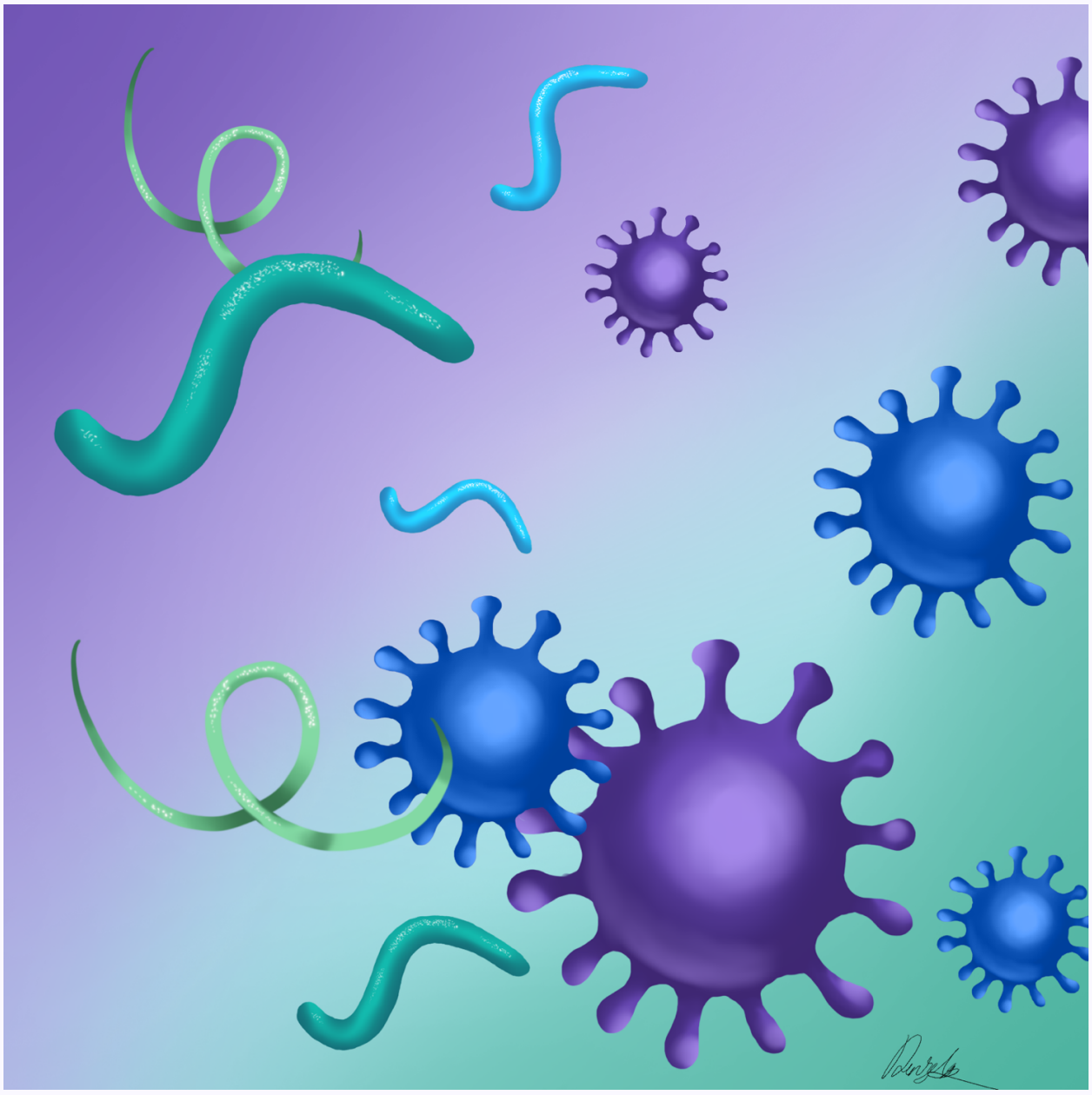
Do Parasites and Viruses Run Our World?



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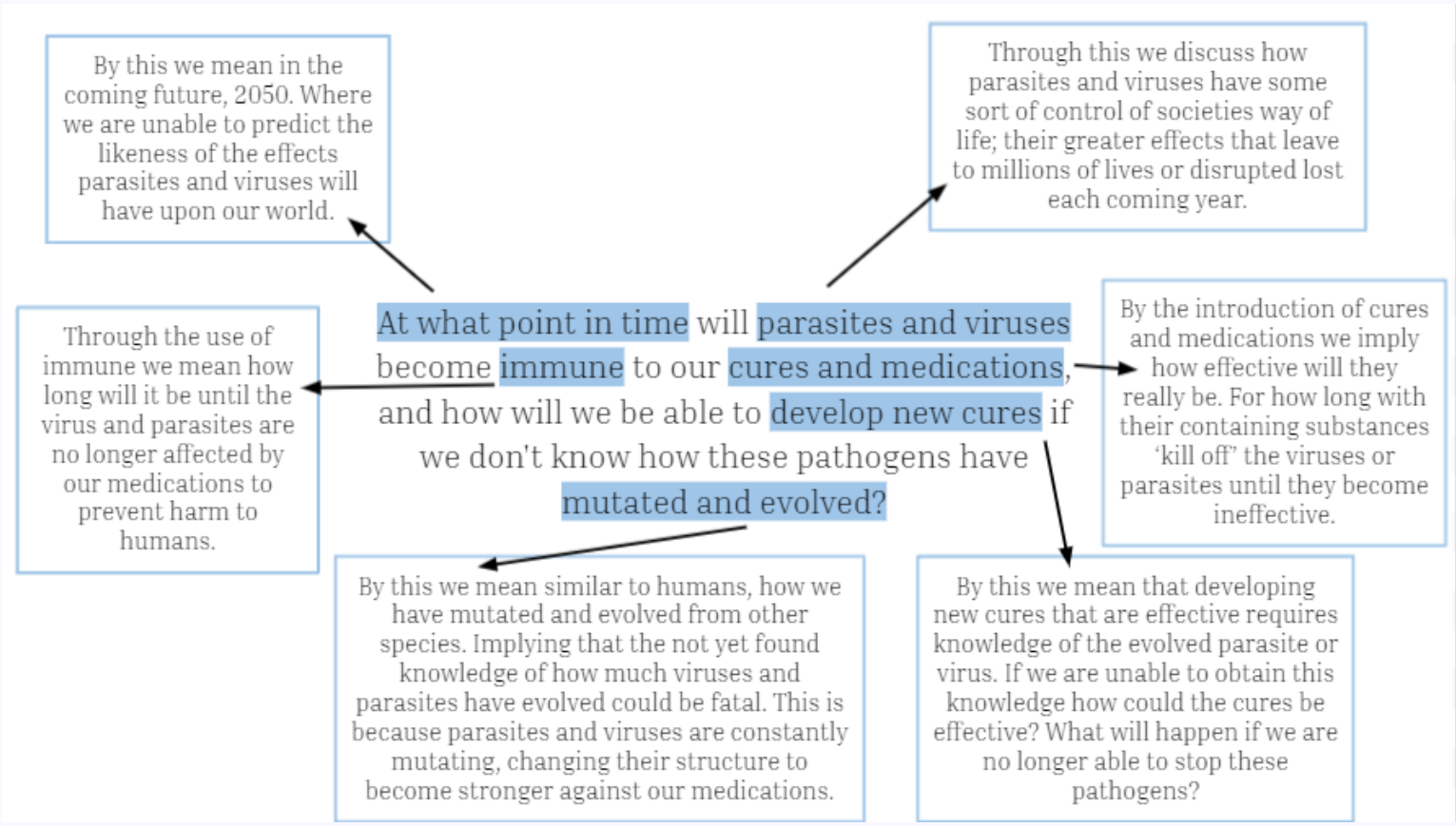

By this we mean in the coming future, 2050. Where we are unable to predict the likeness of the effects parasites and viruses will have upon our world.
Through this we discuss how parasites and viruses have some sort of control of societies way of life; their greater effects that leave to millions of lives or disrupted lost each coming year.
Through the use of immune we mean how long will it be until the virus and parasites are no longer affected by our medications to prevent harm to humans.
At what point in time will parasites and viruses become immune to our cures and medications, and how will we be able to develop new cures if we don't know how these pathogens have mutated and evolved?
By the introduction of cures and medications we imply how effective will they really be. For how long with their containing substances 'kill off' the viruses or parasites until they become ineffective.
By this we mean similar to humans, how we have mutated and evolved from other species. Implying that the not yet found knowledge of how much viruses and parasites have evolved could be fatal. This is because parasites and viruses are constantly mutating, changing their structure to become stronger against our medications.
By this we mean that developing new cures that are effective requires knowledge of the evolved parasite or virus. If we are unable to obtain this knowledge how could the cures be effective? What will happen if we are no longer able to stop these pathogens?

-What are Parasites?-

A parasite is a microorganism that is unable to live without another organism, or in other words its host. Through living in the organism the parasite stays alive by obtaining nutrients. They have a similar cellular makeup that of a human being and the parasites that live inside their host can have multiple morphological changes, therefore they are extraordinarily hard to stop and kill. The parasite has no intent of killing its chosen host as then it will have to find another living organism to live off of, albeit the parasite does often harm the life form it lives off. Parasites can create detrimental effects upon their host, like anemia and blood clots. Parasites have the ability to spread so easily because they can rapidly reproduce, making them like viruses when spreading from host to host at an extreme rate. Parasites have the ability to create diseases for their host so are ultimately connected.

Though in contrast to some parasites that may take lives there are ones that are beneficial to humans in other aspects. Hookworm's larvae are being trialed and administered to those suffering with celiac disease. The study shows from researchers Dr. John Croese and Paul Giacomin, Ph.D., that these parasitic worm larvae do boost the immune system and some patients of the clinical trial were able to eat more gluten based foods than previous. Joel Weinstock, gastroenterologist at Tufts University through his research has come to the conclusion that helminths settle the immune system. With more studies to be done these parasites may possibly become a cure treatment for those suffering from autoimmune diseases. Once more parasitic worms, or otherwise hookworms are being studied and further researched with the intention to discover that these parasites have the ability to cure asthma and, allergies.

Parasites Classification

Protozoa: Protozoa are single celled, eukaryote, microorganisms that have complex membranes, this is the separator of the cell and the environment outside, and organelles, which have specific jobs to perform within the cell, like obtaining information. This complexity of their structure allows the parasite to live in its environment, being salt water and fresh brackish. They primarily live on bacteria and fungi, though on occasion this type of parasite may also eat itself, Protozoa. There are four primary classifications of Protozoans; amoebae, flagellates, ciliates and sporozoa.

Different species of the parasite, Protozoan:

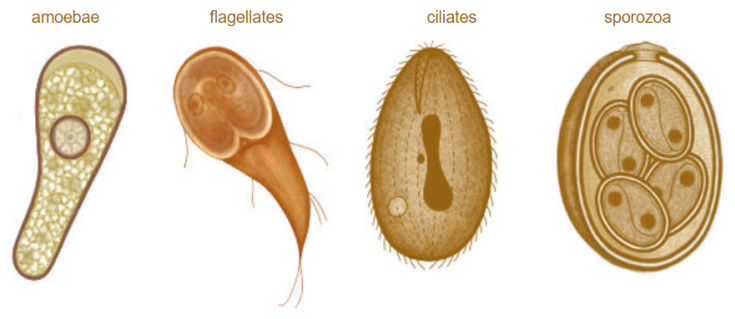


Image source from: ASP, n.d. *protozoa*. [image] Available at: <https://parasite.org.au/para-site/introduction/introduction.html> [Accessed 9 October 2021].

Helminths:

Helminths are parasitic worms that can vary between being large or microscopic. Every parasitic worm is an invertebrate, where an organism does not have a backbone, spine,the parasitic worms either have a round, flat or a long body. These parasitic organisms can neither be found living in marine or terrestrial environments or in a host, such as a human or animals. This is where they get their nutrients to keep on surviving and reproducing. Helminths can be seen to be categorized in three major groups; nematode, cestode and trematode.

Different species of the parasite, Helminths:

Image source from:ASP, n.d. *helminths*. [image]
Available at: <https://parasite.org.au/para-site/introduction/introduction.html> [Accessed 9 October 2021].

Ectoparasites: Ectoparasites or otherwise known as Arthropod parasites are organisms that have an exoskeleton, where the skeleton that supports the back of an organism is external. Ectoparasites do not live inside the host but rather on, infestesting the skin of a living being. They attach themselves to the skin, then being able to obtain their nutrients, varying between blood or skin tissue. The Ectoparasites can be classified into two categories; those with six legs, known as insects, or those with eight legs, called arachnids.

Different species of the parasite, Ectoparasites:

Image source from: ASP, n.d. *arthropods*. [image] Available at:

<https://parasite.org.au/para-site/introduction/introduction.html> [Accessed 9 October 2021].

Killing Parasites and The Diseases Created

Parasites create disease within the host's body so through this research if we are able to eradicate the parasites the diseases will become less problematic and will no longer be able to form. Parasites are so incredibly hard to kill because when inside the human body they are able to change their morphology and reproduce, just like any other living organism. Parasites have a life cycle, which they spend most if not all of their life inside the individual human, or otherwise the parasites host. Their life cycle complicates and confuses the human body, it's functions and methods to fight off the parasite as it attacks the body's erythrocyte, red blood cells. In addition to that, parasites also use 'decoy proteins' which distract the host's body from fighting rather than the parasite itself. Male gametocytes create microgametes, which are essentially fertilisation for the female gametocyte, thus the parasite being able to reproduce. These parasites in context like Plasmodium falciparun can grow and multiply in the host within twenty four hours, to which the human body will only eventually find the original parasite as after reproduction their anatomy has mutated, therefore the body is unable to identify the foriegn organism. Parasites also have a similar cellular structure to that of a human, as aforementioned, making them particularly smart in certain aspects when it comes to compromising the human body to fight off the parasite which makes it ever so hard to kill.

Though some parasites are far easier to kill than others, like the second categorical type of a parasite, Helminths. Malaria has far more complexity when it comes to the diseases and the parasite itself, these complexities. For example the cellular mutilation and the destruction of the humans DNA can also be linked to the development of cancer in the host. This is because damaged cells are at potential risk of developing into cells that are cancerous. Causing leukemia, lymphoma's ect. This relationship between Malaria and cancer, though the relationship between Malaria and cancer is still unknown. This yet attainable knowledge makes those with Malaria and cancer far more at risk but also implies that where Malaria occurs in such underdeveloped worlds the majority wouldn't know if they have also developed cancer. This makes the parasite far harder to kill as opposed to others with the link to cancer since in some cases two diseases must be fought off. Malaria is also harder to indicate than other diseases because of the parasites' actions that lead to the compromisation of the human body making the host immunocompromised and unable to fully function to fight back.

When discussing developing cures for parasites the main objective and focus will be upon the category known as Protozoa. This is because these types of parasites are the causes of the two parasitic diseases that are being focused on, Malaria and Onchocerciasis. Developing cures for parasites is extraordinarily hard as aforementioned they are constantly changing their anatomy each time the parasite reproduces in its host, and then is completely different to before in another host's body as it is carried around. Though, eradicating the primary source of the disease, the parasite, will get rid of the disease as we know it. So yes, focusing on cures or otherwise forms of termination of the parasite is the direction we should be heading in. Parasites are able to cause parasitic diseases in humans which can be extremely deadly and possibly life threatening. Examples of these diseases are;
Malaria
Onchocerciasis, otherwise known as river blindness
Leishmaniasis
Cholera
Schistosomiasis

I compared the DALYS, which stand for the disability-adjusted life year which measures the years lost due to disease, which is different to deaths, of the diseases listed above from The World Health Organization;
Health topics (2021). Available at: https://www.who.int/health-topics/ (Accessed: 6 October 2021).

