Aerosol transmitted COVID-19 virus (SARS-CoV-2) is infectious causing both symptomatic and asymptomatic infections. The viable COVID-19 virus transmission via air has occurred. Therefore, methods must be established to determine the viability of the virus and to disinfect it in air, surfaces, and on foodstuff. In this review article, we have discussed the pattern virus spread in bus, hospital, and cruise ship. The methods of reducing and eliminating the infection in household and public places have been suggested. The safety, efficacy, and phase 3 trials data published by major vaccine candidates Russian Gamaleya’s “Sputnik V”, Oxford University –AstraZeneca, CanSino Biologies, and Moderna Therapeutics have been included. The article is very useful to stop the COVID-19 pandemic spread and finally ending the pandemic.

Keywords: COVID-19 virus viability, Sanitization methods, Mask immunity, Vaccine efficacy, Vaccine safety.

I. INTRODUCTION

COVID-19 pandemic has caused poverty, famine, and loss of more than one billion jobs across the globe. The SARS-CoV-2 virus causes COVID-19 disease. In research article [1], the origin of the SARS-CoV-2 virus and the initial outbreak has been discussed. Initial attempts in testing, treatment, and vaccine development made to contain the pandemic can also be seen. A thorough investigation of earlier attempts made to develop the COVID-19 vaccine and phase 1 and phase 2 trials have been given in another article [2]. Several companies are currently involved in vaccine and treatment developments to contain and eliminate the virus. Mass production of the Russian vaccine “Sputnik V” is underway. While phase 3 trial is being conducted in Russia, Philippines, Vietnam, Brazil, Saudi Arabia, United Arab Emirates, and India. The trial data are awaited. Pfizer-BioNTech’s mRNA-based vaccine is also ready for a large-scale trial. Phase 3 trial of Oxford-AstraZeneca’s vaccine is also underway in the US, Brazil, and India. Moderna Therapeutics company has registered 30,000 volunteers for its vaccine trial and results will be known soon. SinoVac Biotech Ltd. and CanSino Biologies Inc. have also found good immune response of their respective vaccines against the COVID-19 virus. The world’s leaders, bankers, organisations, and researchers are making strong efforts to end the pandemic. European Union has pledged $8 billion for vaccine research. While Russia, the US, and several other countries have announced separately the money they will contribute to overcome the disease. Until now, efforts are being made to contain the pandemic by lockdowns, testing, and use of limited treatments remdesivir, avigan, dexamethasone, steroids, antibiotics, and plasma therapy available. Other methods including isolation, quarantine, wearing face masks, use of personal protective equipment (PPE), social or physical distancing, and sanitization are being used to limit the virus spread. The world’s fastest supercomputer “Fugaku” was employed to find out dozens of potential drugs for COVID-19 from the existing 2128 drug stock. “Fugaku” supercomputer belongs to Japanese company Fujitsu Ltd. Riken institute and Fujitsu Ltd. (Japan) developed it. Supercomputer “Fugaku” performed computation in just 10 days to pick the best suitable drugs compared with other supercomputers that needed the time of one year. Researchers5 using “Fugaku” determined 3 Cs protocols to avoid closed spaces, crowded places, and close contacts. Inhaling a large concentration of airborne COVID-19 virus is avoided following these 3 Cs to help stop the
pandemic from spreading into the larger population. In this review article, we described the aerosol infectious nature of the SARS-CoV-2 virus, the viability of the virus in different mediums, and decontamination and sanitization methods. The article is very useful to limit the pandemic and keeping people healthy till a proper treatment or workable efficient and safe vaccine is obtained. The progress made so far in vaccine development by major companies, efficacy and safety data have been mentioned in detail. The evaluation of the data and results about the vaccine development will remove the worries of the public from safety and efficacy viewpoints.

