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Review on Covid- 19 (Coronavirus)

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ABSTRACT:

Enclosed viruses with nonsegmented, single-stranded, positive-sense RNA genomes are known as coronaviruses. Six coronaviruses have been found to infect humans and cause respiratory illnesses in addition to a range of commercially significant animals. Among these, the highly pathogenic coronaviruses that have caused regional and worldwide outbreaks are the severe acute respiratory syndrome coronavirus (SARS-CoV) and the Middle East respiratory syndrome coronavirus (MERS-CoV). The outer edge, or corona, of the enclosed envelope protein gives coronaviruses their unique appearance and name. Numerous diseases that affect both humans and animals are brought on by members of the Coronaviridae family. Replication of the RNA genome occurs, in a unique way, by creating a nested collection of viral mRNA molecules. Infection with the human coronavirus (HCoV) can result in mild to severe respiratory disorders. Over the past fifteen years, two very pathogenic zoonotic organisms have emerged. Even with the widespread vaccination campaigns, COVID-19 is still causing a growing number of confirmed cases and deaths. There have also been several documented variations. The lack of authorised anti-coronavirus medications has made treating and managing COVID-19 a global health concern.In these situations, drug repurposing is a useful technique to find potential medications that require fewer clinical trial cycles. Here, we provide an overview of the state of medication repurposing in COVID-19, including approaches based on bioactivity, network pharmacology, and virtual computer screening, all of which have the potential to be effective COVID-19 treatments.

INTRODUCTION:

End of 2019 saw the emergence of a new coronavirus in Wuhan, China, known as 2019-nCoV. By January 24, 2020, nine countries China, Thailand, Japan, South Korea, Singapore, Vietnam, Taiwan, Nepal, and the United States had at least 830 cases diagnosed.There were 26 deaths, most of which involved individuals with significant underlying medical conditions. A rising number of cases seem to have been the consequence of human-to-human transmission, despite the fact that many aspects surrounding the virus's emergence including its origin and mode of transmission among humans remain unknown. Considering the 2002 and 2012 outbreaks of the Middle East respiratory syndrome coronavirus (MERS-CoV) and severe acute respiratory syndrome coronavirus(SARS-CoV), 2019-CoV is the third coronavirus to infect humans in the last 20 years, an emergence that has alerted public health institutions worldwide. Following the identification of the causal agent, China acted swiftly to notify the World Health Organization (WHO) about the outbreak and to share sequence information with the global community. In response, WHO moved quickly to coordinate the development of diagnostics, provide current information on the outbreak, and issue guidelines for patient monitoring, specimen collection, and treatment. In an effort to identify 2019 CoV cases before the virus spreads further, a number of nations in the region, including the US, are checking travellers leaving Wuhan for fever. Reports from Korea, Japan, China, Thailand, and Thailand suggest that the 2019-CoV sickness is very mild as compared to SARS and MERS.Infecting birds, mammals, and people alike are the coronavirus family of viruses, according to the World Health Organization (WHO). These viruses have caused multiple global outbreaks, such as the Middle East respiratory syndrome (MERS) outbreak in South Korea in 2015 and the severe acute respiratory syndrome (SARS) pandemic of 2002–2003. Most recently, in December 2019, an outbreak in China caused by a new coronavirus (SARS-CoV-2, commonly known as COVID-19) raised alarm throughout the world. Certain coronaviruses can cause mild to severe respiratory illnesses, such as the common cold, while others have caused deadly epidemics

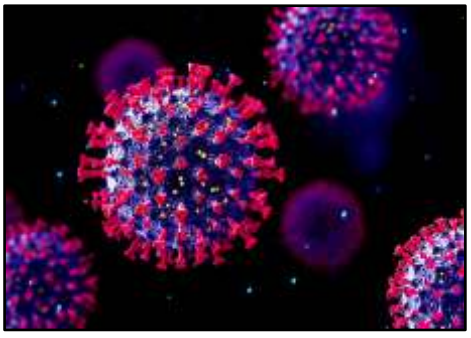


Fig:1

Coronaviruses can spread in the following ways:

Coughing and sneezing without covering the mouth can disperse droplets into the air. Touching or shaking hands with a person who has the virus can pass the virus between individuals. Making contact with a surface or object that has the virus and then touching the nose, eyes, or mouth. Some animal coronaviruses,such as feline coronavirus(FCoV), may spread through contact with faeces. However, it is unclear whether this also applies to human coronaviruses.The National Institutes of Health (NIH) suggest that several groups of people have the highest risk of developing complications due to COVID-19.