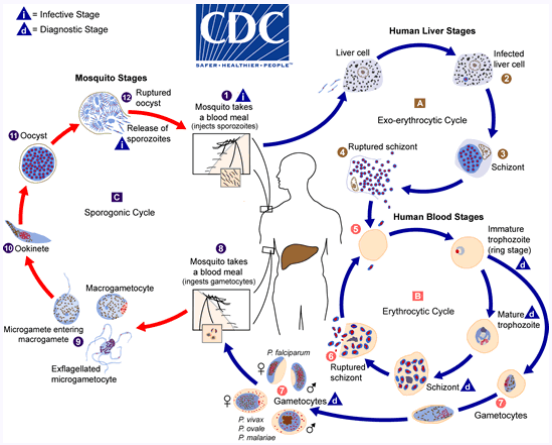
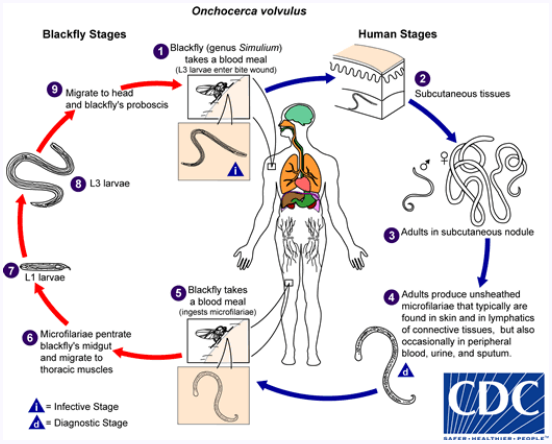
Diseases	Infections in 2019	Deaths in 2019
Malaria	22.9 million	409 thousand
Onchocerciasis; River Blindness	19.1 million	0
Leishmaniasis	1 million	30 thousand
Cholera	4 million	143 thousand

This table displays incredibly infectious parasitic diseases as you can see from the table above. Some, more contagious and easily catched than others, like Malaria and Onchocerciasis. This is because they are easier to obtain due to being carried around by vectors, which is an organism which carries around diseases, but doesn't cause or create them. Though Leishmaniasis is carried around by sandflies, the areas in which they carry the disease are less populated compared to where Malaria and Onchocerciasis is found. Leishmaniasis is generally found in southern Europe, subtropics and tropics, and Malaria and Onchocerciasis is around the continent of Africa, Oceania and South America. This is also because they can easily be contracted due to poor hygiene, like Malaria, Onchocerciasis and Cholera which is spread by water. Though Onchocerciasis is a deadly disease it hasn't been the cause of death for people, yes people do die with it in their system but their deaths are due to another cause, like malnutrition.

-Malaria VS Onchocerciasis-

Topics	Malaria	Onchocerciasis

What is it?	• a serious disease caused by a Plasmodium parasite that infects female *Anopheles* mosquitoes that feed on humans, transmitting the pathogen.
	• predominantly prevalent in third world countries.
	• There are 5 species of the Plasmodium parasite that cause Malaria in humans:
	• P. Falciparum
	  ○ Responsible for 95% of Malaria deaths
	  ○ Mostly found in Africa
	  ○ It is molecularly different so it can live in the blood vessels that lead to the brain, causing blood clots in the brain and leading to death.
	• P. Vivax
	  ○ Causes 60% of Malaria infections worldwide.
	• P. Malariae
	• P. Ovale
	• P. Knowlesi
		• a neglected tropical parasitic disease and is considered to be an eye disease.
		• caused by the transmission of a parasitic worm known as Onchocerca Volvulus, through the repeated action of a blackfly bite on a human.
		• The infectious parasitic worm is where the name of this disease comes from. They become a host of this parasite and once a blackfly comes for another blood feed the parasite's microfilariae is ingested. It is then able to affect another human and find a host through being of the infected blackfly. Which is why this disease has so easily become an epidemic.

Life Cycle		

	CDC, 2020. *Life Cycle*. [image] Available at: <https://www.cdc.gov/malaria/about/biology/index.html>[Accessed 7 October 2021].	CDC, 2017. *Life Cycle*. [image] Available at: <https://www.cdc.gov/dpdx/onchocerciasis/index.html> [Accessed 7 October 2021].
Symptoms	Uncomplicated Malaria • Headache • Lassitude • Fatigue • Abdominal pain • Eating disorders • Malaise • Muscle and joint aches • Fever • Chills • Perspiration • Vomiting Complicated Malaria • Coma (cerebral malaria) • Metabolic acidosis • Severe anaemia • Hypoglycaemia • Acute renal failure or acute pulmonary oedema (in adults)	• Severe Itching; - Rash resembling eczema - Raised rash with dark patches • Disfiguring skin conditions; - Pus filled blisters - Scaly, thick dark skin patches - Thin, dry, wrinkled skin areas - Lumps beneath the skin - Loss of pigmentation in skin • Visual impairment • Permanent Blindness
Transmission	• The vectors of Malaria are female *Anopheles* mosquitoes. • If they are carrying a plasmodium parasite, when they bite a human they inject the parasite into the bloodstream of the human. • These mosquitos must be pregnant females because they only bite humans because they need lots of nutrients to grow eggs. • They only bite between 5 pm and 7 am and their maximum intensity is at midnight. • The lifespan of these mosquitos is 2-3 weeks and each female lays 30-150 eggs every 2-3 days. There are around	• The transmission is through the bite of a black fly that has been infected by the parasitic worm, onchocerca volvulus. • While the black fly bites a human it will drop the microscopic worm larvae onto the skin, the scientific term is microfilariae. • Penetrating the skin, and infecting the human the larvae is able to enter the body. • The parasitic worm is only able to reproduce inside its human host's body, and inside the blackfly is where they complete a partial amount of their growth. • When a person who is already infected is bitten again by a blackfly the Simuliidae ingests the microfilariae. • This worm larvae takes a week to develop

	400 types of *Anopheles* mosquitoes, 30 of which being vectors for Malaria.	in the blackfly to become infectious towards a human. • When the blackfly carrying the parasitic worm bites another human the disease is spread.
DALYS	• causes **46,486,000** DALYS.	• 1 million DALYS, the amount of years of life lost from premature mortality. • Responsible for 40 percent of DALYS from varying eye diseases.
Mortality	• Endemic in 106 countries and kills 400,000 people per year, most of which being African children. • 95% of these deaths are caused by complicated Malaria. • Uncomplicated Malaria is less threatening and has a mortality rate of 0.1%. • Complicated Malaria has much more serious symptoms and has a mortality rate of 15-20%. • If left untreated, severe Malaria is almost always fatal. The most common cause of death is where a blood clot enters the brain cutting off blood and oxygen from entering the brain.	• Though an extremely fatal disease that has many deadly effects on the body such as permanent blindness, according to the World Health Organisation this disease has not been a cause of death.
Treatments	**Antimalarial Drugs:** Drugs can be used to prevent Malaria infection. They are most commonly used before people travel to areas where Malaria is prevalent. Some drugs can cure malaria by eliminating all of the Plasmodium parasites from their system. However, in some places, the parasite has become resistant to them.	• **Ivermectin;** • This medication is shown to prevent the occurence of skin conditions and their seriousness as well as the occurrence of blindness. It kills the blackfly's larvae. **Doxycylcine;** • This medication is taken in a 6 week dosage that has the ability to kill over 60% of the female, adult parasitic worms and sterilize 80% to 90% of them, after 20

Antimalarial Drugs. (2021). [Image]. Retrieved from https://media.sciencephoto.com/image/m7270014/800wm

RTS,S Vaccine:
There is a new Malaria vaccine that protects young children, the most affected demographic by Malaria, from getting the illness.

months of treatment.

Treatments for *Onchocerca volvulus*

Usage/Drug	Adult Dose	Pediatric dose
To kill microfilariae: ivermectin	150 mcg/kg orally in one dose every 6 months	150 mcg/kg orally in one dose every 6 months
To kill macrofilariae: doxycycline*	200 mg orally daily for 6 weeks	200 mg orally daily for 6 weeks

Table from:
CDC, 2020. *Treatments for Onchocerca volvulus*. [image] Available at: <https://www.cdc.gov/parasites/onchocerciasis/health_professionals/index.html> [Accessed 11 October 2021].

-Prevention of Malaria-

Solution	Pros	Cons
Vector Control • The vectors for Malaria are Anopheles mosquitoes. • An effective way to eliminate Malaria in a certain location is to control or eradicate its vector. • This can be achieved through many methods. For example, the process of **Indoor residual spraying** is an effective way of preventing mosquitoes from entering homes. This process involves spraying insecticides on all indoor surfaces where mosquitos would potentially rest at least one or twice per year. • **Insecticide nets** are also used to prevent people from being bitten by mosquitos. They provide a physical and chemical barrier that prevents the mosquitoes from biting people while they are sleeping. • **Larviciding** is the process of targeting the breeding sites of the mosquitoes and treating them with a substance that kills the mosquitos whilst they are in their larval stage.	• An effective way to prevent the spread of Malaria because without the vectors, the parasite will not be able to spread. • **Insecticide nets** can be used on a wide scale in communities that are heavily affected by Malaria. • Killing the mosquitos in their breeding locations through **Larviciding**, reduces the number of potential Plasmodium parasite vectors.	• **Insecticide nets** can have adverse impacts on the health of humans. • They have been linked to health issues such as cardiovascular diseases, diabetes, and neurocognitive development disorders. • These risks are overshadowed by the bigger, overarching issue of Malaria. • **Larvicides** are effective at killing the mosquitoes, they are not specific to the Anopheles mosquito larvae. • The larvicides can be harmful to other aquatic insects in the affected area.
Drugs • **Antimalarial drugs** are used to prevent Malaria infections. This process is called chemoprophylaxis, where the Malaria parasite is killed in the blood stage of its life cycle. Hence, the infected person does not experience any of the symptoms associated with the Malaria infection. • Reduces the risk of being infected with Malaria by 90%. • Many people are prescribed antimalarial drugs before they travel to a location where Malaria is present	• **Antimalarial drugs** prevent large amounts of people from being infected by Malaria and save countless lives. • The drugs give many people confidence to travel to places where Malaria is prevalent without having to worry about being infected themselves. • Allows researchers to travel to places where Malaria is prevalent to	• For **antimalarial drugs** to be effective they must be started before the infection takes place to allow the drug to have time to increase its effectiveness. • Drugs are ineffective at treating the infection after it has already infected the person as the Plasmodium parasite will have already passed the blood stage of its life cycle.

to reduce the risk of being infected. • Some antimalarial drugs can only be used in specific regions of the world because some Malaria parasites are resistant to certain drugs in certain locations, making them ineffective against the parasite. • The majority of antimalarials are used starting from before the person enters the place where Malaria is prevalent so the body has time to increase the level of effectiveness of the drug. • After returning home from their trip, people continue to use the drug for the remaining duration of the potential incubation period.	conduct their studies without being infected themselves.	
Vaccines • The new Malaria vaccine **RTS,S** was proven to be effective six years ago. • Through pilot immunisation programs conducted in Ghana, Kenya, and Malawi, it has been determined that the vaccine prevents 40% of Malaria cases and 30% of severe Malaria cases. • Although 40% effectiveness is not very high, this vaccine still saves a massive number of lives. • Targets the Plasmodium parasite when it has just been injected into the bloodstream, preventing it from attacking and hijacking human cells, preventing the disease and the symptoms that come with it.	• **RTS,S vaccine** prevents 40% of Malaria infections. • Although the vaccine does not sound very effective, 40% is a large number of people who will have their lives saved by the vaccine.	• If the vaccine's effectiveness was increased there would be a chance of eradicating Malaria altogether. • The vaccine only works for children up to the age of 5, and it takes 4 years of injections to gain immunity. Children who get vaccinated are only immune for one year, however, this still saves a lot of lives as most infections affect children under the age of 5.

-Malaria Vaccine-

Malaria is a leading cause of child illness in sub-Saharan Africa and a new vaccine has been developed to change this. According to WHO, Malaria kills 260,000 African children under the age of 5 annually. WHO Director-General Dr Tedros Adhanom Ghebreyesus, reflected that:

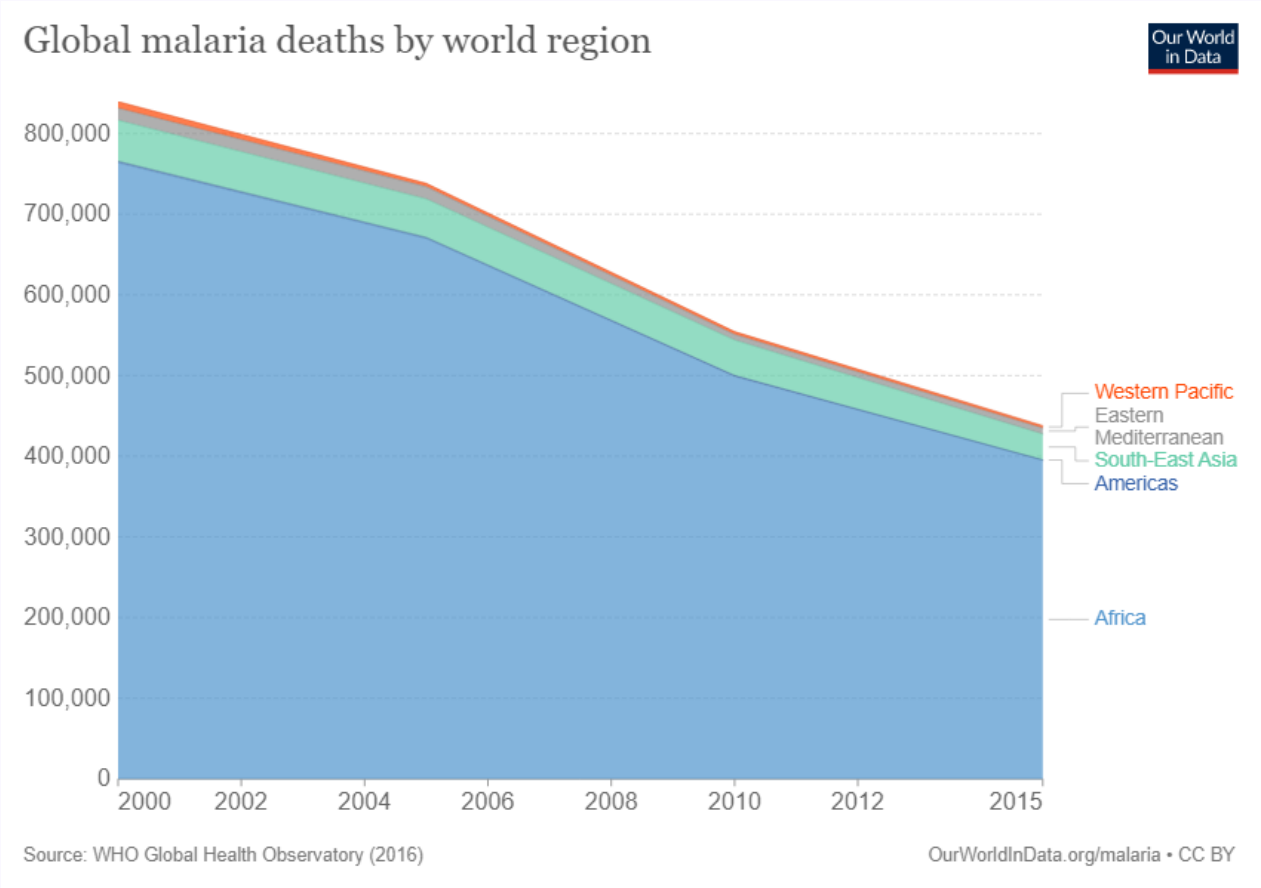
> "This is a historic moment. The long-awaited malaria vaccine for children is a breakthrough for science, child health and malaria control" and "using this vaccine on top of existing tools to prevent malaria could save tens of thousands of young lives each year."

The new RTS,S vaccine recommended by WHO provides protection for young children. Scientists must now research the vaccine and fully understand why and how it works. If they can replicate this vaccine but change some key features so the vaccine works for adults, a new vaccine could, in the coming years, rid sub-Saharan of Malaria altogether through vaccination campaigns and other vaccination-related educational programs.

In protecting these young children, the most affected demographic by Malaria, we are preventing them from getting sick so they can grow into healthier adults. Not only does this help regions in sub-Saharan Africa health wise, but could also potentially prevent tens of thousands of lives being lost due to Malaria infections. This is very beneficial economically as people can grow up to be healthy adults, helping to reduce poverty in these areas. More healthy adults could mean that society becomes more sanitary with more health care and educational opportunities. Ultimately, this new RTS,S vaccine for children is a massive step in the right direction. If scientists and researchers can further develop this vaccine to make it effective for adults, there is a possibility that Malaria could be eliminated from affected regions.

Malaria Vaccine. (2021). [Image]. Retrieved from https://www.salon.com/2021/10/07/why-malaria-vaccine-was-so-hard-to-make/

-Malaria Deaths Trajectory-



Global malaria deaths by world region. (2021). [Image]. Retrieved from https://ourworldindata.org/exports/global-malaria-deaths-by-world-region_v6_850x600.svg

Will Malaria ever be eradicated?

