Effective Health Screening and Prompt Vaccination to Counter the Spread of COVID-19 and Minimize Its Adverse Effects

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Introduction

In the month of November 2019, an epidemic of relentless intense respiratory ailment was detected as a source of bunch of pneumonia patients in city of Wuhan, China, in the name of novel coronavirus perceived as SARS-CoV-2 [1–3]. At the end of February, 2020, i.e., 10–12 weeks after such outbreak, the World Health Organization (WHO) named this disease as the novel coronavirus and considered as the biggest threatening epidemic of the earth in the twenty-first century [4, 5].

People are affected with the COVID-19 virus by many different ways, and in major cases, contaminated person will grow mild to moderate illness and also salvage without admission in hospital [6]. The clinical malady of such coronavirus ranges from mild delirium, cold, fatigue, distaste, absence of smell, hurting throat, diarrhea, etc. to difficulty in breathing or shortness of breath with very severe pneumonia, loss of speech or mobility, chest pain, infected trauma, and multi-organ breakdown that may lead to loss of life [7, 8]. Due to the severity of such infectious disease, the WHO announced such pandemic disease as community health exigency of universal burden and plead to all countries for taking necessary measurable action to detect and prevent such contagious virus and take appropriate steps against the spreading of this pandemic outbreak [9].

Infectious COVID-19 antigen is primarily spread explicit from one to other, through nasal droplets formed from coughing or sneezing of an infected person, and that soggy aerosol can transfer in the entrance of the respiratory tract of people who

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are in adjacent proximity of the contaminated individual and probably inhaled into the lungs [10, 11]. Other feasible avenues include unambiguous meeting with attenuated fomites and penetration of droplets as well as probable transportation of SARS-CoV-2 from an individual of asymptomatic nature (or persons within the incubation phase) to others [12, 13].

When COVID-19 outbreak was first experienced, there is neither FDA-approved medication nor vaccines in the market, which is able to intercept the outspread of infectious virus as well as to restrict the world's most critical situation [14]. Therefore, the WHO recommended guidelines and protocols are the only option to stop the spreading of coronavirus (Fig. 1) [15]. Furthermore, most of the countries try to prevent such infection by forceful lockdown to break the transmission chain of the COVID-19 virus [16].

Before vaccination of people to preclude SARS-CoV-2 bug, effective screening is the most potent tools against such pandemic outbreak [17]. After a successful three-phase clinical trial, COVID-19 vaccines are considered as the best encouraging path for curbing the pandemic and are being vigorously pursued to restrict coronavirus. At the end of November or early December, 2020, quite a large number of COVID vaccines are validated and approved by the WHO for application on emergency basis in different parts of the world [18].

Fig. 1 The WHO recommended guidelines and protocol against COVID-19

Screening

Screening is an important process of identifying or examining within an allegedly healthy population in order to diagnose individuals, who may be at elevated risk of disease or plight but do not yet have symptoms, and also contributing to support individuals to make better informed options about their health [19]. The healthcare provider then offers information about advanced tests and medication that reduces the associated complications or dangers. Although diagnosis is a potential tool and effective process to recover lives and/or to revamp the quality of life through an early clinical testing of severe conditions, this is not an ideal practice, and it cannot offer a guaranteed protection, because there is a chance of false-positive results and erroneous negative results [20].

COVID-19 Screening Tools and Procedure

Screening analysis aims to disclose the risk factors for certain diseases at the preliminary stage, before any symptoms become noticeable, and it is advantageous to cure the disease much earlier before spreading into the population [21, 22]. Therefore, treating a disease at the very first phase will accelerate a better health outcome over correcting it at a final stage after the development of symptoms. There are several COVID-19 screening tools and procedure available to identify the people affected by coronavirus disease 2019 [23].

List of the easier and decisive screening procedures are as the following:

(a) **Temperature Measurement using IR Thermal Gun.**

An infrared thermometer is one of the screening devices that are used most of the places to measure the body temperature or skin surface temperature of any subject within seconds [24].

This device is also known as thermal gun due to its gun shape. This IR thermometer is accurate and reliable and can be used safely to measure the body heat from a certain length in the absence of direct body contact with the subject. That's why this apparatus is further referred as a contactless temperature-measuring device that calculates the temperature from a portion of thermal irradiation often called blackbody radiation emitted by the object being measured [25]. These thermic gadgets have the ability to determine the actual temperature of the human body within a predefine range by calculating the extent of IR energy emitted by the person w.r.t the emissivity of the thermometer.

During the pandemic, it was observed that there is a tremendous application of such machineries at various entryway and key points of airfield campuses, railway premises, healthcare facilities, market place, and other areas with the growing COVID-19 (coronavirus) outbreak to confine the widening of virulent disease in the

Fig. 2 Body temperature measurement during the COVID-19 outbreak using thermal gun

society by comfortably revealing the COVID-19 patient and confine them through a dynamic manner (Fig. 2) [26].

The basic intent of these devices is to examine the subject's body temperature from a specified length, without placing the thermometer in everybody's mouths or rear ends that would be inapplicable, infeasible, and potentially a bit disappointing.

This form of touchless IR thermal gun can check and measure the subject skin heat within a fraction of second. So, tons of crowd can be investigated individually at checkpoints without any trouble, which may support to dwindle the chance of increasing COVID-19 infections.

(b) **RT-PCR Test.**

Presently, reverse transcription-polymerase chain reaction or RT-PCR assay, also known as molecular test, is the most popular diagnostic test for the deadly disease COVID-19 and provides the maximum COVID-19 analysis outcomes that have been recorded [27]. This test is performed using swab obtained from the nasal or mouth of the patient to detect the genetic material of the virus. RT-PCR test specimen is collected by entering a long nasopharyngeal mop into snout and drawing fluid from the rear of our nose or by using a concise nasal swab to bring a sample (Fig. 3). Alternatively, a long oropharyngeal daub is infused in the posterior of our larynx, or we may spit into a test tube to produce a saliva sample.

