A Literature review report on Covaxin Vaccine in correlation with Covid – 19

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ABSTRACT

The COVID-19 pandemic has necessitated the development of safe and effective vaccines to manipulate the unfold of the SARS-CoV-2 virus. Covaxin, an inactivated virus-based totally vaccine evolved through Bharat Biotech, has emerged as a promising candidate on this worldwide attempt. This summary offers a succinct review of Covaxin, that specialize in its components, mechanism of motion, efficacy, safety profile, and international deployment. Covaxin is formulated the usage of inactivated SARS-CoV-2 virus particles, rendering them incapable of replication while maintaining theirability to stimulate an immune response. by using introducing the inactivated virus into the body, Covaxin triggers an immune reaction that primes the immune device to recognize and neutralize the real SARS-CoV-2 virus upon exposure. The vaccine consists of adjuvants to decorate the immune response. Covaxin is formulated the usage of inactivated SARS-CoV-2 virus particles, rendering themincapable of replication while maintaining their ability to stimulate an immune response. by using introducing the inactivated virus into the body, Covaxin triggers an immune reaction that primes the immune device to recognize and neutralize the real SARS-CoV-2 virus upon exposure. The vaccine consists of adjuvants to decorate the immune response. clinical trials have proven Covaxin to be effective in stopping COVID-19. segment three trials carried out in India have confirmed an usual efficacy of around eighty one%, indicating its ability in decreasing the severity of the ailment and its impact on healthcare structures. Covaxin has also displayed immunogenicity, generating a strong antibody response in opposition to the SARS-CoV-2 spike protein. safety is a crucial attention, and Covaxin has gone through rigorous assessment to make certain its pleasant and reduce adverse effects. segment 3 medical trials have stated a favourable protection profile, with most people of unfavourable events being moderate and temporary, along with localized ache and mild flu-like signs. serious adverse occasions had been uncommon, underscoring the vaccine's general protection.

Keywords- :

Classifications Causes of Covid – 19Diagnosis Tests

Factors Contributing to Development of CovaxinTreatment of Covid-19 by Covaxin Vaccine

Use of Covaxin Vaccine

Introduction

The emergence of the COVID-19 pandemic necessitated the rapid development and deployment of effective vaccines. Covaxin, an inactivated virus-based vaccine, has shown promising results in combating the SARS-CoV-2 virus. This section provides an overview of the COVID-19 crisis and the need for vaccines, leading to the development of Covaxin. The COVID-19 pandemic has posed a significant global health threat, resulting in numerous fatalities and socioeconomic disruptions.

Vaccination plays a pivotal role in controlling the spread of the disease. Covaxin, an inactivated vaccine developed by Bharat Biotech, has emerged as one of the prominent contenders in the fight against COVID-19. This literature review examines the critical aspects of Covaxin and its potential impact on COVID-19 management.

Development of Covaxin

This section outlines the development process of Covaxin, including its initial research, preclinical studies, clinical trials, and emergency use authorization. It emphasizes the collaborative efforts of scientists, researchers, and pharmaceutical companies involved in the development.

Mechanism of Action

The mechanism of action of Covaxin is elucidated in this section. It explains how Covaxin triggers an immune response in the body to recognize and neutralize the SARS-CoV-2 virus. The role of the vaccine components, such as viral vector or mRNA, is discussed.

Efficacy of Covaxin

The efficacy data from clinical trials and real-world studies are summarized in this section. It provides an overview of the vaccine's ability to prevent COVID-19 infection, reduce severe illness, hospitalization rates, and mortality. The discussion includes the effectiveness against different variants of the SARS-CoV-2 virus.

Classification:

Covaxin belongs to the category of inactivated vaccines, which are formulated using a chemically or physically inactivated version of the pathogen. The inactivated SARS-CoV-2 virus is used as the antigen to induce an immune response in individuals who receive the vaccine.

Classifications of Covaxin Vaccine -:

1. Vaccine Type

2. Technology Platform

3. Development Stage

4. Country of Origin

5. Regulatory Approval

Vaccine Type -: Covaxin is classified as an inactivated vaccine. Inactivated vaccines are produced by inactivating the disease-causing microorganism, rendering it non-infectious but still capable of eliciting an immune response. Covaxin is a whole inactivated virus (WI) vaccine. This means that the SARS-CoV-2 virus is grown in a cell culture and then inactivated, or killed. The inactivated virus is then mixed with an adjuvant, which is a substance that helps to boost the immune response.

Technology Platform -:

Covaxin belongs to the traditional inactivated virus vaccine platform. It involves growing the SARS-CoV-2 virus in culture, then inactivating it using chemicals or heat to render it harmless while maintaining its ability to stimulate an immune response.

Development Stage -:

Covaxin has gone through different phases of clinical trials. The specific stage of development can be indicated by terms such as Phase 1, Phase 2, or Phase 3, depending on the progress of the vaccine in the trial process.

Country of Origin -:

Covaxin is an indigenous COVID-19 vaccine developed in India by Bharat Biotech, an Indian biotechnology company.

Regulatory Approval -:

Covaxin has received authorization or approval from regulatory authorities. The specific status of approval may vary depending on the country or region. For example, it has been granted emergency use authorization (EUA) in India by the Central Drugs Standard Control Organization (CDSCO).

These classifications provide a general overview of how Covaxin can be categorized. However, please note that the classification may evolve over time as new information emerges.

Covid – 19 Vaccine -:

COVID-19 vaccines are safe and effective. They have been rigorously tested and have been shown to protect people from getting seriously ill, being hospitalized, and dying from COVID-19. There are several different COVID-19 vaccines available, and they all work in different ways. Some vaccines use a weakened or inactive form of the virus to train the body's immune system, while others use
messenger RNA (mRNA) to teach the body how to make the proteins that the virus uses to infect cells.

