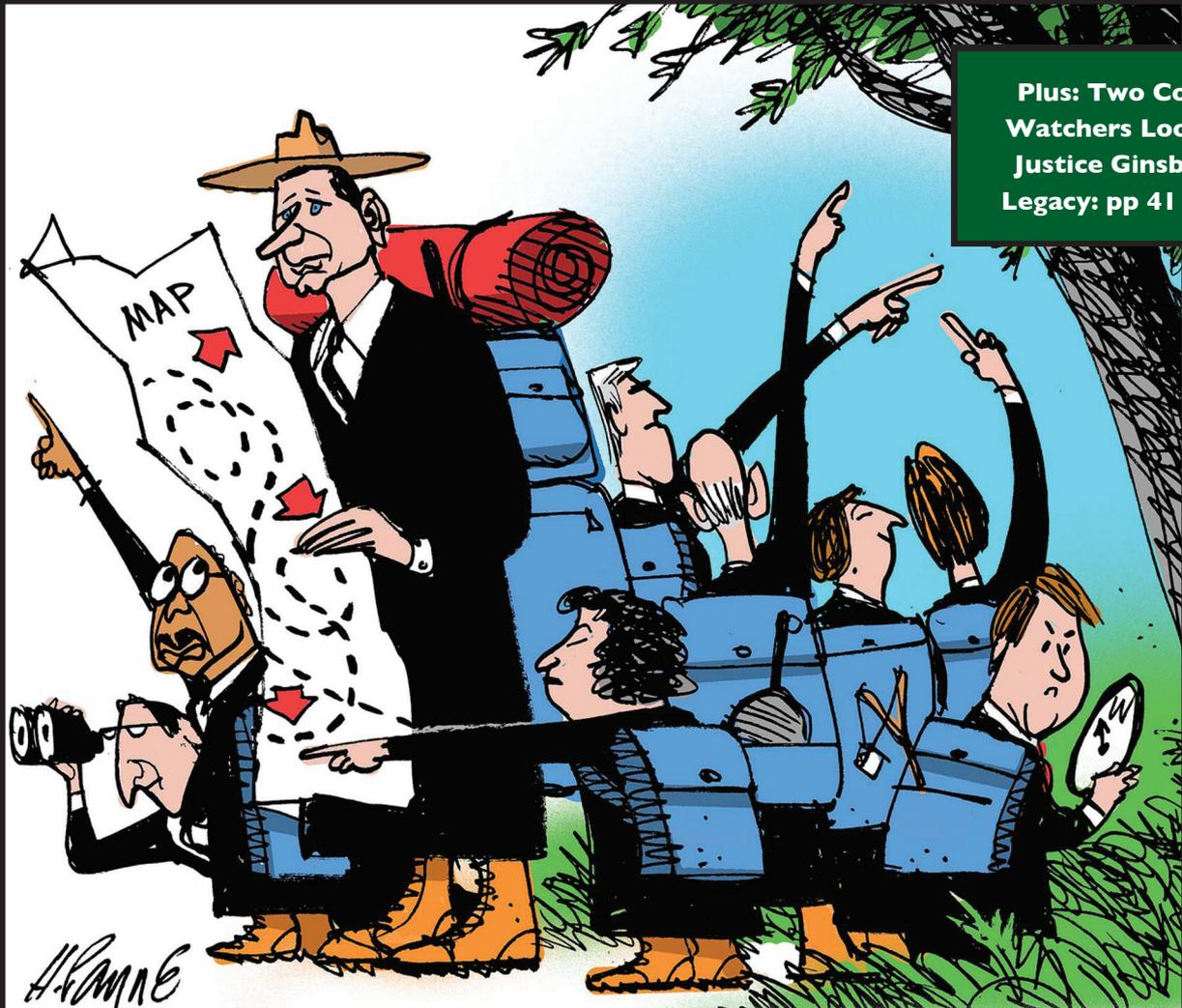


NOVEMBER/DECEMBER 2020

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The Next Pandemic Is Here

It is time to organize in fighting diseases that emerge from animals to impact humans and disrupt society. We can prevent zoonotic infections like the COVID-19 virus by drawing on principles of environmental laws protecting nature and limiting contact with wildlife



Nicholas A. Robinson is university professor on the environment and Gilbert and Sarah Kerlin Distinguished Professor of Environmental Law, emeritus, at Pace University's Elizabeth Haub School of Law.