As shown in the graph above, Malaria cases have significantly decreased from 2000 to 2015. This decrease is due to funding and research into the illness. According to a report published by The Lancet Commission, Malaria could potentially be eradicated by as soon as 2050. However this would require an accelerated constant level of research and intervention to continue. By 2016, $4.3 billion had been invested into Malaria research and intervention. Much more money would have to be invested for this decline in cases to continue. If research was slowed down or stopped altogether, the parasite could mutate once again becoming resistant to some forms of intervention, resulting in cases increasing. A factor that could greatly increase the chances of eradication is an improved Malaria vaccine. Currently, there is a vaccine that protects young children from the disease, but it is not suitable for adults. If the vaccine could be made effective for all age groups, chances of eradication would skyrocket. Overall, there is a possibility that Malaria could be eradicated in coming years, however, this would take more money, more research, and more breakthroughs.

-Prevention of Onchocerciasis-

Solution	Pros	Cons
Drugs • Recommended treatment **ivermectin**. • Administered on a 6 month basis due to the lifespan of onchocerca volvulus, the adult worm. This is approximately 10-15 years. • Though this administration could be longer if the patient still presents symptoms of onchocerciasis. • **Doxycycline** is also a treatment that is used off-label, thus meaning it is used in another way instead of it's approved use. • **Doxycycline** is an antibiotic that destroys the bacteria which the parasitic worms live on, overall starving them to death.	• **Ivermectin,** which has also won a Nobel Prize, is an extremely effective drug against onchocerciasis. • As of 15th of October, 2021, according to Dev Discourse, it has proven to eradicate onchocerciasis from eleven Latin American countries, thus stopping around 600,000 cases. • **Ivermectin** also kills the larvae made by the adult worms, stopping them from causing any damage or harm to the patient's body. • It also helps others prevent from getting onchocerciasis if bitten by a blackfly because it will not have the larvae to ingest and spread. • **Doxycycline** that is used to kill the adult worms in the patient's gut.	• **Ivermectin** does not have the ability to kill the adult worms in the patient • **Ivermectin** also doesn't prevent the parasites from reproducing. • This introduces more potential damage as they continue to reproduce, but also grow and affect the person's organs.
Vaccines • The Tova Institute has created three vaccine candidates using several protein antigens for the disease onchocerciasis at the admitstation for young children. • The development and research for this vaccine, yet to be named, has been going on for twenty five years and as of 2020 and plans to have one vaccine to go through Phase 1 trials by 2025.	• The vaccines produced by the Tova Institute have been chosen because of their effectiveness, efficiency and capability of the reduction of parasites in animals by over 90%.	• Albeit, the three vaccines aren't yet ready to be administered and as stated before one hasn't yet been chosen to participate in the Phase 1 trials yet. • Though it does have a deadline, the potential four years could lead to a large number of cases in onchocerciasis. • This could be estimated to be around 76.4 million over these four years. • It is also to be administered to children under the age of 5 years which eliminates a large population of people who are not yet eligible.

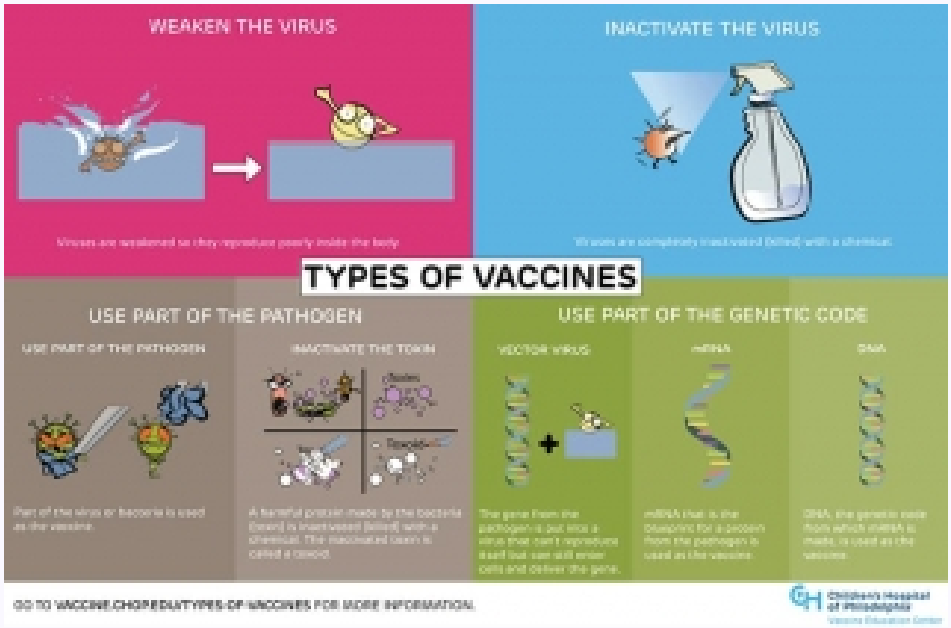
Vector Control • Onchocerciasis' vector is a blackfly infected with the parasitic worm, Onchocerca volvulus. • Vector control is a specific type of method that decreases or kills certain species which carry diseases. • Various methods have been used or are presently being used to help prevent the infectious biting of a black fly and for the population to decrease. • The **Slash and Clear** method, this is when people cut the vegetation along the river where breeding sites are. • To dry off the plants they are placed onto the river bank, which kills the blackfly larvae. • Another method is **Spraying the breeding areas with insecticides**. • This method uses pesticides or repellents from the community on a weekly rotation along the river.	• The use of vector control for the prevention of Onchocerciasis is considered to be an effective method. • The **Slash and Clear** method proved to have declined the biting of blackflys by 89-99%, according PLOS, neglected tropical diseases. • This reduction lasted approximately 120 days after the method was used. • It is considered to be an “effective, inexpensive, community- based tool to supplement ivermectin distribution....” - PLOS, neglected tropical diseases. • The use of the method, **spraying the breeding areas with insecticides**, is effective as it controls the blackflies within the area where it is distributed. • It stops the nearby communities from getting bitten, and potentially obtaining the parasitic disease.	• As aforementioned the **Slash and Clear** method does prove to be effective, but only for 120 days. • In the long term the blackflys will just come back and continue to biting people. • Therefore it is effective when discussing the short term, but it is much needed for a long term result. • **Spraying the breeding areas with insecticides**. The procedure is expensive and the communities lack the financial resources to be able to fund it. • As well as controlling blackflies isn’t the primal option of establishing an area that is free from onchocerciasis, this also includes the first method.

-Vaccines for Parasites-

How are vaccines made?

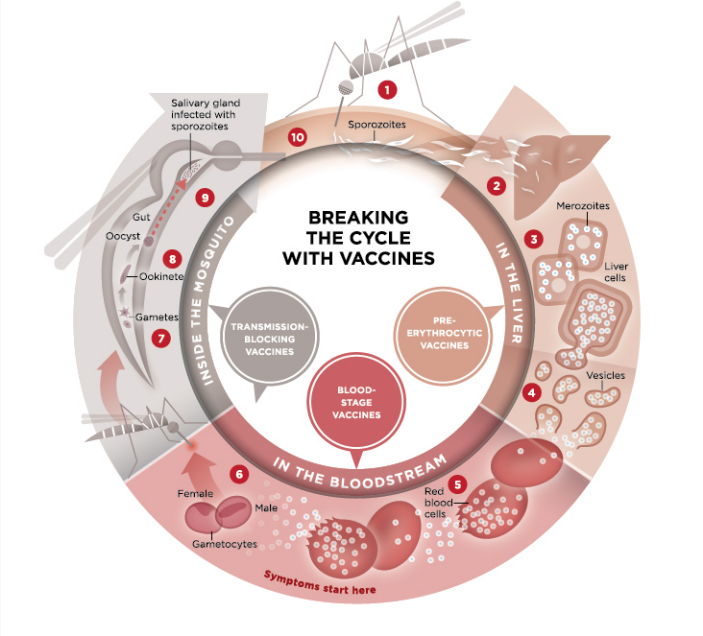
- Protein / peptide vaccine: The entire surface protein of the pathogen is isolated and introduced into the recipient of the vaccine. Once it has entered the body, the surface protein triggers an immune response where specific antibodies are produced to specifically match the antigens of the invading pathogen.
- Viral vector vaccine: a harmless virus is used to obtain a surface that is injected into the patient stimulating the production of antibodies that are specific to the antigens of the pathogen.
- mRNA vaccine: mRNA codes the surface protein. This mRNA is synthesised and introduced into the patient.

This shows 4 types of vaccines.



Types of vaccines. (2021). [Image]. Retrieved from https://www.chop.edu/sites/default/files/styles/16_9_small/public/infographic-types-of-vaccines-780x515.jpg?itok=HfLmuNzJ

This shows how a cycle of a disease can be broken with a vaccine developed for it.



MVI Path, 2007. *Breaking the Cycle with Vaccines*. [image] Available at: <https://www.malariavaccine.org/malaria-and-vaccines/vaccine-development/life-cycle-malaria-parasite> [Accessed 21 October 2021].

Why is it so difficult to develop a Malaria vaccine?

- Malaria hides from its host most of the time.
- It changes form so quickly that the antibodies stimulated by the vaccine are not able to recognise the parasite.

The life cycle of the Plasmodium Parasite:

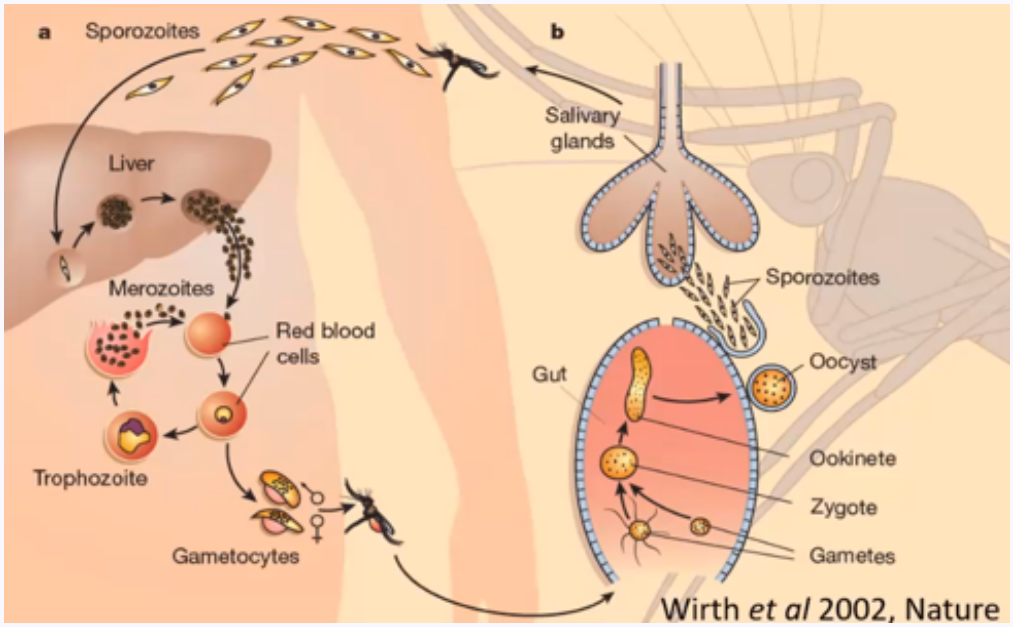
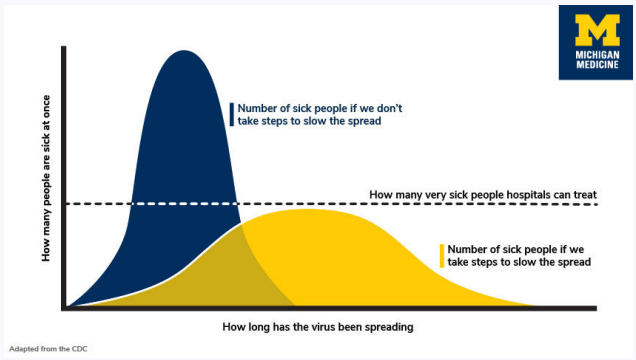


Diagram from the lecture of Dr Jeff Yeoman, Lecturer in Biochemistry and Genetics at LaTrobe University

-What are Viruses?-

Viruses are nonliving organisms that are found around the world in different shapes and sizes. Most are not harmful, however some have dangerous effects on humans and other living things. Viruses are smaller than skin cells, meaning that they spread easily and quickly. They consist of genetic material; RNA / DNA which are packed with proteins and surrounded by lipid membranes. Viruses attack their host by docking onto the surface of the cell and tricking them into letting them inside. Once they enter the host, viruses multiply themselves to tackle different areas of the immune system and take over their host. They are usually spread through human → human transmission, or animal → human (vector) transmission and through contact, coughing, sneezing, and all types of saliva transmissions.

Image of the coronavirus and how if people are sick, if they maintain it, they will reduce The spread.

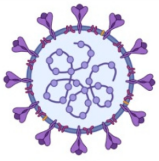
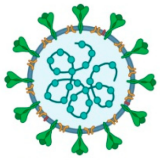
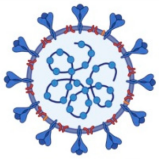


Flattening the Curve for COVID-19: What Does It Mean and How Can You Help? (2021, October 02). Retrieved from https://healthblog.uofmhealth.org/wellness-prevention/flattening-curve-for-covid-19-what-does-it-mean-and-how-can-you-help

As science has progressed, experts have come to realise that vaccines are the most effective cure for viruses. Vaccines are made up of an existing protein or sugar from the virus, in order to train the immune system for fighting the stronger version.

Common examples of Viruses include:

- Coronavirus
- Herpes
- Shingles
- The flu
- Chickenpox
- Megavirus
- Ebola
- Rabies

Disease	MERS	SARS	COVID-19
Disease Causing Viruses	 MERS-CoV	 SARS-CoV	 SARS-CoV-2
Basic Reproductive Number (R_0)	0.3 - 0.8	3	2.0 - 2.5 *
Case Fatality Rate (CFR)	34.4%	9.6 - 11%	~3.4% *
Incubation Duration	6 days	2 - 7 days	4 - 14 days *
Hospitalization Rate	Most cases	Most cases	~19% *
Community Attack Rate	4 - 13%	10 - 60%	30 - 40% *
Annual Infected (global)	420	8098 (in 2003)	N/A (ongoing)

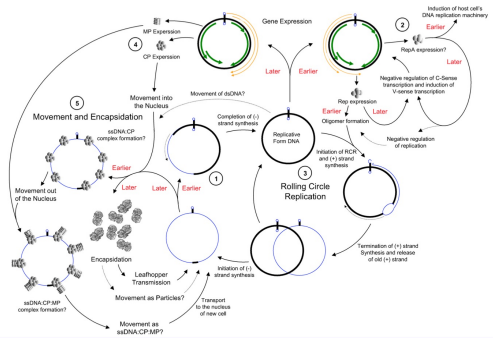
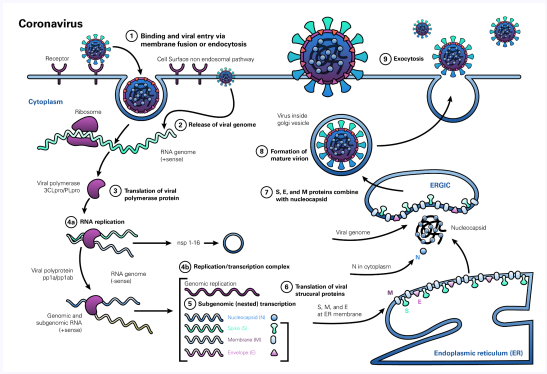
This image compares three different viruses and how they are similar, yet share differences. The Basic reproductive number is the average number of the viruses reproducing.

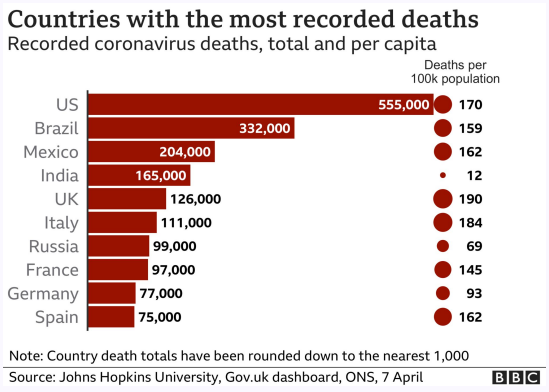
Jha, N. K., Jeyaraman, M., Rachamalla, M., Ojha, S., Dua, K., Chellappan, D. K., ...Kesari, K. K. (2021). Current Understanding of Novel Coronavirus: Molecular Pathogenesis, Diagnosis, and Treatment Approaches. Immuno, 1(1), 30–66. doi: 10.3390/immuno1010004

There have been 2 viruses which have been eradicated from history, which are smallpox and rinderpest.

