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A Mini Review of the Covid-19, Vaccine Platform and Future Preparedness

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ABSTRACT

Many countries are engaged in making vaccine against COVID-19 as the world records more than 38 million SARS-CoV-2 infections and more than one million deaths. It has prompted nations to close the borders, halted companies, kept people inside their homes, and numerous other measures to prevent their spread. We systematically searched on Google scholar, PubMed, LitCovid, and MedRxiv using the certain search terms for published articles. The infection raging through communities is expected to have evoked some degree of immunity in many asymptomatic and recovered individuals. However, the level of protective immunity and duration of such immunity have not been studied in depth. At the same time, spanning from the conventional whole virus vaccine to recombinant vaccines using Adenovirus vectors and first-of-its kind mRNA vaccines are in human trials. Before the effectiveness and safety of such vaccines are established billions of doses have been produced and stockpiled to save time in production and distribution. Antigenic diversity and the potential role of passive surveillance in COVID-19 regulation are explored in this report.

Keywords: COVID-19, SARS-CoV-2, Surveillance, Vaccines

I. INTRODUCTION

Viruses are the smallest among all the microorganisms. A virus is an infectious agent that can only replicate within the host. They depend on the host cells of organisms. They are made up of genetic core material, either DNA or RNA surrounded by a protective proteinaceous layer called 'Capsid'. Sometimes, there is a presence of spikes on the coat called 'Envelope'. A Virion consists of the nucleic acid and protein layer [1].

In 1917-1918 when there was Spanish flu outbreak, this was observed that mortality just was not related to aged people with feeble immunity but also associated with those who were young with regular immunity, in critical cases the virus brings about the overactive immunity response, which leads to generation of different inflammation elements which leads to, injury to respiratory parts especially lungs, which in turn leads to elevated death rate. In epidemics like severe acute respiratory syndrome coronavirus (SARS-CoV) and middle east respiratory syndrome (MERS-CoV), extremely infectious

influenza viruses as well as novel CoV 2019 (nCoV19 or COVID-19) similar detrimental impact because of excessive immune response [2].

Since December 2019, the nCoV-2019 expanded rapidly from Wuhan, China to all over the globe. By planning for the development of diagnostic devices, issuing hospital monitoring, testing and treatment recommendations, and updating disease information, the World Health Organisation (WHO) has responded promptly. The COVID-19 is 96.5 per cent the same as the RaTG13 bat CoV, suggesting that bats could be the virus-host and passed by the nearby and air droplets [3]. COVID-19 is a pulmonary illness that occurs in homo sapiens and physical signs constellation can be inclusive of a varying subordinate signs, involving gastric as well as neural related , that can lead to mortality or can be less severe. COVID-19 is swathe and single-stranded ribonucleic acid. The four major structural proteins hidden in the corona viral genome is the spike protein (SP) that is linked to the angiotensin-converting enzyme-2 (ACE-2) receptor and arbitrates eventually attached among the swathe and host-cell membrane to encourage viral entrance into the host cells. SP, this triggers the cell fusion of the spike into (S1 and S2 domain) of the coronavirus, and it is accountable for the selection of the virus's host tropism [4].

Impact of the pandemic on the healthy living as well as social living is not properly understood. Restrictions of containment are aimed to contain the pandemic, although it can lead to consequences in regard to drug habits a thus can interrupt the worldwide forecast. Individual spacing rules in public places and telemedicine can disrupt with routine safe-keeping, particularly in older individuals with substance use disorders who might feel isolated because of lesser help due to their inability to utilize the online health care and self-aid means [5].

II. SYMPTOMS

Signs of COVID-19 can differ in different people, that can be without any signs and it can also be fatal pulmonary collapse. After incubation time of around 5.2 days, COVID-19 symptoms emerge. There was between 6 and 41 days of onset of COVID-19 mortality symptoms and an average of 14 days. Fever, cough, tiredness are the most frequent symptoms of COVID-19 onset, and diarrhea, headache, hemoptysis, and sputum are other symptoms [6-8].

A research performed in area of Vo Euganeo reported that 50–75 percentage of people with positive test swab taken from throat conclusions were without any signs, whereas another people found to have less severe signs identical to flu and moreover, little percent were difficult breathing, serious interstitial alveoli inflammation, ARDS and various organ collapse. Massive count of individuals who showed signs or fatal conditions were already suffering from comorbidities such as hyperglycaemia, cardiac diseases, high blood pressure etc. [9].