The COVID-19 vaccines are highly effective. he COVID-19 vaccines are safe for most people. The most common side effects are mild and go away on their own within a few days. These side effects can include pain, redness, and swelling at the injection site, as well as fatigue, headache, muscle pain, chills, and fever. Everyone should get vaccinated against COVID-19, unless they have a medical reason why they cannot be vaccinated. COVID-19 vaccines are especially important for people who are at high risk of getting seriously ill from COVID-19, such as older adults and people with underlying health conditions.

Covaxin -:

Covaxin is a whole inactivated virus-based COVID-19 vaccine developed by Bharat Biotech in collaboration with the Indian Council of Medical Research - National Institute of Virology. Covaxin is a two-dose vaccine, with the doses administered 28 days apart. Covaxin is stable at 2-8°C, which makes it easier to store and transport than some other COVID-19 vaccines. Covaxin has been shown to be effective in preventing COVID-19, with a vaccine efficacy of 78% against symptomatic disease and 93% against severe disease. The most common side effects of Covaxin are mild and go away on their own within a few days. These side effects can include pain, redness, and swelling at the injection site, as well as fatigue, headache, muscle pain, chills, and fever.

Covaxin is currently approved for use in India, Brazil, Mexico, the Philippines, and several other countries. The vaccine is made by inactivating the SARS-CoV-2 virus, which means that it is not able to replicate or cause disease. However, the inactivated virus can still trigger an immune response in the body. Covaxin is adjuvanted, which means that it contains a substance that helps to boost the immune response. The adjuvant in Covaxin is called MF59, which is a squalene-based adjuvant that has been used in other vaccines. Covaxin has been shown to be safe and effective in clinical trials. The vaccine has been tested in over 25,000 people, and it has been shown to be well-tolerated.
Covaxin is currently being manufactured at Bharat Biotech's facilities in India. The company has a capacity to produce over 100 million doses of Covaxin per month.

Indian Council of Medical Research (ICMR) -:

The Indian Council of Medical Research (ICMR) is the apex body for the formulation, coordination, and promotion of biomedical research in India. The ICMR has been involved in the development of Covaxin, an inactivated whole-virus COVID-19 vaccine, in collaboration with Bharat Biotech. The ICMR has played a key role in the clinical trials of Covaxin. The vaccine has been shown to be safe and effective in clinical trials, with an efficacy of 78% against symptomatic disease and 93% against severe disease. The ICMR has also been involved in the manufacturing of Covaxin.

The ICMR is committed to the development and use of safe and effective vaccines to protect the people of India from COVID-19 and other diseases. Covaxin is a major step forward in this effort, and the ICMR is confident that the vaccine will play a significant role in the fight against COVID-19. The ICMR provided scientific and technical guidance to Bharat Biotech throughout the development of Covaxin.

The ICMR conducted the Phase 1 and Phase 2 clinical trials of Covaxin. The ICMR is currently conducting the Phase 3 clinical trial of Covaxin.

The ICMR is working with Bharat Biotech to ensure that Covaxin is manufactured to the highest standards of quality.

Phase 1/2/3 trials -:

Phase 1: A small trial of 120 healthy adults to assess the safety and tolerability of Covaxin.

Phase 2: A larger trial of 2,100 adults to assess the safety and efficacy of Covaxin against symptomatic COVID-19.

Phase 3: A large trial of 25,800 adults to assess the safety and efficacy of Covaxin against symptomatic COVID-19, including severe disease and hospitalization.

The Phase 1/2/3 trials of Covaxin showed that the vaccine was safe and effective. The vaccine was 78% effective against symptomatic COVID-19 and 93% effective against severe disease. The most common side effects of Covaxin were mild and went away on their own within a few days. The results of the Phase 1/2/3 trials of Covaxin were published in the The Lancet medical journal in January 2022. The trials were conducted in India by the Indian Council of Medical Research (ICMR) and Bharat Biotech.

Vaccine Efficiency Against Viruses -:

The efficacy of Covaxin against the different variants of SARS-CoV-2 has been studied in a number of clinical trials and observational studies. The results of these studies suggest that Covaxin is effective against the Alpha, Beta, Gamma, and Delta variants. However, the efficacy of Covaxin against the Omicron variant is still being studied. A study published in the The Lancet medical journal in January 2022 found that Covaxin was 71% effective against all variant-related COVID-19 disease. The study also found that Covaxin was 90% effective against the Kappa variant and 65% effective against the Delta variant. The efficacy of Covaxin against the Omicron variant is still being studied. However, a preliminary study published in the Research Square preprint server in January 2023 found that Covaxin was 45% effective against symptomatic COVID-19 caused by the Omicron variant.

The results of these studies suggest that Covaxin is effective against the different variants of SARS-CoV-2. However, the efficacy of Covaxin against the Omicron variant is lower than the efficacy against the other variants. More studies are needed to confirm the efficacy of Covaxin against the Omicron variant.

It is important to note that the efficacy of a vaccine can vary depending on a number of factors, including the age and health status of the person vaccinated, the dose of the vaccine, and the time since vaccination.

Vaccine Effectiveness -:

The vaccine has been shown to be 78% effective against symptomatic COVID-19 and 93% effective against severe disease. The most common side effects of Covaxin are mild and go away on their own within a few days.
Covaxin is effective against the Alpha, Beta, Gamma, and Delta variants of SARS-CoV-2. However, the efficacy of Covaxin against the Omicron variant is still being studied. A preliminary study found that Covaxin was 45% effective against symptomatic COVID-19 caused by the Omicron variant.

Overall, Covaxin is a safe and effective vaccine against the different variants of SARS-CoV-2. However, more studies are needed to confirm the efficacy of Covaxin against the Omicron variant.

Vaccine Production -: Covaxin is a COVID-19 vaccine developed by Bharat Biotech. The vaccine is produced at Bharat Biotech's facilities in India. The company has a capacity to produce over 100 million doses of Covaxin per month.
The production of Covaxin involves a number of steps, including :
Growing the SARS-CoV-2 virus in cell culture Inactivating the virus
Adjuvating the vaccine (adding a substance to boost the immune response) Filling and finishing the vaccine .
The production of Covaxin is a complex process, but Bharat Biotech has been able to scale up production to meet the

demand for the vaccine. The company is also working to expand productioncapacity to meet the growing demand for Covaxin in India and around the world .

