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COVID-19: A REVIEW OF WHAT YOU SHOULD KNOW AND DO TO KEEP SAFE

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ABSTRACT

SARS-CoV-2, the cause of COVID-19, has resulted in high mortalities and global socio-economic disruptions. As knowledge of SARS-CoV-2 and COVID-19 evolves, the public requires up to date and appropriate information in order to keep safe in the absence of a proven vaccine. This review of the literature was written to provide the latest information on the virus and the disease. SARS-CoV-2 bears a higher genomic homology to SARS-CoV-1 than MERS-CoV-1. Globally, COVID-19 has caused more than 4.07 million deaths and infected over 188 million people by 16th July, 2021. In Africa, more than 4.5 million and over 106,000 people have been infected and died, respectively. In Kenya, over 191,000 have been infected and 3,746 people have died from COVID-19 by the date. The figure for Kenya is much lower than the over 150,000 deaths from the Spanish flu of 1918-20. SARS-CoV-2 is transmitted through expiratory droplets and direct contact, while faecal and airborne transmission have been documented, but not confirmed. It enters the body through nasal passages, conjunctiva or mouth. It can survive on bank notes, vinyl plastic, mobile phone, glass, cardboard, cloth fabric and stainless steel for varying periods. At 50% Rh, it can survive on stainless steel, vinyl plastic and glass at 20, 30 and 40°C for 28, 7 days and less than a day, respectively. On cotton fabrics, it can survive for 7, 3 days and less than 24 hr at 20, 30 and 40°C, respectively. Age, late hospitalization, diabetes co-morbidity, obesity, chronic lung disease and hypertension are the major risk factors for COVID-19 mortality. Age and laboratory indicators are predictors of mortality. Vaccines allowed for emergency use include the Oxford/AstraZeneca, Pfizer/Biontech, Moderna, Sinopharm, SINOVAC, Sputnik V and Johnson and Johnson. Although they all have shown high efficacy against the original COVID-19 strains globally, they have lower efficacy against the Brazilian P.1, the UK B.1.1.7, Finnish FIN-796H, the New Jersey/New York B.1.526, the South African B.1.351 and the Indian Delta mutant. Regular hand washing, face masking, avoiding overcrowding, physical distancing, outdoor communing, seeking immediate medical attention and isolating when infected, all can minimize SARS-CoV-2 transmission. Potential infection from frozen foods packaging, frozen foods and food preparation surfaces has been demonstrated. However, good hygiene practices can minimize infection from foods, shopping bags, take-out containers and groceries. Animal foods should not be consumed raw, while groceries require thorough washing with potable water during preparation. Despite concerns posed by the continuing evolution of virulent mutants of SARS-CoV-2, researchers are working to develop effective vaccines in order to eliminate the threat of the virus.

Key words: Viruses, SARS-CoV-1, MERS-CoV-1, SARS-CoV-2, COVID-19, transmission, infection, mutation, treatment, prevention

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INTRODUCTION

From 1918-1920, and up to 1925, many people in the World were infected and died from the Spanish flu, the most significant public health catastrophe in recent history. It was estimated to have infected about 500 million and killed as many as 50 million people worldwide [1]. Asia, Africa, Europe and North America lost 36, 2.5, 2.3 and 1.6 million people, respectively [1]. As the period of the pandemic coincided with the time of World War 1, returning World War 1 veterans, many of whom were attracted to the Colonies to take advantage of free farmland and other gifts that were offered to them, were responsible for the introduction of the disease into Africa. African porters and support staff who were infected contributed to its spread in local communities. In Kenya, the flu caused various forms of socio-economic disruptions including: suspension of non-essential services, paralysis in administrative functions, widespread food shortages, and job losses. It overwhelmed the healthcare sector. The flu had a high mortality rate such that in just nine months–from September 1918 to June 1919, there were approximately 31,908 cases and 4,593 deaths in Kenya's coastal province alone and over 150,000 deaths reported across the country [2]. Most of the deaths occurred among old men and women and fewer among the young and middle-aged. To reduce community transmission, colonial authorities developed preventive guidelines which included physical distancing, personal hygiene practices and medical treatment. Healthy people were advised to avoid contact with sick individuals and to take prophylactic remedies, such as gargling with potassium permanganate and oral quinine [2]. A major difference between then and now is the array of antivirals that are available for trial treatment of COVID-19, although most of them are ineffective. A number of vaccines are available currently for use, but their long-term efficacy has not been determined. By 16th July 2021, the World, Africa and Kenya had recorded over 188 million, 4.5 million, 191,000 COVID-19 cases and over 4.07 million, 106,000 and 3,700 deaths, respectively [3].

