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Author (s):	Alizay, Ariba Nameen, Ayesha Khalid, Tehreem Ishtiaq, Saba, Iram Asim, Humaira Yasmeen
Affiliation (s):	The Women University, Multan, Pakistan
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Determining the Efficacy of Available Treatments and Containment Measures against SARS-CoV-2

Alizay, Ariba Nameen, Ayesha Khalid, Tehreem Ishtiaq, Saba, Iram Asim, Humaira Yasmeen*

Department of Microbiology and Molecular Genetics, The Women University Multan, Pakistan

ABSTRACT

Over the past 20 years, outbreaks related to coronavirus-associated diseases, such as MERS and SARS, have been threatening the whole world. The novel coronavirus emerged in Wuhan, China and belongs to the SARS family. It has been named "Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2)". Keeping in view the history of pandemics faced by the world, it would be fair to say that each of them has been one of its kind, bringing an equal amount of distress and damage to the humanity. With the help of other countries, Pakistan has coped well with the pandemic. Measures taken by different countries included curfews imposed in Italy, Spain, Russia, and India, while the UK, Ireland, and China opted for a more passive approach. South Korea imposed strict self-isolation requirements across the country, whereas UAE suspended all ferry services from Iran. Vaccines authorized by FDA to treat COVID-19 include Pfizer manufactured by Biotech which has 95% efficiency, Moderna with 94% efficiency, and Johnson and Johnson which has an overall efficiency of 72% and 86% efficiency in case of severe infection. These stats are from the USA. Whereas, vaccines such as Sinopharm, Sinovac, CanSino-Bio, and Sputnik have been administered in Pakistan following their approval by the Drug Regulatory Authority of Pakistan (DRAP). This study aims to review the various aspects of the COVID-19 pandemic such as disease symptoms, the mode of action, a brief comparison of control measures taken by different countries, therapeutic trials to cure COVID-19, and the status of vaccines.

Keywords: COVID-19, pandemic, public health, therapeutic trials, vaccination

1. INTRODUCTION

In December 2019, a pneumonia-like infection was discovered in Wuhan, China. The likely origin site, Huanan Seafood Wholesale Market, was immediately sealed. In Wuhan, social distancing was rigidly enforced before being applied everywhere else. All kinds of social events, including the Lunar New Year celebrations, were put on hold by the Chinese government. The WHO dubbed the new infection as COVID-19 and categorized it as a pandemic in January 2020 [1].

1.1. Symptoms

The symptoms of COVID-19 start to appear within 2-14 days after exposure to the virus. It is not necessary that people infected by COVID-19 show all the symptoms of the disease. Indeed, some people remain asymptomatic or their symptoms vary from mild to severe. In line with CDC, symptoms comprise headache, cold or fever, fatigue, sore throat, cough,

* Corresponding Author: humaira.6127@wum.edu.pk

shortness of breath, aches in muscles or body, loss of taste or smell, diarrhea or vomiting, and congestion. People with a prior illness or old age can develop severe health issues because of COVID-19.

1.2. Adequacy of Health Systems

Inadequate health facilities have led to a high mortality rate due to various pandemics across the world. Many people lose their lives in pandemics due to neglecting infectious diseases and lack of preparation on behalf of the healthcare system. Multiple kinds of studies have been conducted on SARS-CoV-2 to learn more about it and the effects it has on the society, the economy, and the health system. The COVID-19 pandemic has caused immeasurable human suffering and deaths, disrupted social relations, and deprived people of their livelihoods and prosperity [2]. New and reemerging infectious diseases have been occurring at an uncommon pace. According to the World Health Organization (WHO), more than 20 infectious diseases have been a source of pandemics all over the globe in the preceding decade [3]. A number of these calamities have been brought [4] on by infectious diseases like H1N1 and MERS.

Recently, COVID-19 pandemic has prompted the researchers to understand the science of emerging organisms and human vulnerability to their risks, creating successful measures to overcome them. Recognizing these issues, on the other hand, is the first step in a well-prepared planning process that would help to ensure the best possible public health protection [5].

Researchers suggest that because of the history of responding to other disease outbreaks, fragile and fragmented health systems, and lack of health knowledge, the government of Pakistan and all relevant agencies should remain vigilant and be fully prepared to respond to abnormal situations [6].

