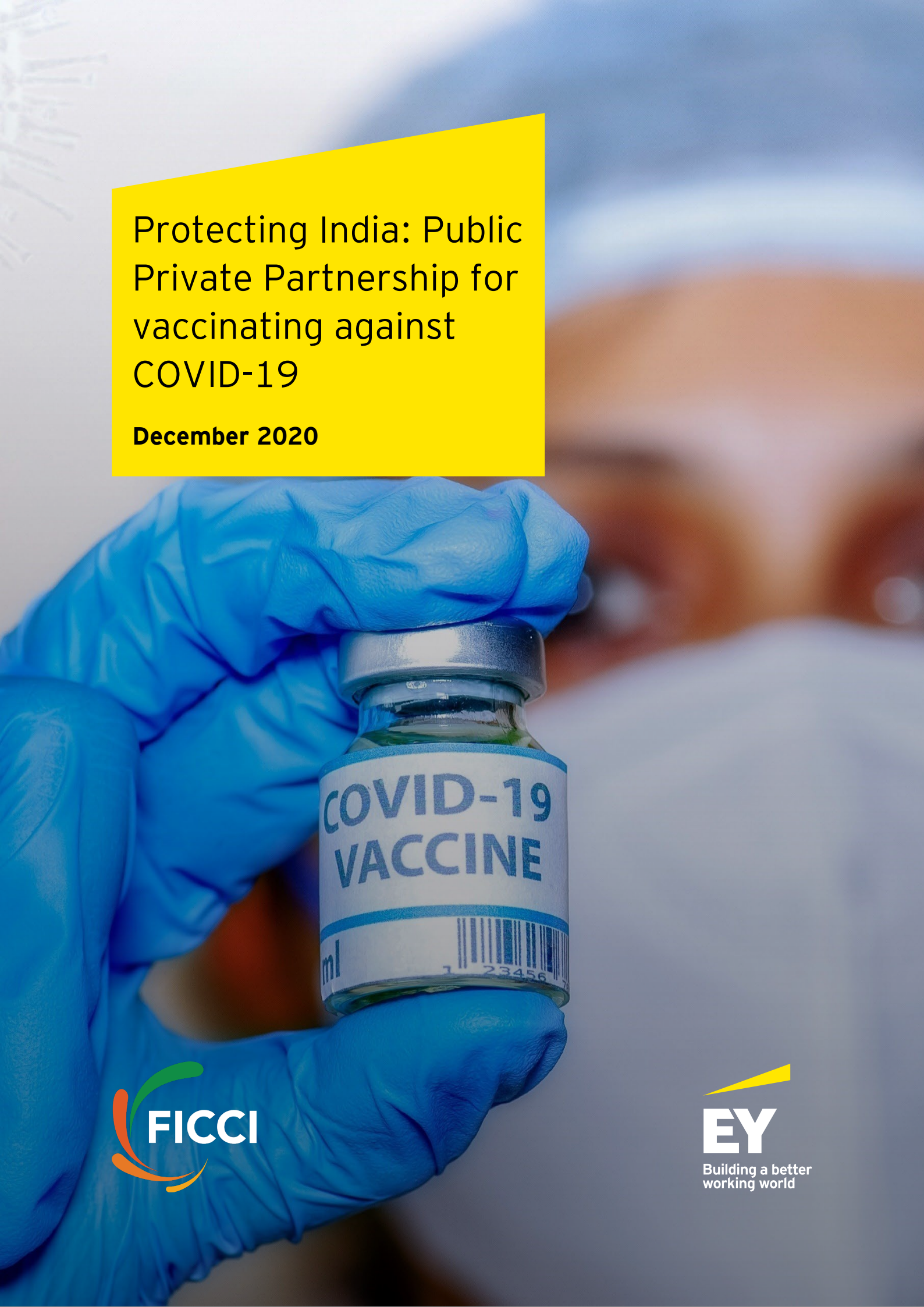
Protecting India: Public Private Partnership for vaccinating against COVID-19

December 2020



FICCI

EY
Building a better working world

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Setting the context

The destruction, disruption and dread unleashed by the unprecedented pandemic of COVID-19 across the world seems to end soon with several vaccine candidates reporting very encouraging results in late-stage trials. While this is a welcoming news that the world has been yearning for, the challenge of producing, distributing and administering the vaccine to the population in the shortest possible time is formidable, more so for a country like India given our population, geographical spread and skewed health infrastructure across urban and rural areas and between the states. The Government of India is acutely aware of this challenge and accordingly, the National Expert Group on Vaccine Administration for COVID-19 (NEGVAC) has been formed with Dr. V K Paul, Member, NITI Aayog as the Chair and the Health Secretary as the Co-Chair. The NEGVAC is responsible for prioritizing the vaccine and also in its procurement and administration. Given the context, the NEGVAC is committed to leverage all available resources, public and private, in the best possible manner to fulfil this national duty in the most effective and efficient manner, for the relief of citizens and in a bid to help the country to return of normalcy as soon as possible.

In this context, the NEGVAC has invited the Federation of Indian Chambers of Commerce and Industry (FICCI) to help assess the private sector's capabilities and capacities for inoculation and distribution of the vaccine.

FICCI, in partnership with EY, has held stakeholder consultations over the past week and developed a strategy paper. The paper aims to highlight the role and extent of private sector participation in supporting the government to accelerate the process of targeted vaccination across the country.

Introduction

Private hospitals have been the bedrock of capacity and capability serving greater than 70% of bed capacity and ~60% of inpatient care in India[1]. In the wake of the Coronavirus outbreak, private hospitals have dedicated up to 40%-80%[2-6] of their bed capacity for treating COVID-19 patients and supplemented government efforts of scaling up testing by contributing to 45%[7] of the testing capacity in India. Given the scale, complexity and timeline of the program for mass-inoculation against the SARS-CoV-2 virus, private players can significantly augment government's capacity across the value chain of vaccine distribution and administration.

To assess the private sector's role in inoculation of 60%-70% of the population in a two-year timeline with inoculation of prioritized groups (30 crore or 22% of population[8]) in the next eight months, we have structured the report as follows:

1. Assessment of demand and supply of healthcare resources for vaccine administration.
2. Assessment of capacity and intent of private players in supporting the mass-inoculation program by looking at the findings from the dipstick survey involving 264 private healthcare participants.
3. Potential engagement models between private and public sector across different stages of the value chain and private sector players' key role towards the same.
4. Role of the private sector from the learnings drawn from other countries.

Executive summary

- India may need 1.3 lakh-1.4 lakh vaccination centers, ~1.0 lakh healthcare professionals (as inoculators) and ~2.0 lakh support staff/ volunteers for mass-inoculation of prioritized individuals (30 crore people as identified by the government, includes healthcare professionals, frontline workers, people above 50 years and also people with co-morbidities) by August 2021 and the entire adult population (80 crore) by the end of 2022.
- To meet the demand of 1.3 lakh-1.4 lakh centers, ~60% of the existing public health infrastructure will have to house a vaccination center.
- Against the requirement of 1.0 lakh inoculators, the public sector can potentially provide 60,000-70,000 (10% of the nurse/ANM capacity in public sector) of them. This could lead to a capacity constraint especially in key states such as Odisha, Bihar, Jharkhand, West Bengal, Uttar Pradesh and Madhya Pradesh as illustrated in the table below.

States where private sector involvement will be necessary and allied health professionals might have to be credentialed and trained for inoculation				
*% of **public health centers** required to house a vaccination center*		*% of active **nurses/ANMs (public + private)** required*		
		10%-20%	20%-30%	>30%
	15%-30%	West Bengal	-	Bihar
	30%-50%	Uttar Pradesh, Assam	-	-
	>50%	Himachal Pradesh, Goa, Mizoram	Madhya Pradesh, Jharkhand	Odisha

  - Private sector can adequately supplement the physical and human infrastructure supply in key capacity constrained regions, specifically in urban and semi-urban areas.
  - Additionally, a second line of inoculators among allied health professionals will have to be made available through training and credentialing process.
- In a dipstick survey of 264 private healthcare participants, a high proportion of respondents stated their capacity and willingness to participate in the vaccination drive.
  - **Physical infrastructure:** 84% have earmarked inoculation facilities in their hospitals/ centers and 54% have cold storage facilities to store vaccines on site.
  - **Manpower allocation:** 88% have trained inoculators available for vaccination, 70% are willing to allocate manpower in semi-urban/rural areas for vaccination and 94% are willing to impart training for inoculation. A trained pool of 30,000 inoculators is also available for inoculation from amongst the participants.
  - **Coverage of inoculation services:** 81% are willing to inoculate front line workers (e.g., police), teachers, students, etc. in local areas, 75% are willing to inoculate their local communities (within 5km radius).
- In the early phases of vaccine roll-out, the entire vaccine administration machinery will be controlled for prioritized beneficiary categories. The program will be largely managed by the government, provided their capacity of human resource for vaccination is adequate. With expansion of the program to include general public enabled by ramp-up in vaccine supply, a hybrid model involving resource sharing between public and private players is likely to emerge to bridge capacity gaps across the value chain as per local requirements for augmentation of infrastructure and technical capacity.

Some of the key areas for private sector's participation in this model include the following:

Focus areas of collaboration	Role of government	Role of private sector
A. Storage, logistics and distribution	▶ Define state-wise nodal points, regulatory and monitoring framework /guidelines for storage of vaccines at nodal and inoculation points, infrastructure requirements, private vendor selection and empanelment process ▶ Provide seamless customs clearance regulations for COVID-19 vaccines	▶ Provide storage infrastructure, freight vehicles and facilities with required technology and undertake capacity augmentation wherever required ▶ Develop SOPs on inventory management, safety protocols and fraud management and train existing workforce on the same ▶ Undertake operation and maintenance of storage facilities, freight facilities and assets (including both self-owned and government-owned)
B. Vaccine center network, human resource for vaccination and outreach for vaccine advocacy	▶ Finalize the number of vaccination centers for defined catchment area across public and private health facilities/practitioners ▶ Define eligibility criteria in terms of minimum physical infrastructure and human resource required for approval of a vaccination center ▶ Establish platform, protocol and guidelines for registration and approval of qualified vaccination centers ▶ Create and execute strategic communication plan ▶ Design and execute targeted immunization campaigns/drives based on assessment of progress on population coverage ▶ Permit companies to utilize their CSR funds for inoculation of their own employees, while also supporting them for inoculation of population in their vicinity, wherever possible.	▶ Allow their facilities to be used as vaccination centers by the government ▶ Adopt specific catchment areas for immunization coverage. Various types of vaccination center locations can be opted by private sector such as hospitals, nursing homes and clinics (including private clinics of GPs), path labs, residential welfare associations, factories, post offices, commercial establishments, such as offices, schools and colleges, community centers ▶ Enlist participation of various medical bodies, such as IMA, FOGSI, AYUSH and hospital associations such as nursing home associations to encourage maximum enrolment of their members as vaccination centers ▶ Leverage the network of service organizations such as Rotary Clubs (1.5 lakh Rotarians and 4,000 Rotary clubs), Lions Clubs, Gymkhana, Grand Lodge of India and other regional clubs for vaccine administration (each Rotary club has 2-3 medical professionals who can extend their services for this cause) and to drive communication campaigns for advocacy. Large government volunteer bodies such as NCC, NSS, Nehru Yuvak Kendra Sangathan, Bharat Scouts and Guides can be used for volunteer support ▶ Leverage e-pharmacy players to support with their technology, capable manpower pool and cold storage network ▶ Leverage research done by communication specialists at public health academic institutions to create communication for vaccine awareness. Also, private sector