VIRUSES

Viruses and bacteria are two major kinds of micro-organisms that infect humans. In comparison to viruses, bacteria are one of the most studied micro-organisms and that have all the necessary components to live and reproduce. Only a small number of bacteria cause human disease, with many of them being regarded as beneficial. Some are even necessary for our survival as humans. Viruses on the other hand are not complete living micro-organisms, as they cannot survive and reproduce without a living host. They are composed of a tiny piece of genetic material contained in a protein envelope, and, are much smaller than bacteria. However, for reasons related to its protein protective coat [4], Severe Acute Respiratory Syndrome Coronavirus Disease-2 Virus (SARS-CoV-2) has been reported to be able to survive outside living tissue such as glass, bank notes, plastics, mobile phones, stainless steel and cloth fabrics for periods ranging between a few hours to 28 days [5].

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CORONA VIRUSES AND COVID-19

There are seven known human coronaviruses including: 229E, NL63, OC43, HKU1, Middle East Respiratory Syndrome Coronavirus (MERS-CoV), the cause of Middle East Respiratory Syndrome-MERS, SARS-CoV (causes SARS) [6] and now 2019-nCOV, which is also being referred to as SARS-CoV-2 or 2019 novel coronavirus (2019-nCoV or nCoV). They are categorized structurally either as beta or alpha and all of them have crossed over earlier from animals or birds to humans and are, therefore, zoonotic [6, 7]. They are commonly associated with pigs, cattle, wild civet cat, domesticated cats, bats, birds, camels, and, they all infect humans [7]. The most infectious of them are MERS-CoV (MERS), SARS-CoV (SARS) and SARS-CoV-2 [6]. SARS-CoV-2, the virus that causes the disease "Corona" or COVID-19 is the newest of these coronaviruses; it has spike projections on its surface, which resemble a crown or corona, when studied under a microscope and thus the name "Corona" Virus. SARS-CoV-2, an mRNA virus, is approximately 60-140 nm long [8]. Both SARS-CoV-1 and MERS-CoV-1 have much higher mortality rates than SARS-CoV-2, but they share a lot in common. Genome sequence analysis has shown that SARS-CoV-2 belongs to the *Betacoronavirus* genus, which includes Bat SARS-like coronavirus, SARS-CoV, and MERS-CoV **[**9**].** Both SARS-CoV and SARS-CoV-2 use human angiotensin converting enzyme-2 (ACE-2) as entry receptor and human proteases as entry activators **[**10**].** SARS-CoV-2 shares approximately 79.5% genomic homology with SARS-CoV-1, but only about 50% similarity with MERS-CoV-1, indicating that SARS-CoV-1 is closer to SARS-CoV-2 **[**9**].** In SARS-CoV-1, the infection to fatality ratio is about 9.6%, while in MERS-CoV-1, it is approximately 35.5% **[**11**].** In comparison, SARS-CoV-2 mortality is in the region of 1.4-4.7% **[**12**],** although the World Health Organization (WHO) puts it at 6.76%. Thus SARS-CoV-2 fatality ratio is still lower than that of SARS-CoV-1 or MERS-CoV-1. However, SARS-CoV-2 mortality rate is significantly higher than that of the common flu, which has an infection to fatality ratio of about or less than 1% [13]**.** Mortality factors for COVID-19 are similar to those of SARS and MERS [9]. The first case of COVID-19 is reported to have occurred in the city of Wuhan in China in December, 2019 [14]. SARS-CoV-2 is highly infectious, as it is easily passed from one person to another, through close contact and aerosol droplets [15]. It spreads by expiratory droplets released when someone with the virus coughs, sneezes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. This is part of the rationale for the recommendation to wear a mask covering the nose and mouth and maintain a physical distance of one metre as a minimum. But as aerosols can travel up to 1.8 metres from the infected person, the maintenance of 2 metres (about 6 feet) physical distance between persons is best [16]. Indoors, the distance should even be greater than 2 metres between persons. In some situations, SARS-CoV-2 may spread by a person being exposed to small droplets or aerosols that stay in the air for several hours in closed spaces-this is referred to as airborne transmission [17]. Airborne transmission has yet to be confirmed by the WHO, although it has been demonstrated [18]. The virus can also spread if a person touches a surface or object with the virus on it and then touches his mouth, nose or eyes [5], but this is not considered to be a major way by which it spreads. The faeces of those with gastrointestinal symptoms have also been implicated in viral transmission [19], such that the taking of faecal samples or

