

Primary Pandemic Prevention

Abstract: *Over the last few decades, hundreds of human pathogens have emerged at a rate unprecedented in human history. Emerged from where? Mostly from animals. The AIDS virus is blamed on the butchering of primates in the African bushmeat trade, we created mad cow disease when we turned cows into carnivores and cannibals, and SARS and COVID-19 have been traced back to the exotic wild animal trade. Our last pandemic, swine flu in 2009, arose not from some backwater wet market in Asia, however. It was largely made-in-the-USA on pig production operations in the United States. In this new Age of Emerging Diseases, there are now billions of animals overcrowded and intensively confined in filthy factory farms for viruses to incubate and mutate within. Today's industrial farming practices have given viruses billions more spins at pandemic roulette. How can we stop the emergence of pandemic viruses in the first place? Whenever possible, treat the cause. The largest and oldest association of public health professionals in the world, the American Public Health Association, has called for a moratorium on factory farming for nearly two decades. Indeed, factory farms are a public health menace. In addition to discontinuing the intensive confinement practices of animal agriculture, we should continue to research, develop, and invest in*

innovative plant-based and cultivated meat technologies to move away from raising billions of feathered and curly-tailed test tubes for viruses with pandemic potential to mutate within.

Keywords: pandemic; coronavirus; animal agriculture; covid-19; plant-based meat

Since about 1975,¹ previously unknown diseases have surfaced at a pace unheard of in the annals of medicine²—more than

concluded that “nearly all” of the emergent disease episodes in the United States and around the world in recent years have come to us from the animal world.⁴

Humanity's biblical “dominion over the fish of the sea and over the birds of heaven; and every living thing that moved upon the earth” has unleashed a veritable Pandora's ark full of humankind's greatest killers.⁵ Tuberculosis is thought to have been acquired through the domestication of goats.⁶ In the twentieth century, it

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30 new diseases in 30 years, most of them newly discovered viruses.³ Emerged, from where?

I did most of my postgraduate medical work taking care of AIDS patients and remember thinking to myself, “When I was growing up, there was no such thing as HIV/AIDS. From where do emerging diseases emerge?”

An increasingly broad consensus of infectious disease specialists has

killed approximately a hundred million people.⁷ Today, tuberculosis continues to kill more than a million people a year.⁸ What started out in goats went on to infect one-third of humanity.⁹

In roughly the past 150 years, measles has been estimated to have killed about 200 million people worldwide.⁷ Measles is thought to have come from domesticated sheep and goats, a mutant of the rinderpest virus.¹⁰

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Smallpox may have resulted from camel domestication.¹¹ We domesticated pigs and got whooping cough, domesticated chickens and got typhoid fever,⁷ and domesticated ducks and got influenza.¹² The list goes on.¹³ Leprosy came from water buffalo¹³ and the cold virus from cattle¹⁴ or horses.¹³ How often did wild horses have the opportunity to sneeze into humanity's face before they were broken and bridled? Before then, the common cold was presumably common only to them.

We know that most of these new diseases are coming from animals, but animals were domesticated thousands of years ago. Why now? What is responsible for this recent fury of new and reemerging zoonotic disease over the past half century?

We are changing the way animals live on a global scale. The leading theory of the emergence of the AIDS virus blames the bushmeat trade in Africa, killing chimpanzees and creating "direct exposure to animal blood and secretions as a result of hunting, butchering, or other activities (such as consumption of uncooked contaminated meat) (p. 611)."¹⁵ Indeed, experts believe that the most likely scenario is that HIV arose from humans sawing their way into the forests of west equatorial Africa on logging expeditions, butchering chimpanzees for their flesh along the way.¹⁶ Severe acute respiratory syndrome (SARS) and SARS-CoV-2, the cause of COVID-19, short for coronavirus disease 2019,¹⁷ have been traced back to the exotic wild animal trade—live animal wet markets in Asia¹⁸⁻²²—and bovine spongiform encephalopathy, commonly known as mad cow disease, was the result of humanity turning natural herbivores like cows and sheep into carnivores and cannibals by feeding them slaughterhouse waste blood and manure.²³⁻²⁶

Our last pandemic virus, the 2009 H1N1 swine flu, arose not from some backwater wet market in Asia, but largely from industrial pig operations in the United States.^{27,28} Thankfully, it resulted in "only" about a half million deaths.²⁹ Next time, we might not be so lucky.

