**AETIOLOGY OF COVID-19; IT’S PATHOGENESIS, HISTOPATHOLOGICAL FEATURES, CURRENT POTENTIAL THERAPIES TO ADDRESS IT AND ITS FUTURE ON PUBLIC HEALTH.**

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**INTRODUCTION TO HISTOPATHOLOGY.**

**(ANA.404)**

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**INTRODUCTION**

Coronavirus disease (COVID-19) is caused by SARS-COV2 and represents the causative agent of a potentially fatal disease that is of great global public health concern. Based on the large number of infected people that were exposed to the wet animal market in Wuhan City, China, it is suggested that this is likely the zoonotic origin of COVID-19. Person-to-person transmission of COVID-19 infection led to the isolation of patients that were subsequently administered a variety of treatments. Extensive measures to reduce person-to-person transmission of COVID-19 have been implemented to control the current outbreak. Special attention and efforts to protect or reduce transmission should be applied in susceptible populations including children, health care providers, and elderly people. In this review, we highlight the symptoms, epidemiology, transmission, pathogenesis, phylogenetic analysis and future directions to control the spread of this fatal disease.

Coronavirus is one of the major pathogens that primarily targets the human respiratory system. Previous outbreaks of coronaviruses (CoVs) include the severe acute respiratory syndrome (SARS)-CoV and the Middle East respiratory syndrome (MERS)-CoV which have been previously characterized as agents that are a great public health threat. In late December 2019, a cluster of patients was admitted to hospitals with an initial diagnosis of pneumonia of an unknown etiology. These patients were epidemiologically linked to a seafood and wet animal wholesale market in Wuhan, Hubei Province, China. Early reports predicted the onset of a potential Coronavirus outbreak given the estimate of a reproduction number for the 2019 Novel (New) Coronavirus (COVID-19, named by WHO on Feb 11, 2020) which was deemed to be significantly larger than 1 (ranges from 2.24 to 3.58).

The chronology of COVID-19 infections is as follows. The first cases were reported in December 2019 [4]. From December 18, 2019 through December 29, 2019, five patients were hospitalized with acute respiratory distress syndrome and one of these patients died. By January 2, 2020, 41 admitted hospital patients had been identified as having laboratory-confirmed COVID-19 infection, less than half of these patients had underlying diseases, including diabetes, hypertension, and cardiovascular disease. These patients were presumed to be infected in that hospital, likely due to nosocomial infection. It was concluded that the COVID-19 is not a super-hot spreading virus (spread by one patient to many others), but rather likely spread due to many patients getting infected at various locations throughout the hospital through unknown mechanisms. In addition, only patients that got clinically sick were tested, thus there were likely many more patients that were presumably infected. As of January 22, 2020, a total of 571 cases of the 2019-new coronavirus (COVID-19) were reported in 25 provinces (districts and cities) in China. The China National Health Commission reported the details of the first 17 deaths up to January 22, 2020. On January 25, 2020, a total of 1975 cases were confirmed to be infected with the COVID-19 in mainland China with a total of 56 deaths. Another report on January 24, 2020 estimated the cumulative incidence in China to be 5502 cases. As of January 30, 2020, 7734 cases have been confirmed in China and 90 other cases have also been reported from a number of countries that include Taiwan, Thailand, Vietnam, Malaysia, Nepal, Sri Lanka, Cambodia, Japan, Singapore, Republic of Korea, United Arab Emirates, United States, The Philippines, India, Australia, Canada, Finland, France, and Germany. The case fatality rate was calculated to be 2.2% (170/7824). The first case of COVID-19 infection confirmed in the United States led to the description, identification, diagnosis, clinical course, and management of this case. This includes the patient's initial mild symptoms at presentation and progression to pneumonia on day 9 of illness. Further, the first case of human-to-human transmission of COVID-19 was reported in the US on January 30, 2020 (https://www.cdc.gov/media/releases/2020/p0130). The CDC has so far screened >30,000 passengers arriving at US airports for the novel coronavirus. Following such initial screening, 443 individuals have been tested for coronavirus infection in 41 states in the USA. Only 15 (3.1%) were tested positive, 347 were negative and results on the remaining 81 are pending (https://www.cdc.gov/coronavirus/2019-ncov). A report published in Nature revealed that Chinese health authorities concluded that as of February 7, 2019, there have been 31,161 people who have contracted the infection in China, and more than 630 people have died (http://www.nature.com/articles/d41586-020-00154) of infection. At the time of preparing this manuscript, the World Health Organisation (WHO) reported 51,174 confirmed cases including 15, 384 severe cases and 1666 death cases in China. Globally, the number of confirmed cases as of this writing (February 16, 2020) has reached 51,857 in 25 countries (https://www.who.int/docs/default-source/coronaviruse/situation-reports)