Focus areas of collaboration	Role of government	Role of private sector
		▶ organizations being skilled at marketing, may enable design of effective communication and use a gamification approach for greater outreach and awareness ▶ Approach large corporates who undertake CSR initiatives to contribute their funds for the administration of COVID-19 vaccine
C. Clinical standards for inoculation-Inoculator capability and training	▶ Define the categories of healthcare professionals who can be enlisted for inoculation and provide qualification criteria based on which they can be enlisted ▶ Approve and accredit agencies and training programs for inoculation training such as Healthcare Sector Skills Council and National Skill Development Council ▶ Allow private sector the flexibility to decide on the degree of participation (such as freedom to restrict participation within urban/non-urban areas, and up to district level and beyond) for vaccine administration, and as trainers to skill inoculators based on their available capacity and capability	▶ Create modules and certification programs for inoculator training and enlist with the government as a registered training/certification agency. Training module can include sections on handling of vaccine, injection technique, patient communication and patient counselling ▶ Involve participation of medical associations like IMA, specialized association of surgeons and physicians such as OMAG, FOGSI that have a strong state-level presence for dissemination of training as well as monitoring of training program ▶ Involve participation of accreditation agencies such as NABH and NABL for imparting training as they have large pool of master trainers/assessors ▶ Leverage academic institutions focusing on public health for training people to administer vaccines, in addition to the players in the healthcare sector ▶ Extend digital platforms such as websites and apps to upload training modules for wider dissemination of the content to their networks and associates
D. Technology infrastructure and services	▶ Existing eVIN network is proposed to track the latest vaccine stock position, temperature at storage facility and geo-tag health centers, and to maintain facility level dashboard for the delivery of the vaccine. Extend the eVIN network to private sector COVID-19 vaccine storage and delivery points as currently it focuses on public health facilities only ▶ Issue guidelines for leveraging CO-WIN, and enable private sector to	**Supply side** ▶ Adopt Track and Trace system to reduce possibility of counterfeit COVID-19 vaccine ▶ For manufacturers-Integrate temperature monitoring data of their storage and transportation facilities with the common vaccine platform to lower wastages and ensure better tracking of temperature breaches ▶ Leverage drone technology to deliver vaccine at isolated areas **Vaccine storage and transportation** ▶ Augment their IT systems to integrate with eVIN. Install temperature loggers (if not already available) in the cold chain equipment and integrate with the Common vaccination platform

Focus areas of collaboration	Role of government	Role of private sector
	build on and build around CO-WIN ▶ Invest in strong analytics engine for not only tracking purposes, but also for planning and predictive analytics related to prioritization of beneficiaries, areas to be targeted, reduce drop-outs, improve vaccine efficacy across target segments, etc.	**Last mile administration** ▶ Set up COVID mobile app facilitating both citizen and private entities with following functionalities: ▶ **Citizen portal** Registration, vaccination center selection, slot booking, beneficiary profile, vaccination certification and e-Health records (if opted) Citizen engagement is a critical aspect for active participation. Gamification is an effective way to ensure citizen's participation ▶ **Vaccination center enrolment portal** Vaccination center enrolment and monitoring, vaccinator registration and authorized vaccinator allocation, vaccination center transaction management system ▶ **Beneficiary authentication, vaccine payment management**, vaccine authenticity verification, administered vaccination details, vaccination certificate management ▶ **Adverse effects, feedback and grievance redressal** mechanism ▶ Deploy data platform capabilities coupled with AI and Machine Learning to mine real-world data to assess the safety and efficacy of COVID-19 vaccines and adverse patient monitoring ▶ Deploy blockchain as an effective tool for privacy and security of personal data

- People who have the ability and are willing to pay for vaccine should be permitted to do so (irrespective of government definition of priority population) as long as the supply of vaccine is controlled and also specifically earmarked by the government for such private sector use. Any kind of hoarding should be prevented.
- Private sector should be allowed to choose the vaccine that they want to use as long as it is approved for use in the country.
- While private healthcare providers have shown willingness to allocate human resources for the vaccination exercise, especially in semi-urban and rural areas, actual execution of the program will be dependent on clear definition of roles and responsibilities of both government and private players as well as agreement on distinctive and well-laid out engagement models for collaboration.
- This report does not endeavor to make any study or recommendations regarding the (a) financing aspect of the program, given the lack of clarity on the pricing of vaccine and the political motivations of state/central government, (b) prioritization of beneficiaries for vaccination, (c) vaccine manufacturing and (d) product liability for any adverse events following immunization.



1

Assessment of demand and supply of healthcare resources for vaccine administration

In this section, we have assessed the demand of healthcare resources for mass inoculation and their available capacity against the total requirement in India. We have estimated the requirement for number of vaccination sites, healthcare professionals (as inoculators) and support staff/volunteers for data entry/crowd facilitation/site operations management. It is estimated that 30 crore (22% of population) prioritized individuals will be inoculated by August 2021 and another 50 crore (rest of the adult population) by the end of 2022. A baseline of 80 crore (60%) of coverage has been considered in a timeframe of two years. This is in line with the plans other countries have made to inoculate 60%-80% of population in one and a half to two years.

The demand assessment does not assume any constraints in the supply of vaccine and associated consumables (syringe, needle) for inoculation. Key vaccine manufacturers in advanced stages of clinical trials and those that are relevant to India have a capacity of 250 crore[9-14] doses annually which can be ramped-up to 300 crore. Considering two doses per individual and an additional wastage of 10%, India shall need 200 crore doses in the next two years requiring the key manufacturers (Serum Institute- AstraZeneca and Oxford Institute/ Novavax, Bharat Biotech- ICMR, Biological E- J&J/ Dynavax and Baylor College, Zydus Cadila, Hetero- Gamaleya (Sputnik V) and Aurobindo- CSIR labs) to commit 30%-40% of their production for India.

The capacity planning for physical and human infrastructure for inoculation has been modelled considering the wide geographical spread of the country, its varied population density and typical throughput of inoculation. A trained inoculator can administer up to 10-15 vaccines per hour. But given the geographical area, centers will need to be accessible to mobilize beneficiaries. Hence, the inoculator throughput will significantly vary between urban (6-7 per hour) and rural areas (3-4 per hour). In rural areas, inoculators can be better utilized by faster completion of the vaccine program in individual sub-districts or by earmarking only limited working hours per day for inoculation.

Key assumptions and the corresponding rationale for demand estimation

Key assumptions		Remarks
Population coverage and timelines		
Phase 1 *(Identified priority groups)*	**30 crore** (by August 2021)	▸ 22% of the population, includes healthcare professionals (70 lakh), frontline workers (2.1 crore), people above 50 years (26 crore) and other people with co-morbidities (1.2 crore) ▸ Uniform distribution of priority groups across urban and rural areas was considered
Phase 2 *(Rest of the adult population)*	**50 crore** (by December 2022)	▸ Overall coverage of all adult population (60%) in a two-year timeframe
Coverage per vaccination site		
Urban	10 sq. km (45,000-50,000 population)	▸ Average area of 10-12 sq. km in urban area and 18-20 sq. km in rural area has currently been covered by the government primary care centers/hospitals ▸ Individuals to be vaccinated per center: 25,000-30,000 in two years (10,000 in Phase 1) in urban areas and 4,000-4,500 in two years (1,500 in Phase 1) in rural areas
Rural	25 sq. km (7,000-7,500 population)	

Key assumptions		Remarks
Throughput per inoculator		
Urban	6-7 doses per hour (45-50 per day)	▶ Maximum potential of 10-15 doses per hour basis interviews with public health experts and medical administrators of private hospital chains ▶ 4-5 minutes per inoculation (basis expert interviews) includes pre-inoculation time (record history/ skin-prick allergies (if any)/ vital signs, prepare for inoculation), inoculation time and post-inoculation time (dispose syringe/ needle, handover inoculation certificate and instructions w.r.t next dose and steps in case of AEFI) ▶ Actual throughput at the site expected to be lower than the max. potential owing to varying inoculator skill-level and the highly decentralized network of centers to cater to the country's geographical spread ▶ Two doses/ individual within a gap of 3-4 weeks considered as is the prescription in most vaccines at advanced stages of clinical trials
Rural	3-4 doses per hour (20-25 per day)	
Manpower to be deployed at each site		
Urban	1-2 inoculators and 2-3 support staff	▶ Inoculators to be deployed based on the number required to maintain optimum throughput at each site ▶ Support staff/ volunteers shall be required for beneficiary identification/ verification, data entry, crowd facilitation and site operations management
Rural	1 inoculator and 2 support staff	

India may need 1.3 lakh-1.4 lakh vaccination centers, ~1.0 lakh healthcare professionals (as inoculators) and ~2.0 lakh support staff/volunteers for mass-inoculation of the country's adult population (80 crore) by the end of 2022



To meet the above-stated demand, ~60% of the existing public health infrastructure will have to house a vaccination center. Key states such as Odisha, Bihar, Jharkhand, West Bengal, Uttar Pradesh and Madhya Pradesh will also have to dedicate more than 10% of their nursing/ANM capacity for inoculation. The private sector can adequately supplement in the capacity constrained regions, specifically in urban and semi-urban areas.

Requirement of vaccination centers as % of total public health centers vs. requirement of nurses/ANMs as % of total active nurses/ANMs (public + private) in each state

		Nurses/ANM (public + private)[15] *% of active nurses/ ANMs required*			
		<10%	10%-20%	20%-30%	>30%
Public health infrastructure[16] *(Primary care center + government hospitals)* *% of Public health centers required to house a vaccination center*	<15%	Arunachal Pradesh	-	-	-
	15%-30%	Kerala, Delhi	West Bengal	-	Bihar
	30%-50%	Tamil Nadu, Haryana, Uttarakhand, Tripura	Uttar Pradesh, Assam	-	-
	>50%	Rest of the states	Himachal Pradesh, Goa, Mizoram	Madhya Pradesh, Jharkhand	Odisha

States where private sector's involvement will be necessary and allied health professionals might have to be credentialed and trained for inoculation

Vaccination centers: With their dominant presence in urban areas, private sector can significantly supplement limited latent capacity available with the government healthcare network in these areas

India has over 2.5 lakh[17] primary care centers (SC, PHC, CHC, HWC) and 25,000-30,000[18] government hospitals. Eighty to ninety percent of these centers currently service in the rural areas, thus adequately supporting the inoculation program in these locations.

To meet the requirement of 10,000 vaccination centers in urban areas, a significant proportion of existing government healthcare centers (9,000[17] primary centers: SC, PHC, CHC, HWC, 4,500[18] government hospitals) will have to house vaccination centers while maintaining physical segregation between COVID-19 care area and inoculation area. With limited latent capacity and ability to re-purpose resources in government centers, access to vaccination in these areas can be significantly supplemented by private players dominant in urban areas.

Manpower: Leveraging private hospitals/labs employing majority of the nurses and allied health workforce can address the immediate requirement of human resources

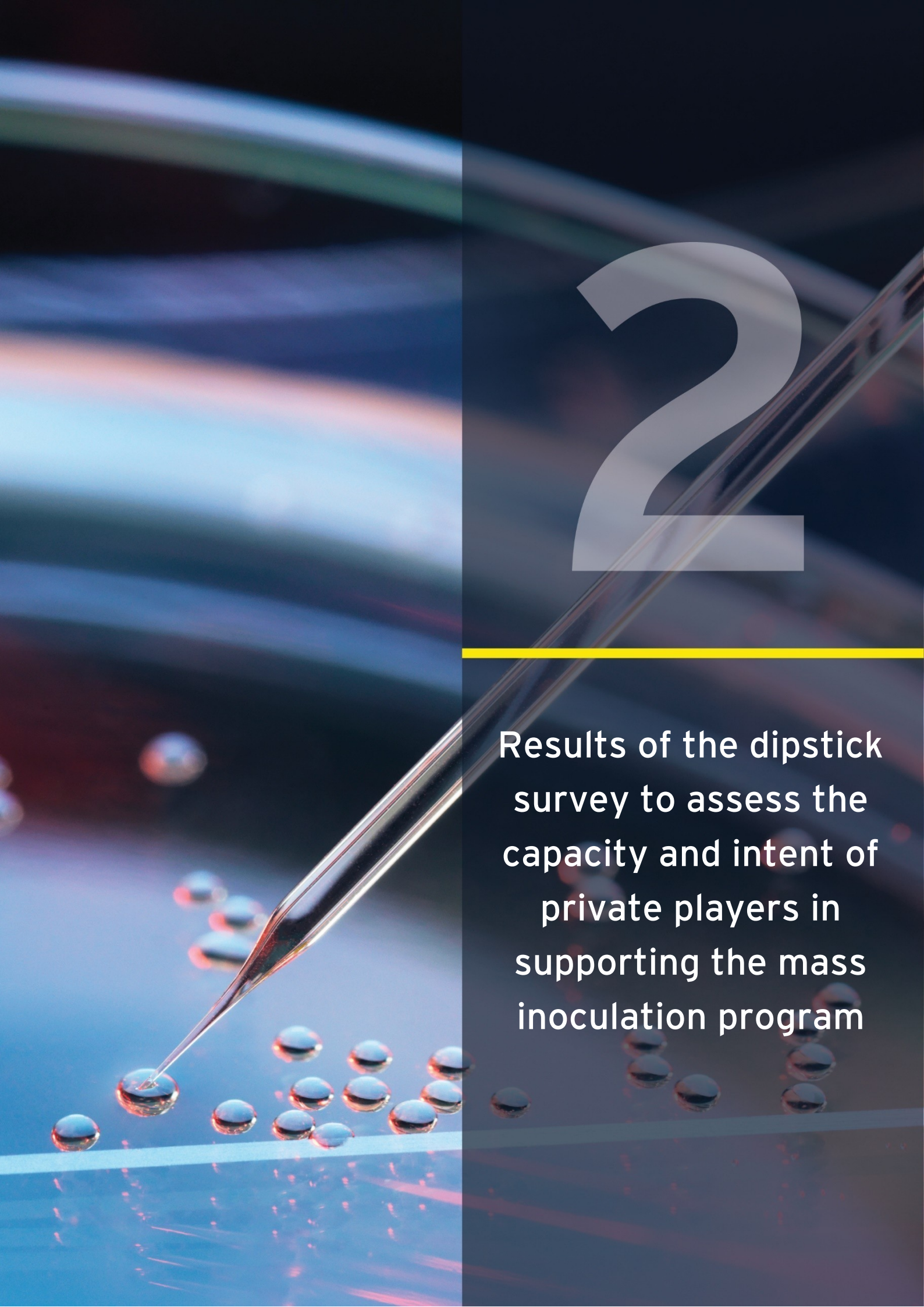
India has a total capacity of over 40-45 lakh[15] active healthcare professionals (~15 lakh doctors, ~15 lakh nurses/ANMs, 10-15 lakh allied health professionals such as pharmacists, phlebotomists, physiotherapists, others) and 20-30 lakh community health workers (ASHA, AWW). While the general practitioners and nurses/ANMs shall be the first line of inoculators, as the demand increases in specific capacity constrained areas, the government will have to notify certain healthcare cadres to be credentialed and trained as inoculators.