These groups include:

1. Young children

2. People aged 65 years or older

3. Women who are pregnant

Coronaviruses will infect most people at some time during their lifetime.Coronaviruses can mutate effectively, which makes them so contagious.To prevent transmission, people should stay at home and rest while symptoms are active. They should also avoid close contact with other people. Covering the mouth and nose with a tissue or handkerchief while coughing or sneezing can also help prevent transmission. It is important to dispose of any tissues after use and maintain hygiene around the home.

COVID-19:

In 2019 the Centers for Disease Control and Prevention (CDC) started monitoring the outbreak of a new coronavirus, SARS-CoV-2, which causes the respiratory illness now known as COVID-19. Authorities first identified the virus in Wuhan, China.More than 74,000 people have contracted the virus in China. Health authorities have identified many other people with COVID-19 around the world, including many in the United States. On January 31, 2020, the virus passed from one person to another in the U.S.The World Health Organization (WHO) declared a public health emergency relating to COVID-19.Since then, this strain has been diagnosed in several U.S. residents. The CDC has advised that it is likely to spread to more people. COVID-19 has started causing disruption in at least 25 other countries.The first people with COVID-19 had links to an animal and seafood market. This fact suggested that animals initially transmitted the virus to humans. However, people with a more recent diagnosis had no connections with or exposure to the market, confirming that humans can pass the virus to each other.Few children get COVID-19, although they are still investigating the reasons for this. However, while some viruses are highly contagious, it is less clear how rapidly coronaviruses will spread.Symptoms vary from person-to-person with COVID-19. It may produce few or no symptoms. However, it can also lead to severe illness and may be fatal. Few children get COVID-19, although they are still investigating the reasons for this. HoweverHowever, while some viruses are highly contagious, it is less clear how rapidly coronaviruses will spread.Symptoms vary from person-to-person with COVID-19. It may produce few or no symptoms. However, it can also lead to severe illness and may be fatal. On February 17, 2020, the Director-General of the WHO presented at a media briefing the following updates on how often the symptoms of COVID-19 are severe or fatal, using data from 44,000 people with a confirmed diagnosis.

Coronavirus life cycle steps:

1. Attachment and entry

2. Replicase protein expression

3. Replication and transcription

4. Assembly and release.

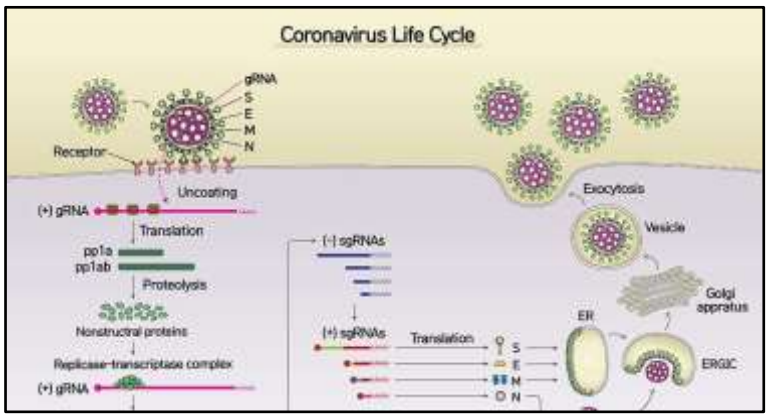


Fig:2

The life cycle of the virus with the host consists of the following 5 steps: attachment, penetration, biosynthesis, maturation and release. Once viruses bind to host receptors (attachment), they enter host cells through endocytosis or membrane fusion (penetration). Once viral contents are released inside the host cells, viral RNA enters the nucleus for replication. Viral mRNA is used to make viral proteins (biosynthesis). Then, new viral particles are made (maturation) and released. Coronaviruses consist of four structural proteins; Spike (S), membrane (M), envelope (E) and nucleocapsid (N) . Spike is composed of a transmembrane trimetric glycoprotein protruding from the viral surface, which determines the diversity of coronaviruses and host tropism. Spike comprises two functional subunits; S1 subunit is responsible for binding to the host cell receptor and S2 subunit is for the fusion of the viral and cellular membranes. Angiotensin converting enzyme 2 (ACE2) was identified as a functional receptor for SARS-CoV .

