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DISCOVERY OF VACCINE UNFOLDS A NEW MARATHON TO CONQUER: STRATEGIC OPTIONS FOR COVID CAPTIVE INDIA

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Abstract:

The world is being threatened by severe humanitarian crisis due to COVID Pandemic. The human civilisation is desperately searching for vaccine or antibiotics which will act as the saviour of mankind. But the discovery of vaccine is not the end of the story but it would open up the curtain for a new set of challenges particularly in the developing countries like India. The country needs to develop strategies how best and how fast the vaccine could be administered among the elephantine population. This paper has attempted to deliberate strategic options to eradicate the COVID Captive India effectively and efficiently.

Keywords: COVID Pandemic, Discovery of Vaccine, Strategic Options, India

Executive Summary:

Uncertainty has been the greatest companion of mankind since our journey began. Many astrophysicist or space scientist claim that existence of our every moment is not natural rather it is matter of accident. Hardly have we bothered to look up at the sky or pay serious interest at cosmos universe. The human being is thriving for excellence in the reins of 4IR. In the being of this year we started to de-learn and relearn that our model of supremacy is not universal. COVID-19 has demolished all our plans, programs, short term dreams and we become house arrest of our own choice. A series of evolving jargons have rampant everywhere from media to medical fraternity, it has even penetrated as a point of discussion in the intelligentsia. Human civilization has literally immersed into the greatest ever humanitarian crisis. After a long battle, mammoth death toll and the on-going tragic situation, there are silver lining with the rays of hope figuring the life-saviour expectancy in the form of vaccine. The world community has been aspiring for that holy day when this vaccine would be incorporated in our life line. For India this will be not be end of the story rather it is the

beginning of an arduous journey to how fast and how best we can reach to the elephantine population. India took 35 years' time to make the nation polio free in 2014 this is a grand achievement but the same strategy cannot be replicated for mitigating COVID pandemic at this critical juncture. The economic growth trajectory has been derailed and became captive of global lockdown inertia. The nationwide vaccination program requires heavy cost burden on the government exchequer particularly the state has been suffering from huge revenue losses. Under this above critical circumstances it is imperative to design and devise best possible strategic intervention which would provide most feasible and viable solution as an when the vaccine would get ready for administration. These research paper essentially discusses and deliberates various dimensions of COVID vaccination and finally has attempted to formulate three strategic options describing its competitive advantages, inherent conflicts limitations and the ease of suitability so that health experts, policy makers may take cognizance of all the entirety and gravity of various dimensions of immunization system in India coupled with best possible strategic alternatives for successful manifestation and implementations. The study has adopted and applied the core concept of strategic options and priority matrix in designing and formulating COVID immunization strategy

1.1 Concept of Strategic Options in Decision Making Process Strategic Priority Matrix:
Decision making is a direction of thoughts to achieve certain objectives in fact policy makers explores all possibilities competitive advantages as well as opportunities along with anticipating threat perception this brings various ways or alternatives. The basket of alternatives constitutes strategic options which can solve defined goals or mitigating crisis within the limiting time and resource. Strategic options can be regarded as set creative alternatives which are action driven and target oriented to respond to the external situation strategic options essentially take the cognizance of advantages and adversities of fact, opportunity matrix and threat perception of the extraneous variables in fact a set of strategic options are explored and formulated based on the inputs insights past experiences and intuitive assessment of the policy makers. In all cases of devising strategic options it is important for the management to understand and analyse the perspectives context and the probable bottle necks in the system [1][2][3][4].