COVID-19 may just be a dress rehearsal for an even greater threat waiting in the wings—of a chicken.

In 1997, a flu virus named H5N1 was discovered in chickens that would forever change our understanding of how devastating pandemics could become. So far, it has remained a disease of poultry, not people, but of the hundreds of rare individuals it has infected, more than half have died. Indeed, H5N1 has an apparent fatality rate exceeding 50%.³⁰ What if a virus like that were to mutate to acquire easy human transmissibility and trigger a pandemic?

The last time a bird flu virus jumped directly to humans and caused a pandemic, it triggered the deadliest plague in human history, the pandemic of 1918 that killed 50 million people.³¹ What if instead of a 2% death rate, it was a flip of a coin?

The COVID-19 pandemic has been devastating, but food is still being restocked in our grocery stores. The internet may be slow, but it is still up. The lights are still on, and safe drinking water is still flowing from the tap. Doctors and nurses are still showing up to work. In 2020, more than 300 000 Americans have died³²—nearly 1 in 1000, but in the pandemic of 1918, 2% of the cases succumbed, leaving about 1 in a 150 Americans dead.³³ Imagine if it were 10 times as bad as 2%, with 1 in 15 dying. Or 25 times as bad, killing 1 in 6 of us.

Coronavirus or influenza virus, the good news is that there is something we can do about it. Just as eliminating the exotic animal trade and live animal markets may go a long way toward preventing the next coronavirus pandemic, reforming the way we raise domesticated animals for food may help forestall the next killer flu.

The last pandemic largely spared us. Swine flu only triggered a Category 1 pandemic in 2009,³⁴ but it showed a new origin point for pandemic viruses—pork production³⁵⁻³⁷—and appears to be epidemiological blowback from our use of overcrowded and intensively confined animal agricultural methods.³⁸⁻⁴¹

In response to the torrent of emerging and reemerging zoonotic diseases

jumping from animals to people, including the H5N1 bird flu,^{42,43} the World Health Organization (WHO), the World Organization for Animal Health (OIE), and the Food and Agriculture Organization of the United Nations (FAO), respectively the world's leading medical, veterinary, and agricultural authorities, held a joint consultation in 2004 to determine the key underlying causes. Four main risk factors for the emergence and spread of these diseases were identified. Bulleted first was "Increasing demand for animal protein."⁴⁴ This has led to what the Centers for Disease Control and Prevention (CDC) refers to as "the intensification of food-animal production," the factor blamed in part for the increasing threat.⁴⁵

The WHO, OIE, and FAO all implicated industrial poultry production as playing a role in the H5N1 crisis. The WHO blamed the increasing trend of emerging infectious diseases in part on the "industrialization of the animal production sector,"⁴⁶ in general, and the emergence of H5N1 on "intensive poultry production," in particular.⁴⁷ The OIE blamed in part the shorter production cycles and greater animal densities of modern poultry production, which result in a "greater number of susceptible animals reared per given unit of time."⁴⁸ Said one senior FAO official, "[I]ntensive industrial farming of livestock is now an opportunity for emerging diseases."⁴⁹

Other experts around the world similarly placed blame at least in part on "so-called factory farming,"⁴⁰ "intensive poultry production,"⁴⁷ "large industry poultry flocks,"⁵⁰ "intensive agricultural production systems,"⁴¹ or "intensive confinement."³⁹ "We are wasting valuable time pointing fingers at wild birds," the Food and Agriculture Organization stated, "when we should be focusing on dealing with the root causes of this epidemic spread which . . . [include] farming methods that crowd huge numbers of animals into small spaces."⁵¹

In the United States, the average numbers of animals on chicken, pig, and cattle operations approximately doubled between 1978 and 1992.⁵² This increasing population density seems to be playing a

key role in triggering emerging epidemics. In terms of disease control, according to the FAO, “[t]he critical issue is the keeping [of] more and more animals in smaller and smaller spaces.”⁵³ The unnaturally high concentration of animals confined indoors in a limited airspace producing enormous quantities of manure provides, from a microbiologist’s perspective, “ideal conditions for infectious diseases.”⁵⁴