RT-PCR examination principally recognizes the abiogenic message of the RNA virus, and it is possible if the virus is present within the ardently infected subjects. So, PCR assessments are ordinarily accomplished to precisely reveal the existence of a ragweed, rather presence of the body's immune response in the form of

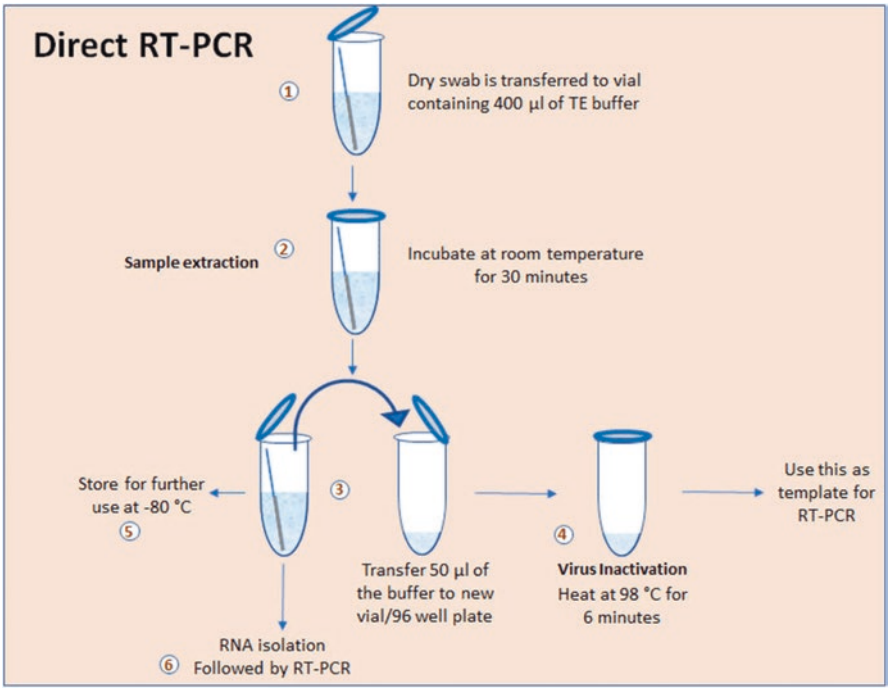

Fig. 3 Procedure of RT-PCR test

antibodies. This arrangement can only persuade the presence of viral RNA within the system before the production of antibodies or ailments of the disease present [28]. As a result, this diagnostic procedure is also referred as SARS-CoV-2 test or COVID diagnostic test. Furthermore, an RT-PCR test is cost-effective and reasonable to afford.

This investigation provides a better expression of the people's physical condition to indicate whether they are affected or not. Therefore, an affected person can be easily isolated and quarantined the crowd who get in contact with infected people. By allotment PCR analysis to screen enormous swaddle of nasopharyngeal swab samples from heavy populace, public health committee get a clear image of the spreading of such infectious disease within a community [29].

The analytic test is hypersensitive and very definitive to the COVID-19 virus. This testing procedure can provide a decisive investigation result within a very short time, i.e., 2–3 h, although laboratories take ordinarily 6–8 h to deliver the result. In contrast with other anticipated approach for virus recognition, RT-PCR test is really faster and presented more authenticate results with fewer chances for contagion or interference, as whole operation is performed within a sealed duct [30]. Thus, it is considered as the most authentic and impressive process convenient for the detection of the COVID-19 virus.

(c) **Rapid Antibody Test.**

At present, rapid antibody test (RAT) is one of the highly effective tools in the context of COVID-19 outbreak, because the maximum possible assessment mode applied for corona detection takes more than 48–72 h to produce the outcomes which is not desirable, because within this period lots of people will be affected by those people [31].

Aforesaid diagnostic method is implemented in the lab to determine the existence of coronavirus genomic sequence within the mucous and/or saliva samples. The testing process requires only 1–2 days to furnish results if patient has an active infection or not. Further, RAT assay, also called as serological test, can give results within 10–15 min (Fig. 4). In this method, antibodies are exposed in the blood of people, who have already been infected with or vaccinated against a virus that causes a disease, and also show the body's attempt or intention to fight off a specific antigen. Once formed, antibodies will protect people from getting that infection or getting severely ill for some period of time afterward. This test will also indicate about the antibodies that developed from either infection or vaccination will diminish over time. After all, it is not a well-established test but can be used as a prescreening analysis to engender picture about how many people got exposed to the virus.

To combat the rapid spreading of COVID-19 pandemic situation, shortfall of laboratory having molecular testing capacity, and lack of reagents, several

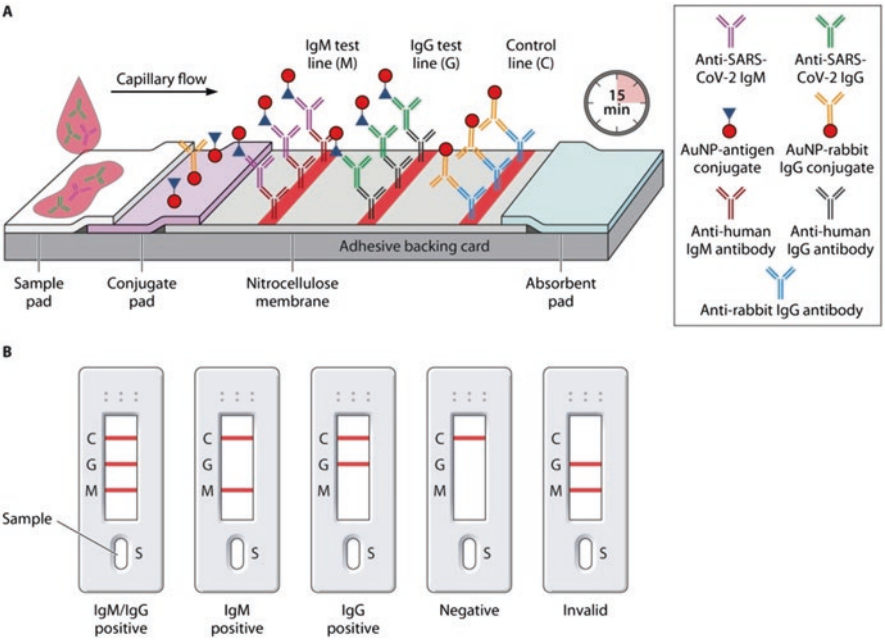

Fig. 4 Mechanism of SARS-CoV-2 rapid antibody test

diagnostic kit manufacturers have developed an expeditious and user-friendly device to promote analyzing procedure outside the laboratory settings. These transparent, safe, and reliable test kits are proficient of detecting antibody strength in the blood of the patient infected with COVID-19.