Structural and functional analysis showed that the spike for SARS-CoV-2 also bound to ACE2 . ACE2 expression was high in lung, heart, ileum, kidney and bladder. In the lung, ACE2 was highly expressed on lung epithelial cells. Whether or not SARS-CoV-2 binds to an additional target needs further investigation. Following the binding of SARS-CoV-2 to the host protein, the spike protein undergoes protease cleavage. A two-step sequential protease cleavage to activate spike protein of SARS-CoV and MERS-CoV was proposed as a model, consisting of cleavage at the S1/S2 cleavage site for priming and a cleavage for activation at the S′2 site, a position adjacent to a fusion peptide within the S2 subunit . After the cleavage at the S1/S2 cleavage site, S1 and S2 subunits remain non-covalently bound and the distal S1 subunit contributes to the stabilisation of the membrane-anchored S2 subunit at the prefusion state . Subsequent cleavage at the S′2 site presumably activates the spike for membrane fusion via irreversible, conformational changes.

The coronavirus spike is unusual among viruses because a range of different proteases can cleave and activate it. The characteristics unique to SARS-CoV-2 among coronaviruses is the existence of furin cleavage site (“RPPA” sequence) at the S1/S2 site. The S1/S2 site of SARS-CoV-2 was entirely subjected to cleavage during biosynthesis in a drastic contrast to SARS-CoV spike, which was incorporated into assembly without cleavage . Although the S1/S2 site was also subjected to cleavage by other proteases such as transmembrane protease serine 2 (TMPRSS2) and cathepsin L, the ubiquitous expression of furin likely makes this virus very pathogenic**.**

Epidemiology of COVID-19

In the beginning, an association with a seafood market selling live animals in Wuhan, where most of the earlier patients having pneu-monia had worked or visited, was recognized. However, as the epidemic disease grew, person-to-person transmission became the principal means of spread. COVID-19 infection is spread using large droplets produced during coughing and sneezing by symp-tomatic cases but may also happen from asymptomatic individuals before starting of their symptoms (9). These infected droplets can travel 1–2 metres and later put down on surfaces. Droplets nor-mally do not extend more than 2 metres and do not hang on in the air. The virus could stay viable on surfaces for days in desirable environmental conditions but are ruined in less than a minute by regular disinfectants, such as sodium hypochlorite and hydrogen peroxide (10). SARS-CoV-2 is obtained either by breathing of the droplets or touching surfaces tainted by them and then touching the nose, mouth and eyes. Cases may be contagious for as long as the symptoms continue and even after clinical improvement. Moreover, certain cases may behave as super-spreaders. As said by a joint WHO-China statement, the rate of secondary COVID-19 disease attacks varied from 1 to 5% among tens of thousands of close contacts of verified cases in China (11). In the USA, the symptomatic secondary attack rate was 0.45% among 445 close contacts of 10 verified cases (12). SARS-CoV-2 RNA has been demonstrated in sputum, blood and stool samples. However, faecal-oral, as well as materno-foetal vertical transmission, have not been identified as an important element in the spread of infectivity.

Pathophysiology of COVID-19:

Coronaviruses are large, enveloped, single-stranded RNA viruses found in humans and other mammals, such as dogs, cats, chicken,cattle, pigs, and birds. Coronaviruses cause respiratory, gastrointestinal, and neurological disease. The most common coronaviruses in clinical practice are which typically cause common cold symptoms in immunocompetent individuals. SARS-CoV-2 is the third coronavirus that has caused severe disease in humans to spread globally in the past decades. The First coronavirus that caused severe disease was severe acute respiratory syndrome (SARS), which was thought to originate inFoshan, China,and resulted in the pandemic.The second was the coronavirus-causedMiddle East respiratory syndrome (MERS),which originated from theArabian peninsula in 2012.Has a diameter of 60 nm to 140 nm and distinctive spikes, ranging from 9 nm to 12 nm, giving the virions the appearance of a solar corona.Through genetic recombination and variation, coronaviruses can adapt to and infect new hosts.

