COVID-19 Vaccinations

Subjects: Infectious Diseases
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Vaccination, in general, is effective in protecting high-risk populations against severe COVID-19 infections and COVID-19-associated mortality. A summary of special population groups with regards to their features, prognosis of infection, and vaccination decision based on current evidence is listed in. Patients without contraindications should be prioritized for vaccination under the careful supervision of healthcare workers after balancing the benefits and risks of vaccinations.

COVID-19 vaccinations | pregnancy | frailty | comorbidities

1. Introduction

COVID-19 has been spreading globally since late 2019 [1]. There is no definitive cure to date. The consequences of being infected with COVID-19 can be multi-faceted, such as multisystem inflammatory syndrome in children, acute multi-organ failure in adults, and long COVID-19 syndrome in all recoverees [2][3][4][5]. Global vaccination programs and multiple preventive measures are the most effective ways to curb rapid transmission. The progress of clinical trials has been accelerating globally to test the protective efficacy of different vaccines [6]. However, there remains a great hesitancy to receive the vaccines due to various reasons, such as fear of the side effects of the vaccination, especially in subjects with underlying co-morbidities [7]. The hesitancy rate of vaccination was found to be 19% in the United States [8], 35% in Ireland, and 31% in the United Kingdom [9]. The major factor is the uncertainty of the safety and efficacy of vaccination in high-risk groups.

2. Focus of Attention: To Receive Vaccination or Not?

Thus, geriatric populations should consider their risk factors, risk of COVID-19-associated mortality, type of vaccination, and vaccination risks and benefits before making a vaccination decision. Counseling on individual risk profile should be done by healthcare workers if in doubt.

Transplant recipients have a higher risk of severe COVID-19 infections [10][11]; they are recommended to receive vaccinations, unless there are other contraindications. Their family members should also consider vaccination to prevent cross-infection between family members.

More recently, the American Diabetic Association and Centre for Disease Control and prevention advocated prioritizing vaccination to diabetic patients in order to minimize their infection risks [12][13].

In view of the uncertainty of the impact of COVID-19 vaccinations in pregnant women, there have been opposing opinions as to whether pregnant women should receive the vaccination. The American College of Obstetricians and Gynecologists (ACOG), American Society for Reproductive Medicine (ARSM), and the Society for Maternal–Fetal Medicine (SMFM) advocate vaccination in all pregnant and lactating women [14][15][16], while the World Health Organization (WHO) advocates vaccinations only in high-risk pregnant women such as medical care workers or those with co-morbidities that add to the risk of severe diseases [17].

3. Contraindications of Vaccination

Several contraindications have been listed by guidelines and pharmaceutical companies. Absolute contraindications are listed in **Table 1** . The United States Centre for Disease Control and Prevention recommends absolute contraindications in two scenarios [18]: History of a severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a component of the COVID-19 vaccine. Immediate allergic reaction of any severity to a previous dose or known (diagnosed) allergy to a component of the COVID-19 vaccine.

Table 1. Absolute contraindications of vaccinations.

Absolute Contraindications	Type of Vaccine	Recommended Actions
Severe allergic reaction, e.g., anaphylaxis	All [18]	1. Do not vaccinate 2. Referral to allergy immunologist 3. Consider other vaccine alternatives
Immediate allergic reaction	All [18]	1. Risk assessment 2. Referral to allergy immunologist 3. Prolong observation period after vaccination (e.g., 30 min)

The components of the COVID-19 vaccine are listed in **Table 2**.

Table 2. Components of 24 COVID-19 vaccines with emergency use authorizations by national regulatory authorities (as at 13 September 2021). The first 7 vaccines on the table have been approved for emergency or full use by at least one WHO-recognized stringent regulatory authority (Pfizer, Moderna, Janssen, Sinovac, Oxford–AstraZeneca, Serum Institute of India Covishield, Sinopharm-BBIBP). The remaining vaccine candidates were arranged in alphabetical order.

