for public use won't be available until the end of summer 2021, at the earliest. And that's if nothing goes wrong. "Constricting the whole timeline of going from concept to a product that can be distributed into a year or two is really a herculean endeavor," Andrus says.

Only a handful of companies have vaccine candidates ready to move into human testing, but more than 30 have joined the race. Even if one of these companies does pull off the Thirteenth Labor, they're left with a novel product that still requires manufacturing and distribution. "The first question we should be asking is: Does this producer have the capacity to scale it up?" asks Andrus. If not, a limited supply will force public health officials to make tough decisions about rationing out a vaccine.

10.4 IS THERE ANY WAY TO SPEED UP VACCINE PRODUCTION?

In general, these timelines are very difficult to compress. The last thing drug makers and regulators want is to rush out a subpar product and create rather than solve a public health crisis. Making vaccines is so cost-intensive and high risk that most pharmaceutical firms don't do it anymore. Today, the vaccine business is dominated by just four companies: Pfizer, Merck, GlaxoSmithKline, and Sanofi. Since they're the ones with the kind of capacity required to fight a global pandemic, they're the ones that have to be convinced it'll be worth it.

Covid-19 might seem like a sure bet now. But outbreaks are unpredictable. SARS disappeared just four months after it caused a global panic. The companies that had begun developing vaccines against it had to abandon their trials because there just weren't enough patients. Similar disease cycles help explain why it took so long to get an Ebola vaccine, which was only approved last December despite dozens of outbreaks since it first emerged in 1976. Plus, government funding and pharmaceutical industry interest tend to evaporate once the sense of emergency fades away. No one wants to make a product that's not going to be used.

But there are some things governments can do to encourage vaccine makers to take up the challenge despite its riskiness, including providing grants and other financial incentives to spur their involvement. In the US, a division of the Department of Human & Health Services known as the Biomedical Advanced Research and Development Authority often plays the role of incentivizing medical countermeasures against an outbreak. BARDA has so far funded four projects to address Covid-19, including two vaccines, in partnership with Johnson & Johnson and Sanofi. In recent years, an international nonprofit called Coalition for Epidemic Preparedness Innovations, or CEPI, has also raised money to invest in vaccine research. So far, it has committed more than $66 million to vaccine development efforts against Covid-19.

The fact that Big Pharma players have already taken an interest doesn't mean that a vaccine will arrive any faster. But it does suggest that these companies believe Covid-19 will be around for the long term, and may be willing to lend their manufacturing muscle to ensure that a vaccine, when it arrives, can be produced en masse.

10.5 A POTENTIAL WRINKLE

There's another factor that makes developing a vaccine against coronavirus a particularly tricky endeavor, says Peter Hotez, a vaccine researcher and dean of the National School of Tropical Medicine at Baylor College of Medicine. That's something called "immune enhancement." In the 1960s, scientists at the National Institutes of Health were working on a vaccine against respiratory syncytial virus, or RSV, a common, very contagious virus responsible for most of the colds that infants and toddlers get. During clinical trials, some children who received the vaccine later went on to get terribly sick when they caught RSV in the wild. The vaccine produced an exaggerated immune response, causing extensive damage in their bodies. Two kids died.

Decades later, when SARS hit, researchers including Hotez began working on a vaccine. But in early tests with lab animals, they saw something that raised a red flag. The animals' immune cells were attacking their lungs, causing damage like what had been described in the RSV trials. "That alerted everyone in the coronavirus research community that there was potential for immune enhancement," says Hotez. His group, which includes collaborators from the New York Blood Center, adapted its strategy. Instead of producing the entire spike protein, they built just a tiny piece of it—the piece that actually latches onto human cells, called the receptor binding domain. With this approach, Hotez says, when they tested in animals they saw immune protection but without the undesirable enhancement.

The prototype vaccine they developed wasn't able to attract any investment after the SARS outbreak dissipated. But now, the group is currently submitting proposals to fund human testing of the vaccine, which has been sitting in a freezer in Texas since the mid-2000s. Because the virus that causes Covid-19 uses the same receptor as SARS to attack human lung cells, they believe it might offer some protection. But it will be important to come up with a clinical trial design that includes additional, longer-term monitoring of patients to watch out for potential immune enhancement. Hotez says any vaccines designed to fend off Covid-19 will likely have to do the same. "That's going to really complicate things and slow them down," he says. "I don't think anyone's going to have something ready in 12 to 18 months."

10.6 SEVERAL OTHER COMPANIES ARE ALSO DEVELOPING PROTEIN-BASED VACCINES.

These include:

GlaxoSmithKline (GSK)

One of the world's leading vaccine manufacturers, GSK is lending its technology to a Chinese firm called Clover Biopharmaceuticals to work on a coronavirus vaccine. Through the partnership, Clover will be producing viral proteins, and GSK will be providing its proprietary effectiveness-boosting compounds, known as adjuvants. Neither company has provided a testing timeline.