Coping with the COVID-19 pandemic is a shared experience. Importantly, we are learning that we share the biosphere. Indeed, the coronavirus came to us from animals, a process called zoonosis. But it was not the first serious disease to do so. Veterinarians have long joined with physicians to treat viruses and bacteria afflicting humans and other vertebrate animals. Public health experts have also been concerned by infectious diseases moving from animals used in commerce to humans. These experts know that hiding in plain sight is the next pandemic. It is already among us.

When it comes to emerging infectious diseases, policymakers seemingly face a Hobson's choice: suffer through pandemics, or organize to avert them. The latter recourse is stated ironically; it too is a difficult choice because society has not done well in the past in organizing to fight emerging pandemics, either long-term or short-term. Strands of unifying concepts for a healthy Earth (including humanity) resonate through veterinary science, medicine, ecology, environmental law, and ethics. Indeed, some veterinarians and physicians have organized around a concept they call One Health, upon which this essay expands — see the box on the adjacent page. But that is just a first step in bringing all stakeholders to work in concert. And who is not a stakeholder? We are learning that lesson with COVID-19.

There are many other lessons to learn. But inconveniently, popular memory forgets the hor-

rors of past pandemics. For instance, these verses from eight centuries ago:

*The world is changed and overthrown,
That is well-nigh upside down,
Compared with days long ago.*

This dismal observation is by the mentor and friend of Geoffrey Chaucer, John Gower, who served two kings as England's poet laureate. He lived through the Great Pandemic of 1348, a bubonic plague which rats carried to humans and which continued into the 1390s. He witnessed English society descend into civil strife and misery, lacking means to cope with the disease.

That wasn't the only affliction to wipe out vast segments of society. Recall the Brucellosis bacterial infections from cows igniting the Plague of Athens (430-426 BCE), or the Antonine Plague of 172 killing one of every ten persons in the Roman Empire, or the Great Smallpox Epidemic during the American Revolutionary War, or the bubonic Third Plague Pandemic in China (1855), or the Russian Flu Pandemic (1889-90). And another lesson is that some zoonotic diseases persist. Tuberculosis takes 1.5 million lives annually. HIV-AIDS is still a scourge. The 1918 Influenza Pandemic has morphed into the viruses that we live with as the common cold and annual flu shots. Who knows what spinoffs COVID-19 will have.

The frequency with which these infectious diseases emerge from the animal kingdom to afflict humans is

accelerating. This is a function of greatly increased human population, disruption of animal habitat in the wake of development, and the expanding interface humans have with animals that shed their microbes because they are stressed by the above. The result is that pandemics are constantly emerging, some taking on serious dimensions.

For example, six months into the COVID-19 pandemic, the National Academy of Sciences published a report entitled “Prevalent Eurasian avian-like H1N1 swine influenza virus with 2009 pandemic viral genes facilitating human infection.” Humans working on pig farms are infecting other humans in China with G4 EA H1N1, a new virus. Pre-existing immunities appear ineffective against this infection. The report found that its “infectivity greatly enhances the opportunity for virus adaptation in humans and raises concerns for the possible generation of pandemic viruses.” The G4 EA H1N1 virus spreads among humans in parallel with a raging animal pandemic of African swine fever virus, known as AFS. AFS is forcing Asians to kill their domestic pig herds. The virus is now in 17 European nations and threatens to spread across all continents. No one knows now how to contain the pandemic among animals and the hope is that it will not leap to human transmission. The AFS pandemic in domesticated pigs also threatens extinction of the remnant wild pig populations in Asia.