Type of Vaccine	Active Ingredient	Inactive Ingredients
Pfizer (mRNA) [19] The United States	Nucleoside-modified mRNA encoding the viral spike (S) glycoprotein of SARS-CoV-2	• 2-polyethylene glycol (PEG)-2000-N, N-ditetradecyclacetamide • cholesterol

Type of Vaccine	Active Ingredient	Inactive Ingredients
		• 1,2-distearoyl-sn-glycero-3-phosphocholine • (4-hydroxybutyl) azanediyl)bis(hexane-6,1-diyl)bis(2-hexyldecanoate) • sodium chloride • monobasic potassium phosphate • potassium chloride • dibasic sodium phosphate dihydrate • sucrose
Moderna (mRNA) [20] The United States	Nucleoside-modified mRNA encoding the viral spike (S) glycoprotein of SARS-CoV-2	• PEG2000-DMG: 1,2-dimyristoyl-rac-glycerol,methoxypolyethylene glycol • 1,2-distearoyl-sn-glycero-3-phosphocholine • cholesterol • SM102: heptadecane-9-yl 8-((2-hydroxyethyl) (6-oxo-6(undecyloxyl)hexyl)amino) octanoate • tromethamine • tromethamine hydrochloride • acetic acid • sodium acetate • sucrose

Type of Vaccine	Active Ingredient	Inactive Ingredients
Janssen (viral vector) [21] The United States	Recombinant, replication-incompetent Ad26 vector encoding a stabilized variant of the SARS-CoV-2 spike (S) protein	• polysorbate-80 • 2-hydroxypropyl-beta-cyclodextrin • citric acid monohydrate • trisodium citrate dihydrate • sodium chloride • ethanol
Sinovac/Coronavac (Vero cell) [22] China	Inactivated SARS-CoV-2 virus (CZ02 strain)	• aluminum hydroxide • disodium hydrogen dodecahydrate • sodium dihydrogen phosphate monohydrate • sodium chloride
Oxford–AstraZeneca Vaxzevria [23] The United Kingdom	Chimpanzee adenovirus encoding the SARS-CoV-2 Spike (S) protein ChAdOx1-S	• L-histidine • L-histidine hydrochloride monohydrate • magnesium chloride hexahydrate • polysorbate 80 (E 433) • sucrose • disodium edetate (dihydrate)
Serum Institute of India Covishield (Oxford–AstraZeneca formulation) [24][25] India	Recombinant, replication-deficient chimpanzee adenovirus vector encoding the SARS-CoV-2 Spike (S) protein in genetically modified	• L-histidine • L-histidine hydrochloride monohydrate • magnesium chloride hexahydrate

Type of Vaccine	Active Ingredient	Inactive Ingredients
	human embryonic kidney 293 cells	• polysorbate 80 (E 433) • sucrose • ethanol • sodium chloride • disodium edetate dihydrate (EDTA)
Sinopharm-BBIBP (inactivated virus in Vero cells) [26] China	Inactivated SARS-CoV-2 virus (HB02 strain) in Vero cell culture	• aluminum hydroxide adjuvant • beta-propiolactone • disodium hydrogen phosphate • sodium dihydrogen phosphate • sodium chloride
Sputnik V (viral vector) [27] Russia	Modified replication-deficient Ad26 and Ad5 encoding the SARS-CoV-2 spike(S) protein	• tris-(hydroxymethyl)-aminomethane • sodium chloride • sucrose • magnesium chloride hexahydrate • disodium EDTA dihydrate • polysorbate 80 • ethanol
Abdala [28][29][30] Cuba	Protein subunit vaccine containing COVID-19-derived proteins	No clinical results and information on ingredients found on electronic databases (PubMed, Google Scholar, Medline, Scopus, Embase)

