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Emerging Viruses are a Global Health Concern Requiring Science-based Solutions and Local Actions

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Abstract: On 11 March 2020, COVID-19 was officially characterized as a pandemic. By this time, the SARS-CoV-2 virus had already spread across continents, causing significant morbidity and mortality, and affecting social and economic systems. The complexities of the impact of COVID-19 call for multidisciplinary to trans-disciplinary research that goes beyond epidemiology research and practice. We aimed to (1) provide a narrative review of scientific knowledge of COVID-19, (2) place the developments by international organizations, governments, and individuals (including researchers at all levels) into a wider context, (3) provide practical suggestions for all actors to respond to the COVID-19 pandemic in the short term within the context of large uncertainties, and (4) describe the need for systemic transformations for sustainability using a trans-disciplinary systems approach. In summary, the literature revealed that improvements of surveillance, prevention, and control programs for the prevention of pandemics are needed to safeguard public health. Embracing a trans-disciplinary systems-based approach with experts from a wide variety of fields will be essential to prevent future outbreaks and other health risks, taking into account the complexities of natural and social systems.

Keywords: World Health Organization (WHO); COVID-19; pandemic; Future Earth

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1 Introduction

The first official report on 31 December 2019 of the novel coronavirus (COVID-19) came from the city of Wuhan, Hubei province, China. In an emergency response, the Chinese government mobilized more than 32,000 medical personnel to fight the epidemic[1]. The government also built two 1,000 bed hospitals and several mobile cabin hospitals[2] and put in place a series of domestic travel bans[3]. As of 25 March 2020, there were 81,848 confirmed infected people in China and rapid spreads according across other countries[4]. The disease hotspot changed to Europe and to the United States.

Activities led by WHO include a strategic response and preparedness plan[5]. WHO also activated the R&D Blueprint for action to prevent epidemics[6], and produced a Research and Development Blueprint research agenda[7]. The agenda was intended to drive innovation in all aspects of outbreak control, from clinical case management to vaccine development. Further, a master plan was developed for coordinating clinical trials that could lead to potential therapies for patients affected with COVID-19[8].

The causative agent of COVID-19 is a coronavirus (single strand RNA virus with envelope). This is a commonly found virus type. SARS is another coronavirus. SARS in China took 6 months to affect 5,000 people; COVID-19 reached that number in one month. Symptoms reported include mild to severe respiratory illness with fever, cough, and difficulty breathing, although COVID-19 may be asymptomatic in some people who can still transmit the virus. Direct exposure through droplets causes person-to-person transmission, with the potential to seed further outbreaks. Preliminary data in China showed a national average case fatality rate of 2.3%[8], with a higher rate in Wuhan and lower in other provinces[9] and increased to 3.8% in China and 3.4% worldwide. A higher average rate of 5.7% is being reported in Europe (10.6% in Italy) that may be because of community infections in areas with a large elderly population. Based on observations made at the end February 2020, researchers recommend using a wide range (0.25%–3.0%) of COVID-19 case fatality rates because of the uncertainties in data and case reporting[10]. This is less than the 7%–10% cited for SARS and could decline as data become available on the numbers of less severe cases, as was the case with the H5N1 avian influenza[11].

An increasing number of patients are recovering in China, where the virus was first detected, but simultaneously, the number of cases in other parts of the world has been increasing. Fear of further spread of COVID-19 led to international travel bans, despite WHO advising against the application of any inappropriate travel or trade restrictions. The scientific community is providing the knowledge for a more coordinated response and prevention across borders.

The COVID-19 outbreak is causing a great deal of worldwide worry, panic, and concern. In a global population of almost 8 billion people, the number infected by COVID-19 who are in critical condition is extremely small and is dwarfed by other more common diseases such as influenza, malaria, and diarrheal disease that kill thousands or even millions of people each year (the number one cause of death in the year 2017 was cardiovascular disease, which claimed the lives of 17.79 million people[12]. For people who live in countries and regions with high numbers of COVID-19 cases (Italy, USA, Spain, Germany or other countries and urban centers), and for front-line responders and others who expect to come into contact with infected people (e.g. airport workers), good science-based information on how to avoid infection is crucial.

2 Responses Outside of the Hotspot Zone

Since the Public Health Emergency declaration for COVID-19 on January 30th, 2020, many countries have introduced travel restrictions and other measures to reduce disease spread. Several organizations and countries repatriated their citizens to avoid exposure and placed them under quarantine. In some instances, ethical considerations were raised. For example, the Australian government announced that citizens repatriated from Hubei province would be placed in quarantine on Christmas Island, within an immigration detention center intended for asylum seekers[13]. Wearing masks in public has limited benefits but can be helpful for infectious patients to prevent disease spread in crowded, poorly ventilated spaces. In many countries, fear of exposure is resulting in shortages and massive price-hikes of surgical masks[14], despite WHO recommending these only for people with respiratory symptoms or healthcare workers dealing with patients. Clear guidance from governments, scientists, and other stakeholders is vital to ensure that individuals understand the appropriate measures to reduce exposure risks.

