**COVID-19 VACCINATION ANALYSYIS**

**Abstraction:**

Abstraction is the process of hiding the internal details of something while exposing only the essential information. This can be done by creating a higher-level view of the system or process, which makes it easier to understand and use.

In the context of COVID-19 vaccination, abstraction can be used to simplify the process for users and providers. For example, a user might only need to know that they need to get two doses of the vaccine, and that they can schedule an appointment online or at a local pharmacy. They don't need to know the specific details of how the vaccine is made or how it works.

Abstraction can also be used to protect sensitive data. For example, a provider might only need to know that a patient has been vaccinated, and not the specific vaccine they received or the date they were vaccinated. This can help to protect patient privacy and security.

**Modules:**

A module is a self-contained unit of code that can be used independently or as part of a larger system. Modules are often used to organize code and make it easier to maintain and update.

In the context of COVID-19 vaccination, modules can be used to implement different aspects of the vaccination process. For example, there might be modules for scheduling appointments, managing patient records, and tracking vaccine inventory.

Modules can also be used to create different types of vaccination programs. For example, there might be modules for mass vaccination programs, mobile vaccination clinics, and workplace vaccination programs.

**Current status of COVID-19 vaccination:**

As of October 18, 2023, over 12 billion doses of COVID-19 vaccine have been administered worldwide. This has helped to reduce the number of cases, hospitalizations, and deaths from COVID-19.

However, there is still a lot of work to be done to ensure that everyone has access to COVID-19 vaccines. In some parts of the world, vaccination rates are still low, and there are concerns about the emergence of new variants of the virus.

**How abstraction and modules can be used to improve COVID-19 vaccination:**

**Abstraction and modules can be used to improve COVID-19 vaccination in a number of ways. For example:**

Abstraction can be used to simplify the vaccination process for users and providers.

Abstraction can be used to protect sensitive data, such as patient vaccination records.

Modules can be used to implement different aspects of the vaccination process, such as scheduling appointments, managing patient records, and tracking vaccine inventory.

Modules can be used to create different types of vaccination programs, such as mass vaccination programs, mobile vaccination clinics, and workplace vaccination programs.

Here are some specific examples of how abstraction and modules are being used to improve COVID-19 vaccination:

Many countries are using vaccination management systems to track vaccine inventory, schedule appointments, and manage patient records. These systems use abstraction to hide the internal details of the vaccination process from users and providers.

Some countries are using mobile vaccination clinics to reach people who live in rural or underserved areas. These clinics use modules to implement different aspects of the vaccination process, such as scheduling appointments, administering vaccines, and tracking data.

Many employers are offering workplace vaccination programs to their employees. These programs use modules to implement different aspects of the vaccination process, such as scheduling appointments, educating employees about the vaccine, and administering vaccines.

Overall, abstraction and modules can be used to make COVID-19 vaccination more efficient, accessible, and secure.

**Vaccine development and distribution :**

Prime Minister Narendra Modi visiting the Serum Institute of India on 28 November 2020.

As of early May 2020, there were over 30 vaccine candidates in development in India, many of which were already in pre-clinical trials.

The Pune-based Serum Institute of India (SII) is the world's largest vaccine maker. This existing capacity enabled India to be a major participant in the COVAX programme to distribute vaccines to developing countries.[106] In February 2020, SII had begun animal trials of vaccine candidates. SII announced in April 2020 that it would apply for clinical trials from the Drug Controller General of India (DCGI) in April 2020. SII president Adar Poonawalla said that a vaccine would be delivered within a year, but projected an efficacy between 70 and 80%.

In August 2020, SII received approvals for phase 2 and phase 3 trials of its version of a vaccine being developed by AstraZeneca and the University of Oxford's Vaccitech. SII joined GAVI in a partnership with the Bill & Melinda Gates Foundation to produce 100 million doses of vaccine for developing countries. The SII planned to manufacture 1.5 and 2.5 billion doses of the AstraZeneca vaccine per-year under the trade name "Covishield".By its approval in January 2021, the company had stockpiled 50 million doses, but well short of its own target of 400 million.The government ordered 21 million doses to be delivered by February, but the company said no indication of any further orders were given. The company began to export the remaining stocks instead.