Estimated 6 lakh[15] nurse/ANM workforce (45% of total) are employed in the public sector. With a requirement of ~1.0 lakh inoculators, almost 15%-20% of them will have to be earmarked for inoculation. Since public health centers have traditionally had a shortfall of healthcare workers, their ability to earmark more than 10% of the capacity for inoculation shall be limited. With these constraints, the stated timeline for Phase 1 shall get significantly extended, especially in key states such as Odisha, Bihar, Jharkhand, West Bengal, Uttar Pradesh and Madhya Pradesh unless the inoculator workforce in public sector is supplemented with:

- **Support from the private sector:** Private hospitals/labs can adequately support with their nursing/ANM capacity in constrained regions. Specifically, in urban areas with 67% of the nurses, predominantly employed in the private sector, leveraging private players shall be paramount to achieving time-bound mass inoculation.
- **Credentialing and training second line of inoculators:** Second line of inoculators amongst allied health professionals such as phlebotomists and pharmacists or penultimate/final year medical students will have to be made available.

Also, ~2.0 lakh support staff/volunteers shall have to be mobilized for smooth operations of the vaccination site, primarily including identification and verification of beneficiaries, entry of inoculation data in the central database and crowd facilitation while ensuring social distancing. To counteract any potential security threat at the sites, the existing security personnel for the center can be trained or the police force/paramilitary force can be mobilized for guarding in highly sensitive regions.

A dipstick assessment highlights that the estimated cost of administration is INR100-INR150/dose excluding the cost of vaccine and logistics/warehousing cost up to the site of administration. Key cost heads included in the above assessment are manpower, consumables, bio-medical waste disposal, refrigeration at site of administration and other one-time costs (infra, IT). The cost estimate however needs to have further diligence and needs to be refined based on the scale of site operation and geography.



2

Results of the dipstick survey to assess the capacity and intent of private players in supporting the mass inoculation program

Vaccine administration to 1.3 billion people in India is a mammoth task and hence, the private health sector would have a key role to play in its implementation. FICCI and EY, in association with NABH, NATHEALTH and other healthcare associations, conducted a survey to assess the capacity of private sector players. The survey was conducted in November 2020 to understand the capacities and willingness of private players to participate in the vaccination drive, summary of which is provided below. The results highlight a high degree of willingness among private players to participate in the program through inoculation of their own staff, dissemination of training for vaccination, allocation of trained inoculators to semi-urban and rural areas for vaccination and taking up responsibility of vaccinating their local community.

Organizations responded

264

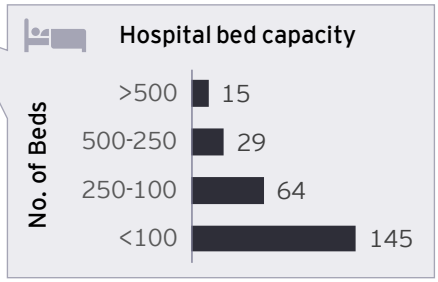
Respondents at a glance

By type

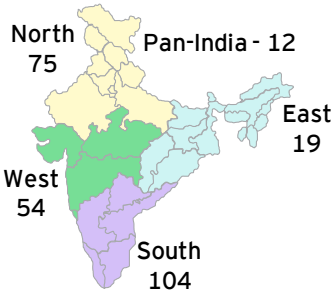
Hospitals **253**

Clinics **7**

Labs **4**



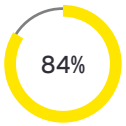
By geography



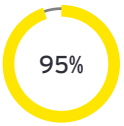
Metro **89**

Non-metro **175**

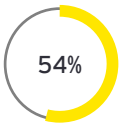
Physical infrastructure



Have **earmarked inoculation facilities** in their hospitals/centers



Have capability to **inoculate their own staff**



Have **cold storage facilities** to store vaccines on site

Key areas of support required in semi-urban/rural:

1. Clarity on reimbursement/pricing
2. Clarity on protocols/guidelines – vaccine type, inoculation process and storage and handling process
3. IT and reporting requirements

Manpower allocation

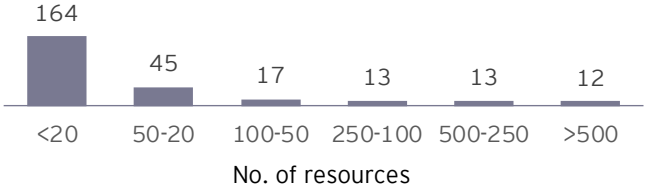
88% Have **trained inoculators available** for vaccination

70% Willing to **allocate manpower** in semi-urban/rural areas for vaccination

94% Willing to impart training for inoculation

Resource allocation for vaccination

~100 respondents willing to allocate >20 resources for vaccination in semi-urban and rural areas



~30k **Total trained pool** available for vaccination

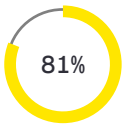
60% **Intended resource allocation** to semi-urban and rural

Areas for vaccination: **80%-90%** allocation from Registered nurses, ANMs and doctors

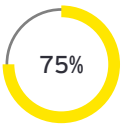
Key areas of support required in semi-urban/rural:

1. Staff training – specifically for ANMs, resident doctors, Phlebotomists and Pharmacists
2. Staff compensation for additional workload
3. Incremental staffing requirement for additional workload

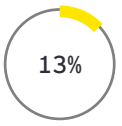
Coverage of inoculation services



Are willing to inoculate **front line workers (e.g. police), teachers, students** etc. in their local area



Are willing to **inoculate their local communities** (in 5km radius)



Will offer services **outside their home state**

Key areas of support required in semi-urban/rural:

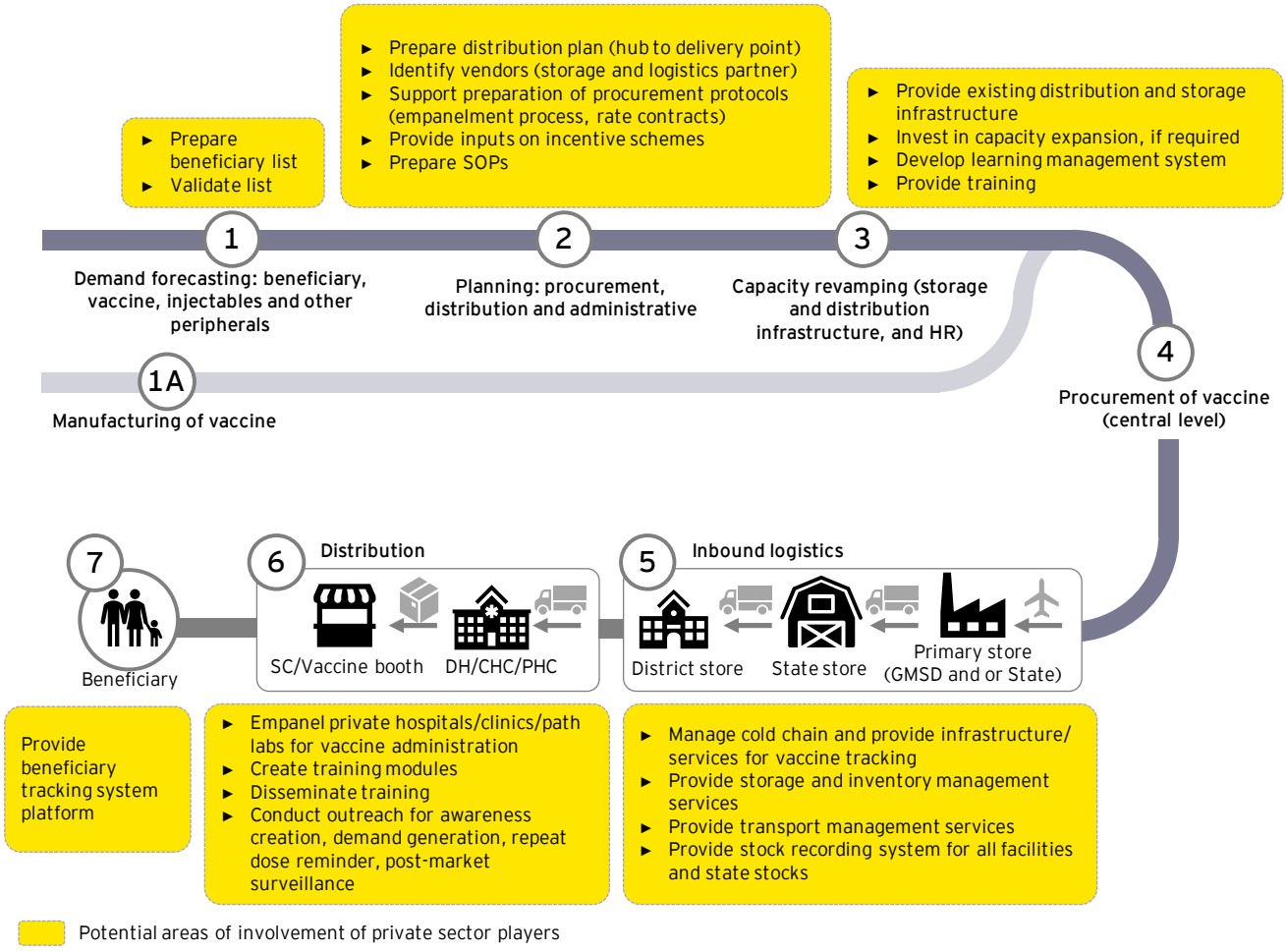
1. Planning and coordination of vaccination camps
2. Regular supply of vaccines
3. Staff safety and security
4. Travel and lodging for staff (if outside their home city)



3

Potential engagement models between private and public sector across different stages of the value chain and private sector players' key role towards the same

There is scope for collaboration between various private players and public entities across the value chain to augment physical infrastructure, human infrastructure and technology capabilities for achieving this aspirational immunization agenda. A high-level assessment of the various components in the value chain wherein private sector participation may be enlisted has been provided in the exhibit below –



While government does the overall regulatory framework and provides standard guidelines for implementation of CO-WIN program across the country, private sector participation may be explored across two indicative models (which may vary based on the need and capacity of the various state governments) as enumerated below:

Model 1: Largely managed by the government: This model is envisaged in the early phases of vaccine roll out when the entire vaccine administration is controlled for prioritized beneficiary categories and government has adequate capacity of human resources for inoculation.