3 What Scientists Have Found

Coronaviruses (CoV) are zoonotic[15], which means they were originally transmitted from animals to humans. There are many coronaviruses circulating in animals that have not yet infected humans; the degree of their infectiousness is unknown. SARS-CoV and MERS-CoV were transmitted from civet cats to humans and dromedary camels to humans, respectively[15]. SARS-CoV like viruses can spread to humans from bat populations[16].

Dr. Peter Daszak from the Ecohealth Alliance and the one HEALTH Global Research Project has been studying zoonotic diseases for over two decades[17–18]. Examples of zoonotic diseases that have caused turmoil around the world include SARS-CoV, Ebola, MERS-CoV, avian flu (HPAI Asian H5N1), Nipah (NiV)[19], and now SARS-CoV-2. Dr. Peter Daszak and his team found that close human-wildlife interactions are key to novel viral emergence[20], driven by demographic and anthropogenic change primarily of environmental nature (e.g. rapid urbanization, agricultural intensification, logging and mining activities destroying biodiversity and disrupting ecosystems, population growth) and increased mobility from previously remote regions—these increase the risk of viruses spilling over and spreading within our globalized population[20–21]. Over the past 10 years, Dr. Peter Daszak and his team identified >500 novel coronaviruses with the purpose of focusing surveillance, prevention, and control programs before they emerge[22]. Bats are a reservoir of a number of important zoonotic viruses and although confirmation is needed, a species of Rhinolophus bat is most likely the natural reservoir of the SARS-CoV-2 virus that causes COVID-19[23]. Such scientific information, when appropriately adopted into international policies, can help prevent future pandemics. One of the challenges lies in the availability of infrastructure and capacity to prepare for and manage outbreaks of novel viruses in the areas where humans and biodiversity interact so closely that spillovers can occur[24].

Fortunately, the severity of COVID-19 is lower compared to other emerging pathogens; however, the virus is spreading at very high speed, affecting entire societies. Over 80% of the cases are mild, with the severe cases primarily among older adults or people with serious chronic prior illnesses such as heart or lung disease, or diabetes. Patients that develop acute respiratory distress syndrome are at the highest risk, requiring ICU admission and oxygen therapy[25]. Symptomatic treatment of respiratory failure places a severe strain on health care

systems world-wide, especially to provide intensive care beds and ventilators. It is difficult to diagnose COVID-19 based on symptoms because of its similarities with other common diseases. Polymerase chain reaction (PCR) tests are needed in a laboratory setting to test for genetic material (RNA); doing so, takes time and resources. Therefore, identification of cases, making it challenging to react quickly while world experts and funders set priorities to identify the best approaches for infection prevention, control, and response[26].

4 Suggestions for Responses to the COVID-19 Outbreak: a Global Problem Requiring Global Solutions That are Implemented Locally

Effectively addressing the COVID-19 outbreak will require global solutions that are implemented locally, based on scientific evidence that takes into consideration uncertainties and assumptions. Closing down the city of Wuhan in an emergency response may have reduced the spread but may also have had unintended consequences, an approach that was later implemented in many other cities around the world to flatten the curve of the number of patients[27]. Some places where community infections have occurred experienced an overflow of patients in hospitals, with challenges around provisioning (e.g. surgical masks and other medical equipment). These cities and countries also experienced an unprecedented social and economic impact. Before gradually reopening the city, and to avoid stigmatization, communication with the public is needed[28]. For this purpose, and in the context of uncertainty, we suggest scientifically-driven actions to reduce the spread, lessen the impact, and avoid further outbreaks for governments, organizations, and individuals. Accumulated benefits of adapting these suggestions across sectors early on may reduce the impact of COVID-19.

4.1 Governments

- Adopt a whole-of-government and whole-of-society approach to responding to the COVID-19 pandemic, including involvement of the private sector and civil society organizations.
- Work collaboratively and transparently with other countries to support efforts to deal with the COVID-19 outbreak across countries including regarding quarantine procedures and international transportation, to ensure that cross-border medical and other essential goods supply chains are able to function effectively and efficiently and streamline importation of critical goods and experimental products.
- Ensure free and open reporting of outbreak data and sharing of virus samples, genetic information, and research results to facilitate vaccine and treatment development and ensure equitable and transparent allocation processes for diagnostics, therapeutics and vaccines.
- Develop and implement national research plans and facilitate health care workers and institutions engagement in priority research at regional and global levels.
- Health is central for people's wellbeing and livelihoods; therefore, governments and other decision makers need to support the health sector in designing and implementing preventative control measures. Policies based on scientific evidence are needed to enable the transition to a safe and healthy way of living on this planet, if we are to be prepared for the next virus and to prevent yet another global outbreak.
- There is a need for increased investment in capacity building for public health in low- and middle-income countries and building resilient health systems that can detect,

prevent, respond, and quickly recover from outbreaks and other health emergencies.

