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COVID-19 Vaccine Development in India during Janaury 2021- December 2021: A Narrative Review

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Abstract

The review was undertaken to evaluate the development of COVID-19 vaccines in India. This review highlights the different types of platforms to develop COVID-19 vaccines, about the safety and efficacy of available COVID-19 vaccines and various strategies applied by government to increase vaccination doses in India. The analysis was done based on data extraction from online electronic databases and utilized all the data available from the WHO, CDC, Indian Government and State Government official portal for COVID-19 vaccines. Search engines like Google Scholar and PubMed were thoroughly searched for keywords like term "COVID-19 vaccines [AND] India, COVID-19 vaccine development [AND] India", "COVID-19 vaccine Safety and efficacy [AND] India", "COVID-19 vaccination [AND] India". Forty articles were searched based on titles, 10 were excluded after reading the abstract. After scrutinizing all retrieved data only ten highly relevant articles were included in the final analysis. Data available from official portal for COVID-19 vaccination daily updates were collected and used as source data for the current study. Hence the data given in the study completely available from the public source. Despite significant increases in the number of well-trained health personnel, facilities, and sophisticated medical equipment, as well as increased access to and sharing of up-to-date scientific and medical information in many countries, the COVID-19 pandemic has proven that pandemic preparedness remains a major global issue that must be addressed urgently.

Keywords: COVID-19 Vaccines, India, Pandemic, Immunisation.

INTRODUCTION

The novel corona virus known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has spread over the world at rapid speed, resulting in over 278 million cases and 5.4 million deaths have been reported globally till December 2021[1]. The coronavirus disease 2019 (COVID-19) pandemic necessitates a rapid assessment of multiple potential techniques in order to establish protective immunity and safety while reducing unwanted immune potentiation, which plays an essential role in the virus's pathogenesis [2].

The pandemic has had an influence on practically every aspect of life, forcing global economies to stop, altering how people work and interact with each other, and pushing healthcare systems to their breaking point. To stop the virus from spreading, governments all around the world have been compelled to impose severe limitations on human activity [3].

Other than treating symptomatic patients, the prevention and control of the epidemic in 2020 included monitoring asymptomatic infections, follow-up and monitoring after cure and discharge, close contact tracking, high-risk population screening, and disinfection of the epidemic source, but effective vaccination is the only way to completely eliminate

COVID19 infections. Vaccines cause the body to generate certain proteins. When the body is exposed to this pathogen again, antibodies are produced with an amnestic reaction [4].

At least nine different technology platforms are being researched and developed in order to build an effective COVID19 vaccine [4]. Nucleic acid technologies (nucleoside-modified messenger RNA and DNA), non-replicating viral vectors, peptides, recombinant proteins, live attenuated viruses, and inactivated viruses were among the platforms being developed in 2020 [4, 5].

Scientists throughout the world are working to develop and produce COVID-19 vaccines. Around the world, there are now and 194 candidates in pre-clinical development, 38 vaccines are in Phase 1, 44 vaccines are in Phase 2, 39 vaccines are in Phase 3, 23 vaccines are in use and 10 vaccines are in Phase 4 [6]. WHO has listed the Pfizer/BioNTech vaccine for emergency use on 31 December 2020; two AstraZeneca/Oxford COVID-19 vaccines on 15 February 2021, produced by AstraZeneca-SKBio (Republic of Korea) and the Serum Institute of India; and COVID-19 vaccine Ad26.COV2.S developed by Janssen (Johnson & Johnson) on 12 March 2021, Moderna vaccine on 30 April 2021, Sinopharm COVID-19 on 7 May 2021, Sinovac-CoronaVac COVID-19 vaccine on 1 June 2021, COVAXIN (developed by Bharat Biotech) on 3 November 2021. The World Health Organization is coordinating vaccine distribution operations around the world, with the goal of distributing two billion doses by the end of 2021. Through the COVAX Facility, it is leading an initiative to ensure that all countries have equal access [7-11].

By the end of September 2021, WHO had set a goal of vaccinating 10% of every country, economy, and territory, but 56 countries had failed to do so, the vast majority of which are in Africa and the Middle East. The new strategy lays out a method for meeting WHO's goals of vaccinating 40% of the population of every nation by the end of this year and 70% by the middle of 2022 [12].

India began administration of COVID-19 vaccines on 16 January 2021 [13]. As of December 2021 India has approved eight COVID-19 vaccines Covishield, Covaxin, Sputnik V, ZyCoV-D Johnson & Johnson's vaccine, Moderna vaccine, Covovax and Corbevax [14]. As of December 2021, India's Covid vaccination coverage exceeds 145 crore, including first and second dose of the currently approved vaccines [15]. In India, 69% of those above 60 years have been fully vaccinated, 73% in the 45-59 age groups have been fully vaccinated and 55% of the 18-44 age groups have received both doses [16].

