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Preserve, prepare, and prevent: environmental actions against pandemics in the COVID-19 era

The COVID-19 pandemic has reached 188 countries and territories around the world, after seven months since its appearance in December 2019 in Wuhan, China. As reported by the Johns Hopkins University [1], at the time of writing, the disease has affected almost 17 million people, and caused more than 660,000 deaths, inducing crises for many health systems and huge economic losses. Grave concerns exist as the pandemic spreads to densely populated regions across the sub-continents, Africa, and South America, and especially to countries where social distancing is impracticable, health systems are under-resourced to offer care for thousands of cases, and intensive care respiratory support for severe cases.

The main attention to this disease has focused on clinical and epidemiological aspects, and research on therapies and vaccines. A holistic health response is required, one that applies a population health lens and incorporates prevention. Understanding the preconditions for pandemics is now an even more urgent task. Around 70% of Emerging Infectious Diseases (EIDs), and almost all recent pandemics, originate in animals (most in wildlife) [2]. Infectious zoonotic diseases typically emerge as a

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result of complex interactions between humans and their natural environment, notably wild or domestic animals, or both, and the environments we all share.

In fact, in the last 17 years, three new coronavirus diseases have emerged from close contact with wild animals and have spread among humans causing deadly diseases. Severe Acute Respiratory Syndrome (SARS-CoV), one of these lethal zoonotic pathogens was first identified in Southern China (Guangdong province) in November 2002, where host to human transmission occurred in a wet food market (that sells perishable foods, among whom sometimes living animals) [3]. At the end of the epidemic in 2003, China had reported > 8,000 cases of the disease and 774 deaths, with a case-fatality rate of 7% [4]. The next coronavirus to generate a global public health crisis was the Middle East Respiratory Syndrome (MERS-CoV) that emerged in Saudi Arabia in 2012 among people working closely with camels. Although this virus was not found highly contagious, yet had a high case-fatality rate, and no available vaccine. By 2019, a total of 2468 laboratory-confirmed cases of MERS with 851 deaths (34.5% mortality) had been reported to WHO [5].

The first known cases of COVID-19 occurred in late 2019. Local health authorities and a further clinical and epidemiological investigation traced direct exposure to the Wuhan wet food market for 66% of patients hospitalized initially [6], then soon after came evidence of person-to-person transmission via respiratory droplets. During the second meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak of novel coronavirus (2019-nCoV), held on 30 January 2020, the COVID-19 pandemic was underway. At that meeting, Chinees authorities reported over 7700 confirmed cases, over 12,000 suspected cases and 170 deaths, and the disease had spread to 18 countries with 83 confirmed cases outside China. Based on these statistics, the WHO declared the COVID-19 a Public Health Emergency of International Concern (PHEIC) [7].

Responses to this latest pandemic have drawn widespread criticism of China, the WHO, and many national governments. We chose not to add our voices to that chorus, but instead affirm calls for a wiser approach to learning the lessons from the two prior epidemics [4], and this third, COVID-19 [8]. All three coronaviruses emerged via zoonotic transmission. SARS-Cov-19 is a new strain of coronavirus not previously identified in humans, but now established, it is likely to persist.

The full ramifications of COVID-19 are yet to fully unfold. Apart from the tragic direct human toll of the COVID-19 coronavirus epidemic, economic cost estimates range from $3.3 trillion to $82 trillion [9]. The World Bank envisions a 5.2 percent contraction in Global GDP in 2020—the deepest global recession in eight decades, and the first since 1870 to be triggered solely by a pandemic [10]. Economic disruptions will not be evenly spread exacerbating global inequities. COVID-19 is also unleashing other pernicious pathways of widespread health harm. This pandemic arrived amidst a landscape of other problems, several global regions are in conflict, and climate change threatens further food insecurity. Social distancing enforcement and interruptions to global trade have left world food aid programs short of supplies and volunteers. Interruptions to food systems are driving a double burden of malnutrition.

In early April 2020, the World Food Program warned the world is on the brink of a hunger pandemic, suggesting a real possibility of COVID-19 pushing an additional

130 million people to starvation by the end of 2020, bringing the global total of people facing immanent starvation to 265 million [11].

Reducing the spread of this highly contagious virus forced nations to launch unprecedented campaigns to eradicate the virus by mandating social distancing and by closing sectors of the economy where close human contact was unavoidable. Instructing people to stay at home meant voluntarily shutting down the economy. Diverging views on whether to prioritize human health or the economy resulted in debate, social media storms, pushback, political division, and considerable variation in intra-national enthusiasm to implement full lockdown. Meanwhile, ongoing ideological debates created an echo chamber of myths and misinformation, labeled an 'Infodemic" by the WHO [12]. Countries reluctant to heed expert health advice are enduring high case rates and deaths.