- National governments should shift their operational stage from regulating points of entry to reflect the situation where more infection is spreading widely within the community. This calls for social distancing as a preventive strategy and an urgent scale-up of aggressive measures to combat COVID-19.
- Prevention and response measures within countries.

4.2 Organizations

- We call on scientific, governmental and non-governmental organizations in the field of conservation, ecology, epidemiology, public health, mathematics and computer science, governance, planning, geography, the science of cities, sustainability science, and others to work collaboratively to prevent future outbreaks and other health risks and disasters to people and the planet, by applying a systems-based approach (Eco-Health, One Health, Planetary Health, and Urban Health communities).
- Research organizations can improve understanding of the causes, risks, infectiousness, severity and threats of a pandemic in communities. Health organizations can emphasize the importance of human behavior in disease emergence, and what can be done to avert the emergence and spread of these diseases. Conservation organizations can communicate openly about the fact that wildlife commonly carry pathogens that can be lethal to people and to increase awareness that the risks of pathogens affecting human health often results from unsustainable transformations of our natural environments and ecosystems that provide life-supporting services for our health.
- Reassure the public, including that ownership of pets, livestock, and presence of wildlife in a community is not necessarily a public health risk, and that the key issue in an outbreak or a pandemic is transmission from person to person through contact with infected people. Emphasize infection prevention and control measures, especially when caring for the sick.
- Actions could protect your employees and your business.

4.3 Individuals

- Individuals can protect themselves from infection and also support government and organizational efforts to deal with the pandemic.
- Individuals should wash their hands frequently, avoid touching their mouth, eyes, and nose too often, avoid dense concentrations of people, maintain social distances of at least 1 m (3 feet) from others who are coughing or sneezing or have other respiratory symptoms, have suspected COVID-19 infection with mild symptoms, or are caring for someone with suspected COVID-19 infection, and avoid staying in poorly ventilated areas with those persons.
- Follow good respiratory hygiene practices by covering your mouth and nose with your bent elbow or tissue when you cough or sneeze. Then dispose of the used tissue immediately.
- Wearing a mask is unnecessary unless you are in contact with infected people, or if you have symptoms of a respiratory infection—this will help reduce shortages and free up masks for people who critically need them.
- Stay home if you feel unwell and seek medical care promptly if you experience fever, cough, and difficulty in breathing as this may be due to a respiratory infection or

other serious condition; use a telephone or other means of remote access (e.g., apps) when available.

- As a general precaution, practice good hygiene when visiting live animal markets, wet markets, or animal product markets and avoid consumption of raw or undercooked animal products.
- Follow reputable sources of information to stay up to date on the developments and suggestions through your national and local public health authorities.
- Continue your daily operations—with the additional points above unless requested otherwise by your local government, organization, or if you are based in a high-risk zone with known cases. Follow advice given by your healthcare provider.
- Take corrective action on any discriminatory posts and wrong information occurring in social media to prevent delays in responding to the outbreak.

5 Transformation Needed

We call on scientific, government and NGO in the field of conservation, ecology, epidemiology, public health, clinical medicine, governance, planning, geography, the science of cities, sustainability science, and many others to work collaboratively to prevent future outbreaks and other health risks and disasters to people and the planet, by applying a systems-based approach for preventing future outbreaks and other health risks and disasters.

Research organizations can improve our understanding of the causes, risks, infectiousness, and threats of a pandemic. Health organizations can emphasize the importance of human behavior in disease emergence, and what can be done to avert the emergence and spread of these diseases. Conservation organizations can communicate openly about the fact that wildlife commonly carry pathogens that can be lethal to people and to increase awareness that the risks of pathogens affecting human health often results from unsustainable transformations of our natural environments and ecosystems that provide life-supporting services for our health. Social scientists can provide understanding about the ways to introduce policies that would enable improved identification, prevention, and control of emerging infectious agents with a potential to cause pandemics.

Further transformations towards a healthier world, may require changes in our social, cultural, and governance systems across scales. A scientific understanding of human and animal behavior and the dynamic relationship between them and the environment is needed to avoid spillovers. The transmission of emerging scientific research to decision makers and the general public is a complex process, in which uncertainties need to be communicated clearly to provide a basis for decision making. International organizations and multiple sectors of government and society need to coordinate to resolve urgent issues and jointly identify the most appropriate responses. Governments and other decisionmakers to need to support the health sector in designing and implementing preventative control measures. Policies based on scientific evidence are needed to support the transition to a safe and healthy way of living on this planet, if we are to be prepared for the next virus and to prevent it before it becomes yet another global outbreak. For more information, please see the Our Future on Earth report[29]. To prepare and learn more about other global risks that researchers and experts perceive to be important, please refer to The Future Earth Risks Perceptions Report 2020[30].