Research founded by Dr Warwick Grant, highlights how “certain viruses contain bacteria which makes these viruses act alive” which results in the viruses themselves being a non-living organism, however, the bacteria structuring the virus makes it seem like they are living. The reason why smallpox was able to be eradicated was because it was not good at evolving, meaning that the evolution of vaccines could easily take smallpox down. However, viruses like influenza are the opposite: it is constantly evolving, meaning that vaccines are having trouble evolving quick enough to impact these types of viruses. There are drugs known as; Artemisinin combination therapies and Chloroquine used to try and treat the disease, Malaria, though are proven ineffective according to Dr Jeff Yeoman at La Trobe University. A vaccine has also been developed but is stated to be “not very effective in phase three clinical trials.” It is known as Mosquirix, which attacks the circumsporozoite protein which is administered from the parasite into the host's blood cells.

-Megavirus VS Coronavirus-

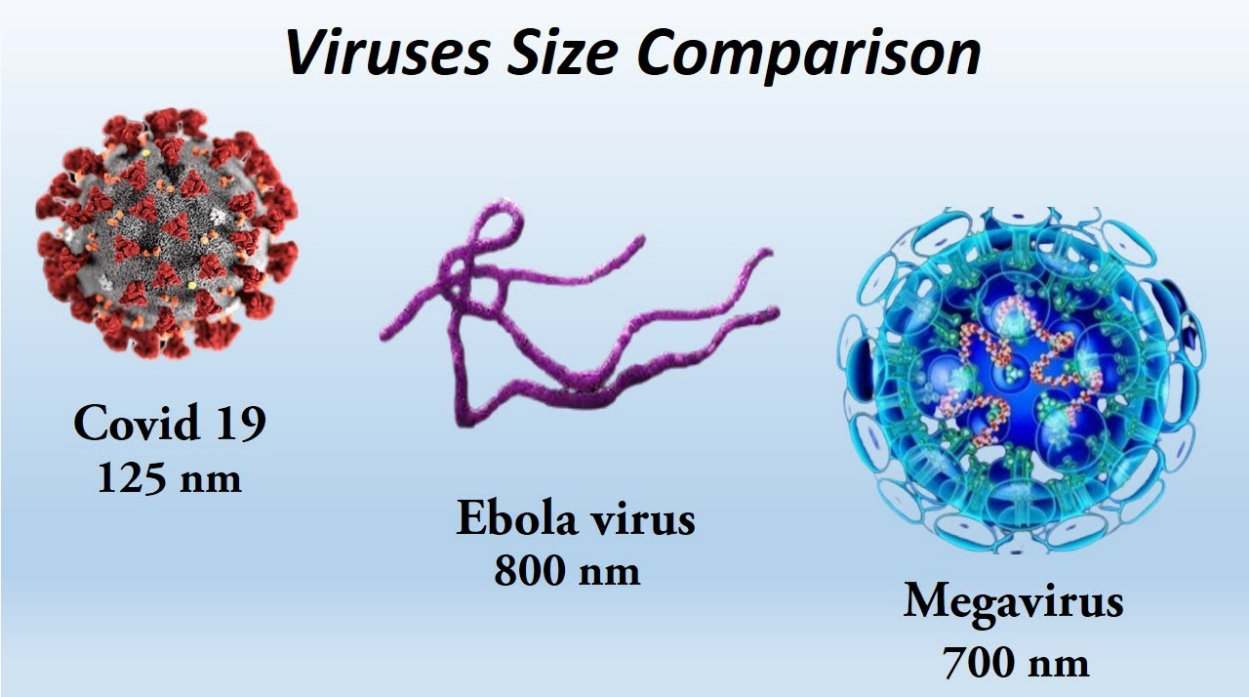
Topics	Megavirus	Coronavirus
What is it?	• A specific virus which mainly targets single-celled marine amoebas. • It was founded in 2010.	• Coronavirus is a recent virus, founded in 2019. • Caused by the SARS-CoV-2 virus
Life cycle	 mimivirus – ViroBlogy. (2021, October 11). Retrieved from https://rybicki.blog/tag/mimivirus	 SARS-CoV-2 and COVID-19 Pathogenesis: A Review | LSBio. (2021, October 17). Retrieved from https://www.lsbio.com/media/whitepapers/sars-cov-2-and-covid-19-pathogenesis-a-review
Symptoms	• No symptoms of the megavirus since the megavirus is harmless to humans. • Approximately 35% of a type of cell, Castelanii amoebas, die off before they infect humans.	• Coughing • Fever • Loss of taste and smell • Fatigue • Difficulty breathing (serious symptom) • Loss of speech and confusion (serious symptom) • Chest pain (serious symptom) • headaches
Transmission	• Through water.	• Saliva transmission • Coughing • Sneezing

DALYS	• Doesn't have a dalys because it doesn't impact humans or animals, meaning that they can't lose their years of living.	• 427.4 (from January 2020 to April 2021)
Mortality	• Last for 17 hours	 BBC News. (2021). Covid: Brazil has more than 4,000 deaths in 24 hours for first time. BBC News. Retrieved from https://www.bbc.com/news/world-latin-america-56657818
Treatments	• No treatments, due to the lack of impact it has on animals.	• Covid vaccine (pfizer/astrazeneca) • Self-isolate • Get tested • Medical assistance

-Megavirus-

What is the megavirus?

Image comparing the different sizes of viruses, and how the megavirus is huge.



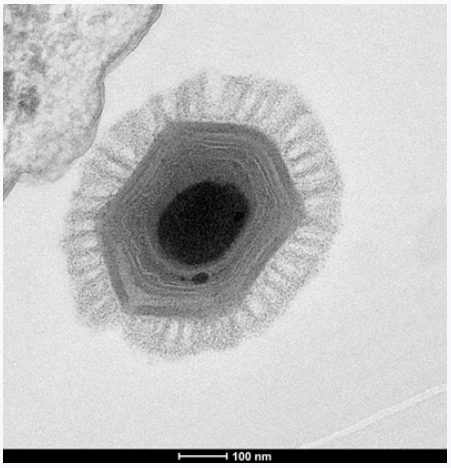
T. V., T. (2020, October 28). Viruses Size Comparison. Youtube. Retrieved from https://www.youtube.com/watch?v=tParckeBalw

The megavirus is the second largest virus known, measured at 680 nanometers wide (diameter). However, though it is somewhat smaller than the Mimivirus, the megavirus has a larger DNA genome. A DNA genome is the genetic information about the organism it came from. Each genome structure is surrounded by the nucleus. The nucleus is a structure made entirely of membrane. A megavirus' genome structure is 1, 259, 197 pairs, larger than the Mimivirus, which has a total of 1, 182, 000 pairs, hence the name, 'megavirus.' Studies show that the megavirus infects water amoebas, as well as mainly infecting some types of marine algae, which cause algal blooms. It was first discovered in 2010 (after the mimivirus in 1992), and got its name due to its size, but mainly its genome structure. It is responsible for infecting single-celled water amoebas. A professor, or the name Professor Jean-Michel Glaverie exclaimed that the megavirus can be spotted without an electron microscope, however it can be seen with a standard light microscope. The electron microscope is a specific microscope which uses electrons to illuminate the subject. This will then provide a high quality image of the cells and organisms. However, the regular light microscope is a standard microscope that has limitations on how far one must adjust it to get a better view of smaller specimens. Though it can cast a light beam on an object or even through a substance, it will not support longer wavelengths, and will use ultraviolet radiation of shorter wavelengths. However, the resolution limit is ~0.2 μ m, whereas the electron microscope can display up to 0.001 μm of data (1nm). This means that the megavirus is big enough to be seen, over 0.2μm, because it is 680nm in diameter, which means that it is 0.68μm.

The megavirus is a marine-based virus, therefore, does not impact or even hazardous to humans whatsoever. It mainly impacts single-celled marine amoebas. A single-cell amoeba is a type of organism that evolved from the sea. It is one of the oldest forms of life on earth. They are made up, hence the name, of one singular cell. The shell has the ability to preserve the amoeba as a fossil, due to its vase-like structure. Regular, smaller viruses have the ability to invade a host by spreading and multiplying itself to have different purposes and effects on the body, however, larger viruses have a different technique to invade and attack the immune system. Larger viruses, such as the megavirus, go into the area necessary, and draw in the structure of life. It then reproduces future viruses by spitting them back out. The megavirus has the ability to kill surrounding amoebas in the sea. By losing amoebas, humans are impacted by the megavirus since humans heavily rely on amoebas to balance out viruses, algae and bacteria located in water.

Research from the Virology Blog declares that the megavirus was once from a cellular ancestor. This ancestor would have later on lost its genes that were no longer useful to itself, and would carry an abundance of protein synthesis. It is from the Mimiviridae family; a family full of large viruses. The mimiviridae family relies on 4 sub categories, separating the types of viruses and diseases known in the main category. The megavirus is located in the subcategory nucleocytoplasmic, which is the holder of very large viruses.

Microscopic Megavirus



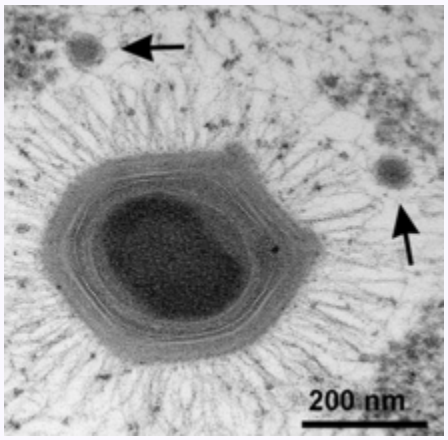
The megavirus is the second largest known virus in the world to date. Its main purpose is to attack and kill single-celled marine amoebas, however it does not create any harm or damage directed at humans and animals. It is classified as a virus, due to the fact that it cannot replicate itself without a host, along with not being a living organism. The way the megavirus attracts its prey (marine single-celled amoebas) is by its hair-like features presented on the external shell, attracting unsuspecting single celled amoebas to be attracted to it.

Contributors to Wikimedia projects. (2021, September 12). Virus - Wikipedia. Retrieved from https://en.wikipedia.org/w/index.php?title=Virus&oldid=1043835770

Once the megavirus takes hold of its prey, like a regular virus, it starts to attack the host. Because the host of the megavirus does not contain an immune system for the megavirus to go for, it will end up engulfing the whole thing. All of these characteristics ensure that the megavirus is, indeed, a virus. Dr Warwick Grant, a professeur who studies medical development through the developing world, such as river blindness, has mentioned that

when viruses look for their prey, they can recognise and combine with certain features located on a specific cell they are trying to make their prey.

Megavirus attracts its prey.



Contributors to Wikimedia projects. (2021, September 02). Mimivirus - Wikipedia. Retrieved from https://en.wikipedia.org/w/index.php?title=Mimivirus&oldid=1042022802

Can the megavirus be cured?

The megavirus, in detail, catching and attracting its prey.

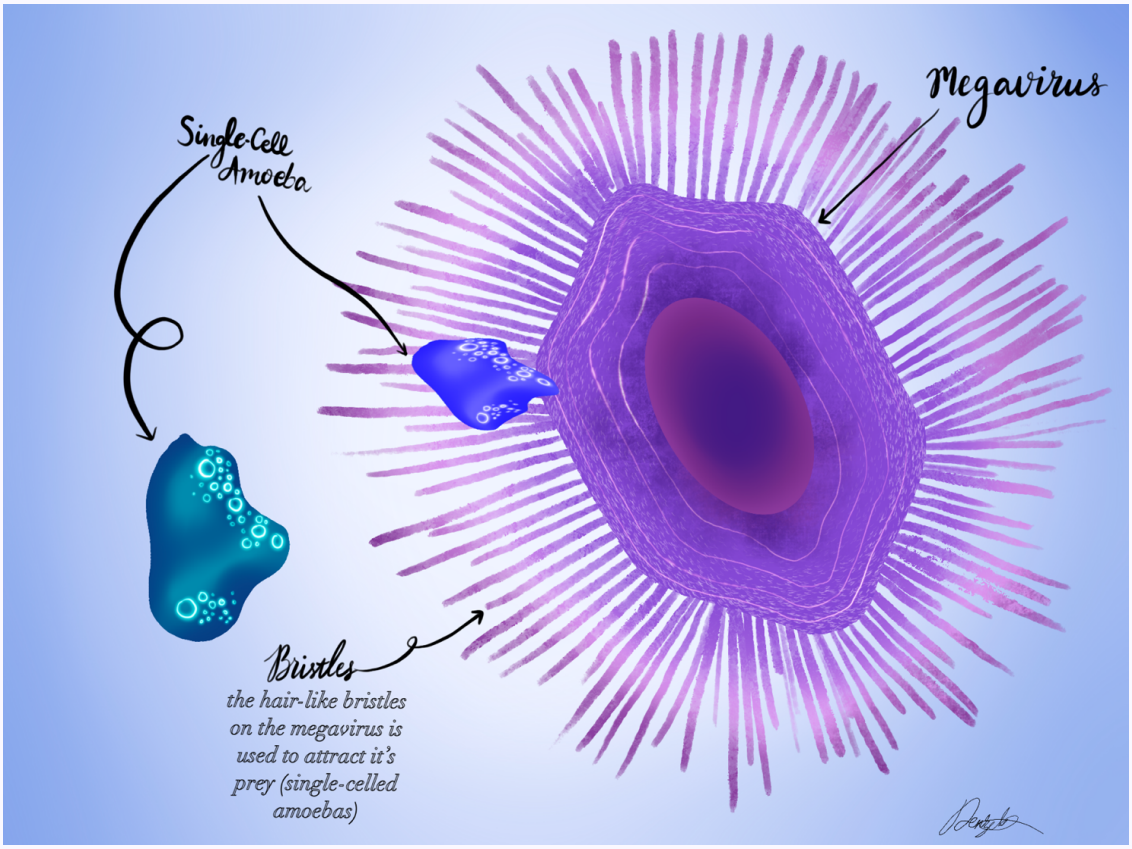
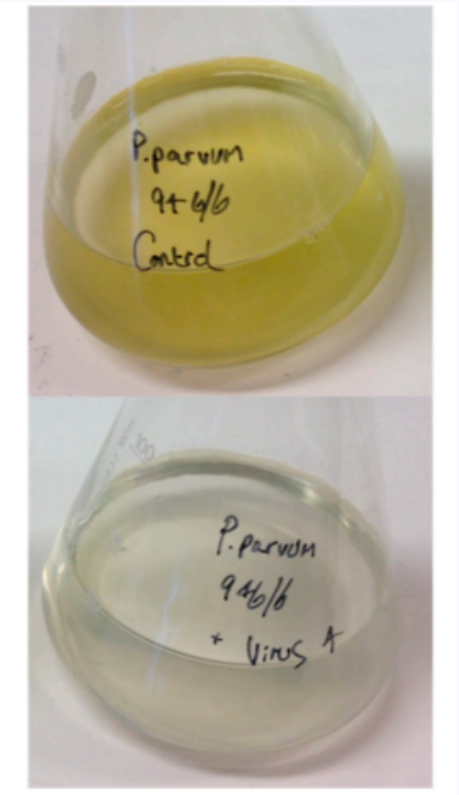


Image created by Denzel Vaghani

Research presented by Dr Warwick Grant, professeur in physiology, as well as anatomy and microbiology, states that the megavirus also is known for killing marine algae. This algae is responsible for producing toxic marine algal blooms, which are a type of toxicity that can kill and affect animals and people. It also creates a death zone in water areas. The megavirus kills some of these algae before they create algal blooms. This concludes in how the megavirus is actually saving animal and human lives, meaning that there's no cure for them because it is actually a cure for some types of algal bloom. Similarly to how other viruses work, the megavirus cannot affect humans, because of the fact that it requires a certain cell to survive. Dr Grant quoted that viruses are similar to locks and keys, that, like a key, they need a certain cell (lock) to combine together to infect. Because the megaviruses main priority is to infect toxic algae, meaning that it will only be binding with algae cells, rather than the human immune system cells. It is also noted that even if the megavirus did want to infect a human cell and invaded it, it would have to face and try and work out the metabolism of that cell, and would have difficulty trying to reproduce that specific virus.