1.3. Strategies Developed by Different Countries

With remarkable speed and resource mobilization, the world has responded to the COVID-19 pandemic. Within a few weeks, Chinese scientists identified and sequenced the causative agent of this pandemic. To date, considerable genomic and clinical data have been exchanged rapidly around the world. Several possible treatments have been suggested for this disease [7]. In the worst-affected countries, the virus wreaked havoc on healthcare services, causing shortages of medical equipment, medication, and sanitary supplies.

More research must be conducted in an innovative laboratory to stop emergency conditions created by countless viruses that reside in nature and have not yet been found or named [8]. Although a coping mechanism cannot be pre-defined for such unprecedented scenarios, different countries may deal with it differently in their unique ways. Strategies have been developed to successfully halt virus transmission that disrupt daily life and economic functioning, prompting officials to take rapid steps to ameliorate their negative impacts. During the pandemic, governments throughout the globe strived to help people cope with the economic and social effects of the lockdown by providing support and compassionate measures for employees and employers. [9].

China, the center of the outbreak, took drastic steps which included lockdowns, bans on traveling, and the closure of theatres, sporting events, and public spaces. South Korea imposed strict self-isolation requirements across the

country, with fines or a possible jail term facing those who break them. UAE suspended all ferry services from Iran and demanded a health statement from all the crew members working in ports 72 hours before their arrival. In Singapore, text and web-based solutions were introduced that required restrictions for patients in home quarantine through which they could share their whereabouts with the government [10].

