**Research on The Topic**

**Understanding Corona Virus:**

Coronaviruses are present in many species of animals, such as camels and bats. Mutations of the virus can infect humans.

Coronaviruses typically affect the respiratory system, causing symptoms such as coughing and shortness of breath. Some people, including older adults, are at risk of severe illness from these viruses.

Previous outbreaks of diseases that coronaviruses have caused in humans have been severe. They typically spread rapidly and can cause death in some people.

One example is [severe acute respiratory syndrome (SARS)](https://www.medicalnewstoday.com/articles/7543), which caused a pandemic in 2002. There were around [8,439](https://www.who.int/csr/sars/country/2003_07_04/en/)cases and [812](https://www.who.int/csr/sars/country/2003_07_04/en/)deaths as a result of the virus.

The outbreak of the disease known as COVID-19 is the result of the novel coronavirus, now renamed SARS-CoV-2, that has spread rapidly across many parts of the world.

**Effects on the body:**

Viruses work by hijacking cells in the body. They enter host cells and reproduce. They can then spread to new cells around the body.

Coronaviruses mostly affect the respiratory system, which is a group of organs and tissues that allow the body to breathe.

Respiratory illnesses affect different parts of this respiratory system, such as the lungs. A coronavirus typically infects the lining of the throat, airways, and lungs.

Early symptoms of coronavirus may include coughing or shortness of breath. In some cases, it can cause severe damage to the lungs.

Usually, the immune system will identify and respond to coronavirus early by sending special proteins, or antibiotics. The immune response to infection has side effects for the body, including fever. During an infection, white blood cells release pyrogens, a substance that causes fever.

A temperature of greater than [100.4°F](https://www.clinicalcorrelations.org/2019/06/18/the-definition-of-a-fever/) from an oral thermometer indicates a fever.

Sometimes other symptoms will occur alongside a fever, including:

* breathlessness
* a cough
* muscle pain
* a [sore throat](https://post.medicalnewstoday.com/articles/311449)
* a [headache](https://post.medicalnewstoday.com/articles/73936)
* chills
* new loss of taste or smell

These symptoms will usually last until the body fights off the coronavirus.

Symptoms might not show up straightaway. For example, people with COVID-19 may get symptoms [2 to 14](https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200320-sitrep-60-covid-19.pdf?sfvrsn=d2bb4f1f_2) days after infection.

**Risks and complications:**

Coronavirus can have severe complications, such as [pneumonia](https://www.nhlbi.nih.gov/health-topics/pneumonia).

Pneumonia occurs if the virus causes infection of one or both lungs. The tiny air sacs inside the lungs can fill with fluid or pus, making it harder to breathe.

Coronavirus can also damage the heart, liver, or kidneys. In some people, it will affect the blood and immune system. For example, COVID-19 can [cause](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)30558-4/fulltext) heart, renal, or multiple organ failure, resulting in death.

**Development of New Vaccines:**

The general stages of the development cycle of a vaccine are:

* Exploratory stage
* Pre-clinical stage
* Clinical development
* Regulatory review and approval
* Manufacturing
* Quality control

Clinical development is a three-phase process.

During **Phase I**, small groups of people receive the trial vaccine.

In **Phase II**, the clinical study is expanded and vaccine is given to people who have characteristics (such as age and physical health) similar to those for whom the new vaccine is intended.

In **Phase III**, the vaccine is given to thousands of people and tested for efficacy and safety.

Many vaccines undergo **Phase IV** formal, ongoing studies after the vaccine is approved and licensed.

**Type of vaccines:**

|  |  |  |
| --- | --- | --- |
| **Type** | **Description** | **Examples of licensed human vaccines** |
| RNA | Consist of messenger RNA molecules which code for parts of the target pathogen that are recognised by our immune system ('antigens'). Inside our body's cells, the RNA molecules are converted into antigens, which are then detected by our immune cells. | None |
| DNA | Consist of DNA molecules which are converted into antigens by our body's cells (via RNA as an intermediate step). As with RNA vaccines, the antigens are subsequently detected by our immune cells. | None |
| Viral vector | Consist of harmless viruses that have been modified to contain antigens from the target pathogen. The modified viruses act as delivery systems that display the antigens to our immune cells. Replicating viral vectors make extra copies of themselves in our body’s cells. Non-replicating viral vectors do not. | Ebola |
| Inactivated | Consist of inactivated versions of the target pathogen. These are detected by our immune cells but cannot cause illness. | Hepatitis A, Influenza, Rabies |
| Attenuated | Consist of active but non-virulent versions of the target pathogen. These are still capable of infecting our body’s cells and inducing an immune response, but have been modified to reduce the risk of severe illness. | Polio, Rotavirus, Measles |
| Protein subunit | Consist of key antigens from the target pathogen that are recognised by our immune system. | Whooping cough, Hepatitis B |
| Virus-like particle | Consist of empty viral shells that resemble the target pathogen but contain no genetic material. | HPV |