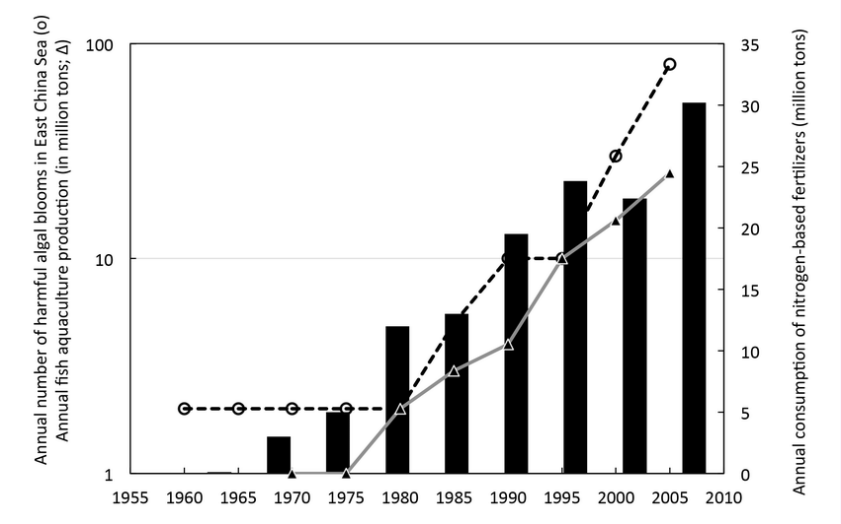
This image here was founded by *Wagstaff, B., Vladu, I., Barclay, E., Schroeder, D., & Malin, G. (2017). Isolation and Characterization of a Double Stranded DNA Megavirus Infecting the Toxin-Producing Haptophyte Prymnesium parvum. Viruses. file:///C:/Users/dvagha24/Downloads/viruses-09-00040.pdf*

It explains the difference between infected water, and non infected water. The bottom one is the one post the infection, whilst the top one remains before the infection.

Relating the megaviruses' impact on the world to the major question, ‘Do parasites and viruses run our world?’ Yes. depending on which virus and parasite it is. Using the megavirus as the current example, the megavirus impacts single-celled marine amoebas, as well as toxic algae. This means it does impact the world, however, it impacts only the major thing which is bad for the environment. As mentioned in previous paragraphs, the megavirus infects these types of algae, killing them, which leads the algae not producing anymore

cyanobacteria, blue-green algae, and red tides, which are harmful algal blooms produced by the algae. Algal blooms are toxins produced by certain types of algae, which are dangerous, and can be fatal to humans and all animals. This makes the megavirus a cure for the algal blooms, rather than a threat to animals and humans.

This image, located from Figure 4: Comparison of the number of harmful algal bloom events in the... (2020, November 27). Retrieved from https://www.researchgate.net/figure/Comparison-of-the-number-of-harmful-algal-bloom-events-in-the-East-China-Sea-over-time_fig4_292963987
States the comparison between algal blooms and how they affected the marine population in the East China Sea.



The megavirus runs the algal bloom world, rather than the globe of people and animals.

This image here tells the viewer just how harmful these algal blooms can be, and how the megavirus is actually preventing this.
Located in *Harmful Algal Blooms. (2021, October 20). Retrieved from*

https://www.britannica.com/story/harmful-algal-blooms

Algal blooms can spread all across the sea, as pictured in this satellite view of earth. The green liquid is the algal blooms, meaning

that any marine-based animals will get killed or seriously ill when encountering these blooms. Founded in *U. S. Department of Commerce, N. O. a. A. A. (2019, October 31). Can we clean up, stop, or end harmful algal blooms? Retrieved from https://oceanservice.noaa.gov/facts/hab-solutions.html*

-Coronavirus-

Timeline of the Virus

It is estimated by scientists that the first ever coronaviruses date back over 55 million years ago, however have only become relevant to humankind since the early 2000's. In 2002, a beta-coronavirus by the name of SARS (Severe Acute Respiratory Syndrome) crossed species barriers from a bat into an unknown mammalian host. The host then passed the virus onto a Human and caused an outbreak in Shunde, Guangdong, China. In 2012 another beta coronavirus, referred to as MERS (Middle East Respiratory Syndrome), appeared from an unknown location and spread throughout the Middle East, South Asia and Africa.

The latest breakout of a virus, Coronavirus, introduced to Wuhan, China in 2019, is classified as the beta species, and is most similar to the SARS strain. Hence, the original rumour of an infected bat consumption, and the name SARS-coronavirus 2. Scientists have yet to discover whether the virus was a direct bat to human transmission, or whether a mammalian intermediate was involved.

Figure 1: COVID testing and procedures in Melbourne

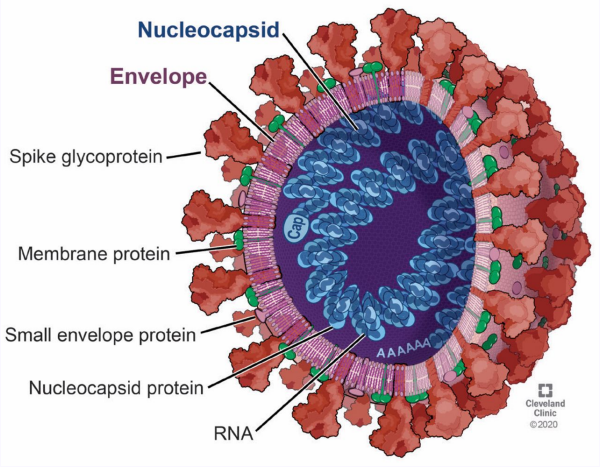
FIGURE 1: Available at: https://www.theguardian.com/australia-news/2021/oct/11/victoria-hotspots-covid-19-full-list-public-exposure-sites-melbourne-tier-1-2-3-vic-venues-case-location-alerts-metro-regional-coronavirus-cases-outbreak-locations (Accessed: 13 October 2021).

Genome Report

The Coronavirus that exists as a global pandemic in 2021 is only a version of the many possibilities of disease from this pathogen. The Family of Coronaviruses (CoVs) are a large selection of enveloped, RNA viruses that are subdivided into four groups. The Alpha and Beta species originate from bats and rodents, whereas the Gamma and Delta species come from birds. The virus is responsible for a wide range of diseases in animals, and for various respiratory viruses in humans.

SARS-Coronavirus 2, the current version of contagious virus that has infected the world since 2019 consists of a large, single stranded, positive-sense RNA molecule. The RNA contains all the information used to create viral components and function and is coated with structural proteins to form a complex called Nucleocapsid. The Nucleocapsid is enclosed within an envelope and is lined with club-like spikes that make the pathogen look like a crown – hence the name, 'corona'.

Figure 2 and 3: Comparison between the Covid (left) and SARS (right) pathogens



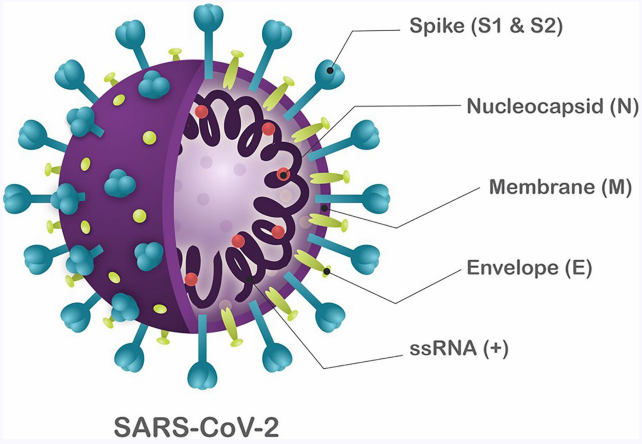


FIGURE 2: Available at: https://www.ccjm.org/content/87/6/321 (Accessed: 20 October 2021).

FIGURE 3: Available at https://www.frontiersin.org/articles/10.3389/fmicb.2020.01818/full (Accessed: 20 October 2021).

The virus infects by binding the crown-like spikes onto a molecule within the host on the receptor cell surface. The receptor that attracts SARS and COVID 19 in humans is called the angiotensin-converting enzyme 2 (ACE2). The infection usually begins within the cells of the respiratory mucosa (the lining of the respiratory tract) and then spreads to epithelial cells (the surface lining of all cells in the body) of the alveoli (where the lungs and blood exchange oxygen and carbon dioxide) in the lungs. Next, the viral membrane fuses with the host's cell membrane to release the nucleocapsid into the cell. The virus then uses the host machinery to multiply by producing viral RNAs and proteins that are assembled into virion (new

particles). They insert themselves into the intracellular membranes (the thin structure to encapsulate the organelles) and more are released until the host's cell dies. The uncontrolled growth of the virus destroys the respiratory tissues and produces symptoms.

Figure 4: List of Coronavirus Symptoms, as suggested by the Australian Government

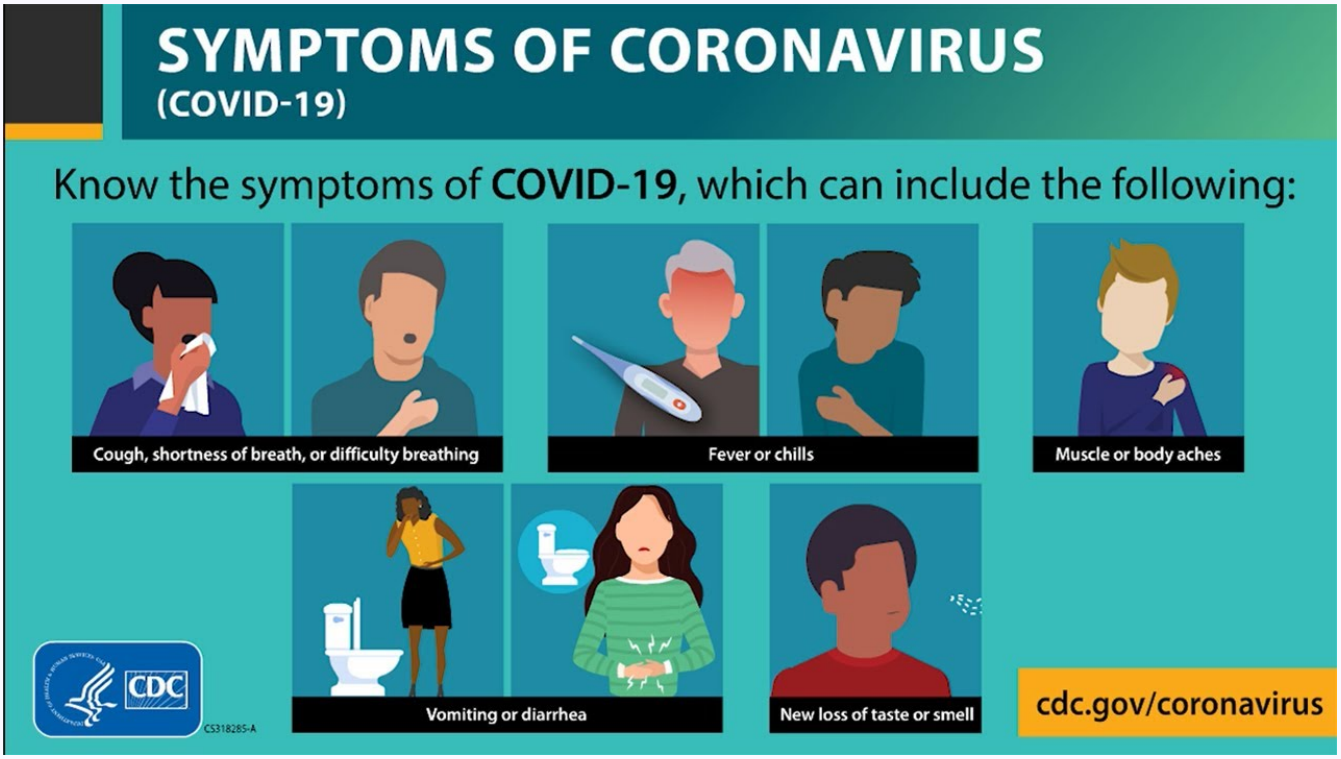


FIGURE 4: Available at: https://www.cdc.gov/dotw/covid-19/index.htm (Accessed: 09 October 2021).

The infection triggers the body's inflammatory response which brings immune cells to the site to fight the virus. This instinct from the immune system is helpful to trigger the T and B Cells within the body to fight the virus, however excessive inflammatory damages the body's own tissues and contributes to the severity of the disease.

In a healthy human being, the virus is usually eliminated with assistance from the immune system and the patient recovers although some may require supportive treatment. However, people with weakened immune systems or underlying chronic diseases may progress to severe pneumonia or acute respiratory distress syndrome, which can be fatal. Depending on various factors such as having substantial healthcare and a healthy immune system, the fatality rates of the virus vary, ranging anywhere from 0.6% - 20%.

What is Virus Immunity?

Viruses have existed on earth 3.5 billion years before humans. Like bacteria, the majority of viruses are harmless to humans. Scientists from the *American Society of MicroBiology* have stated that "Humans are often infected with their own gamma-herpes viruses, and it is conceivable that these could provide similar benefits". Dr Marilyn Roossinick mentions that both the Murine Norovirus and the Pesvirus have benefits towards the immune system. Other viruses are climactic to an extent where it does not impact human human health, and are almost invisible to society.

However, several viruses in the past have escalated to such an extent that global disasters have occured. The worst viral pandemics were caused by the Smallpox Virus (1157 B.C - 1977), the Poliovirus (1894), the Human Immunodeficiency Virus (HIV) (1981), the Influenza 'A' virus subtype (The Flu) (2009) and the Ebola Virus (2013). Only one of these viruses have been completely eradicated from history, whilst others have been contained. For this, Scientists thank Vaccines. It has been proven time and time again that Vaccines are the only solution for taking control of a viral infection.

Are Vaccines the way to go?

According to parasite specialist Warwick Grant, " vaccines are designed to drive the replication of the virus down. Scientists and doctors have extensive experience in the constructing and enforcing vaccines, which is why they are deemed reliable during the pandemic". In theory, the amount of hosts that are susceptible to the disease will lower as vaccination rates elevate, and once there is no habitat for the virus to thrive, it will become extinct.

Figure 5: Number of coronavirus cases in New South Wales from May 2021 - October 2021

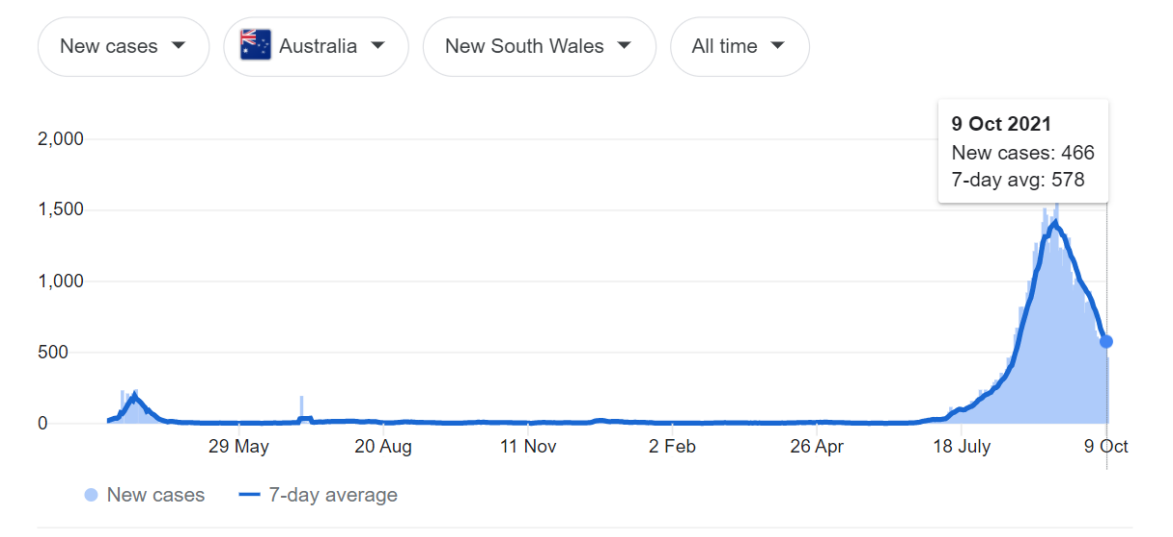


FIGURE 5 - Available at: https://github.com/CSSEGISandData/COVID-19 (Accessed: 13 October 2021).

Figure 5, as shown above illustrates the number of Coronavirus Cases in NSW, Australia. On October 9, 2021, there were 466 new cases, in comparison to a peak of 1603 cases one month ago. The state was in lockdown for over 13 weeks, and after the healthcare system realised that a lockdown would not eradicate the virus alone, Gladys Berejiklian, Premiere of NSW at the time revealed that "getting vaccinated is the only way to get the virus over with". The state currently stands with over 80% on the first dose of vaccinations, and 50% with the second on October 10th. The statistics are clear evidence that increased rate of vaccinations dominantly assists the eradication of the virus.

