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Epidemics

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Introduction

Kenneth Waltz's classic three "images" for explaining the causes of war (2001) have not only become a model in studying different phenomena in international relations but have also proven valuable for framing various international security issues, such as drug trafficking (Kan 2016). Waltzian "images" are likewise useful for exploring the nexus between epidemics and security, for they help us understand how some germs and the diseases they cause can rise to the level of national, international, and global security problems.

At the first (*micro*) level of analysis, pathogens pose a threat to individuals, their health, well-being, and life. This subject, as a patient's condition, falls into the sphere of *human security*, which focuses on the daily life perils people face. The second (*meso*) is the society and state level: disease strikes with a great impact, affecting a large population of a polity. Here an epidemic constitutes a challenge to *homeland* or *national security*. The next echelon is international (*macro*), wherein an epidemic crosses state borders and hits many countries. By turning pandemic, it now becomes a real concern for *international security*. The present age of globalization calls for developing a further Waltzian taxonomy with a fourth level of inquiry, that is, the global (*mega*). For when a disease sweeps across the planet and develops into a wildfire pandemic which erodes public health worldwide, it makes for a *global security* problem. These four "images" of contagion-security intersection should be seen as forming a concentric causal dynamic system with each inner circle posing a potential threat to each and every outer one (inside-outside) and vice versa (outside-inside, to inner ones).

The focus of this chapter is mainly the second image (*meso*), though the *macro* one is evoked, too: it discusses the essence and features of epidemics as a security issue and reviews patterns and trends in pathogenic hazards. The roots of biosecurity threats can be twofold and arise either from a disease generated by naturally occurring infectious microbes (existing, emerging, or reemerging) or from man-induced outbreaks (unleashed by states, non-state actors – such as terrorists, criminals, or scientist gone rogue – or those engendered by laboratory accidents). It is predominantly the first of these, natural pestilences, that is explored below. For the purpose of this essay, an epidemic is understood as a

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temporary, unexpected, and widespread rise in the incidence of infectious disease in a community, state, or region.

According to the utilitarian assessment put forward by James Wirtz, who proposed to capture nontraditional security issues in terms not of their threatening potential but through their amenability to military response, a problem is of a security and strategic concern if:

1. It can be effectively addressed by military action.
2. The military deployment somehow leads to environmental, resource, or demographic consequences.
3. Its effects may shape the ways in which force will be used in the future (2007, p. 341).

Epidemics meet all these criteria.

A New-Old Problem

Throughout centuries, the instances of microbes playing a decisive role in international power relations have not been rare. In his landmark *Plagues and Peoples,* published originally in 1977, William McNeill showed how contagious parasites shaped civilizations and, equally, how humankind affected epidemic patterns across space and time (McNeill 1988). By robustly rewriting social, political, and economic landscapes, epidemics have long constituted a security issue. The importance of the health of a community for a polity's well-being has been rated relatively high in political thinking, beginning with the Greeks. Yet in the second half of the twentieth century, the fruits of advances in medicine, healthcare, and living standards caused disease to be less significant in the geostrategic interests of the developed countries. Pathogenic plagues became – similarly to famine – limited to the non-Western world and thus more a concern of development than one of security. It was believed that in the West, the hazards of life-threatening infectious diseases had ultimately been overcome through what was called the "health transition." However, the outbreak of HIV/AIDS in the early 1980s and other emerging infectious microbes proved these views shortsighted and dangerously premature.