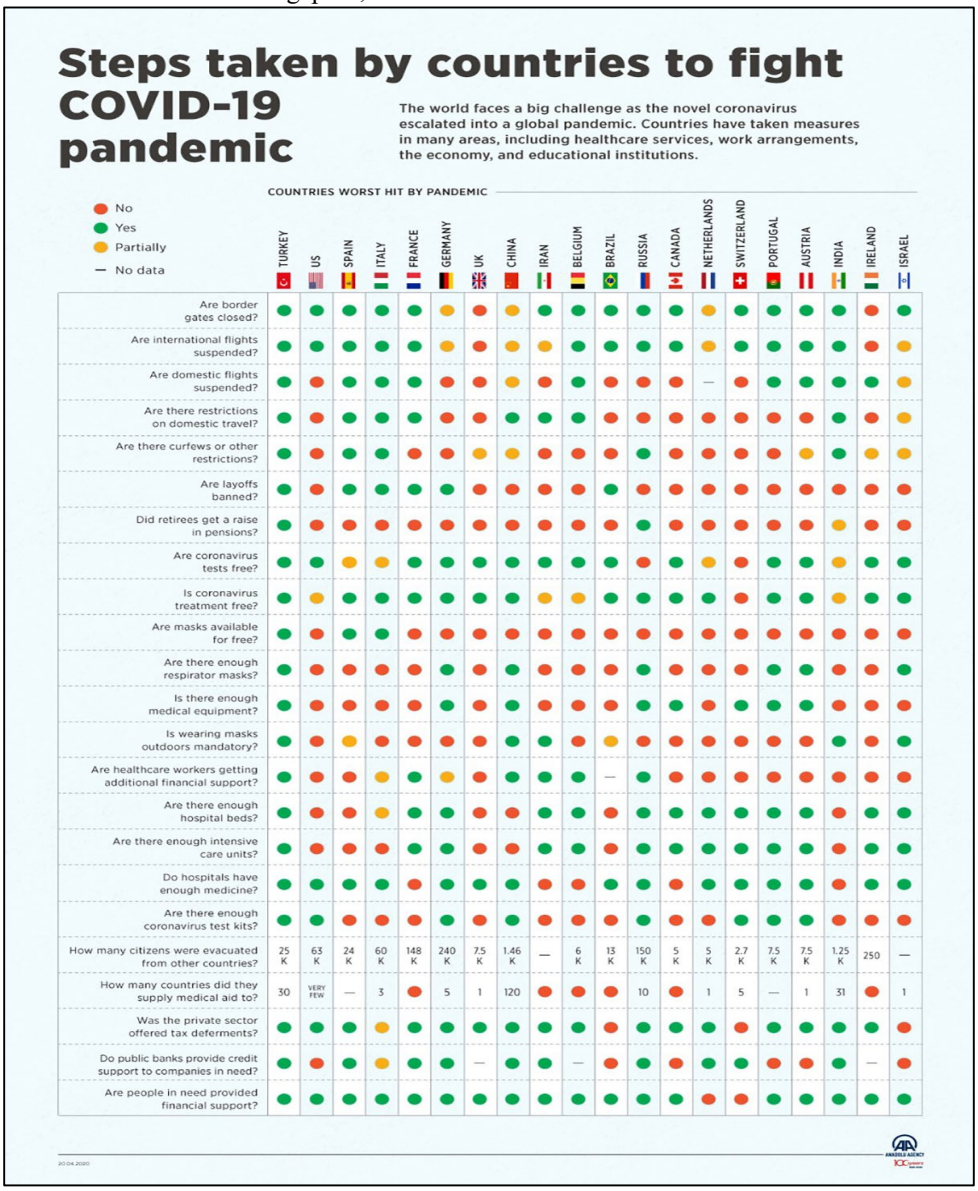

Figure 1. Steps Taken by Countries to Fight COVID-19 Pandemic [9]

1.4. Therapeutic Trials to Cure COVID-19

There is a lot of curiosity about whether drug therapies can be used to prevent COVID-19, although it remains unclear which drugs, if any, are successful. The evidence for hydroxychloroquine is the subject of the first version of the guideline. A panel of international guidelines indicates that hydroxychloroquine is no longer a high priority for research and other promising drugs should be inquired about for their function in the prohibition of COVID-19 [11].

Many therapeutic trials are being conducted to reduce viral transmission, morbidity, and mortality [12]. The only antiviral approved to date is remdesivir. It is a nucleoside analog known for its *in vitro* role against RNA viruses and ebolavirus. It reduces the recovery time in patients with serious COVID-19. In animal experiments, it was administered to a mouse that was already infected with SARS-CoV-2. The results showed a lower virus titer as compared to the control group, improvement in the damaged lung tissues, and better treatment as compared to interferon-beta combined with lopinavir/ritonavir.

Three common approaches are used to discover antivirals effective against SARS-CoV-2. Testing existing antiviral drugs, which are broad spectrum and accustomed to treating other viral diseases, is the first method. By exploiting standard assays, the result of these drugs on plaque constitution, cytopathy, and pseudo coronavirus can be measured. Interferon-II and Interferon-I were identified by using this methodology. The second method comprises a drug repurposing program [13]. It is a method of drug discovery based on the illustration of a novel treatment for COVID-19 by using the chemical library of previously known compounds that can be at the preclinical stage [12]. The chemical library includes data about transcription properties in distinct cell lines. This method was used to identify various drugs with immunological and anatomical implications, such as influencing estrogen receptors, sterol or lipid metabolism, neurotransmitter regulation, kinase signal transfer, DNA synthesis or repair, and protein processing. The third method is based on the redevelopment of novel drugs by exploiting biophysical and genome comprehension of individual SARS-CoV-2 genome [13]. Instead of investing time and cost in the de-novo elaboration of new drugs, it is better to repurpose the existing drugs to cure COVID-19. Antiviral drugs may show an inadequate response in patients with an austere disease. The reason is the production of CRS (cytokine release syndrome). To halt CRS and virus replication, the fusion of immunomodulators and combination of antivirals are used respectively as treatments. Such fusion and combination comprise the potential therapeutic solution for severe COVID-19 infection [14].

Data that provides evidence regarding the efficacy of these methods is still scarce [15]. There is a requirement to validate the safety and effectiveness of these drugs through clinical trials [13]. RCT (randomized controlled trial) is critical in determining the effectiveness and safety of new therapies. The critical problem is the groups that show low representation and it must be addressed. Due to this problem in trials, the advantages of remdesivir cannot be generalized; therefore, patient recruitment should be a key goal. A small, non-randomized, open-label study was performed in China to estimate the effect of favipiravir on non-severe COVID-19. A

comparison was done between 35 patients who received favipiravir and 45 patients who received lopinavir/ritonavir. The group that received favipiravir required a shorter time of 4 days for viral clearance, while the group that received lopinavir/ritonavir required 11 days for viral clearance [14].