Pros	Cons
The American Academy of Pediatrics states that Vaccines are 90-99% effective, thanks to the technological advancements from our medical practices and doctors. Because numerous vaccines have already been developed for a variety of different purposes, there is a sense of experience. Therefore, as we make more vaccines throughout time, it will get easier and easier. A statistic from SKY NEWS highlighted that 5 people die every minute from the virus, however all of these deaths occur in countries that have not been vaccinated. This proves the effectiveness of the virus, because countries like Australia and Portugal have relatively high vaccination rates, and therefore lower virus rates.	Because everyone's immune system is different in terms of productive abilities and strength, multiple vaccines have to be made for the same purpose. For example, those who have a weakened immune system will require a weakened virus that does not risk killing them. Those with specialist conditions, such as heart or lung disease, again, require a specialised vaccine to accommodate. Although this is usually simply a modification of the existing vaccine, it takes plentiful time to test and experiment. It would perhaps be easier to utilise a drug, where the original solution can accomodate for a higher percentage and so less adjusted versions would have to be manufactured.

Figure 6: National Foundation of Infectious Diseases's research to 'Why Vaccines are Safe'

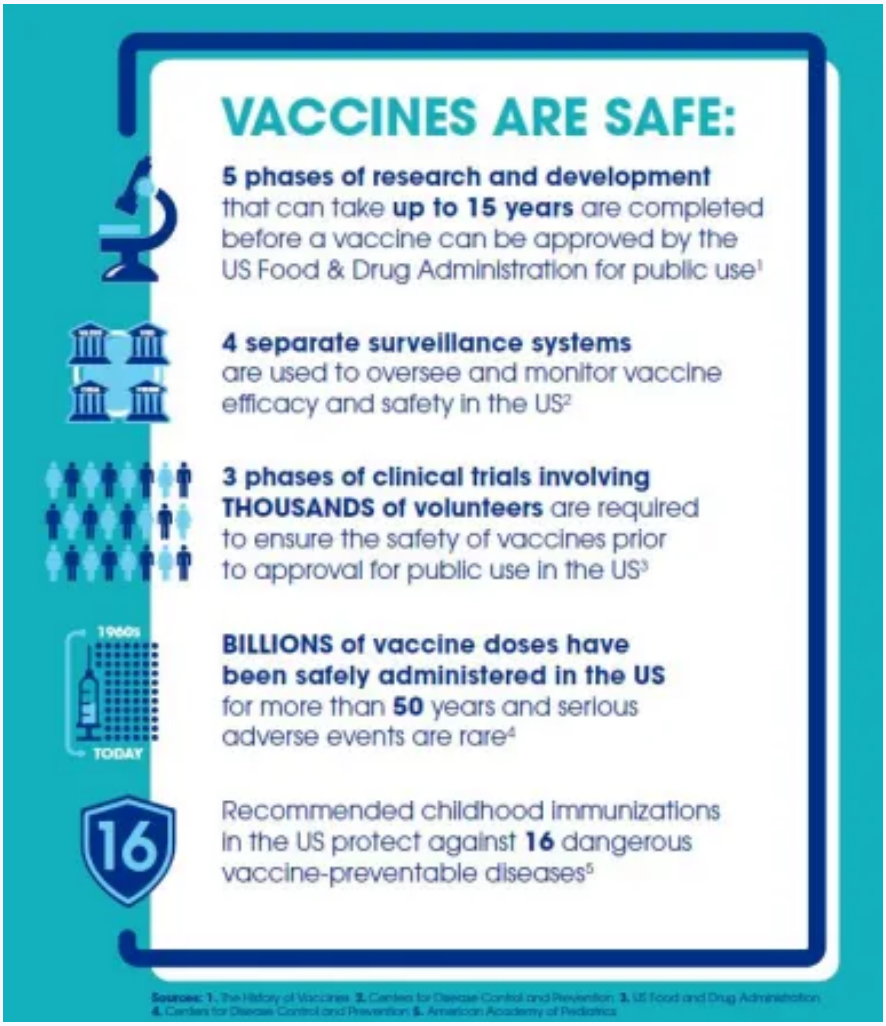


Figure 6, on the left of this text, retrieved from the 'National Foundation of Infectious Diseases' gives five valid reasons, applicable in the real world, as to why vaccines are safe.

Conductive research has been made surrounding this, as it has been relevant since the outbreak of COVID, and for such reasons, vaccines top all other solutions.

FIGURE 6: Available at: https://www.nfid.org/immunization/vaccine-science-safety/ (Accessed: 17 October 2021).

Other Solutions

1. Drugs: Protecting the cell from COVID

Dr Jeff Yeoman, Lecturer in Biochemistry and Genetics at LaTrobe University, revealed that the use of a specialised Drug may be a solution to eliminating the virus from the human population. He states that “if there was a drug that could prevent the virus from entering human cells, COVID 19 would be gone”. Because viruses hijack a host by tricking cells into letting them enter, the idea behind this drug is to strengthen the cells in humans and prevent the virus from being able to enter. Unlike a vaccine, COVID can still live inside a human, but will harm us, whereas vaccines are aimed at gradually eliminating the virus until it no longer exists. This is because the drug still allows the virus to live inside a human, but prevents it from multiplying.

PROS	**CONS**
• Would not have to be specified and modified for those with a weaker immune system. • This drug does not have any visible signs of making the body sick, and because the targeted cells across humans are much more similar to each other than immune systems are, there are limited problems to those with weakened immunity	• Scientists and doctors have a lack of experience in creating drug solutions because vaccines are the norm. • Therefore it would take more time and more money to draft, test and apply new drugs. • The reason that we do not supply and invent drugs is because it is not as resource and time effective as vaccines

2. Lockdown: Stopping the Spread

When the coronavirus first hit Australia, and for the past two years, it was believed that a state-wide lockdown would stop the spread - which it did. After the most of 2020 in Lockdown, there was a period of 28-30 days where case numbers were 0 in Melbourne, and some believed that the Virus was over-with. However, once there was one new case, a domino effect was set off and soon cases were skyrocketing again.

Figure 8: Evidence that Covid cases can Skyrocket in Minimal time

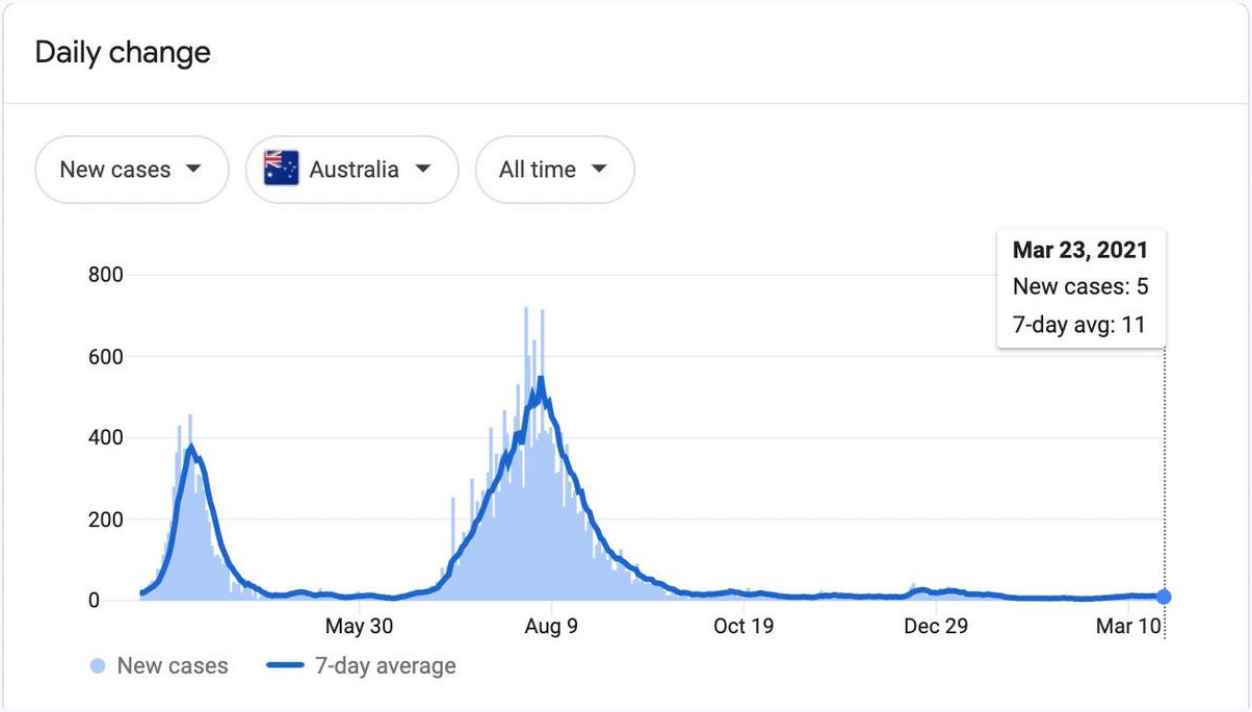


Figure 8: Available at: https://www.forbes.com/sites/williamhaseltine/2021/03/24/what-can-we-learn-from-australias-covid-19-response/?sh=38ca80cd3a01 (Accessed: 20 October 2021).

The Idea behind lockdowns is to contain the virus. By staying at home, there is less space for the virus to spread, and by shutting down non-essential services, there would be far less human → human interactions for the virus to jump from host to host.

Melbournians recognise the 5 stages of lockdown, each getting stricter with more rules as the number gets higher. However, after 18 months in lockdown with no advances in vaccines, Australians started to question whether lockdowns were effective after all?

PROS	CONS
• Whole world 'stopped' and made it easier for scientists and doctors to dedicate their working hours and study to finding solutions to the virus. • Much less movement so less people get sick or injured from illnesses aside from coronavirus and less of a demand to be attending to these people. • Much easier to gather positive covid case statistics: where it came from and where it has travelled to	• Not effective at keeping cases down: after four weeks of zero cases, it took less than a week to rise above 200 cases again • People disobey the rules and make it harder to sustain low numbers: they get annoyed after being in lockdown for too long • Halt in economic growth on businesses that rely on social interaction, hospitality and the advertising that this provides. • Difficult to maintain financial stability and increased poverty • Less leisurely enjoyment: no cafes, sport centers and other social facilities open

Figure 9, as shown below, highlights the days that Melbourne was in lockdown for over six months in 2020. The image to the right of the calendar (Figure 10) illustrates that lockdown was ineffective because despite being at home, there were still 611 deaths.

Figure 9: Highlight of the Days Melbourne was in Lockdown

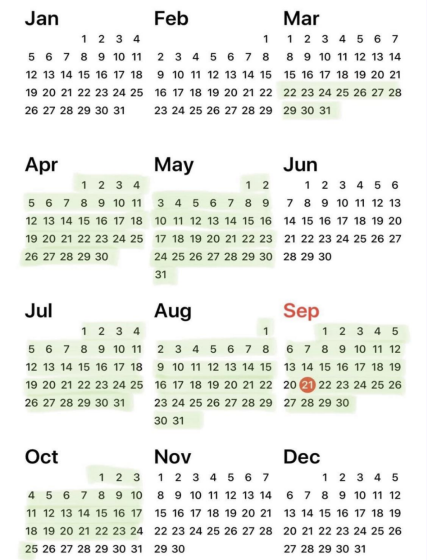


Figure 10: Overview of August 2020, Worst Covid month in Melbourne

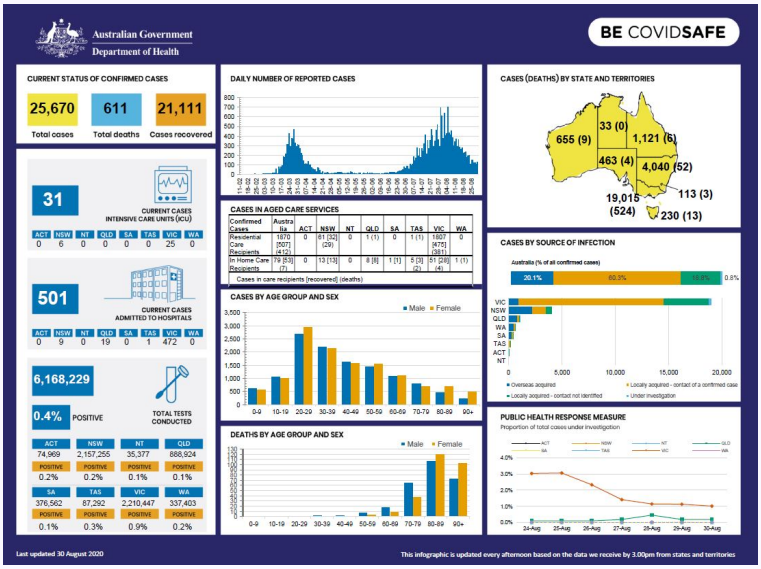


Figure9:https://m.facebook.com/itslauramazza/photos/this-is-how-long-melbourne-has-been-in-lockdown-now-stage-4-now-cut-yourself-som/3489107514490535/

Figure 10: Available at https://www.health.gov.au/resources/publications/coronavirus-covid-19-at-a-glance-30-august-2020

Eradicating the virus with Vaccines - Is it possible?

Both Lectures that were examined throughout this unit of work think differently. Professor Warwick Grant believes quite strongly that there is a great chance that COVID will be eradicated from history. On the other hand, Professor Jeff Yeoman thinks otherwise, and that drugs would be a better option to eliminate the virus.

The table below justifies their answers, and further research was conducted to explore their point of view.

Why - Warwick Grant "It is possible to eradicate COVID with vaccines"	Why Not - Jeff Yeoman "It is impossible to eradicate COVID with vaccines"
For the past six months, vaccine research and distribution has been occurring globally, particularly in first economists' countries. Warwick believes that it is possible to eradicate COVID as long as we stay ahead of the virus. "VIRUS VS VACCINE" He describes the battle between the virus and science as "continuous" because "viruses continue to mutate, but so does the virus". For example, the Delta virus was a mutation of COVID - meaning that it was much stronger and was harder to kill. It was discovered that the original covid virus predominantly developed in middle and older people, however Delta targeted younger people as well. Because the younger generation have stronger immune systems and the virus was able to overcome that, it shows that the pathogen evolved.	Vaccines are able to eradicate COVID - however he believes to some extent that it is only temporary. He agrees that vaccines stop the reproduction of the virus within a host. His point of view expresses that "if there was a drug that could prevent the virus from getting into the cells, COVID 19 could be eradicated". This is interesting, as drugs are often used to eliminate parasites, and vaccines are used to eliminate viruses. Similarly to Warwick Grant, Jeff Yeoman suggests that coronavirus evolves so quickly that it is very difficult to keep up with the new strains. He believes that a drug as such would stop the virus from entering human cells, and would eliminate the virus (not eradicate) from the human population.

This was problematic in Australia when cases in northern parts of Queensland escalated dramatically. However, this was overcome when an evolved vaccine was introduced to tackle this version of the virus. At this stage of time, we are ahead of the virus, because cases are going down. Although there is constant news of the virus mutating again, new vaccines are also being made to keep up with this. Because Coronavirus is constantly evolving, it is extremely difficult to get rid of, however "if we jsu tasty ahead of the virus the numbers will eventually push down to nil" - says Warwick Grant. The professor also claims that it will be "interesting if the Delta Virus will evolve to withstand the covid vaccines - but we don't know. It seems that it will overcome the vaccine, but new vaccines are also being made to push back". Conclusively, Warwick believes that advanced science and technology is actually capable of eradicating the virus. He believes that globally, we need to win the race by keeping vaccines ahead of the evolving viruses - so that the numbers are compressed and eradicated from history.	Eradication refers to the gradual and continual reduction to zero, for example through the use of viruses. However, elimination refers to a complete wipeout and reduction to zero, for example through the use of a drug. If everyone takes the drug, it will instantly stop the virus from entering human cells and affecting us. The reason it will not be eradicated from history is because there is no gradual disappearance of the virus, of which a vaccine would accomplish. Jeff suggests a drug rather than a vaccine because "it is hard to find and isolate a component of the virus to target and utilise". He suggests that when the virus evolves too quickly, we will not be able to keep up with making a new vaccine because it is difficult. Conclusively, both specialists believe in the same ideas, regarding the race between the virus and humans. Warwick Grant has faith in technology and science, so we can accomplish this, however Jeff Yeoman suggests otherwise. He believes that a drug would be more reliable, and would eliminate rather than eradicate covid from the human population.

What do I think?

After conducting my own research and acknowledging both lecturers' point of view, I have not come to a "yes or no" conclusion. I believe in both. A survey conducted with 77 epidemiologists from 28 different countries found that two-thirds of these participants believed that "according to the current covid evolutions, it is more than likely that another mutation will advance within the next year."