***Symptoms***

The symptoms of COVID-19 infection appear after an incubation period of approximately 5.2 days. The period from the onset of COVID-19 symptoms to death ranged from 6 to 41 days with a median of 14 days. This period is dependent on the age of the patient and status of the patient's immune system. It was shorter among patients >70-years old compared with those under the age of 70. The most common symptoms at onset of COVID-19 illness are fever, cough, and fatigue, while other symptoms include sputum production, headache, haemoptysis, diarrhoea, dyspnoea, and lymphopenia. Clinical features revealed by a chest CT scan presented as pneumonia, however, there were abnormal features such as RNAaemia, acute respiratory distress syndrome, acute cardiac injury, and incidence of grand-glass opacities that led to death. In some cases, the multiple peripheral ground-glass opacities were observed in subpleural regions of both lungs that likely induced both systemic and localized immune response that led to increased inflammation. Regrettably, treatment of some cases with interferon inhalation showed no clinical effect and instead appeared to worsen the condition by progressing pulmonary opacities.

**AETIOLOGY OF COVID-19**

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a previously unknown betacoronavirus that was discovered in bronchoalveolar lavage samples taken from clusters of patients who presented with pneumonia of unknown cause in Wuhan City, Hubei Province, China, in December 2019. Coronaviruses are a large family of enveloped RNA viruses, some of which cause illness in people (e.g., common cold, severe acute respiratory syndrome [SARS], Middle East respiratory syndrome [MERS]), and others that circulate among mammals and birds. Rarely, animal coronaviruses can spread to humans and subsequently spread between people, as was the case with SARS and MERS.

SARS-CoV-2 belongs to the Sarbecovirus subgenus of the Coronaviridae family and is the seventh coronavirus known to infect humans. The virus has been found to be similar to SARS-like coronaviruses from bats, but it is distinct from SARS-CoV and MERS-CoV. The full genome has been determined and published in GenBank. GenBank external link opens in a new window

• A preliminary study suggests that there are two major types (or strains) of the SARS-CoV-2 virus in China, designated L and S. The L type was found to be more prevalent during the early stages of the outbreak in Wuhan City and may be more aggressive (although this is speculative), but its frequency decreased after early January. The relevance of this finding is unknown at this stage and further research is required.

***Origin of virus***

Majority of patients in the initial stages of this outbreak reported a link to the Huanan South China Seafood Market, a live animal or ‘wet’ market, suggesting a zoonotic origin of the virus. While the potential animal reservoir and intermediary host(s) are unknown at this point, studies suggest they may derive from a recombinant virus between the bat coronavirus and an origin-unknown coronavirus; however, this is yet to be confirmed. Pangolins have been suggested as an intermediate host as they have been found to be a natural reservoir of SARS-CoV-2-like coronaviruses.

***Transmission***

Based on the large number of infected people that were exposed to the wet animal market in Wuhan City where live animals are routinely sold, it is suggested that this is the likely zoonotic origin of the COVID-19. Efforts have been made to search for a reservoir host or intermediate carriers from which the infection may have spread to humans. Initial reports identified two species of snakes that could be a possible reservoir of the COVID-19. However, to date, there has been no consistent evidence of coronavirus reservoirs other than mammals and birds. Genomic sequence analysis of COVID-19 showed 88% identity with two bat-derived severe acute respiratory syndrome (SARS)-like coronaviruses, indicating that mammals are the most likely link between COVID-19 and humans. Several reports have suggested that person-to-person transmission is a likely route for spreading COVID-19 infection. This is supported by cases that occurred within families and among people who did not visit the wet animal market in Wuhan. Person-to-person transmission occurs primarily via direct contact or through droplets spread by coughing or sneezing from an infected individual. In a small study conducted on women in their third trimester who were confirmed to be infected with the coronavirus, there was no evidence that there is transmission from mother to child. However, all pregnant mothers underwent cesarean sections, so it remains unclear whether transmission can occur during vaginal birth. This is important because pregnant mothers are relatively more susceptible to infection by respiratory pathogens and severe pneumonia (https://www.thelancet.com, DOI:https://doi.org/10.1016/S0140-6736(20)30360-3).

