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Exploratory analysis of cost of Covid-19 vaccines in India

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***Abstract**: This research paper presents a status analysis of the cost of Covid-19 vaccines in India. The status analysis includes the cost of different vaccines and changes made by the Central government in the prices of vaccines during the pandemic. The ramping up of vaccine production and timely procurement from manufacturers was another remarkable effort by the Central government. The research paper further elaborates upon the challenges faced with respect to communication and making a larger population aware of the benefits of vaccination, commitment and responsibility of Government of India (about the vaccination program to save the lives of its citizens). Based on this research, it is concluded that India has vaccinated large part of the population, and caped the prices to an optimal level as compared to other economies, without forcing its citizens to pay for vaccines. It is also observed that even though awareness of vaccine availability, efficacy, and price among urban and semi-urban people of all age and gender was high. Moreover, the percentage of vaccination was initially low due to economic and social factors. Based on the analysis, it is suggested that the health sector (which is a part of state list) should be made a part of the concurrent list so that central government and state governments can share responsibility and fight future scenarios together more effectively.*

***Keywords**: Covishield, Covaxin, Sputnik, Covid-19, Free Vaccines, New Vaccine Policy, Cost of Vaccines*

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Eksploratorna analiza troškova Covid-19 vakcina u Indiji

***Apstrakt**: Ovaj istraživački rad predstavlja analizu cene vakcina protiv Covid-19 u Indiji. Analiza stanja uključuje cene različitih vakcina i promene u cenama vakcina tokom pandemije koje je izvršila Centralna vlada. Pojačavanje proizvodnje vakcina i blagovremena nabavka od proizvođača bio je još jedan izuzetan napor Centralne vlade. U radu se dalje razrađuju izazovi sa kojima se suočava komunikacija i podizanje svesti veće populacije o prednostima vakcinacije, posvećenosti i odgovornosti Vlade Indije (o programu vakcinacije da bi se spasili životi njenih građana). Na osnovu ovog istraživanja dolazi se do zaključka da je Indija vakcinisala veliki deo stanovništva, i svela cene na optimalan nivo u poređenju sa drugim privredama, ne primoravajući svoje građane da plaćaju vakcine. Takođe se primećuje da je svest o dostupnosti vakcine, efikasnosti i ceni bila visoka među urbanim i delimično urbanim stanovništvom svih uzrasta i pola. Štaviše, procenat vakcinacije je u početku bio nizak zbog ekonomskih i društvenih faktora. Na osnovu analize, predloženo je se da zdravstveni sektor (koji je deo državne liste) bude deo konkurentne liste kako bi Centralna vlada i državne vlade mogle da dele odgovornost i da se zajedno efikasnije bore protiv budućih scenarija.*

***Ključne reči**: Covishield, Covaxin, Sputnjik, Covid-19, besplatne vakcine, nova politika vakcina, cena vakcina*

1. Introduction

The National COVID Vaccination Program in India is based on epidemiological and scientific research, WHO recommendations, and international best practices. It is accomplished by efficient and effective engagement from States/Union Territories and the general public, in addition to systematic end-to-end planning. The Indian government has been steadfast and proactive in its commitment to vaccinate and its immunization policy. GOI has strengthened every aspect about vaccines and their delivery to citizens as soon as possible. Presently five vaccines are approved in India for emergency usage. These include Covishield from Serum Institute, Covaxin from Bharat Biotech, Sputnik V from Russia, Moderna, and the single-dose vaccine from Johnson & Johnson (J&J). Additionally, Zydus Cadila's anti-Covid vaccine ZyCoV-D, which was created in India and received regulatory approval from the Drugs Controller General of India (DCGI) for emergency use, is the first DNA-based vaccine for the novel corona virus and will be given to adults and children over the age of 12 worldwide (Dey & Mukherjee, 2021).

First phase of vaccination started on January 16, 2021. This phase was planned to vaccinate 30 million healthcare and front-line workers. They were vaccinated first. Moreover, phase 1 vaccinated 270 million citizens above and below 50 years of age having co-morbidities (Perappadan, 2021). The second phase of vaccination started on March 01, 2021 covering all citizens over 60 years of age, i.e., additional 100 million citizens. Second phase also covered people above 45 years with 20 co-morbidities as defined by Central Ministry of Health & Family Welfare (MHFW) (Saikia, 2021). Third phase of Covid-19 vaccination started on April 01. Every citizen who is older than 45 years is eligible for vaccination (Express Web Desk, 2021). The vaccination drive for youth, i.e., 18+ years of age started on May 01, 2021. But due to shortage of vaccines only six states could start the vaccination (TNN, 2021).

The program of vaccination faced many challenges such as shortage of vaccine, procurement prices for State & Central Government, and private hospitals, registration for vaccination, prices charged by private hospitals, legal framework of the country (Healthcare is a state subject in India), fake news etc. Irrespective of these challenges faced by MHFW, the program of vaccination may be termed as success. Keeping in view the national and international importance of vaccination program of India which is price regulatory regime by government, this research paper presents the dynamics and actual facts about price of vaccines- to citizens, state governments, central government, private hospitals, and manufacture. In addition, research paper includes result of a pilot study about the awareness of selected facets of Covid-19 vaccines in rural and semi urban areas of State of Haryana, one of the northern states of India.

The research paper is divided into eight sections starting with first section of introduction. It is followed with section 2 which presents a brief of data analyzed in the study and research questions. Section 3 lists the role of state and central government. The next section 4 presents the changing rules of Covid-19 vaccines prices. Section 5 presents the data with respect to capping price of vaccines to the private hospitals. Section 6 presents the data and analysis of procurement cost to the central government with new vaccination policy. Section 7 lists the analysis and data of pilot study. The last section presents the framework or policy document arrived at by central government and possible answers of research questions based on data presented in the article.

2. Literature review

The review of literature was mainly done within the databases of available literature to the researchers. The search to identify literature using keywords "vaccine" OR “Covid -19" OR "vaccine prices" was done in the subject area of pharmaceutical sciences, medical sciences and management sciences. Out of

these, further short listing was done on the basis of relevance of topic. The search was further enriched by adding research papers which were available in the existing electronic data bases with two objectives. To set the design of the present study and identify research questions /hypotheses/ propositions of the present study. The review is presented in chronological order both in the form of text and a summary table.

Lu and Comanor (1998) studied major variables that influence drug pricing, both at launch and 4, 6, and 8 years afterwards. The degree of therapeutic advancement a new product incorporates is crucial. Drugs that substantially mimic the activities of currently on the market medications are often priced at comparable levels, whereas drugs that represent significant therapeutic advances can have launch prices that are two or three times that of currently available drugs used for the same objectives. Additionally, the availability of branded alternatives significantly lowers launch pricing, emphasizing the significance of market competition. Thus, duplicate products have a significant economic impact on the pharmaceutical business.

Ekelund (2001) studied completion and innovation in Swedish market and identified many differences in regulated market and not so regulated markets. He compared the pricing of new pharmaceuticals in the Swedish market where prices are regulated, with the results of Lu and Comanor (1998) who conducted research on the US market's new drug price. He discovered that in the context of the Swedish market, some of the pricing restrictions imposed by the regulator counteract the disciplinary consequences that market forces bring.

McGuire (2003) found that, despite the significant social benefit of new vaccinations, there do not seem to be strong incentives for businesses to create new vaccines. He underlined the importance of deciding on a purchase price before new vaccine development linking process to expected benefits. He further emphasized that a supply price of vaccine based on efficient levels of investment must be found ahead of development to make them cost-effective. His analysis identified that the costs of effective vaccines are significantly higher than the costs associated with developing new vaccines.

Brekke et al (2009) noted that price cap regulation and reference pricing are two examples of price control strategies used in the pharmaceutical industry to limit medical expenses to patient. The price cap law prevents pharmaceutical companies from exploiting the market. Whereas, reference pricing mechanism stimulates competition by making demand for pharmaceuticals flexible in price. They studied relationship between pricing methods used by pharmaceutical companies and regulatory frameworks. They examined a novel policy experiment in Norway that replaced the price cap (PC) regulation with a reference price (RP) system (referred to as "index pricing" in 2003) for a sample of off-patent medications. They came to the conclusion that RP significantly

lowers brand-name and generic pricing within the reference group. They noticed that brand names had a bigger impact.

