

What Coronavirus SARS-CoV-2 and COVID-19 Disease Are Telling Us: A Holistic Veterinary and One Health View

By Michael W. Fox, BVetMed, PhD, DSc

Author Contact:

Email IPAN@erols.com

Website www.drfoxonehealth.com

Abbreviations

COVID-19

Coronavirus disease 2019

SARS

Severe Acute Respiratory Syndrome

SARS-CoV-2

Severe Acute Respiratory Syndrome Coronavirus-2

Abstract

Coronaviruses and other emerging diseases could be the seeds of future pandemics. The call for ever more vaccines and medications to address these challenges remains human-centered and does not support the premise of One Health. Rather, it underestimates the importance of factors that precipitate pandemics, such as accelerating climate change, loss of biodiversity, wildlife poaching and trafficking, habitat encroachment, the ever-increasing human population, and consumption of wild and domesticated animals. Coronavirus disease 2019 (COVID-19) may have long term influence on these issues, especially on the collective exploitation and consumption of animals that can trigger pandemics and other zoonotic diseases.

Introduction

In January 2020, a novel respiratory virus was identified as the causative agent of a cluster of pneumonia cases first detected in Wuhan city, Wubei Province, China the previous December (1, 2). According to the CDC, this new coronavirus has been named *Severe Acute Respiratory Syndrome Coronavirus-2* (SARS-CoV-2), and the disease it causes has been named by the World Health Organization *coronavirus disease 2019*, abbreviated as *COVID-19*.

The SARS-CoV-2 virus is a betacoronavirus, like the Middle East Respiratory Syndrome coronavirus (MERS) and the

Severe Acute Respiratory Syndrome coronavirus (SARS). All 3 of these viruses originated in bats, most notably the species *Rhinolophus affinis* (for SARS-CoV-2) (3–6). Bats collected for study from their natural habitats north of the Wuhan market area of China are now considered to be the most likely source, as they share 98.7% genome sequence homology with SARS-CoV-2 (6). Researchers reported evidence that a small proportion of Malayan pangolins (*Manis javanica*), widely sold in Chinese markets, can carry coronaviruses related to the strain responsible for the COVID-19 pandemic (7). While a study published in March 2020 showed no definitive evidence that these coronaviruses are a source for SARS-CoV-2, a subsequent publication asserts that bats and pangolins are the origins of the COVID-19 pandemic (8, 9). Although international commercial trade of all 8 species is strictly forbidden, pangolins are believed to be the most trafficked mammal in the world (7, 10).

Some respected scientists question whether the origin of COVID-19 could be from an accidental laboratory release, as there have been prior accidental releases of coronaviruses from laboratories, and there are 2 laboratories in Wuhan actively involved in coronavirus research (11). This idea was evaluated in a column, published in *Nature Medicine*, which examined the virus's characteristics, the sites that allow it to bind to human cells, and the

hypothesis that it could have been engineered by humans (12, 13). The authors considered the possibility that the outbreak resulted from an inadvertent laboratory release of a virus under study, but concluded that “we do not believe that any type of laboratory-based scenario is plausible” (13).

However, new evidence by Perez and Montagnier in France and Sørensen and associates in Norway reexamines the possibility of accidental or deliberate release from a laboratory (14). These investigators independently have shown the presence of 12 exogenous informative elements of the HIV and simian immunodeficiency viruses as well as the informative elements of the *Plasmodium yoelii* parasite used in mouse vaccine strategies, in the SARS-CoV-2 genome (14, 15). This newly identified long region within the SARS-CoV-2 genome contained 225 nucleotides that were 100% homologous for all COVID-19 genomes and were completely absent in all prior SARS genomes (15).

Bats, a sentinel species of ecosystem health and guardians of tropical forests, are the main carriers of viruses implicated in human pandemics, such as those caused by coronaviruses,

filoviruses, paramyxoviruses, and ebolaviruses, although they are immune themselves (16, 17). Also immune are most indigenous wildlife species, including civets (*Civettictis civetta*), pangolins, and primates, which have co-evolved and co-inhabited their domains for generations of selection and survival (17, 18). When humans and domesticated animals encroach upon these remaining wildlife domains, they may succumb to zoonotic diseases. In the context of bats, this can occur when people capture and take away infective bats into their own crowded and often unsanitary communities.

