

A Review on Vaccination Drive for COVID-19 in India

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ABSTRACT

The Covid-19 pandemic is destructing the whole world rapidly and also results in changing the order of human life. Various strategies and efforts are being applied by health experts to fight against the pandemic. Various vaccines are developed by researchers of different countries. The aim for developing the vaccines is to produce Herd immunity i.e. to resist the spread of SARS-CoV-2 virus. 8-12 years are required for the development of vaccine in normal circumstances but in emergency like Covid-19 pandemic vaccines get ready in 10 months by various methods like viral vector vaccines, mRNA based vaccines, inactivated vaccines. In India only three vaccines i.e. Covaxin, Covishield, and Sputnik-V get the Emergency Use Authorisation (EUA) from the drug controller general of India (DCGI). Vaccines vary in their efficacy that's why only few vaccines get the emergency approval across the globe. These vaccines also show mild to moderate and in some case rare adverse effects.

Key Words – Pandemic, Vaccines, Covid-19, Herd immunity, Adverse effects

INTRODUCTION

The whole world is facing the pandemic viral disease which is caused by the SARS-Cov-2. This COVID-19 disease was first detected in Wuhan, China, in December 2019.^[1] The COVID-19 has emerged as a respiratory disease. Patients who suffered from this novel corona virus has shown symptoms like pneumonia, which may be mild to moderate, also shows symptoms of acute respiratory distress syndrome, septic shock, and multiple organ failure.^[2] Higher incidence of cardiovascular diseases have been reported in patients suffering from COVID-19. Several studies noted that COVID-19 activates coagulation pathways and endothelial cell dysfunction which results in cardiac arrest and cardiomyopathy in patients.^[3] Sectors like travel, tourism, hospitality, economic get adversely affected worldwide due to this pandemic.

Now, there is a need to strengthen the individual's immune system to get protection from COVID-19.^[4] The biggest coronavirus vaccination programme around the globe has launched on January 16,2021 by India. The first priority of vaccination was given to frontline workers of health, education and police. The second priority is given to other people of the country. It is very important for individuals to get vaccinated as soon as possible as this the only way for achieving 'herd immunity' in the country. Two vaccines – Covishield and Covaxin are the part of vaccination programme in India.^[5] Study of evaluation of covid-19 patients affirmed that antibody binder and main bidders attacks on the receptor-binding domain subunit S1. The immunization generates an effective immune response in the human body which is characterized by formation of neutralizing

antibodies, formation of t-cells response and prevention of disease.^[6]

Types of vaccines – as soon as the coronavirus infection found in the world, the researchers started their work in laboratories to make sequences of gene of SARS-CoV-2 virus for identifying the targets to develop vaccine. Vaccine availability is important to develop Herd immunity in the population. Herd immunity refers to the resistance of the transmission of an infectious disease within the population which develops when majority of the population get immune. So, the Herd

immunity is necessary to slow the transmission rate of covid-19 disease. Many vaccines are developed by the scientists across the globe from which only few vaccines get the authorization for emergency use in pandemic. Researchers developed these vaccines through various technologies. The vaccine gets the authorisation after conducting the clinical trials in various phases to evaluate the safety and efficacy of the vaccine. Efficacy limit of 50% has been set by WHO to get the approval for vaccine.^[7,8]

Inactivated virus	Protein subunit	Viral vector	Nucleic acids
Inactivated vaccines obtained through virus grown in culture and then virus get inactivated chemically, which releases stably expressed, conformationally native antigenic epitopes. It is also obtained by inactivating the virus through ultraviolet rays by laboratory biosafety level 3 (BSL3). It includes steps like expansion, titration, inactivation and ultracentrifugation of the virus. ^[6,9,10]	Developed by inducing protein S subunit as a recombinant protein subunit within the cell based systems. Risk is development of polarized immune system. ^[6,9]	Developed by genetically engineered weakened viruses such as rubeola, adenovirus or measles to produce coronavirus proteins in the body. There are two types of vaccines – replicating and non replicating viral vector vaccines. ^[11,12]	Immune response is produced by inducing the genetic information i.e. by nucleic acids in the form of RNA and DNA into human cells and then copies of virus's spike proteins are formed in the body. ^[11]

Vaccines across the globe^[6,11,13,14]