The fear of epidemics recurred in the aftermath of the Cold War and vigorously entered the global security agenda. A conjunction of several developments lay behind this supercharged "securitization" of health, disease, and epidemics in international politics:

1. The rise of "new security" (including such concepts as "human security"). The result was an immense conceptual expansion of the meaning and content of security, which has come to encompass a myriad of nonmilitary issues, from environment to population growth, from scare resources to epidemics. Galvanized by the AIDS pandemic, and beginning with the UN Security Council's resolution 1308 on HIV and peacekeeping in conflict situations (2000), health has come to be recognized as an essential concern of global security. Infectious disease has also been acknowledged as a major national security problem. For instance, the 2006 US National Security Strategy went as far as to equate the threat of pandemic disease to the terrorist acquisition of weapons of mass destruction.
2. The paradigm shift in conceptualizing security – now more in terms of risks instead merely of threats. While a threat is real, risk is potential – the difference boils down to what "is" and what may "become", to "danger" and "dangerousness" (Coker 2004, p. 51). Unpredictability, nonlinearity, and plausibility feature the biorisk potential of virulent pathogens to generate severe scourges.
3. Following the 2001 anthrax attacks in the United States, the risk of deliberate use of germs by malign non-state actors (mostly terrorists), but also states, to cause epidemic outbreaks pushed infectious disease strongly into a direct intersection with national and homeland security.
4. The emergence of novel parasitic microbes feared to be able to cause pandemics (such as SARS, Ebola, and H1N1 influenza) proved epidemics to be a genuine recurring security concern.

The Security Issue

The referent objects of biosecurity are both individuals and states. Correspondingly, there are two main approaches to the relationship between international politics and health (Davies 2010). From a globalist perspective, the ultimate subject of security is the individual. Because their health needs cannot be met by states alone, they should be addressed by global health governance. On the other hand, the statist perspective assumes that a precursor to the good health of individuals is national security. A fundamental function of a state, apart from its survival, is the protection of its population from both domestic dangers (safety) and external threats (security). A major epidemiological risk threatening mass fatality comprises precisely such a national security issue – for what would be the purpose of a government without a populace? This chapter attempts to unpack the *epidemic problematique* mostly within the statist framework which, through its securitization of health and disease, has addressed the subject much more thoroughly than the globalist approach.

Since the late 1990s, the unfolding securitization of infectious diseases has generated robust debate. On the one hand, some scholars of international relations and security studies have questioned the very significance of the matter. On the other, researchers of global health and development have voiced concerns that the detrimental instrumentalization of the problem serves merely the narrow interests of great powers. Only those epidemiological concerns that threaten their security, the argument goes, are ultimately acknowledged and admitted to the global security agenda, while the real needs of the vast populations of the underdeveloped and impoverished regions are neglected. It is not the advocates of the traditional reading of security alone who call for de-securitization and argue that health and disease should be moved back to their seemingly proper realm of the "lower politics" of healthcare, medicine, and development. Stefan Elbe, for example, who initially argued for recognizing communicable disease as a threat to national and international security, later called for HIV/AIDS to be conceptualized rather as a human security problem (2003, 2009, pp. 27–58).

Although many arguments against securitization have merit, it is imperative to consider why epidemics may indeed constitute a security risk. What are the direct links between epidemics and national/international/global security? Six broad answers to this question are discussed below.

Super Killers

Throughout much of human history, pathogenic microbes have been mass killers without parallel. They have claimed more lives than wars, the pivotal traditional concern of security. The Black Death (bubonic plague) of the fourteenth century killed at least a third of Europe's population (an estimated 25 million people) (Crawford 2009, p. 102). The worst pandemic ever, the infamous Spanish influenza, put to death some 50 million people in just over 1 year in 1918. The only greater killer in the twentieth century was the Second World War. The Spanish flu, says historian John Barry by way of comparison, "killed more people in a year than the Black Death of the Middle Ages killed in a century; it killed more people in twenty-four weeks than AIDS has killed in twenty-four years" (2004, p. 5). Since HIV/AIDS broke out in 1981, it has killed over 35 million and infected 75 million people. In Africa, AIDS took more than ten times as many lives as armed conflicts (Elbe 2002, p. 174). Overall, in the course of the last century, interstate wars resulted in some 68 million deaths, between 50 and 150 million people perished in mass killing and genocide, while smallpox alone killed 300 million (Valentino 2000, pp. 1–2; Rummel 2004, p. 15; Crawford 2009, p. 109). Whereas between 1945 and 1993 wars claimed 23 million lives, as many as 150 million persons died from just three communicable diseases: AIDS, tuberculosis, and malaria (World Health Organization 1999, p. 28). While deaths from armed conflicts constitute about 0.3–0.5% of the global mortality rate, those from infectious diseases account for 25% of annual fatalities worldwide (World Health Organization 2004, p. 58; Wang et al. 2015, pp. 1491–1493). If anything, then, epidemics threaten human security more severely than organized violence.