II. INFECTIOUS AEROSOL NATURE OF SARS-COV-2 VIRUS

The aerosol nature of the COVID-19 virus has been established as the virus was found to spread widely in hospital intensive care units (ICU) and COVID-19 general wards (GW) [4]. Contamination was larger in ICU units than GW due to ICU associated machines (attached to patients) that generated aerosols. The virus was widely spread on the floor, computer mice, trash cans, patient bed handrails, masks, doorknobs, sleeve cuffs, gloves of medical staff, and in air 4 meters from the patient. These observations suggest that strict sanitization protocol must be followed by medical staff during the patient examination to prevent virus transmission in ICUs and GWs. Medical personal protective equipment (PPE) must be sanitized before disposal and medical equipment must be disinfected regularly. Virus presence was detected by PCR (polymerase chain reaction) testing, although the virus viability was not studied. Shen et al. [5] reported passengers travelling on a bus became infected with COVID-19 virus due to an infected carrier. The pattern in which the virus infected the travellers in the seating arrangement justified the aerosol nature of the virus. In response to the report [6] of live SARS-CoV-2 virus detection in aerosol, Rubens et al. [7] suggested differentiating between aerosol generating and non-aerosol generating procedures during the patients’ treatments. Under non-aerosol generating conditions, the COVID-19 virus can be considered as droplets that require contact precautions by healthcare workers. When attending patients in an aerosolized environment (ICUs) where viral load is high, extra precautions and stronger PPE are needed. An unmasked worker or a masked worker using a mask of sub minimal efficacy can inhale about 900 live virus particles in 15 minutes [7]. In the findings of Shen et al. [5], COVID-19 spreading to fellow passengers by an infected carrier in the environment of a bus, the viable nature of the aerosolised virus was confirmed. The passengers boarded the bus, a 100 minutes round trip journey, to attend a worship ceremony in a temple located in Ningbo (China). The bus had heating (air conditioning recirculating mode) operating and none of the passengers used a face mask. The bus had 68 individuals of whom 24 were found to become infected including the index patient. The passengers and driver sitting by the window and door did not develop the infection. However, the passenger sitting by the window but directly next to the index patient developed the infection. Only one passenger sitting adjacent to an openable window developed the infection. The study suggested that enclosed spaces with recycled air can contribute to COVID-19 spread via aerosol transmission. A similar spread of COVID-19 can occur in public places, restaurants, and bars through a super spreader. Longer stay-time in such enclosed crowded places causes infection to spread. Due to the operating air circulation system, the absolute distance of a passenger from the index patient was not important in determining infection spread as the distant passengers at the back seats of the bus were also infected. In other words, the infectious COVID-19 virus can get circulated at distances in a closed space via the movement of air such as in air-conditioned places.

III. SARS-COV-2 SURVIVABILITY IN FOOD AND FOOD PACKAGING

In the context of the CDC, Centre for Disease Control and Prevention of the US, the risk of getting infected with the COVID-19 virus from handling or eating food including frozen food, food produce, and food packets is significantly low. The CDC report is supported by the lack of COVID-19 cases occurring by handling food, food packaging, and shopping bags. The US FDA (Food and Drug Administration) also denied foodborne transmission of the disease. However, the CDC and the FDA did not conduct experiments to justify their guidelines. As per the study [8], the viability of SARS-CoV-2 at 4 °C for 14 days has been justified. Therefore, domestic and international food transportation at cold temperature can cause viable virus transmission. Thus, the CDC and FDA guidelines must be revised. The above findings suggested viable SARS-CoV-2 transmission is possible via aerosol and by contact touching the surfaces. The use of suitable PPE must be enforced according to the environment of healthcare workers. Environment and surfaces must be decontaminated to stop the pandemic spread.

