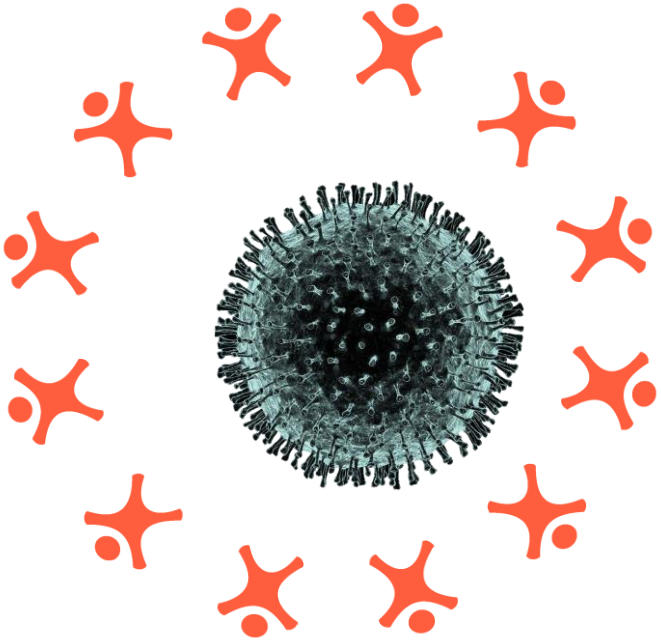
Indian Public Health Association (IPHA),

Indian Association of Preventive and Social Medicine (IAPSM) &

Indian Association of Epidemiologists



2nd Joint Statement on CoVID-19 Pandemic in India – Public Health Approach for COVID19 Control

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Dr. Sanjay K Rai
President, IPHA

Dr. Anil Kumar
President, IAE

Dr. Sanjay Zodpey
President, IAPSM

Dr. Sanghamitra Ghosh
Secretary General IPHA

Dr. Jugal Kishore
Secretary IAE

Dr. A Kadri
Secretary IAPSM

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For further details please contact: Prof. (Dr.) Sanjay K. Rai, Room No. 29, Centre for Community Medicine (CCM), All India Institute of Medical Sciences (AIIMS), New Delhi-29. Phone - 011-26594416, Ph - 9868397358, email - drsanjay.aiims@gmail.com

Indian Public Health Association (IPHA), Indian Association of Preventive and Social Medicine (IAPSM) & Indian Association of Epidemiologists (IAE) Joint COVID-19 Task Force

Second Joint Statement on COVID-19 Pandemic in India – Public Health Approach for COVID-19 Control

Terms of Reference:

A Joint Task Force of eminent public health experts of India was constituted by IPHA, and IAPSM in April 2020 to advise the Government of India for containment of COVID-19 pandemic in the country. Subsequently, Indian Association of Epidemiologists (IAE) also joined the Task Force.

The terms of reference of the Joint Task Force was 1) To review and collate the scientific epidemiological literature pertaining to COVID-19 in India at national, state and district level; 2) To develop consensus amongst the experts regarding COVID-19 disease epidemiology, trends, and develop action plan based on the consensus; 3) To widely disseminate the consensus statement and action plan with public health experts, health professional associations, and other key stakeholders; 4) To share the consensus statement with the policy makers at the highest level at centre and state.

The members of the IPHA, IAPSM, and IAE **Joint COVID-19 Task Force** are as follows: (in alphabetical order)

1. Dr. A. C. Dhariwal, Former Director, NVBDCP & NCDC, and Advisor NVBDCP, MoHFW, GoI, New Delhi
2. Dr Anil Kumar, President, IAE & Dy DGHS (Deafness), Nirman Bhawan, New Delhi
3. Dr. A.M. Kadri, Secretary, IAPSM, Ahmedabad
4. Dr. Chandrakant S. Pandav, Past President IPHA & IAPSM, former Professor & Head, Centre for Community Medicine (CCM), AIIMS, New Delhi, and President, ICCIDD
5. Dr. D.C.S. Reddy, Former Professor & Head, Community Medicine, IMS, BHU, Varanasi
6. Dr. Farooq Ahmed, Former Director NEIGRIMS, and Pro VC KBN University, Gulbarga
7. Dr. Kapil Yadav, Additional Professor, CCM, AIIMS, New Delhi
8. Dr. M. K. Sudarshan, Chief Editor, Indian Journal of Public Health (IJPH), Bengaluru
9. Dr. Puneet Misra, Past President, IAPSM & Professor, CCM, AIIMS, New Delhi
10. Dr. Rajesh Kumar, Former Professor & Head, DCM&SPH, PGIMER, Chandigarh
11. Dr. Rajib Dasgupta, Professor, Community Health, Jawaharlal Nehru University, New Delhi
12. Dr. Sanghamitra Ghosh, Secretary General, IPHA, and CMO (SG) Ministry of Defence, Kolkata
13. Dr. Sanjay K. Rai, National President, IPHA and Professor, CCM, AIIMS, New Delhi
14. Dr. Sanjay Zodpey, President, IAPSM and Vice President-Academics, Public Health Foundation of India (PHFI), New Delhi
15. Dr. Sanjiv Kumar, Former Executive Director, NHSRC, and Chairman, Indian Academy of Public Health (IAPH), New Delhi
16. Dr. Shashi Kant, Past President IAPSM, and Professor & Head, CCM, AIIMS, New Delhi

Executive Summary and Action Plan

Background:

Hon'ble Prime Minister (PM) Shri Narendra Modi ji invited national medical professional associations on March 24, 2020 and sought suggestions for prevention and control of COVID-19. President of IPHA, and IAPSM attended the meeting. In the background of these developments, after due internal deliberations, the first Joint Statement[1] was submitted to Hon'ble PM, Hon'ble Union Health Minister, NITI Aayog, Secretary (HFW), and Secretary (DHR) on 11 April 2020.

However, since then the Joint Task Force reviewed new evidences generated globally and within country. The Task Force members also interacted with many other public health professionals working at national, state, and district level. Inputs were also taken from the social media of various professional associations. This is the second version of the joint statement with recent evidences.

Situation Analysis:

The ongoing COVID-19 pandemic is a public health emergency with grave implications for the entire world. India, as a part of the global community, has also been adversely impacted with a catastrophic 'double burden': 145,000+ cases and 4,000+ deaths, coupled with a humanitarian crisis that encompasses an estimated 114 million job losses (91 million daily wage earners and 17 million salary earners who have been laid off), across 271,000 factories and 65-70 million small and micro enterprises that have come to a standstill.