The global shutdown is triggering an economic recession with deep and long-term consequences. High-resource nations are evidently not immune, and the link between poverty and poor health is well established [13]. Previous recessions in the United Kingdom (UK) indicated that a 1% fall in employment is associated with a 2% increase in prevalence of chronic illness [14, 15].

Failing to consider the possibility of new global pandemic events rendered the world ill-prepared to deal with complex and diverse challenges posed. Learning the lessons of the past, recognizing the health risks of allowing poor management of human–environment interactions, and heeding the warnings of the potential for additional novel diseases combining high contagion and high virulence could have produced more timely and more effective global health responses. A wiser response could have averted much of the human misery generated by COVID-19. With the emergency still enveloping the world, most attention has been paid to health systems as a way forward. We adopt a public health approach and propose examination of interactions between humans and the environment as a fundamental driver of the present and preventing future pandemics. We recommend greater focus on environmental actions to prevent and mitigate them.

Preservation: limit conditions for pandemic threats

The association between Emerging Infectious Diseases (EIDs) and environmental destruction is widely recognized: deforestation destroys natural habitats, increases the density of remaining wild animal populations, increases their movements to look for food accompanied by the probability of human contact–all induce stress that impairs immune systems and increases viral shedding [16]. Moreover, hunting and capture of wild animals for human consumption purposes (such as for food, medicines, dress) expose the animals to even higher stress. And the crowded conditions in food markets create opportunities for direct human and domestic animal contacts with wild animals and their excreta.

Rapid growth of the world population, and increasing demands for food, are powerful drivers of environmental destruction. This combination has accelerated evolution of pathogenic zoonoses and increased the probability of humans interacting with wild animals and spreading disease [17].

Environment preservation is urgent for many reasons: conservation of biodiversity, the fight against climate change, reduction of air, water and food pollution, and improvement of human health and quality of life [18]. Unfortunately, political leaders often postponed these aims to preference economic exigence. The resultant failure to recognize the health and economic value of ecosystem services threatens provision of the necessities of human health, such as clean air, clean food, and clean water. The COVID-19 pandemic has shown dramatically that an event caused by a human–environment perturbation can destroy the fragile equilibrium of human societies and their economies.

Main message: The 'one health' and 'global health' approaches should become priorities in governance to quell pandemics, putting in first place **PRESERVATION** of the natural environment.

Preparedness: implement environmental actions

Environmental spread of microbial pathogens is well established. Similarly, an abundance of evidence demonstrates the efficacy of appropriate interventions for limiting disease. Water may be associated with infectious diseases for several reasons: as vehicle for infections by ingestion, contact, or inhalation, as habitat for intermediate hosts or vectors—or in a protective role, as an essential resource for hygiene. The 6th Sustainable Development Goal "Clean Water and Sanitation" has not yet been reached everywhere. According to the United Nations report 2019, "billions of people still lack safe water, sanitation and handwashing facilities" [18]. Moreover, water scarcity caused by climatic changes imposes water reuse—after treatments validated to eliminate pathogens [19].

The need for water to be free of microbiological contamination is only part of safety, as water must also be free from chemical contamination. An excess of disinfectants and their improper use generates pollution and human exposure to other toxic hazards. Therefore, there is an urgent need to develop and validate efficient methods of sewage treatment and water disinfection, limiting the use of chemicals, and applying them according to a rigorous risk–benefit analysis.

SARS-CoV-2 is eliminated in feces by 20–50% of infected people and its RNA has been found in sewage in disparate parts of the world (USA, Netherland, Australia, France). We do not know if the SARS-CoV-2 can be transmitted by water [20]. Nevertheless, efficient treatment and implementation of Water Safety Plans can ensure water safety for a variety of uses as reported by national and international agencies [21]. Thus, implementation and enforcement of efficient systems and strategies for water treatment are essential preparation for the present and future threats.

Some descriptive epidemiological studies have found correlation between COVID-19 incidence, lethality, and air pollution [22]. Aside from the (highly questionable) hypothesis about long distance transport of pathogens with air particulates, the main role of the air pollution seems related to impairment of airway defences to viruses [23]. Enforcement of regulations against air pollution is essential to prevent respiratory morbidity. Moreover, the most plausible airborne transmission of COVID-19

occurs indoors or, if outdoors, in close proximity to the source. Air treatments in built environments may represent a risk factor or, the opposite, a protective preventive mechanism, depending on the efficacy via proper design and management [24].