IV. SARS-COV-2 VIRUS VIABILITY IN AEROSOLS AND SURFACES AND DECONTAMINATION METHODS

Doremalen et al. [6] studied the viability of the COVID-19 virus on different surfaces and in aerosols. The decay rate of the virus was estimated. SARS-CoV-2 virus aerosols of size <5 μm was prepared for viability tests. The virus remained viable in aerosols for 3 hours. After 4 hours, no viable SARS-CoV-2 virus remained on copper. No viable virus was detected on cardboard surfaces after 24 hours. Chin et al. [8] reported the viability of SARS-CoV-2 at different temperatures in virus transport medium (VTM). At 4 °C, the virus remained viable up to 14 days after which the viability measurement was not conducted. The virus may be stable for longer than that time. The SARS-CoV-2 virus was sensitive to heat. The virus was inactivated in 5 minutes when incubated at 70 °C. For the virus surface stability measurement, the virus culture was inoculated onto surfaces and left at room temperature until the measurement time at approximately 65% relative humidity. Then, the inoculated object was soaked in VTM for 30 minutes to allow virus elution for the viability measurement. After 3 hours of incubation, no infectious virus was found on printing and tissue papers. No viable virus was detected on treated wood and cloth after 2 days. The virus was more stable on smooth
surfaces. No infectious virus was detected on glass and banknote on day 4 and stainless steel and plastic on day 7. Live SARS-CoV-2 virus remained detectable for up to 7 days on the outer layer of surgical masks. Meaning thereby, the virus is more stable on surgical masks than plastic. Authors have also investigated the infectious nature of virus in different pH at room temperature (22 °C). SARS-CoV-2 remained viable in pH range 3-10. Thus, the COVID-19 virus is highly stable and remains infectious in different conditions outside the human body. Guidelines for proper hygiene and surface cleaning must be established accordingly.

The SARS-CoV-2 virus is susceptible to disinfectants. Interestingly, 5 minutes of incubation with hand soap was not enough to disinfect surfaces from the virus [8]. When standard disinfectants (household bleach, ethanol, and other reagents) were used, the virus was inactivated in 5 minutes. The recommended solution of household bleach is prepared by dissolving one part of 5.25% bleach in 99 parts of water (525 ppm) allowing total disinfection of the SARS-CoV-2 virus in 5 minutes. Since the volume and mass of water are equivalent, the solution of disinfectant bleach can be prepared by volume measurement if the weighing of bleach solution is not possible. For example, in a measuring cylinder (while observing the recommended PPE for the handling of hazardous compounds), take 1 mL of household bleach (5.25%) and add water up to the 100 mL mark by adding 99 mL of water. This solution disinfects the SARS-CoV-2 virus in 5 minutes. This is the same as taking 1 g of bleach solution (5.25%) and adding 99 g of water (density of water = 1). WHO (World Health Organization) recommended 0.1% (1000 ppm) hypochlorite solution for inactivating the COVID-19 virus and other pathogens found in healthcare facilities. For large blood spills and body fluids, a higher amount of 5000 ppm (0.5%) hypochlorite solution is recommended. After treating the place or object with disinfectant solution, rinse with water for hygiene. A 70% ethanol solution can be used to disinfect metallic surfaces from the virus in 5 minutes. Experiments were conducted to determine povidone-iodine (7.5%), chloroxylenol (0.05%), chlorhexidine (0.05%), benzalkonium chloride (0.1%) were enough to inactivate SARS-CoV-2 in 5 minutes [8]. Chin and Poon [9] reported that plain soap is regarded as a low-level disinfectant against the SARS-CoV-2 virus. Hand soap needed a longer contact time to disinfect the virus, while 5 minutes were enough for other disinfectants. Higher concentrations of bleach must be avoided as it can corrode metallic surfaces and harm healthy tissues. Household bleach or bleach mentioned above is sodium hypochlorite. Hirose et al. [10] reported that the SARS-CoV-2 virus was viable for 9 hours on human skin. Such extended survivability of the virus requires hand sanitization to stop virus transmission. 80% (w/w) ethanol has been shown to inactivate the virus in 15 seconds [10]. Virus inactivation using ethanol is very useful in clinical and household practices for stopping COVID-19 infection. The virus longevity on stainless steel, borosilicate glass, and polystyrene was recorded to be 84, 85, and 58 hours in Dulbecco's modified Eagle's medium (DMEM), respectively, and 64, 61, and 35 hours in mucus medium, respectively.