endoscopic procedures by healthcare personnel should be done with utmost care. Some re-infections of SARS-CoV-2 have happened [20], although uncommon. It is thus recommended that all individuals, whether previously diagnosed with COVID-19 or not, take precautions to avoid infection or potential re-infection with SARS-CoV-2. The implications of re-infection are relevant for vaccine development and application. In the few cases, different strains of the virus were detected in the re-infected patients [21], indicating virus mutation.

There are currently six confirmed strains of the virus-L (the original one from Wuhan, China that appeared in December 2019-although it is almost disappearing), S (a mutant from L that appeared in early January 2020), V and G (appeared between late January and mid-February, 2020), with G being the most widespread [22]. G mutated to GH and GR from the end of February, 2020. As GH and GR are related to G, they are therefore the three most widespread strains across the globe. G and GR have been the most dominant in Italy and across Europe. In North America, the GH strain is predominant while in South America the GR strain is prevalent-[22]). In Asia, where the Wuhan L strain initially appeared, and globally, the spread of strains G, GH and GR is increasing. In a recent article, Longjohn *et al*. [23] concluded that SARS-CoV-2 shows genomic variability across Africa, but most of the mutations that resulted in this variability align with those described in other countries of the World. In Australia, the G strain of SARS-CoV-2 is dominant [24]. Six more virulent strains are evolving: the South African B.1.351, the Brazilian P.1, the Finnish FIN-796H, the New Jersey/New York B.1.526, the UK B.1.1.7 and the Indian Delta variant. All six strains are more transmissible than the six earlier variants [25]. Up to now, the strains across Continents have little variability between them [22]. It is the ability to transmit easily from one infected person to another that leads to a very large number of infections, and, therefore high fatality rates.

SARS-CoV-2 affects people of over 65 years of age much more seriously [26], and therefore age is being suggested as an independent risk factor. Also, the higher the age group, the more likely a person has other risk factors such as heart disease, hypertension, diabetes, cancer, asthma, or other chronic diseases. It is these pre-existing conditions among high-risk groups including the immune-compromised or those with existing respiratory conditions that lead to a much higher death rate from COVID-19 [27]. This may be compounded in countries with a large number of nursing homes, where elderly patients with weak immune systems and many chronic diseases live close together, thus fuelling the spread of infection [27]. But this does not mean that COVID-19 is dangerous only for the elderly as statistics from around the World have reported infections and deaths in infants as young as two months and older persons up to 95 years of age [28]. In a meta-analysis of recent studies, the median age for mortality by COVID-19 was 49-57 years [30], which was similar to SARS-CoV-1 and MERS-CoV-1 median age for mortality [29]. Age, late hospitalization, diabetes comorbidity, obesity, chronic lung disease and hypertension are the-risk factors for COVID-19 mortality [30]. Case mortality was higher among males than females from the meta-analysis. The spike protein on the surface of SARS-CoV-2 binds to the ACE-2 receptors that lie on the surface of a large number of human cells, lungs, liver, kidneys,

heart and the intestinal tract, thus affecting several organs and blood, leading to multiple organ failure [31].