Symptoms COVID-19:

It may take 2–14 days for a person to notice symptoms after infection.

Fig:3

Scientists cannot easily cultivate human coronaviruses in the laboratory unlike the rhinovirus, which is another cause of the common cold. This makes it difficult to gauge the impact of the coronavirus on national economies and public health. They Are insecure, so treatments include self-care and over-the-counter (OTC) medication. People can take several steps, including:

1. Resting and avoiding overexertion

2. Drinking enough water

3. avoiding smoking and smoky areas

4. Taking acetaminophen, ibuprofen, naproxen for pain and fever

5. Using a clean humidifier or cool mist vaporizer

6. A doctor can diagnose the virus responsible by taking a sample of respiratory fluids, such as mucus from the nose, or blood.

7. Standard recommendations to prevent infection spread.Its include regular hand washing, covering mouth and nose when coughing and sneezing, thoroughly cooking meat and eggs. Avoid close contact with anyone showing symptoms of respiratory illness such as coughing and sneezing.

Diagnosis:

The differential diagnosis consists of all kinds of upper/lower airway viral infectious agents, such as adenovirus, rhinovirus, in-fluenza, parainfluenza, respiratory syncytial virus (RSV), human metapneumovirus, other coronaviruses and other well-known viral respiratory infections, atypical pathogens(chlamydia, mycoplasma) and bacterial microorganisms. In accordance with China National Health Commission, COVID-19 disease is identified on

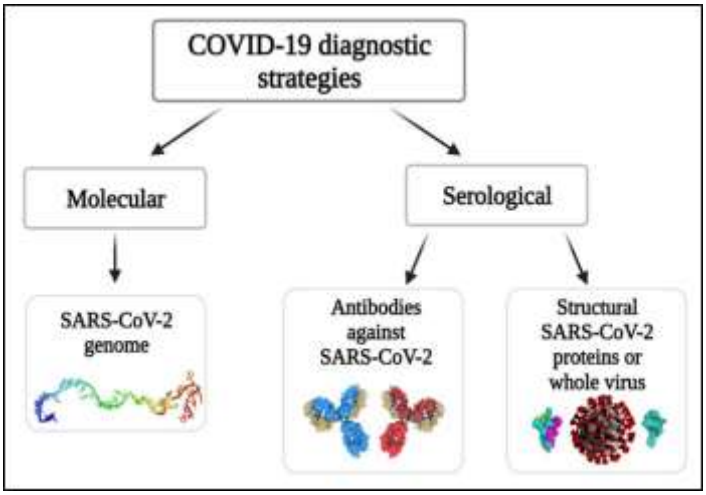


Fig:4

account of the epidemiological history and clinical manifestations, along with verified SARS-CoV-2 infection via one of the subsequent methods: real-time reverse transcrip-tase-polymerase chain reaction (RT-PCR) assay, high-throughput genome sequencing, and serological evaluation of antiviral im-munoglobulin antibodies.

Diagnostic Tests:

PCR test: This test for the presence of the actual virus's genetic material or its fragments as it breaks down. This is the most reliable and accurate test for detecting active infection.

ANTIBODY(serology) test: This test detects if you have an immune response(antibodies) to the virus. This means that the virus and your body have mounted an attack to fight it. The test is detecting those antibodies. This test should not be used to diagnose an active infection.

ORGAN DAMAGE CAUSED BY COVID-19:

Even though COVID-19 is a disease that predominantly affects the lungs, it can also harm other body organs, such as the kidneys, brain and heart. Organ damage may result in long-term health problems post-COVID. Long-term breathing problems, heart complications, chronic kidney damage, stroke, and Guillain-Barre syndrome – a condition that causes temporary paralysis — are all possible long-term health impacts in some people.

Post COVID-19, some adults and children develop the multisystem inflammatory syndrome. Some organs and tissues become significantly inflamed in this situation.