1.5. Virology of COVID-19 and Drug Therapies

An enveloped ssRNA virus SARS-CoV-2 binds spike protein to the host's ACE2 (angiotensin-converting enzyme 2) receptor upon entry into the cell through receptors on the host cell and endosomes. TMPRSS2, a host transmembrane serine protease assists in viral entry. After entry, it controls the host machinery to synthesize viral glycoproteins that form a transcriptase-replicate complex. Structural proteins play an important function in the assembly and release of virions [16].

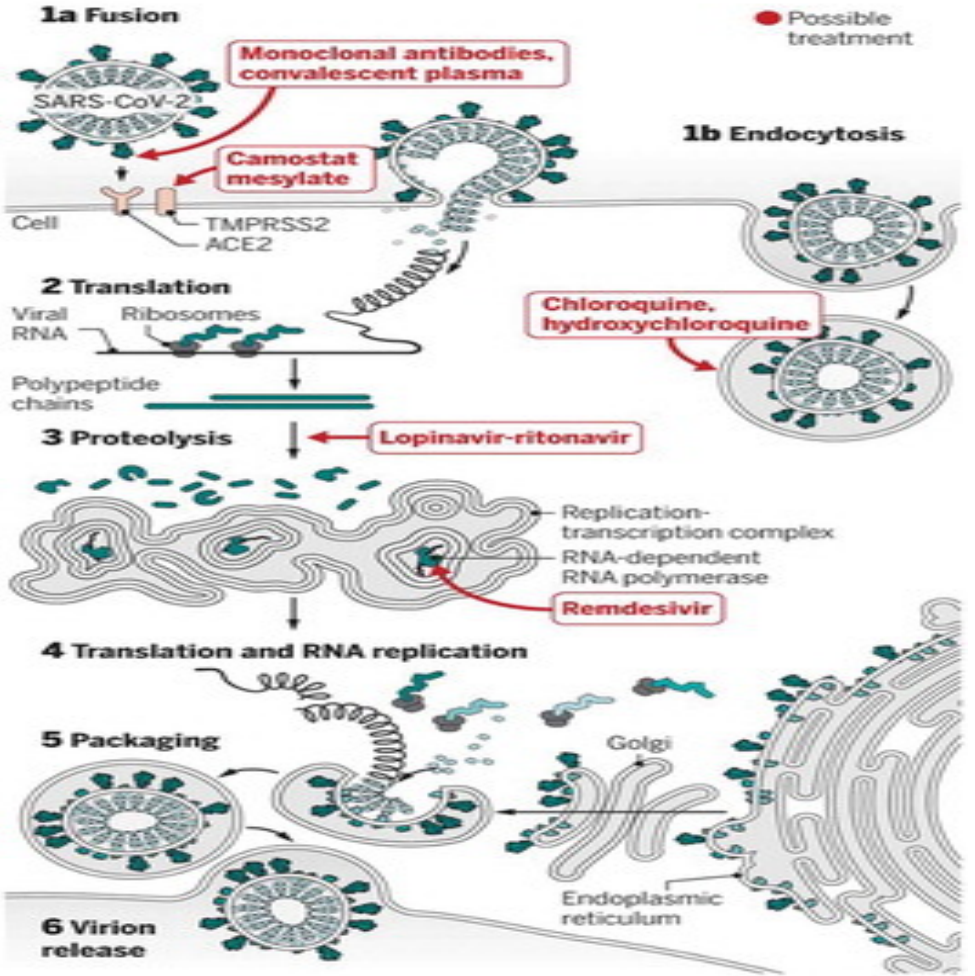

Figure 2. Mode of Action and Site-Directed Therapies to Treat COVID-19 [17]

Table 1. Summarization of Different Therapies with their Mode of Action.

