AMA Journal of Ethics®
August 2025, Volume 27, Number 8: E593-600

MEDICINE AND SOCIETY: PEER-REVIEWED ARTICLE

Why Should Clinicians Care About Infectious Disease Existential Hazards?

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Abstract

Of all infectious disease events, pandemics could result in significant human depopulation in this Anthropocene epoch or even in the next few centuries. Existential factors that exacerbate pandemic risk include global warming, overpopulation, habitat loss, permafrost thawing, geopolitical conflict, and bioterrorism from naturally occurring or engineered pathogens. This article argues that clinicians have ethical duties to strengthen global public health systems and research on pandemic risk factors, promote proven prevention strategies (especially vaccines), and incentivize domestic and international partnerships that build capacity to respond to existential pandemic harms.

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Scientific literacy is an intellectual vaccine against the … charlatans who would exploit ignorance.
Neil deGrasse Tyson[1]

Pandemics and Existential Risks

History documents the stunning mortality and morbidity from pandemics, and we currently face a host of new microbial pathogens, some potentially pandemic. These might arise from spillover from other mammalian species,[2] irreversible permafrost thawing that releases ancient or virulent microorganisms,[3] or the emergence of yet-unknown undersea or exobiological microbes. Novel pathogens, especially viruses, might be unrecognizable by current diagnostic testing. We will therefore need to develop new technologies, as was the case with previously unknown human retroviruses, notably HIV. Providing adequate public health resources, even for known microbial species, might be difficult at best, as was the case with development of timely Ebola vaccines and diagnostics.[4,5,6]

Of all infectious disease events, pandemics could result in significant human depopulation in this Anthropocene epoch or even in the next few centuries. *Depopulation* refers to a substantial reduction in the population of a species in a given

area, usually from multiple factors, especially wars, genocide, famine, or disease. Pandemics in recorded history have exacted dramatic morbidity and mortality but have seldom resulted in mass depopulation. Existential factors that exacerbate pandemic risk include global warming (primarily from rising atmospheric CO_2 and methane levels), rising sea levels with massive flooding of coastal communities, habitat destruction, famine,[7] pollution from multisource microplastics[8] and air pollution, which exacerbates underlying illnesses, especially in very large cities.[7,9] Most scientists agree that by the year 2100, climate change and nonmicrobial threats will pose unimaginable and unlivable threats.[10]

One of these threats is extinction. Extinction, by definition, is the complete and permanent depletion of a species. Familiar examples include the disappearances of dinosaurs and dodo birds. Major indicators of species extinction are magnitude and rate of species loss over time. Mass extinctions occur "when the Earth loses more than three-quarters of its species in a geologically short interval, as has happened only five times in the past 540 million years or so."[11] Barnosky and colleagues cite evidence that suggests that "humans are now causing the sixth mass extinction."[11] This mass extinction could transform the global biosphere into an inhospitable and unlivable state for *Homo sapiens* within the foreseeable future, unless we act wisely and make, as Ceballos and Ehrlich opine, "Immediate political, economic, and social efforts of an unprecedented scale [that] are essential if we are to prevent these extinctions."[12] Such efforts are justified because, with respect to land vertebrates, "[w]e are in the sixth mass extinction event. Unlike the previous five, this one is caused by the overgrowth of a single species, *Homo sapiens*.... It is changing the trajectory of evolution globally and destroying the conditions that make human life possible. It is an irreversible threat to the persistence of civilization and the livability of future environments for *H. sapiens*. Instant corrective actions are required."[12]

This article discusses infectious diseases and their control and argues that clinicians have ethical duties to strengthen global public health systems and research on pandemic risk factors, promote proven preventatives (especially vaccines), and incentivize domestic and international partnerships that build response capacity to existential harms that increase humanity's vulnerability to pandemics.