The response of the Government of India after the first case on 30th January, 2020 blunted the rapid progress of the infection and the nation accepted near-total disruption of all facets of daily living. Clinical, epidemiological and laboratory knowledge for control of the novel corona virus indicate that humankind will have to "live with the virus" and operational strategies rapidly need to be recalibrated from containment to mitigation. The emerging evidence unequivocally indicates that COVID-19 worsened the health inequities, and public health measures need to make that concern central. The global community is collaborating and sharing information to formulate a comprehensive, effective, efficient and sustainable strategy and plan of action to control this pandemic. At the same time each country, and regions within the country, have to adapt the larger general model to its own specifics. Open and transparent data sharing with scientists, public health professionals and indeed the public at large, which is conspicuous by its absence till date, should be ensured at the earliest. This will strengthen pandemic control measures, build bottom-up consensus, and evolve an ecosystem of engagement, faith, and trust.

India's nationwide "lockdown" from March 25, 2020 till May 31, 2020 has been one of the most stringent; and yet COVID cases have increased exponentially through this phase, from 606 cases on March 25 to 138,845 on May 24 (i.e. > 229 times) . This draconian lockdown is presumably in response to a modeling exercise from an influential institution which presented a 'worst-case simulation'. The model had come up with an estimated 2.2 million deaths globally. Subsequent events have proved that the predictions of this model were way off the mark. Had the Government of India consulted epidemiologists who had better grasp of disease transmission dynamics compared to modelers, it would have perhaps been better served. From the limited information available in the public domain, it seems that the government was primarily advised by clinicians and academic epidemiologists with limited field training and skills. Policy makers apparently relied overwhelmingly on general administrative bureaucrats. The engagement with expert technocrats in the areas of epidemiology, public health, preventive medicine and social scientists was limited. India is paying a heavy price, both in terms of humanitarian crisis and disease spread. The incoherent and often rapidly shifting strategies and policies, especially at the national level, are more a reflection of "afterthought" and "catching up" phenomenon on part of the policy makers rather than a well thought cogent strategy with an epidemiologic basis.

Most COVID-19 infected persons are without symptoms; even if symptomatic, the symptoms are mild and not life threatening. Majority of the patients do not require hospitalization and can be treated at domiciliary level with a modified "enforced social distancing" imposed on the household. Had the migrant persons been allowed to go home at the beginning of the epidemic when the disease spread was very low, the current situation could have been avoided. The returning migrants are now taking infection to each and every corner of the country; mostly to rural and peri-urban areas, in districts with relatively weak public health systems (including clinical care).

It is unrealistic to expect that COVID-19 pandemic can be eliminated at this stage given that community transmission is already well-established across large sections or sub-populations in the country. No vaccine or effective treatment is currently available or seems to be available in near future (there are a few promising candidates though). The expected benefit of this stringent nationwide lockdown was to spread out the disease over an extended period of time to flattened the curve and effectively plan and manage so that the healthcare delivery system is not overwhelmed. This seems to have been achieved albeit after 4th lockdown with extraordinary inconvenience and disruption of the economy and life of the general public. The case fatality rate in India has been relatively on the lower side, and mostly limited to the high risk groups (elderly population, those with pre-existing co-morbidities etc.). However, the lockdown cannot be enforced indefinitely as the mortality attributable to the lockdown itself (primarily because of total shutdown of

routine health services and livelihood disruption of nearly the entire bottom half of the Indian population) may overtake lives saved due to lockdown mediated slowing of COVID-19 progression.

Abundant scientific and evidence-based interventions are available to control the pandemic at state and district levels in India. These measures should be implemented while at the same time ensuring optimal provisions for the livelihood of the poor and marginalized. Simultaneously, provision of health care for all, especially children and women and those suffering from chronic conditions and emergencies requiring medical attention is an urgent imperative.

Recommendations:

Representing a very wide community of public health academics, practitioners and researchers in India we recommend the following11point action plan during COVID-19 pandemic:

1. **Constitute a panel** of inter-disciplinary public health and preventive health experts and social scientists at central, state and district levels to address both public health and humanitarian crises.
2. **Free sharing of data in public domain and Public Health Commission:** All data including test results should be made available in public domain (unlinked anonymous) for the research community (clinical, laboratory, public health and social sciences) to access, analyze and provide real-time context-specific solutions to control the pandemic. A Public Health Commission with task-specific Working Groups may be urgently constituted to provide real-time technical inputs to the government. The opaqueness maintained by the Government of India as well as state governments in the context of data so far has been a serious impediment to independent research and appropriate response to the pandemic.
3. **Lift lockdown, replace with cluster restrictions:** The ongoing nationwide lockdown needs to be removed and replaced with cluster specified restrictions (based on epidemiological assessment); reasonable criteria and milestones for control of the current phase of the pandemic in the country should be set, taking into account that successive wave of cases is possible. The *raison d'être* of the lockdown was health system preparedness; the government needs to come out with clear monitorable benchmarks to this effect.
4. **Resumption of all the routine health services:** It is of utmost importance that all routine health services at all level of (primary, secondary and tertiary) care be immediately started with due measures to ensure protection of HCWs. Ample evidence has emerged that the human cost of disruption of routine health services specially for terminally ill patients, those with life threatening catastrophic health events like myocardial infarctions, stroke, chronic infectious disease like TB and

preventable measures like immunization have far outweighed the deaths due to COVID-19. The brunt of disruption of health services may even be higher in days to come.