**Advantages and disadvantages of vaccine production platforms:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Platform** | **Target** | **Existing, licensed human vaccines using the same platform** | **Advantages** | **Disadvantages** |
| RNA vaccines | Spike protein | No | No infectious virus needs to be handled; vaccines typically very immunogenic, rapid production possible | Safety issues with reactogenicity have been reported |
| DNA vaccines | Spike Protein | No | No infectious virus needs to be handled; easy scale up; low production costs; high heat stability; has been tested in humans for SARSCoV-1; rapid production possible | Needs specific delivery devices to reach good immunogenicity. |
| Recombinant protein vaccines | Spike protein | Yes, for baculovirus (influenza, HPV) and yeast expression (HBV, HPV). | No infectious virus needs to be handled; adjuvants can be used to increase immunogenicity. | Global production capacity might be limited; antigen/epitope integrity needs to be confirmed; yields need to be high enough. |
| Viral vectorbased vaccines | Spike protein | Yes, for VSV (Ervebo) but not for other viral vectored vaccines | No infectious virus needs to be handled; excellent pre-clinical and clinical data for many emerging viruses including MERS-CoV | Vector immunity might negatively impact on vaccine effectiveness (depending on the vector chosen) |
| Live attenuated vaccines | Whole virion | Yes | Straight forward process used for several licensed human vaccines; existing infrastructure can be used | Creating infectious clones for attenuated coronavirus vaccine seeds takes time due to large genome size; safety testing will need to be extensive |
| Inactivated vaccines | Whole virion | Yes | Straight forward process used for several licensed human vaccines; existing infrastructure can be used; has been tested in humans for SARS-CoV-1; adjuvants can be used to increase immunogenicity | Large amounts of infectious virus need to be handled (could be mitigated by using an attenuated seed virus); antigen/epitope integrity needs to be confirmed |

**Related Works:**

* <https://github.com/sllloyd/vaccine_predictions>

**Vaccine Pipeline Modelling**

* <https://www.nytimes.com/interactive/2020/science/coronavirus-vaccine-tracker.html>

**Coronavirus Vaccine Tracker**

* <https://www.raps.org/news-and-articles/news-articles/2020/3/covid-19-vaccine-tracker>

**COVID-19 vaccine tracker**

**Reference:**

* **https://www.who.int/immunization/programmes\_systems/policiesstrategies/vaccine\_intro\_resources/nvi\_guidelines/en/**
* [**https://youtu.be/BtN-goy9VOY**](https://youtu.be/BtN-goy9VOY)
* [**https://vac-lshtm.shinyapps.io/ncov\_vaccine\_landscape/**](https://vac-lshtm.shinyapps.io/ncov_vaccine_landscape/)**#**
* [**https://marlin-prod.literatumonline.com/pb-assets/journals/research/immunity/SARS-CoV-2%20vaccines%20status%20report.pdf**](https://marlin-prod.literatumonline.com/pb-assets/journals/research/immunity/SARS-CoV-2%20vaccines%20status%20report.pdf)

**Gathering Information For Filling Our Data Set**

Our Model basically takes a dataset having all the past data which helps it to predict the future COVID vaccine release date, There are many factors affecting the release date of covid vaccine, our dataset contains all that factors and after keeping that factors in its memory it helps to give an approx. date for the release of vaccine. Such factors are as follows:

1. Funder
2. Developer
3. Current Phase
4. Technology used
5. Phase 1 start date
6. Phase 1 end date
7. Phase 2 start date
8. Phase 2 end date
9. Phase 3 start date
10. Phase 3 end date
11. Phase 4 start date
12. Phase 4 end date
13. Phase ½ overlap
14. Phase 2/3 overlap
15. Phase ¾ overlap
16. And many more…

References for data set are as follows :

1. Factors affecting development rate of vaccine:

<https://www.bcg.com/publications/2020/covid-vaccines-timelines-implications>

1. WHO’s useful links to build our dataset :

<https://www.who.int/publications/m/item/who-target-product-profiles-for-covid-19-vaccines>

<https://www.who.int/publications/m/item/draft-landscape-of-covid-19-candidate-vaccines>

1. Funding of vaccines :

<https://www.devex.com/news/funding-covid-19-vaccines-a-timeline-97950>

1. Work Flow of a number of COVID Vaccines :

<https://racap.com/media/Covid-19/COVID-19_VX_10162020_F.pdf?v=6tLEaP76XtgzTBXPaPA3rDPUOKfSUjaQAWO9bhcTpWg>

1. Feasibility Count :

<http://vaccinedevelopment.org.uk/decision-guide.html>

1. Used to Build dataset :

<https://en.wikipedia.org/wiki/COVID-19_vaccine>