On the other hand, COVID-19 caused a temporary reduction in air and water pollution: while lockdown stopped many economic activities, it also could improve water and air quality. At the same time, massive use of disposable gloves and masks and hand disinfectants caused an immense surge in medical wastes, not always properly disposed [25]. For preparedness against pandemics, all urban and medical waste collection and treatment should be efficiently managed.

Main message: Development and implementation of technologies, structures, and regulations to limit environmental pollution will be very important for **PREPAREDNESS** to control future epidemics.

Prevention: knowing and controlling environmental pathways

Preventing the spread of an infectious disease in a population necessitates understanding transmission pathways. When a novel pathogen appears, initial interest focuses on diagnosis and therapy, then on developing and testing a suitable vaccine. But, as we saw in the response to the SARS-CoV-2, the first line of the defence against the diseases is the prevention of initial transmission into the human population, that generally involves the environment.

Once a disease is established in populations, along with person-to-person spread, quarantine measures of social distancing and contact tracing come to the fore as primary means of restricting further transmission. Although close contacts are predominant means of transmission for respiratory viruses, their airborne spread requires attention. Its probability varies, depending on the source of infective aerosol (respiratory or fecal), on the pathogen's survival in the environment, and on environmental conditions [26, 27].

For COVID-19, the possibility of spreading by aerosol, in addition to direct spread through large droplets (> 5μ) and close contacts, is a risk in indoor environments including homes, restaurants, vehicles, nursing residences, temples, among others. The advice of distancing by 1 m was probably insufficient to prevent transmission for someone without any protective equipment [26]. And there is possible occupational exposure in settings other than healthcare facilities, for example, in wastewater treatment plants and waste processing facilities.

Even if science shows us that water and food are minimally involved in the COVID-19 pandemic, these means and risks transmission should be thoroughly investigated for every emerging infection.

Main message: In most cases, the possible ways of infection are known by analogy with similar diseases, even if every new pathogen is characterized by unique peculiarities. It is advisable to apply the precautionary principle, without waiting for epidemiological evidence. Remember that **PREVENTION** is the priority, even if timely actions could limit the possibility of evidencing their added value in comparison with no action.

Conclusion

EIDs such as Ebola, influenza, SARS, MERS, and, most recently, COVID-19 can erupt, creating global pandemics with massive mortality and morbidity. Disruptions to trade and travel bring devastating and long-lasting economic impacts. The seemingly opposing forces of economic development and public health need to be reconciled, they are not in opposition, rather reinforcing. Over and above the devastating human toll of pandemics, COVID-19 provides further evidence that healthy environments and healthy people are critical to healthy economies. Disruption to one domain escalates catastrophic repercussions in others.

Potential for new infectious diseases is ever present, not remote; we ignore them to our peril. The main challenge is to be ahead of epidemics at every step ahead of emergence, transmission, and spread. The human–environment interface must never be underestimated in its capacity to enrich or harm human health. Environmental actions are essential in fighting pandemic; an effective strategy includes keywords with the same prefix: PREservation, PREparedness, and PREvention.

We should share and implement this strategy worldwide, focusing also on actions involving health systems and society.

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References

1. Johns Hopkins University Coronavirus Resource Center. Available from: https://coronavirus.jhu.edu/map.html. Accessed 30 July 2020.
2. Morse SS, Mazet JAK, Woolhouse M, Parrish CR, Carroll D, Karesh WB, et al. Prediction and prevention of the next pandemic zoonosis. Lancet. 2012;380(9857):1956–65.
3. Di Marco M, Baker ML, Daszak P, De Barro P, Eskew EA, Godde CM, et al. Opinion: Sustainable development must account for pandemic risk. Proc Natl Acad Sci USA. 2020. https://doi.org/10.1073/pnas.2001655117.
4. Peeri NC, Shrestha N, Rahman MS, Zaki R, Tan Z, Bibi S, et al. The SARS, MERS and novel coronavirus (COVID-19) epidemics, the newest and biggest global health threats: what lessons have we learned? Int J Epidemiol. 2020. https://doi.org/10.1093/ije/dyaa033.
5. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A Novel Coronavirus from Patients with Pneumonia in China, 2019. New Engl J Med. 2020;8:727–33.
6. El-Kafrawy SA, Corman VM, Tolah AM, Al Masaudi SB, Hassan AM, Muller MA, et al. Enzootic patterns of Middle East respiratory syndrome coronavirus in imported African and local Arabian dromedary camels: a prospective genomic study. Lancet Planet Health. 2019;3(12):e521–e528528.
7. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan. China Lancet. 2020;395(10223):497–506.
8. WHO. Statement on the second meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak of novel coronavirus (2019-nCoV). Geneva: World Health Organization; 2020 30 January. Available from: https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov). Accessed 18 April 2020.