Drug	Rationale for Understanding	Mode of Action	Target Site	Side Effects	Success	References
Chloroquine (CQ) and Hydroxychloro-quine (HCQ)	They show antiviral immunomodulatory properties against SARS-CoV-2	Blockage of viral entry through ACE2, interference of endosome acidification, inhibition of cytokine squall, and impediment of sialic acid receptors.	Potential targets are enzymes and regulatory proteins linked with SARS-CoV-2 pathogenesis.	Gastrointestinal complications, rashes, itching, and headaches.	Data obtained from RCTs does not show any clinical benefit and it is not recommended routinely.	[14, 18, 19,]
5-amino leuvilinic acid (5- ALA)	It is a natural amino acid and provides virus reducing effect.	PPIX interferes with G-4 assembly to inhibit infection.	G- quadruplex (G4) with binding proteins is the target site for antiviral activity.	Low blood pressure, photosensitivity reactions	It is still not possible to use as medicine due to the poor bioavailability of the drug. It is a broad-spectrum antiviral drug.	[20, 21]
17 beta-estradiol	COVID-19 affects men more than women and sex hormones are involved in it.	Reduction in viral load by estradiol treatment of VERO E6 cells.	SARS-CoV-2 increases the gene expression of ACE2 and TMPRSS2 genes in VERO E6 cells which in turn increases the effective capacity of the coronavirus. Estrogen pretreatment	Headache, vaginal irritation, clouded breast tenderness	It is suggested that beta-estradiol would apply to human cell lines within a short time before human use as COVID-19 hormone therapy.	[22, 23]

Drug	Rationale for Understanding	Mode of Action	Target Site	Side Effects	Success	References
			reduces the expression of these genes.			
3-Hydroxyphthalic Anhydride-Modified Chicken Ovalbumin	It acts as a viral entry inhibitor against many types of viruses.	Inhibition of SARS-CoV-2 replication by HP-OVA.	The S glycoprotein forms a connection with ACE2 to mediate fusion and viral entry. HP-OVA binds to both, breaks their interaction, and inhibits infection.	Not yet known	It is an efficient, secure, affordable therapeutic, and promising candidate for further development.	[24]
Convalescent Plasma	Transfer of potent neutralizing antibodies	Plasma acts as the first line of protection against SARS- CoV- 2.	Antibodies make a connection with the RBD of SARS-CoV-2 and do not allow the interaction between ACE2 and RBD.	Transfusion reactions, hypercoagulability risk	Authorization (EUA) from the FDA for emergency use.	[14, 25]
Colchicine	Its administration is associated with betterment in COVID-19 outcomes.	Given in combination with other antivirals and HCQ to lower cytokine storm	Inhibits –IL-1beta activates IL-6 and IL-18 and shows action on NLPP3	Gastrointestinal symptoms, muscle spasms	It can be used for COVID-19 treatment according to the findings. To validate this, further RCTs are required	[26]
Ionic Liquids	Hydrophobicity and dispersed charge	Shows pharmacokinetic	The target site is CoV-2 protease.	Not known	No clinical data is available	[27]

Drug	Rationale for Understanding	Mode of Action	Target Site	Side Effects	Success	References
	make them antimicrobial agents	properties and cytotoxicity	They successfully bind to the active site.			
siRNA molecules	Advancement in siRNA therapeutic approaches may be a promising alternative to vaccine	Suppression of viral gene expression by hybridizing and neutralizing complementary mRNAs	Target sites are nucleocapsid phosphoprotein and glycoprotein genes	Not known	8 siRNA molecules were effective against 139 strains of SARS-CoV-2. No clinical data is available.	[28]
Remdesivir	*In vitro* research shows that SARS-CoV-2 inhibition is effective. RCTs show a reduction in the time it takes for symptoms to resolve and the length of stay in the hospital.	Nucleoside analog that causes detention chain termination	Prohibits RNA-dependent RNA polymerase of the virus	Elevated liver enzymes, nausea, vomiting, and phlebitis	For hospitalized patients, this is the current standard of treatment.	[14]
Favipiravir	SARS-CoV-2 inhibition was discovered *in vitro*.	Pro-drug that is changed into purine nucleotide	Prohibits RNA-dependent RNA polymerase of the virus	Elevated liver enzymes, nausea, QT prolongatin, and diarrhea	Clinical evidence is scarce, not available in the US.	[14]
Azithromycin	There is no evidence of antiviral action *in vitro* or in humans. SARS-CoV-2 viral load was reduced in one study with HCQ and azithromycin.	Possible immunomodulator	Inhibits CRS	Nausea, QT prolongation, and diarrhea	Clinical benefit was not demonstrated in RCTs. COVID-19 is not advised for treatment.	[14]