5. **Source reduction measures through** i**ncrease of public awareness and practice of preventive measures:** The most effective strategy for control of novel corona virus spread during all stages of transmission is source reduction strategy. Universal use of face mask (homemade and others), hand hygiene (washing with soap and water and hand sanitizers) and cough etiquette, should be adopted by all with special focus to high risk population.
6. **Ensure physical distancing with social bonding, avoid social stigma:** Physical distancing norms need to be practiced to slow down the spread of infection. At the same time, enhanced social bonding measures need to be promoted to address mental health concerns of anxiety and lockdown. Stigma and discrimination in COVID-19 tend to be associated with specific population groups (such as religious groups or returnee migrants) even though not everyone in those groups is specifically at risk. Stigma can also occur after a person has been released from COVID-19 quarantine. Governments, media and local organizations need to be pro-active by making people aware and treating them with empathy and respect.
7. **Sentinel and active surveillance:** It is important to conduct extensive surveillance for Influenza like Illnesses (ILI) through ASHA/ANMs/MPWs, and Severe Acute Respiratory Illness (SARI) through clinical institutions (including private hospitals), daily reporting to identify geographic and temporal clustering of cases to trace transmission foci (hot spots / cluster events). This must be supported by trained epidemiologists from local medical colleges and public health institutions. In future, use of already existing HIV serological surveillance platform could be a cost-effective way to do the serological surveillance and also provide an estimate of the burden and trend, needs of vaccine, and impact of other preventive strategies.
8. **Test, trace, track, and isolate with marked scaling up of diagnostic facilities:** India has significantly enhanced testing rates though some states continue to lag behind. Benchmarks based on population norms are essential to keep this key pandemic counter-measure on track. Some states have high numbers of backlogs; instituting standard turnaround time is equally crucial. Governments need to support free testing in private laboratories as well. As the number of (potential) contacts as well as returnee migrant populations continue to increase rapidly across the country, home quarantine need to be promoted and protocols followed with active participation and support from frontline health workers and local communities.
9. **Strengthening Intensive Care Capacity:** Intensive care is only to be given by the well trained adequately protected health care providers. Newer evidence is emerging that symptomatic and even

SARI cases can be effectively managed with oxygen and other supportive measures. Makeshift (fangkang) hospitals are already being established in Mumbai, Maharashtra, and same may be built in other cities of India to cater to increase in number of patients during the peak of COVID-19.

10. **Optimal PPE for frontline workers:** Nosocomial infection of COVD-19 is a serious challenge affecting safety and morale of health care providers (HCP). This is also important mode of infection transmission amplification and acceleration once HCP become "super-spreaders". Appropriate PPE must be provided to HCP to instill confidence and alternate teams identified to take care of attrition due to fatigue, exposure and quarantine. India has now enhanced capacity to produce PPEs and should continue to ramp up production.
11. **Strengthening of public health system/institutions/discipline:** The historic and systematic neglect of public health as a discipline and non-involvement of public health experts in policy making and strategy formulation has cost the nation enormously especially in the current pandemic. Rapid scaling up of public health (including medical care) -- both services and research -- should be done on a war footing with an allocation of 5% of GDP to health expenditure at center and state level.

We sign out on a positive but cautious note. Evidence based scientific and humanistic policies will help us in overcoming this calamity with minimal loss to human life, social structures and economies. Nature has once again reminded us of our tenuous situation in the wider universe. It is high time that humankind takes note of the warning signals and undertakes midcourse corrections urgently and now. The "One World One Health" approach should be central in ensuring optimal harmony amongst all humans and animals of the world based on principle of "*Vasudhaiva Kutumbakam"* (The entire world is one family). Being respectful and mindful of all animate and inanimate beings of this planet is the way forward in the post-COVID-19 world. Even in the face of the current once in a century humanitarian and health crisis of this proportion, if we do not sit up and take notice and bring about some fundamental changes to our life styles and also in policy making specially in health policy making, we are doomed to face the consequences of same and may see unprecedented human costs in present pandemic and more worryingly see an encore much sooner again.

1). Epidemiology of COVID 19

Introduction: Coronavirus disease 2019 (COVID-19) is a respiratory tract infection caused by a newly emergent coronavirus called Severe Acute Respiratory Syndrome Corona Virus-2 (SARS-CoV-2) that was first recognized in Wuhan, China, in December 2019. Genetic sequencing of the SARS-CoV-2 suggests that it is a beta coronavirus closely linked to the SARS virus.[2] Epidemiological investigations have suggested that the outbreak was associated with a seafood market in Wuhan, China.[3]

Since December of 2019 and up to May 26, 2020, over 5.48 million cases of SARS-CoV-2 infection, with over 0.34 million deaths have been reported in more than 200 countries. The pandemic is accelerating at an exponential rate. The first 100 thousand cases took 67 days. The second 100 thousand took 11 days; the third 100 thousand took just 4 days and the fourth 100 thousand just 2 days. Now more than 50 thousand cased are added every day. The epidemic picture is changing on a daily basis.

The World Health Organization (WHO) issued a travel advisory on international travel on 27thJanuary, 2020. It declared the outbreak a public health emergency of international concern on 30th January, 2020. On 11th March 2020, WHO declared COVID-19 as a pandemic.

Indian Scenario: In India, the SARS-CoV-2 is not indigenous. It is an "Immigrant Virus". It has entered the Indian Territory along with the travelers coming from countries where transmission was ongoing. The countries from which the immigrants entered India (domestic/foreign) are China, Iran, Arab countries, Italy, and other European countries, North America, Indonesia, South Korea and Japan. India reported first case on 30th January, second case on 2nd February, and third case on 3rd February 2020. All the three cases were reported from Kerala and had travel history to Wuhan.

Table-1: Number of cases and deaths due to COVID-19 In Different States of India as on May 26, 2020

States	Total Number of COVID-19 Cases	Total No of Deaths
Maharashtra	52667	1695
Tamil Nadu	17082	118
Gujarat	14460	888
Delhi	14053	276
Rajasthan	7300	167
Madhya Pradesh	6859	300
Uttar Pradesh	6532	165
West Bengal	3816	278
Andhra Pradesh	3110	56
Bihar	2730	13
Karnataka	2182	44
Punjab	2060	40
Telangana	1920	56
Jammu & Kashmir	1668	23
Odisha	1438	7
Haryana	1184	16
Kerala	896	5
All other States	5423	20
Total	145380	4167

Till 1st March, 2020 India did not report any new cases. However, from 2nd March, 2020 onwards COVID-19 cases were reported from all States in India. As on 26th May, 2020 a total of 1,45,380 cases and 4167 deaths have been reported. Out of 37 States, and Union Territories, 35 have reported cases of COVID-19. States like Maharashtra (52667), Tamil Nadu (17082), Gujarat (14460), Delhi (14053), Rajasthan (7300), Madhya Pradesh (6859), Uttar Pradesh (6532), West Bengal (3816), Andhra Pradesh (3110), Bihar (2730), Karnataka (2182) and Punjab (2060) reported 2000+ cases. Remaining states reported less than 2000 cases each (Table-1). The economic and

humanitarian dimensions of the COVID crisis in India comprise of an estimated 114 million job losses (91 million daily wage earners and 17 million salary earners who have been laid off), across 271,000 factories and 65-70 million small and micro enterprises that have come to a standstill.[4]