Examples of Infectious Disease Surveillance and Control

Infectious diseases with pandemic potential. Malaria, tuberculosis, bubonic plague, smallpox, influenza, and HIV lead the historic list of deadly microbes.[13,14,15] Two major bubonic plagues—the Justinian plague of the sixth century CE and the Black Death of the 14th century CE—probably killed at least 50 to 100 million Europeans, or an estimated 25% to 60% of the population.[14,15,16] Even more devasting was the impact of smallpox on Indigenous populations of the Americas after its introduction by Europeans beginning in the early 16th century. Up to 90% of certain Native populations perished.[15] In absolute terms, the influenza pandemic ("Spanish flu") of 1918 to 1920 had the largest recorded human death toll from a pandemic caused by a contemporaneously (though incorrectly) identified microbe,[17] resulting in a global mortality previously estimated at 50 to 100 million persons and, more recently, at about 17.4 million, with estimates ranging from less than 1% to 5.4% of the global population.[18,19] And the ongoing HIV/AIDS pandemic continues to bring high mortality and morbidity despite effective diagnostic, therapeutic, and preventive advances. HIV/AIDS had caused an estimated 32 million deaths as of 2021.[20]

More recently, the novel severe acute respiratory syndrome coronavirus (SARS CoV-2) has caused the current and well-studied COVID-19 pandemic. As variants continue to occur and infect more populations, the cumulative mortality and morbidity continue to rise. As of April 2025, over 7 million deaths attributable to COVID-19 had occurred globally.[21]

There are many more known emerging infectious diseases that could cause pandemics. The Institute for Health Metrics and Evaluation Pathogen Core Group described the global burden of infectious disease in a 2019 study[22] that listed dozens of pathogens that could cause global mortality and morbidity. Most are bacteria for which we have therapeutic antibiotics, albeit of variable efficacy. But the rising global incidence of antibiotic resistance necessitates ongoing research and continued collection of samples. We have no effective broad-spectrum antiviral agents, although some existing antiviral drugs exhibit modest cross-viral inhibition.[23]

Public health goals for infectious disease. All prevention and control paradigms utilize specific countermeasures targeting a specific pathogen. Such countermeasures include isolation, quarantine, mass vaccinations, antimicrobial drugs, control of vectors (such as insects) and vehicles of transmission (such as contaminated water), and continued surveillance.[13] Clinicians must support evidence-based best practices and majority-expert recommendations that promote reasonable public health policy for all citizens.

Eradication of a human pathogenic species refers to "zero disease," in which control measures are no longer needed.[13] To date, we have achieved eradication of only the smallpox virus. It has been 47 years since the last naturally occurring case of smallpox occurred.[24] However, the presence of frozen smallpox virus in a few secure governmental laboratories, its presence in permafrost corpses, and the potential for intentional or unintentional recrudescence of smallpox make vigilance and public health surveillance still necessary.[25] *Elimination* of a pathogen denotes achievement of zero disease in a specific region, not worldwide. Polio, for example, has been eliminated from the Western Hemisphere.[13] Nevertheless, polio surveillance and immunization remain necessary.

Clinicians' Roles

Communication. Although rapid development of vaccines against SARS-CoV-2, utilizing a novel messenger-RNA platform strategy, prevented at least 20 million deaths in the first year alone,[26,27] diminishing public trust in science has led to unnecessary mortality and morbidity from vaccine-preventable diseases, including COVID-19. Initial uncertainty about COVID-19 vaccines prompted politicians and other public opinion leaders to propagate conspiracy theories and other sources of misinformation. Failure to be vaccinated led to tens of thousands of unnecessary deaths.[28]

Physicians have ethical duties to dispel falsehoods that harm patients and the public.[29] All clinicians should become more active in countering disinformation, especially regarding vaccines, to renew the public's trust in America's public health system and in medical sciences. For example, explanatory videos can be effective in building trust. Buhr, Romero, and Wisk recently reported that trust in systems improved among lay persons and health care workers when exposed to a simple video on scarce resource allocation policies when demand for critical health services exceeds supply.[30]

Pathogen identification. Bioterrorism remains a concern, especially if nefarious actors develop novel pathogens, mutate known ones into highly transmissible and deadly agents, or recover replicative smallpox or even yet-unknown viruses from permafrost corpses.[2] Science has already sequenced the entire genome of the 1918 influenza virus from permafrost corpses.[31] Smallpox viruses trapped in cryptobiosis could be thawed and transformed into biologic weapons.[3] Bioterrorism becomes even more concerning if rogue terrorist agents develop high-efficiency delivery techniques in today's high-tech world. The remote possibility also exists that a laboratory accident could release a deadly pathogen. We must anticipate global chaos that could be caused by the appearance of such agents, against which most populations have lost vaccine-induced or natural immunity.