V. FACE MASKS AND COVERINGS DEVELOPED IMMUNITY IN THE POPULATION

The recent global pattern of the pandemic shows that the number of mild and asymptomatic COVID-19 cases increased, while COVID-19 associated mortalities and critically ill patients decreased over time since the onset of the pandemic. Face masks and coverings have provided protection [11] against the virus thus, limiting the pandemic. The wider usage of masks and other nose and mouth coverings stop virus transmission as originating from infected persons. Significantly fewer viral particles slip into the user’s airway by chance when observing a mask in a high viral load environment. Health experts have previously supported that long exposures to a significantly small load of SARS-CoV-2 generated immunity. This represents the concept of variolation known in the old era before vaccines appeared that was in practice for smallpox. The users of the face masks or coverings may be exposed to controlled small doses of the COVID-19 virus the same way as variolation works for smallpox. In variolation, a person is infected with a controlled dose of smallpox virus to build immunity against the incoming severe infection. The development of public immunity against the SARS-CoV-2 is advantageous until a proper vaccine is available.

The procedure of covering the face and nose with masks or other effective cloths may have resulted the public to get inoculated with small doses of the COVID-19 virus accidentally thus, providing immunity against the virus. In a study, cages of infected rodents and healthy rodents were separated by a mask. Hamsters that were in the masked cages were less susceptible to COVID-19. If infected in the masked cages but showed significantly mild symptoms. The rate of SARS-CoV-2 asymptomatic infection was less in universal face mask settings than without universal facial mask usage which justifies the possibility that masks lead to immunity development in the body without requiring severe COVID-19 infection. In a simulated hamster model, masked animals were less likely infected and remained asymptomatic than unmasked hamsters. On an Argentinian cruise ship, where passengers and staff wore masks, the rate of asymptomatic infection was 81% compared to 20% on other cruise ships where passengers and crews did not use masks. In an outbreak affecting 500 people that occurred in a US food processing plant, 95% of workers who wore masks remained asymptotically infected and only 5% displayed mild-to-moderate symptoms. The above observations justify that mask usage will increase asymptomatic SARS-CoV-2 infections falling short of severe symptoms and will immune the population to avoid serious illness and deaths.

VI. UPDATES ON SARS-COV-2 VACCINES DATA

Russian laboratory Gamaleya prepared [12] Sputnik V COVID-19 vaccine consisting of adenovirus 26 (rAd26) and 5 (rAd5) vectors carrying the gene for SARS-CoV-2 spike glycoproteins rAd26-S and rAd5-S. The vaccine formulation was assessed for safety and immunogenicity. Frozen and lyophilised versions of the vaccine were prepared. The vaccine trial was conducted on patients in the age group of
18-60 years. Formulations were injected intramuscularly and patients were examined for safety for 28 days. SARS-CoV-2 antibodies produced were measured. Also, T-cell responses and changes in neutralising antibodies were investigated. Both vaccine formulations were well tolerated and safe. Only mild adverse events were noticed upon vaccine inoculation. Every participating volunteer produced antibodies to COVID-19 virus glycoprotein. The receptor binding specific IgG titers at day 42 were 14,703 and 11,143 with frozen and lyophilised formulation, respectively. The neutralising antibodies were 49.25 and 45.95 with frozen and lyophilised formulation, respectively. The seroconversion rate was 100% for both the vaccines. The volume per dose for frozen and lyophilised preparations was 0.5 and 1.0 ml, respectively. The data are awaited if the vaccines could prevent COVID-19 pandemic. The authors claimed that there are advantages of two adenovirus components 26 (rAd26) and 5 (rAd5) over single adenovirus types vaccine that CanSino Biological (Beijing, China), Johnson & Johnson, USA, and AstraZeneca (Oxford University, UK) companies have developed. Russia has received already an order for 1 billion doses.