The Escalation Ladder

For Carl von Clausewitz, its propensity to escalate is inherent to the nature of war: violence, death, and destruction tend to grow to the extremes. Certainly, this is not always the case, as some conflicts intensify, while others remain limited; nonetheless, the risk of *escalation remains intrinsic*. The very same, albeit due to different reasons, might be said of infectious diseases: they carry a risk of rapid, wide cross-border, and lethal expansion. Some pathogens get out of control and go from causing individual afflictions to build into epidemic events which sometimes develop into global perils.

A disease turns into an epidemic when microbes find favorable conditions in which to become diffuse within a susceptible population. An outbreak is likely, if the value of R_o is higher than one, where R_o represents the reproductive rate of disease or the average number of new infections passed on by a single individual. For a ratio lower than one, the infection cannot perpetuate itself and will naturally burn out. Overall, the pattern and dynamics of an epidemic depend on:

1. The pathogen's transmission route (the likelihood of a pandemic is significantly higher for airborne microbes)
2. The length of the incubation period (if very long, like the average 8–10 years for HIV/AIDS, it can become global unnoticed, before hitting hard as a pandemic)
3. The size and density of the susceptible population (for each and every type and strain of microbes, a certain minimum number of infected persons is required to initiate and sustain the chain of infection)
4. For a vector-borne disease, the geographical range of the vector and the characteristics of its habitat (Crawford 2009, p. 22)

When does an epidemic become a pandemic? To be categorized as such, an event must meet some specific criteria: widespread geographic extension (critical here is the simultaneous occurrence of severe outbreaks over different continents), prevalent disease movement (person-to-person or via vectors), high contagiousness and explosiveness (multiplying cases within a short time), low or minimal population immunity, novelty (caused by emergent microorganisms or new, altered variants of already known pathogens), and severity (serious or fatal illness) (Morens et al. 2009, pp. 1019–1020). Simply put, a pandemic is epidemic gone large.

State Destabilization

Getting down to the *meso* level, epidemics can threaten to weaken states and create environments in which communities become more vulnerable to tensions and crisis. Long-running worker absenteeism across multiple sectors can challenge the operation of critical infrastructure, hamper the movement of goods and people, delay supplies of essential commodities, and disrupt the functioning of core institutions. Soaring rates of disease may impair a state's ability to provide healthcare and other public goods and crucial services, protect citizens, and, ultimately, to maintain order. With prosperity curtailed and coherence destabilized, trust in government could be further undermined by epidemic-induced economic turmoil. Thus a major outbreak could have a devastating impact on nearly every aspect of state and society, thereby eroding a government's managerial capacity.