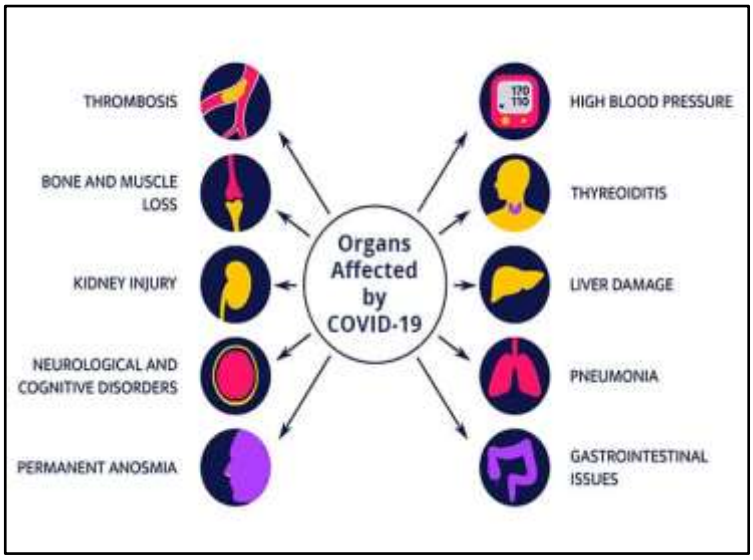


Fig:5

Clinical management of COVID-19:

WHO develops most up-to-date technical guidance for clinical management of COVID-19 patients, including optimised supportive care interventions and therapeutics based on ongoing "living" assessment of new evidence generated by the global community. This work is supported by the Guidelines Development Group. Hosts the Global COVID-19 Clinical Data Platform for clinical characterization and management of hospitalised patients with suspected or confirmed COVID-19. Develops COVID-19 Clinical Management training resources for health workers based on the most up-to-date clinical guidance for online or download hosted on the WHO Academy and OpenWHOplatforms.Hosts the global COVID-19 Clinical Management web series for health workers, health researchers and health policy makers. Convenes the Clinical Characterization and Management Research Working Group, to advance clinical research. Convenes the Global Clinical Management Network, bringing together front-line clinicians from all over the world, to share expertise and experience in a peer-to-peer knowledge exchange forum. Produces tools for Member States to support operational decision making, medical supply forecasting and access for essential medicines and supplies to manage COVID-19 inventory.

Fig:6

Transmission:

The initial cases were presumably linked to direct exposure to infected animals (animal-to-human transmission) at a seafood market in Wuhan, China. However, clinical cases with diversity in exposure history have emerged. This helps further elaborate that human-to-human transmission of the virus is also possible. Therefore, human-to-human transmission is now considered the main form of transmission. Individuals who remain asymptomatic could also transmit the virus . However, the most common source of infection is symptomatic people. Transmission occurs from the spread of respiratory droplets through coughing or sneezing. Data also suggest that close contact between individuals can also result in transmission. This also indicates possible transmission in closed spaces due to elevated aerosol concentrations.

SARS-CoV-2 has a basic reproduction number of 2.2. This suggests that a patient can transmit the infection to two other individuals. Current data suggest that the virus has an incubation period of three to seven days. These findings are based on initial cases. Therefore, further studies are needed to address transmission dynamics and incubation times.

Management:

Isolation remains the most effective measure for containment of COVID-19. No specific antiviral medication or vaccine is currently available. Therefore, the treatment of COVID-19 includes symptomatic care and oxygen therapy. Patients with mild infections require early supportive management. This can be achieved with the use of acetaminophen, external cooling, oxygen therapy, nutritional supplements, and anti-bacterial therapy. Critically ill patients require high flow oxygen, extracorporeal membrane oxygenation (ECMO), glucocorticoid therapy, and convalescent plasma. The administration of systemic corticosteroids is not recommended to treat ARDS. Moreover, unnecessary administration of antibiotics should also be avoided. ECMO should

be considered in patients with refractory hypoxemia despite undergoing protective ventilation . Patients with respiratory failure may require intubation, mechanical ventilation, high-flow nasal oxygen, or non-invasive ventilation . Treatment of septic shock requires hemodynamic support with the administration of vasopressors. Organ function support is necessary for patients with multiple organ dysfunction.

Therapeutically, aerosol administration of alpha-interferon (5 million units twice daily), chloroquine phosphate, and lopinavir/ritonavir have been suggested. Other suggested antivirals include ribavirin and . The use of three or more antiviral drugs simultaneously is not recommended. Ongoing clinical studies suggest that remade (GS5734) can be used for prophylaxis and therapy. Furthermore, a fusion inhibitor targeting the HR1 domain of spike protein is reported to have the potential to treat COVID-19.