Lee and McGlone (2010) reported that the following eleven elements make up pricing strategy of new vaccine: (i) Analyze the target population; (ii) Locate prospective rivals and alternatives; (iii) Create a target product profile (TPP) for the vaccine and assess it against anticipated or real TPPs for rival vaccines; (iv) Calculate the incremental value of the traits of the new vaccination; (v) Ascertain the position of vaccines in the market; (vi) Calculate the price-demand curve for vaccines; (vii) Determine the costs associated with producing, distributing, and developing vaccines; (viii) Take into account numerous legal, regulatory, third-party payer, and competitive issues; (ix) Take the entire product portfolio into account; (x) Establish pricing goals; (xi) choose prices and pricing structures.

Dylst and Simoens (2011) investigated the relationship between the market share of generic drugs and the shift in the level of drug prices in European off-patent marketplaces, it was discovered that the countries with high generic market share had greater price reductions than the countries with low market share. Hecht et al. (2011) emphasized a transparent pricing policy for vaccines in relation to rich and poor nations. They mentioned that price transparency for vaccines appeared to be especially important for middle-income countries, which were currently in the dark when negotiating with manufacturers to purchase the new vaccines.

Jacobson (2012) mentioned that vaccine pricing is a complex process. This phenomenon has support across the globe. He reviewed the thoughts of many researchers on the cost and price of the vaccine in the context of many factors that are taken into consideration in pricing the vaccines. Proano et al. (2012) advocated that Combination vaccinations can be priced as a single item since they are collections of antigens. They formulated an optimization problem (mixed integer non-linear programming) that establishes the distribution of combination vaccines between vaccine producers and various nations under a price discrimination agreement with the aim of meeting antigen demand for countries at the most affordable price while ensuring a reasonable profit for the vaccine producers. Additionally, they offered a constructive heuristic as a means of estimating the optimum distribution of combination vaccines and their potential price range.

Robbins and Jacobson (2015) found that selection of affordable vaccines and charging the right price for vaccines were the main factors for the success of immunization program. They concluded that, due to limited profitability, the pediatric vaccine sector only comprises of a small number of pharmaceutical companies that are involved in the research, development, manufacturing, and distribution of pediatric vaccines.

Chen et al. (2017) examined a number of variables that affected the cost of non-influenza childhood vaccinations purchased by the public sector between 1996 and 2014. They concluded that relations of the factors differ between combination vaccinations and vaccines with price caps. Additionally, they noticed an actual pricing trend for non-price-capped vaccinations that was rising with time but was mostly offset by the impact of the market longevity. When manufacturer and vaccine component fixed effects were not taken into account in the model for analysis, the effect of competition in lowering costs was more pronounced in cases of non-price-capped vaccinations.

Chaterjee et al. (2018) reported that India presently allots about US$25 (1,951) per kid for vaccines and administrative costs for its universal immunization program. They examined many cost categories in the Indian context, including staff, vaccines and supplies, travel and transportation, training, maintenance and overhead costs, incentives, and the annual worth of capital expenditures like cold chain, buildings, and cars.

Hussain et al. (2020) discovered that the expense of necessary technology and research and development operations accounts for the higher prices of recently introduced vaccinations. However, costs fall with time as a result of the Global Alliance for Vaccine Initiative (GAVI) and other stakeholders' involvement. Additionally, they discovered that UNICEF and other high-income nations charged far higher costs for vaccines than those in China, a country with high demand. With the help of organizations like the World Health Organization (WHO), GAVI, UNICEF, and the Pan American Health Organization-Relieving Fund (PAHO-RF) and through the use of tendering processes without any market failure, it can be concluded from this review that affordable vaccine prices can be achieved.

Wouters et al. (2021) mentioned that to tackle COVID-19, there is a significant need for vaccinations to be manufactured overseas, economically priced, and distributed internationally so that they are available wherever they are required. They have created a dashboard to showcase the salient features of 26 top vaccine candidates, such as their efficacy levels, dosage schedules, storage needs, prices, production capacity in 2021, and stocks set aside for low- and middle-income nations. Additionally, they provide unique data from a survey (n=26 758) on the possible adoption of COVID-19 vaccines that was done in 32 countries between October and December 2020. Vietnam (98%), India (91%), China (91%), Denmark (87%), and South Korea (87%) had the highest vaccination acceptance rates, whereas Serbia (38%), Croatia (41%), France (44%), Lebanon (44%), and Paraguay (51%), had the lowest.

Mohfw.gov.in (2021) reported that Covid-19 Vaccination Program in India is “based on scientific and epidemiological evidence and focuses on systematic end-to-end planning”. It is best on inputs from “Global Best Practices, SOPs of

WHO and recommendations of India's foremost experts in the National Expert Group on Vaccine Administration for Covid-19 (NEGVAC)". It "encourages domestic R&D, domestic manufacturing and efficient administration of vaccination to protect and strengthen country's Healthcare System as well as protect the most vulnerable".

Griffiths et al (2022) estimated cost of vaccination program of Covid-19 for four scenarios', i.e., "Protecting Fully" (US$ 8.4 billion), "Protecting Partially", "Balancing" (US $3.7 Billion), "Leveraging" for 133 countries of middle and low income category. They have also identified financing gaps along with estimate of different components of the costs.

Table 1. Key point of vaccine prices based on review of literature

Author(s)	Key findings
John and Comanor (1998)	Launch pricing for pharmaceuticals with significant therapeutic advantages can be two or three times higher than those of comparable existing medications. On the other hand, medications that mainly duplicate the effects of currently available products are frequently priced similarly.
Ekelund (2001)	It has been discovered that introductory pricing varies with the level of therapeutic innovation. However, Sweden (regulated market) has higher average relative launch prices than other countries. In contrast to what has happened in the US market,
McGuire (2003)	Vaccines have high social value. Vaccine efficient price based on cost effective analysis must be determined in advance before development.
Brekke et al. (2009)	Compared price control mechanisms, i.e., price cap regulation and reference pricing which are used to contain medical expenses to patients in Norway.
Lee & McGlone (2010)	Presented eleven components of new vaccine pricing strategy.
Dylst & Simoens (2011)	More nations with strong generic market shares than those with low market shares have seen a reduction in drug prices.
Hecht et al (2011)	Suggested pricing transparency for vaccinations becomes particularly pertinent for middle income countries, which are currently in the dark when negotiating with the makers to purchase the new vaccines.
Jacobson (2012)	Reviewed the thoughts of many researchers on the cost and price of the vaccine in the context of many factors that are taken into consideration in pricing the vaccines.
Proano et al. (2012)	Advocated for the pricing of combination vaccinations as single items because they are collections of antigens. Heuristics and a mixed integer nonlinear programming model were used to achieve the goal.
Robbins & Jacobson (2015)	Concluded that a relatively limited number of pharmaceutical companies dominate the pediatric vaccine market as a result of low profitability.
Chen at el. (2017)	They examined a number of variables that affected the cost of non-influenza pediatric immunizations acquired in the public sector between 1996 and 2014.
Chatterjee et al. (2018)	Personnel, vaccinations, supplies, travel, transportation, training, maintenance and overhead costs, incentives, and the annual worth of

	capital investments such as cold chain, buildings, and cars in the Indian context were the cost categories covered in their analysis.
Hussain et al. (2020)	Discovered that China (high demand) had substantially cheaper vaccine prices than other high-income nations and UNICEF.
Wouters et al. (2021)	Built a dashboard to showcase the important traits of 26 top vaccination candidates, including their efficacy levels, dosing schedules, storage needs, cost, and production capacities in 2021.
Mohfw.gov.in (2021)	Presented various facets of India's national Covid-19 vaccination strategy.
Griffiths et al. (2022)	Estimated cost of vaccination program of Covid-19 for four scenarios', i.e., "Protecting Fully", "Protecting Partially", "Balancing", and "Leveraging" for 133 countries.

It is worth to mention that drugs in India are considered essential under essential commodity act but government does not control prices of drugs. It is left to the market forces. National Pharmaceutical Pricing Authority (NPPS) fixes the ceiling price of 884 drugs and retail price of 1533 drugs as on May 2021 (Sahadeva, 2021). These drugs are needed by majority of the citizens and therefore, are under this category. This is the reason government fixes the ceiling prices. It is evident from the review of literature and other data collected for the purpose of research that not much is reported in the literature about policies adopted by government agencies in the context of development, production, and implementation of large vaccination program to control diseases like Covid-19 in a highly regulated pharmaceutical markets of India. This research paper attempts to fill this gap with two main objectives. The first to document what is done in case of pandemic by a country with such a large population which will be useful for future generations. Secondly, to analyze various policies/ decisions made during Covid-19 related to prices of vaccines, development and Covid-19 vaccine program implementation in the country to get more insights.