COVID-19 INFECTION, DIAGNOSIS AND HANDLING

The initial infection has been shown to occur through airborne particles carried in droplets that are released by the infected person [32]. Therefore, the initial infection takes place in the nose, throat, or upper respiratory tract. Where the body can fight the infection in the upper respiratory tract and defeat it, it may exhibit itself only as a mild throat irritation, dry cough, or mild fever [33]. Quite often, some infected people do not even show symptoms, they are said to be asymptomatic, but they can still infect others [34]. The symptoms of infection show after 2-5 days of incubation, but commonly in 7-14 days, with an average of 5 days [12]. From that, it is recommended that one can go into self-isolation at home for 14 days, if the disease is not severe for one to require hospitalization. The self-isolation can curtail the spread of the infection and allow recovery. The most common symptoms of COVID-19 are: fever, cough and tiredness, while the less common symptoms are: aches and pains, sore throat, diarrhoea, conjunctivitis, headache, loss of taste or smell, a rash on the skin or discoloration of fingers or toes [35]. The laboratory indicator tests are lactate dehydrogenase, C-reactive protein, neutrophil count, blood urea nitrogen and albumin, which are highly correlated with COVID-19 mortality [36]. After the initial upper respiratory tract infection, the infection travels to the lungs and the lower respiratory tract to trigger pneumonia-like disease. The lungs in such patients show a ground glass opaque effect visible in computed tomography (CT) scans [37]. Some long-term damage as scars and blockage of air sacs and other abnormalities have been observed in the lungs of COVID-19 patients who have healed, but still remain unwell for long periods after recovery [38]. The outcomes in such patients can be better with immediate entry into a rehabilitation programme upon recovery and following good nutrition. While CT scan is not a standard for the diagnosis of COVID-19, its findings help the diagnosis in the appropriate setting. It is crucial to correlate chest CT scan findings with epidemiological history, clinical presentation, and RT-PCR test results [39]. For the elderly, viral infection can also be accompanied by secondary bacterial infections [40], which may be responsible for a considerable number of deaths, if not treated [41].

As of 16th July 2021, there were over 188 million confirmed cases of COVID-19 globally, with over 4.07 million deaths [3]. The worst hit countries were the USA, India, Brazil, Russian Federation, France, Turkey, the UK, Argentina, Colombia, Italy, Spain and Germany in that declining order by number of cases by the date [3]. In Africa there were over 4.5 million confirmed cases and over 106,000 deaths by the date [3]. Greenland (49 cases), Solomon Islands (20 cases), Sint Eustatius (a Special Municipality of the Netherlands-20 cases), Montserrat (a British Overseas Territory-20 cases), Saba (a Special Municipality of the Netherlands-7 cases), Marshall Islands (4 cases), Vanuatu (3 cases), Samoa (one case), Cook Islands, Federated States of Micronesia, Kiribati, Nauru, Niue, North Korea, Tonga, Tuvalu, Turkmenistan, Tokelau, Saint Helena, Pitcairn Islands, Palau and American Samoa all had not reported a single case of COVID-19 by the 21st June, 2021 [3]. As they all had reported 0-49 cases by the 21st June, 2021, the WHO classifies them as having no cases. Their

safety is largely due to their remoteness, being surrounded by the sea, early closures to tourists, indefinite lockouts of non-residents and non-citizens, enforcement of the ban on travelling out of the Island/country, and, adherence to WHO guidelines such as masking and social distancing [3]. North Korea and Turkmenistan, which are overland countries, are a special case in this category, as their reports on the virus are doubtful. They share boundaries with countries where infections and deaths from the virus have been reported. In Africa, countries with the most cases are South Africa, Ethiopia, Kenya, Zambia, Nigeria, Algeria and Namibia, in that descending order of infection and deaths *per capita* by the 16th July, 2021[42, 3]. Compared to other continents (despite the poor health systems), the *per capita* infection and death rate are lower. This has been attributed to the relatively younger population, with over 60% under the age of 25, lower disease load of lifestyle diseases such as diabetes, lower tendencies to travel, greater outdoor living, and cross-immunity from other viral diseases such as Ebola and Dengue fever, making the continent fare better [42]. Many African countries took early precautions through lockdowns, curfews and other control measures. From past experiences with other viral diseases, African Governments trained community volunteers, who organized to get the recommended Ministry of Health and WHO protocols implemented. These measures have contributed to keeping potential infections and deaths low. However, the rate of testing is still very low and this may hide some infections, especially among asymptomatic cases [42]. Also, the continent's weak healthcare systems and the large immune-compromised population owing to the high prevalence of malnutrition, anaemia, malaria, HIV/AIDs, tuberculosis, make its population susceptible. Unfortunately, the strict preventive measures are likely to lead to a recession in many countries. Also, recent relaxation of control measures to save economies from collapse and the delayed and slow rate of vaccination is leading to rising infection rates.