What is more, high-density production allows for disease to spread faster to greater numbers of animals.⁵⁵ Because intensive operations are vulnerable to catastrophic losses from disease,⁵² the US Department of Agriculture considers animal disease “the single greatest hindrance to efficient livestock and poultry production on a global basis.”⁵⁶ Industrial animal factories lead not only to more animal-to-animal contact, but also to more animal-to-human contact, particularly when production facilities border urban areas.⁴

The stress associated with the routine mutilations farm animals are subjected to without anesthesia⁵⁷—including castration, branding, dehorning, detoeing, teeth clipping, beak trimming, and tail docking⁵⁸—coupled with the metabolic demands of intensive production, such as artificially augmented reproduction, lactation, early weaning, and accelerated growth rates, leave animals, according to one review, “extremely prone to disease.”⁵⁹ Never before have microbes had it so good. In the 20 years between 1975 (around the time when the dean of Yale’s School of Medicine famously told students that there were “no new diseases to be discovered”⁶⁰) and 1995, 17 foodborne pathogens emerged, almost 1 every year.⁶⁰ With billions of feathered and curly-tailed test-tubes for viruses to incubate and mutate within, a WHO official described the past few decades as “the most ambitious short-term experiment in evolution in the history of the world.”⁶¹

Modern corporate chicken sheds cluster tens or hundreds of thousands of chickens into what are essentially giant slums.⁶² These animals spend their entire short lives eating, sleeping,

and defecating in the same cramped quarters, breathing in particles of their neighbors’ waste and the stinging ammonia of decomposing feces. Their first breath of fresh air is on the truck to the slaughter plant. In this kind of environment, the perfect storm may be created and mass disease outbreaks inevitable.⁶³

This is why the United Nations issued a press release stating, “Governments, local authorities and international agencies need to take a greatly increased role in combating the role of factory-farming, commerce in live poultry, and wildlife markets which provide ideal conditions for the virus to spread and mutate into a more dangerous form.”⁵¹

The H5N1 virus started out like all bird flu viruses as harmless waterborne intestinal infections of waterfowl, but only gained airborne transmission and the ramping up of extreme virulence within massive intensive poultry production.⁶⁴ Perhaps only a change in conditions as great as mega-farms with 10 million birds could account for the dramatic series of mutations sufficient to create such a monster virus. Intensive poultry facilities have become “ideal”⁶⁵ “breeding grounds for disease”⁶⁶ with “poor ventilation, high stocking density, poor litter conditions, poor hygiene, high ammonia level, concurrent diseases and secondary infections (p. 25).”⁶⁷

According to the CDC, the leading candidate for the next pandemic is a bird flu virus known as H7N9,⁶⁸ which is a hundred times deadlier than COVID-19. With an apparent case fatality rate of nearly 40%—2 in 5 people—it is one of the deadliest human pathogens ever described and, as a flu virus, has the potential to blanket the globe. One published estimate of the impact an H7N9 pandemic could have on the United States suggests that millions of Americans could die.⁶⁹

Thankfully, neither H5N1 nor H7N9 has yet acquired the capacity for easy human-to-human transmission. But, given that both H5 and H7 viruses have displayed the propensity to infect humans, there is heightened concern that they may evolve the ability to transmit

between people and initiate a pandemic. Mutating is what influenza does best.⁷⁰

And, they are still out there. Still mutating. Former Senate Majority Leader Bill Frist, MD, compared H5N1 to a gambler. From the floor of the Senate, Frist explained, “Billions of mutations of the virus are occurring every day. With each mutation, the virus multiplies its odds of becoming transmissible from human to human. It’s like pulling the lever on a Vegas slot machine over and over again. If you pull enough times, the reels will align and hit the jackpot.”⁷¹

In the end, the virus that wins, the virus that succeeds in making the most copies of itself, is the virus that outperforms the others, passing through thousands of individual cells to learn how best to infect the human species. It is that virus that gets breathed into the next person’s lungs and the process starts all over, so the virus can get even smarter.