Type of Vaccine	Active Ingredient	Inactive Ingredients
Chinese Academy of Medical Sciences Covidful [31][32] China	Inactivated virus vaccine	No clinical results and information on ingredients found on electronic databases (PubMed, Google Scholar, Medline, Scopus, Embase)
Cansino Convidecia [33][34] China	Recombinant replication-deficient adenovirustype 5-vectored vaccine expressing full-length spike gene based on Wuhan-Hu-1 (Genebank accession number YP_009724390)	Details of inactive components were not listed
Covaxin [35][36], India	Whole-virion inactivated SARS-CoV-2 antigen (strain: NIV-2020770)	• aluminum hydroxide • imidazoquinolinone • 2-phenoxyethonol • phosphate-buffered saline
COVIran Barakat [37][38] Iran	Inactivated SARS-CoV-2 virus with Vero cell culture	• aluminum hydroxide • modified egg's medium • fetal bovine serum
CoviVac [39][40] Russia	Inactivated SARS-CoV-2 virus (strain:AYDAR-1) with Vero cell culture	• beta-propiolactone • aluminum hydroxide • disodium phosphate dihydrate • sodium dihydrogen phosphate dihydrate • sodium chloride
EpiVacCorona [41][42] Russia	Chemically synthesized peptides (short fragments of viral spike protein) conjugating to a carrier protein containing	• L-histidine • aluminum hydroxide

Type of Vaccine	Active Ingredient	Inactive Ingredients
	nucleocapsid proteins and maltose-binding proteins	
FAKHRAVAC [43][44] Iran	Inactivated SARS-CoV-2 virus based with cell culture	Details of ingredients not published
Medigen [45][46][47] Taiwan	Recombinant S-2P spike protein adjuvanted with CpG 1018	• CpG 1018 • aluminum hydroxide • phosphate buffer solution
Minhai [48][49][50] China	Inactivated SARS-CoV-2 virus based with Vero cell culture	Details of ingredients not published
QazCovid-in [51][52] Kazakhstan	Inactivated SARS-CoV-2 virus based with cell culture	Details of ingredients not published
Sinopharm-WIBP [53][54][55] China	Inactivated SARS-CoV-2 virus (strain WIV-04) in Vero cell culture	• aluminum hydroxide • disodium hydrogen phosphate • sodium dihydrogen phosphate • sodium chloride
Soberana [56][57][58] Cuba	Receptor binding domain of SARS-CoV-2 spike protein conjugated chemically to tetanus toxoid	Details of ingredients not published
Sputnik light [59][60] Russia	Recombinant replication-deficient Ad26 encoding the SARS-CoV-2 spike(S) protein	• tris-(hydroxymethyl)-aminomethane • sodium chloride • sucrose • magnesium chloride hexahydrate • disodium EDTA dihydrate • polysorbate 80

Type of Vaccine	Active Ingredient	Inactive Ingredients
		• ethanol
Zifivax [61][62] China	Recombinant tandem repeat dimeric receptor-binding domain-based protein subunit vaccine	• aluminum hydroxide Details of ingredients not published
ZyCoV-D [63][64] (DNA plasmid vactor) India	DNA plasmid vector carrying the gene encoding the spike protein (S) of the SARS-CoV-2 virus	Details of ingredients not published

Patients with absolute contraindications should reassess their risk of vaccination and refer to an allergy immunologist. A longer observation period (e.g., 30 min) after vaccination is recommended if they have an immediate allergic reaction or minor contraindications [18]. They may also choose to receive alternative COVID-19 vaccination from other brands without their allergic components. Currently, 24 COVID-19 vaccines have been granted emergency use authorizations by national regulatory authorities (as at 13 September 2021). The first seven vaccines listed in **Table 2** have been approved for emergency or full use by at least one WHO-recognized stringent regulatory authority (Pfizer, Moderna, Janssen, Sinovac, Oxford–AstraZeneca, Serum Institute of India Covishield, Sinopharm-BBIBP).

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