The classic consequence of such human encroachment is exemplified by African sleeping sickness, caused by a blood-borne infection with the protozoan *Trypanosoma brucei* (19). When human communities invaded the domain of disease-resistant wildlife and the arthropod vectors, there was spillover of *T. brucei* into millions of people and their livestock (20). Public health efforts to eradicate sleeping sickness have been unsuccessful in part due to continual transmission and identification of *T. brucei* in additional wildlife reservoirs, including bats, supporting the premise that continued intermingling of human populations and wildlife will exacerbate widespread disease outbreaks

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(21). Although the spillover of *T. brucei* from wildlife to people had severe and widespread implications among African communities, there was no global spread because tsetse flies are needed to transmit this disease (22). With COVID-19, there is no such intermediary host-vector needed, as direct human-to-human transmission is the primary route of infection (23).

There will always be calls for government funds to be directed toward public health efforts such as vaccinations and pharmaceuticals to “protect” the public from new emerging diseases like COVID-19 and potential pandemics. However, if wildlife poaching, international wildlife trade, and illegal trafficking continue along with ever-increasing human population growth and inevitable encroachments, these government efforts will not be sustainable in combating zoonotic pandemics. In many countries, the immune systems of indigenous peoples are challenged by lack of sanitation, contaminated drinking water, chronic malnutrition, tuberculosis, HIV/AIDS, and malaria, suggesting potential susceptibility to both infections from wildlife and adverse reactions to vaccinations (24–28).

Environmental Factors Increasing Susceptibility to Zoonotic Pandemics

Since COVID-19 primarily attacks the lungs, millions of people across all socioeconomic classes may be at risk in urban communities with high levels of fine particle air pollution (29). According to the US Environmental Protection Agency, this pollution causes early death (from both short-term and long-term exposure); cardiovascular harm (heart attacks, strokes, heart disease, and congestive heart failure); respiratory harm (worsened asthma, chronic obstructive pulmonary disease, and inflammation); inflammatory and degenerative changes in the brain, pancreas, and other organs; and may cause cancer and reproductive and developmental harm (30).

The above associations suggest that poor air quality in urban and industrial communities creates ideal conditions for COVID-19 spread. Air pollutants absorb and scatter UV rays away from the earth's surface (31). The UV radiation from the sun is a primary germicide in the environment and is associated with seasonal increases in vitamin D levels in humans. Decreased UV levels are associated with more severe influenza outbreaks and may contribute to seasonal differences, increasing the likelihood of influenza pandemics (32–33). Consequently, in the author's opinion, more widespread use of UV light-generating devices for the purposes of air

purification and potential infectious disease reduction is long overdue.

Earlier Pandemics and Epidemics

The *Precautionary Principle* states, "When human activities may lead to morally unacceptable harm that is scientifically plausible but uncertain, actions shall be taken to avoid or diminish that harm" (34). This principle began to take form in the latter part of the last century, but the consequences of human activities have been many centuries in the making. The Black Death, also called the Great Plague, serves as one of the first indicators of the potential risks of unmonitored globalization of trade and commerce. This plague likely originated in Central Asia or East Asia (where it continues to be endemic) and traveled along the Silk Road, reaching Crimea by the year 1343 (35). From there, it was most likely carried by fleas living on black rats that traveled on Genoese merchant ships, spreading throughout the Mediterranean Basin and reaching the rest of Europe via the Italian peninsula (35). Human to human transmission took place via fleas and lice (36–37). In some communities, there is anecdotal evidence that cats were blamed and persecuted, and to this day black cats are still shunned by many, considered bad luck, and are stigmatized around Halloween (38). This bacterial plague is estimated to have killed 30% to 60% of the population of Europe and reduced the world population from an estimated 475 million to 350–375 million in the 14th century (39).

The 1918-1919 Spanish flu pandemic, which killed at least 50 million people worldwide (including many who were stressed and malnourished from World War I), was an H1N1 influenza virus strain with genes of avian origin (40, 41). The swine influenza pandemic of 2009 originated in Mexico and killed close to a quarter of a million people worldwide (40, 42). This virus was a new strain of H1N1, resulting from a previous triple reassortment of bird, swine, and human flu viruses further combined with a Eurasian pig flu virus, leading to the term *swine flu* (42). This is now a regularly circulating seasonal human flu virus worldwide (42).