3. Research methodology

Research methodology of the research paper is exploratory and descriptive in nature and is based on secondary, fragmented data gathered from the website of vaccine manufacturers, news in digital media with respect to various facets of vaccine, websites of government monitoring and regulatory agencies, websites of implementation agencies such as government and private hospitals, and Non- Government Organizations (NGOs) working in heath sector, etc.

The research paper contains sufficient amount of secondary data not so historical but current about prices of Covid-19 vaccines. The qualitative and quantitative secondary data were collected from the various resources on internet as mentioned earlier. The secondary data consists of cost of vaccines

to the manufacturer, price paid by citizens in private hospitals at various locations (it is free in government hospitals), justification of price to citizens, government intervention for keeping upper limit of price, price of vaccines in other countries etc. Secondary data is analyzed in the form of trend analysis, content and event analysis for answering the following research questions:

Research Question 1: Is it right on part of Central Government to have different prices for different vaccines?

Research Question 2: Is it right on part of Central Government to have a cap on prices of vaccines for private hospitals?

Research Question 3: Is it right to include private hospitals in the National Vaccination Program?

Research Question 4: Is it right to include the cost of vaccination in health insurance policies?

Research Question 5: Are the common men aware about the Central Government policies with respect to prices of vaccines?

Research Question 6: What is the level of awareness among different strata of Indian citizens based on different demographics?

Research question 7: Which strategy is best for pricing vaccine of a pandemic such as Covid-19 with reference to strategies suggested by Lee and McGlone (2010)?

Additionally, primary data was collected with a structured questionnaire having three questions of demographics and 8 questions of knowhow of Covid-19 vaccines and 7 statements on perception of citizens about efficacy & availability and price of vaccines on 5-point Likert scale. The 7 statements are as listed in the following. In the subsequent sections the statement numbers will be used in place of complete statement due to paucity of space and better presentation.

Statement 1: I think Covid-19 vaccines are harmless.

Statement 2: I believe the Covid-19 vaccine will successfully guard me against COVID-19 infection.

Statement 3: Covid-19 vaccine is provided by the Government for free.

Statement 4: I believe the Covid-19 vaccines are available in hospitals for cost.

Statement 5: The government has disclosed enough information about the vaccine's efficacy and safety.

Statement 6: I believe it will be helpful in eliminating Covid-19.

Statement 7: I believe Covid-19 vaccine is easily available in my locality.

Primary data was collected from 200 respondents from rural, as well as urban areas, and was analyzed in the form of percentages and frequencies. Likert type data is analyzed for testing the null hypotheses with respect to the differences in mean perception scores for different categories of respondents and in the form of frequency analysis. Likert type data was also subjected to reliability test, and data reduction techniques to find out hidden or latent factors. The data of both categories was analyzed to get possible answers to the research questions and to test null hypotheses with a view to draw meaningful conclusions keeping price regulatory regime prevalent in India.

Null Hypotheses
Null hypotheses to be tested are for original seven statements about various aspects of Covid-19 vaccines & latent variable/factors (identified as a result of factor analysis) as per different categories of three demographics are listed in the following:

Original Seven Statements/ variables
H_o: Mean perception score of respondents for the seven statements as listed above is equal for male and female.
H_o: Mean perception score of respondents for the seven statements as listed above is equal for different categories of Age.
H_o: Mean perception score of respondents for the seven statements as listed above is equal for the respondents living in Urban and semi-urban areas.

Factor/ Latent Variables
H_o: Mean perception score of respondents for the two factors, i.e., efficacy & availability, and price is same for male and female.
H_o: Mean perception score of respondents for the two factors, i.e., efficacy & availability, and price is same for different age categories.
H_o**:** Mean perception score of respondents for the two factors, i.e., efficacy & availability, and price is same for the respondent living in urban and semi-urban areas.

4. Policy decisions and cost of vaccines for different channels

4.1. Policy decisions

Between January 16 and April 30, 2021, the Central Government purchased 100% of the vaccine doses needed for the National Covid Vaccination Program from the manufacturers and gave them free to the State Governments. In turn the state governments would administer free vaccines to the prescribed groups.

The government of India revised the guidelines on 1st May, 2021 on suggestions made by the state governments. Under the revised guidelines, the central government will procure 50% of the vaccines produced and provide them to the states free of cost. Apart from that the states were empowered to procure remaining 50% of the vaccines directly from manufacturers.

States were still facing difficulties in managing and procuring vaccines affecting the vaccination program. On repeated requests from state governments, the guidelines have been reviewed and revised. According to the new vaccine policy revised on 21st June 2021, the Central Government will procure 75% vaccines directly from the vaccine providers and continue to provide free vaccines to the states. To incentivize the production of vaccines and encourage manufacturers they were also given an option to supply vaccines directly to the private hospitals but their supply is restricted to 25% only (Mohfw.gov.in, 2021). Another policy decision which is often subject of criticism across the globe is approval process for emergency use of vaccines. India was no exception to it (Thakur, 2020).

4.2. Evolution of cost of vaccines- Government and private hospitals

India is among the countries in the world which did not demand ordinary citizens to pay cost of Covid Vaccine from their pocket. However, citizens with higher income are opting vaccination in private hospitals and paying out of pocket on their own. Criticism of high cost in private sector hospitals by some experts, academia and politicians did not have any justification. To present empirical evidences, the facts with respect to prices and changes in prices of vaccines in private hospitals along with the views of private hospitals, and prices of vaccines in other parts of world are presented in the following text.

On 27th February, 2021, Dutta (2021) mentioned that manufacturers, representatives of private hospitals, and the government have agreed that vaccine producers will get ₹150 (US$2.03) per jab while hospitals will earn ₹100(US$1.35) per shot.

On 25th April, 2021, Bharadwaj and Mukherjee (2021) reported that Bharat Biotech will charge ₹600(US$8) from state governments and ₹1200(US$16.01) from private hospitals but central government will pay ₹150(US$2) for the same vaccine. On the other hand, another manufacturer (SII) will charge ₹600(US$8) from private hospitals and ₹400(US$5.33) from State Governments but only ₹150(US$2) from central government.

On May 01, 2021, Leo (2021) mentioned that SII tagged price of its vaccine at ₹400(US$5.39) for central and state governments and ₹600(US$8.09) for

private hospitals from May 01, 2021. On May 11, 2021 SII was charging ₹600(US$8.22) per dose from private hospitals. Bharat Biotech's Covaxin is costing ₹1250(US$17.13) to the private hospitals (FE Online, 2021).

4.3. Private hospital and vaccine prices- justification

Tandon (2021) reported that The Indian government advised the states that they could use some 10,000 private hospitals accredited under the Ayushman Bharat Prime Minister Jan Arogya Yojana, more than 600 hospitals accredited under the Central Government Health Scheme, and other hospitals accredited under state health insurance programs as vaccination centers.

Nagarajan (2021) reported on May 05, 2021 that, according to Max hospital representative that for Max hospital, the landed price of Covishield was ₹660-670(US$8.94-9.07), including GST and transportation and storage costs. If one includes 5-6% wastage due to breakage, the landed cost of vaccine per inoculation is approximately ₹710-715(US$9.62-9.68). In addition, the vaccine administration charges including hand sanitizer, PPE kit for staff, biomedical waste disposal etc. comes to ₹170-180(US$2.30-2.43). It makes net cost of ₹900(US$12.19).

Table 2. Cost of vaccines: Covishield Vaccine in different cities in India in private hospitals

Location/ Vaccine	Hospital	Cost/ date (₹ &US $) (10.05.21)	Increase from (₹ & US $) (27.02.21)	Source
Mumbai	H.N. Reliance	₹ 700 ($9.59)	₹ 250 (US$ 3.42)	Nagarajan (2021), Tandon (2021)
Mumbai	Apollo Hospital	₹ 700-900 ($12-12.28)	₹ 250 (US$ 3.42)	Nagarajan (2021), Tandon (2021)
Mumbai	Max Hospital	₹ 700-900 ($12-12.28)	₹ 250 (US$ 3.42)	Nagarajan (2021), Tandon (2021)
Mumbai	Fortis Hospital	₹ 700-900 ($12-12.28)	₹ 250 (US$ 3.42)	Nagarajan (2021), Tandon (2021)
Mumbai	Manipal Hospital	₹ 700-900 ($17-12.28)	₹ 250 (US$ 3.42)	Nagarajan (2021), Tandon (2021)
Mumbai	Max Hospitals	₹ 900 ($12.33)	₹ 250 (US$ 3.42)	Nagarajan (2021), Tandon (2021)
Mumbai	Nanavati Hospital	₹ 900 ($12.33)	₹ 250 (US$ 3.42)	FE Online (2021), ET Online (2021)

On May 11, 2021, FE Online (2021) said that as per industry, several more variables contribute to the pricing discrepancy. For instance, the Apollo Group began talks with Bharat Biotech in November 2020 and procured the vaccine at ₹1,000(US$13.70) per dose. Additionally, Apollo Hospitals are charging ₹200(US$2.74) for administration plus consultation and another ₹50(US$0.68) for GST (The Wire Staff, 2021).