Even if public health systems can contain the spread of novel coronavirus G4 EA H1N1, as Ebola has been contained for the moment in Africa, there is always another infectious disease emerging. For the foreseeable future, our reality is to live in an era of escalating numbers of zoonoses, with animals shedding viruses onward to humans the more they are stressed by human activities. Zoonosis accounts for 61 percent of all human diseases and 75 percent of the new infectious diseases of the past decade. Spill-overs of infection are natural: Zoonotic diseases emerge from the animal kingdom, the terrain of the countryside, the lands and places of biodiversity. Development invariably degrades animal

health as it displaces wildlife habitat and diminishes biodiversity. When an animal can no longer serve as a healthy host for microbes, it sheds bacteria and viruses, which can then infect a new host — a process called spill-over. Humans are infected either directly, as when handling meat, or indirectly through intermediate vectors such as rats and mice or ticks and mosquitos.

When the Plague of Athens raged, Earth held only some 190 million people. When Gower wrote, the 13th century’s Great Plague killed 40 percent of Earth’s then 500 million inhabitants. Demographers estimate that Earth will hold 8,000 million humans in 2024 — more than a magnitude higher. The biomass of humans today is estimated to be 10 times that of all wild animals. If trends continue, theoretically there could be 9 billion people in 2038, 10 billion in 2056, and 11 billion in 2088. There are plenty more humans to host viruses and bacteria, and society’s needs will result in disrupted habitat and ecologies.

Biodiversity declines precipitously as human population grows. Twenty percent of the Amazon forests have been lost in the past five decades. Half the world’s ecosystems are degraded. Populations of mammals, birds, fish, reptiles, and amphibians have, on average, declined by 60 percent between 1970 and 2014. Dislodged from healthy habitats, distressed animals shed their microbes. Of the millions of viruses yet to be studied, perhaps some 700,000 are capable of zoonosis. Bacterial infections are also

worrying, with some resisting antibiotic treatments. There are doubtless many spill-overs to come because the interface between humans and animals has never been greater.

The COVID-19 virus warns us that humanity has already taken the proverbial step too far. This world is changed and overthrown, by us and the virus. The coming succession of new emerging infec-

ONE HEALTH is the universal policy and practice of care for the integrity, stability, resilience, and beauty of Earth’s biotic community through nurturing the interdependent health links that are shared among humans, wildlife, domesticated animals, plants, ecosystems, and all nature. One Health transcends and unites the contributions of the life sciences for stewardship of ecosystem integrity and biodiversity to sustain the health and well-being of life on Earth.

tious diseases will cement our common fate. Benjamin Franklin counseled that “an ounce of prevention is worth a pound of cure.” In a world overthrown, are not the escalating costs of infectious diseases the best evidence that all countries need to rethink how they act, and to fund measures to prevent the next pandemic? Because that pandemic is already among us.

To cope with spill-overs from animals to humans, the process starts by differentiating the measures appropriate for each of three stages of zoonotic infectious disease emergence.

The first stage is when animals live within healthy ecosystems. Intact habitat dilutes the risk of spill-overs because microbes are then stable within their wild animal reservoirs. In a vibrant ecosystem, predators keep in check the numbers of animals that host microbes. However, nature conservation, though vastly less expensive than the costs of a pandemic, is chronically underfunded.

The second stage is emergence, the spill-overs resulting from disruptions to wildlife. Humans disrupt animal habitats in much of what they do, such as building new settlements and roads, clearing land for commercial development and agribusiness plantations, commercial hunting and marketing of wild animals killed for food, harvesting timber, or mining and other natural resource extraction. Encroachments into natural areas disrupt intact ecosystems, fragmenting habitat. Humans find increased numbers of animals with their microbes living in their midst. But few, if any, governmental resources are devoted to the health of wild animal habitat to avert or contain spill-overs. Environmental laws, such as requiring environmental impact assessments, are rarely deployed to address zoonoses. Governmental capacity in this second stage is weak. There is little funding for surveillance and nearly two-thirds of laboratories capable of identifying zoonotic diseases are in developed nations, with virtually none in the developing countries where many zoonotic diseases are emerging.