CLINICAL SYMPTOMS OF CORONAVIRUS DISEASE

CATEGORY OF SYMPTOMS	SYMPTOMS
Common symptoms	Fever Dry cough Tiredness Pneumonia Dyspnea
Less common symptoms	Aches & pains Sore throat & Diarrhoea Nausea & Vomiting Conjunctivitis & headache Loss of taste or smell Skin rashes Discolouration of finger and toes
Serious symptoms	Difficulty in breathing Chest pain or pressure Loss of speech or movement chills

Figure 1 : Clinical Symptoms of Coronavirus disease [10].

III. DIFFERENT STRAINS OF CoVS

COVID-19 is the 7th coronavirus that has been identified to infect humans [11]. Six various CoV

strains are known to infect humans before SARS-CoV-2. HCoV229E, HCoV-OC43, HCoV-NL63, HCoV-HKU1, SARS-CoV, and MERS-CoV are also included in these groups (Table 1). SARS-CoV is a pathogenetic agent that caused over 8,000 human infections and 774 deaths in China during a 2002–2003 serious respiratory illness outbreak and since 2012, the MERS-CoV causes 2458 infections and 848 deaths by 2019 as the disease-causing pathogen for the outbreak of serious breathing diseases in the Middle East [12].

Table 1. List of human pathogenic coronavirus.

Virus	Genus	Symptoms
SARS-CoV-2	Beta	Lower Respiratory tract infection, Pneumonia
MERS-CoV	Beta	Sever acute Respiratory syndrome, 37% mortality rate
SARS-CoV	Beta	Sever acute Respiratory syndrome, 10% mortality rate
Human CoV-OC43	Beta	Mild Respiratory tract infection
Human CoV-HKU1	Beta	Pneumonia
Human CoV-NL63	Alpha	Mild Respiratory tract infection
Human CoV-229E	Alpha	Mild Respiratory tract infection

IV. TRANSMISSION

Distinguished ways of transmissions are recognised involving eye, active contact and pulmonary drops are mortal, known till now. One to another spread might happen between lesser proximity connections primarily due to pulmonary air drops formed in case suffering patient wheezes or comes in contact with surfaces & spreads it by such ways, transmittable objects and snuffle particulates might spread the disease to another people, as SARS-CoV has reported to stay on sites for up till seventy-two to ninety-six hours. (Figure 2) [13].

Proofs show that spread of SARS-CoV and MERS-CoV from animals to homo sapiens need a medium host for example, palm civets for SARS-CoV and camels for MERS-CoV. Various scientists assert that because of analogy among SARS-CoV and the 2019-nCoV, different animal as middle host is required to spread 2019-nCoV to homo sapiens. If legible, then searching for the middle host for spread of 2019-nCoV is crucial to inhibit spread among different species. In relation to this, pangolins have been thought as middle host for 2019-nCoV, however, this is not yet proven [14,15]. A suspect case is identified with cough, sore throat, and fever, clinical features may be asymptotic or without fever. Virus may isolate from respiratory samples (throat swab/nansopharyngeal swab/branchoalveolar lavage/sputum) and spread through primarily respiratory tract, droplet, direct contact and respiratory secretions in acute condition whereas in chronic conditions virus has been also isolated from stool and blood, indicating the possibility of multiple route transmission. Studies have been found that elderly and patients underlying diseases like lung infections, cardiovascular, diabetes, hypertension account for a large proportion of COVID-19 [16].

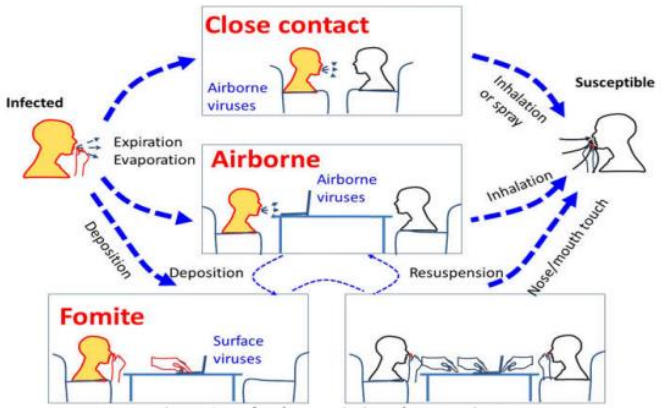

Figure:2. Mode of transmission of corona virus

V. VACCINE PLATFORM

Multiple vaccine platforms have been explored for COVID-19 vaccine development as each vaccine platform has unique advantages and disadvantages (Table 2). It is very likely that the world will need more than one type of approved vaccine to combat this pandemic with assurance of broad target population coverage, production quantities, and storage and transportation requirements on top of vaccine safety and effectiveness [17].