(d) **SARS-CoV-2 Rapid Antigen Test.**

The analytical evaluation is a faster chromatographic immunoassay for the qualitative scrutiny of explicit antigens of SARS-CoV-2 existence in human nasopharynx [32].

This assessment is highly precise to identify unique antigens from the SARS-CoV-2 virus in a person who imagined for COVID-19 infection. This special diagnostic examination is convenient for both symptomatic and asymptomatic people (Fig. 5); and it may provide backing the healthcare specialists to find out SARS-CoV-2-infected people who are suspected to carry the virus, with results typically ready within 15 minutes. Accordingly, such assay accurately screens individuals with known exposure to infected SARS-CoV-2 patients, providing rapid answers regarding their infection status and also allowing informed treatment decisions. The available test kit for COVID-19 is portable, reliable, and instrument-less testing tool that facilitates acceptable use for medical experts at different point of healthcare locations or in resource-limited settings. Considering various laboratory testing approach and/or patient mobility, the rapid antigen testing increases the access of high-quality diagnostics solutions for the detection of a present SARS-CoV-2

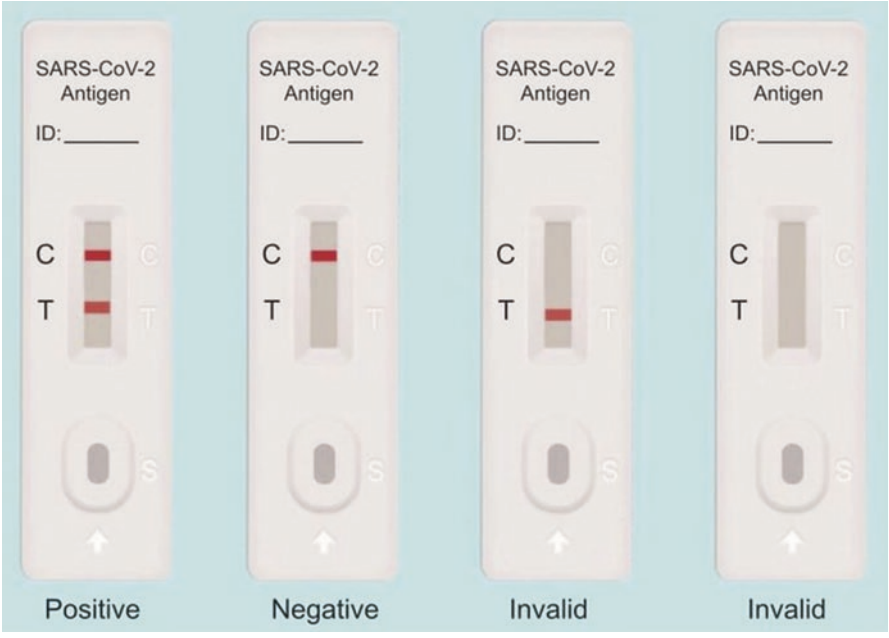

Fig. 5 Test kit for rapid antigen examination of SARS-CoV-2 (colloidal gold)

infection in a best possible way and, additionally, maintains a beneficial early screening result for every individual who have been exposed with SARS-CoV-2-infected patients or high-risk environment.

This type of unambiguous test procedure will reveal results of person who is presently infected with the SARS-CoV-2 virus or not. The antigen diminishes immediately after the recovery from COVID-19 infection. Unlike RT-PCR test, RAT techniques are of low cost and profitable, as it lends the test results to also distinguish glycan's like spike proteins availability on the surface of the SARS-CoV-2 immediately. Furthermore, such diagnostic procedure can be more susceptible to point-of-care use, which could make them more relevant for testing in the community or even in remote locations.

In addition to the abovementioned screening procedure, some different pathways for diagnosing new test samples are available with added benefits.

(i) For fast, point-of-care diagnostic test procedure, a mucus sample obtained from the nose or throat is used for analysis at the doctor's chamber or clinic, and results may be available within a few minutes. This method may be either molecular or antigen test.
(ii) Internal collection test measure is feasible only by the instruction from a medical practitioner that allows the patient to collect the sample from home and deliver it precisely to the pathological laboratory for investigation.
(iii) Apart from collecting mucus from the nose and throat, saliva tests are also accomplished in which patient is endorsed to spit inside a test tube. This experiment is comfortable for some people than any other assessment method available for corona detection and also provides safer and easier method for healthcare personnel who can be farther away during the sample collection.

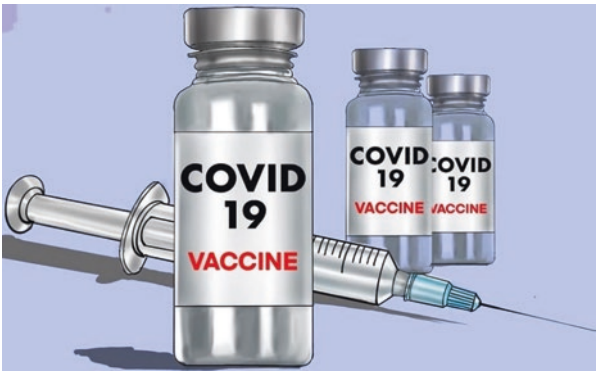

Fig. 6 COVID-19 vaccine

Vaccine

Vaccine is a biological preparation that typically contains a bioactive element that stimulates any disease-causing microorganism and is often prepared from deactivated forms of pathogen and its toxins, or one of its surface proteins that provides active acquired immunity to a particular infectious disease (Fig. 6) [33].