Within a single individual, a virus evolves, adapts, and learns. It hits dead ends and tries something new, slowly notching up mutations that may lock into place the ability to effectively survive in, and transmit between, people. Every single person who gets infected presents a risk of spawning *the* pandemic virus. Describes one virologist, “You’re playing Russian roulette every time you have a human infection.”⁷² Experts fear that as more and more people become infected, a virus will finally figure out the combination—the right combination of mutations to spread not just in one elevator or building, but in every building, everywhere, around the globe. Then, it will not just be peasant farmers in Vietnam dying after handling dead birds or raw poultry—it will be New Yorkers, Parisians, Londoners, and people in every city, township, and village in the world dying after shaking someone’s hand, touching a doorknob, or simply inhaling in the wrong place at the wrong time. It has happened before, and it may soon happen again.

Pandemics are always a matter of when, not if, and a pandemic with more than a few percent mortality would not only threaten financial markets but civilization itself as we know it.

How can we stop the emergence of pandemic viruses in the first place? If there is one concept to draw from my work on preventing and reversing chronic disease, it is to treat the cause whenever possible.

We need to give these animals raised for meat and eggs, by the billions, more breathing room. They are the ones who could use some social distancing. To lower our risk of generating increasingly dangerous farmed animal flu viruses, the global meat and egg industries must reverse course away from greater intensification. But how? As suggested in the *Annals of the New York Academy of Sciences*, by “replacing large industrial units with smaller [farms] with lower stocking densities,”⁷³ potentially resulting in less stress, less disease susceptibility, less intense infectious contact, and smaller infectious loads.

The public health community has been shouting from the rooftops for years about the risks posed by factory farms. In 2008, the Pew Commission on Industrial Farm Animal Production concluded that industrialized animal agriculture posed “unacceptable” public health risks: “Due to the large numbers of animals housed in close quarters in typical [industrial farm animal production] facilities there are many opportunities for animals to be infected by several strains of pathogens, leading to increased chance for a strain to emerge that can infect and spread in humans.”⁷⁴

Five years before that, the American Public Health Association (APHA), the largest and oldest association of public health professionals in the world, was among those advocating for “radical” (from the Latin *radix*, for “root”⁷⁵) change. In 2003, the APHA passed a “Precautionary Moratorium on New Concentrated Animal Feed Operations,” in which it urged all federal, state, and local authorities to impose an immediate moratorium on the building of new factory farms—including industrial turkey, laying hen, broiler chicken, and duck facilities.⁷⁶ In November 2019, it reiterated its stance, publishing a new policy statement calling once again for a moratorium on new factory farms as well

as a moratorium on the expansion of existing ones.⁷⁷

Perhaps COVID-19 is the dry run we needed, the fire drill to awaken us from our complacency to reform the food system before it is too late.

But, if, as the FAO visualized it, the next pandemic starts with increased demand for poultry products,¹⁸ before ending up with human-to-human transmission, perhaps we need to move beyond just giving these animals some more breathing room. In fact, the journal of the APHA published an editorial entitled, “The Chickens Come Home to Roost” that went beyond just calling for a deintensification of the pork and poultry industries. The editorial questioned the prudence of raising so many animals for food in the first place, given the pandemic threat they may pose:

It is curious, therefore, that changing the way humans treat animals, most basically ceasing to eat them, or at the very least, radically limiting the quantity of them that are eaten—is largely off the radar as a significant preventive measure. Such a change, if sufficiently adopted or imposed, could still reduce the chances of the much-feared influenza epidemic. It would be even more likely to prevent unknown future diseases that, in the absence of this change, may result from farming animals intensively and killing them for food. Yet humanity doesn't even consider this option (p. 1545).⁷⁸

However, thanks to food innovations, this may be changing. Have you looked in the dairy case at the supermarket lately? Some of America's largest dairy producers have recently filed for bankruptcy as a result of the constellation of new consumer choices.⁷⁹ Expanded options are now hitting the meat case as well.