Following steps are generally adapted to develop strategic options

1. Contextualizing the external variable
2. Identifying the sequence of action in order of priority
3. Clustering the opportunity and threat matrix
4. Developing appropriate strategic options so as to address the problem effectively and efficiently
5. Rating each of the options in terms of suitability viability exploring strategic opportunity and threat
6. Ranking of options for achieving best possible outcome during the process of strategic implementation
7. Follow up

1.2 Idea of Strategic Priority Matrix:
In our daily life we encounter variety of issues, problems and even crisis in alarming situation. It is difficult for an individual or an organization to solve all theses problems. At times it is not feasible to address all the issues and the same time all the issues are not equally important or significant for effectively managing the system. Addressing all the problems involve huge financial liability which may not be worthy to spend rather it is imperative to

siphon the most critical factor in first phase and respect up to solving the problem which impacts on the administration or policy implementation process. Some issues are large in number, some problems occur very frequently and minuscule of factors may occur very rarely but it may devastate the system completely. So all the real life problem can be broadly grouped in two dimensional or three dimensional matrix [5].

For example in two dimensional setup the problems can be grouped in two broader entities i.e. the frequency of its occurrence (X) and intensity of its impact (Y) booth the axis can be further subdivide in terms of its magnitude

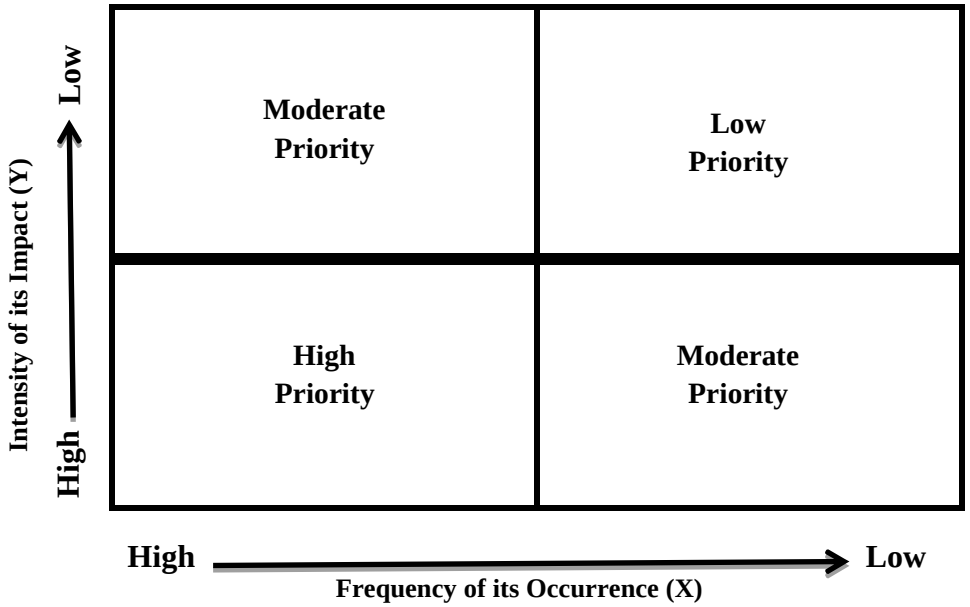

Figure 1: Two Dimensional Strategy Priority Matrix

Strategic priory matrix is best suited to identify the set of issues to be addressed in a sequence prioritizing form conflicting criteria. Strategic options and priory matrix has been widely used in government, industry, social work and inter-governmental mechanisms. This model can be used in the on-going health sector in India particularly it may be use full for mass immunization program in the back drop of COVID19 pandemic in India.

India is an ideal place to utilize this model since country has second largest population in the world with massive socio economic inequality and lack of inbuilt infrastructure or adequate resources.

This paper has attempted to understand the gravity of COVID19 pandemic across the globe with special reference to India along with its preparedness for mitigating mass immunization agenda towards achieving successful post COVID transition.