Agent Factors:

- **Agent:** The agent of COVID-19 is a single-stranded RNA virus of genus beta coronavirus called SARS-CoV-2.This is the seventh coronavirus known to infect humans. Initially this virus strain was designated as WH-Human 1 coronavirus (WHCV).[3]
- **Origin of the Virus:** The origin of the virus is not fully understood. However, studies have indicated that COVID-19 is a zoonotic virus. From phylogenetics analyses undertaken with available full genome sequences, bats appear to be the reservoir of COVID-19 virus, but the intermediate host(s) has not yet been identified.[5]Outside of bats, pangolins are the only mammals reported to date, that have been found to be infected with a coronavirus related to SARS-Cov-2. The researchers have said their findings highlight a potentially important role of pangolin could be considered as possible hosts in the emergence of SARS-CoV-2 virus.
- **Source of Infection:** Usually a case, or subclinical and asymptomatic case. There are some evidences that pre-symptomatic and asymptomatic contact can transmit the virus.
- **Period of infectivity:** Not clearly known. Few studies have observed median duration of viral RNA detection was 20.0 days (IQR17.0–24.0) in survivors. However, SARS-CoV-2 virus was detectable until death in non-survivors. The longest observed duration of viral shedding in survivors was 37days.[6] Studies also suggest that the infected individuals are more likely to be infectious in the earlier stages of infection. Viral RNA levels from upper respiratory specimens appear to be higher soon after symptom onset compared with later in the illness. Studies have shown that the virus can be isolated from naso/oropharyngeal specimens during the first eight days of illness, but not after this interval, despite continued high viral RNA levels at these sites. Modelling studies from China found that the infectiousness started 2.3 days prior to symptom onset, peaked 0.7 days before symptom onset, and declined within seven days[7].

Host Factors:

- **Age and Sex:** COVID-19 affects all ages and both sexes. But data on individuals aged 18 years or less suggest that there is a relatively low attack rate in this age group (2.4% of all reported cases in China). In the absence of results from serologic studies, it is not possible to determine the extent of infection among children, what role children play in transmission, whether children are less

susceptible or if they present differently clinically (i.e. generally milder presentations)? Older age and co-morbid disease (such as asthma, diabetes, heart diseases) have been reported as risk factors for death. Recent multivariable analysis confirmed that older age, higher Sequential Organ Failure Assessment (SOFA) score, and d-dimer > 1 μg/L on admission were associated with higher mortality.[4]

- **Close contact and human mobility:** Close contact and human mobility is an important factor in the spread of infection.
- **Susceptibility:** As SARS-CoV-2 is a newly identified pathogen, there is no known pre-existing immunity in humans. Based on the epidemiologic characteristics observed so far in China, everyone is assumed to be susceptible, although there may be risk factors that increase the susceptibility to the infection.
- **Immunity:** The antibody response in infected patient remains largely unknown. The clinical value of antibody testing has not been fully demonstrated. In a study the seroconversion rate for Ab, IgM and IgG was 93.1% (161/173), 82.7% (143/173) and 64.7% (112/173), respectively. The seroconversion sequentially appeared for Ab, IgM and then IgG, with a median time of 11, 12 and 14 days, respectively.[8]

The figures 1 and 2 show the humoral response from 208 samples tested in Wuhan and Beijing hospitals. The findings were as follows:

Fig 1: Time of appearance of IgM, IgA, and IgG antibodies to SARS-CoV-2, determined by ELISA of plasma samples obtained from 208 in-patients with SARS-CoV-2 infection.[9]

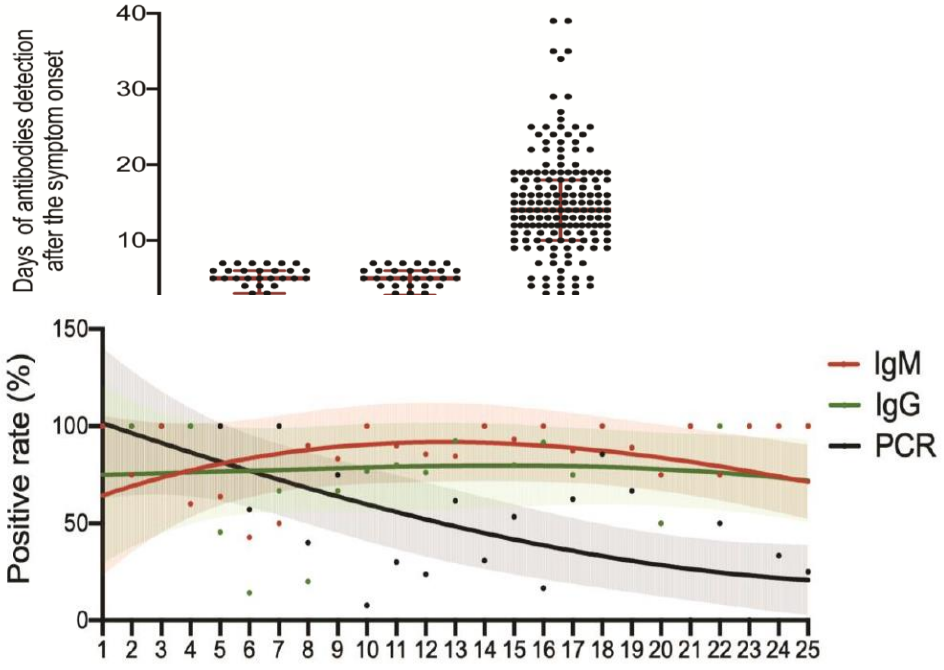

Fig 2: Fitted curve of the positive detection by PCR, IgM or IgG ELISA on different days after symptom onset[9].