There has been a tremendous surge in interest in diversified protein sources, given the increasing consensus that reduced meat consumption is critical for addressing both the climate crisis and our burgeoning epidemics of lifestyle diseases. Eating less meat may not only help save the world but 10 million

human lives a year.⁸⁰ A completely plant-based diet might save \$30 trillion from the health benefits alone and that would be just from the lowered rates of chronic diseases such as cancer, heart disease, and type 2 diabetes,⁸¹ not even factoring in the decreased catastrophic pandemic risk.⁸² What we eat does not just affect our personal health, but our global health in more ways than one, so it is critical that we accelerate the movement toward plant-based milks, plant-based meats, and plant-based egg products.

No longer a niche market for vegetarians, major meat producers have started blending in vegetable proteins to make hybrid meat products like Tyson's “Whole Blends” sausage links and Perdue's “next generation” chicken nuggets.⁸³ Smithfield, the world's largest pork producer, recently debuted an entire line of plant-based products.⁸⁴ How many fewer porcine viral mixing vessels are there now that Dunkin' Donuts has a meat-free breakfast sausage?⁸⁵ How many fewer hens are caged beak-to-beak now that egg-free mayo has taken the sandwich spread sector by storm?⁸⁶ Quorn, a brand of meat-free meat made from the mushroom kingdom, opened a single facility that can produce the meat equivalent of around 12 million chickens per year.^{87,88}

An even more innovative approach to pandemic prevention was suggested by Winston Churchill in 1932. In an article in *Popular Mechanics* entitled “Fifty Years Hence,” he predicted that “[w]e shall escape the absurdity of growing a whole chicken in order to eat the breast or wing, by growing these parts separately under a suitable medium,”⁸⁹ and his prediction is becoming a reality. Instead of taking a cutting from a plant and growing vegetables, a sample is taken from an animal and meat is grown, perhaps a billion pounds from a single sample. In terms of efficiency, growing meat straight from muscle cells could reduce greenhouse gas emissions and water use by as much as 96% and lower land use by as much as 99%,⁹⁰ but if you factor in pandemic risk, the benefits to

human health could arguably rival those to the planet.

Food safety has been considered the primary human health benefit of a slaughter-free harvest. There has been a 6-fold increase in food poisoning over the past few decades, sickening tens of millions of Americans every year, and contaminated meats and animal products are the most common cause.⁹¹ So, when the cultivated meat industry calls its product “clean meat,”⁹² that is not just a nod to clean energy. Food-poisoning pathogens such as *Escherichia coli*, *Campylobacter*, and *Salmonella* are a result of fecal residue, traces of which are found on most poultry sampled in the United States and about half of retail ground beef and pork chops.⁹³ They are intestinal bugs, so you do not have to worry about them if you are producing meat without intestines, just like you do not have to worry about brewing up new respiratory viruses if you are making meat without the lungs.

The APHA’s “Chickens Come Home to Roost” editorial concludes, “Those who consume animals not only harm those animals and endanger themselves, but they also threaten the well-being of [future generations]. . . . It is time for humans to remove their heads from the sand and recognize the risk to themselves that can arise from their maltreatment of other species (p. 1546).”⁷⁸

How we treat animals can have global public health implications. As a spokesperson for the WHO has said, “The bottom line is that humans have to think about how they treat their animals, how they farm them, and how they market them—basically the whole relationship between the animal kingdom and the human kingdom is coming under stress.”⁹⁴

In this Age of Emerging Diseases, there are now billions of animals overcrowded and intensively confined in filthy factory farms for viruses to incubate and mutate within, giving them billions more spins at pandemic roulette. A 2019 review on emerging human infectious diseases concluded that most new animal-to-human diseases have been a result of how we now raise animals for our

food.⁹⁵ Along with human culpability, though, comes hope. If changes in human behavior can cause new plagues, changes in human behavior may prevent them in the future.⁹⁶

We may be 1 bushmeat meal away from the next HIV, 1 pangolin plate away from the next killer coronavirus, and 1 factory farm away from the next deadly flu. Tragically we do not tend to shore up the levees until after disaster strikes, and it may take a pandemic that wipes out millions before the world realizes the true cost of cheap chicken.

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