Type	Vaccine	Mechanism	Dose	Storage	Efficacy
Inactivated virus	CoronaVac (sinovacbiotech,china)	Inactivated CNO2 Strain created from vero cells of covid-19 virus.	3µg (2 doses in 14 days)	2-8°C	50%
	BBIBP-CorV (sinopharm 1/2, china)	Inactivated HBO2 strain created from vero cells of virus.	4µg (2 doses in 21 days)	2-8°C	79%
	BB15V2 / Covaxin (Bharatbiotech, India)	Inactivated covid-19 virus with a beta-propiolactone chemical	2 doses in 28 days	2-8°C	81%
Viral vector	Ad26.CO2. S (Johnson & Johnson, US)	Adenovirus vector with spike protein of covid-19 virus.	5×10 ¹⁰ viral particles (1 dose)	2-8°C (3 months) ; -20°C (2yrs)	72%
	ChAdOx1/A ZD1222 [Covishield] (Oxford/Astra Zeneca, UK)	Adenovirus vector with spike protein of covid-19 virus.	5×10 ¹⁰ viral particles (2 doses in 28 days)	2-8°C (6 months)	82%
	Sputnik V / Gam-CovidVac (Gamaleya, Russia)	Adenovirus vector with spike protein of covid-19 virus.	10 ¹¹ viral particles (2 doses in 21 days)	2-8°C (6 months) ; -20°C (2yrs)	91.6%
Protein subunit	NVXCov2373 (Novovax, US)	Recombinant full length, perfusion S protein	5 µg + 50 µg (2 doses)	2-8°C (6 months)	86%
mRNA vaccine	mRNA1273 (moderna, US)	Encoded mRNA with spike protein in lipid nanoparticle.	100µg (2 doses in 28 days)	-25 to -15°C; 2-8°C for 30 days	94%
	BNT162b2 (Pfizer-BioNtech, US)	Encapsulated in lipid nanoparticles with mRNA and spike protein.	30µg (2 doses in 21 days)	-80 to -60°C; 2-8°C for 5 days	95%
	CVnCoV (GlaxoSmithKline, Germany)	Stabled and perfused length of S protein of virus.	12µg (2 doses in 28 days)	2-8°C for 6 months	unknown

Vaccines in India

A huge vaccination drive in India has been started on 16th January 2021 with two vaccines Covishield and Covaxin but on 1st May 2021 India has received the first lot of third vaccine i.e. Sputnik V from Russia. The drugs controller general of India has approved these vaccines for public use. The government of India has decided to vaccinate the population above 18yrs of age by August 2021. Vaccination is contraindicated in pediatric age group, pregnant and lactating women but can be extended after ensuring post marketing surveillance results of the vaccines.^[15,16]

1. Covishield vaccine – This is a viral vector vaccine which is manufactured by the Serum institute of India but developed by Astra Zeneca with Oxford university, UK and labelled as AZD1222. Immune response is generated by using the recombinant technology which is used to deliver the adenoviral vector (ChAdOx1) from chimpanzees containing glycoprotein antigen of spike protein of Covid-19 virus.^[7,15] 0.5 ml dose of vaccine is administered in people and it requires 2°C - 8°C storage requirements. Studies of interim analysis shows that efficacy of vaccine after 1st dose is 62% and after 2nd dose it is near about 90%. In some studies it is noticed that after 1st dose at 14th day the T-cell response is high and at 28th day the anti-spike IgG antibody response is high so the 2nd dose for boosting effect is given between 4 to 8 weeks of first dose after which neutralising antibody effect is generated in the body.^[8,14,17]

2. Covaxin vaccine– Bharat Biotech manufactured this vaccine in collaboration with ICMR (Indian Council of Medical Research). The immune system from this vaccine is generated by inactivated whole virion of SARS-CoV-2.^[15,17] It is labelled as BBV152. Bharat Biotech received the isolated and sequenced virus strain from ICMR-NIV (National Institute of Virology) to develop Covaxin which is then

formulated with TLR 7/8 agonist molecule absorbed to alhydroxiqum-II (algel IMDG). 0.5 ml dose is administered intramuscularly in each dose and it requires 2°C - 8°C temperature for storage. Th1-biased response was reported in first phase clinical trial of BBV152 vaccine and it is the first vaccine which induced this response and in 2nd phase trial the T-cell memory response was induced. Due to strong production of cell mediated and humoral antibody response, it is hypothesised that immune response may last for 12 months after the 2nd dose.^[18,19] According to ICMR the multiple variants and double mutant strain of SARS-CoV-2 virus has been found in India gets neutralised by Covaxin.^[20]