- Private sector manufactures vaccines, manages its transportation, and private healthcare providers vaccinate their own staff.
- Government defines and implements the regulatory framework, provides physical and human resource infrastructure for storage and inoculation of beneficiaries, designs SOPs, defines beneficiary prioritization plan, deploys systems and processes for post-marketing surveillance, and provides end-to-end IT infrastructure for vaccine tracking and administrative monitoring.

Model 2: Hybrid model, sharing of resources and services: This model is envisaged as vaccine supply ramps up. In this, general public is included among beneficiaries for inoculation and the requirement of manpower for inoculation exceeds the latent capacity that can be made available by the public sector.

- Private sector manufactures and sources vaccines. Additionally, private sector can adopt various alternative models of resource sharing across different components of the supply chain (i.e. storage, logistics and distribution) as per local parameters of infrastructural and technical capacity augmentation requirements of the government. The sector can also engage in last-mile service delivery by providing infrastructure and human resource for inoculation through an empanelment process. It can also provide partial or end-to-end IT infrastructure and technology support for vaccine tracking and administration monitoring.
- Government defines and implements the regulatory framework for vaccination program, selects and approves private sector service providers as per defined qualification criteria, designs and enforces SOPs, defines beneficiary prioritization plan, oversees implementation and drives management of deviations.

People who have the ability and are willing to pay for the vaccine should be permitted to do so (irrespective of government definition of priority population) as long as the supply of vaccine is controlled and also specifically earmarked by the government for such private sector use. Any kind of hoarding should be prevented. Private sector should be allowed to choose the vaccine that they want to use as long as it is approved for use in the country.

A detailing of various models and roles of government and private sector across different avenues have been provided below as a matrix. It is important to note that the hybrid model provides various avenues of private sector participation and can be determined based on existing public sector resources and the need to augment public capacity in specific geographies.

Government | Private

Areas of collaboration	Sub- areas of collaboration	Model 1	Model 2		
			Hybrid model, sharing of resources and services		
		Largely managed by government	2A (low private intensity)	2B (moderate private intensity)	2C (high private intensity)
Regulations	Policy and SOPs				
	Beneficiary prioritization (as applicable)				
Planning and manufacturing	Demand forecasting				
	Vaccines manufacturing				
Capacity revamping and inbound logistics A. Cold storage	Storage capacity				
	Equipment and support system				
	Operations and maintenance of facility				
Capacity revamping and inbound logistics B. Logistics and distribution	Freight capacity				
	End-to-end monitoring				
	Operations and maintenance (O&M)				
Distribution-vaccination centers and human resource for vaccination	HR provisioning				
	Training of existing HR (capacity building)				
	Technology for IEC and its monitoring				
	Setting up immunization booth				
	Delivering services at immunization booth				
	Outreach for vaccine awareness				
	Post-marketing surveillance				
Technology - infrastructure and services	End-to-end technology services				
	Revamping capacity of existing software				
	Design, development, deployment of software				
	O&M of software				

Key roles of private players

Private players may potentially perform the following key roles across the various areas of collaboration in the supply chain (excluding sourcing of vaccines and consumables):

A.	Storage, logistics and distribution
Key context	A network of 27,000 cold chain points[19,20] is established under the Universal Immunization Program of India. These cold chain points provide refrigeration of 2°C to (-)8°C at a capacity of ~10 cubic metre each or more20. Un-utilized storage capacity of these cold chain points can be consumed for storing COVID-19 vaccines with technical upgradation. Leading front runners in development of COVID-19 vaccine require sub-zero temperatures during transportation. They demand specialized freight containers and reefer trucks. For phase 1 of inoculation (20%-25% of the population), there seems to be no constraint around capacity and logistics as there is going to be rolling stock. A high-level logistics assessment indicates there would be a total requirement of 125-150 reefer containers and trucks for trips from plants to state-wise nodal points in the first phase, spreading over three months period (Refer Annexure 1). An up-down trip would cost ~INR4 lakhs each. These trucks can handle temperatures up to +20°C to (-)35°C. The government may look at hiring 30-40 containers and trucks from shipping companies (e.g., Maersk Line/MSC/Hapag/CMA) at a fixed cost with provision of drivers and fuel to cover these movements on a monthly basis. These reefer trucks can be used at the last-mile storages. Vaccine manufacturers can package some vaccines in insulated containers with GPS trackers and temperature monitors to directly ship them to vaccination centers. These containers can be available in small sizes (i.e., approximate size of a large suitcase) to allow shipment of ~1,000 doses. The first leg of vaccine supply (from manufacturer/depot to vaccination center) can be achieved by utilizing these technologies. The final leg of vaccine supply (vaccination center to patient) requires design of an immunization plan that will be available as per local technology. It is anticipated that vaccination centers will be equipped with a refrigerator (that can maintain temperatures of 2-8 degree centigrade) to store vaccines for a few days to weeks basis guidance from the manufacturer. These centers shall need to plan and schedule the immunization according to shipment schedule. However, large centers with access to more advanced technology such as dry ice or even ultra-low temperature freezers shall have more flexibility in scheduling, planning and executing immunization schedule.
Role of government	▶ Define state-wise nodal points/last point of contact ▶ Define regulatory and monitoring framework and guidelines for storage of vaccines at nodal and inoculation points (example deep freezers to be placed at public/government schools/hospitals), infrastructure requirements, private vendor selection and empanelment process ▶ Hand-over unutilized cold storage to private players in case of complete outsourcing of storage and logistics services ▶ Provide official list of all approved vaccines with their industry names and universal product IDs to ensure product integrity ▶ Provide seamless customs clearance regulations for COVID-19 vaccines to enable their prompt import and exports
Role of private sector	▶ Provide storage infrastructure, freight vehicles and facilities with required technology ▶ Capacity augmentation, if required:

	▪ Equip existing storage facilities, freight facilities and assets with additional paraphernalia (temperature monitoring devices, stabilizers, GPS tracking, ice pack preparation) ▪ Train human resource for vaccine handling and other operations at storage facilities ▪ Develop SOPs with respect to: ▪ Inventory management for vaccine handling, packaging, shipping and waste reduction practices ▪ Implementation/monitoring of safety protocols and to keep a check on fraudulent practices ▪ Operation and maintenance of storage facilities, freight facilities and assets (including both self-owned and government-owned) ▪ Train existing workforce
B.	**Distribution of vaccination center network and human resource planning**
Key context	While India has made substantial progress in immunization coverage under the aegis of the Universal Immunization Program (UIP), the population coverage under the current UIP is ~15.7 crore[20] (pregnant women 3 crore, new-borns 2.7 crore and children between 1-5 year age groups 10 crore) which is assumed ~5 times lower than the current scope of the COVID-19 vaccination program. Additionally, the UIP has significantly leveraged public health facilities (~90% of vaccination coverage achieved through public health facilities as per NFHS 4 2015-16)[20] which has significant penetration largely in rural areas. The program has also shown greater improvement in coverage in rural areas (39% → 61% between 2005-06 to 2015-16)[20] than in urban areas (58% → 64% between 2005-06 to 2015-16)[20] as per NFHS 4 2015-16. Private healthcare sector represents greater than 70% share of bed capacity (total bed capacity of ~ 19 lakh beds) and 60% share of inpatient care in India. Additionally, there are ~ 1 lakh private diagnostic labs, ~ 5.25 lakh retail pharmacy chains, ~3-5 lakh private GPs a majority of whom will have their own clinics/OPD chambers. There is a likely need for ~10,000 vaccination centers to achieve coverage of 20%-25% population in urban areas. Considering limited latent public health capacity of the government in terms of HWCs and government hospitals in the urban areas, it is imperative to formally involve private sector's participation in last-mile delivery especially in urban areas which will necessitate creation of a robust delivery network plan. In rural areas due to the significant penetration of public health facilities, involvement of private sector can be enlisted on need basis.
Role of government	▪ Finalize the number of vaccination centers for defined catchment area in urban, semi-urban and rural areas across public and private health facilities/practitioners ▪ Define eligibility criteria in terms of minimum physical infrastructure and human resource required for approval of a vaccination center. The requirements for the presence of medical professionals, back-up emergency or urgent care management to be clarified while defining the eligibility criteria ▪ Establish platform, protocol and guidelines for registration and approval of qualified vaccination centers
Role of private sector	▪ Allow their facilities to be used as vaccination centers by the Government ▪ Adopt specific catchment areas for immunization coverage. To ensure wider coverage of target population in allocated catchment areas, various types of delivery points/vaccination center locations can be opted by private sector such as- ▪ Hospitals, nursing homes and clinics (including private clinics of GPs) ▪ Path labs

	▪ Residential welfare associations ▪ Factories ▪ Post offices ▪ Commercial establishments, such as offices ▪ Schools and colleges ▪ Community centers ▪ Leverage the e-pharmacy players that can support with their technology, capable manpower pool and cold storage network ▪ Take ownership of vaccinating their own on-roll and contractual employees (including clinical as well as non-clinical support teams) ▪ Enlist the participation of various medical bodies, such as IMA, FOGSI, AYUSH and hospital associations such as nursing home associations to encourage maximum enrolment of their members as vaccination centers ▪ Expand available base of eligible inoculators through empanelment of phlebotomists, pharmacists, retired medical professionals such as doctors and nurses and other eligible healthcare workers who are permitted to inoculate. Empanelment process for such inoculators should be based on guidelines as defined by the government. ▪ Service organizations such as Rotary Clubs and Lions Clubs could be approached for distribution and inoculation. Rotary Clubs for instance, have played an active role in polio eradication. Rotary members worldwide have so far contributed more than US$2.1 billion and significant volunteer hours to protect nearly 3 billion children in 122 countries, including India, from this paralyzing disease. While administering COVID-19 injectable vaccines is more complicated than oral drops, it is possible to leverage their vast network of qualified GPs, medical personnel, hospitals, dispensaries, health care centers and a large member network (1.5 lakh Rotarians and 4,000 Rotary clubs) across India and Rotary's proven execution skills for this cause too. They have already contributed significantly to the fight against the spread of COVID-19. Around 1.5 lakh Rotary members across 4,000 Rotary clubs in India have distributed 75,000 personal protective equipment (PPE) kits and other supplies to those in need across the country. Most of the clubs are likely to have two to three medical professionals who would lend support through their services or through their healthcare facilities. The rest of the Rotary network can contribute through communication campaigns for advocacy on the need for vaccination as well as for supporting the local authorities by working as a volunteer. ▪ Similarly, other service clubs like Lions Clubs, Gymkhana, Grand Lodge of India and other regional clubs can also be considered for their contribution through their wide networks. Further, large government volunteer bodies in the country like NCC, NSS, Nehru Yuvak Kendra Sangathan, Bharat Scouts and Guides can be utilized for volunteer support at vaccination sites as well as for mobilizing the population for vaccination. ▪ Ensure compliance with minimum physical and human resource infrastructure requirements at the vaccination centers as defined by government, including well- established processes and protocols to provide back-up medical support in case of adverse events and emergencies
C.	**Distribution - clinical standards for inoculator capability, inoculator training, patient screening, post marketing surveillance**
Key context	In order to achieve coverage of 20%-25% population there would be requirement of ~1.0 lakh inoculators and ~2.0 lakh administration and facilitation staff. The total nursing/ANM pool which can be considered as the first line of healthcare worker for inoculation is 14-15 lakh in India of which ~45% (~6 lakh) is in the public sector. Even if 10% of the latent capacity of nursing pool in the public sector is made available for

	the program, there will be significant gap between inoculator requirement and availability which can be met by including private sector nurses in the program as well as enlisting other healthcare workers (such as penultimate year/final year medical and nursing students, AYUSH doctors, phlebotomists and pharmacists) into the program through a rapid training (virtual / in-person) and certification process. Additionally, appropriate technical guidelines for medical assessment and screening of patient before vaccine administration needs to be in place for streamlined management of last mile execution. Continuous surveillance of potential vaccine-related adverse events and monitoring outcomes even after licensure of vaccines would also be required.
Role of government	▶ Define the categories of healthcare professionals who can be enlisted for inoculation and provide qualification criteria including educational background and certified training programs based on which they can be enlisted ▶ Approve and accredit agencies and training programs for inoculation training such as Healthcare Sector Skills Council and National Skill Development Council ▶ Allow private sector the flexibility to decide on the degree of participation (such as freedom to restrict participation within urban/non-urban areas, up to district level and beyond) for vaccine administration, and as trainers to skill inoculators based on their available capacity and capability ▶ Approve patient medical assessment questionnaires and screening requirements (such as temperature, pulse, blood pressure, saturation) prior to vaccine administration ▶ Approve SOPs and protocols for safe disposal of bio-medical waste ▶ Define surveillance guidelines including training modules for conducting post-marketing surveillance. Leverage digital tools for documentation, tracking and traceability of post-marketing surveillance results
Role of private sector	▶ Create training modules and certification programs and enlist with the government as a registered training/certification agency. These modules can comprise of sections covering – a) Handling of vaccine - Contents can be provided by vaccine manufacturers b) Injection technique - Contents can be provided by private healthcare providers/industry bodies. The module can cover details such as methods for administering intramuscular injection (considering use of auto disable syringe which is commonly used by the MOHFW under immunization program), right site selection depending on age, hand hygiene and safe disposal of used injections c) Patient communication - Contents can be provided by private healthcare providers/industry bodies based on inputs from the MOHFW w.r.t to any dos and don'ts, timelines for subsequent injection, adverse reactions and its management d) Patient counselling - Post-vaccination, there could be a need to counsel patients on critical aspects of post-vaccination consequences. The content may need to be co-developed by manufacturer and healthcare professionals A comprehensive training curriculum on immunization would involve 12-14 hours of actual time as it would include understanding and microplanning immunization sessions, some technical details about the vaccine, cold chain, documentation, adverse event management and social mobilization besides the core skill of injections. Each module of the training may require 1-1.5 hour for dissemination. The training module can be shared with hospitals, nursing homes, medical associations that would be able to train resident doctors, MBBS students, dentists, registered nurses, AYUSH doctors, ANMs, phlebotomists and technicians