Drug	Rationale for Understanding	Mode of Action	Target Site	Side Effects	Success	References
Lopinavir-Ritonavir	SARS-CoV-2 inhibition was discovered *in vitro*.	Viral protease inhibitor	The target site is a protease.	Elevated liver enzymes, nausea, QT prolongation, vomiting, and diarrhea	Significant drug-drug interactions. Not recommended for the treatment of COVID-19 based on available study data.	[14]
Interferon- beta	Possibility of action against SARS-CoV and MERS-CoV	Immunomodulator	Inhibits CRS	Headache, asthenia, myalgia, flu-like symptoms, hypertonia, abdominal pain, edema	Several RCTs of interferon-beta in combination or alone found no therapeutic benefit. The value of utilization is outweighed by the lack of data.	[14]
Ribavirin	Action against SARS-CoV and MERS-CoV was discovered *in vitro*.	Prohibition of the extension of RNA fragments	Viral RNA polymerase inhibitor	Headache, nausea, anemia, and fatigue	When used with other antivirals, it can be quite effective. The scarcity of clinical evidence outweighs the advantage of use.	[14]

Drug	Rationale for Understanding	Mode of Action	Target Site	Side Effects	Success	References
Umifenovir	SARS-COV-2 suppression was discovered *in vitro*.	Prohibits cell membrane-virus fusion	The target is spike S glycoprotein.	Diarrhea, nausea	It is not available in the United States. Clinical data available through clinical trials is limited.	[29]
Ivermectin	At very high doses, shows activity against SARS-CoV-2 in infected Vero-E6 cells	Prohibition of viral RNA by NS3 helicase in RNA binding	The potential target is alpha/ beta1 (host nuclear transport importin)	Pruritus, lymphadenitis, arthralgia, and fever	Without clinical study or trial, it cannot be advised.	[30]
Nitazoxadine	*In vitro* data reveals its effectiveness against SARS COV-2 and MERS-CoV	Mechanism unknown	Target host-regulated process involved in viral replication	Headache, vomiting, nausea	Clinical data is not available.	[31, 14]
Camostat mesylate	*In vitro* results showed that mice injected with a lethal dosage of SARS-CoV had a lower mortality rate.	Prohibition of TMPRSS2	Blocks viral entry site TMPRSS2	Gastrointestinal symptoms, skin rash, eosinophilic pneumonitis	In a clinical trial of COVID-19 therapy, it was discovered as a potential oral medication with minimal adverse effects.	[14]
Baricitinib		Disrupts endocytosis regulators and viral assembly	Inhibits CRS	High risk of infection when utilized for other indications	Clinical data with baricitinib is limited.	[14]

* PPIX: Protoporphyrin IX; RBD: Receptor Binding Domain; VERO: Verdo Reno; siRNA: Small Interfering RNA; iRNA stands for RNA Interference: ILs Ionic Liquids

1.6. Status of COVID-19 Vaccine

Table 2. Types of Vaccines, Their Target, and Who Formulated Them

Vaccine Platform	Vaccine	Vaccine Type	Vaccine Target	Formulated by	Status	Reference
Inactivated virus	Adsorbed COVID-19 (inactivated) vaccine	Non-activated	Viral structural proteins	Sinovac Biotech (China)	Stage-3	[32, 33]
	Inactivated SARS-CoV-2 vaccine (Vero cell)	Non-activated	All structural proteins of the virus	Wuhan Institute of Biological Products/Sinopharm	Level-3	[32, 33]
	BBIBP-CorV	Inactivated/adjuvant-based	Spike proteins	Institute of Biological Products/Sinopharm in Beijing	Phase-3	[32, 33]
	BBV152A BBV152B BBV152C	Inactivated	Structural proteins from the virus	Bharat Biotech	Phase-1/2	[32, 33]
Inactivated SARS-CoV-2 Vaccine		Inactivated	All structural proteins of the virus	Chinese Academy of Medical Sciences Institute of Medical Biology	Stage-1/2	[32, 33]
	QazCovid-in	Inactivated	All structural proteins of the virus	Kazakhstani Research Institute for Biological Safety Issues	Level-1/2	[32, 33]
Virus-like particle (VLP)	COVID 19 Vaccine Recombinant Coronavirus-Like Particle	Recombinant particles	Unknown	ExpreS2ion Biotechnologies ApS (Denmark), Medicago (Canada), Griffith University (Australia)	Phase-1	[33]
	Receptor binding domain SARS-CoV-2 HBsAg virus-like particle	Receptor binding domain -HBsAg virus-like particles	Spike proteins	India's SpyBiotech/Serum Institute	Level-1/2	[32, 33]