Social disruption may result, additionally facilitated by public anxiety about an unfamiliar and ferocious disease. Panic often generates the stigmatization and social exclusion of the infected. Such reactions are well known from history and were evident, for example, in the initial representation of HIV/AIDS as "the gay plague." Crucial in understanding the debilitating consequences of epidemics, morbidity, and mortality apart is their psychological effect. When a population is hijacked by the individual and collective fear of infection and contagion, the social contract that obliges governments to protect their citizens comes under severe strain. What Henri Poincaré observed in 1905 still holds: "the plague was nothing; fear of the plague was much more formidable" (1914, p. 278). State-of-emergency measures introduced to prevent public breakdowns, such as outbursts of violence, plundering, or breaking quarantines, may fuel popular discontent. In September 1994, after the plague erupted in the Indian city of Surat, the authorities were forced to use police rapid reaction units to quarantine the city and stop the exodus after a quarter of its residents fled in just 4 days (500,000 people boarded trains within 48 h) (Garrett 1996, p. 73). The incident demonstrates how the erosion of trust in a government's capability to provide safety may threaten domestic order, more so in the less developed countries. It is also illustrative of the power of epidemics to rot social fibers when fear combined with ignorance undoes basic interpersonal sentiments (the strain of *Yersinia pestis* that caused the outbreak in Surat was actually very weak, with a mortality rate of only 1%). Tight epidemiological measures can in turn provoke popular resistance, because citizens may feel mistreated or denounced as sick and menacing "others." For example, during the SARS outbreak in China in 2003, rumors that the authorities were planning to set up local patient isolation wards resulted in riots in some parts of the country. Subsequent protests were propelled by the introduction of rural quarantine centers. Tensions heightened further when villagers built road blockades to protect themselves against refugees flowing from Beijing (Eckholm 2003; Price-Smith 2009, p. 143).

It cannot be excluded that a catastrophic epidemic in severely affected societies could incite sub-state violence, and "in extreme cases it may accelerate the processes that lead to state failure" (Prince-Smith 2002, p. 121). In fact, one of the main reasons that the UN Security Council declared AIDS an international security concern in 1999 was the epidemic's additionally destabilizing impact on the already very fragile African states. By striking mostly young adults in their productive years, the disease undermined the infrastructures essential for governance in sub-Saharan Africa – from healthcare to education, from workforce to armed services. AIDS manifested the power of epidemics to destabilize not only single states but entire regions. The International Crisis Group bluntly compared the disruptive impact of AIDS to that of war (2001). Epidemics do not, of course, cause wars themselves, but they can prepare the ground for them by making communities more vulnerable to conflict. Some experts warn of a worst-case scenario in which the outbreak of devastating infectious disease triggers violent conflict (Peterson 2002, pp. 54–68; Price-Smith 2002, pp. 117–139). A severely drained state, harrowed by an epidemic, poses a potential threat to its neighbors. Chaos could spill over and jeopardize regional stability and therefore might, theoretically, provoke a foreign military response to thwart "pathogenic" violent dysfunction.

In sum, although the grim scenario rarely becomes actual, a major epidemic meets the criteria of a security problem as defined by Ole Wæver: it can threaten to rapidly and dramatically undermine political and socioeconomic order within a state, thereby depriving it of the capacity to manage by itself and fulfill its basic functions (2011, p. 52). Epidemics differ in severity, and not all constitute a security concern, yet they should be conceived of as risk factors. And even if epidemics like AIDS, SARS, or flu are not in themselves a security threat, their collective impact on state strength and cohesion is what creates the underlying problem.

The Epidemiology of Warfare

Pathogens have affected the outcomes of armed conflicts much more frequently than they functioned as "war-starters." This conjunction of war and epidemics can take four essential forms.

The Trigger

Since ancient times, disease has been an intrinsic cost of war. Conflicts create settings that favor the spread of infectious pathogens among combatants and civilians. Malnutrition, poor hygiene, severe living conditions, high stress, lowered immunity, impeded epidemiological surveillance, and limited access to healthcare and medicines are breeding grounds in which microbes can thrive amidst vulnerable populations. Epidemics are therefore likely to break out in conflict zones as happened, for example, with the fourfold rise in the incidence of tuberculosis during the wars in Bosnia and Herzegovina (1991) and Somalia (1991–1992). Other examples are the outbreaks of cholera in the war-torn Democratic Republic of the Congo

(2013) and Yemen (2017). By destroying infrastructure, especially health, sanitation, and transportation, wars produce conditions directly conducive to epidemics in post-conflict societies. For instance, civil wars in Sierra Leone and Liberia left the countries susceptible and unprepared for the Ebola crisis in 2014–2016, which killed more than 11,300 people. Overall, nearly a third of sub-Saharan African countries to have experienced civil war since 1976 were later hit by Ebola (Fazal 2014).