The binding of a receptor expressed by host cells is the first step of viral infection followed by fusion with the cell membrane. It is reasoned that the lung epithelial cells are the primary target of the virus. Thus, it has been reported that human-to-human transmissions of SARS-CoV occurs by the binding between the receptor-binding domain of virus spikes and the cellular receptor which has been identified as angiotensin-converting enzyme 2 (ACE2) receptor. Importantly, the sequence of the receptor-binding domain of COVID-19 spikes is similar to that of SARS-CoV. This data strongly suggests that entry into the host cells is most likely via the ACE2 receptor. Person-to-person spread has been confirmed in community and healthcare settings, with local transmission now occurring in many countries around the world. An initial assessment of the transmission dynamics in the first 425 confirmed cases found that 55% of cases before 1 January 2020 were linked to the Huanan South China Seafood Market, whereas only 8.6% of cases after this date were linked to the market. This confirms that person-to-person spread occurred among close contacts since the middle of December 2019, including infections in healthcare workers.It is uncertain how easily the virus spreads between people, but transmission in chains involving several links is increasingly recognised. Available evidence indicates that human transmission occurs via close contact with respiratory droplets produced when a person exhales, sneezes, or coughs; via direct contact with infected people; or via contact with fomites. Airborne transmission has not been reported; however, it may be possible during aerosol-generating procedures performed in clinical care.

The virus has been found to be more stable on plastic and stainless steel (up to 72 hours) compared with copper (up to 4 hours) and cardboard (up to 24 hours). This study also found that the virus was viable in aerosol particles for up to 3 hours; however, aerosols were generated using high-powered apparatus that do not reflect normal human cough conditions or a clinical setting where aerosol-generating procedures are performed. The World Health Organization has confirmed that there have been no reports of airborne transmission. In healthcare settings, the virus is widely distributed in the air and on object surfaces (e.g., floors, rubbish bins, sickbed handrails, and computer mice) in both general wards and intensive care units, with a greater risk of contamination in the intensive care unit.

The contribution to transmission by the presence of the virus in other body fluids is unknown; however, the virus has been detected in blood, cerebrospinal fluid, saliva, tears, and conjunctival secretions. Faecal-oral transmission may be possible (virus has been detected in the stool samples of almost half of the patients in one meta-analysis), although it has not been reported yet.

Nosocomial transmission in healthcare workers and patients has been reported in 41% of patients in one case series. The majority of healthcare workers with COVID-19 reported contact in the healthcare setting. In a study of over 9000 cases reported in healthcare workers in the US, 55% had contact only in a healthcare setting, 27% only in a household, 13% only in the community, and 5% in more than one setting.

Widespread transmission has been reported in long-term care facilities and on cruise ships (19% of 3700 passengers and crew were infected aboard the Diamond Princess). Clusters of cases originating from family gatherings have been reported, emphasising the importance of social distancing even within families. The rate of secondary transmission among household contacts of infected patients is approximately 30%.

**Presymptomatic transmission**

A small number of studies suggest that some people can be contagious during the incubation period, the time between exposure to the virus and the onset of symptoms. The incubation period is estimated to be between 1 and 14 days, with a median of 5 to 7 days (possibly longer in children). Approximately 97.5% of patients develop symptoms within 11.5 days of infection. Presymptomatic transmission has been reported in 12.6% of cases in China. A study in Singapore identified 6.4% of patients among seven clusters of cases in which presymptomatic transmission was likely to have occurred 1 to 3 days before symptom onset. Presymptomatic transmission still requires the virus to be spread by infectious droplets or contact with fomites.