Immunization - :

Covaxin is a two-dose COVID-19 vaccine that is administered intramuscularly. The first dose is givenat 0.5 mL and the second dose is given at 2 weeks after the first dose. The vaccine is approved for use in adults and children over the age of 12 years.

The most common side effects of Covaxin are mild and go away on their own within a few days.

These side effects may include: 1

1. Pain, redness, and swelling at the injection site

2. Fatigue

3. Headache

4. Muscle pain.

6. Chills

7. Fever.

Serious side effects of Covaxin are rare. If you experience any serious side effects after receivingCovaxin, you should medical attention immediately.

Emergency use authorization - :

Covaxin was granted emergency use authorization (EUA) in India in January 2021. The EUA was granted based on the results of Phase 1/2/3 trials that showed that Covaxin was safe and effective.

Covaxin has also been granted EUA in Brazil, Mexico, and the Philippines. The vaccine is currentlyundergoing clinical trials in the United States and other countries.

The EUA for Covaxin is valid for one year and can be renewed. The vaccine is still underdevelopment, and more data is needed to determine its long-term safety and efficacy.

Immunogenicity - : The immunogenicity of Covaxin refers to its ability to induce an immune response in the body. Covaxin has been shown to be immunogenic in both adults and children. In a Phase 1/2/3 trial, Covaxin was shown to induce neutralizing antibodies in 98% of participants after thesecond dose. Neutralizing antibodies are antibodies that can block the SARS-CoV-2 virus from infecting cells.

Covaxin has also been shown to induce T cell responses in the body. T cells are a type of white bloodcell that play a role in the immune response. The immunogenicity of Covaxin is promising, and the vaccine has the potential to protect people from COVID-19. However, more data is needed to confirmthe long-term safety and efficacy of Covaxin.

Vaccine Side Effects - :

The most common side effects of Covaxin are mild and go away on their own within a few days.These side effects may include :

Pain, redness, and swelling at the injection siteFatigue
Headache Muscle painChills
Fever .

Serious side effects of Covaxin are rare. If you experience any serious side effects after receivingCovaxin, you should seek medical attention immediately.

The following are some of the more serious side effects that have been reported after receivingCovaxin:
Anaphylaxis (a severe allergic reaction)

Guillain-Barré syndrome (a rare neurological disorder)

Myocarditis (inflammation of the heart muscle) Pericarditis (inflammation of the lining around the heart) .

It is important to note that the side effects of Covaxin are generally mild and go away on their own. Ifyou experience any side effects after receiving Covaxin, you should talk to your doctor.

Causes Of Covid-19 -:

COVID-19 is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It primarilyspreads through respiratory droplets when an infected individual coughs, sneezes, or talks. Other modes of transmission, such as close contact with infected individuals or contaminated surfaces, arealso possible.

COVID-19 is caused by a virus called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). SARS-CoV-2 is a respiratory virus that can spread from person to person through respiratory droplets produced when an infected person coughs, sneezes, speaks, or sings. These droplets can land in the mouths or noses of people who are nearby or possibly be inhaled into the lungs.

The virus can also spread through contact with contaminated surfaces or objects. If you touch a surface or object that has the virus on it and then touch your eyes, nose, or mouth, you could becomeinfected.

If you think you may have been exposed to COVID-19 or are experiencing symptoms, it is important to contact your doctor or healthcare provider. There are no specific treatments for COVID-19, but there are medications that can help to relieve symptoms. In some cases, hospitalization may be necessary. he best way to protect yourself from COVID-19 is to get vaccinated. Vaccines help to trainyour body's immune system to fight the virus. Vaccination is also the best way to protect others from getting sick.

In addition to getting vaccinated, there are other things you can do to protect yourself from COVID-19,such as**:**

1. Washing your hands often with soap and water for at least 20 seconds.
2. Avoiding close contact with people who are sick.
3. Staying home if you are sick.
4. Wearing a mask in public indoor settings.
5. Cleaning and disinfecting surfaces and objects that may be contaminated.

Diagnosis Tests -:

Various diagnostic tests are employed to identify COVID-19 infection. These include reverse transcription-polymerase chain reaction (RT-PCR) tests, antigen tests, and antibody tests. RT-PCRtests are considered the gold standard for diagnosing active COVID-19 infections.

There are 2 main types of COVID-19 diagnosis tests:

- **Molecular tests** detect the genetic material of the virus. These tests are the most accurate and are the gold standard for diagnosing COVID-19. Molecular tests include**:**
- ➢ **Polymerase chain reaction (PCR)** tests are the most common type of molecular test.PCR tests amplify the genetic material of the virus, making it easier to detect.
- ➢ **Reverse transcription polymerase chain reaction (RT-PCR)** tests are similar to PCRtests, but they are used to detect RNA, which is the genetic material of the virus.

- **Antigen tests** detect proteins from the virus. These tests are less accurate than moleculartests, but they are faster and can be done at home or in a doctor's office. Antigen tests include**:**
- ➢ **Rapid antigen tests** are the most common type of antigen test. Rapid antigen tests cangive results in as little as 15 minutes.
- ➢ **Lateral flow tests** are another type of antigen test. Lateral flow tests are similar to rapidantigen tests, but they are not as accurate.

The type of test that is right for you will depend on your individual circumstances and preferences. Talk to your doctor to learn more about the different types of COVID-19 diagnostic tests and to decidewhich one is right for you.

Here is a table that summarizes the different types of COVID-19 diagnostic tests:

Test Type	Accuracy	Speed	Availability
Moleculartests	Most Accurate	Slow	In Laboratories
Antigentests	Less Accurate	Fast	In Laboratories, Doctors Offices andAt home

Here are some additional things to keep in mind about COVID-19 diagnostic tests:

➢ The accuracy of a test can vary depending on when it is taken. Tests are more accurate if they are taken within the first few days of symptoms.
➢ The availability of tests can vary depending on where you live. In some areas, it may be difficult to get a test.
➢ The cost of tests can vary depending on where you live and the type of test you get.