Although the disease can infect any person, of any age, the casual, carefree attitude where young people may be dismissive of the disease as “old people’s disease” may be contributing to the increasing infections among young people, especially among those who smoke cigarettes, vape and are obese [43]. This may also place older people who they interact with at risk. It is estimated that susceptibility to infection in individuals under 20 years of age is approximately half that of adults aged over 20 years, and that clinical symptoms manifest in 21% (95% credible interval: 12–31%) of infections in 10- to 19-year-olds, rising to 69% (95% credible interval: 57–82%) of infections in people aged over 70 years [44]. Nevertheless, a substantial decrease in the total number of lymphocytes indicates that SARS-CoV-2 affects immune cells and inhibits the body’s cellular immune function, irrespective of age. Therefore, a low absolute lymphocyte count could be used as a reference index in the diagnosis of new SARS-CoV-2 infections in a clinical laboratory [45]. The RT-PCR test is an essential standard and confirmatory laboratory test for COVID-19. But the sensitivity of the test is not uniform, and is affected not only by the assay itself, but also by the limit of detection, the amount of viral inoculum, the timing of testing, infection phase and sample collection site [46]. Other laboratory tests may, therefore, be required to validate RT-PCR results. False negatives with RT-PCR have been observed in patients who have shown symptoms of the disease [47]. The rate of false-negatives is highest on the day of infection, lowest eight days after infection, and then begins to rise again as infection

and symptoms become pronounced [48]. A high risk of false-positives should be considered when extending the testing strategy, whereas false-negatives may occur during local outbreaks. This may have consequences for containment strategies and research. A false-positive result erroneously labels a person infected, with consequences including unnecessary quarantine and contact tracing. False-negative results are more consequential, because infected persons, who might be asymptomatic, may not be isolated and can infect others. Persons showing false-negatives should, therefore, be re-tested and more so in areas with high disease prevalence. To improve detection and RT-PCR sensitivity for SARS-CoV-2, double-quencher probes are recommended to decrease background fluorescence [49]. In some cases, COVID-19 becomes particularly dangerous when it causes the immune system to overreact resulting in the production of high levels of cytokines and other inflammatory agents. This heightened immune response not only attacks infected cells, but also healthy cells, creating what is referred to as a cytokine storm [40], which may damage the lungs even further.

ATTITUDE, TRANSMISSION AND CONTROL

COVID-19 is a stealth disease that is difficult to predict in terms of the likelihood of infection for someone or where the infection can come from. There are lessons to learn from the authoritarian enforcement of public order in China, where infections are controlled forcefully and expediently, whenever an outbreak occurs anywhere in the country [50], or the speedy and uncompromising Australian approach. Lack of sensitivity is likely to lead to large-scale infections of masses at super spreader events such as political rallies or large indoor parties. Strong public health measures such as lockdowns and widespread testing have more or less brought SARS-CoV-2 under control in China, and returned life to something resembling normal in many regions of the country. However, in lax and poorer countries, the need to keep the economies running makes the implementation of far-reaching control measures difficult. Rejection of the vaccines, hesitancy in some population groups for religious reasons, or sometimes out of concerns about the safety of the vaccines is sustaining infections mainly among the unvaccinated.

MINIMIZING INFECTION

The WHO has provided basic safety protocols to slow the spread of the pandemic. Some of these protocols include:

1. **Hand washing**-it is recommended to thoroughly wash hands with soap for not less than 20 seconds and as frequently as is possible.
2. **Use of alcohol-based hand sanitizer**-70% alcohol media are effective on viruses as is the use of water and soap for viral kill on hands and common surfaces. Food handling surfaces should, therefore, be frequently cleaned with disinfectant and liberal amounts of treated water to keep infection down, and, kill viruses that may be present on surfaces.