Avian influenza A (H5N1) viruses are endemic in poultry in parts of the world and are infecting people sporadically, often with deadly results (43). In February 1957, a new influenza A (H2N2) virus emerged in East Asia, triggering a pandemic *Asian flu* (44). The estimated number of deaths from H2N2 was 1.1 million worldwide and 116,000 in the United States (45). This virus was a reassortant (mixed species)

strain, originating from strains of avian and human influenza viruses (42). It circulated until 1968 when it was replaced by the H3N2 influenza virus (42). When compared to these influenza outbreaks, COVID-19 is causing higher mortalities, given a larger world population and worsening particulate air pollution and electrosmog (the electromagnetic radiation emitted by computers and cell phones) and may similarly circulate in the human population in the years to come. This prediction could especially hold true if preventive measures are ignored and reliance on post-pandemic vaccines rushed to market is continued (46).

According to the World Health Organization, the coronavirus responsible for SARS has reappeared 4 times, with 3 of the 4 originating from laboratory accidents in Singapore and Chinese Taipei (11). Researchers from the University of Hong Kong examined 25 animals representing 8 species in a live animal market in southern China and found the virus in all 6 masked palm civets they sampled, as well as in a badger and a raccoon dog (47, 48). A study from Guangdong Province in southern China, where the SARS outbreak first emerged in November 2002, indicated that more than 30% of the early SARS cases there occurred in food handlers (48). This SARS epidemic infected more than 8,000 people in 26 countries and killed at least 689, the vast majority in China and Hong Kong (49). Chinese authorities subsequently ordered the deaths of some 10,000 civet cats by drowning and electrocution in January 2004, when they were identified as the primary source of SARS (50). The precursor virus is present in wild *Rhinolophus* bats (51). Civet cats and other small mammals sold as delicacies in wet markets provided a reservoir and amplifier for the virus and the potential opportunity for its adaptation to humans (50).

Banning Wildlife Alive and Dead in Food Markets

Amid speculation that a novel coronavirus had spread from bats to an intermediary species and then to people at a meat market, on February 24, 2020, China officially and permanently banned the trade and consumption of wildlife, but not dogs and cats (51). Since there is still a demand for wild meat, enforcement of any ban will be difficult, according to wildlife-policy researcher Zhao-Min Zhou; this is further complicated by legislative loopholes in renaming of species, so that traded species may not be covered under the ban (52). In the author's opinion, such a permanent ban is therefore unlikely to be effectively enforced, considering the money, power, and influence of

international cartels involved in wildlife and other illegal trafficking activities.

Farmed Animals and Public Health: Zoonotic Diseases

The CDC states, "Zoonotic diseases are very common, both in the United States and around the world. Scientists estimate that more than 6 out of every 10 known infectious diseases in people can be spread from animals, and 3 out of every 4 new or emerging infectious diseases in people come from animals" (53).

Viruses can spread zoonotically through farmed animal systems. The number of live pigs, goats, cows, and sheep transported worldwide in 2017 was 30% higher than in 2007, according to the Food and Agriculture Organization (54, 55). Pandemics of swine and avian influenza generally originate from live markets, which many of these animals pass through, as well as from animal slaughtering in rural and peri-urban poor communities (56). One previous study suggests that keeping chickens outside of cages and mixing breeds contributes to the spread of influenza strains at live markets (57). In the author's opinion, this spread could also be due in part to the unavailability of centralized processing and cold storage facilities and from workers exposed to infected animals inside the wet markets.

As a One Health-advocating veterinarian, this author appeals to all consumers and governments to consider the impossibility of preventing such pandemics and other animal-foodborne epidemics and regional outbreaks of disease because of the enormous scale of factory farm animal production systems—billions of poultry and pigs worldwide that are the primary source of various strains of influenza virus and antibiotic-resistant strains of bacteria.

The spread of infectious diseases in farmed animals extends beyond influenza and SARS-CoV-2. Richer communities and countries like the United States, where pork and poultry products are dietary staples, pay the environmental and public health costs of many other zoonotic diseases stemming from antibiotic-resistant bacteria. According to the CDC report *Antibiotic Resistance: Threats in the United States 2019*, more than 2.8 million antibiotic-resistant infections occur in the United States each year, and more than 35,000 people die as a result (58). These and other infectious disease concerns in poultry lead to practices in the United States in which carcasses are washed in a dilute bleach and chlorine antimicrobial solution prior to storage

in a cold facility (59, 60). Due to these ongoing concerns, the United Kingdom has refused to accept America's chlorine-treated chicken under current trade negotiations (60).