The viral vectored COVID-19 vaccine ChAdOx1 nCoV-19 [13] that expressed SARS-CoV-2 spike protein was prepared. For the clinical trial, a dose equivalent to 5×10^10 viral particles was injected intramuscularly. Immunogenicity parameters were reported, and safety was followed for 28 days. Mild and temporary reactions causing fever, chills, muscle ache, headache, and discomfort were noticed. No adverse and permanent events were reported. After a single dose in all participants, neutralising antibody responses were noticed. The antibody responses further increased when a second dose was injected. Antibodies against COVID-19 virus spike protein reached at the peak on day 28 and stay high till 56 day. On inoculation of a second booster dose antibodies increased further. The vaccine ChAdOx1 nCoV-19 produced ample antibodies. It was safe and tolerable. The mild temporary common symptoms caused were cured with paracetamol. The vaccine is in the final clinical trial for mass inoculation. Chinese group (CanSino Biologics) developed [14] an adenovirus 5(Ad5) type vectored vaccines for SARS-CoV-2 that expressed spike glycoprotein when intramuscularly injected in humans. The volunteers were in the age group 18-60 years and were injected intramuscularly one of the three (5×10^10, 1×10^11, and 1.5×10^11) viral particles dose. The effect of vaccination was noticed 7 days after inoculation. Significant antibodies were formed in 14 days and reached at peak within 28 days of injection. However, T-cell response reached the plateau much earlier of 14 days of inoculation. Safety was monitored for 28 days. Ample antibodies were formed that neutralised the COVID-19 virus. T-cell responses were also recorded. Mild and short-lived symptoms of fever, fatigue, headache, and muscle pain occurred as vaccine inoculation reaction. The low single shot consisted of 5×10^10 viral particles per 0.5 mL in one sealed vial. The middle shot was of 1×10^11 viral particles per mL. A higher dose consisted of two shots (two vials, 2×5×10^10 viral particles) injected in one arm and one shot (one vial, 5×10^10 viral particles) in another arm making a total viral amount of 1.5×10^11 particles. The authors concluded that the Ad5 vectored SARS-CoV-2 vaccine developed by CanSino Biologics is safe, tolerable, and immunogenic. Immune responses developed on inoculation of one shot reached the peak on day 28 and T-cell responses were reported from day 14. Large population vaccination data are pending. Moderna Therapeutics’ (US) mRNA-1273 vaccine [15] encoded spike protein of SARS-CoV-2 virus. The clinical trial was conducted on 18-55 years old healthy adults who were given two inoculation shots in 28 days gap. The vaccination dose was from 25 μg, 100 μg, or 250 μg amount. Researchers reported that the mRNA-1273 vaccine successfully induced good antiviral immune responses in all volunteers and no safety issues were noticed. The safety and immunological data justified the application of the mRNA-1273 vaccine for large scale clinical trials. Of the above three doses, 100 μg amount had high neutralization responders.