Wars often result in large movements of people who either seek survival through escape or are forced to flee (e.g., because of ethnic cleansing). Migrants, greatly vulnerable to diseases, serve as effective propagators of infectious agents, and overcrowded camps favor epidemic outbreaks. In 1994, after nearly a million Tutsi fled the Rwandan genocide, the cholera bacterium preyed on the terrible sanitary conditions in the refugee camps of Goma in Zaire. With a stunning mortality rate of 48%, it took the lives of 12,000 Tutsis in just 3 weeks (Crawford 2009, p. 138).

Counterintuitively, sometimes war can protect from diseases. Closed borders, frozen trade, and curtailed social mobility impede the migration of pathogens. It was civil conflict that kept HIV out of Angola, and it was only with the opening of the border in its aftermath in 2002 that the infection rate increased. Namibia, Nigeria, South Africa, and Zimbabwe illustrate a similar correlation. Overall, however, wars have more frequently served as drivers of the emergence of pathogens and as amplifiers of epidemics.

The Transmitters

Armed forces can spread diseases both unintentionally (by infecting enemy forces and noncombatants, but also their own communities after demobilization) and deliberately (by using germs as a tool of war). Throughout the centuries, armies, which by their nature assemble individuals of diverse immunity coming from a variety of epidemiological backgrounds, have been incubators for diseases. Consequently, moving troops have been powerful and effective conduits for the dissemination of manifold contagions, from smallpox to typhoid, from cholera to influenza. This has, however, taken on a dramatic new form during many wars in Africa, the epicenter of the AIDS epidemic, where at the turn of the twenty-first century, some 40% of all armed conflicts occurred. The prevalence rates of communicable diseases among military personnel are generally higher than in the civilian population, two to five times for venereal diseases. In the early 2000s, the average HIV infection rate in the African forces was 30%, but as high as 50% for the Democratic Republic of the Congo, 66% for Uganda, and 80% for Zimbabwe (Elbe 2002, p. 164; Singer 2002, p. 148). In the age of HIV/AIDS, coinciding with savage civil wars, sexual violence turned into a deliberate psychophysiological weapon. In the 1990s, the strategic use of rape as an instrument of war occurred in Congo, Liberia, Mozambique, Rwanda, and Sierra Leone. It is estimated that during the 100-day genocide in Rwanda in 1994, between 250,000 and 500,000 Tutsi females were raped. In some areas, almost all women survivors were sexual victims (Sharlach 2000, p. 98; Aginam 2012, p. 252). The HIV-positive Hutu soldiers who raped Tutsi girls and women were reported to say: “We are not killing you. We are giving you something worse. You will die a slow death” (cited in Elbe 2002, p. 168). With its long latency, HIV was thus weaponized into a genocidal biological time bomb.

In short, diseases disseminated by militaries may not only impact the outcome of conflicts by weakening enemy forces and populations but also impose a long-lasting post-conflict epidemiological burden.

The Jeopardizer

High rates of infection among troops can undermine their fighting effectiveness and erode morale. Hans Zinsser famously noted that “soldiers rarely won wars”; it was epidemics that “decided more campaigns” (Zinsser 1935, p. 153). Most troops during the Napoleonic Wars (1803–1815) died not from combat but from typhus, and more British men in the Crimean War (1854–1856) were killed by dysentery than by Russian bullets. Overall, it was only during the First World War that more soldiers died from fighting than from diseases, excluding the Spanish flu. Throughout history then, time and again, epidemics disrupted the conduct of wars and undermined the combat capabilities and efficiency of armed forces. The cataclysmic prevalence of HIV/AIDS in many African armed forces at the beginning of the twenty-first century is a powerful reminder of the risks. The problem may, even if only infrequently, be severe, as illustrated by the extreme example of the Congolese Armed Forces which between 1989 and 1993 lost from disease the equivalent of three companies (Mikangou 2000). More worrisome perhaps are those infectious microbes that rapidly inflict a disease, such as the influenza or respiratory syndrome viruses, as they could literally bring operating forces to a standstill. Add to this the costs of medical care and urgent replacements of unwell servicemen and the problem become much more profound.