	▶ Involve participation of medical associations like IMA, specialized association of surgeons and physicians such as OMAG, FOGSI that have a strong state-level presence for dissemination of training as well as monitoring of training program ▶ Involve participation of accreditation agencies such as NABH and NABL for imparting training as they have large pool of master trainers/assessors ▶ For training people to administer vaccines, in addition to the players in the healthcare sector, academic institutions focusing on public health such as Harvard School of Public Health could be roped in ▶ Extend digital platforms such as websites and apps to upload training modules for wider dissemination of the content to their networks and associates ▶ Ensure compliance and documentation of assessment and screening protocols and bio-medical waste management as approved by the government ▶ Collaborate with government to support post-marketing surveillance management using various outreach initiatives such as call centers, reporting on care provided for adverse event management
D.	**Distribution- citizen prioritization, delivery scheduling and tracking**
Key context	Shortage in supply of vaccine is expected in the initial months. Due to this, the need for prioritizing population for vaccine coverage cannot be over emphasized upon. While government will be prioritizing individuals for vaccination based on defined criteria, it is imperative to ensure adherence to the prioritized list and prevent administration of vaccination to unauthorized individuals. Also, since the potential vaccine candidates are required to be administered twice on every individual within gap for few days/weeks, it is important to ensure that a robust follow up/reminder/compliance management process is in place for effective implementation of the program.

Role of government	▶ Approve criteria for prioritizing patients and timelines for vaccination coverage of the different priority categories
	▶ Define eligible patient categories to be covered by private sector
	▶ Create verified database of prioritized beneficiaries leveraging Aadhar/other national, state or local ID database. Establish mechanism for pre-verification of criteria used for citizen prioritization such as –
	  ▶ Occupation
	  ▶ Age
	  ▶ Co-morbidities
	▶ Provide technology support/protocols across stages starting from registration (including verification) to generation of certification for completion of vaccine administration
	▶ Define mechanism for follow up/reminder for second dose which covers roles and responsibilities of private sector
	▶ For ensuring effectiveness and efficiency of this massive program, government will need to define its outcome metrics. It will also need to establish systems and technology tools to record and report performance against the same. Some of the key outcome metrics that can be focused on include percentage coverage of population for first dose and second dose, number of new COVID-19 cases and number of adverse events due to vaccination. Private sector players can support the government in measurement and reporting of performance against the targets.

Role of private sector	▶ Provide technology platforms with ability to exchange/upload data with government IT interfaces. The key features required for such system include- ▶ Advance registration/slot booking of beneficiaries on designated dates at designated locations

	▶ Vial mapping/serialization to registered beneficiary ▶ Verification of beneficiary and vial at vaccination center (Biometric, physical ID, proof of comorbid conditions) ▶ Recording brief beneficiary medical assessment prior to vaccination (such as temperature, pulse, blood pressure, saturation, co-morbid conditions, allergies) ▶ Generating proof/certification for completion of vaccine administration ▶ Generating reminders for second dose ▶ Provide call center support for registration/slot booking, reminder for second dose, tracking of any adverse events post defined time frame after vaccination day ▶ Drawing learnings from the current Universal Immunization Program wherein incentives are provided to ANMs and ASHA workers for mobilization of beneficiaries and creation of awareness in the community, private sector can evaluate creation of an incentive-based model for engaging manpower to conduct specific outreach to expand enrolment for both first and second dose of vaccination ▶ Establish robust auditable processes to ensure appropriateness of beneficiary verification and compliance to dispensing of vaccines as per serialization of vials ▶ Ensure processes for queue management at vaccination centers through various options such as creation of kiosks operated through token management system
E.	**Distribution- outreach planning and execution**
Key context	For the vaccine once launched, to achieve the desired population coverage in each phase, in addition to ensuring its allocation and distribution, it would be very critical to ensure the right "demand generation". For a vaccine which is targeted towards adult population and has been developed with unparalleled speed, it would be highly crucial that right perceptions are created about its safety and efficacy from the very start and effective communication of the same is carried out at the grassroot level leveraging a multitude of communication channels.
Role of government	▶ Create and execute strategic communication plan covering: ▶ Mass and targeted communication channels - Include mass media (newspapers, TV, radio), digital and social media, mid media such as media mobile vans, trained theatre artists. Enlist influencers and area-wise champions to drive social and behavioral change including celebrities, dignitaries, healthcare workers (specifically ANMs, ASHA, Anganwadi workers in rural areas), religious leaders and faith-based organizations, gram panchayats, self-help groups, student bodies, workers unions, social and cultural organization such as Rotary Clubs, Lions Clubs and NGOs ▶ Communication stories and messages leveraging evidence-based literature on safety and efficacy of the vaccine, on likely side effects, benefits of vaccination ▶ Design and execute targeted immunization campaigns/drives based on assessment of progress w.r.t population coverage ▶ Permit companies to utilize their CSR funds for inoculation of their own employees, while also supporting them for inoculation of population in their vicinity, wherever possible
Role of private sector	▶ Research done by communication specialists at public health academic institutions can create the communication for vaccine awareness. Also, private sector organizations being skilled at marketing, may be able to help design effective communication ▶ Collaborate with government in providing manpower, wherever required, to conduct outreach activities involving NGOs, social and cultural organizations such

	as Rotary and Lions Clubs. They can partner with private healthcare providers to drive demand generation in catchments. Similar to the immunization drives under Mission Indradhanush[21] of the government, various key opinion leaders in micro catchments such as gram panchayats, religious leaders, faith-based institutions, religious organizations, academic institutions, professional bodies should be engaged by private sector to create vaccine awareness and drive demand generation ▶ Collaborate with government to provide support in marketing and communication efforts such as outreach on digital and social media platforms owned by private players ▶ Collaborate with government to provide training to outreach workers of various partner organizations ▶ Large corporates who undertake CSR initiatives may be approached to contribute their funds for the administration of COVID-19 vaccine. The government should allow all companies to utilize their CSR funds for inoculation of their own employees, while also supporting them for inoculation of population in their vicinity, wherever possible.
F.	**Technology infrastructure and services**
Key context	Digital interventions would be key to how, we as a country can best plan for COVID-19 vaccination of our citizens in a streamlined and efficient fashion keeping the cost low, meeting the priorities laid out and achieving the targeted level of adoption at the shortest possible time. Last mile vaccination administration should be robust and a closely knit ecosystem should be created that leverages strengths of all current entities and technology solutions. Annexure 3 shows an illustrative depiction of last-mile vaccine administration. Government needs to play the role of a technology enabler and provider of core backbone (CO-WIN) while private sector to adopt, integrate, build-on and build around the core backbone.
Role of government	▶ Existing eVIN network is proposed to track the latest vaccine stock position, temperature at storage facility and geo-tag health centers, and to maintain facility level dashboard for the delivery of the vaccine. Currently, it focuses on public health facilities and would need to get extended to private sector COVID-19 vaccine storage and delivery points. CO-WIN app (extension to eVIN) will help in vaccine's procurement, distribution, storage; scheduling of dosage; and to provide notification to recipients ▶ Government needs to open-up the common vaccination platform (CO-WIN ++) for both public and private sector ecosystem partners for last-mile vaccine administration ▶ Issue guidelines for leveraging CO-WIN, and also enable private sector to build on and build around CO-WIN ▶ Play a major part in upskilling and capacity building: Digital training on protocols and certain specifics and other SOPs through proven digital online training platform like Diksha ▶ The central and state government would need to invest in strong analytics engine for not only tracking purposes, but also for planning and predictive analytics related to prioritization of beneficiaries, areas to be targeted, reduce drop-outs, improve vaccine efficacy across target segments, etc. ▶ Compliance management by leveraging technology would also be a key area for the government to focus on. The government might involve private sector to operationalize and rollout this ▶ State governments would need to repurpose their COVID command and control systems along with augmentation of resource planning tools for managing scale ▶ Technology solutions for monitoring drop-out rates would also be required to be implemented to ensure coverage

Role of private sector	**Supply side** ▶ Adoption of Track and Trace system for pharma is vital for COVID-19 vaccine supply. Traceability technology will play major role in reducing possibility of counterfeit COVID-19 vaccine and providing assurance to the stakeholders (including citizens) about the effectiveness of the vaccine ▶ Manufacturers need to integrate the temperature monitoring data of their storage and transportation facilities with the common vaccine platform. This will ensure lower wastages and better tracking of temperature breaches enabling prompt corrective action. ▶ Using drone technology to deliver vaccine at isolated areas is also an option to be evaluated. **Vaccine storage and transportation** ▶ Given the magnitude of dosages to be stored, vaccine storage cannot be restricted to only public sector warehouses at central, state, regional and district level. Private sector storage facilities would need to be leveraged and appropriate monitoring of quantities and temperature would need to be undertaken by integrating with eVIN application ▶ Private sector storage providers (including hospitals/labs) would need to augment their IT systems to integrate with eVIN. Temperature loggers would need to be installed (if not already available) in the cold chain equipment and integrated with the Common vaccination platform. ▶ Again, the vaccine stock demand, irrespective of public or private, has to be raised in the vaccination platform. Existing HMIS/pharmacy/stock management solutions in private sector labs/hospital would need to be integrated thereby automating the process of indenting and supplying vaccine based on prioritization and demand forecasting. Data integration between silo/existing systems and Common vaccination platform needs to be undertaken. ▶ Transportation of vaccine would need robust tracking mechanism and private sector can play a big role in providing solutions around this **Last-mile administration** ▶ In order to address last-mile administration challenge, there needs to be strong private sector participation. There can be a Vaccine Service Providers (VSP), selected by state /central government who can undertake this exercise. ▶ Private hospital, labs, etc. can register as VSPs, provided, they are registered and approved in the central vaccination platform. There can be an integration between their existing applications and the vaccination platform for sharing beneficiary details and effective beneficiary and vaccine tracking. This should a cross agency collaboration platform. ▶ VSPs would require technology solutions for managing their day-to-day internal operations like scheduling of resources, vaccine management, accessories management (needles, syringes, etc.) payment reconciliation, and reporting to center and state government agencies. At the point of administration / inoculation, they would require beneficiary authentication devices, access to central system for recording, integration with payment gateways and printing facilities among other things. ▶ A COVID mobile app facilitating both citizen and private entities with following functionalities would also be critical: ▶ **Citizen portal** registration, vaccination center selection, slot booking, beneficiary profile, vaccination certification and e-Health records (if opted) Citizen engagement is a critical aspect for active participation. Gamification is an effective way to ensure citizen's participation[22] ▶ **Vaccination center enrolment portal**

Vaccination center enrolment and monitoring, vaccinator registration and authorized vaccinator allocation

Vaccination center transaction management system

- **Beneficiary authentication, vaccine payment management, vaccine authenticity verification, administered vaccination details, vaccination certificate management**
- **Adverse effects, feedback and grievance redressal mechanism**

- Data platform capabilities coupled with AI and Machine Learning can mine real-world data to assess the safety and efficacy of COVID-19 vaccines and adverse patient monitoring. This would also helpful in multi-vaccine administration scenarios
- Given the exigency, the private sector health workers with a certain level of training have to be a part of this vaccination exercise. Government's online training and certification platform like Diksha (along with practical/hands-on vaccine administration training for non-certified administrators) can be utilized for the same. Scheduling of staff members for vaccination can be prepared using the existing staff scheduling applications in the hospitals.