Vaccine Platform	Vaccine	Vaccine Type	Vaccine Target	Formulated by	Status	Reference
	Recombinant Coro-navirus- like the COVID 19 vaccine particle	Adjuvanted Plant-derivative virus-like particle with CpG 1018 or AS03	Spike proteins	Medicago Inc.	Stage-1	[32, 33]
Virus-related vector	Gam-COVID Vaccine	Adeno-built (rAd26-S+rAd5-S)	Spike proteins	Institute of Gamaleya Research	Stage-3	[32, 33]
	AZD1222	ChAdOx1-S	Spike proteins	Oxford University /AstraZeneca	Phase 3	[32, 33]
	Ad5-nCoV	Adenovirus (Class 5)	Spike proteins	Beijing Institute of Biotechnology and CanSino Biological Corp	Level 3	[32, 33]
	Ad26.COV2. S	Adeno-derived	S glycoprotein/ unknown	Janssen Pharmaceuticals	Stage 3	[32, 33]
	hAd5-S-combination and N-ETSD	hAd5 Spike (S) and NucleocapsidN	Spike proteins	NantKwest Inc and ImmunityBio Inc.	Stage 1	[32, 33]
	GRAd-COV2	replication error Adenovirus Simian (GRAd)	Spike proteins	LEUKOCARE/Univercells	Phase 1	[32, 33]
	Ad5(nCoV)	Ad5-derived	Spike proteins	Academy of Military Medical Sciences, CanSino Biological Inc./Institute of Biotechnology, PLA of China	Level 1	[32, 33]
	VXA(CoV2-1)	dsRNA-adjuvanted Ad5	Spike proteins	Vaxart	Stage 1	[32, 33]
	MVA-SARS (2S)	MVA and spike protein	Spike proteins	Ludwig Maximilian University in Munich	Level 1	[32, 33]
	V590	VSV and S protein	Spike proteins	IAV / Merck Sharp and Dohme	Stage 1	[32, 33]
	TMV 083	Measles derived vector	Spike proteins	Institute Pasteur, Themis, University of Pittsburgh	Level 1	[32, 33]

Vaccine Platform	Vaccine	Vaccine Type	Vaccine Target	Formulated by	Status	Reference
				CVR, and Merck Sharp and Dohme		
	DelNS1-2019 (nCoV) RBD OPT1	Intranasal flu-derived Receptor binding domain	Spike proteins	Xia Men University/Beijing Wantai Biological Pharmacy	Stage 1	[32, 33]
	Ad26 (COV2.S)	Adeno-derived	Spike proteins	Janssen Pharmaceuticals (Belgium)	Level 3	[32, 33]
RNA	mRNA (1273)	Lipid nanoparticles encapsulated mRNA	S glycoprotein/ unknown	NIAID/ Moderna USA	Stage 3	[32, 33]
	CVnCoV	mRNA	Spike proteins	CureVac (Germany)	Phase 2	[32, 33]
	Lipid nanoparticles (nCoVsaRNA)	Self-amplifying ribonucleic acid (saRNA) that codes for the S protein	Spike proteins	Imperial College London (UK)	Level 1	[32, 33]
	ARCT-021	mRNA	Spike proteins	Arcturus Therapeutics/DukeNUS Medical School (USA)	Phase 1/2	[32, 33]
	SARS (CoV-2) mRNA	mRNA encoding for S protein receptor binding domain	Spike proteins	Academy of Military Sciences of the People's Liberation Army (PLA) and Walvax Biotech	Stage 1	[32, 33]
	BNT162b1 BNT162b2	Lipid nanoparticle -mRNAs	Spike proteins	BioNTech, Fosum Pharma, and Pfizer (Germany/China/ USA)	Phase 3	[32, 33]
DNA	INO(4800)	DNA plasmid created using electroporation	S glycoprotein/ unknown	International Vaccine Institute/Inovio Pharma	Stage 1/2	[32, 33]