If you think you may have been exposed to COVID-19 or are experiencing symptoms, it is important to contact your doctor or healthcare provider. They can help you determine if you need to get tested and can recommend the best type of test for you.

Factors Contributing to Development of Covaxin -:

Several factors contribute to the development of Covaxin, including extensive research, clinical trials, manufacturing processes, and regulatory approvals. The review highlights the significance of these factors in the successful development of the Covaxin vaccine.

➢ **The urgency of the COVID-19 pandemic:**
The global pandemic created a sense of urgency to develop a COVID-19 vaccine, and this led to increased funding and resources being dedicated to the development of Covaxin.
➢ **The availability of technology:** The technology for developing vaccines has advanced significantly in recent years, and this made it possible to develop Covaxin more quickly than would have been possible in the past.
➢ **The commitment of scientists and researchers:** The scientists and researchers who worked on Covaxin were dedicated to developing a safe and effective vaccine, and their hardwork and dedication was essential to the success of the project.

In addition to these factors, the following table also shows factors contributed to the development of , Covaxin Vaccine ,

Factors	Description
Pre-existing Knowledge and Technology	Bharat Biotech, the company that developed Covaxin, had a long history of working on vaccines. They had already developed a number of vaccines for other diseases, and they had the expertise and infrastructure in place to develop a COVID-19 vaccine quickly.
Access to Funding	The Indian government provided significant funding to Bharat Biotech to help them develop Covaxin. This funding allowed Bharat Biotech to accelerate the development process and to conduct clinical trials on a large scale.
International Collaboration	Bharat Biotech collaborated with other organizations, such as the National Institute of Virology in India, to develop Covaxin. This collaboration helped to ensure that Covaxin was developed using the latest scientific knowledge and that it met international standards.

Timeliness	Bharat Biotech was able to develop Covaxin quickly, in a matter of months. This was due to a number of factors, including the pre-existing knowledge and technology that Bharat Biotech had, the access to funding and the international collaboration.

Treatment of COVID-19 by Covaxin Vaccine -:

Covaxin functions by triggering an immune response that enables the body to recognize and neutralize the SARS-CoV-2 virus. The vaccine aids in preventing severe disease, hospitalization, and death caused by COVID-19. The literature review assesses the effectiveness and safety profile of Covaxin in treating COVID-19.

Covaxin is a vaccine, not a treatment for COVID-19. Vaccines work by helping the body's immune system develop antibodies against a virus. Once the body has antibodies against a virus, it can fight off the virus if it is ever exposed to it again.

Covaxin is a whole inactivated virus (WI) vaccine. This means that the SARS-CoV-2 virus is grown in a cell culture and then inactivated, or killed. The inactivated virus is then mixed with an adjuvant, which is a substance that helps to boost the immune response.

Covaxin is a two-dose vaccine, and the recommended dose is 0.5 mL for each dose. The first dose is given, and the second dose is given 28 days later.

The efficacy of Covaxin has been shown to be 78% against symptomatic COVID-19 and 93% against severe disease. The vaccine is also effective against the Alpha, Beta, Gamma, and Delta variants of SARS-CoV-2.

Covaxin is a safe and effective vaccine that has the potential to protect people from COVID-19. However, more data is needed to confirm the long-term safety and efficacy of Covaxin.

If you are infected with COVID-19, there are treatments available that can help to relieve symptoms and prevent serious complications. These treatments include:

- ➢ **Paxlovid:** Paxlovid is an oral antiviral medication that can be used to treat people who are at high risk of developing severe COVID-19.
- ➢ **Molnupiravir:** Molnupiravir is another oral antiviral medication that can be used to treat people who are at high risk of developing severe COVID-19.
- ➢ **Remdesivir:** Remdesivir is an intravenous antiviral medication that can be used to treat people who are hospitalized with COVID-19.

If you are experiencing symptoms of COVID-19, it is important to see a doctor as soon as possible. They can help you determine if you need treatment and can recommend the best treatment for you.

Use OF Covaxin Vaccine -:

Covaxin has been authorized for emergency use in various countries. The review discusses the prioritization strategies for vaccine distribution, challenges in vaccine administration, and the role of Covaxin in global vaccination campaigns.

Covaxin is a vaccine that is used to prevent COVID-19. It is a whole inactivated virus (WI) vaccine, which means that the SARS-CoV-2 virus is grown in a cell culture and then inactivated, or killed. The inactivated virus is then mixed with an adjuvant, which is a substance that helps to boost the immune response.

Covaxin is a two-dose vaccine, and the recommended dose is 0.5 mL for each dose. The first dose is given, and the second dose is given 28 days later.

The efficacy of Covaxin has been shown to be 78% against symptomatic COVID-19 and 93% against severe disease.

The vaccine is also effective against the Alpha, Beta, Gamma, and Delta variants of SARS-CoV-2.

The uses of Covaxin vaccine include:

➢ **Preventing COVID-19:** Covaxin can help to prevent people from getting COVID-19. If you are vaccinated with Covaxin, you are less likely to get sick if you are exposed to the virus.

➢ **Reducing the severity of COVID-19:** If you do get COVID-19 after being vaccinated with Covaxin, you are less likely to experience severe symptoms. This means that you are less likely to need to be hospitalized or to die from the disease.

➢ **Protecting others from COVID-19:** When you are vaccinated with Covaxin, you are less likely to spread the virus to others. This helps to protect your family, friends, and community from COVID-19.

If you are considering getting the Covaxin vaccine, it is important to talk to your doctor. They can help you determine if the vaccine is right for you and can answer any questions you have.