3. Sputnik-V Vaccine - Gamaleya National Center of Epidemiology and Microbiology in Russia has developed Sputnik-V Covid-19 Vaccine which was recently approved by India for its population.^[21] Sputnik-V is a viral vector vaccine based on heterologous recombinant adenovirus (rAd), which contains the combination of two viral vectors i.e. rAd type 26 (rAd26)18 and rAd type 5 (rAd5). rAd5 and rAd26 comprises a gene of spike protein S of Covid-19 virus and it becomes rAd5-S and rAd26-S. rAd26-S is given as first dose and rAd5-S is given as second dose.^[22,23,24] It requires the 21 days interval between first dose and second dose and 0.5ml is administered intramuscularly into the deltoid muscle .in each dose. Single immunisation of viral vector vaccines like Covishield and sputnik-v may induce cellular and humoral immunity both, that's why these vaccines are allowed in pandemic as a emergency prophylaxis tool. In addition of double immunisation produce long lasting immunity. The interim analysis shows that vaccine's efficacy is about 91.6% against covid-19.^[21,22] Earlier in the month of April the study of Argentina shows that people had those antibodies in their body after the completion of both the doses of Sputnik-V which are effective against the UK variant B.1.1.7 variant.^[21,25]

Adverse effects of vaccines –

Local side effect	Systemic side effect	Rare side effects
Redness at injection site	Fever	Appendicitis
Swelling at injection site	Headache	Thromboembolism
Pain in arm for 3 days	Chills	Myocardial infarction
Rashes on arm	Vomiting	Cerebrovascular accident
Itching on arm for 3 days	Diarrhoea	Shoulder injury
	Body pain	
	Lymphadenopathy	
	Joint pain	
	Bell's palsy (sudden weakness in the muscles of half of the face)	
	Myalgia	
	Dizziness	
	Vertigo	
	Palpitation	
	Chest pain for 1 day	

Thromboembolism a rare side effect of Covishield–

Many European countries had banned the Covishield (AZD1222) vaccine for their population because cases of thromboembolism (formation of blood clot) had reported after vaccination. 5 million people had received the ChAdOx1-nCoV-19 in European area by march 2021 but 30 cases from this had been reported of thromboembolism.^[26,27] In early march Germany had reported 9 cases of thrombocytopenia and intra cranial venous sinus thrombosis in recipients of Oxford-AstraZeneca vaccine against the covid-19 pandemic.^[28] In UK 20 million people had received Covishield vaccine and among these 79 individual had been reported with thromboembolism with thrombocytopenia and with 19 causalities. The study of new England journal of medicine also shows that there are 11 patients of median age of 36 yrs had developed thromboembolism between 5 to 16 days after vaccination. The researchers had tested their blood samples and blood samples showed the presence of antibodies against platelet factor 4 (PF4) with no previous exposure of heparin but researchers cannot concluded the study yet that whether these antibodies are autoantibodies which are produced by vaccination as an inflammatory stimulus or vaccine produced these antibodies which cross react with platelet factor 4 and platelets. After the observations researchers suggested that thromboembolism with thrombocytopenia due to Oxford AstraZeneca vaccine is a rare immune

response which is similar with heparin induced thrombocytopenia i.e. a rare side effect due to heparin. On April 7, 2021 the UK's Expert Haematology Panel has suggested the use of intravenous immunoglobulin, avoiding platelet transfusions, and non-heparin blood thinners as a management therapy for thrombosis and thrombocytopenia induced after vaccination.^[29,30]

CONCLUSION

Vaccination is the only way to achieve protective level of Herd immunity against COVID-19 infection. Vaccination should be received by everyone whether those who have suffered from COVID-19 in past or those who hasn't suffered from it yet. People who are suffering from any underlying disease like diabetes, liver disease, heart disease etc. must get vaccinated to fight against COVID-19 infection. People can receive any vaccination from the available three vaccination in India as clinical trials and various studies shows that all three vaccines which are available in India are safe have enough efficacy. It is recommended that anyone if develops the serious side effects which is very rare after vaccination should seek prompt medical advice.

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