VII. COVID-19 TREATMENT AND VACCINE (EFFICACY, SAFETY ISSUES, AND REMEDIES)

The international research community [16], [17] expressed concerns about the safety and efficacy of Russian and Chinese vaccines as some of the standard processes were bypassed. Some repetitive data appeared in the published vaccine trials. The data publisher ‘The Lancet’ is following the Russian vaccine development closely for these concerns. In a separate note [18], the Russian vaccine developer has addressed the concern regarding vaccine data raised by some researchers. Researchers have raised questions about the effectiveness of high profile COVID-19 vaccines developed by Russia and China in a record short time. Vaccine Sputnik V developed by Moscow’s Gamaleya Institute, already approved for phase 3 trial, is an Ad5 type vaccine. CanSino Biologics’ vaccine, also approved for military use in China and seeking approval to inoculate the population in many other countries, is a modified Ad5 adenovirus. These both Russian and Chinese vaccines are based on common cold Ad5 virus. The researchers have expressed the fear with common cold (Ad5) virus type vaccine is that pre-existing antibodies in humans against the common cold virus may selectively attack the Ad5 vector rather than generating antibodies against COVID-19 virus. On the other hand, the positive opinion the world community expressed about vaccine efficacy is that the vaccines with efficacy as low as 40% are still better than having nothing. The working principle of a vaccine is a harmless virus or “vector” that is used to transport genes from the disease-causing virus, SARS-CoV-2, into the human body to develop antibodies against the real incoming COVID-19 virus thus making a person immune to the disease. AstraZeneca-Oxford University used chimpanzee adenovirus while Johnson & Johnson vaccine is based on Ad26, a rare strain, thus, avoiding the Ad5 issue. In China and the US, 40% of people display antibodies against Ad5 from earlier exposure. Anti-Ad5 antibodies levels were estimated to be >80% in Africa. Vaccines such as the Oxford candidate which do not use Ad5 virus have this advantage over the CanSino vaccine. Ad5-based HIV vaccine, from Merck & Co in 2004, was given to people that displayed pre-existing Ad-5 immunity, they became more prone to the AIDS causing virus rather becoming immune to
it. This issue must be addressed by current vaccine developers. Gamaleya, the Russian vaccine maker will combine doses of Ad5 and Ad26 vector vaccine to address the pre-existing immunity issue. However, experts have concerns for Ad5 based vaccines as no data supporting its safety is yet available. The safety concerns of vaccines and drugs have been addressed by the food and drug safety agencies in respective countries. To ensure product’s safety and efficacy, regular examinations of the participants are conducted by the developers and the data and results are published and made available for reproducibility checks. The clinical trials of Johnson & Johnson’s vaccine and Eli Lilly’s COVID-19 antibody drug were put on hold due to safety concerns. Similarly, AstraZeneca’s vaccine trial was stopped after two volunteers developed transverse myelitis which causes inflammation of the spinal cord, although the trial was resumed later after analysing the data. Eli Lilly’s COVID-19 antibody drug trial was paused due to inconsistent results in the treatment and placebo groups. In vaccine and drug trials, mild and short-lived symptoms like headache, fever, chills, and muscle pain can be cured by paracetamol are not the reasons for a pause in the trial. Meanwhile, adverse events are a serious matter that is reported to regulation officials. If the adverse event calls for an investigation, the trial is put on hold till clearance is obtained from the concerned authority. In the case an adverse event is not found due to direct effects of the vaccine or drug, the trials may be resumed. At times, side effects may arise due to a single contaminated batch then the trial has to be stopped and the matter must be solved. Johnson & Johnson has put its vaccine trial on hold that would inoculate 60,000 volunteers in 10 countries. A halt in the trial does not necessarily indicate a failed project. Most halted trials are continued to next stages without any adverse events. It is not surprising that the AstraZeneca and Johnson & Johnson vaccines and Eli Lilly’s COVID-19 antibody drug trials were paused. The COVID-19 is an unprecedented pandemic in human history. The whole world is under lockdown, a vaccine or drug must be developed in a very short time to reinstate economies and stop global suffering. For the above reason, many vaccines and COVID-19 specific drugs are being developed simultaneously at a fast pace using new and cutting-edge technologies that were not known before. To date, 43 vaccine candidates are in clinical trials. Since new technologies and designs are being used for the first time, vaccine and drug makers are double-checking their products to ensure the safety of billions of people. The reasons for halting the drug trial are not always new drugs. The people receiving the trial drug are already sick and on some medication for the pre-existing disease. Some diseases are very serious. The same happened with the trial of Eli Lilly’s antibodies drug. The drug was given to already COVID-19 sick hospitalized patients. The group had severe pre-existing conditions succumbed to illness. In this case, new trial treatment drug is not responsible for the unfortunate death. There is a hope of the success of antibody treatment of two different companies Eli Lilly and Regeneron’s products. As these monoclonal antibodies have already been given successfully to thousands of COVID-19 infected persons some of them had mild cases. Back on the trial data analysis, if a trial is paused and adverse events are rectified in a short time then much notice is not taken. However, the concerning authority responsible for the safety and licensing needed to be informed. The pause in the trial becomes irrelevant if adverse events are rectified in a short time and needs no mention. The halted trial is abandoned when the adverse events cannot be resolved and the data are published in peer reviewed journal for future reference. In COVID-19 pandemic, some heads of states not familiar with the safety, trial, and developmental procedures of vaccines and drugs are putting pressure to come out hurriedly with results and conclusions of vaccine or treatments but professional researchers and makers follow strict protocol and stick to the high standards. They do not come under pressure to bypass any step as it involves the health of million and billions of people.