Recently, a team of Chinese researchers led by Tian Qin reported on the efficacy of existing technology to identify the possible pathogens and their animal origins associated with a "what-if" scenario known as "Disease X."[32] Using a framework developed by the United Nations Secretary-General, researchers assigned 11 international laboratories to apply a "Disease X Test" to identify known and discover new pathogens. Six of the 11 laboratories correctly identified "pathogen X" as a new Mammarenavirus, and 5 correctly identified the animal origin as *Rattus norvegicus,* the common brown rat. Their study suggests that many of the world's top laboratories might already have capacity and ability to identify a new virus associated with an outbreak, epidemic, or pandemic.

Surveillance. To predict the next pandemic, clinicians will need to use increasingly sophisticated laboratory methods. For example, public health laboratories will need yet-to-be-developed metagenomic microbial sequencing for surveillance, especially for wastewater and clinical samples. Clinicians must be able to test patients more often and depend on the latest laboratory techniques for rapid pathogen identification. Clinicians must also depend on their local, state, and national public health officials for timely and accurate surveillance data and direct reports. Physician researchers, academicians, and clinicians must collaborate more often to publish scientifically accurate results more rapidly.

The current US spread of influenza H5N1 ("bird flu") since March 2024 has triggered the Centers for Disease Control and Prevention to utilize a national targeted H5 surveillance system on clinical and environmental samples.[33] As of April 29, 2025, 70 human cases had been detected (with one death); most were exposed to backyard or wild birds. None of the cases involved person-to-person transmission.[34]

Advocacy to Rebuild Trust

Need for advocacy. Global partisanship stems from overlapping, rapidly expanding issues, including overpopulation, geopolitical differences, distrust of diverse populations viewed as "other," increasing distrust of governments and science (especially of public health), misuse of artificial intelligence, and disinformation (the nefarious use of misinformation for personal or political gain).[35,36] These factors further public misunderstanding of science and even foster escalation of existing hostilities, multinational crises, regional and even global wars, and the increasing threat of unthinkable global nuclear war.[37] A "multicrisis"[37] could be the most serious existential threat yet.

We cannot ignore expedient political arguments that seek to dismantle (and even demonize) public health in the guise of promising less expensive and better or different results in the future. We must repair the anti-science harm done and rebuild trust with wise critical thinking, active involvement in organized medicine, and countering misinformation from nonmedical sources.

So, how can physicians do all this? By using their voices. A 2024 Gallup poll found that physicians still rank among the top 5 professions rated "very high" or "high" on honesty, trust, and ethics (behind nurses, pharmacists, and military officers), although there was a 14% decline (from 67% to 53%) between 2021 and 2024 (during the COVID-19 pandemic) for uncertain reasons.[38] More notable was a concurrent drop in ratings for members of Congress, from 9% to 8%,[38] but, counterintuitively, many members of the public now trust these members to exert key political influence on decisions that will affect all Americans' health.

Clinicians who provide or promote vaccines now have a special stake in the current political climate. Anti-public health forces are already fragmenting our world-class public health system for unscientific political reasons. Increasing anti-vaccine disinformation is already being propagated unchecked on social media. It's up to the medical profession to stand up for truth to apparent power.

Advocacy efforts. To protect and promote good health for all our patients and the public, all physicians, even busy ones, should become more active in their professional societies, community organizations, and even in politics. Some might choose to become activists for specific causes, write or visit their local and state politicians (or even become politicians), sign petitions, help finance just causes, and otherwise advocate for protecting patients' and the public's health. Regardless of specialty, keeping wisely informed via trusted and respected medical sources is essential.

We clinicians must continue to educate ourselves, our colleagues and patients, leaders and politicians, and the general public. As the Latin etymology of doctor is *docere*, to teach, we are obligated to continuously and dispassionately learn and teach science, medicine, and wisdom ethics. Broad medical competence is required to overcome current public complacency, ignorance, and disinformation. We must stay highly and wisely informed.

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Citation
AMA J Ethics. 2025;27(8):E593-600.

DOI
10.1001/amajethics.2025.593.

Conflict of Interest Disclosure
Contributor disclosed no conflicts of interest relevant to the content.

The viewpoints expressed in this article are those of the author(s) and do not necessarily reflect the views and policies of the AMA.

ISSN 2376-6980