The third phase is rapid spread of the disease among humans, as in the 2003 epidemic of SARS, or as in today’s COVID-19 pandemic. In this phase, travel and trade expand the person-to-person infec-

tions worldwide. Governments concentrate most of their financing for health care and containment of pandemics in this phase. Their costs, few budgeted in advance, are astronomical. Lyme disease illustrates the importance of sustaining healthy ecosystems. Probably for centuries, the microbes responsible were living in wild animal hosts in this pre-emergent stage. Suburban sprawl after World War II displaced woodlots, wetlands, and other natural areas. The countryside no longer sustained native predators, and small mammals began living amidst humans, enabling spill-overs. In the 1970s the disease was identified in Connecticut. In 1982 ticks were identified as disease vectors conveying a bacterium, a spiroche, from small mammals like mice to infect humans. This emergent second phase became well documented. Since then the incidence of Lyme disease keeps growing, with over 400,000 new cases annually. It is now found in all states except Hawaii. As this third phase persists, there is no definitive cure for individuals suffering from late-stage Lyme disease.

Humans first learned about zoonosis through contacts with domesticated animals. To their credit, veterinarians who noticed this transmission have long urged a collaborative approach to human and animal health. They forged a partnership with physicians and public health specialists, and have scoped out processes by which epidemiologists can pinpoint how and where an animal infects a human. That means governments and public health specialists can build capacity to contain the outbreak in the field, limit human-to-human transmission, find treatments, and of course start the vaccine search. This initial articulation of One Health is practical and instrumental, necessary but not sufficient to avert the next pandemic.

Given the millions of microbes and lack of capacity in most nations to watch for spill-overs and react, or even to care for large numbers of persons infected, attaining the narrow One Health approach at best lies in the distant future. More immediate action to prevent new spill-overs must focus on keeping wild animals healthy in the first place. Stewardship of ecosystems and biodiversity is an essential part of One Health. Medical teams of veterinarians and physicians need to partner also with conservationists, indigenous peoples, and protected area managers. The

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legal profession is essential too, since the groundwork of environmental law is essential to implement this more holistic objective. Indeed, the ethics of environmental protection can figure prominently in containing zoonoses.

Acknowledging the shared bonds, including the ethical dimensions that link these stakeholders together — often through the principles and processes of environmental law — can generate public support, and budgets, for their work. For One Health successfully to enlist multiple stakeholders beyond the medical professions, it will need to make explicit the human love of nature articulated by Thomas Berry, Edward O. Wilson, or Aldo Leopold. While microbes lack consciences, humans are moral animals. One Health cannot succeed unless it becomes embedded in social and environmental justice and equity among peoples. Ultimately care for the health of nature and the biosphere is a moral imperative. Public acceptance of One Health, and funding, is unlikely to advance based only on scientific rationales or utilitarian benefits of collaboration among health professionals. Ben Franklin's ounce of prevention will be hard to come by.

The ounce to find and fend-off the COVID-19 pandemic just before its Phase 2 emergence was too little, too late. In 2012, *The Lancet* published a series on preventing pandemics, emphasizing prediction and prevention of the next zoonosis. Johns Hopkins University's Center for Health Security held preparedness training in 2015 for "Event 201," a pandemic. In February 2018, the World Health Organization called for enhanced surveillance to detect the next global zoonotic threat, which it labeled "virus X."

In 2019, WHO and the World Organization for Animal Health, which since 1924 has led international cooperation on containing zoonoses in farmed and traded animals, joined with the UN Food and Agricultural Organization to publish the "Tripartite Guide To Addressing Zoonotic Diseases in Countries." This handbook focuses on cooperation between veterinary and public health authorities, and promotes a One Health approach to agriculture, food markets, domestic animals, and human health. But in 2018, the United States discontinued the Directorate for Global Health and Security, part of the White House's National Security

Council, which monitored emerging infectious diseases capable of pandemics. Unfortunately, this was opposite to what the guide suggests in preventing spill-overs.

Preventive measures depend on collaboration across disciplines and agencies. Proposals to establish close cooperation between veterinary science and human medicine date back to 1964, when Calvin Schwabe posited "One Medicine in Veterinary Medicine and Human Health." As new zoonotic infectious diseases emerged, such as Hendra (1994) or Nipah (1998), there were further calls for cooperation between animal and human health sectors. After the SARS epidemic, for instance, the Wildlife Conservation Society launched the "Manhattan Principles" for wildlife health.