Regarding the efficacy of COVID-19 vaccines, unvaccinated persons were 5 times more likely to be infected, 10 times more likely to be hospitalized, and 11 times more likely to die than fully vaccinated people, according to the CDC [17, 18].

Existing evidence suggests that various vaccine candidates could help protect people and slow the spread of a pandemic. Because the conceptual and technological platforms used are so diverse, different vaccinations are likely to be better suited to different segments of the human population.

Thus, the present review was conducted to evaluate the development of COVID-19 vaccines in India. This review highlights the different types of platforms to develop COVID-19 vaccines, about the safety and efficacy of available COVID-19 vaccines and various strategies applied by government to increase vaccination doses in India.

MATERIAL AND METHODS

The analysis was done based on data extraction from online electronic databases and utilized all the data available from the WHO, CDC, Indian Government and State Government official portal for COVID-19 vaccines. Search engines like Google Scholar and PubMed were thoroughly searched for keywords like term “COVID-19 vaccines [AND] India, COVID-19 vaccine development [AND] India”, “COVID-19 vaccine Safety and efficacy [AND] India”, “COVID-19 vaccination [AND] India”. Forty articles were searched based on titles, 10 were excluded after reading the abstract. After scrutinizing all retrieved data only ten highly relevant articles were included in the final analysis. Data available from official portal for COVID-19 vaccination daily updates were collected and used as source data for the current study. Hence the data given in the study completely available from the public source. Literature search covering the electronic databases: Cochrane library, PubMed, Pubmed Central, Science Direct and google scholar. Case reports, editorials, case series, Previews, reviews, comments were searched to sought out the information for COVID-19 vaccine development.

RESULTS

Table-1: Describes COVID-19 vaccines granted for emergency use approval in INDIA and their effectiveness in prevention of COVID-19 infection.

Vaccine Company	Vaccine Name	Type Of Vaccine	Number of Doses	Efficacy
Oxford–AstraZeneca	Covishield	Viral Vector	2	81.6% [19]
Bharat-Biotech	Covaxin	Inactivated	2	78% [20]
Gamaleya	Sputnik V	Viral Vector	2	94.3% [21]
Moderna	Spikevax	mRNA	2	94.1% [22]
NOVAVAX	Covovax	Subunit	2	90.0% [23]
Zydus Cadila	ZyCoV-D	DNA	3	66.6% [24]
Johnson and Johnson	Johnson and Johnson	Viral Vector	1	75.0% [25]
Biological-E	Corbevax	Subunit	2	90.0% [26]

DISCUSSION

COVID-19 Vaccination rollout in India

Fig-1: India began administration of COVID-19 vaccines on 16 January 2021 [28]

The government of India has constituted a National Expert Group on Vaccine Administration for COVID-19 (NEGVAC) to provide guidance on all aspects of COVID-19 vaccine administration in India [8, 9]. India began administration of COVID-19 vaccines on 16 January 2021 [27].

As of December 2021, India's Covid vaccination coverage exceeds 145 crore, including first and second dose of the currently approved vaccines [29]. In India, 69% of those above 60 years have been fully vaccinated, 73% in the 45-59 age group have been fully vaccinated and 55% of the 18-44 age group has received both doses [31].

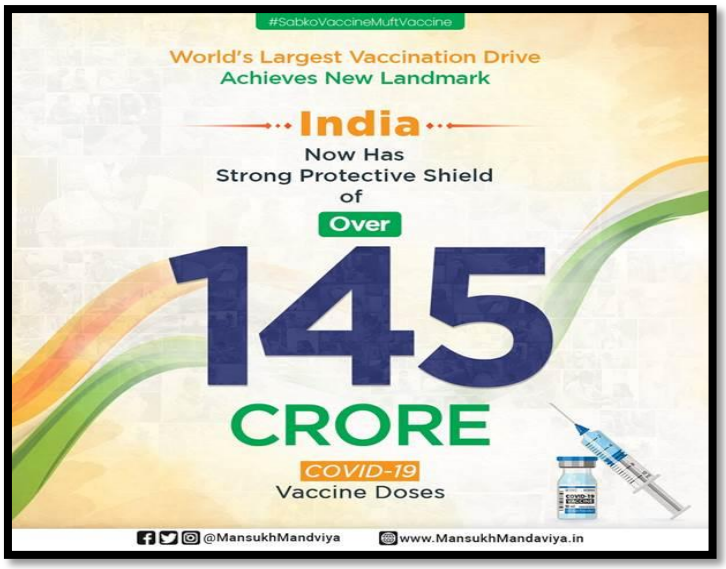

Fig-2: As of December 2021, India's Covid vaccination coverage exceeds 145 crore [30].