13 COVID Pandemic across the world: Strategic Inertia and Way-out:

It was on December 31 2019 that China alerted the World Health Organization regarding a unknown source of pneumonia in Wuhan city after a denial for quite some time and also denied the possibility of a reoccurrence of SARS outbreak. WHO then took reconnaissance of the matter and declared the discovery of new novel virus. It was not long before those South Asian countries that had an experience with earlier SARS virus that share border with china started getting cases and closed their land borders to prevent the transmission. By early February WHO declared COVID19 as a global emergency. By March first week large

number of cases was noticed in European, Middle Eastern and other parts of Asia. Many countries followed the Chinese model and started imposing strict lockdown [6].
India imposed a strict lockdown on 25th march 2020 initially for 21 days after a huge spike in cases [7]. However this was just the beginning of a miserable tale that highlight the underlying problems that sickens this largest democracy in the world since centuries. As all means of transportation were halted migrant labours, daily wagers, and workers from the large unorganized labour industry, who suddenly ran out of work started moving towards their respective destinations creating another chaotic, emergency situation. In this unprecedented situation in the history of independent India it exposed the limitations, insensitivity, and lack of managerial ingenuity in the highly bureaucratic federal structure controlled by the political elite. Suddenly willing and able individuals became unemployed and unpaid in this no-work situation. Small and medium industries also felt the heat of this financial stand still where demand and supply is suddenly paused due to economic halt, this reinforces one to look back at the basics of the factor of production and how we manage them for a potential leverage on growth. The nation-wide lockdown period in India was extended till 31 May 2020, followed by phased reopening of the economy. However, there are several restrictions and limitations imposed by the state governments across several states and districts extending the lockdown on a case to case basis based on the number of rising cases and deaths.

1.4 Health immunization strategy: Nature, Types & Success indicators in Indian context
Ever since Edward Jenner created the first vaccine against small pox in 1796, it also marked the beginning of a new era of vaccine preventable dieses. However it was not until 08th may 1980 that the world was finally declared as free of small pox by the World Health Assembly [8]. Numerous other vaccines were created using the same techniques to address other diseases. At present the world health organization lists 26 vaccine preventable diseases and 25 of them are available commercially except for malaria vaccine. Some of the vaccines are not available in India as the diseases are not listed as frequent reoccurring [9].
The table below shows the list of all the available vaccines along with its price per dose.

No.	Targeted Diseases	Year of Genesis	Targeted Age Group	Vaccines' Trade Name	Price (Rs.)
1	Cholera	1883	1 Year and Above or Travellers	Shanchol Injection 1.5ml	324
2	Dengue	2015	9 to 95 Years	Dengvaxia (Not available in India)	NA
3	Diphtheria	1920	6 Week onwards	Boostrix Injection	1199
4	Hepatitis A	1995	1 Year and Above	Havrix 720 Paediatric Injection 0.5ml	1139
5	Hepatitis B	1981		Genevac B Injection 1ml	80.46
6	Hepatitis E	2011	NA	Hecolin (Only available in China)	NA
7	Haemophilus influenzae type b (Hib)	1987	All infants below 5	INFANRIX HEXA Vaccine 0.5ml	2850
8	Human papillomavirus (HPV)	2006	9-14 years	Cervarix 20mcg Injection 0.5ml	2405

9	Influenza	1940	All age groups	Vaxigrip Adult Injection 0.5ml	885
10	Japanese encephalitis	2009	All age groups	JE Shield Injection 0.5ml	540
11	Measles	1963	All new born	M Vac Injection 0.5ml	65.25
12	Meningococcal meningitis	1974	1 to 29 years	Meningococcal A&C 50/50 Mcg Injection 0.5ml	418.75
13	Mumps	1989	All new born	Tresivac Injection 0.5ml	168.65
14	Pertussis	1920	All new born	Boostrix Injection	1199
15	Pneumococcal disease	1977	All new born	Pneumovax 23 Injection 0.5ml	1750
16	Poliomyelitis	1953	All new born	POLIOVAC Prefilled Syringe 0.5ml	465.5
17	Rabies	1885	Recomened for people exposed throuh animal bite/ occupational hazard	Rabivax S Vaccine 1ml	351.13
18	Rotavirus	2006	All new born	ROTASIIL Oral Vaccine 2.5ml	650
19	Rubella	1969	All new born	R Vac Vaccine 0.5ml	103.75
20	Tetanus	1924	All new born/ people exposed due to cut etc.	Tetanus Toxoid Injection 10X0.5ml	108.9
21	Tick-borne encephalitis	1941	Unknown	Tick-Borne Encephalitis (TBE) Vaccine	75
22	Tuberculosis	1921	All new born	Tubervac Vaccine	61.19
23	Typhoid	1896	All new born	Vactyph Injection 0.5ml	200
24	Varicella	1974	All new born	Varilrix Vaccine 0.5ml	1850
25	Yellow Fever	1944	All new born	Stamaril Vaccine 0.5ml	4060