- **Effect of BCG vaccination: There is no evidence that the Bacille Calmette-Guérin vaccine (BCG) protects people against infection with COVID-19 virus. Few clinical trials addressing this question are underway.[10]**

Environmental Factors:

- Season: Seasonal effect is not well documented. But meteorological parameters are the important factors influencing the infectious diseases such as severe acute respiratory syndrome (SARS) and influenza. Few studies reported that the COVID-19 was related to the meteorological factors, which decreased with the increase in the temperature. Warm and dry weather conditions result in increase in atmospheric suspended matter, providing conditions for virus adhesion, breeding and transmission. Analysis of samples collected from patients reporting to hospital in Stockholm county from 2010 to 2019 showed the coronavirus positivity rate was 2% for winter months and 0.2% for summer months. This could be a reasonable proxy of higher prevalence of diseases caused by coronavirus in winter months.[11]

  Diurnal temperature range (DTR) and humidity on the daily mortality of COVID-19 in Chinese population shows that the daily mortality of COVID-19 is positively associated with DTR but negatively with absolute humidity. In summary, this study suggests the temperature variation and humidity may also be important factors affecting the COVID-19 mortality.[12]Other studies from China found that the optimum temperature for virus transmission was 10^0C. Lower or higher temperatures suppress the transmission.[13]One study concluded that temperature ranging 13^0C~19^0C and humidity in 50% ~ 80% are suitable for the survival and transmission of the new coronavirus.[14]
  Mode of transmission: Major modes of transmission are droplet and fomite. SARS-CoV-2 is transmitted via droplets and fomites during close unprotected contact between an infector and infectee. Airborne spread has not been reported for COVID-19. It is not believed to be a major driver of transmission based on available evidence. However, it can be envisaged if certain aerosol-generating procedures are conducted in health care facilities. Fecal shedding has been demonstrated from some patients, and viable virus has been identified in a limited number of case reports. Thus, the fecal-oral route does not appear to be a driver of COVID-19 transmission. Its role and significance for COVID-19 remains to be determined.[15]

  Few studies have documented that the SARS-CoV-2 virus was detectable in aerosol for up to 3 hours, up to 4 hours on copper, up to 24 hours on cardboard, and up to 3 days on plastic and steel surface. Secondary attack rate among household contact was found to be 3-10% (R0 of 2-2.5).[16]

Incubation period: Incubation period varies between 2 days to 2 weeks. However, majority of the COVID-19 patients have an incubation period of 3 to 7 days with the mean duration of incubation period of 5.2 days (95% CI, 4.1 to 7.0). Based on studies from China, the basic reproduction number (R0) is estimated to be approximately 2.2 (95% CI, 1.4 to 3.9), i.e. on average each patient can infect 2.2 other people.[17]

Case Definitions[18]

Suspect case

- A patient with acute respiratory illness (fever and at least one sign/symptom of respiratory disease (e.g., cough, shortness of breath), AND with no other etiology that fully explains the clinical presentation AND a history of travel to or residence in a country/area or territory reporting local transmission of COVID-19 disease during the 14 days prior to symptom onset;

OR

A patient with any acute respiratory illness AND having been in contact with a confirmed or probable COVID-19 case in the last 14 days prior to onset of symptoms;

OR

A patient with severe acute respiratory infection (fever and at least one sign/symptom of respiratory disease (e.g., cough, shortness breath) AND requiring hospitalization AND with no other etiology that fully explains the clinical presentation.

Probable case

A. A suspect case for whom testing for the COVID-19 virus is inconclusive.

OR

B. A suspect case for whom testing could not be performed for any reason

Confirmed case

A person with laboratory confirmation of COVID-19 infection, irrespective of clinical signs and symptoms.

Clinical Features: Symptoms are nonspecific and disease presentation can range from no symptom to severe pneumonia and death. Fever, cough and fatigue are the most common symptoms. Studies have documented fever (87.9%), dry cough (67.7%), fatigue (38.1%), sputum production (33.4%), shortness of breath (18.6%), sore throat (13.9%), headache (13.6%), myalgia or arthralgia (14.8%), chills (11.4%), nausea

or vomiting (5.0%), nasal congestion (4.8%), diarrhea (3.7%), and hemoptysis (0.9%), and conjunctival congestion (0.8%).[3]

While most people with COVID-19 develop only mild (40%) or moderate (40%) disease, approximately 15% develop severe disease that requires oxygen support, and 5% have critical disease with complications such as respiratory failure, acute respiratory distress syndrome (ARDS), sepsis and septic shock, thromboembolism, and/or multiorgan failure, including acute kidney injury and cardiac injury . Older age, smoking , and underlying no communicable diseases (NCDs), such as diabetes, hypertension, cardiac disease, chronic lung disease and cancer, have been reported as risk factors for severe disease and death[19].

Radiological features: Chest Computed Tomography features of COVID-19 patients were characterized by the ground-glass opacity and bilateral patchy shadowing.[20]

Diagnostic Test:

- Real-time RTPCR (rRT-PCR) on samples from nasopharyngeal swab or Broncho-alveolar lavage (BAL) fluid,
- Recently Cartridge Based Nucleic Acid Amplification Test (CBNAAT) using Cepheid Xpert Xpress SARS-CoV2 is recommended by ICMR.

Treatment: There is no specific treatment for COVID-19. No pharmaceutical products have yet been shown to be safe and effective for the treatment of COVID-19. However, those infected with the virus should receive appropriate supportive care to relieve and treat symptoms. A number of medicines have been suggested as potential investigational therapies. Many clinical trials are going on for the treatment of COVID-19. One of the most important trials in the 'Solidarity Clinical Trial'. This trial is a multinational phase III-IV trial which has targeted to compare four untested treatments for hospitalized patients with severe COVID-19. The aims of the study is to dramatically cut down the time needed to generate robust evidence about what drugs work. Over 400 hospitals in 35 countries are actively recruiting participants for this trial and more than 100 countries have expressed interest in this trial. The treatments included in this trial are as follows.[21]

1. Remdesivir
2. Lopinavir/ritonavir combined
3. Lopinavir/ritonavir combined with interferon-beta
4. Hydroxychloroquine (or chloroquine)

II) Strategies for control of COVID-19 outbreak and recommendations:

Available interventions for control of COVID-19 outbreak and the current strategy for the same being implemented in India are discussed in brief below. The known interventions are categorised as individual level, community level, and overarching interventions (though there may be some overlap in case of some interventions). The current best available evidence and implication of interventions for each of the intervention is discussed in brief.

a) Individual level interventions-

- *Hand hygiene*- Frequent hand washing is highly effective in reducing human to human transmission for respiratory virus spread predominantly by droplets/fomite/on surfaces. Alcohol based sanitizers, and soap and water may be equally effective. [22]

In 2015, there were an estimated 150 million people without access to 'at least basic' water in India with a greater share in rural areas than urban.[23] The National Sample Survey (NSS) 76th round 2019 reported that 25.3 per cent rural households and 56 per cent urban households washed hands with soap or detergent before a meal.[24] Behaviour change interventions have been demonstrated in India to lead to significant increase over baseline rates but require sustained inputs, up to a year. [25] Community engagement (CE) strategies are participatory processes that enable equitable partnerships developed with community stakeholders who are enabled to identify, develop and implement community-led sustainable solutions; these lead to better outcomes than conventional BCC or IEC campaigns.[26]

Recommendation: Novel decentralised strategies are required to ramp up supply of both water (through municipal and panchayat systems) and soap (through the PDS) and complement with context sensitive community engagement strategies.