Virulent Peacekeeping

The UN Security Council's resolution 1308 called attention to the potentially debilitating effects of HIV/AIDS on peacekeeping missions and personnel (United Nations Security Council 2000). Apart from being at risk of contracting diseases, peacekeepers are likely to serve as vectors of their transmission. Hence stabilization and humanitarian assistance may come at the price of importing destructive pathogens. The relatively low levels of AIDS infection in West Africa increased radically with the arrival of peacekeepers in the aftermath of the civil conflicts in Liberia and Sierra Leone (Singer 2002, p. 152). AIDS was also a legacy of the blue helmets' mission in Cambodia in the 1990s. In another example, 9 months after the catastrophic earthquake struck Haiti in January 2010, the island was further battered by a cholera epidemic which infected nearly 700,000 people and took the lives of over 8500. The etiological *Vibrio cholerae* strain was not indigenous but arrived with the UN stabilization troops from Nepal where the epidemic had been reported earlier (Orata et al. 2014).

A Military Response

The Ebola epidemic in 2014–2016 showed that the deployment of military units may be critical for containing some outbreaks which would otherwise escalate further, particularly in remote and underdeveloped locations. Britain, France, Germany, and the United States provided a military backup of mobile hospitals, medical personnel, airlift capacity to transport patients and supplies, and units to enforce isolation and quarantine in the affected West African states. Drawing on this experience and the WHO's failure, in 2014 German Foreign Minister Frank-Walter Steinmeier called for the establishment of a badly needed "white helmet battalion" ready for rapid deployment anywhere in the world, which was soon endorsed as an EU proposal. The goal of this military-like and fully equipped – with medical field facilities and personnel (including lab and security teams) – but essentially civilian mission unit would be to prevent local outbursts from advancing into full-blown epidemics (Klain 2015).

As in the past, when in times of scourge the military were often deployed to enforce a quarantine or cordon sanitaire (cutting off certain geographic areas from the outside to restrict the movement of people), armed forces remain the ultimate means capable of large-scale epidemiological emergency response.

The Economic Burden

According to Price-Smith, for a disease to be regarded as a security threat, it should cause at least 1% GDP loss per year (2009, p. 206). Yet even if incurring lower costs, epidemics can still acutely harm the economic security of states. By removing unwell skilled personnel from their workplace for weeks on end, or causing mass fatalities, they can lead to lost productivity, impaired economic growth, decreased domestic product, undermined business confidence, and discouraged foreign investments. Sudden emergency responses (including quarantines, mass hospitalizations, and the distribution of medicines and preventive kits) impose additional financial strains.

The impact of HIV/AIDS on the African countries reveals the magnitude of economic consequences resultant from the virus's long latency. In the 1990s, the epidemic prompted a decline in Africa's per capita annual growth of 0.8%. In

2001 it was estimated that AIDS pushed down the income of the affected households by 80% (UNDP 2001, pp. 2, 9).

Epidemic-generated fear quickly goes global. Protective response measures undertaken by governments can seriously curtail transnational flows. In the contemporary global just-in-time economy, any disruption in the free movement of goods and people impairs production, business, and financial and stock markets. Global interconnectedness amplifies the economic consequences of local epidemics, no matter how minor or mild they are. Consider the outbreak of pneumonic plague in Surat in 1994, which cost the Indian economy nearly $2 billion due to lost sales, falls on the Bombay stock market, international boycotts of Indian goods, and a decline in tourism (Garrett 1996, p. 74).