Table 1: Indicative list of commercially available vaccine, trade names and Maximum Retail Price [9][10]

In the year 1978 immunization program was started under the umbrella term Expanded Programme of Immunization which later was renamed as Universal Immunization Programme in the year 1985 it became of the largest health program undertaken in the world. The union Ministry of Health and Family Welfare rearranged the program and renamed it as Mission Indradhanush and was launched in December 2014. These programs target both pregnant women and children for vaccine like BCG for tuberculosis, Oral polio vaccine & inactivated polio vaccine for poliomyelitis, hepatitis B vaccine, pentavalent vaccine, measles vaccine, rota virus vaccine, and DTP Vaccine, JE vaccine, pneumococcal conjugate vaccine (PCV) along with vitamin A doses [11][12]. The program effectively targets 14 vaccine preventable diseases and it is administered free of cost for all children and pregnant women [13]. Under the Mission Indradhanush 2.0 around 7, 35,655 number of children and 1, 51,894 pregnant women were vaccinated across the county as of on March 2020 (Round 4)[14]

India was able to eradicate polio in the year 2014 owing to these immunization programs. An effective universal immunization program would help full fill the targeted health dimensions mentioned under the united nations sustainable developmental goals, with accountability across all the dimensions[15].

15 Ease of Exploring COVID Vaccine :

Most of the vaccines produced in the world are a result of the pioneering techniques developed around 100 years ago. This included the techniques like inactivating the disease causing organism and subsequently injecting the immunogenic component or attenuates the organism before injecting. However the 1970's marked a remarkable benchmark for sequencing DNA and the possibility of recombine DNA sequence. This later helped in creating the first recombinant vaccine in 1986 as a vaccine solution for Hepatitis B. Genetic engineering has since influenced all types of vaccine creation, this development has also helped create Virus like particles that trigger the same immune response for the disease. This was used to create Gardasil a vaccine against human papilloma virus (HPV). Apart from this revolutionary science of vaccine creation that potentially shortens the duration of vaccine exploration, vaccine delivery mechanism like intradermal delivery or mucosal delivery is being explored essentially to reduce the time and training required to deliver the vaccines[16].

There are approximately 139 candidate vaccines in preclinical evaluation as on 30 July 2020, 26 vaccine candidates have approvals for clinical study and Vaccine candidate number 1 to 25 are already conducting clinical trials while vaccine candidate number 26 will tentatively begin its clinical study form 1 September 2020. Vaccine candidate number 1 to 6 are in their final phases of the study (Clinical Trial Stage 3) and will be available for common public as early as September or by the end of 2020 [17].