Others

- Private insurance players can integrate their application for any COVID related packages through OpenAPIs.

All being said, privacy and security of personal data is of prime importance. Heavy investment in comprehensive data privacy and security program is the need of the hour to keep data secure while providing choice and transparency. Blockchain may be an effective tool to maintain data security and ensure supply chain planning.



4

Role of the private sector from the learnings drawn from other countries

Vaccine prioritization, immunization timeline and governance structure are some of the key parameters to enable vaccine distribution and implementation. A review of the policies of several countries including the US, the UK, Australia, the EU and Indonesia, highlights that the policies developed by the Indian government are broadly in alignment with other countries for aspects related to population coverage and program governance structure.

Like majority of countries, India plans to immunize 20%-25% of population (27-30 crore beneficiaries) in a phased program spanning seven to eight months. On the governance structure, the program in India is expected to be regulated centrally and executed by state governments which is also in line with program structure adopted by other international markets. Majority of countries are looking at enrolling participation of the private sector specifically in the last-mile vaccine administration process. Some of the key learnings in this regard are as follows:

Dimension	What are other countries doing?	Key learnings for India
Vaccine administration		
Physical infrastructure	▶ The US will employ three to four centers/million population and inoculate through private hospitals and clinics and alliance such as CVS and Walgreens pharmacy chains and homeless shelters ▶ The HHS in the US has appointed pharma distribution company, McKesson, to supply vaccination kits to centers, and UPS and FedEx have built expansive freezer farms for vaccine storage	▶ In urban and semi-urban areas, private hospitals, private nursing homes, old age homes, schools/ colleges and large factories can be set-up as hubs for vaccination with the support of the private sector ▶ The private sector can support the government in vaccine logistics providing cold chain, cold storage solutions, warehousing facilities, last-mile delivery (companies like Flipkart) and optimizing delivery pathways using AI technologies
Human capital	▶ The US, Spain and French governments have instructed state governments to engage with private sector hospitals and private GP practices to supply key clinical staff groups such as general practitioners, doctors, nurses and pharmacists the vaccines to utilize them in close proximity to the population to reduce cold storage requirements	▶ **Public-private partnerships can provide doctors** and nurses for inoculation, including wider staff groups in the private sector such as pharmacists, phlebotomists, therapists, etc. to provide additional capacity where required ▶ **NGOs, not-for-profit and organizations such as the Rotary Clubs** can be used to gather volunteers for crowd management, registration, data entry and reporting
Regulation for additional workforce	▶ The UK has undergone and completed a public consultation on making amendments to the regulations to include midwives, nursing associates, operating department practitioners, paramedics and physiotherapists as key resources who can inoculate and administer the vaccine	▶ Private sector paramedical staff groups such as pharmacists, phlebotomists, therapists, healthcare and nursing assistants, trainee nurses, junior doctors, if trained, can provide additional inoculation capacity and outreach, specifically in rural areas

Dimension	What are other countries doing?	Key learnings for India
Vaccine administration		
 **Process and systems**	▶ The US is using the Vaccine Tracking System (VTrckS), a secure, web-based IT system integrating the entire vaccine supply chain and administration ▶ Australia is integrating the Australian Immunization Register (AIR) and My Health Record (MHR) will be unifying national monitoring system ▶ Simplus and Ixlayer have developed cloud-based vaccine management systems	▶ The **private sector can support with tracking of individuals and dosages, improving interoperability of public/private systems** and developing a national portal for monitoring of vaccines ▶ **Private sector can also support in upskilling/ digital training** for GNMs, Asha and Anganwadi workers and improving communication channels to reduce misinformation
 **Partnerships and outreach efforts**	▶ The US has set-up the federal-pharmacy partnership, a consortium of 20 retail and community pharmacy chains to increase the reach of COVID-19 vaccination specifically into rural and impoverished areas ▶ The Australian Government is partnering with the Aboriginal and Torres Strait Islander Community Centers and other religious and interfaith centers to increase the awareness of the COVID-19 vaccination program	▶ **India can capitalize on the large private hospital sector** and empanel/authorize hospitals and nursing homes (of certain capacity) to inoculate and partner with organizations such as **Rotary and Lions Clubs** to increase vaccine's penetration in urban and semi-urban areas ▶ Create awareness and communication on the vaccine through partnerships with hospitals, NGOs (e.g., Bill and Malinda Gates foundation, Wish Foundation), religious groups and leaders, samajs, Gram Panchayats, unions, Asha and Anganwadi workers to increase their outreach



Annexure

Annexure 1: Analysis for Stage 1 container and warehouse space requirement- (plant to warehouse/State-wise nodal points)

GMSD	Karnal (9)	Kolkata (13)	Chennai (6)	Mumbai (7)
State	Haryana, Punjab, Delhi, Himachal Pradesh, Jammu and Kashmir, Rajasthan, Chandigarh, Uttaranchal and Uttar Pradesh	West Bengal, Bihar, Odisha, Assam, Meghalaya, Manipur, Sikkim, Mizoram, Arunachal Pradesh, Nagaland, Jharkhand, Andaman-Nicobar Island and Tripura)	Andhra Pradesh, Kerala, Tamil Nadu, Karnataka, Lakshadweep and Puducherry	Maharashtra, Chhattisgarh, Goa, Gujarat, Madhya Pradesh, Dadra and Nagar Haveli, Daman and Diu
Population in m	405	348	277	300
Dosage requirement for India in m	567	487	388	420
Phase 1 population to be inoculated (25%)	101	87	69	75
Dosage requirement for phase 1	142	122	97	105
Cold Chain Capacity (m MT)	19.2	8.5	2.7	6.6
Cold Chain Capacity for Pharma (m MT)	0.19	0.09	0.03	0.07
Dosage/Carton	5000	5000	5000	5000
Carton Per pallet	18	18	18	18
Dosage per Pallet (m)	0.09	0.09	0.09	0.09
Dosage per week (m)	21.8	18.72	14.93	16.17
Pallets requirement for the region	6297	5407	4312	4671
Pallets requirement for Phase 1	1574	1352	1078	1168
Truck/Reefer container requirement	39	34	27	29
Dosage/container (m)	3.6	3.6	3.6	3.6
Dosage requirement for phase 1 (m)	142	122	97	105
Timeline for phase 1	3 months	3 months	3 months	3 months
Container truck trips requirement per week (six months)	3	3	2	2
Warehouse space requirements	105 pallets/month	104 pallets/month	83 pallets/month	90 pallets/month

Key assumptions:

- Consideration of vaccines that require cold chain of -70 to -80 °C is not being done as India does not have the capability for the same
- Wastage in transportation is being considered as 0.25%-0.5%
- Dosage has been considered as 0.3 ML, 10 dose packaging per vial and 5000 doses per shipper
- It will take a maximum of seven days to reach any location in India from the site of manufacturing
- Cost for reefer truck per km would be ~INR100

Annexure 2: Components of training plan for COVID-19 vaccination

With 59 million total COVID-19 cases and 16 million active cases, the world is eagerly waiting for a vaccine. At ~9 million cases, India has the second highest number of total COVID-19 cases in the world. The vaccine developed by both Pfizer/BioNTech and Moderna have reported impressive efficacy, around 95%, as per latest news. Therefore, on one side, there is a clear demand for COVID-19 vaccine across the world and there are viable candidates to fulfil that demand; on the other side, several agencies are working together to ramp-up the vaccine manufacturing capability in different parts of the world to ensure access of life saving vaccine to those who need it as early as possible. One of the key considerations in the COVID-19 vaccination process is last-mile access and administration of the vaccine, which is especially relevant in low-and-middle income countries such as India.

Training of relevant stakeholders to plan and execute administration of vaccine would be important to achieve the desired scale and efficiency in a timely manner. The objective of this document is to highlight important elements which would be part of the training plan for COVID-19 vaccination.

I. Key components

Various cadres of resources under the Ministry of Health (MoH) would be trained on different aspects connected with vaccine delivery. The key components of the training plan would include:

- Criteria for determining eligibility and prioritization plan of potential beneficiaries
- Identification of eligible beneficiaries for vaccination as per government guidelines
- Planning and execution of the vaccination campaign at different fixed and outreach locations across the country in both public and private sector. This will include list of locations where vaccination would be provided along with time slots.
- Management of cold chain and other logistics related to executing the mass vaccination campaign including transportation by using RFID and wireless sensor networks if required
- Detailed training plan for each cadre including development of training modules (online and hand-on training; induction and refresher); training of trainers, down trainings and follow-up skill assessments and continuous learning activities
- Monitoring vaccine safety and efficacy through surveillance
- Inventory management
- Quality control
- Managing the Adverse Events Following Immunization (AEFI) during the whole campaign and ensuring access to appropriate health facilities for recipients
- Managing safe disposal of humongous bio-medical waste to be generated during the campaign
- Conducting mass awareness campaigns – to communicate intended beneficiaries about the benefits and potential risk factors of the vaccination

II. Training of resources on the field

- **Development of training modules**
  - **Content development:** Training modules will be developed by national experts in collaboration with various bodies and experts from industry. These modules would be approved by a technical team from the immunization division of the Ministry of Health and Family Welfare (MoHFW). There will be various technical and operational modules

related to the vaccination campaign. The module on vaccine administration would include:

- A module on safe injection practices (basics of safe injections, dos and don'ts of vaccine administration)
- Key steps for vaccine preparation, administration and disposal (including beneficiary identification, site selection, site cleaning, syringe selection, injection, safe disposal practices, beneficiary care post disposal, relevant documentation and quality assurance methodology)
- Standard precaution to be undertaken (such as hand hygiene, use of sterile equipment, COVID-19 specific PPE, etc.)

- **Online and offline:** Content will be developed for both online and offline training modules in different languages.
- **Hands-on training:** Training curriculum will include on-site hands-on training on injection use and sharp disposal. Online modules will also include videos.
- **Timing of each module:** The modules should be short, crisp, concise, easy to digest and easy to circulate via different modes such as WhatsApp groups, email, etc.
- **Pre and post quiz:** All the trainees need to undergo a pre and post quiz to ensure correct understanding of the content delivered to them. This will be followed by a quarterly online follow-up skill assessment to ensure retention of the knowledge provided to the workers.
- **Role based modules:** For different cadres, such as ANMs, ASHA, program managers etc., different modules will be prepared. Some of these modules will be common and others will be specific to the role played by a given cadre in the process.