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3. **Wearing face masks**-as the mouth, nasal passages and throat are the reservoirs of the virus in those infected, covering them restricts the virus to the inside of the face covering, thus minimizing transmission to others nearby, even if the infected person coughs or sneezes. The quality of face masks in respect of the absorbent layer is critical, as not any material is effective against the virus **[**51**].** A surgical mask such as the N95 is best for face wear, but just as effective are 3-layered polypropylene and multi-thread cotton fabrics [51]. Two-layer loose fitting masks are not protective as they let in aerosols. Bandanas and handkerchiefs are not recommended.
4. **Air exchange-**this is an important determinant of the aerial viral load in closed spaces [52]. It is important to ensure good ventilation in closed spaces. Good ventilation and adequate air circulation can minimize airborne aerosol build-up and potential transmission of SARS-CoV-2 [53]. Outdoors are recommended for sports and parties.
5. **Temperature-**in cold weather, air particles are less mobile and stay close to the ground as they are heavily laden with moisture. Viruses on surfaces have been shown to survive for shorter periods at 30 and 40 ºC than at 20 ºC [6]. In a simulation, the virus was rapidly inactivated by sunlight [54], implying that in areas with high sunlight intensity such as deserts, it may not survive direct sunlight exposure for long before it is inactivated by the high ambient temperature and accompanying heat. Jahangari *et al.* [55], suggest that average ambient temperature and population size have low and high sensitivity to COVID-19 transmission, respectively. Thus, there seems to be no firm scientific basis to suggest that the number of COVID-19 cases in warmer climates would be less than that of colder climates.
6. **Social/physical distancing**-droplets and aerosols have been shown to travel for distances of up to 1.8 metres depending on the harshness of the sneeze or cough, while soft sneeze droplets travel for about a metre, thus the requirement for the 1-1.5 metre physical separation between persons [16]. In crowded or closed spaces, the distance between persons could be more [16].
7. **Avoiding crowded places-** the advice to avoid crowded places is premised on the high infection rates that are highly likely where the recommended physical distancing cannot be guaranteed.
8. **Avoiding shaking hands**-similar to the advice to keep hands clean, hand shaking is an avenue for the transmission of the virus from an infected person or from one who has touched a surface where the virus may be present and is still alive. Therefore, avoidance of handshaking is likely to reduce virus transmission.
9. **Avoiding touching the nose, eyes and mouth**-these are ports of entry of the virus into the body and avoiding touching them can minimize infection.

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INFECTION POTENTIAL FROM FOODS AND OTHER SOURCES

Foods, food containers and **food packaging-**these surfaces can potentially harbour the virus. When one is concerned about the safety of a take-away, it is reasonable to follow general food safety guidelines. One should wash hands for at least 20 seconds with soap and potable water after handling take-out containers, and transferring food to a clean dish and using sanitized utensils all the time. As recommended, hands should be washed before eating. After disposing of the containers, one should clean and disinfect any surface that had take-out containers on them. Raw animal foods such as fish, other seafood, milk and meat should not be consumed at all.

Groceries-it is theoretically possible that SARS-CoV-2 might linger for some time on fruits and vegetables that have been handled by a person carrying the virus. To guard against infection, it is best practice to wash all fruits and vegetables thoroughly, using running potable water, before eating them. Some scrubbing of the produce that has a rind or thick skin with a clean brush is a good habit and practice. It is also good hygiene practice (GHP) to wash hands properly with soap and water as soon as one gets home from the grocery store or supermarket. The door knobs one touches on entry into a house can also hold the virus and, therefore, the precaution to wash hands on entering the house should become routine practice. It is GHP to clean and disinfect any reusable bags that one carried from the grocery store. Most cloth bags can go through a dish-washer and dryer, while other bags can be cleaned using a disinfectant wipe or spray followed by potable water rinse. A number of incidents of food contamination have recently been reported across China, where SARS-CoV-2 was detected on imported foods, mostly on their packaging materials. Most of those incidents were traced to frozen shrimp, which were imported from Ecuador, where novel coronavirus was found on their packaging materials, and in one particular case, SARS-CoV-2 was also detected on the interior of a shipping container [56]. In an incident in Shenzhen, Guangdong Province on August 12, 2020, local authorities found SARS-CoV-2 on the surface of a frozen chicken wing sample that originated in Brazil, which became the first known case where the novel coronavirus was detected on actual food samples [57].

In a controlled laboratory study, Fisher *et al.* [58] examined the persistence of SARS-CoV-2 on refrigerated and frozen salmon, chicken, and pork over a period of 21 days. The study found that the titers of SARS-CoV-2 remained virtually constant, and the inoculated viruses maintained their infectivity on both refrigerated (4°C) and frozen (−20°C and −80°C) samples. In an earlier study conducted by United States Army Medical Research Institute of Infectious Diseases, researchers found that SARS-CoV-2 remained largely stable on swine skin throughout the 14-day experiment at 4°C [59]. These incidents demonstrate the stability of the virus in refrigerated and frozen storage and potentially in frozen and cold stored food.