COVID19 Vaccines already under Clinical Evaluation				
No.	**Potential Candidate**	**Originator**	**No of doses**	**Strategic collaborator**
1	ChAdOx1-S	University of Oxford	1	AstraZeneca/ Serum Institute of India
2	Inactivated	Sinovac	2	-
3	Inactivated	Wuhan Institute of Biological Products	2	Sinopharm
4	Inactivated	Beijing Institute of Biological Products	2	Sinopharm
5	LNP-encapsulated mRNA	Moderna/ NIAID	2	Moderna
6	3 LNP-mRNAs	BioNTech/Fosun Pharma/Pfizer	2	Pfizer
7	Adenovirus Type 5 Vector	CanSino Biological Inc./Beijing Institute of Biotechnology	1	CanSino Biological Inc.
8	Adjuvanted recombinant protein (RBD-Dimer)	Institute of Micro ─ biology and Anhui Zhifei Longcom Biopharmaceutical	2 or 3	Anhui Zhifei Longcom Biopharmaceutical
9	Inactivated	Institute of Medical Biology,	2	-

		Chinese Academy of Medical Sciences		
10	DNA plasmid vaccine with electroporation	Inovio Pharmaceuticals/ International Vaccine Institute	2	Inovio Pharmaceuticals
11	DNA plasmid vaccine + Adjuvant	Osaka University/ AnGes/ Takara Bio	2	AnGes/ Takara Bio
12	DNA plasmid vaccine	Cadila Healthcare Limited	3	-
13	DNA Vaccine (GX-19)	Genexine Consortium	2	-
14	Whole-Virion Inactivated	Bharat Biotech	2	-
15	Full length recombinant SARS CoV-2 glycoprotein nanoparticle vaccine adjuvanted with Matrix M	Novavax	2	-
16	RBD-based	Kentucky Bioprocessing, Inc	2	-
17	mRNA	Arcturus/Duke-NUS		-
18	Adeno-based	Gamaleya Research Institute	1	
19	Native like Trimeric subunit Spike Protein vaccine	Clover Biopharmaceuticals Inc./GSK/Dynavax	2	-
20	Recombinant spike protein with Advax™ adjuvant	Vaxine Pty Ltd/Medytox	1	-
21	Molecular clamp stabilized Spike protein with MF59 adjuvant	University of Queensland/CSL/Seqirus	2	Seqirus
22	LNP-nCoVsaRNA	Imperial College London	2	-
23	mRNA	Curevac	2	-
24	mRNA	People's Liberation Army (PLA) Academy of Military Sciences/Walvax Biotech	2	Walvax Biotech
25	Plant-derived VLP adjuvanted with GSK or Dynavax adjs.	Medicago Inc.	2	-

26	S-2P protein + CpG 1018	Medigen Vaccine Biologics Corporation/NIAID/Dynavax *(Trails to start from Sep 1 2020)	2	NIAID/Dynavax

Table 2: Indicative list of COVID19 vaccines and the features as on 31 July 2020[17]

Vaccine Candidate 1 which seems to be wining the COVID19 Vaccine race as for now has already announced the tentative price range may be around 1000 rupees, Moderna plans to sell the vaccine at profit and the tentative price may range in between Rs. 3700 to Rs. 4500, while Pfizer plans to sell the vaccine at an approximate cost of Rs.225 to Rs. 300 [18]. Indigenous Indian vaccine candidate also known as COVAXIN has announced to keep the price affordable without making any price quotations.

1.6 Challenges of COIVID immunization in India:

COVID immunization is not a straight-line problem if we are committed to provide the entire population of the country. The Immunization process doesn't confine to any specific age bracket, gender, demographic or socio economic stratification it is imperative to explore the possible strategic options so that the entire or majority of population can be empowered with the desired antibody support. If we assume that 10 lakh people could be immunized per day so it takes around 1350 days not less than 3 years 8 months approximately to cover the total population (1.35 billion people). This long period to cover up entire population is essentially detrimental to bring back the engine of growth immediately. Moreover, the intermittent period would effectively force our public healthcare system to collapse and further paralyze the financial ecosystem due to loss of productivity, health morbidity. This suggests there is serious need of identifying strategic options followed by choosing the most feasible and viable alternative in order to generate a time bound outcome. In the backdrop of these issues the study explores three possible strategic solutions.