Prevention:

Preventive measures must focus on optimising infection control protocols, self-isolation, and patient isolation during the provision of clinical care. The WHO has advised against close contact with patients, farm animals, and wild animals . Patients and the general public must cover coughs and sneezes to help prevent aerosol transmission. Frequent handwashing with soap and water is also required. As an alternative measure, hand sanitizers can also be used. Immunocompromised individuals are advised to avoid public gatherings. Emergency medicine departments must apply strict hygiene measures for the control of infections. Healthcare personnel must use personal protective equipment such as N95 masks, FFP3 masks, gowns, eye protection, gloves, and gowns.

Fig:7

Treatment and medications:

Some people treated with Paxlovid can test positive two to eight days after initial recovery, and a return of COVID-19 symptoms is possible. If that happens, the CDC recommends that patients re-isolate for at least five days, until fever has resolved for 24 hours (without the use of fever-reducing medication) and symptoms are improving. Patients should wear a mask for 10 days after rebound symptoms start.

Treatment for COVID-19 depends on the severity of the infection and risk factors affecting individuals. For milder illness, resting at home and taking medicine to reduce fever is often sufficient. A doctor may prescribe antiviral pills if a patient is at high risk of severe infection or has other indications for this therapy. More severe cases may require hospitalisation.

Coronavirus Treatment:

Treatment at home:-

- Rest- It can make you feel better and may speed your recovery.
- Drink fluids: Dehydration can make symptoms worse and cause other health problems.
- Monitor: If your symptoms get worse call your doctor right away. Don't go to their office without calling first.

Treatment in hospital:

- Check the levels of oxygen in your blood with a clip on your finger monitor.
- Give you covid -19test. This involves putting a 6-inch cotton swab up both sides of your nose for about 15 seconds.
- Give you a chest x-ray of CT scan.

Antiviral Medication:

Antiviral medications are available to treat several viral infections, such as influenza. Antiviral drugs generally don't kill a virus but instead limit the production of new viruses inside host cells. Effective antiviral treatments can shorten the duration of the illness and lessen complications for some people.

COVID-19 pills and ritonavir:

Two pills, taken by mouth, can treat COVID-19 in some people. One pill, ritonavir, is produced by Merck. The other, Paxlovid (and ritonavir tablets, co-packaged for oral use), is made by Pfizer. Both medications were granted an emergency use authorization (EUA) by the U.S. Food and Drug Administration (FDA) in December 2021.

According to FDA criteria, people who can get Pax Lovid are those who meet all of these criteria: Have tested positive for COVID-19Are at least 12 years oldWeigh at least 88 lbs Have certain health conditions, such as cancers, diabetes, obesity or others associated with more severe cases of COVID-19. To be eligible for these pills, people must be at high risk for progression to severe COVID-19, including hospitalisation or death. Paxlovid is available by prescription only and should be started as soon as possible after diagnosis of COVID-19 — no later than five days after symptoms began.If you are prescribed Paxlovid for treatment of COVID-19, be sure to tell all of your doctors and care team members about other medicines you are taking and ask about drug interactions with Paxlovid. Some medicines, including certain blood thinners and immunosuppressants, are not safe to take with Paxlovid. Your usual medications or doses may need to be temporarily adjusted.

Remedesivir:

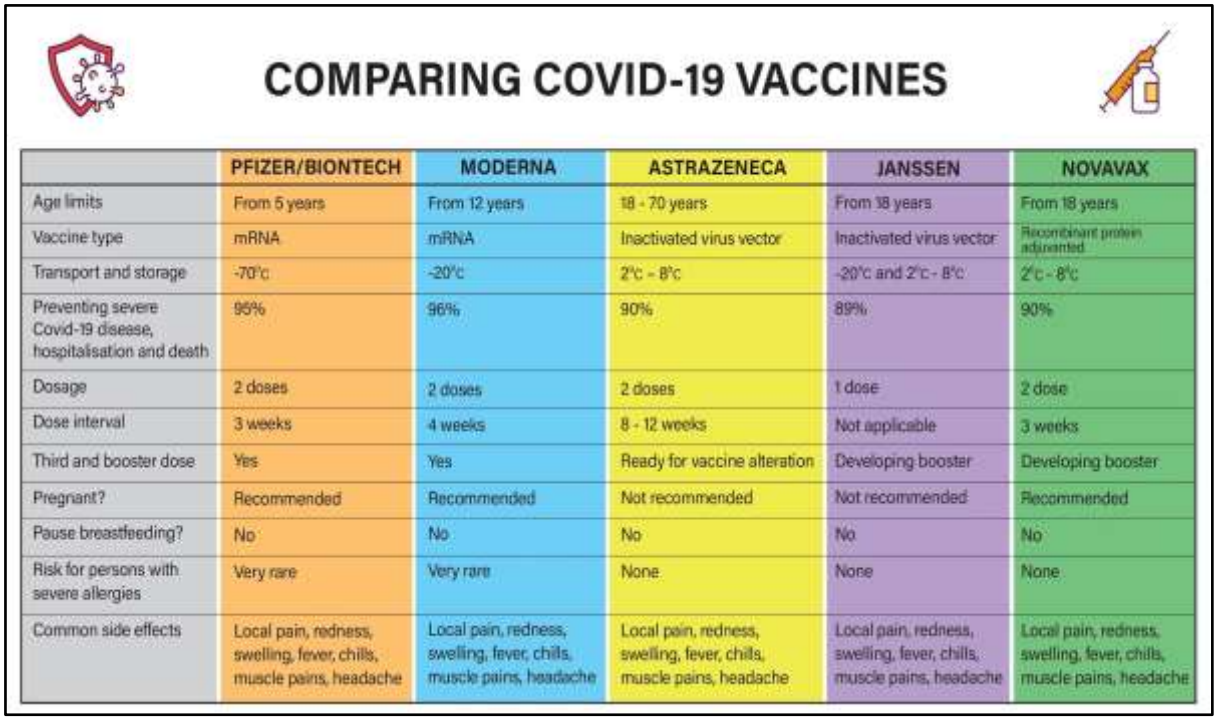
The antiviral drug remdesivir was developed to treat people infected with the Ebola and hepatitis C viruses. On Oct. 22, 2020, the FDA approved the drug for treatment of hospitalised adult and paediatric patients with suspected or laboratory-confirmed COVID-19, whether the illness is mild or severe. The drug is an intravenous medication with a course of treatment lasting five to 10 days.Remedesivir is an antiviral drug from the family of nucleoside analogues developed by the Gilead Pharmaceutical Company to treat Ebola virus and Marburg virus infections. Due to its antiviral properties, it has also been used against other single-stranded RNA viruses such as respiratory syncytial virus, blood virus, lasagna virus, NIPAH virus, Hendra virus and coronavirus family (including coronavirus Mers and SARS) . This drug has been successful in the treatment of Covid-19 in many cases and is also being studied. It is an adenosine analogue that interferes with the function of the RNA-dependent RNA polymerase enzyme and prevents the virus from being sampled and genetically modified by the enzyme exoribonuclease (ExoN), thus reducing virus production and replication. It is not known whether this drug terminates the RNA chain or causes a mutation in it . But like any other drug that AE has, it has been reported for Remdesivir AEs, and some AEs are associated with its use. The most common side effects in Remdesivir studies for COVID-19 include respiratory failure and organ dysfunction, including low albumin, low potassium, low red blood cell count, low platelet count, which helps clots, and yellow skin discoloration . Reported side effects include gastrointestinal upset, increased levels of transaminases in the blood (liver enzymes), and injection site reaction . Other possible side effects have been reported with remdesivir due to its injection reactions; During or around the time of remdesivir injection, it has been observed that the signs and symptoms of injection-related reactions may include: low blood pressure, nausea, vomiting, sweating and chills. Elevated levels of liver enzymes, seen in abnormal liver blood tests. Elevated levels of liver enzymes have been observed in people receiving remdesivir, which may be a sign of inflammation or damage to liver cells .

Monoclonal Antibodies:

Manufactured in a laboratory, monoclonal antibodies are proteins that in some cases, can help your body fight infectious disease. Monoclonal antibody treatment is given by infusing the material into the bloodstream.In January 2022, the CDC discontinued treatment with some types of monoclonal antibodies because those therapies did not work on the recent coronavirus variants(mutated viruses).Current recommendations issued by the National Institutes of Health say that a monoclonal antibody called bebelove man can be given to patients age 12 and older, only when Paxlovid and remdesivir are not available or not clinically appropriate for the patient.