This biological element triggers the immune response of our body to remember the agent as a hazards and sabotage and to further recognize and destroy any of the microorganisms associated with that agent that it may confront in the near future. Once administered with the vaccine, the body is able to produce antibodies as the initial response against an antigen. It also initiates to create antibody-generating memory cells, which stand active after defeat of foreign bodies through by the antibodies. If the host tissues again are exposed to the similar nature of pathogen more than once, the antibody reaction is much faster and more impressive than first-time action, because the memory cells are ready to release antibodies against those antigens. Vaccines may be prophylactic to intercept the facets of upcoming disease by an instinctive pathogen and/or therapeutic agent to combat an infection that has already entered into the system. Some vaccines provide full castrate immunity against the disease as it interrupts the pathogen comprehensively.

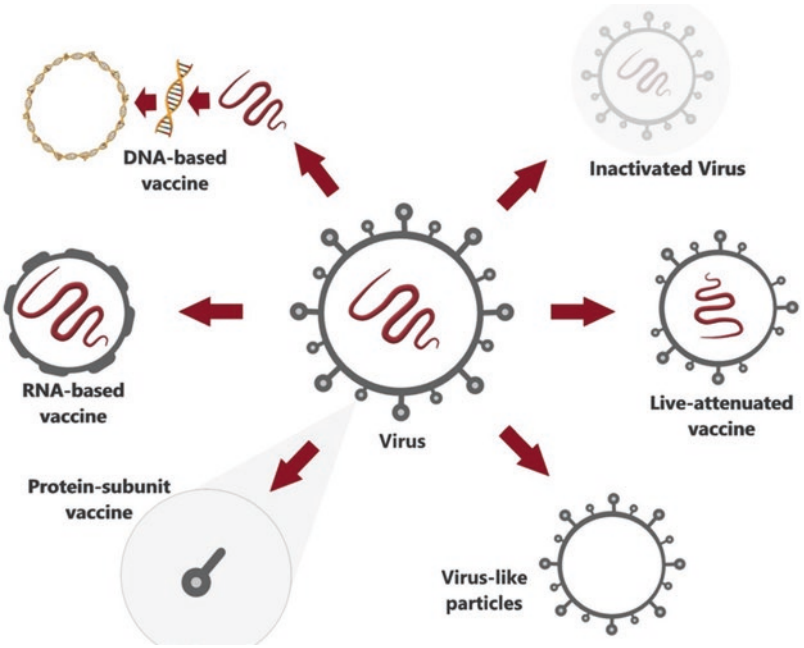

Fig. 7 Different types of COVID-19 vaccine

COVID-19 Vaccine

All over the universe, scientists are advancing to develop many potential vaccines for COVID-19 (Fig. 7) [34–36]. There are almost 12 different vaccines developed to counter COVID-19 disease that have been approved by the WHO for use in various locations around the world, although a number of potential vaccines to prevent COVID-19 disease have been developed [37, 38].

These types of vaccines are broadly classified into four categories such as:

(i) **RNA and DNA vaccines** are the most modern and updated vaccines that apply genetically constructed RNA or DNA-created protein that itself cautiously encourages our immunity [39, 40].

The first authorized mRNA vaccines for COVID-19 developed by BioNTech-Pfizer and Moderna are used in humans after successful clinical trials. This antiserum does not consist of any specimen of the SARS-CoV-2 virus, but it carries a chemically synthesized messenger (m)RNA obtained from the COVID-19 virus itself that gives the necessary instruction to host cells about the making of harmless spike protein unique to virus (Fig. 8) [41].

After making imprint of that protein, they kill the genetic material from the vaccine. When our immune system recognizes the undesired protein, they build long-serving immunity in the name of T-lymphocytes, immediately followed by B-lymphocytes that will commemorate how to fight against the virus that is responsible for COVID-19 if we are infected in near future. It is impossible to evolve coronavirus against mRNA vaccine, as it does not bring any necessary information to generate the integrated coronavirus [42].

Like any other available vaccines against coronavirus, mRNA vaccines will provide highest satisfaction to the vaccinated subject by providing them safeguard against diseases like COVID-19 without any risk of the potentially dangerous consequences of capturing sick. mRNA vaccines are freshly available

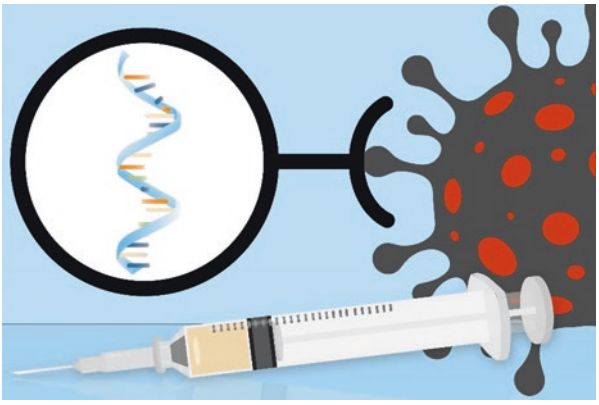

Fig. 8 The COVID-19 mRNA vaccine

in the market for the common people. Identical composition of such vaccine is applied as double shots of elementary series.

(ii) **Protein subunit vaccines** utilize harmless fragments of proteins or protein shells of the SARS-CoV-2 virus that mimic the nature of the COVID-19 virus instead of the entire germ to harmlessly achieve an immune response [43]. This type of vaccines delivers the protein directly to our cell instead of providing necessary genetic code to make a viral protein. Once vaccinated, our bodies easily recognize the disease-causing protein and build T-lymphocytes followed by antibodies accordingly, which will remember how to fight against such virus that is responsible for COVID-19 disease if we are infected in the future [44].