Data of major vaccines costs in private hospitals in India is presented in Tables 2 and 3. It is evident from the data given in the Tables 2 and 3 that private hospitals were charging more than three times in May 2021 in comparison to their charges in February 2021.

Table 3. Cost of vaccines: Covaxin Vaccine in different cities in India in private hospitals

Mumbai	H.N. Reliance	₹ 1250 (US$ 17.13),(10.05.21)	₹ 250 (US$ 3.42)	Nagarajan (2021)
Kolkata	Woodlands Hospital	₹ 1500 (US$ 17.13), (10.05.21)	₹ 250 (US$ 3.42)	FE Online (2021)
Bangalore	BGS GG Hospital	₹ 1500 (US$ 17.13), (05.05.21)	₹ 250 (US$ 3.42)	FE Online (2021)
Bangalore	Manipal Hospital	₹ 1350 (US$), (05.05.21)	₹ 250 (US$ 3.42)	Nagarajan (2021)
Goa	Manipal Hospital	₹ 1350 (US$), (10.05.21)	₹ 250 (US$ 3.42)	Nagarajan (2021)
Delhi	Fortis Hospital	₹ 1250 (US$), (10.05.21)	₹ 250 (US$ 3.42)	Nagarajan (2021)
Noida	Fortis Hospital	₹ 1250 (US$), (10.05.21)	₹ 250 (US$ 3.42)	Nagarajan (2021)
Jaipur	Fortis Hospital	₹ 1250 (US$), (10.05.21)	₹ 250 (US$ 3.42)	Nagarajan (2021)
Hyderabad	Yashoda Hospital	₹ 1200 (US$), (10.05.21)	₹ 250 (US$ 3.42)	Nagarajan (2021)
Hyderabad	Apollo Hospitals	₹ 1200 (US$), (10.05.21)	₹ 250 (US$ 3.42)	Nagarajan (2021)
Chennai	Apollo Hospitals	₹ 1200 (US$), (10.05.21)	₹ 250 (US$ 3.42)	Nagarajan (2021)

4.4. Changing prices in other countries

Mathew (2021) reported that internationally, the cost of the COVID-19 vaccination has ranged from $10 to $37 per dose (730-2700/dose). Mancini et al. (2021) reported that Pfizer had raised its vaccine price. The new price for a Pfizer shot was €19.50(₹1,693.94) (US$ 23.03) against €15.50(₹1346.47) (US$ 18.31) prior, as per the Financial Times' review of selected contracts. According to the contracts, the cost of a Moderna injection was $25.50 (1874.92) per dose, up from the first procurement deal's price of about €19 ($22.60, 1661.69), according to people with knowledge of the situation. However, the price was less than the $28.50 (2095.49) originally agreed upon because the order had increased, according to one official involved in the negotiations. According to Press Release (2021), Pfizer's CEO has predicted that future costs could reach $175 per dose, which would be 148 times more expensive than the estimated cost of production. Kaplan and Wehrwein (2021) mentioned that the European

Union (EU) is paying less for the Pfizer-BioNTech vaccine than the United States (US). The figures for EU and US are $14.70(₹1,147.50) per dose versus $19.50(₹1,522.19). Kaplan and Wehrwein (2021) further reported that during mid-July, 2020, Boston-based Moderna had received $955 million in U.S. funding. Moderna announced in August, 2020 that it would charge between $32 (₹ 2,498) and $37(₹2,888) per dose for its vaccine with adjustment in price depending on the number of orders. To mention, Moderna priced it vaccine $15(₹1,170.95) per dose to US government for its 100 million dosage order. The corporation has been questioned for its pricing in the context of its funding from the United States Government. Moderna received one of The Lown Institute's Shkreli Awards in January 2021 in Boston for Moderna being the "worst examples of profiteering and dysfunction in health care." Pfizer/ BioNTech and Moderna are charging 24 times the cost of production of the vaccine in rich countries (Press Release 2021).

4.5. Justification of prices by vaccine manufacturers

Bharat Biotech said that government procurement price of ₹150(US$2.03) is unsustainable. This is the reason it is charging higher price from private hospitals (Times Now Digital, 2021). Another reason could be the royalty of 5% on sale paid to Indian Council of Medical Research (ICMR), the developer of Vaccine (Kapur, 2021). The one disturbing fact is that Covaxin price is higher than Sputnik for private hospitals. Low procurement volumes, high distribution costs and retail margins are some other factors responsible for higher cost (PTI, 2021). Further to it, low price did not leave scope of very basic level of innovation in vaccines and pharmaceutical products. In a large country like India, companies need money for innovation and product development for home-grown innovators. Low price realization will certainly constrain innovation and product development. In the absence of better price realization by home grown innovators will reduce them to mere contract manufacturers with intellectual property licensed from developing nations or innovating countries. In the long run country will pay more than what government and citizens are paying now (Telangana Today, 2021).

4.6. Policy decisions to control cost of vaccines

In the month of May, 2021, Central Government advised private hospitals not to charge more than ₹100 (US$1.34) as service charges (FE Online, 2021). It was further announced by Central Government that it will buy 75% of the vaccines from the vaccine manufacturers for giving free to the state governments. Rest 25% will be procured by the private hospitals. According to the New vaccine policy revised on 21st June 2021, the private hospitals may charge only up to a maximum of ₹150(US$2.02) per dose as service charges.

The responsibility of monitoring of the prices will be with State Governments. During the same period many private hospitals were charging more than ₹150(US$2.02). To mention, in the month of May 2021, Apollo Hospitals were charging ₹200(US$2.56) more than the price of vaccine including Good and Services Tax (GST). The details of upper prices details fixed by central government are listed in Table 4.

Table 4. Cap by Central government for private hospitals

Vaccine	Price per dose (₹ &US $)	GST @ 5% (₹ &US $)	Maximum service charge per dose (₹ &US $)	Maximum price that can be charged (₹ &US $)	Sources
Covishield (08.06.21)	₹ 600 (US$ 8.23)	₹ 30 (US$ 0.41)	₹ 150 (US$ 2.05)	₹ 780 (US$ 10.70)	Timesofindia.com (2021), Kapur (2021)
Covaxin (08.06.21)	₹ 1200 (US$ 16.46)	₹ 60 (US$ 0.82)	₹ 150 (US$ 2.05)	₹ 1410 (US$ 19.35)	Timesofindia.com (2021), Kapur (2021)
Sputnik V (08.06.21)	₹ 948 (US$ 13.01)	₹ 47.40 (US$ 0.65)	₹ 150 (US$ 2.05)	₹ 1145 (US$ 15.71)	Timesofindia.com (2021) , Kapur (2021)

4.7. Decisions of procurement prices

The procurement prices of Covishield and Covaxin for Central Government had gone through many corrective changes as shown in Table 5 from January 2021 to December 2021. The decisions of procurement during the pandemic of that intensity were driven by cost of manufacturing and developing vaccines and political compulsions to reduce the number of casualties.

Table 5. Central Government Procurement Prices (₹& US $)

Vaccine	Order Month	Price (Inclusive of all taxes) (₹ & US $)	Sources
Covishield	January 2021	₹ 200 (US$ 2.73) (16.01.21)	Das (2021), Dutta (2021)
Covishield	March 2021	₹ 150 (US$ 2.06) (15.03.21)	Das (2021)
Covishield	August 15 December 2021	₹ 215 (US$ 2.89) (15.08.21)	Das (2021)
Covaxin	January 2021	₹ 295 (US$ 4.03) (16.01.21)	Das (2021), Dutta (2021)
Covaxin	March 2021	₹ 150 (US$ 2.06) (15.03.21)	Das (2021)
Covaxin	August 15 December 2021	₹ 225 (US$ 3.03) (15.08.21)	Das (2021)

The data with respect to payment made to manufacturer showed the prices at ₹150(US$1.92) per dose for Covishield and Covaxin. A sum of ₹17325 million ($234.12) (after TDS ₹16995 million -$) was given to the Serum Institute of India (SII) on April 28, 2021, for 110 million doses of the Covishield vaccine to be administered between May and July of that year. Bharat Biotech India Ltd (BBIL) received a payment of 7875 Million (after TDS of 7725 Million) on April 28, 2021, for 5 Million doses of Covaxin during the same time. (PIB, 2021).