Vaccine Platform	Vaccine	Vaccine Type	Vaccine Target	Formulated by	Status	Reference
	AG0301 (COVID-19)	DNA plasmid with adjuvant	Spike proteins	Takara Bio, AnGes, and Osaka University	Level 1/2	[32, 33]
	nCov	DNA (plasmid)	Spike proteins	Cadila Healthcare Limited	Stage 1/2	[32, 33]
	GX 19	DNA	Spike proteins	Genexine Consortium	Level 1/2	[32, 33]
Protein subunit	SARS CoV-2 vaccine	Adjuvanted S protein	S glycoprotein and peptides/unknown	Sanofi Pasteur (France)/GSK	Phase 1/2	[32, 33]
	NVX (CoV2373)	rS/Matrix SARS CoV 2 adjuvant	S-glycoprotein	Novavax	Stage 3	[32, 33]
	SCB (2019)	Modified S protein	Unknown	GSK/Dynavax/Clover Biopharmaceuticals Inc.	Stage 1	[32, 33]
	COVAX (19)	S protein with Advax-SM adjuvant	Spike proteins	Vaxine Pty Ltd	Level 1	[32, 33]
	SARS (CoV-2) Sclamp vaccine	S protein with Molecular Clamp Stabilization and MF59 Adjuvant	Spike proteins	University of Queensland/ Seqirus	Stage 1	[32, 33]
	MVC (COV1901)	S2P protein plus CpG 1018	Spike proteins	Dynavax/NIAID/Medigen Vaccine Biologics Corporation	Step 1	[32, 33]

Vaccine Platform	Vaccine	Vaccine Type	Vaccine Target	Formulated by	Status	Reference
	Soberana (01)	Receptor binding domain for S protein with adjuvant	Spike proteins	Cuba's Instituto Finlay de Vacunas	Level 1	[32, 33]
	EpiVac Corona	Adjuvanted with peptide antigen	Spike proteins	Rospotrebnadzor, Koltsovo, and FBRI SRC VB VECTOR	Stage 1	[32, 33]
	Recombinant SARS (CoV-2)	S protein Receptor binding domain (Sf9 cells)	Spike proteins	Sichuan University's West China Hospital	Level 1	[32, 33]
	IMP CoVac 1	Cocktail of SARS-CoV2 HLA-DR peptides	Spike proteins	Tuebingen University Hospital	Level 1	[32, 33]
	UB 612	S1-receptor binding domain protein	Spike proteins	COVAXX	Stage 1	[32, 33]
	Novel recombinant coronavirus vaccine (CHO cell)	Recombinant receptor binding domain - Dimer adjuvanted	Spike proteins	Anhui Zhifei Longcom Biopharmaceutical/Institute of Microbiology, Chinese Academy of Sciences	Level 2	[32, 33]
	KBP (COVID-19)	S protein receptor binding domain derivative	Spike proteins	Kentucky Bioprocessing, Inc	Stage 1/2	[32, 33]
Live attenuated virus	COVI-VAC	Live attenuated strain	All proteins of the virus	Codagenix/Serum Institute of India (USA/India)	Phase 1	[32, 33]

2. CONCLUSION

The pandemic brought on by the SARS-CoV-2 infection was dubbed COVID-19 by the World Health Organization (WHO). There are numerous vaccines available that protect against the SARS-CoV-2 infection, although there are no widely available effective antiviral medications for COVID-19 caused by SARS-CoV-2. Remdesivir has simultaneously been approved by many nations as the first treatment for COVID-19. The requirement of a COVID-19 vaccination that is both safe and effective is widely acknowledged as essential in the containment of the pandemic. The difficulties and work required to quickly design, assess, and deliver something at scale are significant. So, all the available vaccines should be evaluated to know which are effective against the disease.

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