The Novavax COVID-19 vaccine is an example of this type of vaccine. Scientists are trying to produce enormous numbers of the SARS-CoV-2 spike protein in laboratory for this empirical vaccine using insect cells to cultivate proteins before purification. The purified proteins then are converted to nanoparticles. Individually, such nanoparticles are not strongly sufficient to produce the adequate immune reaction through antibody production, so Novavax addition acts as a catalyst to stimulate the immune system. Subunit vaccines does not produce any COVID-19 symptoms, because they do not import adequate viral component to make integrated SARS-CoV-2 virus.

This vaccine incorporates only a part of the virus, i.e., harmless S proteins that best stimulate our immune system. Once our body's resistance system remembers these components, it builds antibodies and white blood cells for defensive mechanism. If we are infected with coronavirus in the near future, the antibodies will fight against that virus.

(iii) **Viral vector vaccines** contain a safe, altered variant of a virus that is different from the original one being targeted to deliver imperative lessons to host cells to make spike protein, which doesn't create disease but provides as base to generate coronavirus proteins to produce resistance power [45]. Inside exo-skeleton/cover of the mutated virus, there is a substance available within the virus to make COVID-19. Once viral vector invades the owner's cells, the

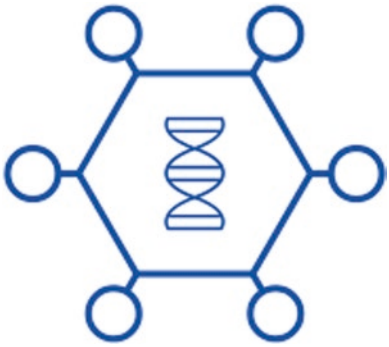

Fig. 9 Viral vector vaccine to coronavirus

ancestral material gives directions to the cells for formation of protein that is exclusive to the virus that causes COVID-19 [46].

Following these guidance's, our cells form imprint of such protein, which stimulates our immune system to evolve T-lymphocytes and B-lymphocytes that memorize how to battle with virus if we are infected in the upcoming days (Fig. 9).

Like mRNA vaccines, these types of vaccines don't bring indispensable message for presenter cells to compose the entire SARS-CoV-2 virus, because they are not incorporated in the full SARS-CoV-2 virus. Accordingly, they are unable to cause COVID-19 disease [47].

Three types of viral vector vaccines, named Oxford-AstraZeneca, Sputnik V, and Johnson & Johnson vaccines, utilizes different adenoviruses as the delivery system. Chimpanzee adenovirus vector ChAdOx1 is used in the Oxford-AstraZeneca vaccine, but two different human adenoviruses, i.e., Ad26 and Ad5, are incorporated in Russian Sputnik V vaccine. Further, Johnson & Johnson uses only one virus, i.e., Ad26, in such product. All three vaccines incorporate the gene for the spike protein and deliver into cells after injection. After that, this cell makes such protein and available within our immune system.

(iv) **Inactivated or weakened virus vaccine normally** uses the killed version of germ that doesn't motivate the disease but develops a strong immune response like live vaccines (Fig. 10). Therefore, we need a number of same doses over time (booster dose/precaution dose) in order to maintain the ongoing protection against diseases. Unlike the abovementioned three different classes of vaccines (i.e., mRNA, viral vector, and subunit), inactivated vaccines consist of the unified SARS-CoV-2 virus, but this virus is synthetically mutated to appease or weakened that is incapable to induce disease [48–50]. For the inactivation of SARS-CoV-2 virus in their vaccines, Sinovac, Sinopharm, and Bharat Biotech apply beta-propiolactone, which modifies the genetic material as well as nature of viruses. This form of vaccines is impotent to originate

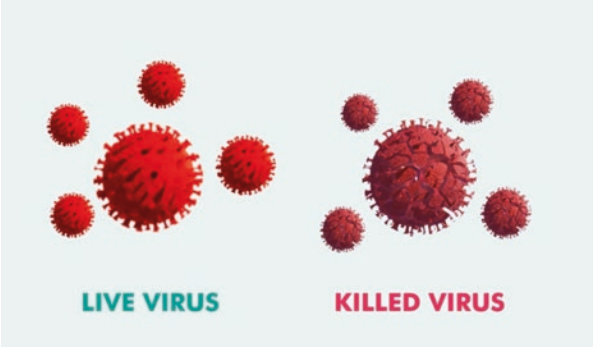

Fig. 10 Inactivated virus vaccine for COVID-19 disease

COVID-19 disease, because the virus is unable to reprint itself. Additionally, such antibody generated element does not induce sufficient immune response; as a result, immunity may not be long-lasting like the others. All the above-mentioned manufacturers are practiced with different adjuvants in their corona vaccines to achieve an improved and stronger immune response.

Working Mechanism of COVID-19 Vaccine

Although all the available vaccines offer protection by working in different ways, all types of vaccines are effective to generate sufficient number of "memory" T-lymphocytes and B-lymphocytes that may recall how to combat with this virus in the upcoming days (Fig. 11). In general, after 2–3 weeks of vaccination, our immune system is able to produce antibody generating T-lymphocytes as well as B-lymphocytes [51].

Therefore, it is impossible to protect a person from the infection of coronavirus just before or after vaccination and getting sick, because the vaccine did not have adequate time to develop immunity power for protection.

Occasionally just after vaccination, the mechanism of building immunity can cause mild to moderate symptoms in the form of fever, tiredness, muscle pain, headache, etc. These ailments are quite familiar and are normal signs, indicating that our body is developing immunity. To combat such symptoms, our doctors mainly prescribed pain-relieving medicine paracetamol, such as ibuprofen, acetaminophen, and aspirin (applicable for people age 18 years or above), or antihistaminic drug for any pain and/or discomfort experienced after vaccination.