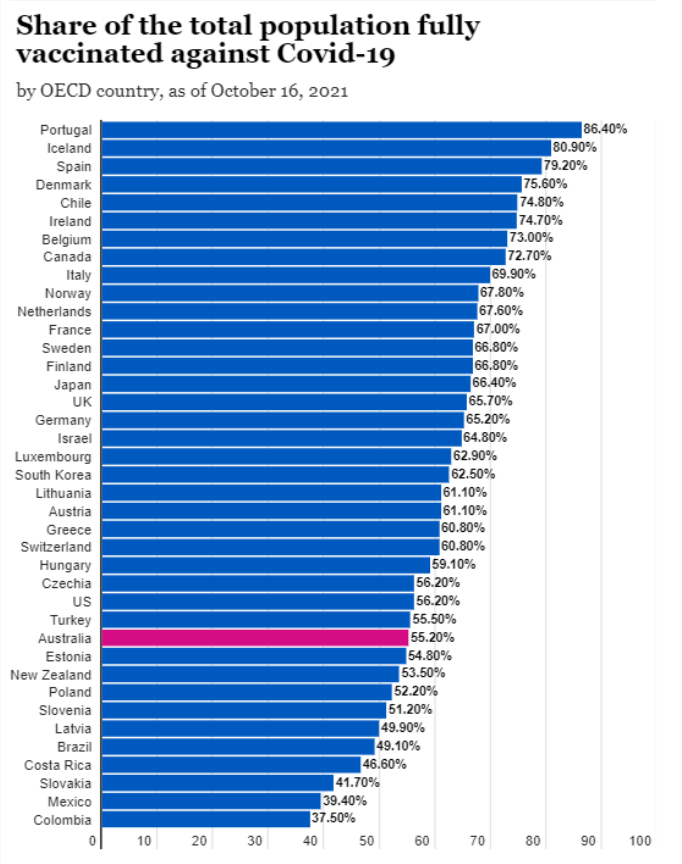
This is extremely concerning. If the whole world is not vaccinated before this mutation occurs, the new virus will develop even stronger than the current and the cycle will begin again.

In my opinion, it is a matter of getting the whole world fully vaccinated within the next 12 months, or eradicating the virus by then - otherwise a much stronger virus will evolve and cause destruction to our world.

The real question is not "can we eradicate the virus?" but more-so "can we eradicate the virus in the next twelve months". This will determine the future. If we can do this, COVID will be over, if we cannot, who knows how strong the next mutation of the virus will be.

Figure 9: **Global Vaccination Rates of Each Country as of October 16.** Available at: https://www.news.com.au/world/coronavirus/global/australia-urged-to-act-on-vaccine-inequality-as-experts-warn-covid19-could-mutate-within-a-year/news-story/752a3e3018caa43b8fb5b0f8500ce25d (Accessed: 18 October 2021).

Figure 10: **Total Global Vaccination Percentage as of October 16**. Available at: https://www.google.com/search?q=global+vaccination+rates&rlz=1C1GCEV_enAU834AU834&oq=global+vacc&aqs=chrome.0.0i131i433i512j69i57j0i512l5j69i60.3007j0j7&sourceid=chrome&ie=UTF-8&safe=active&ssui=on (Accessed: 18 October 2021).

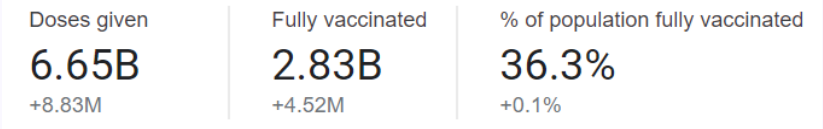


NOTE: extracts from October 16: out of date.

The source on the left of this text is the statistics for the percentage of the population that was fully (double dose) vaccinated against the virus as of October 16th.

At that point in time, we can see that many countries are on their way and have progressed in vaccination rates.

Figure 10:



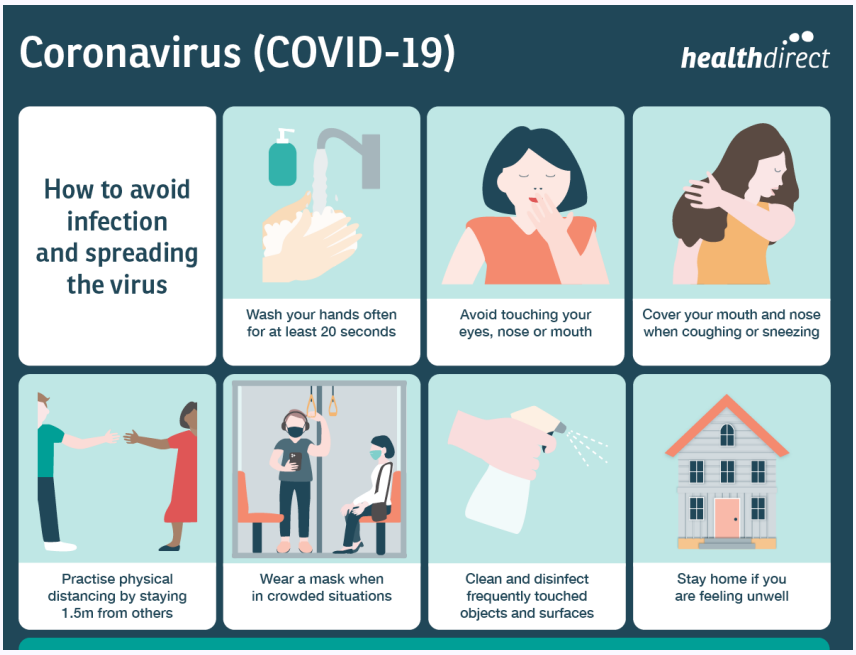
As of October 16th, 36.3% of the worldwide population have been vaccinated. It is over one third of the population, however to be safe the goal should be at least 90%.

What do we need to do to Eradicate Coronavirus? : Solutions

In terms of solutions to the virus, there are different responsibilities for each individual, depending on their abilities. For example, authoritative figures like the collective government and epidemiologists would have more control over procedures for the future, in comparison to children and non-medical business workers. However, everyone has their role and there are responsibilities to take to help eradicate the virus.

House Responsibilities	Community Responsibilities
• Getting tested when sick • Getting vaccinated • Following the restriction rules • Helping others when appropriate • Knowledge about the virus	• Available testing / vaccine facilities • Following restriction rules • Advertisement to do the right thing • Activities to maintain positive spirits • Assisting struggling businesses

Figure 11: **Health Direct's Solutions to Stopping the Coronavirus Spread** Available at: https://www.healthdirect.gov.au/coronavirus-covid-19-how-to-avoid-infection-faqs (Accessed: 18 October 2021).



The seven step instruction manual to the left illustrates a way for people to stay safe at home and in their community around other people.

Similar advertisements as such are created and broadcasted on google ads, TV ads and other advertisements as such.

Australia's Responsibilities	Global Responsibilities
• Idolising flourishing countries "Which countries are thriving and why?" For example, Russia is handling their coronavirus cases extremely well and have minimal lockdowns during prime case times because their hospital systems are able to cater for this. They did this by utilising lockdown periods to increase hospital capacities and build new facilities to host more sick patients. • Assisting developing countries "How do we help the rest of the world?" Recently, Australia was urged to donate 20 million jabs of the virus to developing countries. Research reveals that "the virus will not end for anyone if it does not end for everyone", which is why the world needs Australia's help. Because we have helped our country get on track to surpassing vaccination rates, we now have a responsibility to help those who need it.	• Global science coming together "How do we work together to succeed?" Countries such as the US, Canada, Australia, India and Japan have made conscious efforts to come together and share knowledge to create vaccines and support each other. However, further assistance from first economists towards third world countries is required for the eradication of covid. • Spread the vaccine, not the virus "How do we vaccinate the whole world?" It is important to realise that it is not a problem trying to vaccinate independent countries who are relatively wealthy. The effort should be put into third world countries, particularly parts of Africa that hold over 15% of the population. Additionally, viruses like covid are more likely to thrive in hot conditions like Africa where there is a lack of personal space and hygiene.

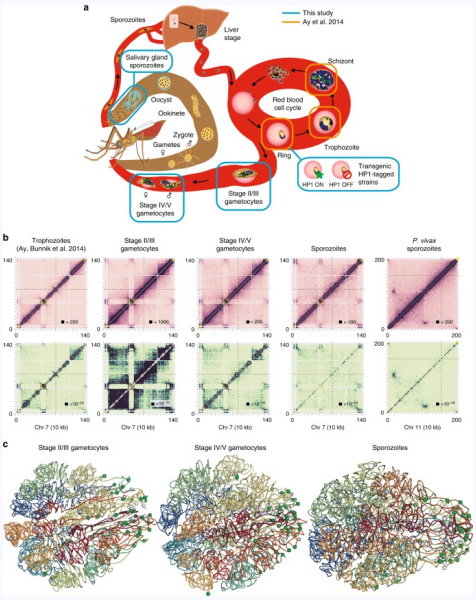
-Pathogens Immunity-

The most effective way of making human beings immune to a variety of pathogens is through vaccination. Keeping up constant hygiene is also extremely important, as well as drinking clean water and eating well cooked food. Humans can never be fully immune to a specific virus or disease but a vaccination will help prevent obtaining the pathogen, though if the virus or disease is obtained the symptoms and severity will lessen due to the vaccine. Our bodies do have the ability to become immune to a virus, however, that is only to one strain of the virus. When it mutates and evolves our bodies will not be immune to the new strain as it has changed its properties become “better.” Influenza, as an example evolves every year which is why vaccines are important to get because they create an immune response to that certain strain; which in the future will help our immune system to fight off other variants of the virus.

Parasites do have the ability to be immune to vaccinations or other drugs that we use to get rid of them from the human body; this is known as antiparasitic resistance. This is when parasites have the genetic ability to not be affected or survive the drugs that were previously affected in the past. Though, this applies to mostly animals like sheep, goats and cattle. Scientists say that this response from parasites is unable to be prevented, that they will continue to develop further resistance. Additionally it does also affect humans. Ways to prevent antiparasitic resistance are:

- Not over prescribing or using antibiotics used to treat the parasite.
- Practicing good and appropriate hygiene.
- Completing the entire cycle of prescribed antibiotics.

Parasites can mutate and evolve over time, some faster than others, like the cause of Malaria, the parasite is genetically broad and their genomes are constantly changing. Genomes referring to the complete genetic information in a living organism.



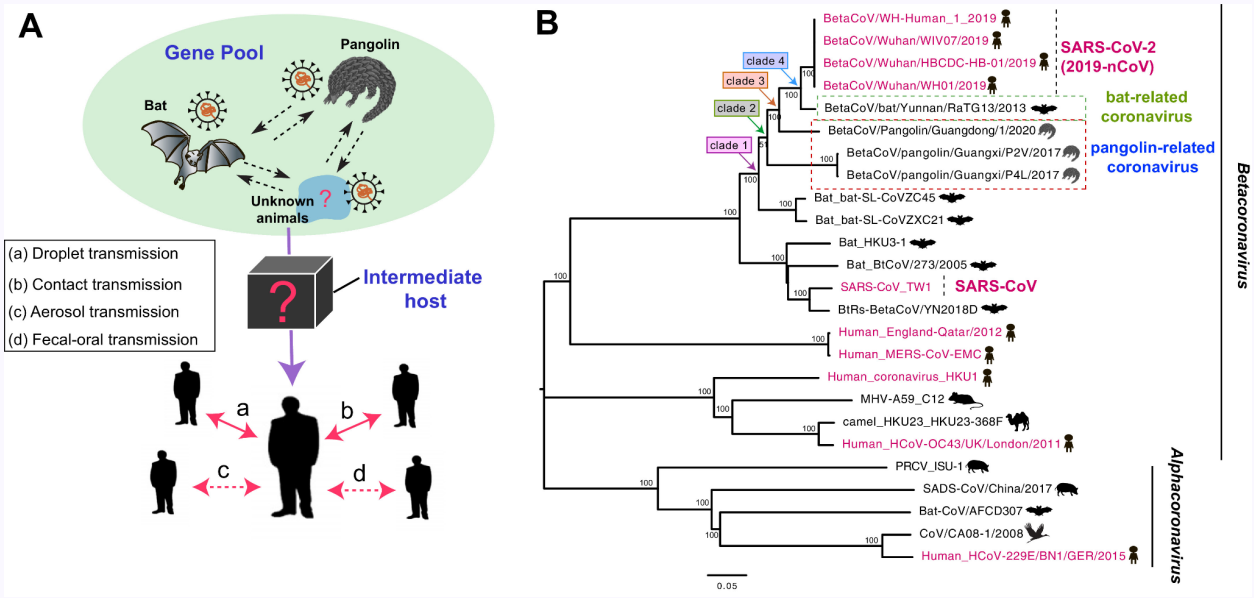
Displaying how the Malaria parasite has evolved and mutated over time.

Nature, 2018. *Changes in Genome*. [image] Available at: <https://www.nature.com/articles/s41467-018-04295-5> [Accessed 16 October 2021].

-What will these pathogens look like in the future?-

It isn't extraordinarily easy to estimate what different viruses and parasites will act and behave in the future. Though, through developing more of an understanding of how and why they evolve so the studies and research can become more directed. As an example, coronavirus has evolved and been responsible for three different diseases through two decades, SARS, MERS and COVID-19. When a virus or disease mutates it becomes a variant of that specific disease or virus. Viruses' are far more likely to change as a result of their environment. Viruses, information from WHO, change because of what is known as the "proofreading mechanism." Which is when a virus can correct its faults when it makes copies of itself. But, as aforementioned researchers are still continuing to study this method of evolution to develop a further and much better understanding. Parasites and viruses will always continue to evolve either more slowly and calcutled or faster. Unless we completely eradicate all existence of these viruses and parasites they will evolve and human beings will have to live with them until further research is provided.

This shows the transmission of SARS and its relationship with COVID



Journal of Infection, 2019. *Coronavirus Evolution.* [image] Available at: <https://www.journalofinfection.com/article/S0163-4453(20)30106-7/fulltext#relatedArticles> [Accessed 14 October 2021].

-Parasites VS Viruses-

It may seem obvious that parasites and viruses are different types of organisms. One clear way to tell them apart is to see which one is living. A virus is a non-living organism that is filled with bacteria, making it act and seem alive. This means that they are easy to get rid of. Viruses contain protein and sugar that can be taken and turned into a vaccine, whereas parasites, on the other hand, are living, which means that they can change their form whenever they please. This makes it more difficult to create a suitable vaccine for them. If a sugar is taken from a parasite to be turned into a vaccine, the parasite can change its structure, meaning that once the previous sugar is injected into the body, nothing will happen. Though this is the most known one, there are also more differences between viruses and parasites, such as that because viruses are not living, they can survive without a host, meaning that they can rest of surfaces, whereas, because parasites are alive, they have to always be with a host, like how humans need air to survive. There are also some negatives when it comes to parasites being stuck with a host. Antibiotics are a way to destroy bacteria and parasites, however if too much is taken, the parasites can adapt and learn how to escape from the antibiotics. It also helps to take the full course of the antibiotics, even if the symptoms have left. On the other hand, viruses are not impacted by antibiotics.

Though there are many differences when it comes to comparing viruses and parasites, there are also some similarities when it comes to infections. Most viruses and parasites have the ability to give an animal pneumonia, however, when having a deeper dive down into the symptoms between these two causes, viruses and parasites have minor differences in the symptoms.

Both parasites and viruses, however, can be treated and even prevented. The treatments are quite similar to curing both parasites and viruses:

- Drinking an abundance of fluids, such as water, can increase the immune system to fight back against the parasite and virus. This is because water has the ability to carry nutrients to the cells, as well as stabilizing heart beats and protecting organ tissues.
- Washing one's hands and frequently sanitizing hands is a way to prevent viruses and parasites from having any contact and entry ways into the body. Before contact is made with these types of viruses and parasites, there are some clear prevention tactics to help stop the infection.
- Vaccines work very well for viruses, as they are not living, meaning that sugars and proteins can be extracted from them, and injected into the body. However, it will not work for parasites.

  Parasites are living, meaning that if a sugar or protein cell is taken out from the parasite and injected into the body, the parasite can change its form and still infect

the body. However, though this is a negative, antibiotics can impact parasites. There are courses for antibiotics, and if they are followed correctly, they can easily eliminate parasites from the body. But, when taking them, one should make sure to not overdo it, as parasites can adjust to the way antibiotics work after a few experiences, and make sure to not take too little as well. Even if the symptoms are not displayed, it is always best to still follow the course, as the symptoms may be gone, but the parasite could still be there.