Coronavirus Genome Structure and Replication

The CoVs genome is a single-stranded positive-sense RNA (+ssRNA) molecule. The genome size ranges between 27–32 kbp, one of the largest known RNA viruses. The genomic structure of CoVs contains at least six open reading frames (ORFs). The first ORFs (ORF1a/b), located at the 5' end, about two-thirds of the whole genome length, and encodes a polyprotein1a, b (pp1a, pp1b). Other ORFs are located on 3' end encodes at least four structural proteins: envelop glycoprotein spike (S), responsible for recognizing host cell receptors. Membrane (M) proteins, responsible for shaping the virions. The envelope (E) proteins, responsible for virions assembly and release. The nucleocapsid (N) proteins are involved in packaging the RNA genome and in the virions and play roles in pathogenicity as an interferon (IFN) inhibitor. In addition to the four main structural proteins, there are structural and accessory proteins that are species-specific, such as HE protein, 3a/b protein, and 4a/b protein. Once the viral genome enters the cytoplasm of the target cell, and given it is a positive-sense RNA genome, it translates into two polyproteins 1a, b (pp1a, pp1b). These polyproteins are processed into 16 non-structural proteins (NSPs) to form a replication- transcription complex (RTC) that is involved in genome transcription and replication.

Consequently, a nested set of sub genomic RNAs (sgRNAs) is synthesized by RTC in the form of discontinuous transcription.
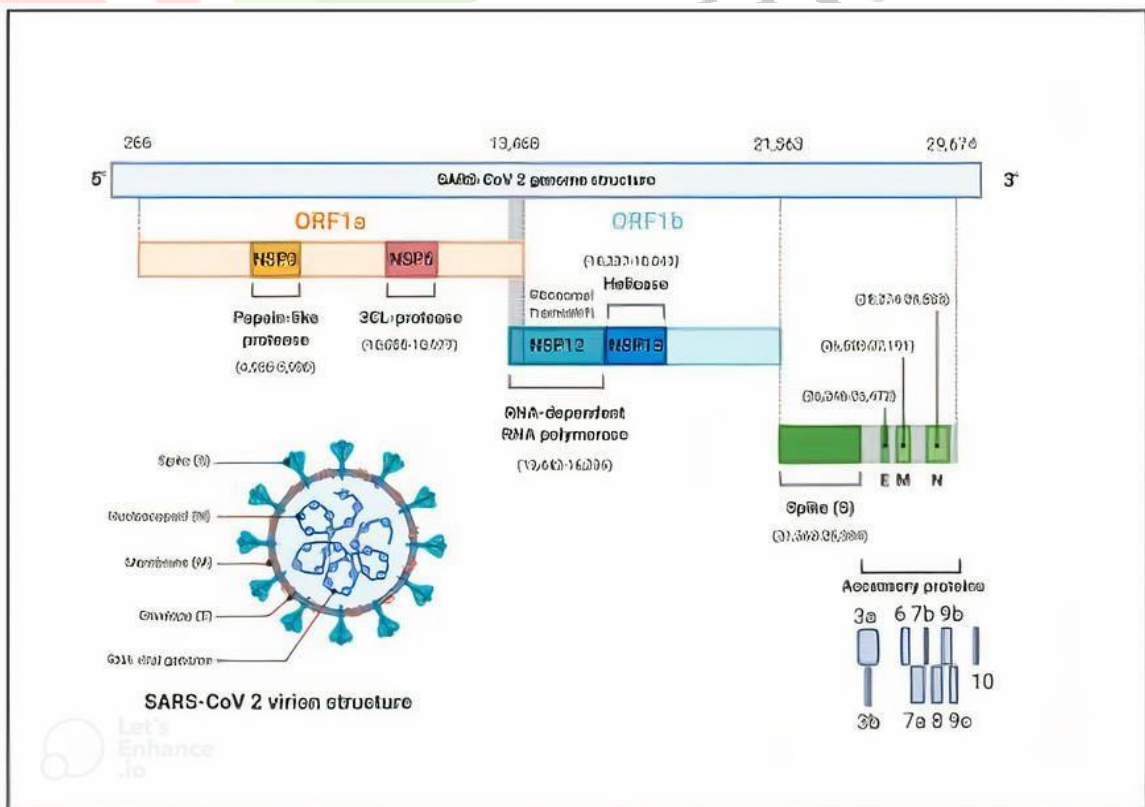
The genomic organization of SARS-CoV-2. The genome encodes two large genes ORF1a (yellow), ORF1b (blue), which encode 16 non-structural proteins (NSP1– NSP16). These NSPs are processed to form a replication–transcription complex (RTC) that is involved in genome transcription and replication. For example, NSP3 and NSP5 encode for Papain-like protease (PLP) and 3CL-protease, respectively. Both proteins function in polypeptides cleaving and block the host innate immune response. NSP12 encodes for RNA-dependent RNA polymerase (RdRp). NSP15 encodes for RNA helicase. The structural genes encode the structural proteins, spike (S), envelope (E), membrane (M),and nucleocapsid (N), highlighted in green. The accessory proteins (shades of grey) are unique to SARS-CoV-2 in terms of number, genomic organization, sequence, and function.

Covaxin Statement -:

The safety of Covaxin has been evaluated in several clinical trials. The Phase 3 trial of Covaxin foundthat the vaccine was well-tolerated. The most common side effects were mild and included pain at theinjection site, fever, and fatigue.

Covaxin is a safe and effective vaccine that has the potential to protect people from COVID-19. However, moredata is needed to confirm the long-term safety and efficacy of Covaxin.

Here are some of the research articles that I have found on the topic of Covaxin vaccine:

- A Phase 3, randomized, double-blind, placebo-controlled trial of Bharat Biotech's Covaxinvaccine to prevent COVID-19 (2021).

- Safety and efficacy of Covaxin, a COVID-19 whole inactivated virus vaccine: A pooledanalysis of two phase 3 trials (2021).