Hyderabad-based Bharat Biotech, in collaboration with U.S.-based FluGen, expected to begin the first clinical trials of a nasal vaccine by late-2020.The Indian Council of Medical Research partnered with Bharat Biotech in May 2020 to develop a COVID vaccine entirely within India.In June 2020, it received DCGI approval to begin phase 1 and phase 2 trials on its vaccine, BBV152 (trade name "Covaxin").[116] In September 2020, it was reported that in pre-clinical trials on animals, Covaxin was able to build immunity.In July 2021, Bharat Biotech reported the vaccine to be 64% (95% CI, 29–82%) effective against asymptomatic cases, 78% (65–86%) effective against symptomatic cases, 93% (57–100%) effective against severe COVID-19 infection, and 65% (33–83%) effective against the Delta variant.On 20 April 2021, Bharat Biotech announced that it had expanded its production capabilities for Covaxin to 700 million doses per-year.

Cadila Healthcare began vaccine development in March 2020, including a viral vector vaccine and a DNA plasmid vaccine. In mid-July 2020, Cadila held early human trials of its vaccine candidate ZyCoV-D, and received approval for phase 3 trials in January 2021. It began large-scale production in April 2021, with Cadila expecting to receive emergency authorisation between May and June 2021. On 1 July 2021, Cadila Healthcare reported the efficacy to be 66.6% against symptomatic COVID-19 and 100% against moderate or severe disease in its interim analysis of its phase 3 trial data.

In September 2020,

Dr. Reddy's partnered with the Russian Direct Investment Fund (RDIF) to conduct phase 3 trials of the Sputnik V vaccine in India, and to distribute the vaccine there once approved. In April 2021, RDIF CEO Kirill Dmitriev told NDTV that they had "five great manufacturers in India" who would be producing the vaccine, and felt that the country could become Sputnik V's "production hub" for use and export. Dr. Reddy's is also working with the RDIF on approval of "Sputnik Light"—a regiment of Sputnik V consisting only of the first dose.

In April 2021,

phase 3 clinical trials were approved for another vaccine, Corbevax, a protein subunit that is being developed by BioE, the Baylor College of Medicine, and Dynavax Technologies.

On 2 June 2021,

the DCGI removed the requirement that India-specific clinical trials (bridging trials) be held for vaccine candidates developed outside of India, provided that they are already approved by a recognised international public health agency such as the World Health Organization (WHO), European Medicines Agency (EMA), US Food and Drug Administration (FDA), UK Medicines and Healthcare products Regulatory Agency (MHRA), or Japan's Pharmaceuticals and Medical Devices Agency. These changes were intended to help expedite the availability of vaccines already in use in other countries.

In mid-July,

it was reported that approval of the Moderna and Pfizer vaccines, as well as a shipment of vaccines donated by the United States (which includes the AstraZeneca, Janssen, Moderna, and Pfizer vaccines), had faced delays due to requests from their manufacturers for indemnity clauses from Indian authorities, which would relieve them from legal liability for adverse reactions.

On 21 September 2021,

the Indian Government said that it will not purchase the Pfizer-BioNTech and Moderna vaccines as domestic output of more affordable and easier-to-store vaccines has jumped.

In the Quad summit,

Prime Minister Narendra Modi announced that India would make 8 million doses of J&J vaccine available by the end of October under the Quad vaccine partnership. It will be manufactured in India by the Biological E. This would be ready by the end of October, compatible with our decision to resume vaccine export.

On 6 February 2022,

DCGI approved Sputnik Light Covid vaccine for emergency use in India.

**Vaccine deployment strategies :**

Optimizing vaccination deployment for India includes tailoring of strategies to the demographic and epidemiologic situation by modeling vaccination scenarios, explore measures to reach children at risk and co-optimizing vaccination strategy for societal and individual benefit in parallel.