But cooperation between sectors has progressed haltingly. Most public health departments lack collaboration with veterinary specialists. Financing is inadequate. Between 2009 and 2019, the University of California at Davis operated its PREDICT project, which worked in 30 countries to detect 949 novel virus species from 164,000 samples of wildlife, livestock, and humans. U.S. AID funding for PREDICT terminated just as COVID-19 emerged, and has not been renewed. Since 99 percent of the wildlife virome remains to be identified, even if adequately staffed and funded globally, surveillance remains a daunting task.

It will take decades to fund and build the capacity for the One Health preventative activities scoped out for Phase Two. Scaling up ongoing nature conservation in Phase One to add a mission to avert zoonotic spill-overs, which can bring benefits in each part of the world, should begin at once. All nations have protected area laws and managers, albeit underfunded for their missions. The infrastructure exists to avert new pandemics by keeping wild nature healthy. Currently advocates of One Health have not embraced this mission. Their instrumental concepts ignore a century of nature conservation accomplishments, practices, and laws that restore or sustain the health of wild animals and their natural habitats.

Since 1948, the International Union for the Con-

**One Health is not new.
Proposals to foster
cooperation between
veterinary science and
human medicine date
back to 1964**

ervation of Nature has provided the focus for nature protection worldwide. It is unmatched in its members' multidisciplinary expertise on preservation of ecosystems and habitats. IUCN's members are responsible for nature conservation at all levels of government, through national, state, and local parks, wildlife refuges, wilderness areas, wildlife migration corridors, and conserved wetlands. Protected areas have kept wild nature healthy across vast areas of the planet. These stewards of natural areas already manage, de facto, the interface between animals and humans, averting spill-overs of zoonotic diseases. IUCN motivated international agreements to back up national conservation work, such as the UNESCO World Heritage Convention, the Ramsar Convention of Wetlands of International Importance, the Bonn Convention on Migratory Species, or the Convention on Biological Diversity.

COVID-19 dramatically exposed the lack of contact, much less cooperation, between IUCN and the animal and human health sectors. When the pandemic forced adjournment of the Global Conference on Animal Welfare in Edinburgh and the IUCN World Conservation Congress in Marseille, it became evident that each governing event was scheduled for exactly the same days last June. One Health cannot realize its potential until it unites all the stakeholders that have roles to play across all three of the phases of coping with emerging infectious diseases.

The One Health divide between a veterinarian and public health focus and the nature conservation sector also surfaced in June, when the UN Environment Programme issued its own zoonosis guide. "Preventing the next pandemic — Zoonotic diseases and how to break the chain of transmission" focuses primarily on the health of domesticated animals in close contact with people. UNEP's guide oddly neglects both the assessments in its Global Environmental Outlook on the crisis in biodiversity, and the UNEP Assembly's Resolution 4 of 2017, which endorsed the united, holistic approach to One Health to address zoonotic risks and biodiversity conservation. UNEP and IUCN collaborate closely, but not it seems on scoping out how to cope with zoonotic spill-overs in the wild.

For its part, IUCN has been too parochial in focusing on nature conservation without addressing

zoonosis. The organization's lack of strategic collaboration is short-sighted. The Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services, akin to the Intergovernmental Panel on Climate Change, last year reported that zoonotic diseases are significant threats to human health, requiring stronger protection. But IUCN has yet to include

pandemic prevention among its traditional conservation missions, although it would have much to contribute. For example, IUCN's World Commission on Environmental Law can add its expertise on how best to apply the environmental laws in each nation to avert zoonotic spill-overs. IUCN's World Commission on Protected Areas has long recommended use of buffer zones to curb human interface with wildlife habitats.

The core for a One Health approach exists. In 2019 the German Foreign Office and the Wildlife

Conservation Society convened a conference to draft and endorse the Berlin Principles. These are not expressions of legal devices, but of best practices. They urge an ecosystem approach with integration across all sectors. The core value is both ethical and scientific: "Retain the essential health links between humans, wildlife, domesticated animals and plants, and all nature," and "Ensure the conservation and protection of biodiversity, which interwoven with intact and functional ecosystems provides the critical foundational infrastructure of life, health, and well-being on our planet."