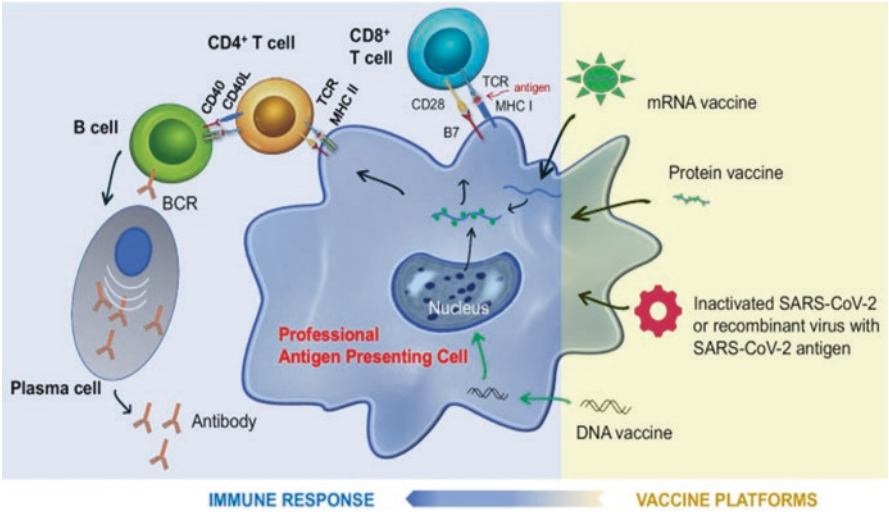

Fig. 11 Working mechanism of COVID-19 vaccine

Therefore, COVID-19 vaccines start working after administering into the immune system as mitigated form of the SARS-CoV-2 coronavirus or a part which is not responsible for COVID-19 but prepare hosts to confront against impending disease with same type of antigen [52].

The vaccines teach our body's resistance system about the recognition principle and how to wipe out the virus, before it causes us to be seriously ill. Our body's immune system builds such safeguard over time against such virus. We are fully secured within 7–14 days after the second dose of vaccination.

The vaccines help the body to:

- Confess these spike proteins as a threat
- Fight against coronavirus that has similar proteins

Vaccination

Vaccination is the process of a straightforward, secure, and successful approach of protecting people from detrimental pathogens by introducing a chemical compound into the body, before we come into contact with affected people (Fig. 12). It enhances our body's inherent defense mechanism to frame resistance toward distinct infections and builds our immune system stronger and stronger [53].

Vaccines to counter the COVID-19 disease are the most supreme tool to break the pandemic condition, but they are unable to do it individually. Public health and social measures including surveillance, contact tracing, isolation, and individual protective behaviors, such as social distancing (staying minimum 6 ft away from others), wearing the WHO recommended N95 or surgical mask over nose and mouth, avoiding poorly ventilated places and staying home if feeling unwell,

Fig. 12 Vaccination drive to stop the COVID-19 outbreak

covering coughs and sneezes, and cleaning our hands frequently with soap, remain crucial to breaking the chain of transmission [54, 55].

The impact of aforesaid vaccines over the pandemic situation depends on various factors, such as the effectiveness of the vaccines; how fast they are approved; how many people get vaccinated, produced, and delivered; the possible development of other variants; etc. [56].

Vaccination preserves us from serious danger and possible death of COVID-19 disease. After inoculation, for the first 14 days, we do not have satisfactory levels of protection as sufficient number of antibodies, but afterward, antibodies increased progressively. For the single-dose vaccine, prerogative will typically grow after 15 days of vaccination, but for double-shot vaccines, two doses, maintaining the prescribed interval between both shots, are essential to achieve the highest degree of immunity possible.

Although all of us know that any type of COVID-19 vaccine will defend us from serious disturbances and death, we still be studying and collecting information about the scope to which it keeps us from being infected and transmitting the virus to the others [57]. Statistical report obtained from other countries proclaiming that currently use vaccines are protecting us from severity of coronavirus disease and hospitalization. However, it is true that no vaccine is 100% proficient and breakthrough infections are regrettable, but to be expected up to that.

Present analytical data concede that vaccines provide some shelter from corona infection and spreading, but that safeguard is not up to the mark to counter serious illness and death. We are still researching about the latest variants of concern and also investigating whether the vaccines provide sufficient protection against those strains as non-variant virus. For these testaments, if most of the peoples of society may not be vaccinated, then maintaining other preventive measures is of paramount importance, especially in communities having notable SARS-CoV-2 transmission [58].

Service to keep us and others safe, and while efforts continue to reduce viral transmission and ramp up vaccine coverage, we should continue to maintain the WHO specified social distancing from others, cover a cough or sneeze in our elbow, clean our hands frequently, and wear an appropriate mask, particularly in enclosed, crowded, or poorly ventilated spaces or areas. Therefore, it is recommended to always pursue guidelines from the local authorities based on the situation and risk where we survive.

The COVID-19 vaccines available in the emergency use listing (EUL) of the WHO recommendation furnished different levels of protection toward mild infection, serious problems like respiratory syndrome, hospitalization, and possible death. Ongoing research investigation is carried out by thousands of scientists around the globe to understand how new virus mutations and variants will affect the effectiveness of different COVID-19 vaccines. In general, the COVID-19 vaccines are highly trustworthy against serious illness, hospitalization, and death from all current virus variants, but they are less active for protection to infection and mild disease than they were for earlier virus variants. If we do get ill after being vaccinated, our symptoms are more likely to be mild.

However, it is proven that the WHO-recommended COVID-19 vaccines are incredibly effective at reducing our risk of developing serious illness and death, but no vaccine is 100% potent. A small percentage of people will still get affected with COVID-19 disease even though they have been vaccinated. Presently, there is very limited information about the risk of vaccinated people who are passing the virus to another infected person. Thus, it is very relevant to continue to practice public health and social measures, even after we have been fully vaccinated.