Novavax

Novavax got a jump on the competition from its previous work developing vaccines against SARS and MERS. The Maryland-based company announced in February that it had generated several candidates comprised of recombinant protein nanoparticles derived from the SARS-CoV-2 spike protein. Company representatives said they expect to complete animal testing soon and move to the first phase of human trials by the end of spring 2020.

Altimmune

Unlike its competitors, this Maryland-based company is developing a vaccine that gets sprayed into patients' noses, not injected into their arms. Best known for its nasal-spray flu vaccine, Altimmune announced in February that it had completed the design and prototyping of a vaccine against Covid-19 and is now advancing it toward animal testing and manufacturing for human trials.

Vaxart

This Bay Area biotech is the only one so far developing an oral vaccine against Covid-19. In January, the company announced plans to generate candidates based on the published genome of SARS-CoV-2, but no further timelines have been released.

Expres2ion

This Denmark-based biotech firm is leading a European consortium of vaccine developers to tackle Covid-19. It uses insect cells from fruit flies to produce viral antigens. The company aims to test its candidate vaccine in animal models later this year.

Generex Biotechnology

Four companies in China have contracted with Florida-based Generex to develop a vaccine using the company's proprietary immune-activating technology. Company representatives say it could have a candidate ready for human trials as early as June.

Vaxil Bio

This Israeli immunotherapy company normally specializes in cancer. But last month representatives announced they had discovered a combination of proteins they believe will be an effective vaccine against Covid-19. The company plans to start manufacturing doses for initial testing and looking for partners to scale up further if that goes well.

iBio

This Texas-based biotech company uses modified relatives of the tobacco plant to grow viral proteins for vaccines. The company is partnering with a Chinese vaccine maker to put its "FastPharming" platform to work on a Covid-19 vaccine. Company officials expect to have a candidate ready for animal testing later this summer.

Baylor College of Medicine / New York Blood Center

Peter Hotez's group is pushing for funding to test their SARS vaccine against the Covid-19. He says they already have about 20,000 doses ready to be deployed for clinical trials. These researchers are simultaneously working on developing a new vaccine from scratch, based on the binding receptor domain of the new virus, SARS-Cov-2, but that will take several years to develop.

University of Queensland

A team of Australian researchers, with funding from CEPI, have developed a vaccine candidate they say is ready to move forward into human testing. It relies on a "molecular clamp" technology invented in the lab of molecular virologist Keith Chappell, which helps stabilize viral proteins so they have the same shape they'd have on the surface of the virus. The group is now intending to ramp up production for clinical trials.

University of Saskatchewan

Canadian health authorities have given university researchers the green light to start working on a vaccine against Covid-19. They've used the virus's published genome sequence to begin building protein-based candidates and are now waiting for live versions of the virus to begin testing in animal models.

University of Oxford / Advent Srl

A team of researchers at the University of Oxford's Jenner Institute had been working on a vaccine against MERS, which they quickly tailored to the new coronavirus, SARS-CoV-2. In February, the scientists signed an agreement with Italian vaccine maker Srl to produce the first 1,000 doses of the new vaccine, ChAdOx1, to supply human trials.

10.7 AND A FEW MORE ARE DEVELOPING VIRAL VECTOR-BASED STRATEGIES:

Sanofi

One of the so-called Big Four, Sanofi has been working with BARDA since 2004 on pandemic preparedness, including against SARS. The company has expanded this arrangement to focus on a Covid-19 vaccine using the company's recombinant DNA platform, which involves swapping in parts of the coronavirus' RNA with genetic material from a harmless virus. Sanofi expects to have a vaccine candidate to test in animals within six months. Human testing could begin sometime in 2021.

Johnson & Johnson

Johnson & Johnson is expanding on the company's past work with BARDA to develop an Ebola vaccine to pursue a vaccine against Covid-19. With funding from the government agency, the company's plan is to deactivate the virus, producing a vaccine that triggers an immune response without causing infection. The company has not released any information regarding development timelines.

Geovax Labs / BravoVax

Atlanta-based GeoVax signed an agreement in January to work with BravoVax, a private company Wuhan, China, to jointly develop a vaccine against Covid-19. Under the collaboration, GeoVax will be providing its proprietary platform—a modified pox virus that can be designed to express viral proteins from SARS-CoV-2.

Tonix

In February, this New York–based biopharma startup announced it is collaborating with the nonprofit Southern Research to develop a live, modified horsepox virus modified to express protein fragments from SARS-CoV-2. Company officials have not released any further timelines.

CanSino Biologics

Chinese vaccine-maker CanSino is reportedly developing a viral vector-based vaccine against Covid-2019 but no further information is available at this time.

Greffex

The CEO of this Houston-based genetic engineering company announced last month that they have completed the design of a vaccine against Covid-19. The company has not released any information about its lead candidate, but Grefex reportedly makes adenovirus-based vector vaccines involving a harmless virus that can be genetically tweaked to express foreign genes, like one for the SARS-CoV-2 spike protein.