Susceptibility of Domesticated Species to SARS-CoV-2

Chinese scientists investigated the susceptibility of ferrets and other species that have close contact with humans to SARS-CoV-2, including cats, dogs, pigs, chickens, and ducks (61). Laboratory exposure tests showed that SARS-CoV-2 replicates poorly in dogs, pigs, chickens, and ducks, but ferrets, Syrian hamsters, mink, and cats are susceptible to infection (61, 62). Ferrets develop mild upper respiratory infections with lethargy and inappetence from which they are likely to recover (62). Cats are susceptible to airborne infection and can infect each other, with extensive lung damage evident in young cats (61, 62). It has since been determined that cats with COVID-19 cannot infect people, but in the author's opinion, these findings suggest that domestic cats should be tested and monitored for signs of respiratory illness if exposed to infected people (62, 63). In view of these findings, the sale of civet cats, which are related to mongooses and not domestic cats, in Chinese markets should be prohibited (63).

Protecting Wildlife from Cruel Exploitation

There are degrees of inhumanity and cruel treatment of animals for which we unwittingly pay the price. Civet cats, known carriers of coronaviruses, routinely have their anal glands scraped out to harvest musk for the perfume industry in Ethiopia (64, 65). In Indonesia, these animals are fed coffee beans which are then collected from the feces and sold as gourmet fermented beans called *Kopi luwak* (65). In the author's opinion, such practices reflect the depravity that surfaces where a lack of empathy is combined with the lure of money. This is exemplified especially by China's bear-bile farms, where confined bears have abdominal cannulas collecting their bile, to be sold as medicine (66). One of the alleged cures from traditional Chinese medicine that the government recommends for treating severe and critical cases of COVID-19 is an injection of *Tan Re Qing*, which contains bear bile, and has been previously examined for its anti-inflammatory properties in patients diagnosed with acute lung injuries (67, 68).

Conclusions

International trade in wild and domesticated animals, dead or alive, for human consumption should be curtailed as a public health service, for national security and for animal health and welfare. National farmed-animal production and trade should be tempered in order to reduce the industry's

contributions to climate and extinction crises, public health declines, and rural poverty, where small, sustainable producers may be marginalized and veterinary services directed towards larger commercial operations. It is speciesism to claim that animals were created for our own use and that we can therefore kill, consume, and otherwise exploit them as our needs and wants dictate.

Hopefully, this global health crisis is catalyzing international collaboration in prevention and treatment. We may yet see the emergence of a "United Environmental Nations" that unshackles public health from politics, nationalism, isolationism, and prioritization of the economy over the health and security of the people, and that links public health with environmental and animal health. Above all, humans should keep out of wildlife habitat where diseases emerge to which they have no immunity. Consumers in industrial countries should support producers of organically certified foods and should sustain a healthful diet, with limited and considered consumption of eggs, dairy, meat, and seafoods.

The British Veterinary Association's initiative promoting the benefits of sustainable consumption of farmed animal products in order to help reduce climate change is also applicable to reducing zoonotic diseases, as it embraces the concept of *less and better* farmed animal produce for animal welfare, One Health, and sustainability reasons. "Eating less and better sees some citizens reduce consumption of animal derived products, while maintaining proportional spending on high animal health and welfare products" (69).

Continuing to consume animals as a basic food source, marketing more vaccines, and having unchecked population growth, the rich and poor alike will be subject to the indiscriminate justice of natural law until we all abide in greater harmony with other species as well as with each other. We will then need fewer guns, chemicals, and other bioweapons when our appetites and numbers are under more effective self-control. Alternatively, with deteriorating natural controls of health-sustaining biodiversity, plagues and pestilences of biblical proportions will be the legacy of our collective failure in planetary stewardship that surviving generations will inherit. Albert Schweitzer, MD, summed it up with prescience decades ago when he opined, "We must fight against the spirit of unconscious cruelty with which we treat the animals. Animals suffer as much as we do. True humanity does not allow us to impose such sufferings on them. It is our duty to make the whole world recognize it. Until we extend our circle of compassion to all living things, humanity will not find peace" (70).

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