1.7 Strategic solutions: Options, Priority matrix and Implementation strategy

Strategic Option 1: Nationwide Holistic Vaccination Drive – Excellency Protocol

India is the largest democracy in the world. The constitution of India provides a federal structure which empowers the existence of provincial governments along with union government at centre. After 73rd Constitutional Amendment, democratic structure has penetrated up-to the village level with the introduction of Panchayati Raj Intuitions. This testimonies of our commitment, participation and vast experience in various levels of election in order to reign and enforce our democratic pillars where the commoners have the final say on the doctrine of power structure.

Capitalizing such intangible assets the conserved regulatory authority may create appropriate nationwide infrastructure up to the level of a booth at village level in consonance with our model of phase wise general election. The people would come to the respective vaccination station (Like an Electoral Booth) for availing the appropriate immunization for COVID. The vaccine dispensing station would have to be developed keeping various dimensions of health protocol like appropriate pre-administering test (like Skin test), vaccine preservation eco system and post vaccination care if required and other standard operating procedure as directed by the conserved authority from time to time. This model would enable us to win over from such pandemic crisis instantly within a month's time even if it is administered state wise. However, this model has some inherent conflicts in contrasts with conducting general election. If the vaccine is provided free of cost to everyone then this model would be highly

effective. Additionally the government should allocate funds for meeting huge expenditure for deployment, distribution, supply chains and resource mobilization. If the vaccine is not provided free of cost it will be difficult to bring Indian under the ambit of nationwide mission. Then the expenditure of this mission would be miserably wasted. The problem would remain unaddressed. It is the government's calls to take appropriate decision based on the wisdom of the policy makers.

Strategic Option 2: Administrating vaccine through Geographical Segmentation – Using Top down traditional Approach.

Regular immunization process is being manifested through top down approach using geographic segmentation through its all health infrastructure, hospital, Community health centre, Public health centre and sub centre [19]. Certain empanelled NGO's or private hospitals and clinics dispense vaccine in order to cover the target population. This traditional route has been in practice for many years for administering multiple vaccines catering to specific or defined population mostly the children up to the age group of 10 years. This is best suited for on-going vaccination process targeting specific age group and small population segment. This model may not be adequate to address the exigency and vulnerability of the on-going humanitarian crisis due to COVID pandemic. If the traditional route is deployed for COVID vaccine administration, it would defunct the existing schedule of immunization program for many other vaccine. It is imperative to mention India was officially declared a polio free country by UNICEF in 2014 after traversing a long journey of than 35 years' time to eradicate polio which is targeted to only to early age child population [20][21][22]. This is indeed a great achievement for India but may not be appropriate or adequate to follow similar channel and strategy for addressing COVID pandemic since every individual is susceptible to be infected irrespective of any demographic or socio economic variables. Moreover polio vaccine is administered orally whereas the upcoming COVID vaccine would be either intravenous (IV) or intramuscular (IM) which may require pre testing (like skin test) followed by managing potential post vaccination complications if any. So the model 2 is not sound for immunization for severe acute respiratory syndrome Coronavirus 2 (SARS-CoV-2) as per the present context and terms of reference discussed above.

Strategic Option 3: Strategic Priority Matrix utilizing public healthcare and infrastructure along with other stake holders, outreach program.

Probability of acquiring infections among the population in order of priority from top to bottom i.e. X1 ….to X7 (X-axis)		**Probability of the extent of Life Threat / Intensity if infected by COVID among the population in order of priority from top to bottom i.e. Y1 ….to Y7 (Y -Axis)**	
X1	Health Professionals, Security Personnel, Journalists	**Y1**	Patient Suffering from Critical illness
X2	Work Place Hazards, Extensive Travel Oriented Jobs	**Y2**	Health Professionals, Security Personnel, Journalists
X3	Patient Suffering from Critical illness	**Y3**	Aged Population 60+
X4	Children and youth up-to 18 years	**Y4**	Children and youth up-to 18 years
X5	Aged Population 60+	**Y5**	Already infected and cured Patients / Asymptotic
X6	Aged Population 40 – 59	**Y6**	Work Place Hazards, Extensive Travel