- *Cough etiquette including universal mask usage*- It has emerged as one of the key interventions for control, primarily by providing inward and outward protection against droplet borne infections and also aerosol borne infections. Mask usage (surgical and N95) from initial recommendations for use by only HCWs and those symptomatic, is being gradually expanded to the general population with a requirement of assured supplies for all. [27,28]

Evidence and policy on masks is rapidly unfolding with WHO, other national agencies, and scholars having differing positions. 'Mass mask panic' and panic buying occurred irrespective of advice from public health authorities. [29] India modified its mask policy on 4th April 2020 based on assessment of the epidemiological

risks by the health authorities. India now advises handmade reusable face cover for those not suffering from medical conditions or having breathing difficulties to protect the community at large.

Recommendation: This entails both ramping up the production of simple masks, making it available throughout the country and wide ranging campaign on how to prepare simple handmade masks. Given the large numbers of vulnerable population, the local health authorities have an enormous task of making simple masks universally available and accessible.

- *Quarantine and isolation of exposed and suspected/symptomatic cases:* the chain of transmission can be significantly slowed and may be even broken if all those who are exposed can be quarantined (for at least 14 days) and those who are symptomatic (flu like symptoms) can be isolated. It may be difficult to implement and the presence of asymptomatic/early prodrome in case of COVID-19 has put question mark on this intervention strategy.

  Stochastic transmission modelling, parameterised to the COVID-19 outbreak scenarios, indicates that highly effective contact tracing and case isolation may control a new outbreak of COVID-19 within 3 months. The probability of control decreases with long delays from symptom onset to isolation, fewer cases ascertained by contact tracing, and increasing transmission before symptoms.[30] Economists are weighing subtle interactions between health and the economic consequences of prolonged lockdowns. Current models are simplistic and efforts are on to create more sophisticated scenarios that include the size of different age groups in a population to account for differences in how deadly the disease is for different ages, and modified 'smart' lockdowns that allow more economic activity.[31]

  Recommendation: Urgent research incorporating Indian data and scenarios need to construct models for the country and design effective social protection schemes to adequately cushion the shocks of the ongoing lockdown that may potentially need to be extended at least in certain states/districts.

- *Isolation of high risk individuals:* elderly (>70years,), those with co-morbidities (CKD, diabetes, underlying lung diseases) - considering the overwhelming majority of death being reported amongst these groups, this may be highly effective in reducing the total deaths. India may be in a better position to implement this because of low proportion of elderly and also the fact that even this lower percentage of elderly in India is relatively less mobile and not engaged in economic activities (unlike western populations), so may be easier to isolate them, at least during the peak of the outbreak.

  Analysis of Census 2011 indicates that there are almost 15 million households comprising only of single elderly Indians, nearly three-fourths of them women. Such households are in higher proportion in post-

demographic southern states. An estimated 15% elderly persons live in households where there is nobody below the age of 60.[32] India also has more than 1.7 million homeless persons, a little more than half of them in urban areas.[33]

Recommendation: These population groups represent additional vulnerabilities that social protection schemes should urgently cater to while ensuring isolation.

- Pharmaceutical intervention - prophylaxis with Hydroxychloroquine (HCQ), Azithromycin, and anti-virals - anecdotal evidence of questionable benefit. Needs to be further verified with controlled trials before they can be recommended.

  The National Taskforce for COVID-19 has recommended the use of hydroxychloroquine (HCQ) for chemoprophylaxis of SARS-CoV-2 infection for the following categories: (i) Asymptomatic household contacts of laboratory confirmed cases, (ii) All asymptomatic healthcare workers involved in containment and treatment of COVID-19 and asymptomatic healthcare workers working in non-COVID hospitals/non-COVID areas of COVID hospitals/blocks, and (iii) Asymptomatic frontline workers, such as surveillance workers deployed in containment zones and paramilitary/police personnel involved in

  COVID-19 related activities[34].

  Recommendation: A dynamic policy shall guide the relevance and application of the emerging evidence for public health operations.

- *Role of vaccine in future* - Vaccine has limited role in controlling ongoing outbreaks. Development of effective vaccine may prevent future outbreaks, or may be useful in protecting those at high risk. Considering a few candidate antigens have been identified, and that SARS-CoV2 is relatively more stable than seasonal influenza virus, theoretically vaccine may be a useful intervention in future. But currently or in near future it has no role.

  Recommendation: As vaccine trials and production becomes a real possibility India needs to work towards technology transfer and local production. India's vaccine industry is technologically robust but will require suitable fiscal support and incentives.

b) Community Interventions

- *Social distancing:*-has been identified as important intervention, specially from droplet borne infection in the radius of 1-2 meters. However, it is seemingly not possible for majority of the population in India, and also difficult to practice for a sustained period. It has a definite role in controlling the spread in institutional settings like schools, colleges and religious congregations.

  Physical distancing is possible only for the better off: not so for the nearly 4% homeless and 40% households of India living in one-room houses (Census 2011), or for the majority who cannot stay off work, in a country where over 90% are dependent on the informal sector for livelihoods.[35]

  Recommendation: Social distancing may be more appropriately replaced with physical distancing and social bonding

- *Test, Trace, Track and Isolate:* early detection and contact reduction is a well-established epidemiologic intervention. However, availability of test kits and health system capacity to undertake this on scale limits its use. May be of use in defined geographies or once the supply chain of kits as well as health system strengthening is achieved.