Table 6. Price for Central & State Governments and private hospitals

Date	Vaccine	Price for Central Government	Price for State Government	Price for Private Hospitals	Sources
28.04.21	Covishield	₹150(US$2.01)	₹300*(US$4.03)	₹600(US$8.07)	Banerjee (2021)
28.04.21	Covaxin	₹150(US$2.01)	₹150(US$2.01)	₹1200(US$16.14)	Banerjee (2021)
*It was earlier ₹400					

BusinessToday.In (2021) reported that total size of the population that will now be eligible for vaccination will be 841.9 million out of a total population of 1332.6 million. This is based on Ind-Ra report. Though other sources are showing higher figure for total and eligible population of India. It was calculated that this "may cost ₹671, 93 million, of which the Union government will incur 208,700 million and state governments together will incur ₹463,230 million". According to a study by India Ratings and Research (Ind-Ra), immunizing all citizens over the age of 18 against COVID-19 will cost about 0.36 percent of India's annual GDP (Gross Domestic Product). The fiscal impact on the union budget would be 0.12% of GDP, and the fiscal impact on state budgets would be 0.24% of GDP.

Aggarwal and Mishra (2021) mentioned that the estimated size of the population in the 18-44 age bracket is 594 million. The total vaccine requirement of two doses each stands at 1188 million. The estimated size of this group is 207 million as per the government projections for 2021. The total doses needed, will be 414 million. The estimated size of third group, i.e., 60-plus age population in the country is 137 million, with their total vaccine requirement of 274 million doses.

5. Awareness of Covid-19 vaccination and its prices

This section presents the analysis of primary data which consists of three sets of questions in different sub sections. Section 5.1 presents analysis in percentage of the responses of citizens of different demographic categories for

eight questions with ‘yes’ and ‘no’ options from urban and semi-urban locations in Northern States of Haryana, India. Section 5.2. presents the analysis of Likert types 7 item/statements. Section 5.3 analyzed open questions. Based on data presented in section 4 and section 5, right answers to research questions and results of various hypotheses are given.

5.1. Analysis of data with ‘yes’ and ‘no’ answers

The data of eight questions is analyzed for percentage and presented in Table 7a and Table 7b. Based on this analysis following inferences are drawn.

(i) In general, knowledge of severity of disease (Covid-19) is better among males of 45+ years age categories and in semi urban areas. However, it does not mean that women are not aware. They are part of families and had to bear the consequences after losing a family member.
(ii) Majority of respondents reported that vaccine is highly useful in reducing the chances of deaths. This is another surrogate of awareness of vaccination among masses not only in urban areas but also in semi urban areas.
(iii) Data given in Tables 7a and 7b reveals that not all citizens are vaccinated at the time of data collection for this study. It requires attention of government agencies.
(iv) Majority of citizens could recall the name of the vaccine. Maximum percentage of citizen who could recall the name of Covishield vaccine followed by Covaxin. Sputnik was not so popular in Northern State of Haryana.
(v) Majority of citizens across all categories are aware that vaccination of Covid-19 is free for all, in government hospitals including government designated health centers in rural areas.
(vi) Majority of respondents are aware of the fact that private hospitals are charging for covid-19 vaccine.
(vii) Majority of respondents are aware that vaccines have saved life of many of us and help in controlling the pandemic. Except few every respondent was of the view that vaccine should be provided free to all by government. However, few are of the view that government may charge for vaccine if one can pay.
(viii) Respondents are of the view that private hospitals must charge for vaccine. Private hospitals must be a part of vaccination program. When further probed on the subject they said private hospitals are part of Covid treatment & testing. Therefore, they have right to be part of all solutions as suggested by the government.

Table 7a. Frequency distribution of responses of respondents for eight questions with respect to three demographics (in % age)

Gender	Locality	Age (Years)	Q1	Q1	Q1	Q2	Q2	Q2	Q3	Q3	Q4	Q4	Q4
			Y	N	C	Y	N	C	Y	N	CS	CV	SP
Male	Rural	<18(10)	0	30	70	10	40	50	0	100	0	0	0
130	70	18-44 (20)	50	20	30	40	20	40	40	60	50	30	20
		45-60 (30)	70	20	10	50	30	20	60	40	60	30	10
		60+ (10)	80	20	0	80	10	10	75	25	60	20	20
	Semi-Urban	<18 (10)	0	30	70	30	40	30	0	100	100	00	0
	60	18-44 (20)	60	30	10	50	30	20	60	40	80	10	10
		45-60 (20)	81	14	5	70	20	10	80	20	95	0	5
		60+ (10)	100	0	0	95	0	5	85	15	80	10	10
Female	Rural	<18 (5)	0	20	80	5	30	65	0	100	100	0	0
70	30	18-44 (5)	45	25	30	30	30	40	30	70	50	50	0
		45-60 (10)	50	20	30	40	30	30	50	50	50	25	25
		60+ (10)	60	30	10	70	20	10	65	35	50	50	15
	Semi-Urban	<18 (10)	0	40	60	20	40	40	0	100	100	0	0
	40	18-44 (10)	50	30	20	45	25	30	50	50	85	15	0
		45-60 (10)	70	30	0	65	15	20	70	30	80	20	0
		60+ (10)	100	0	0	90	5	5	75	25	80	20	0

Q1: Do you know about severity of Covid-19 as an individual? (Yes (Y), No (N), Cannot say (C)).
Q2. Do you know vaccine reduces the risk of death in case you are Covid-19 infected? (Yes (Y), No (N), Cannot say(C)).
Q3. Are you vaccinated? (Yes (Y) or No(N))
Q4. Can you recall name of vaccine? (This question is asked if answer to Q.N.3 is yes). (Covishield-CS, Covaxin-CV, and Sputnik-SP)

Table 7b. Frequency distribution of responses of respondents for eight questions with respect to three demographics (in % age)

Gender	Locality	Age (Years)	Q5	Q5	Q5	Q6	Q6	Q7	Q7	Q8	Q8
			Y	N	C	Y	N	Y	N	Y	N
Male	Rural	<18 (10)	90	10	0	10	90	10	90	0	100
130	70	18-44(20)	70	20	10	80	20	20	80	60	40
		45-60 (30)	80	0	20	70	30	60	40	84	16
		60+ (10)	60	0	40	60	40	50	50	100	0
	Semi-Urban	<18(10)	20	0	80	90	90	10	90	10	90
	60	18-44(20)	70	0	30	90	10	70	30	50	50
		45-60 (20)	90	0	10	100	0	85	15	60	40
		60+ (10)	90	0	10	90	10	80	20	100	0
Female	Rural	<18 (5)	20	0	80	20	80	80	20	100	0
70	30	18-44 (5)	80	20	0	10	90	10	90	50	50
		45-60 (10)	60	10	30	60	40	50	50	80	20
		60+ (10)	50	30	20	20	80	30	70	100	0
	Semi-Urban	<18 (10)	30	0	70	10	90	10	90	80	20
	40	18-44 (10)	80	0	20	70	30	70	30	60	40
		45-60 (10)	100	0	0	90	10	80	20	70	30
		60+ (10)	100	0	0	80	20	80	20	100	0

Q5. Do you know it is free in Government Hospitals and Government designated Vaccine Centers? (Yes (Y), No (N), cannot say(C)).
Q6. Do you know that private hospitals are charging for vaccination? (Yes (Y) or No(N))
Q7. Early availability of Vaccine could have saved many lives? (Yes (Y) or No (N))
Q8. Do you think it is good that vaccine is free for all? (Yes (Y) or No(N))

5.2. Citizen's perception on efficacy, availability and price of vaccine

The survey participants were asked seven questions on Likert 5-point scale related to the attributes of efficacy, availability, and price of Covid-19 vaccines in India. The responses were subjected to the calculation of mean score, standard error, and analysis of variance to test the above stated null hypotheses. The result of analysis for gender, age and location are presented in Tables 8, 9 and 10 respectively. It is evident from Table 8 that the mean perception score is highest for statement 2 and 6 for male. It is highest for statement 6 and minimum for statement 4 for the female. None of the null hypotheses for the 7 statements could be rejected for difference between mean perception score as p-value for all statements is greater than 0.05.