The Drug Controller General of India (DCGI) certified the Oxford–AstraZeneca vaccine for emergency use on January 1, 2021. (local trade name "Covishield") [32]. BBV152 (trade name "Covaxin"), a domestic vaccine produced by Bharat Biotech in collaboration with the Indian Council of Medical Research and the National Institute of Virology, received an interim emergency use authorization from the DCGI on January 2,2021 [33]. Health personnel and frontline employees, such as police, paramilitary forces, sanitation workers, and disaster management volunteers, were involved in the first phase of the implementation. Only 14 million healthcare and frontline employees have been vaccinated as of March 1, falling short of the 30 million target [34, 35].

All individuals above the age of 60, residents between the ages of 45 and 60 with one or more qualifying comorbidities, and any health care or frontline worker who did not receive a dose during phase 1 were included in the next phase of the vaccination rollout. On March 1, online registration for the Aarogya Setu app and the Co-WIN ("Winning over COVID-19") website opened [36, 37].

All individuals over the age of 45 have been eligible since April 1, 2021. Prime Minister Narendra Modi announced on April 8,2021 that a four-day Teeka Utsav ("Vaccine Festival") will be held from April 11, 2021 to April 14,2021 with the purpose of speeding up the vaccination programme by vaccinating as many eligible residents as possible. India had reached a total of over 111 million vaccination doses by the end of the Utsav [36-41].

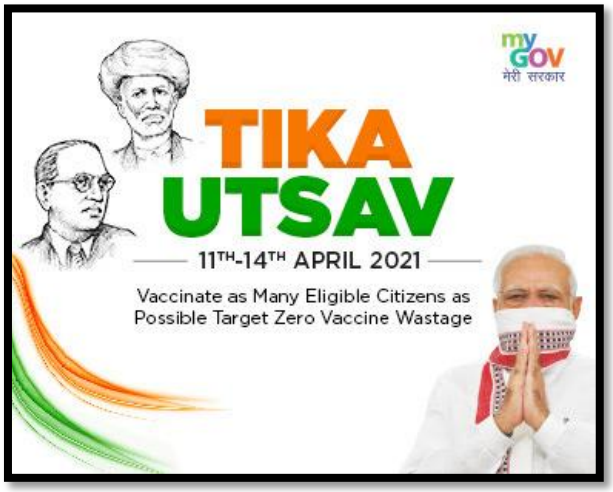

Fig-3: Tika Utsav was a four day mass vaccination programme for COVID-19 from April 11, 2021 to April 14, 2021 announced by the Prime Minister of India Narendra Modi in view of the resurgence in the COVID-19 cases in the country with the aim to vaccinate maximum eligible people [42].

On 12 April 2021, the DCGI approved Russia's Sputnik V vaccine for emergency use in India [43]. On April 19, 2021, it was announced that the next phase of the vaccination programme will begin on May 1, 2021, with all residents over the age of 18years becoming eligible [44]. On 13 May 2021, the DCGI approved phase 2 and phase 3 trials of Covaxin on children 2–18years. The union administration authorised walk-in vaccination registrations across the country on May 23, 2021, with a health worker at the vaccination Centre registering the recipient in the Co-win vaccination database [45]. In an affidavit to the Supreme Court, the administration claimed that as of June 23, 2021 around 78 % of vaccines had been delivered via walk-in registration [46].

On May 31,2021 an affidavit was filed in India's Supreme Court, asking a review of the central government's vaccine distribution plan, claiming that the decision to distribute free vaccination shots solely to priority workers and residents above the age of 45 was "prima facie arbitrary and irrational [47]."

India reached a milestone of over 300 million vaccination doses provided on June 23, 2021 [48]. India surpassed the United States in total vaccination doses administered on June 28, 2021 [49]. The DCGI approved the Moderna vaccine (imported by Cipla) for emergency use in India on June 29, 2021 [50].

India reached the 500 million doses milestone on August 6, 2021, just six months after the vaccination programme began [51]. The Drug Controller General of India (DCGI) approved the Johnson & Johnson single-dose vaccine for emergency use on August 7, 2021 [52].

On 20 August 2021, India granted emergency use approval to the world's first DNA based COVID-19 vaccine, ZyCoV-D manufactured by Zydus Cadila for adults and children aged 12 years and above. The vaccine is administered using a needle-free applicator. The government announced on 30 September 2021 that the ZyCoV-D vaccine will be a three dose vaccine and it will be included in the Covid vaccination programme of India [53-55].

By August 26, 2021, 50% of India's adult population has received at least one dose of recommended vaccines, with 99 % coverage among healthcare workers and 100% coverage among front-line workers for the first dosage [56]. India achieved a new global record on August 27, 2021, when it administered more than 10 million (1 crore) doses of COVID-19 vaccine in a single day [57].