Currently, there are 16 vaccine candidates in Phase III trials, with encouraging efficacy data from testing in nonhuman primates and Phase I and II trials. Most current vaccines in Phase III are administered intramuscularly (few are administered using different routes). Intramuscular vaccination induces strong IgG responses that protect the lower respiratory tract but does not induce sufficient secretory IgA to protect the upper respiratory tract, as in the case of natural infection. These Phase III vaccine candidates have been developed using different platforms. Several of these platforms have already produced licensed vaccines, whereas other have not, such as the mRNA platform [18].

Table 2. Vaccine Platforms and Their Potential Advantages and Disadvantages

VACCINE PLATFORM	ADVANTAGES
DNA	• Scalable • Non-infectious • Reusable platform • Stable at room temperature
INACTIVATED	• Broad antigenic profile
MRNA	• No genome integration risk • Reusable platform • Stimulates strong T cell response • Simple formulations • Non-infectious
NONREPLICATING VIRAL VECTOR	• Reusable platform • Strong in both cell- and antibody-mediated immune responses
PROTEIN SUBUNIT	• Targeting key antigens • Non-infectious
REPLICATING VIRAL VECTOR	• Lower doses/single dose • Reusable platform • Strong in both cell- and antibody-mediated immune response

VI. CONCLUSIONS AND FUTURE PREPAREDNESS

The global health and economic consequences of the SARS-CoV-2 pandemic are severe. Although many therapies have been suggested, at present there are no specific options capable of treating COVID-19 disease or preventing SARS-CoV-2 infection. Vaccination strategy for disease control depends on extent of prevalence of the infection in the susceptible population, and antigenic nature of circulating virus strains. The incubation period of COVID-19 varies from 2 – 14 days, more commonly 4-5 days after virus exposure. Affinity of antibodies to antigens increases over time since sensitization. The duration and nature of immunity against SARS-CoV-2 infection is not yet known. Other human β-CoVs have immunity lasting for only one year, and there could be some amount of cross-reactivity/ cross immunity between different human CoVs. Both IgM and IgG have been detected as early as 5 days post clinical symptom. Vaccine efficacy is likely to be higher in countries with high seroprevalence, leading to faster herd immunity. As the disease has emerged since only less than one year, there has been limited information on its seroprevalence.

In India, number of cases are higher in states with higher population density. The R0 value has been between 1.55 to 3.0, with mean incubation period of 5.2 days. Looking at the gradual increase in number of new cases, we may reach a point soon where sero-prevalence crosses 50% mark. Extent of the infection and rate of its spread can be better estimated, compared to nucleic acid tests and antigen tests. There is also a need for continuous vigilance for the emergence of new variants/ strains. Also, there is a need to develop appropriate serological assays to monitor virus activity in the population.

It is not premature to consider non-specific antibody response to BCG (and trained immunity), prior exposures to Malaria, and helminth infections in countries such as India and those in South Asia and Sub-Saharan Africa. Such antibodies may already provide a degree of protection against SARS-CoV-2.

To the contrary, existing antibodies against other circulating Corona viruses and asymptomatic individuals recently infected with Cov-2 raise serious red flags in the context of antibody mediated enhancement of disease and hypersensitivity reactions. SARS and MERS Corona viruses primarily infect respiratory parenchyma not macrophages, and hence, reduce the chance of antibody dependent enhancement of disease as seen in Dengue virus. However, challenge with live virus post vaccination has resulted in vaccine hypersensitivity reactions (VAH) in animals, similar to those in humans given inactivated vaccines respiratory syncytial virus or measles vaccines. Such reactions should be taken seriously when considering whole virus vaccines alongside of RNA, DNA-based and recombinant adenovirus-vectored vaccines. Collection of robust longitudinal sero-epidemiological data and long-term evaluation of adverse events after introduction of vaccines are essential in deciding safe and cost-effective modalities for control of COVID-19.

VII. CONFLICT OF INTEREST

The authors declare no affiliations with or involvement in any organization or entity with any financial or nonfinancial interest related to this manuscript.

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