Table 8. Mean perception score of responses of respondents about Covid-19 Vaccines as per their gender

Statement	Gender		p-value
	Male	Female	
	Mean ± SEM	Mean ± SEM	
Original Variables/ Statements			
Statement 1	3.75 ±0.12	3.64 ±0.13	0.79
Statement 2	3.96 ±0.10	3.80 ±0.10	0.30
Statement 3.	3.45 ±0.15	3.32 ±0.15	0.44
Statement 4	3.35 ±0.14	3.10 ±0.13	0.41
Statement 5	3.70 ±0.12	3.68 ±0.12	0.51
Statement 6	3.96 ±0.09	3.88 ±0.11	0.45
Statement 7	3.48 ±0.13	3.40 ±0.14	0.49

The results presented in Table 9 reveals that the mean perception score is highest for statement 6 (4.60) and 7 (4.60) for the citizens of less than 18 years. It is highest for statement 6 (3.89) and minimum for statement 4 (3.19) for the age group 18 to 45 years. For the age group 46-60 years, maximum score is for statement 2(4.08) and statement 5(4.08) and minimum for statement 3(3.25). Mean perception score values are highest for statement 2 (4.25) and minimum for statement 3 (3.00). None of the null hypotheses for the 7 statements could be rejected for difference between mean perception score as per age categories as p-value for all statements is greater than 0.05.

Table 9. Mean perception score of responses of respondents about Covid-19 vaccines as per their age

Statement	Age				P Value
	Below 18	18-45	46-60	Above 60	
Original Variables/ Statements					
Statement 1	4.00 ±0.55	3.67 ± 0.09	3.83 ±0.35	4.25 ±0.48	0.83
Statement 2	3.80 ±0.58	3.86 ± 0.08	4.08 ±0.34	4.50 ±0.29	0.50
Statement 3.	1.80 ±0.49	3.45 ± 0.11	3.25 ±0.35	3.00 ±1.16	0.09
Statement 4	3.80 ±0.80	3.19 ± 0.10	3.33±0 .36	4.00 ±0.71	0.63
Statement 5	4.00 ±0.45	3.65 ± 0.09	4.08 ±0.23	4.00 ±0.41	0.45
Statement 6	4.60 ±0.25	3.89 ± 0.07	4.00 ±0.30	4.25 ±0.25	0.33
Statement 7	4.60 ±0.25	3.39 ± 0.10	3.50±0 .38	4.00 ±0.41	0.18

It is evident from Table 8 that the mean perception score is highest for statement 2 and 6 for male respondents. It is highest for statement 6 and minimum for statement 4 for the female. None of the null hypotheses for the 7 statements could be rejected for difference between mean perception score as p-value for all statements is greater than 0.05.

Table 10. Mean perception score of responses of respondents about Covid-19 vaccines as per their Location (urban & semi-urban)

Statements	Location		P-Value
	Semi-Urban	Urban	
Statement 1	3.49 ±0.24	3.76 ±0.09	0.34
Statement 2	3.74 ±0.20	3.93 ±0.08	0.51
Statement 3.	3.31 ±0.26	3.40 ±0.11	0.80
Statement 4	2.77 ±0.27	3.33 ±0.10	0.07
Statement 5	3.54 ±0.22	3.73 ±0.09	0.63
Statement 6	3.74 ±0.18	3.96 ±0.07	0.33
Statement 7	3.43 ±0.21	3.44 ±0.10	0.99

5.2. Factor analysis

This section presents results of factor analysis of 5-point Likert scale perception data of 7 statements with respect to Reliability Coefficient, KMO, Bartlett Test, Factors, Communality, and null hypotheses about latent variables.

Table 11. Reliability coefficient, KMO and Bartlett test output

Covid-19 vaccines	Cronbach's alpha	KMO	Bartlett test
Familiarity with the vaccines	0.750	0.831	Chi-square = 458.287 Degree of Freedom = 21 Significance = .000

The value of Cronbach's Alpha (Reliability coefficient), Kaiser-Mayor-Olkin (KMO), the measure of sampling adequacy and chi-square value of Bartlett's test are given in Table 11. The value that was calculated of Cronbach's alpha was found to be more than 0.75 for all 7 statements about the vaccines. The value of KMO suggest that the degree of common variance is middling and the values of Bartlett test are indicative that sample's inter-correlation matrix did not come from population in which inter-correlation matrix is an identity matrix in this case.

Table 12. Factor Analysis- rotation Component Matrix and Communality. (Familiarity with the vaccines)

Statements/ Variables	Factor 1	Factor 2	Communality
Statement 1	0.582	0.517	0.606
Statement 2	0.754	0.349	0.689
Statement 3.	0.241	0.589	0.405
Statement 4	-0.103	0.915	0.847
Statement 5	0.847	0.099	0.727
Statement 6	0.841	0.181	0.740
Statement 7	0.813	-0.091	0.670
Total Variance Explained	47.315	15.831	
Cumulative Variance Explained	47.315	63.146	

Based on the factor analysis, two factors/ components emerged to explain variation in the citizen's perception scores. The details of factor loading and variation explained by different factors are presented in Table 12. The variation explained by factor 1 (Efficacy & availability) is 47.32 per cent, and by factor 2 (Price) is 15.83 per cent. Cumulative variation explained by both the factors is 63.146 per cent which is not a very high value but above threshold. The values of communality are also adequate, except for the statement 3.

Descriptive statistics of factors, i.e., Efficacy and Availability, and Price and p-value for testing null hypotheses relating to these two factors are given in Table 13. As it is evident from the results given in Table 13, there is no statistically significant difference between mean scores of two factors for different categories of age, gender, and their location of staying.

Table 13. Mean perception score of Factors/ Latent Variables about Covid–19 Vaccines as per their Age, Gender & Location & p-values

Factors/ Latent Variables	Age				P Value
	Below 18	18-45	46-60	Above 60	
Factor 1 (Efficacy & availability)	0.48 ±0.33	-0.38±0.79	0.09±0.28	0.61±0.33	0.523
Factor 2 (Price)	0.17± 0.44	-0.02 ±0.78	-0.08±0.23	0.64±0.48	0.738
	Gender				
	Male	Female			
Factor 1 (Efficacy & availability)	0.03± 0.10	-0.04 ±0.11			0.776
Factor 2 (Price)	0.10 ±0.10	-0.16 ±0.10			0.312
	Location				
	Semi-Urban	Urban			
Factor 1 (Efficacy & availability)	-0.12±0.20	-0.29± 0.21			0.740
Factor 2 (Price)	0.03± 0.08	0.07±0.08			0.161

6. Results and discussion

India is one of the few countries that did not charge its citizens for the Covid-19 vaccines. However, given the magnitude of the disease and the large population, it kept the channel of private hospitals for paid vaccines open for those who can afford and want to go to private hospitals. Though health care is a subject of State Government, Central Government is funding Covid-19 vaccination programs at present as per the latest policy. In the early stage of vaccination, cost was shared by State government, Central government and citizens.

Based on the data presented in earlier sections, it can be concluded that prices of Covid-19 vaccine in India are at its present level due to:

(i) Central government's will to vaccinate the large population at the earliest so that impact of new waves (if it is there) is minimized.

(ii) Demand from opposition parties to give vaccines free to the states though it is their subject as per law (ET Bureau, 2021)

(iii) To charge the citizens who can afford to pay and ready to avail facilities of slightly better facilities of private hospitals. It will help to achieve the stated objective of government and a small portion of the cost to the central government is cross subsidized.

(iv) To increase the awareness of the disease and its severity among citizens and reduce the fear of those outcomes who are infected with the disease.

Research Question 1: Is it right on part of Central Government to have different prices for different vaccines?

Yes, it is right to have different prices for different vaccines specifically in private hospitals. Many experts as contacted by authors believe that it is based on the two facts, i.e., volume of production in case of SII and cost of innovation in case of Bharat Biotech, the two major developers and manufacturer of the vaccines.

Research Question 2: Is it right on part of Central Government to have a cap on prices of vaccines for private hospitals?

Yes, it is right on part of Central Government to cap the price for private hospitals. Though it is very less in comparison of developed countries but it still makes business for profit to the manufacturers. Another fact of reality is that vaccine prices to government are less than a mineral water bottle in five-star hotels.

Research Question 3: Is it right to include private hospitals in the National Vaccination Program?