Household surfaces-in a study, researchers found that SARS-CoV-2 can live up to 4 hours on copper, up to 24 hours on cardboard, and, three days on stainless steel and plastic surfaces [60]. It is therefore recommended to regularly clean and disinfect commonly-touched surfaces in homes including tables, countertops, doorknobs, light switches, toilets, faucet handles and sinks to keep infections low.

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Drinking water-SARS-CoV-2 has not yet been detected in drinking water. However, water treatment facilities have processes to filter and disinfect water before it goes into our homes and these processes should keep our water free from the virus. Containers for drinking should be sanitized to minimize viral infections, while containers for use by those infected should be isolated from those for healthy persons.

Dogs, cats and **insects-**SARS-CoV-2 mainly spreads from person to person, and experts do not therefore consider animals to be a significant way that the virus spreads. However, COVID-19 being a zoonosis, the potential for transmission of SARS-CoV-2 from humans to animals and *vice versa* exists [6, 7]. A report found evidence for SARS-CoV-2 infection in two dogs from households with human cases of COVID-19 in Hong Kong, despite the dogs being asymptomatic [61]. A study in Wuhan after the COVID-19 outbreak, showed evidence of SARS-CoV-2 infection in a cat [62]. However, there is no evidence as yet to suggest that SARS-CoV-2 spreads through mosquito or other insect bites.

Stool, urine and **other body fluids-**expiratory droplets are the main source of spread of SARS-CoV-2. The virus has also been detected in the stool of some people who had recovered from COVID-19 [18]. Experts, however, do not yet know what the risk of transmission from stool, urine and other body fluids is. Theoretically, SARS-CoV-2 therefore has the potential to spread through untreated sewage.

TREATMENT AND VACCINE DEVELOPMENT

Vaccination is the major route to control viral infections, which are fought largely by the body's antibodies and T-cells. Herd immunity can protect a significant proportion of the population and thereby break the transmission chain when about 60-90 of the World's population is vaccinated [63]. The knowledge on nSARS-CoV-2 is developing and no effective treatment for it exists up to this point in time. A number of medicines have been tried with most having undesirable side effects, some being dependent on the stage of the infection or just ineffective for treatment. These include chloroquine and hydroxychloroquine [64], remsedivir [65], ritonavir/lopinavir [66], interferon beta-1 [67], and convalescent plasma [68]. Dexamethasone, a steroid, has been found to be somewhat effective in treating severely ill COVID-19 patients, as low doses reduced deaths in hospitalized COVID-19 patients on ventilators by one-third [69].

Trial vaccines against SARS-CoV-2 are already available. The Oxford/AstraZeneca vaccine (Oxford/AZ) is 70.4% effective, but its effectiveness could go up to 90% in symptomatic cases [70]. In addition, it may be cheaper and can be stored under ordinary refrigerator conditions (2-8ºC), thus making it amenable to wide and less complicated distribution. The Pfizer/Biontech vaccine is rated to be 95% efficacious [71], while the Moderna vaccine has a reported efficacy of 94% [72]. All these vaccines have been approved by the competent authorities, but are not yet available for the young below 16 years of age, the pregnant, lactating and breast-feeding female. These groups did not take part in the initial trials or any current trials the author is aware of. However, trials in children below the age of 16 are ongoing in the UK, US

and Canada. The SINOVAC vaccine is able to maintain its efficacy (50-78%) in storage at refrigerator temperatures of 2-8 ºC, but it showed disappointing results in trials in several countries. The main reasons are the inclusion in some of the trials of both asymptomatic and symptomatic cases, while other trials considered only symptomatic cases. The situation is further compounded by paucity of published data on the vaccine in the English Language media. There is also the SinoPharm vaccine, with an efficacy of 79% [73] and the Russian Sputnik V vaccine.