**Asymptomatic transmission**

An asymptomatic case is a laboratory-confirmed case who does not develop symptoms. There is some evidence that spread from asymptomatic carriers is possible, although it is thought that transmission is greatest when people are symptomatic (especially around the time of symptom onset). Estimating the prevalence of asymptomatic cases in the population is difficult. The best evidence so far comes from the Diamond Princess cruise ship, which was quarantined with all passengers and crew members repeatedly tested and closely monitored. A modelling study found that approximately 700 people with confirmed infection (18%) were asymptomatic. However, a Japanese study of citizens evacuated from Wuhan City estimates the rate to be closer to 31%. Data from a long-term care facility in the US found that 30% of patients with positive test results were asymptomatic (or presymptomatic) on the day of testing. Early data from an isolated village of 3000 people in Italy estimates the figure to be higher at 50% to 75%. Other studies ranged from 4% to 80%.

A study in a New York obstetric population found that 88% of women who tested positive for SARS-CoV-2 at admission were asymptomatic at presentation. The proportion of asymptomatic cases in children is thought to be significant, and children may play a role in communist spread.

**Perinatal transmission.**

It is unknown whether perinatal transmission (including transmission via breastfeeding) is possible. Retrospective reviews of pregnant women with COVID-19 found that there is no evidence for intrauterine infection in women with COVID-19. However, vertical transmission cannot be ruled out. There have been case reports of infection in neonates born to mothers with COVID-19, and virus-specific antibodies have also been detected in neonatal serum samples.

**PATHOGENESIS**

The severe symptoms of COVID-19 are associated with an increasing numbers and rate of fatalities specially in the epidemic region of China. On January 22, 2020, the China National Health Commission reported the details of the first 17 deaths and on January 25, 2020 the death cases increased to 56 deaths. The percentage of death among the reported 2684 cases of COVID-19 was approximately 2.84% as of Jan 25, 2020 and the median age of the deaths was 75 (range 48–89) years. Patients infected with COVID-19 showed higher leukocyte numbers, abnormal respiratory findings, and increased levels of plasma pro-inflammatory cytokines. One of the COVID-19 case reports showed a patient at 5 days of fever presented with a cough, coarse breathing sounds of both lungs, and a body temperature of 39.0 °C. The patient's sputum showed positive real-time polymerase chain reaction results that confirmed COVID-19 infection. The laboratory studies showed leucopenia with leukocyte counts of 2.91 × 10^9 cells/L of which 70.0% were neutrophils. Additionally, a value of 16.16 mg/L of blood C-reactive protein was noted which is above the normal range (0–10 mg/L). High erythrocyte sedimentation rate and D-dimer were also observed [14]. The main pathogenesis of COVID-19 infection as a respiratory system targeting virus was severe pneumonia, RNAaemia, combined with the incidence of ground-glass opacities, and acute cardiac injury [6]. Significantly high blood levels of cytokines and chemokines were noted in patients with COVID-19 infection that included IL1-β, IL1RA, IL7, IL8, IL9, IL10, basic FGF2, GCSF, GMCSF, IFNγ, IP10, MCP1, MIP1α, MIP1β, PDGFB, TNFα, and VEGFA. Some of the severe cases that were admitted to the intensive care unit showed high levels of pro-inflammatory cytokines including IL2, IL7, IL10, GCSF, IP10, MCP1, MIP1α, and TNFα that are reasoned to promote disease severity.

Signs and symptoms of COVID-19 may appear two to 14 days after exposure and can include:

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• Fever

• Cough

• Shortness of breath or difficulty breathing

• Other symptoms can include:

• Tiredness

• Aches

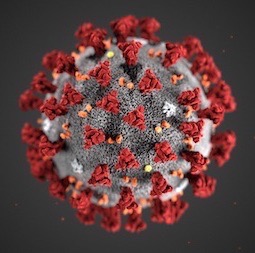
• Runny nose

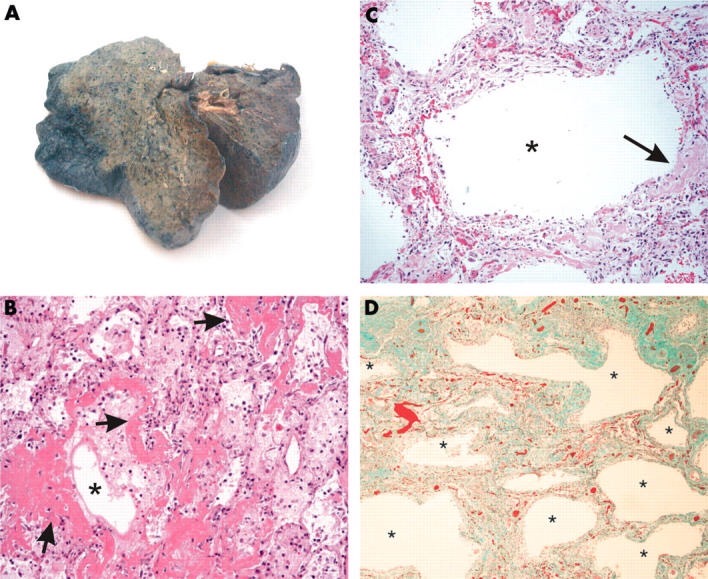
• Sore throat

• Some people have experienced the loss of smell or taste.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have no symptoms at all. People who are older or who have existing chronic medical conditions, such as heart disease, lung disease or diabetes, or who have compromised immune systems may be at higher risk of serious illness. This is similar to what is seen with other respiratory illnesses, such as influenza.

**HISTOPATHOLOGICAL FEATURES**

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(A) Extensive consolidation with a greyish cut surface was noted in most of the patients. (B) All the patients showed features of the acute phase of diffuse alveolar damage, with pulmonary oedema and formation of a hyaline membrane. The airspaces are indicated by asterisks and some of the hyaline membranes lining the alveolar spaces are highlighted by arrows (haematoxylin and eosin stain; original magnification, ×100). (C) Mild infiltrate of interstitial inflammatory cells with interstitial thickening, accompanied by dilated airspaces (the asterisk indicates the dilated airspace). A small amount of hyaline membrane, as indicated by the arrow, was still evident (haematoxylin and eosin stain; original magnification, ×100). (D) Pronounced interstitial fibrosis with honeycombing was noted in patient 7 (asterisks indicated the abnormally dilated airspaces; Masson’s trichrome stain; original magnification, ×40).

***Pulmonary pathological features in coronavirus associated severe acute respiratory syndrome (SARS)***

**THERAPEUTICS/ TREATMENT OPTIONS**

The person-to-person transmission of COVID-19 infection led to the isolation of patients that were administered a variety of treatments. At present, there are no specific antiviral drugs or vaccine against COVID-19 infection for potential therapy of humans. The only option available is using broad-spectrum antiviral drugs like Nucleoside analogues and also HIV-protease inhibitors that could attenuate virus infection until the specific antiviral becomes available. The treatment that have so far been attempted showed that 75 patients were administrated existing antiviral drugs. The course of treatment included twice a day oral administration of 75 mg oseltamivir, 500 mg lopinavir, 500 mg ritonavir and the intravenous administration of 0·25 g ganciclovir for 3–14 days. Another report showed that the broad-spectrum antiviral remdesivir and chloroquine are highly effective in the control of 2019-nCoV infection in vitro. These antiviral compounds have been used in human patients with a safety track record. Thus, these therapeutic agents can be considered to treat COVID-19 infection. Furthermore, there are several other compounds that are in development. These include the clinical candidate EIDD-2801 compound that has shown high therapeutic potential against seasonal and pandemic influenza virus infections and this represents another potential drug to be considered for the treatment of COVID-19 infection. Along those lines, until more specific therapeutics become available, it is reasonable to consider more broad-spectrum antivirals that provide drug treatment options for COVID-19 infection include Lopinavir/Ritonavir, Neuraminidase inhibitors, peptide (EK1), RNA synthesis inhibitors. It is clear however, that more research is urgently needed to identify novel chemotherapeutic drugs for treating COVID-19 infections. In order to develop pre-and post-exposure prophylaxis against COVID-19, there is an urgent need to establish an animal model to replicate the severe disease currently observed in humans. Several groups of scientists are currently working hard to develop a nonhuman primate model to study COVID-19 infection to establish fast track novel therapeutics and for the testing of potential vaccines in addition to providing a better understanding of virus-host interactions.