- **Trainers:** Master trainers could be selected from the following cadres:
  - **Public sector**
    - Technical officers from development partner organizations such as Immunization Technical Support Unit (ITSU, funded by BMGF); WHO, UNICEF, PATH, USAID, etc.
    - Technical officers from state health missions (under the aegis of NHM)
    - Faculty from medical colleges
    - Faculty from regional Health and Family Welfare institutes
    - Clinicians and nurses from various autonomous bodies such as armed forces, railways, ESI, public sector corporations like BHEL, SAIL, etc.
    - Healthcare Sector Skills Council and NSDC can be approached to impart this training to aspirants/existing students who are eligible for the same
  - **Private sector**
    - Professional bodies such as Indian Medical Association (IMA); Indian Nursing Association (INA), India Academy of Pediatrics (IAP), etc.
    - Clinicians and faculty from different health care organizations such as corporate hospital, lab chains and private medical colleges
    - Independent medical consultants from various streams.
  - **Trainees:** The MoH to use Train the Trainer (ToT) model wherein master trainers will be developed (possibly in thousands) for each type of training module, who will further train the resources under them in a timely manner.
    - Non-healthcare workers can be used to reduce data entry and other such ancillary efforts of healthcare workers, and HCWs' time can be effectively utilized for vaccine administration only

- **Platform for delivery:** A mixed method approach will be undertaken where trainings will be conducted via both classroom settings and through online training platforms (webinars, online self-learning platforms, etc.)
- **Frequency:** The MoH to conduct induction training followed by refresher training at regular intervals

III. Partnerships to enable efficient vaccine delivery

Ensuring successful delivery would require partnerships at various levels. Industry could play a significant role in making this vaccination campaign successful by harnessing their techno-managerial bandwidth. Some examples of these partnership would include:

- Partnership with healthcare laboratories and industries to develop training content and support in the training of trainers in public and private sector
- Partnership with hospitals to support dissemination of training modules by utilizing their network and platform for distribution of modules
- Partnership with bodies such as IMA to ensure dissemination of accurate and consistent information on the COVID-19 vaccination program to all healthcare workers
- Partnership with software companies to support designing of (a) systems which can help in real-time tracking of movement of vaccine from warehouse to the last mile and (b) dashboards showing achievements as opposed to targets by each geography and population group in graphical formats (such as heat charts, root cause analysis, etc.)
- Partnership with advertisement agencies to ensure development of strong offline and digital vaccination campaigns aimed at providing accurate, easy to absorb information to different target groups. The campaign would also focus on encouraging people to follow the guidance by the MoH during different phases of vaccination

The Public Private Partnerships (PPP) would galore at various levels, in different formats, to fast track implementation of COVID-19 vaccination campaign.

IV. Role of digital technology in the entire process

Technology will play a critical role in all stages of vaccination process. The MoH plans to develop a unique ID for each beneficiary to record completion of vaccination. It also plans to use eVIN system for vaccine management. eVIN is an indigenously developed technology system that digitizes vaccine stocks and monitors the temperature of the cold chain through a smartphone application. Besides this, technology would play a critical role in accomplishing the following activities:

- **Training and capacity building:** Digital platforms would be needed to host content and share it with different users
- **Planning process:** Use of centralized database of public sector employees and healthcare facilities to plan sites and teams for vaccination
- **Reporting:** Applications would be used by healthcare workers to record details of those who have been provided vaccines. Additionally, dashboard would be required by program managers at national, state, district and block level to track progress.
- **Beneficiary information application:** Applications such as Aarogya Setu are needed to provide regular and accurate information to the beneficiaries about dates and timing of vaccination campaign, eligibility for vaccination in a given phase, record feedback/adverse events after immunization, etc.

- **Vaccine usage against supply:** In order to avoid pilferage of vaccines (due to initial high demand and low supply), it would be imperative to link use of each vaccine with a beneficiary to ensure complete transparency.

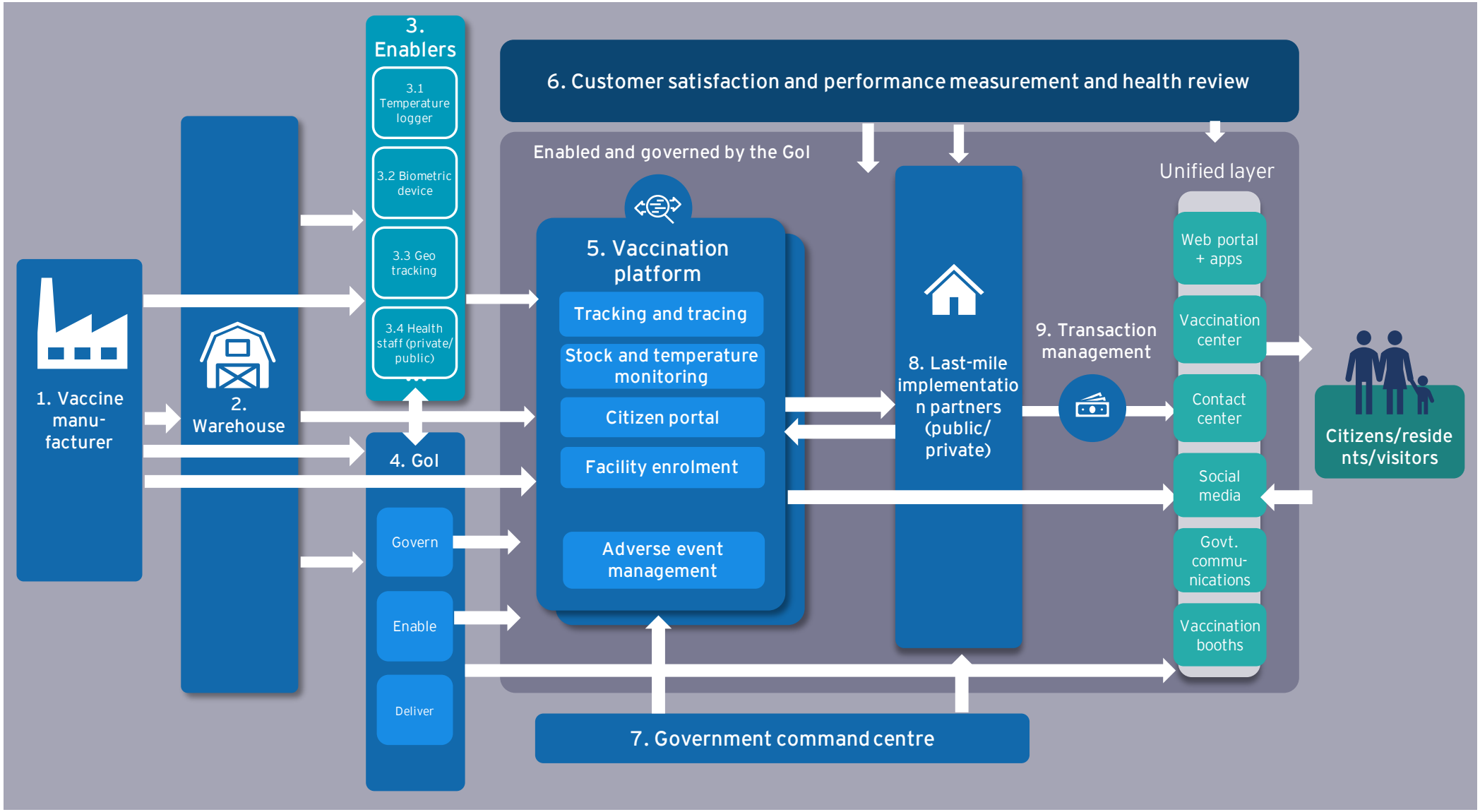
V. Other considerations

- Requirement to filter eligible beneficiaries from the non-eligible ones as per government's defined priority plans.
- Manage risk for health care professionals (HCPs) of contracting the COVID-19 infection while promoting COVID-19 vaccination campaign. As demand will be more than supply, managing the security and safety of the vaccine administering teams would need to be addressed.
- Effective inventory management: Forecasting adequate supply of vaccine related logistics and making them available at each vaccination site would require significant analytics and proactive preparations
- There would likely be a requirement to plan in advance for leveraging and deploying healthcare personnel from other programs to support COVID-19 vaccination efforts across the country. It may impact the program's functioning in short term.
- Mass awareness campaigns would be necessary to build traction and educate the intended beneficiaries about the dos and don'ts, frequency of dosage, benefits and possible adverse effects of COVID-19 vaccination, etc.

Conclusion

Rolling out COVID-19 vaccine for over a billion Indians requires an unprecedented level of preparation and implementation. The roll out is expected to be taken up in phases basis clearly-defined criteria for determining eligibility and prioritization of potential recipients. Training and grooming cadres of staff at different healthcare levels would be a critical component. It will require Public Private Partnerships (PPPs) at different levels and large numbers of skilled manpower not only for vaccinating people but also for reporting adverse events, if they happen post-vaccination. Estimating the scale of vaccination in phases and accordingly preparing logistics and training human resources at different levels would be critical to ensure success and sustainability.

Annexure 3: Illustrative depiction of last-mile vaccine administration



Annexure 4: Study of COVID vaccination's strategy and planned administration roadmap of select international geographies

Country Characterization

Country/Region	USA	UK	EU	Germany	Indonesia	Australia
Key characteristics	▸ Population size- 382m [24] ▸ Total COVID-19 cases- 11.9m [23] ▸ Total COVID-19 cases (% of population) – 3.1% ▸ Mortality (% of total cases) - 2.1% [23] ▸ Population above 65 years- 16% [25] ▸ Immunization coverage- 94% [26]	▸ Population size- 66m [24] ▸ Total COVID-19 cases- 1.4m [23] ▸ Total COVID-19 cases (% of population) – 2.1% ▸ Mortality (% of total cases) - 3.7% [23] ▸ Population above 65 years- 19% [25] ▸ Immunization coverage- 94% [26]	▸ Population size- 447m [24] ▸ Total COVID-19 cases- 10m [23] ▸ Total COVID-19 cases (% of population) – 2.2% ▸ Mortality (% of total cases) - 2.3% [23] ▸ Population above 65 years- 20% [25] ▸ Immunization coverage- 94% [26]	▸ Population size- 83m [24] ▸ Total COVID-19 cases- 1m [23] ▸ Total COVID-19 cases (% of population) – 1.2% ▸ Mortality (% of total cases) - 1.5% [23] ▸ Population above 65 years- 22% [25] ▸ Immunization coverage- 93% [26]	▸ Population size- 270m [24] ▸ Total COVID-19 cases- 0.5m [23] ▸ Total COVID-19 cases (% of population) – 0.2% ▸ Mortality (% of total cases) - 3.2% [23] ▸ Population above 65 years- 6% [25] ▸ Immunization coverage- 87% [26]	▸ Population size- 26m[24] ▸ Total COVID-19 cases- 0.02m [23] ▸ Total COVID-19 cases (% of population) – 0.1% ▸ Mortality (% of total cases) - 3.3% [23] ▸ Population above 65 years- 16% [25] ▸ Immunization coverage- 96% [26]

Vaccine coverage

Country/Region	USA	UK	EU	Germany	Indonesia	Australia
Population prioritization criteria	▸ Healthcare workers (doctors, nurses, etc.)[27] ▸ Essential workers (e.g., police, teachers, etc.) [27] ▸ Adults with co-morbidities and people over 65 years [27]	▸ Adults older than 50 years [28] ▸ Healthcare and social care workers on the front line [28] ▸ Adults with underlying co-morbidities [28]	▸ Healthcare workers [29] ▸ People above 60 years of age and with co-morbidities [29] ▸ Essential workers (teachers, law enforcement, etc.) [29]	▸ High-risk population (people with chronic diseases, co-morbidities, etc.) [30] ▸ Healthcare workers [30] ▸ High-risk institutions (old-age home etc.) [30] ▸ Public workers (police, etc.) [30]	▸ Healthcare workers [31] ▸ Police, military [31] ▸ Public servants (teachers, law enforcements, etc.) [31]	▸ High-risk population (e.g., health care workers) [32] ▸ Elderly population, ▸ Population with co-morbidities [32] ▸ Essential workers (e.g., teachers, etc.) [32]
Targeted population coverage and timelines	▸ Phase1: (six to eight months) administration to priority groups [27] ▸ Phase 2: (one year) Administration to a larger population [27] ▸ Phase 3: (one and a half to two years) vaccine universally available. [27]	▸ Phase 1: (six months) administration to 21 million priority population [33] ▸ Phase 2: (one to one and a half year) Administration to 80% of the population [33]	▸ Phase 1: (six months) administration to 21m priority population [33] ▸ Phase 2: (one to one and a half year) Administration to 80% of the population [33]	▸ Phase 1: (six months) administration to priority population [30] ▸ Phase 2: (one to one and a half year) Administration to 55% of the population [30]	▸ Phase 1: (six to eight months) administration to 16m priority population ▸ Phase 2: (one to one and a half year) Administration to 90%-100% of population [35] [36] [37] [34]	▸ Phase 1: (six to eight months) Administration to 4-5m priority population [32] ▸ Phase 2: (timeline TBD) Administration to 100% of population [32]