Yes, it is good to include private hospitals in the national vaccination program since private hospitals have better infrastructure. They are already part of testing, treatment and post covid-19 care. This is one of the reasons for private hospitals to be part of the vaccination program. On the other hand, Government Health Systems and infrastructure are full of inefficiency. The job security, good payment, lack of accountability, political interference, bureaucratic approach etc. made it less effective. In many cases, this gap is filled by private hospitals.

Research Question 4: Is it right to include the cost of vaccination in health insurance policies?

Many experts and citizens are of the view that cost of treatment of Covid-19 and vaccination is very high (not in India except in private hospitals). It would be a better option that vaccine cost in case of pandemic like Covid-19 is included in medical insurance schemes. Some of the medical insurance companies have included it in parts and with conditions.

Research Question 5: Are the common men aware about the Central Government policies with respect to prices of vaccines in comparison of women?

Men are more aware of all facets of prices of Covid-19 vaccines in comparison to women in India. The reason is domestic responsibilities of women in India devoid them in many cases with external communications.

Research Question 6: What is the level of awareness among different strata of Indian citizen as per their different demographics?

The data presented in Tables 7a and 7b clearly indicate that people of greater age are more aware of various facets of vaccination in comparison to youth. The reason is more death of elderly people in all localities and states in India in comparison to youth. People of more age are aware that their generation is the most affected. When these differences are tested using statistical methods, it was seen the differences are not statistically significant as shown in Tables 8, 9, 10, 13.

Research Question 7: Which of the strategy is the best for pricing vaccines of a pandemic such as Covid-19 with reference to strategies suggested by Lee and McGlone (2010)?

Out of 11 strategies suggested by Lee and McGlone (2010) for pricing new vaccines. To some extent three strategies may be followed by government, i.e., target population analysis, incremental value of the new vaccine's characteristics, and vaccine costs. The main factors for pricing strategies were severity of the disease & impact of the disease on the economy as a whole, magnitude of disease, number of citizens affected, and somewhat compulsions including political compulsions.

7. Concluding remarks

Based on the data analysis & results presented in earlier sections, following conclusions/suggestions are proposed with respect to legality, price, awareness, availability, security, manufacturing, innovation and development dimensions of Covid-19 vaccines.

As per the Indian law, health is a matter of state subject. However, the recent empirical evidences of severity of the Covid-19 and resource mobilization to

control the disease suggests that health may be shifted to the concurrent list wherein, state governments and Central Government will together take care of healthcare as in the case of few other sectors of the economy. Bringing healthcare into the concurrent list would provide greater flexibility and uniformity for the Central Government along with consistency in the reinforcement of acts.

Price of Covid-19 vaccines are controlled by the Central Government. It is a good gesture on the part of government to control the cost of vaccination however, in the long run research, development and innovation aspects must also be kept in mind. Funds are needed for innovation to create better, cheaper and more effective vaccinations and limitation of funds can/will act as an inhibitor to this effort thereby negating all the efforts made in the past.

There is awareness about vaccines across all the segments of population. They are well aware about all the aspects of Covid-19 vaccines across all categories of demographics. Differences does exist but are not statistically significant as evident from the data given in earlier sections.

Medical insurance companies must include new known diseases as a part of their portfolio when selling their policies to the citizens. Central Government schemes have provision but it does not cover the cost of treatment for the patients with high severity of the disease.

Government must create a fund with ministry of health services to meet such eventualities which can be provided to pharmaceutical companies to do continuous innovation, research and development and also to upgrade manufacturing capacities as the need arise. A proactive approach is needed.

References

Aggarwal P., & Mishra M. (2021). How much of India's population has been inoculated, age wise, July 2, 2021. Retrieved on September 4, 2021 from https://www.indiatoday.in/diu/story /how-much-of-india-population-has-been-inoculated-age-wise-1823256-2021-07-02

Banerjee, S. (2021). Serum Institute of India cuts Covishield price for states to ₹300 per dose, April 28. Retrieved on August 27, 2021 from https://www.thehindu.com/ news/ national/serum-institute-of-india-cuts-covishield-vaccine-price-for-states-to-300-per-dose/article34431403.ece

Bharadwaj, S. & Mukherjee, R. (2021). Covid-19 vaccine: Covaxin priced at Rs 600 for states, Rs 2000 for private hospitals, April 25. Retrieved on September 02, 2021 from https://timesofindia.indiatimes.com/india/covaxin-to-cost-rs-600-for-states-rs-1200-for-private-hospitals-says-bharat-biotech/articleshow/82234371.cms

Brekke, K.R., Grasdal, A.L., & Holms, T.H. (2009). Regulation and pricing of pharmaceuticals: reference pricing or price cap regulation? European Economic Review, 53(2),170-85.

BusinessToday.In (2021). Vaccinating Indians above 18 years to cost less than 1% of annual GDP: India Ratings, Apr 23, 2021. Retrieved on September 4, 2021 from https://www.businesstoday.in/latest/economy-politics/story/vaccinating-indians-above-18-years-to-cost-less-than-1-of-annual-gdp-india-ratings-294171-2021-04-23

Chatterjee, S. Das, P., Nigam, A. Nandi, A. Brenzel, L., Ray, A., Haldar, P., Aggarwal, M.K., & Laxminarayan, R. (2018). Variation in cost and performance of routine immunisation service delivery in India. BMJ Global Health 2018, 3:e000794. doi:10.1136/ bmjgh-2018-000794

Chen, W., Messonnier, M., & Zhou, F. (2017). Factors associated with the pricing of childhood vaccines in the U.S. public sector. Health Economics, 27(2), 252–265. doi:10.1002/hec.3539.

Das, S. (2021). New price is good but Rs 250 a dose better: Covid-19 vaccine makers, July 17. Retrieved on August 21, 2021 from https://www.business-standard.com/article/current-affairs/new-price-good-but-rs-250-a-dose-better-covid-19-vaccine-makers-121071601548_1.html

Dey, S. and Mukherjee, R. (2021). Government approves first Covid-19 vaccine for children above 12 years, August 21. Retrieved on September 02, 2021 from https://timesofindia.indiatimes.com/india/government-approves-first-covid-19-vaccine-for-children-above-12-years/articleshow/85492651.cms

Dutta, S.S. (2021). COVID-19 vaccine to cost Rs 250 per dose in private hospitals, only Covishield to be available, February 27. Retrieved on September 10, 2021 from https://www.newindianexpress.com/nation/2021/feb/27/covid-19-vaccine-to-cost-rs-250-per-dose-in-private-hospitals-only-covishield-to-be-available-2269799.html

Dylst, P., & Simoens, S. (2011). Does the Market Share of Generic Medicines Influence the Price Level? PharmacoEconomics, 29(10), 875–882. doi:10.2165/11585970-000000000-00000.

Ekelund, M. (2001). Competition and innovation in the Swedish pharmaceutical market, Ph.D. Thesis, Stockholm School of Economics, Stockholm, Sweden. Retrieved on November 11, 2021 from https://ex.hhs.se/dissertations/221657-FULLTEXT02.pdf.

ET Bureau (2021). Opposition demands 'One Nation, One Vaccine Price', April 22. Retrieved on September 02, 2021 from https://economictimes.indiatimes.com/news/india/opposition-demands-one-nation-one-vaccine-price/articleshow/82190586.cms?from=mdr

ET Edit (2021). For vaccine costs, tap health insurance, May 01. Retrieved on August 21, 2021 from https://economictimes.indiatimes.com/blogs/et-editorials/for-vaccine-costs-tap-health-insurance/

ET Online (2021). What will the coronavirus vaccine cost you? April 25. Retrieved on September 01, 2021 from https://economictimes.indiatimes.com/news/india/what-will-the-coronavirus-vaccine-cost-you/articleshow/82242752.cms?from=mdr