All current emergency vaccines except the Johnson and Johnson vaccine require two shots administered at a 2 week interval. The Johnson and Johnson vaccine confers 70% immunity with one shot after 28-30 days [25]. However, the period the immunity from these vaccines lasts, has not yet been determined by researchers. Generally, an effective vaccine should be efficacious irrespective of age, ethnicity, race, and be free of any safety concerns. Vaccine development typically takes a minimum of 5-10 years [74], but the seven emergency vaccines for COVID-19 were available for use in 10-12 months. Questions on their safety were therefore being raised. The urgency to find a vaccine for the killer pandemic which has claimed more than 4.07 million lives and over 188 million global infections to date was unprecedented, as it generated fear, anxiety and impatience all over the world. This somewhat justified the high speed research and accelerated the testing of potential vaccines. Also, the use of mRNA is a simpler and swifter approach to vaccine production than any of the traditional techniques. As a word of caution, it should be noted that being vaccinated with a50% efficacy vaccine carries a higher risk of being infected with SARS-CoV-2 than with a90% efficacy vaccine. Therefore, face masking, physical distancing, frequent hand washing with soap and other preventive measures currently in use, should continue being applied until herd immunity is high enough, and, a highly effective vaccine is available. The longer-term assessment of safety and efficacy of any vaccine requires phase 3 trials, which have not been carried out using any of the current vaccines.

What is most concerning currently is the low efficacy of the emergency vaccines against the new and virulent UK B.1.1.7, the Brazilian P.1, the South African B.1.351, the Finnish FIN-796H, the New Jersey/New York B.1.526 and the Indian Delta mutants [25], which are referred to as viruses of concern (VOC). Although boosters for the vaccines are being developed to increase their efficacy against the new VOC mutants, some countries of the EU had temporarily stopped vaccinating the public, especially women 18-30 years of age with the Oxford/AZ vaccine over safety concerns. However, the European Medicines Agency declared the vaccine was not associated with the blood clotting suspicion that had led to its temporary suspension. As we do not yet have a proven vaccine, the World has to tackle the concerns arising from misinformation on the safety of the emergency vaccines and hesitancy, which could turn people away from being vaccinated, and, can complicate return to normalcy. Providing for personal choice is a point of discussion in the vaccination campaign. However, the public should be made aware that the choice not to accept vaccination carries the risk of infection with SARS-CoV-2. Also, the chain of SARS-CoV-2 transmission will be difficult to break and the World stands the prospect of having the virus lingering in some populations, for years, and COVID-19 breaking out sporadically.

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CONCLUSION

SARS-CoV-2 causes COVID-19, a zoonosis, which was first detected in December 2019 in Wuhan, China. The virus is responsible for over 188 million infections and more than 4.07 million deaths worldwide by the 16th July, 2021. Six original SARS-CoV-2 variants are recognized, although six more highly transmissible mutants were recently confirmed. SARS-CoV-2 enters the body through nasal passages, conjunctiva or mouth. Expiratory droplets and direct contact are the confirmed major modes of transmission, although faecal and airborne transmission have also been documented, but not confirmed by the WHO. The virus can survive on a variety of surfaces for varying periods depending on relative humidity, temperature and nature of surface. Age, late hospitalization, diabetes comorbidity, obesity, chronic lung disease and hypertension are the major risk factors for COVID-19 mortality. Africa, despite her poor health systems has fared better than other continents, as it has recorded over 4.5 million infections and over 106,000 deaths by the date. However, recent relaxation of interventions, scarcity of vaccines, hesitancy and the delay in vaccinating the public is raising the rate of infections. Vaccines which have been approved for emergency use include the Oxford/AstraZeneca, Pfizer/Biontech, Moderna, SINOVAC, Sinopharm, Sputnik V and Johnson and Johnson. A current grave concern with these vaccines is their low efficacy against the new South African, Brazilian, New Jersey/New York, Finnish, the UK and Indian Delta mutants. Evidence suggests that contaminated consumer foods, especially refrigerated and frozen varieties and their packaging, are likely to be potential long-range carriers of SARS-CoV-2, and pose a systematic risk that requires constant assessment. Therefore, the potential for frozen, uncooked foods and their packaging to transmit the virus exists. In view of the above concern, the current recommended preventive protocols, and, GHP application in food handling and preparation should be adhered to in order to slow the spread of the virus and its mutants.

The potential for transmission of the virus through urine, vomit, breast milk and semen should be investigated. It is also necessary to confirm the strains of SARS-CoV-2 in circulation and continue to map out their regional specificity, and, improve the efficacy of the emergency vaccines on new virus mutants. The efficacy of the various vaccines on age, ethnicity and gender are also areas of potential investigation. Information on how long the acquired immunity from the various vaccines or their improved types lasts is needed. Further research is required to understand why certain individuals remain asymptomatic when infected.

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