Immunomodulators:

In June 2021, the FDA granted an EUA for tocilizumab for treatment of adults and children hospitalised with severe COVID-19. This biologic agent can reduce inflammation and is FDA approved to treat autoimmune illnesses such as rheumatoid arthritis. It is given by medical practitioners as an injection or infusion.Another medication, baricitinib, is being studied to determine if it can benefit people with COVID-19 in a similar way.



COMPARING COVID-19 VACCINES

	PFIZER/BIONTECH	MODERNA	ASTRAZENECA	JANSSEN	NOVAVAX
Age limits	From 5 years	From 12 years	18 - 70 years	From 18 years	From 18 years
Vaccine type	mRNA	mRNA	Inactivated virus vector	Inactivated virus vector	Recombinant protein adjuvanted
Transport and storage	-70°c	-20°c	2°c - 8°c	-20°c and 2°c - 8°c	2°c - 8°c
Preventing severe Covid-19 disease, hospitalisation and death	95%	96%	90%	89%	90%
Dosage	2 doses	2 doses	2 doses	1 dose	2 dose
Dose interval	3 weeks	4 weeks	8 - 12 weeks	Not applicable	3 weeks
Third and booster dose	Yes	Yes	Ready for vaccine alteration	Developing booster	Developing booster
Pregnant?	Recommended	Recommended	Not recommended	Not recommended	Recommended
Pause breastfeeding?	No	No	No	No	No
Risk for persons with severe allergies	Very rare	Very rare	None	None	None
Common side effects	Local pain, redness, swelling, fever, chills, muscle pains, headache	Local pain, redness, swelling, fever, chills, muscle pains, headache	Local pain, redness, swelling, fever, chills, muscle pains, headache	Local pain, redness, swelling, fever, chills, muscle pains, headache	Local pain, redness, swelling, fever, chills, muscle pains, headache

Fig:8

Common side effects of medicines:

people should stop taking Paxlovid and call a health care provider right away if they experience any of the following signs of an allergic reaction:

1.Hives.

2.Trouble swallowing or breathing.

3.Swelling of the mouth, lips, or face.

4.Throat tightness.

5.Hoarseness.

6.Skin rash.

7.Back Pain

8.Chest tightness

9.Headache

10.Nausea and Vomiting

11.Yellow eyes or skin

12.Tiredness or weakness

CONCLUSION:

Many years ago the emergence of many different coronaviruses that cause a wide variety of human and veterinary diseases occurred. It is likely that these viruses will continue to emerge and to evolve and cause both human and veterinary outbreaks owing to their ability to recombine, mutate, and infect multiple species and cell types.

Future research on coronaviruses will continue to investigate many aspects of viral replication and pathogenesis.Here, we summarise several commonly used techniques for drug repurposing and discuss the main contributions of each. First,through virtual screening in multiple databases, repurposing approaches have predicted a variety of drugs acting on key SARS-CoV-2 protein targets. Second,network pharmacology has been used to identify and screen various candidate drugs for COVID-19, such as mercaptopurine and sirolimus. Finally, through experimental verification of drugs with multiple activities, such as improving respiratory symptoms, antiviral activity, and immunomodulatory activity, activity-based drug repurposing has found a series of drugs with therapeutic effects onCOVID-19, such as LH and kaletra. Among them, in repurposing approaches are likely to be more effective and

quicker to work in COVID-19 treatment.Although a vast number of coronavirus-based or host-based trials for drugs with in vivo or in vitro activities against SARS-CoV-2 have been carried out, only a few of these drugs can be applied in clinical practice. Drug repurposing provides a personal reference basis for rapid and efficient drug discovery for COVID-19treatment. However, as the accuracy of results in drug repurposing is related to the sufficient degree of data mastered by researchers,the application of this method in practice is limited to a certain extent. Further clinical trials of the screened drugs still have the possibility of limited efficacy and potential side effects. Developing more accurate and efficient drug repurposing technologies could potentially reduce the risk of and increase the effectiveness of drug repurposing, thus better finding effective drugs against new infectious disease.

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