The commonly used COVID-19 vaccines are:

(a) **Covaxin vaccine** – India's first indigenous, inactivated virus-based COVID-19 vaccine is Covaxin, developed by Bharat Biotech in collaboration with the Indian Council of Medical Research (ICMR) and National Institute of Virology (NIV) (Fig. 13). Whole-Virion Inactivated Vero Cell-derived platform technology is implemented for the evolution of this vaccine. It is a two-dose vaccination system given 4 weeks apart that received approval from Drugs Controller General of India (DCGI) for Phase I and II clinical trials, and the trials began all over India from July, 2020. It is proved and well-documented that this vaccine is able to neutralize the variants: B.1.1.7 (Alpha), first isolated in the UK; P.1 – B.1.1.28 (Gamma) and P.2 – B.1.1.28 (Zeta), primarily confined in Brazil; B.1.617 (Kappa), initially segregated in India; B.1.351 and B.1.617.2 (Beta and Delta), mainly outlined in RSA and India. According to analysis and subsequent findings of clinical trial, Bharat Biotech confirms that this vaccine is 65.2% effective against the SARS-CoV-2, B.1.617.2 Delta variant.

(b) **Covishield vaccine** – The Covishield vaccine, formerly known as ChAdOx1 nCoV-19 vaccine, is formulated from a deactivated variant of a common cold virus ChAdOx1, i.e., adenovirus (Fig. 14). A hereditary substance has been added to the adenovirus to build the spike (S) glycoprotein from the SARS-CoV-2 coronavirus. It is a recombinant, reproduction-impaired chimpanzee

Fig. 13 Covaxin – India's first indigenous vaccine against COVID-19

Fig. 14 The Covishield COVID-19 vaccine

adenovirus vector encoding the SARS-CoV-2 spike (S) glycoprotein. After vaccine is administered, the genetic material from a part of the coronavirus is exposed, which stimulates an immune response.

On emergency basis, drug regulators in India approved this coronavirus vaccine for public uses that is developed by AstraZeneca Plc, along with the University of Oxford on January 1, 2021. The World Health Organization (WHO) recommended Serum Institute of India Pvt. Ltd. COVID-19 to produce Covishield on February 15, 2021. On March 19, 2021, the regulatory organization also confirmed that the AstraZeneca COVID-19 vaccine (Covishield) has a favorable benefit-risk profile, with an exceptional potential to prohibit infections and reduce deaths worldwide.

AstraZeneca announced on December 23, 2021, about Vaxzevria (ChAdOx1-S) that it substantially endorsed the levels of antibodies against the Omicron SARS-CoV-2 variant (B.1.1.529), following a third booster dose, according to the report obtained from a new laboratory study. The neutralizing antibody levels against Omicron following a third booster dose of Covishield was predominantly similar to levels accomplished after two doses to counter the Delta variant.

(c) **Johnson & Johnson vaccine** – COVID-19 vaccine formulated and developed by Johnson & Johnson contains a fragment of a modified virus, known as vector virus that is not the microbes that is responsible for corona, as they are unable to reproduce itself (Fig. 15). The composition used gives instructions to host cells to constitute an immune response which cooperates to insulate us from

Fig. 15 Johnson & Johnson-developed COVID-19 vaccine

Fig. 16 Moderna COVID-19 vaccine

getting ill with COVID-19 in the forthcoming days. After the host develops sufficient immunity, it gets rid of all of the vaccine ingredients, just as it would discard any information that cells no longer need. Based on the investigation and results obtained from the clinical trial by the manufacturer, this vaccine has shown to be 66.9% effective on Delta and other variants.

(d) **Moderna vaccine** – The COVID-19 vaccine developed by Moderna is available under the EUA category of the WHO as a two-dose primary course, for individuals of 18 years or more; as a third dose, as precaution dose for individuals of the same age group who have been determined to have certain kinds of immune compromise; and as a single booster dose for individuals at least 6 months after completing an elementary series of the vaccine. The Moderna COVID-19 vaccine consists of a harmless piece of messenger RNA (mRNA) (Fig. 16). Based on the evidence and data obtained from clinical trials of people in the age group of 18 years or more, this vaccine was 94.1% effective against COVID-19 disease.

(e) **Sputnik V vaccine** – The Russian COVID-19 vaccine named as Sputnik V (Gam-COVID-Vac) is a viral vector vaccine based on adenovirus DNA, in which the SARS-CoV-2 coronavirus gene is unified. It is a twofold vaccine against the SARS-CoV-2 coronavirus, in which a weakened virus is to deliver small parts of a pathogen and stimulate an immune response to body. The host cell will utilize the gene of deactivated virus to grow the spike protein. The owner's immune system will determine this spike protein as foreign substances and cultivate a natural defense mechanism by developing antibodies and T cells against this protein. Unlike other vaccines, the Sputnik V vaccine minimizes the time required for the actual development of immunity to SARS-CoV-2, i.e., the Beta variants of COVID-19 pandemic. Gam-COVID-Vac is one of three corona vaccines in the world whose potency is more than 90% and became the world's first registered vaccine against coronavirus (Fig. 17).

(f) **Zydus Cadila vaccine** – On August 20, 2021, DCGI recommended Zydus Cadila-manufactured ZyCoV-D vaccine for emergency use authorization (EUA). This is the first DNA-based vaccine for COVID-19 in the world, indigenously developed by India, and has been administered in human beings, including youngster of 12 years and above and adults (Fig. 18). In association with DBT, the Government of India, Zydus Cadila developed this vaccine under "Mission COVID Suraksha" scheme implemented by Biotechnology Industry Research Assistance Council (BIRAC). ZyCoV-D has been financed through the National Biopharma Mission for preclinical studies, Phase I and Phase II clinical trials under COVID-19 Research Consortia, and subsequently the Mission COVID Suraksha for Phase III clinical exploration. The three-dose vaccine in injected form produces the spike protein of SARS-CoV-2 virus and extorts an immunity, which plays an indispensable role in security from disease as well as viral removal.

Fig. 17 Russian Sputnik V vaccine against COVID-19

Fig. 18 ZyCoV-D vaccine manufactured by Zydus Cadilla

Fig. 19 Various side effects of COVID-19 vaccine

Side Effects of COVID-19 Vaccine

Just like other vaccines, few people experience mild to moderate reaction after being vaccinated against COVID-19, because this is a normal signal which indicate that our body is developing shelter (Fig. 19). Aftereffects to COVID-19 vaccines are

not common for all, as well as it differed according to the specific vaccine, including delirium, fatigue, headache, muscle spasm, cold, diarrhea, and pain or redness at the injection spot. Most of the side effects disappear within a few days without medication by their own healing mechanism. We can subside the syndrome with rest, plenty of nonalcoholic liquids, and taking anti-inflammatory medication to manage pain and fever, if required.