Few preventive measures have been declared by NCDC so as to prevent the spread of this disease and these includes:

1. Wash your hands frequently

Regularly and thoroughly clean your hands with an alcohol-based hand rub or wash them with soap and water. Washing your hands with soap and water or using alcohol-based hand rub kills viruses that may be on your hands.

1. Maintain social distancing

Maintain at least 1 metre (3 feet) distance between yourself and anyone who is coughing or sneezing. When someone coughs or sneezes they spray small liquid droplets from their nose or mouth which may contain virus. If you are too close, you can breathe in the droplets, including the COVID-19 virus if the person coughing has the disease.

1. Avoid touching eyes, nose and mouth

Hands touch many surfaces and can pick up viruses. Once contaminated, hands can transfer the virus to your eyes, nose or mouth. From there, the virus can enter your body and can make you sick.

1. Practice respiratory hygiene

Make sure you, and the people around you, follow good respiratory hygiene. This means covering your mouth and nose with your bent elbow or tissue when you cough or sneeze. Then dispose of the used tissue immediately. Droplets spread virus. By following good respiratory hygiene, you protect the people around you from viruses such as cold, flu and COVID-19.

If you have fever, cough and difficulty breathing, seek medical care early

Stay home if you feel unwell. If you have a fever, cough and difficulty breathing, seek medical attention and call in advance. Follow the directions of your local health authority.

National and local authorities will have the most up to date information on the situation in your area. Calling in advance will allow your health care provider to quickly direct you to the right health facility. This will also protect you and help prevent spread of viruses and other infections. Advice for public

WHO (World Health Organization) launches global megatrial of the four most promising corona virus treatment:

* Remdesivir

The new coronavirus is giving this compound a second chance to shine. Originally developed by Gilead Sciences to combat Ebola and related viruses, remdesivir shuts down viral replication by inhibiting a key viral enzyme, the RNA-dependent RNA polymerase.

Researchers tested remdesivir last year during the Ebola outbreak in the Democratic Republic of the Congo, along with three other treatments. It did not show any effect. (Two others did.) But the enzyme it targets is similar in other viruses, and in 2017 researchers at the University of North Carolina, Chapel Hill, showed in test tube and animal studies that the drug can inhibit the coronaviruses that cause SARS and MERS.

The first COVID-19 patient diagnosed in the United States—a young man in Snohomish county in Washington—was given remdesivir when his condition worsened; he improved the next day, according to a case report in The New England Journal of Medicine (NEJM). A Californian patient who received remdesivir—and who doctors thought might not survive—recovered as well.

* Chloroquine and hydroxychloroquine

At a press conference on Friday, President Donald Trump called chloroquine and hydroxychloroquine a “game changer.” “I feel good about it,” Trump said. His remarks have led to a rush in demand for the decades-old antimalarials. (“It reminds me a little bit of the toilet paper phenomenon and everybody’s running to the store,” Caplan says.) The WHO scientific panel designing SOLIDARITY had originally decided to leave the duo out of the trial but had a change of heart at a meeting in Geneva on 13 March, because the drugs “received significant attention” in many countries, according to the report of a WHO working group that looked into the drugs’ potential. The widespread interested prompted “the need to examine emerging evidence to inform a decision on its potential role.” The available data are thin. The drugs work by decreasing the acidity in endosomes, compartments inside cells that they use to ingest outside material and that some viruses can coopt to enter a cell. But the main entryway for SARS-CoV-2 is a different one, using its so-called spike protein to attach to a receptor on the surface of human cells. Studies in cell culture have suggested chloroquines have some activity against SARS-CoV-2, but the doses needed are usually high—and could cause serious toxicities.

Encouraging cell study results with chloroquines against two other viral diseases, dengue and chikungunya, didn’t pan out in people in randomized clinical trials. And nonhuman primates infected with chikungunya did worse when given chloroquine. “Researchers have tried this drug on virus after virus, and it never works out in humans. The dose needed is just too high,” says Susanne Herold, an expert on pulmonary infections at the University of Giessen.

* Ritonavir/lopinavir

This combination drug, sold under the brand name Kaletra, was approved in the United States in 2000 to treat HIV infections. Abbott Laboratories developed lopinavir specifically to inhibit the protease of HIV, an important enzyme that cleaves a long protein chain into peptides during the assembly of new viruses. Because lopinavir is quickly broken down in the human body by our own proteases, it is given with low levels of ritonavir, another protease inhibitor, that lets lopinavir persist longer.