			Oriented Jobs
X7	Already infected and cured Patients / Asymptotic	**Y7**	Aged Population 40 – 59
X8	Aged Population 18 – 39	**Y8**	Aged Population 18 – 39

Table 3: Priority population matrix

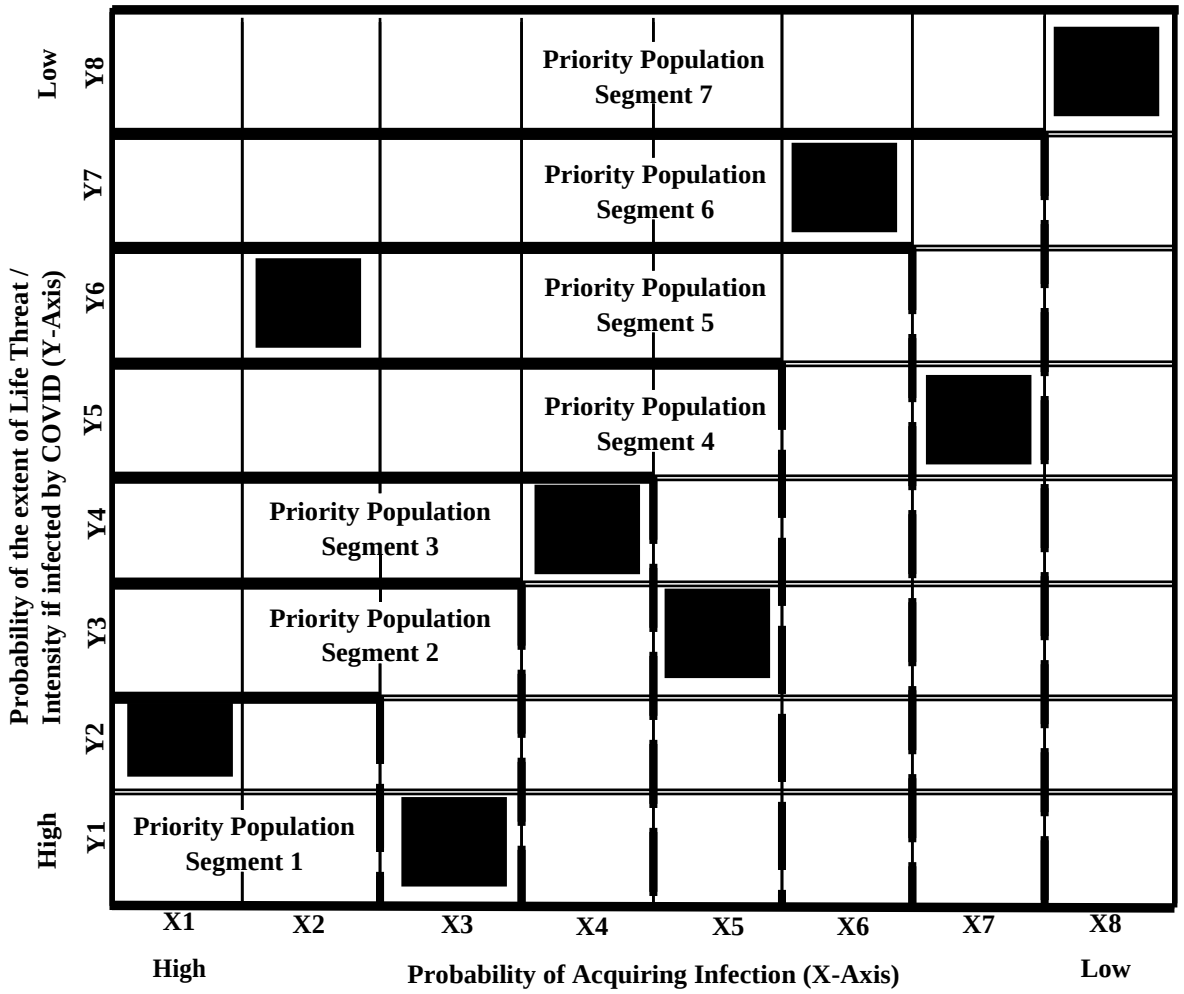

Figure 2: Indicative Mapping of population segment to be vaccinated in order of sequence - Strategic priority Matrix