6 Importance of Well-functioning and Resilient Healthcare Systems

WHO expressed concern about the impact the virus may have if it spreads to a country with a weak healthcare system or insufficient resources to prevent a pandemic. It is likely that there are undiscovered person-to-person transmissions ongoing in countries located in Asia, Latin America, and sub-Saharan Africa; these are regions where the funds for monitoring are constrained. Thus, an outbreak reinforces the global commons problem—pathogens that emerge in resource-constrained countries can spread even more rapidly and have a more significant impact on the most vulnerable. This presents an obvious need for increased investment to build well-functioning and resilient health systems in low- and middle-income countries that can detect, prevent, respond, and quickly recover from outbreaks and other health emergencies. While the current priority for health systems is to control and contain this outbreak, there are important messages from the scientific community about how we could have done a better job at preventing COVID-19 from emerging in the first place.

The scientific evidence on emerging viruses demonstrates critical links between biodiversity loss and anthropogenic environmental changes, including deforestation, urbanization, agricultural intensification, and the wildlife trade and the impact of these changes on health, including infectious diseases[31]. These systemic linkages need to be better understood and knowledge needs to be shared with all stakeholders to improve collective intelligence and action. Both elements are integral to a systems approach. To implement this approach to prevent future pandemics, further investments are needed in research, knowledge communication, coordination, teaching, and training. Investments are cost-effective considering the direct and indirect costs of emergency response measures.

Re-evaluating the hidden costs of pandemics[32] and identifying more sustainable development pathways will mobilize resources to build knowledge and action. Furthermore, increasing donor support for sustainability and building resilient health systems in low- and middle-income countries with emerging infectious disease hotspots can lower the number of severe cases and casualties when an epidemic threatens. Estimates suggest that around 1 million viruses that are able to infect people likely exist in wildlife around the world and that investments to prevent this from happening would provide rapid health benefits[33–34].

Actions for implementing a systems-based approach for the prevention of pandemics include: 1) build capacity for better surveillance for known and novel pathogens in countries within emerging disease hotspots; 2) identify the hidden costs of pandemic emergence from activities that drive them—agricultural intensification, mining, deforestation, and global travel and trade—and work with those industries to reduce our global footprint; 3) request governments to strategically invest in a research program to discover the viruses related to those known to cause emerging diseases, to devise better tests, drugs, and vaccines; 4) work with the most vulnerable communities in these hotspot regions to reduce the risks associated with activities such as wildlife hunting and consumption, to promote acceptable and sustainable alternatives; and 5) facilitate coordination and communication between different branches of health-related science programs, including all sectors of society, to increase the sustainability of individual consumption behavior, public awareness and engagement, business practices and trade, government interventions, and other activities. These and other measures will improve our collective intelligence for identification and prediction of emerging disease hotspots, and for building capacity for the prevention of pandemics[33].

Globalization has changed the way we are connected. The increasing interconnectedness of complex urban systems[35] requires a systems approach and preparedness for the preven-

tion and effective management of population health emergencies. The need for such a systems approach is widely discussed, for example under the Urban Health and Wellbeing programme of the International Science Council (2020). To do so, a learning cycle that combines knowledge, decision-making, and action in society is needed. The Anthropocene requires planetary health approaches[36] with hygienic standards, infection prevention and control standards, and rules to facilitate a healthy life[37]. The standards and rules need to be based on scientific evidence and behavior that can be implemented while taking into account different needs across regions and cultures and desirable futures.

At present, the global interconnected system is experiencing a social and economic shock. The impact of that requires interventions by governments, institutions, and individuals. There is hope that interventions will lead to changes in the way we operate and consume but the changes underway may not necessarily lead to resilience and sustainability[38] without intentional actions to do so.

There are challenges that need consideration in decision making[39] and forecasting in a high-stakes, fast-moving situation. Challenges include rapidly changing information, uncertainties, a range of values and concerns, and a need for the decisions to be made urgently. A transdisciplinary approach can support decisionmaking that takes into account insights into the development of the virus; medical information about contagion, treatment, and avoiding infection; and the possible economic impacts of the outbreak. It takes a truly transdisciplinary team of people from a range of disciplines and sectors, end-users, policy makers, and practitioners to effectively manage a complex situation. These science-based activities linking global environmental change to health have been conducted under the Future Earth Health Knowledge-Action Network[40].

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Conflict of Interest

None.

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