  Though the testing rates were very low during the initial days of the epidemic, it has improved significantly in recent times. More than 100,000 tests are being performed daily but nearly three fourths of the labs (194/281) set up in May were in seven hotspot states though states with current surge of infections continue to lag behind (for example, UP, Bihar and Orissa have testing facilities only in 60 of 143 districts). Some states have high numbers of backlogs; instituting standard turnaround time is equally crucial. Governments need to support free testing in private laboratories as well. Government has also taken a key decision to use CBNAAT as a testing tool thereby further expanding the testing capacity. Antibody based serological test has also been approved by ICMR which could be used for surveillance purposes.)

  Recommendation: Both diagnostic and serological testing may require significant acceleration, with specific state/district policies in sync with the prevailing epidemiological scenario. Benchmarks based on population norms are essential to keep this key pandemic counter-measure on track.

  Focus on hot spots and its containment: due to droplet infections being the predominant transmission route supplemented by fomite and airborne transmission, super spreaders and clusters outbreaks are the early hall marks of spread of infection into the community. Containment, and active case search strategy should continue in cities and areas where disease has not spread at other places active case search won't yield much benefit. The areas where community transmission has already established the focus should be more on

mitigation measures rather than containment. It would not stop the disease transmission while will bring fatigue among health care workers who are important asset to fight with pandemic.

Recommendation: The ongoing nationwide lockdown needs to be removed and replaced with cluster specified restrictions (based on epidemiological assessment).

- *Social Behaviour Change Communication (SBCC):* is the bedrock of most of the interventions for respiratory virus infection transmission. It should be the key intervention for any strategy adopted whether suppression or mitigation.

  Risk Communication and Community Engagement (RCCE): is an essential component of the preparedness and response action plan.[36] India has framed some action points and states are implementing it, with local adaptations.

  Recommendation: Decentralised and socially and culturally appropriate risk communication and community preparedness plans need to be operationalized urgently.

- *Protection offered by BCG, malaria infection and other infections:* some ecological studies are available, but evidence needs to further critically reviewed before the same can be adopted as interventions.

- *Travel restriction* - International and within country restrictions: though travel restrictions have not been shown to be very effective against respiratory virus, however this does delay the epidemic curve significantly. This delay provides ample time to health system to prepare for the eventual outbreak.

- *Optimal PPE for Health Care Providers:* critical for protection of health care worker, and also for stopping the spread of infection from HCW to general public and thus prevent health system becoming a super spreader of infection. Good quality PPE which can protect against aerosol transmission of the infection is warranted for all health care workers dealing directly with COVID positive and high suspicion cases.

  Several media reports have emerged highlighting shortages of PPE at least in select institutions and several health care workers have tested positive in the last few days. Germany's decentralised federal system is considered to have experienced relatively greater success in both testing and stockpiling PPE.[37]

  Recommendation: India is now entering the phase where significant load of clinical cases can be expected. There is a narrow window of opportunity for institutions to stockpile PPE. The states/districts may consider stockpiling using decentralised mechanisms particularly supported by the respective State Medical Supplies Corporations and/or State Health Resource Centres.

- *Lock down or shut down:* last resort for control of epidemic when all else fails or we do not have capacity to implement other interventions. It does slow the epidemic curve, however cannot be implemented in perpetuity and may have serious overall deleterious effect not related to COVID-19.

c) Overarching interventions

- *Health system strengthening including capacity enhancement for intensive care:* considering that a significant proportion of those infected will develop severe disease (5-15%) and some may require intensive care (1-5%), health system strengthening is important. Robust health system helps to avoid panic and also keeps overall mortality low.

- *Enhanced R &D* - for newer drugs, vaccines and basic research to understand the epidemiology and also other operational research is required.

Comparison of COVID-19 control measures across select countries - China, Japan, South Korea, USA, France, India, Italy, Spain, UK, Iran, Russia and Brazil

The weekly progress of COVID-19 cases across various countries has shown differential trends and may have been because of epidemiological differences, demograhic characteristics and effect of control measures adopted by each of the countries.

"*When a novel influenza A virus with pandemic potential emerges, non-pharmaceutical interventions (NPIs) often are the most readily available interventions to help slow transmission of the virus in communities, which is especially important before a pandemic vaccine becomes widely available. NPIs, also known as community mitigation measures, are actions that persons and communities can take to help slow the spread of respiratory virus infections. NPIs can be phased in, or layered, on the basis of pandemic severity and local transmission patterns over time.*"

Table 2: Weekly progression of COVID-19 cases in few selected countries

Weeks	Total	China	Japan	South Korea	USA	France	Russia	India	Italy	Spain	UK	Iran	Brazil
1st Week	1 *(Dec 31,19)	1 *(Dec 31,19)	1 *(Jan 15,20)	2 *(Jan 20,20)	5 *(Jan 23,20)	5 *(Jan 24,20)	2 *(Feb 01,20)	3 *(Jan 30,20)	2 *(Jan 31,20)	1 *(Jan 31,20)	2 *(Jan 31,20)	61 *(Feb 19,20)	1 *(Feb 26,20)
2nd Week			6	15	11	6	2	3	3	2	9	1501	2
3rd Week	282	278	20	27	13	11	2	3	3	2	9	7161	25
4th Week	2798	2761	26	29	15	12	2	3	400	12	13	14911	234
5th Week	17391	17238	65	602	53	18	2	6	3089	198	89	23049	1546
6th Week	40554	40235	157	3736	108	282	4	60	12462	2140	460	41495	4256
7th Week	71429	70635	268	7134	696	2269	34	137	35713	13716	2630	60500 (07.04)	11130
8th Week	79311	77262	514	8162	3536	9043	199	562	74386	47610	9533	73303	22169
9th Week	88948	80174	829	8897	51914	24920	1036	1636	110574 (02.04)	102136 (02.04)	29478 (02.04)	83505	38654
10th Week	109577	80904	1128	9583	163199	56261	3548	5194	139422	146690	60737	91472	61888
11th Week	167515	81077	1953	10237	363321	81095	11917	11439	165155	177633	98480	98647	101147
12th Week	332930	81601	3906	10512	578268	105155	32008	19984	187327	208389	133499	109286	162699
13th Week	693224	82447	7645	10661	776907	117961	68622	31332	203591	212917	165225	122492 #(May,19)	241080 #(May,19)
14th Week	1210956	83005	11119	10728	983467	127066	114431	49391	214457	220325	201205		
15th Week	1773084	83597	13576	10793	1171185	135468	187859	74281	222104	228691	229709		
16th Week	2314621	84237	15231	10874	1322054	138609	262843	106750 #(May,20)	227364 #(May,21)	232555 #(May,21)	248297 #(May,21)		
17th Week	2878196	84341	15874	11050	1477459 #(May,20)	141312 #(May,21)	326448 #(May,23)						
18th Week	3435894	84400	16365 #(May,19)	11190 #(May,24)									
19th Week	4006257	84450											
20th Week	4618821	84494											
21st week	5304772 #(May,25)	84536 #(May,25)											