These are how parasites and viruses differ, as well as their similarities;

-Parasites VS Viruses Table-

Topics	Parasites	Compare	Viruses
Mortality	In 2013 according to PLOS, there were over 1,000,700 annual deaths from parasitic infections.	together have reached over 1 million deaths throughout the years, caused by lack of awareness around them, and how some infections could not be controlled.	Viruses are extremely contagious and can be quite fatal. 2021 has recorded 4,913,936 deaths due to covid19 alone.
Countries found in	All different species of parasites are found in all countries around the globe. Though, they are more prevalent in the continent of Africa and other underdeveloped countries.	Both are located in every country, however, due to the lack of developing countries, these viruses and parasites are mainly found in Africa and some, more underdeveloped countries in Asia.	Research shows that viruses are distributed all over the world, however, it is more prevalent throughout Asia and Africa.
DALYS	In the year of 2010, NTD's, neglected tropical diseases caused 26 DALYS worldwide.	Both DALYS are majorly impacted by certain parasites and virus infections in people, as more people get them, the more DALYS are caused.	Since 2000, the DALYS have dropped 50% due to the impact of HIV/AIDS, making life spans shorter for people who have these viruses.
Treatment	All parasitic infections differ with their extremities, thus saying, some are far more treatable than others. Like ectoparasites which live on the outside of the host's body and are much easier to be rid of as they don't cause much damage to hosts' bodily functions. Treatment for parasitic	Viruses and parasites share the fact that they can be treated, depending on how big the virus or parasite is. They both have certain procedures to make sure that the virus/parasite is well kept under control, such as how parasites can be killed by antibiotics, whilst viruses	Viruses have different treatments due to the amount of varied viruses in the world. However, when dealing with viruses, antibiotics will not work, as they kill off living organisms which impact the body badly. This means that the immune system is

	infections will depend on the diagnosis and medications will be prescribed unless a cure or medication has not been found yet.	cannot, due to how they are both different, in the sense that parasites are living and viruses are not.	responsible for treating symptoms of the virus. There are also some virus medications which can reduce the symptoms and impacts of viruses.
Contagious	Parasitic infections are not contagious, passed from person to person. Though as aforementioned when discussing Malaria and Onchocerciasis they can be easily transmitted through other organisms that act as vectors, or through infected food, water and soil, or some through sexual contact or intercourse.	Parasites are not infectious, because they are living and mainly are stuck to a living host, so they cannot be transmitted through saliva. However, viruses are not living, meaning that they don't need a living host to survive, resulting in them being transmitted through saliva and other contact methods.	Viruses, on the other hand, are very contagious. They can be transmitted through sneezing, coughing, and any saliva transmission. This is also due to the fact that once viruses enter the body, they can clone themselves, meaning that they can attack the immune system, whilst also infecting other people if saliva is sprayed.
Preventable?	Yes, parasitic infections are preventable. By; - washing your hands regularly. - Drinking clean and filtered water. - Practicing safe sex. - Not drinking water from lakes, streams or other bodies of water. Though, many of these practises aren't able to be used by majority of the world as 90% of the population don't have access to clean water and 72 million people don't have the right education when it comes to practising safe sex.	Together, they have similar ways of prevention, such as drinking an abundance of fluids, and washing hands regularly to prevent any more illnesses contacting the human body. This makes it easier to keep both viruses and parasites under control.	Depending on how harsh the virus is, viruses can be treated and prevented by certain vaccines. Vaccines take a certain sugar or protein from the actual virus, which is then injected into people. However, a simpler way to prevent virus spreading is by; - Washing hands frequently - Using sanitizers - Avoid contact with people who are sick.

What is more important? Prevention or treatment?

Viruses and parasites have different methods of treatment and prevention. What is more useful for the future of society? Prevention, or treatment?

When talking about **viruses**, there are different methods to treat it and prevent it, depending on what the virus is and its impacts. Viruses, such as the coronavirus, needs a treatment to prevent the spread occuring, as well as making sure people limit their touch with each other, meaning that whoever gets it, knows how to treat it. This is done using the vaccine, Pfizer or Astrazeneca. On the other hand, some viruses aren't meant to be treated, because they are good for the future of society, animals and humans. The megavirus, for instance, is a type of virus which helps animals and humans live in a body of water. Algal blooms is a type of toxin released in the water, killing all the marine life and animals (including humans) entering it. The megavirus is responsible for killing the algae which releases these blooms. This resulted in that there is no treatment or prevention needed for viruses like these, because they are actually good for animals, including humans and marine life (as well as land animals which drink that water.

Parasites are a living source, meaning that they cannot be prevented, since they heavily rely on a living host, such as mosquitos, which cannot be controlled on where they go. Unlike how viruses can be prevented and treated, parasites cannot be prevented, since many mosquitos around the globe would contain them, and inject them into humans. Whereas they can be treated.

Reflections

Denzel's Reflection

I have really enjoyed researching our big question, 'Do parasites and viruses run our world?' Throughout this journey, I have gained a better understanding of how viruses work and the differences between them and parasites. I have also gained an abundance of new knowledge on how parasites act compared to viruses. Before beginning this unit, I built up in my head that this assignment was going to take lots of time, due to previous classes mentioning how this unit involves an extreme amount of writing. Though experiencing this myself, I found that, yes, it does take quite a lot of writing, but it was very interesting and was more of a pleasure to learn rather than a chore. However, I found that I chose a very hard virus to study. Whilst other people in my group chose very prevalent viruses and parasites which impact the world in a major way, such as Malaria, Oncholoritus, and CoronaVirus, I chose one called the Megavirus. This topic required an abundance of detail, and there was extremely limited material relating to the megavirus, due to how it is not a scientist's priority at the moment. This made it harder to write a solution for the megavirus, since I could not find how the megavirus infected the single-celled marine amoebas. Though this was a hard virus to research, I am so glad that I chose it, since it was something that I have never heard of before and I wanted to do something that was not mainstream. Originally, when I chose the virus, i wanted it to have lots of information and had a huge impact on the world (because I am interested to see what the world has that i don't know about), and when i first saw the megavirus, I thought it had a massive impact on the world, due to the name having 'mega' in it. However, it was big in size, but had such a small impact on the world.

I am so grateful for my group; Claudia, Stamos, and Alana. From what I have seen, they have worked so well and we all work well together. During class time, we all join the call together, and ask questions to help improve our work. They were always open minded, and everyone carried their weight equally. Plus, my group was always supportive of each other, and encouraged each other whenever it was needed. I find that it is advantaged in lockdown, since I was able to connect with my group better without getting interrupted by friends or me getting distracted (because I do get distracted...A LOT). I find that it also helped because during class time, we would have to start and end our work at a certain time because of when school ends and things like that. But because of the lockdown, we could continue for another 10 hours if we wanted to and if we're still in the zone to work. Lockdown also made it easier to access technology such as my ipad to do drawings for my group project. I decided to draw the front cover of this project and a diagram of the megavirus for my piece of writing at the last minute, so if I was at school, I would have to wait to get home to do it. However, if we were in class, I would be able to see them face to face and ask more questions regarding the piece of work. We would be able to connect a bit better and discuss more about certain aspects of the topic.

When choosing our big question, we had a variety of different options, however, they all involved the impact of viruses and parasites. In the first few lessons, the whole group was writing questions (Alana and I wrote a total of around 54 questions to study (there were only two of us since Stamos wasn't able to access the call because of technology issues, and Claudia wasn't in our group at the time). After a few brainstorms, Claudia raised our attention, a question about the comparison of viruses and parasites and their impacts on society, and we all agreed to do it.

When working, I had a few different strategies which helped me write better quality and produce a better outcome for my work. I make sure that I do not leave all my work to the last minute. I found that by leaving work to the last minute (and I am a victim of doing it a lot), there is a higher chance of not writing good quality stuff, compared to if it was completed earlier. I also make sure that I ask plenty of questions. This helps me gain a better understanding of the topic, and to make a better outcome for my writing. This will also make it easier to complete the task.

Overall, I loved this topic, and if i were to do it again, i would make sure to do extra work outside of school, other than that, i feel that this was a great learning lesson. Though I chose a hard virus, if I hadn't chosen it, I would still think that the megavirus is a huge virus that is deadly. I am so thankful for getting such a good group, who have made working on this topic so much easier, since everyone was working well together and completing everything they needed to complete.

Alana's Reflection

I am thrilled to say truthfully that I have enjoyed this unit. Throughout the extent of the year, previous Science of Life classes have spread rumours, particularly about the large workload and demand for research and application of new knowledge. To be honest, I thought that this topic was going to be extremely draining and pointless, and that a 50 page report about infectious diseases was going to be a chore. But I was wrong, and pleasantly surprised.

Within my topic, I am extremely happy that I chose to study Coronavirus, because it is relevant to the world at this moment, and there was a constant thrill for daily updates from several news articles like The Age, News.com and the Guardian. I was surprised that the majority of my research was from these articles, along with several youtube videos from various medical practices.

Being able to talk to the lectures for a general information session and then being able to ask further questions specific to my topic was extremely insightful and helped to answer questions. It was interesting that our main lectures, Warwick Grant and Jeff Yeoman, had opinions about viruses that were so different yet overlapping at the same time. This definitely comes to show how everyone's views on things are different, and it is interesting to explore this.

The most rewarding part of this task was being able to rely on logic and self - reasoning to answer various topics. Although I am not an expert on COVID, it was fascinating how I was able to provide insights to the pros and cons of virus eradication and list solutions with reasoning, through doing research within my brain - and not through the web. I would describe it as extremely satisfying, and reflective of the knowledge that I have gained in this unit.

I am very happy with the group that I put in, as Claudia, Stamos and Denzel are very bright and supportive work partners who have extreme work ethic and collaborative abilities. From previous observations, I figured them to be quite academically strong before entering this unit, which made me feel quite confident in our group, and that we had potential to do a really good job on this project. I am delighted to praise them, as well as myself, to have come together and produce hundreds of different insights on such a broad question. I remember Ms D'elia telling us that our question is very broad, and it will be difficult to get down to the "meaty stuff" without elaborating on the "boring stuff that you don't get points for" too much. However, our group accepted the feedback and made sure to keep the facts to a minimal.

I did struggle with online learning this time around, and it was extremely difficult to find motivation to start this project. I saw the long road ahead of me and I admit that within the first week or so, all my group members had already dove into the project, however I had a

mere 1 sentence. However, once I started listening to youtube videos about the virus, and when I began writing I realised that this would actually be fun to write about.

If our group was face to face, I think that it would have been a lot more fun for all of us. I believe that we would constantly be having open discussions about our topics to each other. It would have been much easier to plan and structure our project if we could talk face to face, but the fact that we have still done an okay job makes the end result far more rewarding.

I like to think that you can only feel success when you have felt failure, otherwise everything would feel the same. In this project, although it has been extremely difficult to overcome the constant demand for decision making and a little bit of confusion, especially given the circumstances, the outcome has grown to be more satisfying.

I thank my group members for supporting and proofreading my work, and for being super fun to work with, and to Miss D'Elia for believing in us and pushing us to do our very best. This unit of work has shown me what I am capable of, and I am happy to say that I would like to further explore epidemiology in the future.

Claudia's Reflection

Throughout the course of this unit, Science of Life, I have been able to gain more insight and knowledge on topics I have never heard of before. From my own in depth research and what I was taught from the two academics I listened and learned from, Prof. Warrick Grant and, Dr Jeff Yeoman. From my second lecture from Warrick Grant, even though I wasn't able to stay for the whole duration of it I still managed to take away new information that continues to stick in my mind everyday. Choosing this topic was through my interests of medicine, which connects to diseases and viruses but also because I think it is a very important issue during today's time and is beneficial to learn from. I loved the topic my group and I chose and, I would choose it all over again, perhaps more in depth and detailed to get to the very difficult yet extraordinarily interesting information. Though, overall it was so incredibly insightful and made me develop a new perspective when discussing diseases and viruses as I have developed all this new knowledge.

From learning from my own personal experience at first I found this topic to a be stressful as I wasn't put in a group yet which made me wonder who I was going to be with as I didn't know many at this school, as well as the amount of work, hours and research I had to put in. Though, after being put in this group I came to realise that my stress was unnecessary. We all worked collaboratively, made sure to listen to everyone's ideas and distributed the work evenly. My group, Alana, Stamos and Denzel all made sure to be attentive and help each other out whether it was finding an image, sending a link that may be of need, putting in the information for what we must do or just discussing what to do next. Everyone made sure to always attend the meet link, be online and take the teachers feedback into consideration and then make changes or input to their work. I believe that everyone pulled their own weight and was incredibly appreciative of each other's work, giving feedback and other topics to put in. I am incredibly grateful for this group and I believe that we worked incredibly well together.

Being in lockdown was a struggle to continue to work throughout every lesson without getting distracted and outside of class. I did manage to overcome my first issue which I have now continued to use in my other lessons and to keep managing and my second still remained. I believe that I could have done more work outside of class which would have certainly benefited my group and myself. Doing this subject online wasn't easy, and I personally think I would have worked much more efficiently if I was able to learn this at school, easily get teachers feedback and be in an easier learning environment. I did find this topic quite stressful, but wasn't as bad as how others described it and, I have certainly taken away a more positive experience than negative. Despite everything I really loved this topic as I have been able to learn so much from not only the academics and research but from myself, to continue to persevere.

This topic gave and provided me with so much more insight to the world around us, I never realised how much I didn't know and know how much I have learnt. I loved coming across new websites and information that I know will be helpful for future subjects. I think personally the most important thing I developed was a far greater insight into underdeveloped countries and how they are plagued with diseases and viruses. Though, bringing some light onto the situation it was so amazing to see and learn about all these scientists coming together to create drugs and vaccines. I also grew as a person in this project, usually I prefer to do them on my own, especially if it's with people I don't know. But, by the end I have come to realise I actually like working in groups and from it I have developed better learning skills, techniques and ways to work effectively.

Stamos's Reflection

Throughout this year, I have heard many stories and rumours about the notorious Science of Life TDU. These stories definitely made me worry about this unit but also prepared me for what was ahead. When I asked people who had previously completed the project, the common piece of advice they gave was to use time as effectively as possible because if this project is left to the last minute, it can be a very stressful experience. I took this advice to heart and have made sure that I am using both class time and homework time effectively to make sure the project does not catch up with me so I am able to complete it to the best of my ability, especially with exams looming just round the corner.

Jeff Yeoman' lecture on Malaria and Warwick Grant's lecture on neglected tropical diseases, specifically Onchocerciasis, were really eye-opening and made me really grateful for what I have here in Australia, a country that is not affected by neglected tropical diseases. They also sparked an interest in my mind. Why have they lasted so long? Why can't we find a cure? Why can't we find a vaccine? These are the questions that gave me the desire to continue to research further into this topic. Conveniently, my team was also interested in this topic, so we chose a topic based on pathogens and diseases and the rest is history.

I feel like I would have enjoyed this TDU even more if I was able to have the full experience of going to the lectures at La Trobe to listen to the lecturers in person. However, listening to them online was really engaging as well and a benefit of this was that I had no distractions around me. Learning in class would have been a lot easier as I would have been able to converse and communicate with my group, Alana, Denzel and Claudia, in person. This would have been a lot easier without being limited to Team meetings. However, I also think there are some benefits of working online. I was able to work comfortably at my desk with no distractions around me which helped me to work effectively.

I am very grateful for my group, Alana, Claudia and Denzel for pulling their weight and producing work of a very high standard. I am really happy that I was allocated to a group with like-minded people who have a high work-ethic like myself. Even though we were not able to communicate in person due to COVID-19 lockdown, I still think that we communicated pretty well as all of us joined our Teams call every week to discuss ideas and issues that we had. They were really helpful in terms of bouncing ideas off each other and we all gave advice when it was needed. Overall, we all worked really well together and I couldn't have asked for a better group.

I would also like to thank our teacher, Ms D'Elia, for pushing us to achieve our potential and use our time effectively as well as providing us with advice to take our project to the next level. This advice has not only helped me with this project, but it can also be applied to future tasks. I took all of this advice and tried my best to address the issues identified and improve my work.

At the beginning of the project, I struggled to understand what the project was about. The type of thinking required to do well in this task is one that I had not used and developed before. Hence, when I finished my background research, I felt a bit lost as I didn't know where to go next. I think I wasted a bit of time trying to plan out what I was going to do and I had to work harder later on in the project to make up for it. I should have started thinking bigger earlier. I began researching and on that very day, news of a new approved Malaria vaccine flooded the internet. I began to research the vaccine and how it worked, why it worked, and who it worked for. I continued down that path and came to the conclusion that if the new RTS,S vaccine was made effective for all demographics, Malaria could potentially be eradicated.

Ultimately, at first, this project was illustrated as a massive, stressful task. However, through using my time wisely, I was able to alleviate stress and make this project an enjoyable experience that has provided me with a newfound way of thinking that I will continue to use in the future..

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