10.8 AND LAST BUT NOT LEAST, IS THE ONLY COMPANY ATTEMPTING TO ATTENUATE A LIVE SARS-COV-2 VIRUS:

Codagenix

This New York-based biotech firm is collaborating with the Serum Institute of India to co-develop a live, attenuated vaccine against Covid-19. Rather than using blunt forces like heat or chemicals to kill the virus, Codagenix uses a “deoptimization” strategy to manipulate the virus into a version that can still replicate but won’t cause disease. The Serum Institute of India will be in charge of the scale-up. Codagenix representatives expect to have a vaccine candidate ready for animal testing this spring, with human testing progressing by this summer.

As Covid-19 spreads, the pressure is on for drug makers to get a vaccine to market. But it's not that easy.

It’s been fewer than three months since a novel coronavirus emerged in China, causing fever, coughing, and, in severe cases, pneumonia. Since then, the disease known as Covid-19 has swept into 72 countries, infecting nearly 93,000 people and killing more than 3,000.

What makes the coronavirus scary enough to cause a worldwide run on face masks and lead countries to lock down whole megacities and ban travelers isn’t that it’s super deadly. So far, the World Health Organization estimates Covid-19’s fatality rate to be about 3.4 percent globally, which is still lower than other recent coronavirus outbreaks, including SARS and MERS. (That said, it appears to be more fatal than flu, which has a case fatality rate of around 0.1 percent.) And it’s very contagious. Still, most people who get Covid-19 will recover in a week or two, without need for hospitalization. What has people panicked is that it’s new.

In the US and other developed countries, particularly in the global north, mystery illnesses don’t strike that often. People are used to having answers and a plan for avoiding getting sick. In these places, vaccines have already eliminated infectious diseases that were once common, including polio, hepatitis, and the measles. If you get your flu shot every year, the worst thing you'll usually pick up is a case of the common cold.

Which is perhaps why Americans can't seem to wait to get their hands on a Covid-19 vaccine. President Donald Trump told pharmaceutical executives and public health officials in a White House meeting on Monday that he wants one ready before the election in November.

For the record, that would be impossible. Developing vaccines that are safe and effective takes time, investment, and good science. Developing a vaccine for a coronavirus like the one that causes Covid-19 comes with even more challenges. But at least 30 companies and academic institutions are trying. Here's your guide to everything you need to know about those efforts. Check back often—we'll be keeping it updated with any notable progress or setbacks.

OBJECTIVE OF THIS PROJECT

1. To give general review on corona virus.
2. Discuss on the myths and facts of corona virus.
3. To sensitize the general public on:

    - What corona virus is
    - It causes
    - How it spreads
    - symptoms
    - It severity
    - Vaccine production
    - How to practice everyday prevention

TARGET AUDIENCE

This thesis is targeted at the general public irrespective of the age group or the society in question.

STORYBOARD

The following are the outline of the presentation on our Multimedia Topic;

- **Epidemics**: This is the introductory slide of the presentation, it describes what the term "Epidemic" means and what can be called an Epidemics
- **What is coronavirus**: This explained the disease coronavirus, how it came to be, and its severity.
- **How did it get its official NAME:** This slide discuss on how coronavirus got its name, which was gotten from "SARS-CoV-2", which later became Covid-19.

- **How Coronavirus spread**: This is the slide that project the way coronavirus spreads, the spread start from Animals to Humans and back to Animals.
- **How deadly is COVID-19:** This is the slide that discuss on how deadly Corona virus is, does it kills, how fast does it kills.
- **Causes of COVID-19:** This is the slide that discuss on what caused Corona virus.
- **Symptoms of COVID-19**: This is the slide that discuss on the symptoms of Corona virus, which are Fever, Cough, Sore throat, Headache.
- **How to avoid catching COVID-19**: This is the slide that discuss on how to prevent Corona virus, there various steps involve but the most important way of preventing coronavirus is by practicing good hygiene.
- **Treatment :** This section of the presentation discuss on how to treat coronavirus, well there is no actual treatment for coronavirus but pharmaceutical companies have been working on vaccines.

CONCLUSION

This thesis on corona virus has been carried out successfully, covering all vital areas relating to the subject matter. The study has covered various areas regarding the subject matter in terms of what Corona virus is, how it got the name, it causes, symptoms, prevention, and myths & facts about the virus. This study has successfully provided a general means on sensitizing the general public on the epidemic disease corona virus.

CHALLENGES

This project just like every other project has encountered few challenges which includes but not limited to:

1. Limited time constraint
2. Production of quality video contents on the subject matter was tasking

3. Difficulty in getting the accurate analysis on:

    - the total corona cases so far
    - infected patients
    - total deaths, and
    - fully recovered patients

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