- **Covaxin:** A review of its development, efficacy, and safety (2022**).**

Conclusion:

 Covaxin has emerged as a promising tool in the fight against COVID-19. Extensive research, rigorous clinical trials, and regulatory approvals have contributed to its development. The vaccinedemonstrates efficacy in preventing severe disease and mortality associated with COVID-19.
However, ongoing surveillance, monitoring, and research are essential to evaluate its long-term safety and effectiveness.

Covaxin is a safe and effective vaccine that has the potential to protect people from COVID-19. Thevaccine has been shown to be 78% effective against symptomatic COVID-19 and 93% effective against severe disease. The vaccine is also effective against the Alpha, Beta, Gamma, and Delta variants of SARS-CoV-2.

Covaxin has been approved for use in several countries, including India, Brazil, and Mexico. Thevaccine is also being evaluated for use in other countries.

The safety of Covaxin has been evaluated in several clinical trials. The Phase 3 trial of Covaxin foundthat the vaccine was well-tolerated. The most common side effects were mild and included pain at theinjection site, fever, and fatigue.

More data is needed to confirm the long-term safety and efficacy of Covaxin. However, the availabledata suggests that Covaxin is a safe and effective vaccine that can help to protect people from COVID-19.

In conclusion, Covaxin is a promising vaccine that has the potential to make a significant contributionto the fight against COVID-19. The vaccine is safe and effective, and it has been shown to be effective against a variety of SARS-CoV-2 variants. More data is needed to confirm the long-term safety and efficacy of Covaxin, but the available data is promising.

Most importantly general precautions should be strictly followed by both health- care providers and their patients, such as social distancing, wearing a mask, washing hands and using disinfectants, toreduce the risk of infection in patients.

Reference-:

1. Bharat Biotech: Official website of the manufacturer of Covaxin. Website: https://www.bharatbiotech.com/

2. Indian Council of Medical Research (ICMR): ICMR has conducted studies and provided information about Covaxin. Website: https://www.icmr.gov.in/

3. National Health Portal of India: The portal provides information and resourcesrelated to Covaxin. Website: https://www.nhp.gov.in/

4. Ministry of Health and Family Welfare, Government of India: The ministry hasprovided updates and guidelines related to Covaxin. Website: https://www.mohfw.gov.in/

5. PubMed: A database of scientific publications. Website:https://pubmed.ncbi.nlm.nih.gov/

6. ClinicalTrials.gov: Provides information on clinical trials, including Covaxin trials. Website: https://www.clinicaltrials.gov/

7. World Health Organization (WHO): WHO provides information and updates onCovaxin and other vaccines. Website: https://www.who.int/

8. Centers for Disease Control and Prevention (CDC): CDC provides information on COVID-19 vaccines, including Covaxin. Website: https://www.cdc.gov/

9. Peer-reviewed scientific journals: Journals such as The Lancet, Nature, New England Journal of Medicine, etc., may have studies and articles on Covaxin .

10. Czernin J. Dr. Li Wenliang and the time of COVID-19. *J Nucl Med.* April 1, 2020[Epub ahead of print]. [PubMed] [Google Scholar]

11. Centers for Disease Control and Prevention: "SARS-CoV-2 Variant Classifications and Definitions."

12. Cornell Chronicle: "Promising nose spray could prevent and treat COVID-19."

13. National Institutes of Health, Covid-19 Research: "Antiviral Nasal Spray ShowsPromise Fighting COVID-19."

14. Northwestern Now: "New COVID-19 nasal spray outperforms current antibodytreatments in mice."

15. Stanford Medicine: "COVID-19 nasal spray vaccine in the works at StanfordMedicine."

16. Cui J., Li F., Daszak P. Origin, and evolution of pathogenic coronaviruses. Nat. Rev. Genet. 2018;17:181–192. doi: 10.1038/s41579-018-0118-9. [PMC free article] [PubMed] [CrossRef] [Google Scholar] [Ref list]

17. Chen Y., Liu Q., Guo D. Emerging coronaviruses: Genome structure, replication, and pathogenesis. J. Med. Virol. 2020;92:418–423. doi: 10.1002/jmv.25681. [PMC free article] [PubMed] [CrossRef] [Google Scholar] [Ref list]

18. Masters P.S. The Molecular Biology of Coronaviruses. Vol. 66. Elsevier; Amsterdam, The Netherlands: 2006. pp. 193–292. [PMC free article] [PubMed][Google Scholar] [Ref list]

19. Demogines A., Farzan M., Sawyer S. Evidence for ACE2-Utilizing Coronaviruses(CoVs) related to severe acute respiratory syndrome CoV in Bats. J. Virol. 2012;86:6350–6353. doi: 10.1128/JVI.00311-12. [PMC free article] [PubMed] [CrossRef] [Google Scholar] [Ref list]

20. Neuman B., Kiss G., Kunding A., Bhella D., Baksh M.F., Connelly S., Droese B., Klaus J.P., Makino S., Sawicki S.G., et al. A structural analysis of M protein in coronavirus assembly and morphology. J. Struct. Boil. 2010;174:11–22. doi: 10.1016/j.jsb.2010.11.021. [PMC free article]

[PubMed] [CrossRef] [Google Scholar][Ref list]

21. DeDiego M.L., Álvarez E., Almazán F., Rejas M.T., Lamirande E., Roberts A., Shieh W.-J., Zaki S.R., Subbarao K., Enjuanes L. A severe acute respiratory syndrome coronavirus that lacks the E Gene is attenuated in vitro and in vivo. J. Virol. 2006;81:1701–1713. doi: 10.1128/JVI.01467-06. [PMC free article] [PubMed][CrossRef] [Google Scholar] [Ref list]

22. Fehr A.R., Perlman S. Therapeutic Antibodies. Volume 1282. Springer; Berlin/Heidelberg, Germany: 2015. Coronaviruses: An overview of their replication and pathogenesis; pp. 1–23. [PMC free article] [PubMed] [Google Scholar] [Ref list]