Country/Region	USA	UK	EU	Germany	Indonesia	Australia
Vaccine candidates and doses committed	▸ Johnson & Johnson (J&J): 100m [38] ▸ Moderna: 100m [38] ▸ AstraZeneca: 300m [38] ▸ Sanofi - GSK: 100m [38] ▸ Pfizer: 100m [38]	▸ Sanofi - GSK: 60m [39] ▸ Pfizer: 90m [39]	▸ AstraZeneca: 300m [29] ▸ Sanofi - GSK: 300m [29] ▸ J&J: 200m by 2021 (Q1) [29]		▸ Novavax Inc.: 30m [31] ▸ Sinovac Biotech Ltd.: 85m [31] ▸ Merah Putih: 57m ▸ AstraZeneca: 100m [31] ▸ Expected starting 2021 [31] (13) (14)	▸ AstraZeneca: 3.8m [32] ▸ Novavax Inc.: 40m [32] ▸ Pfizer: 10m [32] Expected by early 2021 [32]

Vaccine administration

Country/Region		USA	UK	EU	Germany	Indonesia	Australia
Capacity - physical and human resource	Critical channels for administration (e.g., Hospitals, clinics, etc.) & capacity requirements	▸ Large hospitals and health systems [27] ▸ Mobile vaccination providers [27] ▸ Homeless centers [27] ▸ Organizations serving people at high risk (e.g., dialysis centers, etc.) [27] ▸ Pharmacies (e.g. CVS, Walgreens etc.) [27]	▸ Mass vaccination sites (e.g., sports arenas, etc.) [28] ▸ Large and small mobile (e.g., pop-up) sites [28] ▸ Drive through vaccination sites [28] ▸ General practitioners ▸ Pharmacies (e.g., Boots, Lloyds, etc.) [28] ▸ Roving teams to visit care homes [28]	▸ Defined by each member state separately. Likely to be like the US and the UK, with linkups with: ▸ Pharmacies ▸ Private health centers	▸ Two government centers per district [30] ▸ Mobile vaccination teams [30] ▸ Large exhibition halls [30]	▸ Pharmacies [38] ▸ Drug stores [38] ▸ Clinical pharmacy [38] ▸ Public healthcare center (Puskesmas) [38] ▸ Hospital installations [38]	▸ General practice clinics [32] ▸ Vaccination clinics [32] ▸ Workplace vaccinations [32] ▸ Nursing teams to visit aged care facilities [32] ▸ Pharmacies [32] ▸ Aboriginal and Torres Strait Islander community centers [32]
		Centers needed to achieve 70% immunity ▸ Major cities – 200 ▸ Small cities – 300 ▸ Rural regions - 400 (3.5 centers/million) [42]	Centers needed in Europe to achieve 70% immunity ▸ Major cities – 100 ▸ Small cities – 200 ▸ Rural regions – 100 (3-4 centers/million) [42 24] Germany will setup 100+ centers for 80 million population; each location will manage thousands of people each day [42] (1.3 centers/million) [42]			▸ Any guidance yet to be published Centers needed to make 46% population immune in Asia: ▸ Major cities – 1000 [42] ▸ Small cities – 1000 [42] ▸ Rural areas – 7000 [42] (4 centers/million) [42 24]	▸ Individual states responsible for estimating consumables and workforce with the exact numbers still under development [32]
Capacity - physical and human resource	Human capacity requirements	▸ Estimated inoculators required – 21,000 to inoculate 80% population equivalent to 1.5% of the available doctors and nurses [43 44] ▸ Inoculation can be administered by doctors and nurses only	▸ Estimated inoculators required – 4,000 to inoculate 80% population equivalent to 3% of the available doctors and nurses [45] ▸ Inoculation can be administered by doctors, nurses, trained pharmacists and midwives	▸ Inoculators: numbers vary with individual member state ▸ Inoculators vary by state	▸ Estimated inoculators required – 5,000 to inoculate 80% population equivalent to 2% of available doctors and nurses [46] ▸ Inoculation can be administered by doctors and nurses only	▸ N/A	▸ Estimated inoculators required – 1,400 to inoculate 80% population equivalent to 1% of available doctors and nurses [47] ▸ Inoculation can be administered by doctors, nurses, trained pharmacists and midwives

Country/Region		USA	UK	EU	Germany	Indonesia	Australia
	Key organizations partnered with to ensure availability of required capacity	▸ Public health clinics ▸ Chain of pharmacies and independent ones (e.g., CVS, etc.) [27] ▸ Worksites clinics [27] ▸ Hospitals [27] ▸ Temporary or off-site vaccination clinics [27] ▸ Mobile vaccinators [27] ▸ School health centers [27]	▸ Private healthcare ▸ Pharmacies (Boots, Lloyds, etc.)	▸ Key organizations partnered will be defined by individual members [29]	▸ Mobile teams for vaccination in larger cities [30] ▸ Large exhibition halls in smaller regions, to have a wider reach [30]	▸ Pharmacies [48] ▸ Private hospital installations [48] ▸ Clinical pharmacy installations [48]	▸ Nursing teams to visit aged care facilities [32] ▸ Pharmacies [32] ▸ Aboriginal and Torres Strait Islander community centers [32]

Country/Region		USA	UK	EU	Germany	Indonesia	Australia
	Privilege workforce addition via regulation to increase inoculator capacity	Jurisdiction responsible for recruiting additional vaccination providers, which will include: [27] ▸ Medical societies ▸ IHS/tribal entities ▸ College and universities	Regulation changes in HMR to include: ▸ Paramedics [42] ▸ Pharmacists (Boots, Lloyds, etc.) [42] ▸ Midwives [42] ▸ Nursing associates [42] ▸ Physiotherapists [42]	▸ Each member state will define addition in workforce	▸ Any clear guidance yet to be published, although it will likely be like the UK	▸ Any clear guidance yet to be published	States responsible for ensuring that inoculator: ▸ Have legal authority to administer [32] ▸ Meet the necessary qualification [32] ▸ Provided necessary training to inoculate and use multi-dose vials [32]
Process and technology	Cold-storage, Distribution and tracking	▸ Vaccine storage: In freezer or within the dry ice thermal shipping [27] ▸ Temperature monitoring: Through digital data loggers (DDL) [27]	For Pfizer vaccine: ▸ 1000 doses kept in a box at negative 70 ºC for 10 days when flown to the UK ▸ Thermal sensors and GPS trackers will monitor the temperature during transportation ▸ Stored in fridge for up to five days at 2-8 ºC on administrative site	▸ Storage requirements will vary according to each member state and the type of vaccine [29]	▸ Any clear guidance on storage is yet to be published, although it will probably be like other countries	▸ A roadmap including cold-chain requirements and human-resource capacity under development [48]	▸ Any clear guidance on storage is yet to be published, although it will probably be like other countries
	Vaccination process pre-vaccination outreach, vaccination day and post-vaccination plan	▸ Outreach via public, non-profit and private partners (e.g., state health dept., drug stores, etc.) [27] ▸ Vaccination scheduling via VTrckS system [27] ▸ Post-vaccination analysis, including second dose tracking via VTrckS system [27]	▸ Outreach via NHS, primary healthcare center, GP's, pharmacies and Public Health England ▸ Vaccination scheduling through Track and Trace application ▸ Post-vaccination monitoring, second dose reminder through Track & Trace application	▸ Devolved to individual member states	▸ Any clear guidance on the vaccination process is yet to be published. Likely to be like other countries	▸ Any clear guidance on the vaccination process is yet to be published. Likely to be like other countries	▸ Outreach program by engaging school-based vaccination programs, Aboriginal and Torres Strait Islander Community, and national campaigns [32] ▸ Vaccination scheduling through MHR app. [32] ▸ Australian Immunization Register (AIR) for tracing post-vaccination and second dose reminders [32]

Country/Region		USA	UK	EU	Germany	Indonesia	Australia
	Digital/Technology tools for tracking and reporting	▸ Vaccine Tracking System (VTrckS) – it is a secure, web-based IT system integrating the entire vaccine supply chain [49]	▸ Existing Track and Trace application to be enhanced to register individuals, monitor vaccine dosage and send a personalized reminder to take the second dose	▸ Member states responsible for putting monitoring strategies in place along with suitable registries [29]	▸ Electronic register is in development for keeping vaccination record[51] ▸ Application in development to record potential side effects[51]	▸ Any clear guidance on the use of technology is yet to be published	▸ AIR for monitoring immunization coverage, service delivery and to provide history statement [32] ▸ My Health Record (MHR) will act as immunization record for Australians [32]
	Technology-enabled storage and transport solutions	Internet of Things (IoT) for vaccine transportation: [50] ▸ IoT sensors placed on pallets can collect and analyze light, humidity, and temperature data and send notification to relevant stakeholder in case of discrepancy IoT techniques can help vaccine distributors to send data to a blockchain system in the cloud by scanning barcodes: [50] ▸ These barcodes collect supply chain history and send notifications when scanned ▸ When a shipment is delivered, health care workers can scan the barcode and immediately receive details concerning the safety of the vaccine, as well as advice on how to preserve them based on their transport history Maintaining security in complex IoT system: [50] ▸ Routine risk management, given the complexity of new devices that are added ▸ Private information such as customer data housed separately from the control systems ▸ Regulating access to IoT devices to manage risk					

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Abbreviations

A	
AEFI	Adverse Events Following Immunization
AI	Artificial Intelligence
AIR	Australian Immunization Record
ANM	Auxiliary Nurse Midwife
APIs	Application Programming Interfaces
ASHA	Accredited Social Health Activist
AWW	Anganwadi Worker
AYUSH	Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homoeopathy
B	
BHEL	Bharat Heavy Electricals Limited
BMGF	Bill & Melinda Gates Foundation
BMW	Bio-Medical Waste
C	
CHC	Community Health Center
CMA	Compagnie Maritime d'Affrètemen (Maritime Freighting Company)
COVID-19	Coronavirus Disease 2019
CSIR labs	Council of Scientific and Industrial Research
CVS	Consumer Value Store
D	
DDL	Digital Data Logger
DH	District Hospital
Diksha	Digital Infrastructure for Knowledge Sharing
E	
ESI	Employees' State Insurance
EU	European Union
eVIN	Electronic Vaccine Intelligence Network
F	
FICCI	Federation of Indian Chambers of Commerce and Industry
FOGSI	Federation of Obstetric and Gynecological Societies of India
G	
GMSD	Government Medical Store Depot
GNMs	General Nursing and Midwife
GoI	Government of India
GPS	Global Positioning System
GPs	General Practitioners
GSK	GlaxoSmithKline plc
H	
Hapag	Hamburg-American Line

HCP	Healthcare Professional
HCW	Healthcare Worker
HHS	U.S. Department of Health and Human Services
HIS	Hospital Information System
HR	Human Resource
HWC	Health and Wellness Center
I	
IAP	India Academy of Pediatrics
ICMR	Indian Council of Medical Research
ID	Identification
IEC	Information, Education and Communication
IMA	Indian Medical Association
INA	Indian Nursing Association
IoT	Internet of Things
IT	Information Technology
ITSU	Immunization Technical Support Unit
J	
J&J	Johnson and Johnson
M	
MBBS	Bachelor of Medicine and Bachelor of Surgery
MHR	My Health Record
MOH	Ministry of Health
MOHFW	Ministry of Health and Family Welfare
MSC	Mediterranean Shipping Company
N	
NABH	National Accreditation Board for Hospitals & Healthcare Providers
NABL	National Accreditation Board for Testing and Calibration Laboratories
NATHEALTH	Healthcare Federation in India
NEGVAC	The National Expert Group on Vaccine Administration
NCC	National Cadet Corps
NFHS	National Family Health Survey
NGOs	Non-Governmental Organization
NHM	National Health Mission
NITI Aayog	National Institution for Transforming India
NSDC	National Skill Development Corporation
NSS	National Service Scheme
O	
O&M	Operations and Maintenance
OMAG	Organized Medicine Academic Guild
OPD	Outpatient Department

P	
PATH	Program for Appropriate Technology in Health
PHC	Primary Health Center
PPE	Personal Protective Equipment
PPP	Public Private Partnership
S	
SAIL	Steel Authority of India Limited
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2
SC	Sub Center
SOPs	Standard Operating Procedure
T	
TBD	To Be Decided
ToT	Train the Trainer
U	
UIP	Universal Immunization Program
UK	United Kingdom
UNICEF	United Nations Children's Fund
USA	United States of America
USAID	United States Agency for International Development
V	
VSP	Vaccine Service Providers
VTrckS	Vaccine Tracking System
W	
WHO	World Health Organization

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