VIII. CONCLUSION

COVID-19 pandemic is a big global concern due to its rapid spread, high death toll, and worldwide lockdown it has caused. This paper reviews current literature describing SARS-CoV-2 viability in air, surfaces, effective disinfection practices, and vaccine and treatment development. The infectious aerosol nature of the SARS-CoV-2 virus was emphasized by studies that found widespread SARS-CoV-2 contamination in a bus, cruise ship, and hospital ICUs and GWs. To limit surface contact and aerosolised spread, medical equipment and frequent-contact surfaces must be regularly sanitized. The PPE should be sanitised prior to disposal or autoclaved as SARS-CoV-2 is inactivated by heat at 70 °C. Effective concentrations of disinfectant household bleach (sodium hypochlorite) must be used to disinfect hospitals and public places regularly. A 525 ppm sodium hypochlorite solution is enough to disinfect the SARS-CoV-2 virus but for the COVID-19 virus and other bacteria, 1000 ppm (0.1%) bleach solution is recommended. To sanitize large contamination of blood spills and body fluids, 5000 ppm (0.5%) bleach is used. For medical equipment and tools, 70% ethanol must be used. Inside the country and from one country to another SARS-CoV-2 virus transmissions are possible through virus contaminated food and food packages as the virus remain viable up to 14 days at 4 °C. People can be infected by a virus carrier in a crowded place when air conditioning plants with air recycling are operating. To prevent aerosol-based transmission, effective face masks should be used. Face mask usage may successfully develop SARS-CoV-2 immunity due to variolation with significantly small doses of the COVID-19 virus that builds up on the mask surfaces and pass through the mask barrier. In terms of vaccine development, Russian Gamaleya’s Sputnik V recombinant adenovirus types 26 (rAd26) and 5 (rAd5) Covid-19 vaccine, encoding SARS-CoV-2 spike glycoprotein, successfully generated antibodies when administered intravenously. Sputnik V advantageously employs two adenovirus components compared to single component vaccines made by CanSino Biologics (China), Johnson & Johnson (USA), AstraZeneca-Oxford University (UK). Vaccine trials for the viral vectored ChAdOx1 nCoV-19 vaccine, CanSino Biologics adenovirus type-5 (Ad5) vaccine, and Moderna Therapeutics mRNA-1273 vaccine,
all expressing SARS-CoV-2 spike protein are currently in progress. For the development of COVID-19 vaccines and drugs, the possibility of adverse reactions, data discrepancies, and effectiveness in treatment are being examined thoroughly. Since the health of billions of people is in question, 100% compliance to the regulatory procedures with the help of cross questioning in the scientific community is being ensured.

STATEMENT OF HUMAN AND ANIMAL RIGHTS

No animal and human rights issues exist in this research. No animal or human experiments were conducted in this research.

AUTHORS’ DECLARATION

The data and results given in this article on the COVID-19 pandemic and virus are very reproducible. The authors take responsibility for the authenticity of the data. Authors Noha Yamin Siddiqui and Tooba Khan contributed remotely.

REFERENCES