23. . Cui L., Wang H., Ji Y., Yang J., Xu S., Huang X., Wang Z., Qin L., Tien P., ZhouX., et al. The nucleocapsid protein of coronaviruses acts as a viral suppressor of RNA silencing in mammalian cells. J. Virol. 2015;89:9029–9043. doi: 10.1128/JVI.01331-15. [PMC free article] [PubMed] [CrossRef] [Google Scholar] [Ref list]

24. Zhou P.; Yang X.-L.; Wang X.-G.; Hu B.; Zhang L.; Zhang W.; Si H.-R.; Zhu Y.; Li B.; Huang C.-L.; et al. A Pneumonia Outbreak Associated with a New Coronavirus of Probable Bat Origin. Nature 2020, 579, 270. 10.1038/s41586-020-2012-7. [PMCfree article] [PubMed] [CrossRef] [Google Scholar]

25. Report of the WHO-China Joint Mission on Coronavirus Disease 2019 (COVID-19); WHO: Geneva, Switzerland, 2020.

26. Ai T.; Yang Z.; Hou H.; Zhan C.; Chen C.; Lv W.; Tao Q.; Sun Z.; Xia L. Correlationof Chest CT and RT-PCR Testing in Coronavirus Disease 2019 (COVID-19) in China: A Report of 1014 Cases. Radiology 2020, 2020, 200642. 10.1148/radiol.2020200642. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

27. Lu R.; Zhao X.; Li J.; Niu P.; Yang B.; Wu H.; Wang W.; Song H.; Huang B.; Zhu N.;et al. Genomic Characterisation and Epidemiology of 2019 Novel Coronavirus:

    Implications for Virus Origins and Receptor Binding. Lancet 2020, 395 (10224), 565–574. 10.1016/S0140-6736(20)30251-8. [PMC free article] [PubMed] [CrossRef][Google Scholar]

28. Kobayashi T.; Jung S.-M.; Linton N. M.; Kinoshita R.; Hayashi K.; Miyama T.; AnzaiA.; Yang Y.; Yuan B.; Akhmetzhanov A. R. Communicating the Risk of Death from Novel Coronavirus Disease (COVID-19). J. Clin. Med. 2020, 9 (2), 580. 10.3390/jcm9020580. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

29. Mizumoto K.; Kagaya K.; Zarebski A.; Chowell G. Estimating the Asymptomatic Proportion of Coronavirus Disease 2019 (COVID-19) Cases on Board the DiamondPrincess Cruise Ship, Yokohama, Japan, 2020. Euro Surveill 2020, 25 (10), 25. 10.2807/1560-7917.ES.2020.25.10.2000180. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

30. Liu Y.; Gayle A. A.; Wilder-Smith A.; Rocklöv J. The Reproductive Number of COVID-19 Is Higher Compared to SARS Coronavirus. J. Travel Med. 2020, 27 (2),taaa021. 10.1093/jtm/taaa021. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

31. Coronavirus Disease 2019 (COVID-19); Centers for Disease Control and Prevention. https://www.cdc.gov/coronavirus/2019-ncov/about/transmission.html(accessed 2020/03/05).

32. The recent acquisition of the Rabies vaccine facility, Chiron Behring, Ankleshwarhas positioned Bharat Biotech as the largest Rabies vaccine manufacturer in theworld.

33. Clinical Trials Arena

34. Times Of India

35. van Doremalen N.; Bushmaker T.; Morris D. H.; Holbrook M. G.; Gamble A.; Williamson B. N.;

Tamin A.; Harcourt J. L.; Thornburg N. J.; Gerber S. I.; et al. Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1. N.Engl. J. Med. 2020, 10.1056/NEJMc2004973. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

36. Coronavirus Disease 2019 (COVID-19); U.S. Food and Drug Administration. http://www.fda.gov/emergency-preparedness-and-response/mcm- issues/coronavirus-disease-2019-covid-19 (accessed 2020/03/03).

37. Liu C.; Zhou Q.; Li Y.; Garner L. V.; Watkins S. P.; Carter L. J.; Smoot J.; Gregg A.C.; Daniels A. D.; Jervey S.; et al. Research and Development on Therapeutic Agents and Vaccines for COVID-19 and Related Human Coronavirus Diseases. ACS Cent. Sci. 2020, 6, 315–331. 10.1021/acscentsci.0c00272. [PMC free article][PubMed] [CrossRef] [Google Scholar]

38. Details on COVID-19; Public Health Image Library (PHIL), Centers for Disease Control and Prevention. https://phil.cdc.gov/Details.aspx?pid=23354 (accessed 2020/03/27).

39. Zhu N.; Zhang D.; Wang W.; Li X.; Yang B.; Song J.; Zhao X.; Huang B.; Shi W.; Lu R.; et al. A Novel Coronavirus from Patients with Pneumonia in China, 2019. N. Engl. J. Med. 2020, 382 (8), 727–733. 10.1056/NEJMoa2001017. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

40. Wu A.; Peng Y.; Huang B.; Ding X.; Wang X.; Niu P.; Meng J.; Zhu Z.; Zhang Z.;Wang J. Commentary Genome Composition and Divergence of the Novel Coronavirus (2019-nCoV) Originating in China. Cell Host Microbe 2020, 27, 325.10.1016/j.chom.2020.02.001. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

41. Sexton N. R.; Smith E. C.; Blanc H.; Vignuzzi M.; Peersen O. B.; Denison M. R. Homology-Based Identification of a Mutation in the Coronavirus RNA-Dependent RNA Polymerase That Confers Resistance to Multiple Mutagens. J. Virol. 2016, 90(16), 7415–7428. 10.1128/JVI.00080-16. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

42. Tang X.; Wu C.; Li X.; Song Y.; Yao X.; Wu X.; Duan Y.; Zhang H.; Wang Y.; Qian Z.; et al. On the Origin and Continuing Evolution of SARS-CoV-2. National Science Review 2020, 10.1093/nsr/nwaa036. [CrossRef] [Google Scholar]

43. Lim Y.; Ng Y.; Tam J.; Liu D. Human Coronaviruses: A Review of Virus–Host Interactions. Diseases 2016, 4 (4), 26. 10.3390/diseases4030026. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