Governments can use existing international law to implement the Berlin Principles. Nations can readily incorporate One Health standards and implementing measures into WHO's International Health Regulations. Binding on all WHO member states, these regulations can establish standard rules and focus local and regional actions appropriate to avert zoonotic spill-overs. Moreover, governments can coordinate such national measures through the decisions in the UN General Assembly and the multilateral environmental agreements, such as the biodiversity and climate conventions. Governments can avail themselves of Article XX in the 1947 General Agreement on Tariff and Trade, and

Nations can readily incorporate One Health standards and implementing measures into WHO's International Health Regulations

the 1998 Agreement on the Application of Sanitary and Phytosanitary Measures, to establish new standards for curbing the spread of zoonotic diseases in air travel and commerce. States can enforce the 1973 Convention on the International Trade in Endangered Species by preventing trade practices that spread zoonotic diseases.

National and local governments and states do not need to wait for such international developments. They can apply One Health within their own jurisdictions. Most of these levels of government already have enacted laws that can implement a holistic approach. Governments can deploy three bodies of existing law to secure its benefits: laws for nature conservation, for environmental impact assessment, and for spatial planning and land use.

For example, state and municipal parks, wetlands, and open space can be managed to minimize zoonotic risks. Healthy natural areas are essential to bacteria and viruses remaining relatively stable in their natural hosts. Doing so dilutes the chances of spill-over to humans. Wild animals prefer to “shelter in place” in their natural homes. Environmental laws help them to do so. Stewardship of existing parks and protected areas should be enhanced, and buffer zones delineated around each, to minimize the human interface with animals. Urban parks and tree cover need to be expanded.

Governments can deploy their environmental impact assessment procedures to minimize risk of zoonotic spill-overs. Virtually every nation has enacted an EIA law, and under international law, nations are legally obliged to implement EIA procedures. All EIA procedures are essentially the same, and could be revised to assess the health of natural systems where development is proposed, identify possible pathogens, mandate buffer protections for humans, and establish One Health links for continuing stewardship.

Spatial planning of cities and new developments determines environmental security. Cities are front lines managing zoonotic diseases, since most of the world’s people live in cities. Last July, the Global Pandemic Network, a consortium of leading academics, chose cities for their top research focus. As the Stockholm Resilience Center put it, “If the coronavirus has taught urban planners anything, it is that public access to green areas is more important than ever.” Cities and regions can deploy

their spatial, town, and country planning, zoning, and building codes to “design with nature.” IUCN’s 2014 guidelines for urban protected areas expressly addressed “emerging infectious diseases.” Urban wetlands and forestry programs can enhance wildlife corridors, by designating overlay zones across suburbia.

All these environmental laws reflect norms about caring for the Earth. The biodiversity crisis has been festering into an open wound for two centuries. Zoonotic diseases are spilling out of the wounds. Restorative, conservation biology is everyone’s obligation in order to contain and manage safely future zoonotic spill-overs. This reality is not yet widely understood. Moving to embrace and implement a holistic One Health approach can expand awareness and induce remedial action. Caring for the Earth will bring us to care for each other.

Past pandemics teach us that human resilience shines through even as disease tears asunder the essential health links between humans, wild flora and fauna, domestic animals, and ecosystems. This adversity can focus our collective vision. During the Great Depression and Dust Bowl of the 1930s and into World War II, the ecologist Aldo Leopold arrived at his Land Ethic. He observed that “we abuse the land because we regard it as a commodity belonging to us. When we see the land as a community to which we belong, we may begin to use it with love and respect.” In *A Sand County Almanac* published in 1949, Leopold posited what One Health advocates have since discovered. “A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise.”

Leopold guides us back to health: “The land ethic simply enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land. . . . In short, a land ethic changes the role of *Homo sapiens* from conqueror of the land-community to plain member and citizen of it.”

COVID-19 is just the latest pandemic to call on humanity to care for the entire community of life.

Only in that way can humanity be saved from continual diseases inflicted by a biotic community that it disrupts at its peril. **TEF**

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