Source: WHO situation report available from https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports
Note – *the date in first week column signifies the date of first case reported to WHO in each country
the date with last figure in columns signifies the date of end of last week identified in each country

III) The Way forward -

The current COVID-19 pandemic has been playing out in manner of heightened stress for both the general population and health care system. The ongoing "lock down" announced till May 30,2020 cannot go on in perpetuity and will have to reviewed and appropriate modifications be made at national, state and may be district and sub-district level also. The proposed strategy and interventions at national and state level may be broadly divided into immediate, short term, medium term and long term as follows:

a) Immediate:

- Geo spatial distribution of cases, active and old, at the district level should be considered for prioritizing specific public health action.
- The natural history of COVID-19 in India till date is based on the observation of 150000 odd cases (subject to authentication from existing data). Most of the COVID-19 infected person are symptomless. If at all symptomatic the symptoms are mild and not life threatening and majority of the lot do not require hospitalization or even graduate medical care and can be treated at domiciliary level with a modified "Enforced Social distancing" imposed on the household. This will serve three purposes: isolation of a case and its treatment and monitoring for complication and quarantining the household contacts.
- Those who require specialist care should only be admitted in the hospital. This will free up the beds and reduce the work load of the treating hospital. The chances of infection among the health care providers will also be less.
- Intensive care is only to be given by the well trained well protected health care provider.
- All hospitals, public or private, should start a fever clinic. Each of the patients attending a hospital should be screened by recording temperature and any with fever should be sent to "Fever Clinic" manned by well protected staff for further clinical work out. This will act as the "Sentinel" surveillance" post.
- To prevent nosocomial Infection of COVID 19 (which is the most prevalent type in western countries and even in china), the above steps are necessary.

b) Short term

- Inputs on a) Decision making set up of Govt, and others b) Managing medical countermeasures c) Travel and trade activity advisories d) Research and development of vaccines, therapeutics and diagnostics etc e) Risk communication to public

- Health services can play a great role in containing the epidemic by:
- Creating of awareness about modes of transmission and methods of prevention of COVID-19 which helps in reduction of stigma and removal of fear of isolation and quarantine through health workers and by sensitizing the community leaders,
- Conducting surveillance for ILI through ASHA/ANM/MPW and SARI through health centres and hospitals
- Testing, contact tracing and ensuring containment by involving local volunteers
- Daily reporting of cases which helps in identifying geographic and temporal clustering of cases
- And putting in place well equipped rapid response teams (RRT) coordinated by DSO and supported by an epidemiologist and public health laboratory
- Appropriate PPE must be provided to HCWs to instill confidence in them and an alternate team should be identified to take care of attrition of HCW due to exposure & quarantine.
- Approve and scale up diagnostic facilities to increase the number of people tested. Procure sufficient equipment and goods to handle the case load
- There is time for preparation so as to face boldly the impending crisis with sensitivity without extending forced curfew covering entire country putting large section of people in distress.
- Maintain strict surveillance of suspect cases and their contacts

c) Medium term:

- Health policy maker and planners should be cautious not to be instrumental in creating a "Pandemic of human misery" by advocating impromptu Community Medicine (Public health) decision, not supported by epidemiological data and evidence based scientific reasoning. Such action will be an antithesis of the philosophy of "Community Medicine" especially tenets of the first level of prevention i.e. Promotion of health & protecting the community from disease and disability.
- Strategy will need to be changed if wide spread community transmission without transmission foci is detected. Then hospital teams will play major role for care of sick and safe disposal of the bodies of unlucky ones (Municipality and Panchayats should be sensitized about it).
- Engage medical/ nursing colleges in all pandemic control activities at district and state level.

d) Long term measures:

A large scale expansion (5 times) of public health service & medical service should be done immediately on war footing with allocation of about 5% of GDP.

- Increase the capacity at the state and district levels to respond to the current pandemic and also similar public health emergencies in future.
- Strengthening of public health system / institutions/discipline: The need of hour is to have an effective public health system with autonomusautonomous institutions. All the existing public health institution like NCDC, ICMR and Community Medicine Departments of Medical Colleges and Public Health Departments of universities and autonomous institutions should work in synergy without encroaching others domain. The historic and systemic neglect of public health as a discipline has led to immense cost to the nation in current pandemic, further compounded by non-involvement of public health experts in policy making and strategy formulation. Bureaucrat -driven policy making in a highly technical and science based discipline like health and medicine is highly detrimental and should be addressed at highest level.
- Sentinel and active surveillance: Conduct extensive surveillance for Influenza like Illnesses (ILI) through ASHA/ANMs/MPWs, and Severe Acute Respiratory Illness (SARI) through clinical institutions (including private hospitals), daily reporting to identify geographic and temporal clustering of cases to trace transmission foci (hot spots / cluster events). This must be supported by trained epidemiologists from local medical colleges and public health institutions. As SARC CoV-2 is a new virus, there is need to monitor the behavior of the virus through periodical serological surveillance. Use of already existing HIV serological surveillance platform could be a more cost effective way to do the serological surveillance. The Indian HIV Sentinel Surveillance (HSS) is one of the largest serological surveillance in the world and in operation since more than three decades. The data generated are primary source of information on the level and trends of HIV epidemic in India. The National AIDS Control Organization (NACO), Ministry of Health and family welfare, Government of India implements HIV Sentinel Surveillance (HSS) biennially among various population group e.g. aantenatal Clinic (ANC) attendees, high risk groups (HRGs – Female Sex Workers, MSM, IDUs, etc.) and bridge populations (truck drivers). These surveillance sites were spread over in almost all the districts of India. Around five lakh blood specimens were tested across all population groups during the last round of HSS. The entire data collection was completed in 3 months-time frame. To understand the behavior of the virus in the community through already existing HSS platform could be a cost-effective way to do the serological surveillance and also provide an estimate of the burden and trend, needs of vaccine, and impact of other preventive strategies within very short time frame.

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