From the above strategic priority matrix model seven priority segments have been emerged who needs to be vaccinated in order of priority. The descriptions of priority population segment are mentioned below:

Priority Population Segments in Sequence	**Corresponding Coordinates in the Strategic Priority Matrix Graph**	**Description of Priority population Segment**
Priority Population Segment 1	**X1Y2**	Health Professionals, Security Personnel, Journalists

Priority Population Segment 2	**X3Y1**	Work Place Hazards, Extensive Travel Oriented Jobs
Priority Population Segment 3	**X4Y4**	Patient Suffering from Critical illness
Priority Population Segment 4	**X5Y3**	Children and youth up-to 18 years
Priority Population Segment 5	**X2Y6**	Aged Population 60+
Priority Population Segment 6	**X7Y5**	Aged Population 40 - 59
	X6Y7	Already infected and cured Patients / Asymptotic
Priority Population Segment 7	**X8Y8**	Aged Population 18 - 39

Table 4: Priority segment and Corresponding regions

In addition to administering vaccine to the population in accordance with the priority matrix all the district of India would be provided a buffer stock of vaccine. The distribution of vaccines would be based on certain critical factors such as population size, infection pattern, recovery rate and extreme remoteness of the region etc. As per 2011 census, there are 593 districts which would be provided equitable number of vaccines from a total indicative supply of 6 Cores (Assuming 10 lakh vaccines per district, straight line method). This buffer vaccine would not be administered to common people unless COVID infected patients are admitted and required of administering vaccine on the advice of competent medical authority on a case to case basis. In fact the strategic buffer stock of vaccine would act as a lifesaving shield during the transit period of availing vaccine by the commoners.

Strategic Option 3 would be able to address all the priority dimension in an equitable manner so that the lengthy vaccination process would not pose threat to life among a large number of people and would be able to minimize severe and vulnerable consequences, complications in the existing public health care system. The buffer stock would eliminate the fear-psychosis and mental block to many of us which in turn would propel the engine of growth with higher momentum. COVID hit society would attempt to proceed towards development vector from its regressive syndrome of no work inertia leading revamping normalcy in a brief time. This is the high time for India to aggressively develop the profiling of people using the administrative infrastructure up-to the block level, accompanied by NGOs, Civil Society and three tier Panchayati Raj Institutes. Developing Universal Health database is essential to implement appropriate strategies in India [23] particularly addressing the most vulnerable pandemic of the century.

Conclusion:

COVID 19 has resulted in greatest ever humanitarian crisis in last hundred years in the era of 4IR modern science and health care system could not protect more than six hundred thousand death-tolls across the globe as on now. The world community is seriously helpless and desperately expecting for a vaccine or antibiotics which can save the lives of innocent victims. The situation has become worse and alarming in the developing countries with huge population size as evidenced in India. Commercial inception of vaccine is not the end to the crisis for a country like India. There are series of debacles like affordability, availability and sustainability of performance which become counterproductive in such complex situations.

The present research work is very much relevant and contemporary to the present context. The paper has attempted to explore three strategic options in order to ensure quality immunization process reaching to entire population. However, all the possible options were adequately deliberated to understand the ease of its use possible outcome, inherit limitation and over all suitability so that the planners and the apex decision makers can formulate appropriate strategies to handle this COVID immunization effectively and efficiently keeping in view the highest commitment of the nation towards welfare of its people.

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