Express Web Desk (2021). Third phase of Covid-19 vaccination begins today: All your questions answered, April 03. Retrieved on August 21, 2021 from

https://indianexpress.com/article/india/coronavirus-vaccine-third-phase-45-age-guide-registration-7253020/.
FE Online (2021). Cpvid-19 vaccine wide disparity in vaccination charges at private hospitals in India, May 11. Retrieved on September 01, 2021 from https://www.financialexpress.com/lifestyle/health/covid-19-vaccine-wide-disparity-in-vaccination-charges-at-private-hospitals-in-india/2249818/.
Griffiths, U., Oyatoye, I., Asman, J., Mandalia, N. Logan Brenzel, L. Brooks, D., & Resch, S. (2022) Costs and predicted financing gap to deliver COVID-19 vaccines in 133 low- and middle-income countries, WHO Health Workforce Department, 2021
Hecht R, Kaddar M, & Schmitt S (2011). Transparent pricing of vaccines would help poor as well as rich countries. BMJ 2011, 343:d7414. doi: 10.1136/bmj.d7414
Hussain, R., Bukhari, N., Rehman,A., Hassali,M., Babar, Z. (2020). Vaccine Prices: A Systematic Review of Literature. Vaccines, 8(4), 629 doi: 10.3390/vaccines8040629.
Jacobson, S. (2012). Vaccine pricing: how can we get it right? Expert Review of Vaccines, 11(10), 1163–1165. doi:10.1586/erv.12.95.
John Lu, Z. & Comanor, W.S. (1998). Strategic Pricing of New pharmaceuticals. The Review of Economics and Statistics, 80 (1), 108-118. doi: 10.1162/003465398557212
Kaplan, D., & Wehrwein, P.(2021) The Price Tags on the COVID-19 Vaccines, MHE March, 31(3), 26-27. Retrieved on September 12, 2021 from https://www.managedhealthcareexecutive.com/view/the-price-tags-on-the-covid-19-vaccines.
Kapur, M. (2021). For all its “made in India” pitch, Covaxin is the most expensive Covid-19 vaccine in India, June 10. Retrieved on September 01, 2021 from https://qz.com/india/2019375/why-does-covaxin-cost-more-than-covishield-and-sputnik-in-india/
Lee, B.Y. & McGlone, S.M. (2010). Pricing of new vaccines: Hum Vaccin.6(8), 619–626.
Leo, L. (2021). SII set price tags for Covishield vaccine, April, 22. Retrieved on September 4, 2021 from ivemint.com/news/india/covishield-to-cost-400-per-dose-for-states-600-for-private-hospitals-11618991072705.html
Lu, J.C., & W.S. Comanor (1998). Strategic Pricing of New Pharmaceuticals. Review of Economics and Statistics, 80(1), 108-118.
Mancini, D.P., Kuchler, H. & Khan, M. (2021). Pfizer and Moderna raise EU Covid vaccine prices, August 01. Retrieved on September 03, 2021 from https://www.ft.com/content/d415a01e-d065-44a9-bad4-f9235aa04c1a
Mathew, J.C. (2021). Bharat Biotech Justifies high prices of Covaxin in private market; says it’s “required”, June 15. Retrieved on September 17,2021 from https://www.businesstoday.in/coronavirus/story/bharat-biotech-justifies-high-price-of-covaxin-private-market-required-298748-2021-06-15.
McGuire, T. (2003). Setting Prices for New Vaccines (in Advance). International Journal of Health Care Finance and Economics, 3(3), 207-224. doi:10.1023/A:1025336903645
Mohfe.gov.in (2021a). Liberized pricing and accelerated national Covid-19 vaccination strategy, April 21. Retrieved on August 03, 2021 from

https://www.mohfw.gov.in/pdf/LiberalisedPricingandAcceleratedNationalCovid19VaccinationStrategy2042021.pdf

Mohfw.gov.in (2021). Revised Guidelines for implementation of National COVID Vaccination Program. Retrieved on September 3, 2021 from https://www.mohfw.gov.in/pdf/RevisedVaccinationGuidelines.pdf.

Nagarajan, R. (2021). At Rs 700-Rs 1,500, price of Covid vaccine in India's private sector among costly, May 10. Retrieved on August 21, 2021 from https://timesofindia.indiatimes.com/india/at-rs700-rs1500-price-of-covid-vaccine-in-indias-private-sector-among-costliest/articleshow/82509814.cms

Perappadan, B.S. (2021). Coronavirus| First phase of Vaccination to start on January 16, January 09. Retrieved on September 01, 2021 from https://www.thehindu.com/news/national/india-to-start-covid-19-vaccination-drive-on-jan-16/article33536670.ece

PIB (2021). HFW/COVID Immunisation strategy, April 19. Retrieved on November 11, 201 from https://pib.gov.in/PressReleasePage.aspx?PRID=1712710

PIB (2021). Media reports alleging that Centre has not placed any fresh order for COVID19 vaccines are incorrect and not based on facts, May 03. Retrieved on September 04, 2021 from https://pib.gov.in/PressReleasePage.aspx?PRID=1715649

Press Release (2021). Vaccine monopolies make cost of vaccinating the world against COVID at least 5 times more expensive than it could be, July 29. Retrieved on September 12, 2021 from https://www.oxfam.org/en/press-releases/vaccine-monopolies-make-cost-vaccinating-world-against-covid-least-5-times-more

Press Release (2021). Vaccine monopolies make cost of vaccinating the world against COVID at least 5 times more expensive than it could be, July 29. Retrieved on September 09, 2021 from https://www.oxfam.org/en/press-releases/vaccine-monopolies-make-cost-vaccinating-world-against-covid-least-5-times-more

Proano, R.A., Jacobson, S.H., & Zhang, W. (2012). Making combination vaccines more accessible to low-income countries: the antigen bundle pricing problem. Omega 40(1), 53-64.

PTI (2021). Low Covaxin Price for Centre Pushing Up Cost of Vaccine for Private Sector: Bharat Biotech, June 15. Retrieved on August 09, 2021 from https://thewire.in/business/low-covaxin-price-for-centre-pushing-up-cost-of-vaccine-for-private-sector-bharat-biotech

Robbins, M., & Jacobson, S. (2015). Analytics for vaccine economics and pricing: insights and observations. Expert Rev Vaccines, 14(4), 605-16. doi: 10.1586/14760584.2015.985662.

Sahadeva, A. (2021). Pricing & reimbursment lawas and regulation 2021, Global Legal insights. Retrieved on August 08, 2022 from.https://www.globallegalinsights.com/practice-areas/pricing-and-reimbursement-laws-and-regulations/india#:~:text=Drug%20pricing,-Back%20to%20top&text=In%20India%2C%20while%20all%20drugs,are%20left%20to%20market%20forces.

Saikia, A. (2021). The private sector will lead India's second phase of Covid-19 vaccinations. What does it mean? February 27. Retrieved on August 21, 2021 from https://scroll.in/article/988042/the-private-sector-will-lead-indias-second-phase-of-covid-19-vaccination-what-does-it-mean

Tandon, A. (2021). Covid vaccine cost in private hospitals capped at Rs 250 per dose, February 27. Retrieved on August 30, 2021 from https://www.tribuneindia.com/

news/nation/covid-vaccine-cost-in-private-hospitals-capped-at-rs-250-per-dose-218280

Telangana Today (2021). Differential vaccine pricing for private sector justified: Bharat Biotech, June 15. Retrieved on August 25, 2021 from https://telanganatoday.com/differential-vaccine-pricing-for-private-sector-justified-bharat-biotech

Thakur, D. (2020). India's drug regulator has failed the pandemic stress test. The U.S. should take notice, December 11. Retrieved on August 20, 2022 from https://www.statnews.com/2020/12/11/drug-regulator-india-failed-pandemic-stress/

The Wire Staff (2021). Everything You Wanted to Know About the Price of Vaccines in India, April 22. Retrieved on August 21, 2021 from https://science.thewire.in/health/everything-you-wanted-to-know-about-the-price-of-vaccines-in-india/

Times Now Digital (2021). Bharat Biotech justifies high price of Covaxin for private hospitals, says government procurement cost unsustainable, June 15. Retrieved on September 01, 2021 from https://www.timesnownews.com/india/article/bharat-biotech-justifies-high-price-of-covaxin-for-private-hospitals-says-govt-procurement-cost-unsustainable/770929

Timesofindia.com (2021). Centre caps vaccine prices Covishield at Rs 780, Covaxin at 1410. June 08. Retrieved on August 21, 2021 from https://timesofindia.indiatimes.com/india/centre-caps-vaccine-prices-covishield-at-rs-780-covaxin-rs-1410/articleshow/83343406.cms

TNN (2021). Covid 19: Only six states to begin vaccination for 18+ from today, May 01. Retrieved on September 01, 2021 from https://timesofindia.indiatimes.com/india/covid-19-only-six-states-to-begin-vaccination-for-18-from-today/articleshow/82335939.cms

Wouters, O.J., Shadlen, K.C., Salcer-Konard, M., Pollard, A.J., Larson, H.J. Teerawattananon, Y., & Jit, M. (2021). Challenges in ensuring global access, affordability, allocation, and development. The Lancet, 397(10278), 1023-1034. doi: 10.1016/S0140-6736(21)00306-8