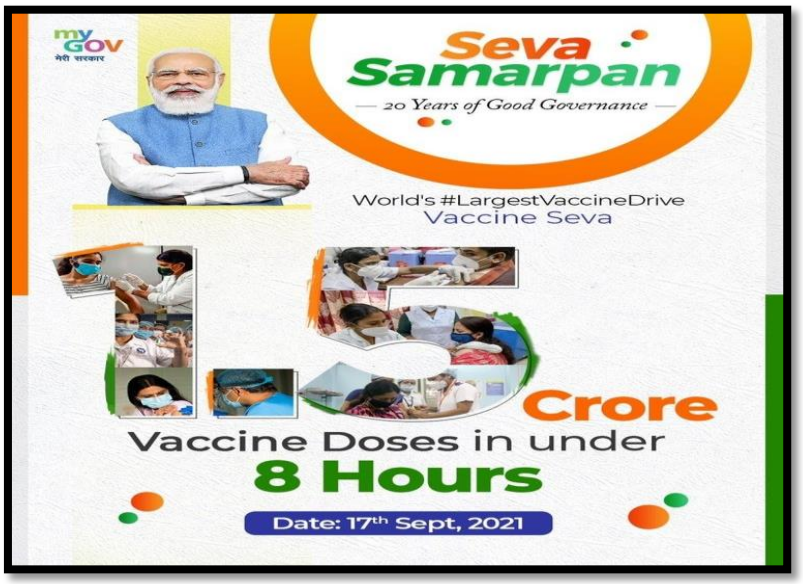

Fig-4: 'Vaccine Seva' campaign on Narendra Modi's birthday, September 17th, 2021 [58]

According to the Ministry, 25 million people were vaccinated as part of the 'Vaccine Seva' campaign on Narendra Modi's birthday, September 17th, 2021. This was the world's biggest single-day vaccination total to date [58].

On September 28, 2021, the government and India's drug regulator allowed vaccine manufacturer Serum Institute to enroll children aged 7 to 11years in its COVID-19 vaccine trial [59]. India reached a milestone of one billion doses administered on October 21, 2021 [60].

By December 2021, as announced by Prime Minister Narendra Modi it was decided that India would begin administering booster shots from January 10, 2022 to health and frontline workers and those over 60 with comorbidities or other health problems. He also

said vaccinations will begin for children between 15 and 18 years from January 3, 2022 [61]. The only covid vaccination available for children aged 15 to 18years is Covaxin [62]. India has approved eight COVID-19 vaccines. It's currently using only three - Covishield, Covaxin by Indian firm Bharat Biotech and Russian-made Sputnik V - for its vaccination drive. Of these, Covishield accounts for over 90% of the doses given so far. It also approved ZyCoV-D vaccine - the world's first DNA vaccine against Covid - by Indian firm Cadilla, but it's not available yet. The federal government had also approved Johnson & Johnson's single-dose vaccine, which was to be introduced in India through a supply agreement with Biological E; and it had authorised Indian pharma company Cipla to import the Moderna vaccine. But it's unclear when either of those will be available in India. In response to fears of a third wave fueled by Omicron, India has approved two additional vaccines, expanding its programme. The new vaccines, Covovax from the Serum Institute of India and Corbevax from Biological

E, have both been approved for "limited use in emergency situations. "More than 1.4 billion doses have been administered so far in the country. The government had hoped to vaccinate all Indians by the end of the year 2021, but it has fallen short. Since the programme began in January 2021, almost 62% of eligible adults have been fully vaccinated, and more than 90% have received at least one dose [63, 64].

CONCLUSION

Despite significant increases in the number of well-trained health personnel, facilities, and sophisticated medical equipment, as well as increased access to and sharing of up-to-date scientific and medical information in many countries, the COVID-19 pandemic has proven that pandemic preparedness remains a major global issue that must be addressed urgently. SARS, MERS, Ebola, and numerous influenza outbreaks were all contained before they became global pandemics; nevertheless, the ongoing COVID-19 pandemic has demonstrated that the world has to reassess its emergency preparations and enhance its preparedness for future outbreaks.

The rapid development and commercial availability of COVID-19 vaccines has been a bright spot during this pandemic. This has been made possible in great part by targeted international collaborative research and scientific initiatives, as well as major financial resources from governments, individuals, institutions/international organisations, and philanthropists. Despite the fact that developing COVID-19 vaccines in less than a year was one of the most significant breakthroughs in medical science history, with the emergence of new COVID-19 variants, future research must focus on vaccines that have the potential to act against new variants to either stop transmission or infection**.**

Despite this, a number of key concerns persist, including vaccination availability/distribution around the globe, price, and an increase in vaccine hesitancy. If the full promise of COVID-19 vaccinations is to be realised for all individuals in all countries, regardless of socioeconomic position, cultural and/or religious backgrounds, strong political will and leadership, as well as coordinated public health campaigns and communications, will be required. This is the challenge that lies ahead of mankind.

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