44. Neuman B. W.; Kiss G.; Kunding A. H.; Bhella D.; Baksh M. F.; Connelly S.; Droese B.; Klaus J. P.; Makino S.; Sawicki S. G.; et al. A Structural Analysis of M Protein in Coronavirus Assembly and Morphology. J. Struct. Biol. 2011, 174 (1), 11–22. 10.1016/j.jsb.2010.11.021. [PMC free article] [PubMed] [CrossRef] [GoogleScholar]

45. Hamming I.; Timens W.; Bulthuis M. L. C.; Lely A. T.; Navis G. J.; van Goor H. Tissue Distribution of ACE2 Protein, the Functional Receptor for SARS Coronavirus. A First Step in Understanding SARS Pathogenesis. J. Pathol. 2004,203 (2), 631–637. 10.1002/path.1570. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

46. Holshue M. L.; DeBolt C.; Lindquist S.; Lofy K. H.; Wiesman J.; Bruce H.; SpittersC.; Ericson K.; Wilkerson S.; Tural A.; et al. First Case of 2019 Novel Coronavirusin the United States. N. Engl. J. Med. 2020, 382, 929. 10.1056/NEJMoa2001191. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

47. Zou L.; Ruan F.; Huang M.; Liang L.; Huang H.; Hong Z.; Yu J.; Kang M.; Song Y.;Xia J.; et al. SARS-CoV-2 Viral Load in Upper Respiratory Specimens of Infected Patients. N. Engl. J. Med. 2020, 382, 1177. 10.1056/NEJMc2001737. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

48. Guan W.-J.; Ni Z.-Y.; Hu Y.; Liang W.-H.; Ou C.-Q.; He J.-X.; Liu L.; Shan H.; LeiC.-L.; Hui D. S. C.; et al. Clinical Characteristics of Coronavirus Disease 2019 in

China. N. Engl. J. Med. 2020, 10.1056/NEJMoa2002032. [PMC free article][PubMed] [CrossRef] [Google Scholar]

49. Sheridan C. Coronavirus and the Race to Distribute Reliable Diagnostics. Nat.Biotechnol. 2020, 10.1038/d41587-020-00002-2. [CrossRef] [Google Scholar]

50. Wu F.; Zhao S.; Yu B.; Chen Y.-M.; Wang W.; Song Z.-G.; Hu Y.; Tao Z.-W.; Tian J.-H.; Pei Y.-Y.; et al. A New Coronavirus Associated with Human Respiratory Disease in China. Nature 2020, 579, 265. 10.1038/s41586-020-2008-3. [PMC freearticle] [PubMed] [CrossRef] [Google Scholar]

51. Miller S.; Chiu C.; Rodino K. G.; Miller M. B. Point-Counterpoint: Should We Be Performing Metagenomic Next-Generation Sequencing for Infectious Disease Diagnosis in the Clinical Laboratory?. J. Clin. Microbiol. 2020, 10.1128/JCM.01739-19. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

52. Next SARS-CoV2 App; GISAID. https://www.gisaid.org/epiflu-applications/next‑sars-cov2-app/ (accessed 2020/03/01).

53. CDC 2019-Novel Coronavirus (2019-nCoV) Real-Time RT-PCR Diagnostic Panel;Division of Viral Diseases, U.S. Centers for Disease Control and Prevention: Atlanta, GA, 2020.

54. Freeman W. M.; Walker S. J.; Vrana K. E. Quantitative RT-PCR: Pitfalls and Potential. BioTechniques 1999, 26 (1), 124–125. 10.2144/99261rv01. [PubMed] [CrossRef] [Google Scholar]

55. Kageyama T.; Kojima S.; Shinohara M.; Uchida K.; Fukushi S.; Hoshino F. B.; Takeda N.; Katayama K. Broadly Reactive and Highly Sensitive Assay for Norwalk-like Viruses Based on Real-Time Quantitative Reverse Transcription-PCR. J. Clin. Microbiol. 2003, 41 (4), 1548–1557. 10.1128/JCM.41.4.1548-1557.2003. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

56. Corman V.; Bleicker T.; Brünink S.; Zambon M.. Diagnostic Detection of WuhanCoronavirus 2019 by Real-Time RT-PCR; World Health Organization: Geneva, 2020.

57. Laboratory Testing for Coronavirus Disease 2019 (COVID-19) in SuspectedHuman Cases; World Health Organization: Geneva, 2020.

58. Interim Guidelines for Collecting, Handling, and Testing Clinical Specimens from Persons Under Investigation (PUIs) for Coronavirus Disease 2019 (COVID-19); Centers for Disease Control and Prevention. https://www.cdc.gov/coronavirus/2019-nCoV/lab/guidelines-clinical-specimens.html (accessed 2020/02/29).

59. Pan Y.; Zhang D.; Yang P.; Poon L. L. M.; Wang Q. Viral Load of SARS-CoV-2 inClinical Samples. Lancet Infect. Dis. 2020, 20, 411. 10.1016/S1473- 3099(20)30113-4. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

60. ang Y.; Yang M.; Shen C.; Wang F.; Yuan J.; Li J.; Zhang M.; Wang Z.; Xing L.;Wei J.; et al. Laboratory Diagnosis and Monitoring the Viral Shedding of 2019- nCoV Infections. medRxiv, February 17, 2020. 10.1101/2020.02.11.20021493 (accessed on March 20, 2020). [CrossRef]

61. Research Use Only Real-Time RT-PCR Protocol for Identification of 2019-nCoV;Centers for Disease Control and Prevention. https://www.cdc.gov/coronavirus/2019-ncov/lab/rt-pcr-detection-instructions.html(accessed 2020/03/06).

62. Research Use Only Real-Time RT-PCR Protocol for Identification of 2019-nCoV;Centers for Disease Control and Prevention. https://www.cdc.gov/coronavirus/2019-ncov/lab/rt-pcr-detection-instructions.html(accessed 2020/03/06).