The combination can inhibit the protease of other viruses as well, specifically coronaviruses. It has shown efficacy in marmosets infected with the MERS virus, and has also been tested in SARS and MERS patients, though results from those trials are ambiguous.

The first trial with COVD-19 was not encouraging, however. Doctors in Wuhan, China, gave 199 patients two pills of lopinavir/ritonavir twice a day plus standard care, or standard care alone. There was no significant difference between the groups, they reported in NEJM on 15 March.

* Ritonavir/lopinavir and interferon-beta

SOLIDARITY will also have an arm that combines the two antivirals with interferon-beta, a molecule involved in regulating inflammation in the body that has also shown an effect in marmosets infected with MERS. A combination of the three drugs is now being tested in MERS patients in Saudi Arabia in the first randomized controlled trial for that disease.

But the use of interferon-beta on patients with severe COVID-19 might be risky, Herold says. “If it is given late in the disease it could easily lead to worse tissue damage instead of helping patients,” she cautions. https://www.sciencemag.org/news/2020/03/who-launches-global-megatrial-four-most-promising-coronavirus-treatments

**FUTURE OF COVID-19 ON PUBLIC HEALTH**

The COVID-19 pandemic has created unprecedented disruption for the global health and development community. Organizations fighting infectious disease, supporting health workers, delivering social services, and protecting livelihoods have moved to the very center of the world’s attention. But they find their work complicated by challenges of access, safety, supply chain logistics, and financial stress like never.

The short-term implications of this global challenge are evident everywhere, but the long-term consequences of the pandemic — how it will reshape health and development institutions, occupations, and priorities — are still difficult to imagine.

1. The outcry in virtually every country about the lack of equipment and supplies to test for and protect against COVID-19 will lead countries to reexamine their supply chains for critical health and livelihood related products. This will lead to a surge of nationalism with respect to the need to produce pharmaceuticals, medical supplies, and equipment domestically. Even countries that traditionally had no capability in these areas will seek to develop the same. The realization that the economic costs of a pandemic can be huge, far surpassing investments in research and prevention, will lead to billions more dollars of investment in research, vaccines, therapeutics, and non-medical methods of prevention. This will mean that trillions of dollars in economic losses, loss of life, and loss of livelihoods for millions of poor people all over the world will be averted. (Ngozi Okonjo-Iweala is chair of the board at Gavi, the Vaccine Alliance and Nigeria’s former minister of finance).

2. The pandemic could become the new excuse for nationalism, isolationism, anti-immigration policies, and institutionalized racism. We are already starting to see some of this. All of this could increase inequities that already plague global health, and further concentrate power among the elite in the global north. (Madhukar Pai is director at McGill Global Health Programs). After the pandemic: How will COVID-19 transform global health and development? | Devex

***Public health crippled***

Local health departments run programs that treat chronic diseases such as diabetes. They also help prevent childhood lead poisoning and stem the spread of the flu, tuberculosis and rabies. A severe loss of property and sales tax revenue following a wave of business failures will likely cripple these health departments, said Adriane Casalotti, chief of government affairs with the National Association of County and City Health Officials, a nonprofit focused on public health.

After the 2008 recession, local health departments in the U.S. lost 23,000 positions as more than half experienced budget cuts. While it’s become popular to warn against placing economic concerns over health, Casalotti said that, on the front lines of public health, the two are inexorably linked. “What are you going to do when you have no tax base to pull from?” she asked.

Carol Moehrle, director of a public health department that serves five counties in northern Idaho, said her office lost about 40 of its 90 employees amid the last recession. The department had to cut a family planning program that provided birth control to women below the poverty line and a program that tested for and treated sexually transmitted diseases. She worries a depression will cause more harm.

◦ “I honestly don’t think we could be much leaner and still be viable, which is a scary thing to think about,” Moehrle said. https://uk.reuters.com/article/uk-health-coronavirus-usa-cost-special-r/special-report-how-the-covid-19-lockdown-will-take-its-own-toll-on-health-idUKKBN21L21K

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