9. Horton R. Facts are not enough—Offline. Lancet. 2020;395(10224):546.
10. WEF. This is how much the coronavirus will cost the world's economy, according to the UN. World Economic Forum and United Nations; 2020 30th March. Available from: https://www.weforum.org/agenda/2020/03/coronavirus-covid-19-cost-economy-2020-un-trade-economics-pandemic/. Cited 27 April 2020.
11. ReliefWeb. WFP Chief warns of hunger pandemic as COVID-19 spreads (Statement to UN Security Council). OCHA; 2020 21st April. Available from: https://reliefweb.int/report/world/wfp-chief-warns-hunger-pandemic-covid-19-spreads-statement-un-security-council. Cited 27 April 2020.
12. Zarocostas J. How to fight an infodemic. The Lancet. 2020;395(10225):676.
13. Borisch B, Lomazzi M, Moore M, Krech R. Update on the Global Charter for the Public's Health. Bull World Health Org. 2018;96:439–40.
14. Janke K, Lee K, Propper P, Shields K, Shields MA. Macroeconomic Conditions and Health in Britain: Aggregation, Dynamics and Local Area Heterogeneity. IZA DP No. 13091. London: IZA Institute of Labor Economics; 2020 March. p. 49. Available from: https://www.iza.org/publications/dp/13091/macroeconomic-conditions-and-health-in-britain-aggregation-dynamics-and-local-area-heterogeneity. Cited 28 April 2020.
15. Horton R. CoHERE a call for a post-pandemic health strategy—Offline. Lancet. 2020;395(10232):1242.
16. Butler CD, Hanna EG. Ecosystems, Biodiversity, Climate, and Health. In: Adegoke J, Wright C, editors. Climate Vulnerability Understanding and Addressing Threats to Essential Resources Volume 1 Health. Elsevier Inc., Academic Press, 2013. p. 69–78
17. Tortell PD. Earth 2020: Science, society, and sustainability in the Anthropocene. Proc Natl Acad Sci USA. 2020;117(16):8683–91.
18. UN - Water, WWAP. The United Nations world water development report 2019: leaving no one behind. United Nations; 2019 March. p. 201. Available from: https://unesdoc.unesco.org/ark:/48223/pf0000367306. Cited 15 May 2019.
19. UNESCO, UN - Water. The United Nations World Water Development Report 2020 - Water and Climste Change Paris: UNESCO; 2020 21st March. p. 235. Available from: https://unesdoc.unesco.org/ark:/48223/pf0000372985.locale=en. Cited 15 April 2020.
20. Kitajima M, Ahmed W, Bibby K, Carducci A, Gerba CP, Hamilton KA, Haramoto E, Rose JB. SARS-CoV-2 in wastewater: state of the knowledge and research needs. Sci Total Environ. 2020. https://doi.org/10.1016/j.scitotenv.2020.139076.
21. World Health Organization & United Nations Children's Fund (UNICEF). (2020). Water, sanitation, hygiene, and waste management for the COVID-19 virus: interim guidance, 19 March 2020. World Health Organization. https://apps.who.int/iris/handle/10665/331499. License: CC BY-NC-SA 3.0 IGO
22. Contini E, Frediani B, Caro D. Can atmospheric pollution be considered a co-factor in extremely high level of SARS-CoV-2 lethality in Northern Italy? Environ Pollut. 2020. https://doi.org/10.1016/j.envpol.2020.114465.
23. Moriyama M, Hugentobler WJ, Iwasaki A. Seasonality of respiratory viral infections. Annu Rev Virol. 2020. https://doi.org/10.1146/annurev-virology-012420-022445.
24. Wiggington KR, Boehm AB. Environmental engineers and scientists have important roles to play in stemming outbreaks and pandemics caused by enveloped viruses. Environ Sci Technol. 2020. https://doi.org/10.1021/acs.est.0c01476.
25. Saadat S, Rawtani D, Hussain CM. Environmental perspective of COVID-19. Sci Total Environ. 2020;728:138870. https://doi.org/10.1016/j.scitotenv.2020.138870.
26. Leung NHL, Chu DKW, Shiu EYC, et al. Respiratory virus shedding in exhaled breath and efficacy of face masks. Nat Med. 2020. https://doi.org/10.1038/s41591-020-0843-2.
27. Carducci A, Federigi I. Marco V. Covid-19 airborne transmission and its prevention: waiting for evidence or applying the precautionary principle? Atmosphere. 2020;11:741. https://doi.org/10.3390/atmos11070741.