More dangerous or lifelong side effects to COVID-19 vaccines are possible but exceptionally scarce and uncommon. In case of anyone struggling with any difficulty in respiration, chest spasm, distraction, speech loss, or impaired mobility after vaccination, it is advised to contact his/her healthcare provider immediately. The side effects of COVID-19 vaccines are under microscope for a long time since their use to detect and respond to rare adverse effects.

Importance of COVID-19 Vaccination

The inception of COVID-19 vaccine is the most important and massive step toward diminishing the acceleration of pandemic situation and further reducing the identical disease and deaths. The introduction of COVID-19 vaccine is the largest injection drive of globe and roll out that requires effective planning at various levels for proper execution. The major advantages of getting COVID-19 vaccines includes the following:

(i) **The vaccine reduces our risk of infection.**

Once we reap our maiden dosage of COVID-19 vaccine, our system starts to produce antiserum against coronavirus and support the resistance system to prevent such virus. If we were exposed to the infection, it lowers the chance of catching the disease. All types of available vaccines used worldwide are 70% or more effective toward infection.

It's true that some peoples are still affected after the full course of vaccination, but when a maximum number of people are vaccinated, those risks are progressively decreased. This adoption is known as herd immunity. So, fully vaccinated people will not only diminish their chance of getting infected but also devote to neighborhood protection, shortening the tendency of virus transmission.

(ii) **The vaccine can help the unborn or newborn baby.**

Researches admit that pregnant women who received COVID-19 vaccine create antibodies to counter the virus and transmit serum to their awaited baby through the placenta. Mothers were also shown to transfer immunity to newborn offspring through breast milk. The aforementioned study suggests that if mothers were fully vaccinated, then their newborn babies have some sort of immunity toward the virus, which is so crucial as budding children up to 12 years of age cannot get the vaccine till now.

(iii) **The vaccine protects against severe illness.**

During investigation, it was confirmed that all available vaccines are powerful against coronavirus and prevent severe illness from COVID-19. Thus, by any means, if we were infected after vaccination, chances of serious illness and possible death are reduced further. The clinical studies reveal that Pfizer-BioNTech- and Moderna-manufactured vaccines were 100% successful to prevent serious collapse, whereas Johnson & Johnson products exhibit 85% success rate to counter severe illness. Others offered more than 75% effectiveness for such infectious disease. These vaccines are also effective against different variants of the COVID-19 virus. As a result, all the vaccines will defend us from serious illness and scale down the possibility for hospitalization against COVID-19 disease.

As per the statistical report received from different studies, it is clear that the vaccinated people have less fierce effect of corona disease than the mass who aren't vaccinated if they were infected. Thus, our prospect toward hospitalization and the likelihood of death due to COVID-19 is almost dissipated once we are fully vaccinated.

(iv) **The vaccine helped us ditch the mask.**

Vaccine is the utmost solution in our attempt to recoup with the new normal of life, along with communal health screening, like skin temperature monitoring, face covering, social distancing, avoid gathering, hand-cleaning, sanitization, etc., executed properly to ease down the spread of the virus, and that has proven to work effectively. Although masks are still recommended in indoor areas, with high infection rates, as well as in public places, vaccine is our avenue toward the final destination beyond them.

Research data reveals that fully vaccinated people, if infected with such novel virus, have contain lesser virus particles in their body, especially in the respiratory path and mouth, and are less possible roll out to others. This statement is so salient that getting vaccinated now not only preserves us but also restricts the transmission of virus to our loved ones and friends.

Till now, people continue to receive their vaccine in time, we might reach herd immunity that clearly impede the spreading of virus becomes unlikely. Therefore, it is of paramount importance that all should receive vaccine in time to helps us accomplish this public health goal.

(v) **The vaccine will help us to reconnect with friends and family.**

After receiving the double dose of vaccine and waiting for the approved period for our body to develop the immunity, we can talk in person with other vaccinated people without wearing a mask. Moreover, if we've been near someone who has tested positive for COVID-19, we don't need any quarantine period to segregate ourselves.

Almost 1 year of anxiety, the vaccine has finally boomed and has clear benefits that should make everyone strongly believe for getting the shot. By selecting every individual to be vaccinated, we can't only protect ourselves but also provide safeguard to our family and community.

Conclusion

From the various literature and evidence collected from different incident and research, we know that proper health screening and vaccination against COVID-19 will minimize the chances of spreading coronavirus in the community. Through different health screening practices, we can quickly find out a COVID-19 victim at the initial phase and isolate them from their family and common people. All the above-mentioned examination and analysis steps will support the medical personnel to segregate affected people from others and outset medication to sufferer at the primary step of such infection. If the picture of screenings raises successfully for every individual, we can prohibit the growing of coronavirus to the society. Furthermore, vaccination against coronavirus disease may be the best hope in the world for the denouement of current pandemic situation. Available COVID 19-vaccines, such as Covishield, Covaxin, Sputnik V, etc., are highly impressive and competent and can easily weaken the endanger of getting and spreading the virus that causes COVID-19. Accelerated vaccination will not only protect us from getting mild to moderate symptoms, being more seriously ill, or dying due to coronavirus but also restrict us from spreading the pathogen that is responsible for COVID-19 disorder to a number of people in the community. Intercepting from thriving and reproducing the virus concedes it to mutate into less threatening genomic sequences that are least resistant to vaccines. Additionally, continuous awareness program also enforced to restrict the COVID-19 virus transmission within the population and efficiency of vaccines to curb the virus. Therefore, effective health screening and prompt vaccination will prevent the spreading of virus that causes COVID-19 disease and also minimize its adverse effects.

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