The Trajectories of Epidemic Dynamics

"It is time to close the book on infectious diseases, and declare the war against pestilence won." This often quoted statement attributed to William Steward, the US Surgeon General (1965–1969), was allegedly made in 1967 or 1969. Because no primary source has been identified, it remains apocryphal, but it well reflects the hurrah-optimistic and triumphant belief dominant at that time (Spellberg 2008, p. 294). It proved unfounded. Perhaps humankind will never be able to close "the book on infectious diseases" as its new chapters are continuously written by nature with the substantial editorial help of humans. Written and rewritten also are larger security risks associated with epidemics and their changing patterns.

Emerging, Reemerging, and Mutating Risks

The idea of emerging pathogens is broad and encompasses a novel organism that comes into being through mutation; a zoonotic microbe that spills over from animals to humans (like HIV, avian and swine flu, or SARS), in fact the most common type of emerging agent; and an already known pathogen which becomes significantly more virulent and/or transmissible due to its mutation or changes in either the host (lowered tolerance or resistance) or the environment (e.g., when vectors advance to new geographical areas, like the spread of the dengue fever mosquito to North America) (Wayne and Bolker 2015, pp. 82–83). The rise of new pathogens is, in short, spawned by five main factors: cross-species transmission, geographical diffusion, pathogenic evolution, a new recognition of an existing disease, and changes in the human-environment relationship (Mayer 2000, pp. 940–943). Since 1973, the family of contagious pathogens has vastly expanded to include, among many others, Ebola (1977), HIV (1983), *Vibrio cholerae* 0139 (1992), variant strains of H1N1 influenza (1997), and coronaviruses such as severe acute respiratory syndrome (SARS 2002) and Middle East respiratory syndrome (MERS 2012). Over the last two decades, new pathogens have emerged with increasing pace and intensity, at a rate of 1 per year on average (Heymann 2003, p. 193).

Viruses are in a constant flux. For some, like influenza or HIV, persistent mutation is their very survival mechanism. These rapid and unpredictable changes often make the creation of vaccines inconceivable. Different strains can mix through the process known as antigenic drift, which at times produces new, highly virulent and fatal strains, some capable of generating global calamity (like the flu pandemics in 1918, 1957, and 1968). Viruses may jump from animals to humans and back, adapt to humans, turn transmissible between them, and master more efficient methods of dissemination. Consider the 2009 H1N1 flu which arose when different segments from the viruses already adapted to birds, humans, and swine mixed in pigs. Historically, newly appearing viral diseases have usually resulted from this "cross-species transmission" rather than the "co-divergence" of host and microbes – that is, the process whereby germs mutate following the evolutionary changes of their hosts (Locklear 2017). Human lifestyles, practices, and behavior have frequently fostered the interspecies travel of microorganisms: from the domestication of animals to deforestation, from urbanization to intravenous drug use, and from growing transnational travel to greater consumption of meat.

Furthermore, old diseases that were assumed controllable, endemic, and barely dangerous have reemerged and spread, often in dramatic ways. For instance, tuberculosis has resurged, developed multidrug resistance, and become the main killer of patients suffering from AIDS. At present, tuberculosis claims more lives than at any other time in the past (1.7 million in 2016). And in 1991 cholera made its comeback, spreading to South America. Notwithstanding rare potential side effects, vaccination is one of the best weapons in the human antimicrobial arsenal. It has made many lethal pathogens of the past extinct or at least manageable. Yet anti-vaccination sentiment poses the danger that it may create the very conditions under which they may return, for if the rate of vaccination within a community falls below 80%, then epidemics can reappear with fatal consequences.

In 1945 Sir Alexander Fleming accurately predicted that if we expose bacteria to doses that are insufficient to kill them, they would develop antibiotic resistance. The prolonged over- and misuse of antimicrobials in humans and animals (80% of antibiotics given to livestock are for subtherapeutic applications) have resulted in bacteria gaining multidrug resistance and fighting back. Examples include the methicillin-resistant *Staphylococcus aureus*, and the future will bring more such terrifying "superbugs." Thus human activity has often affected and shaped the microbial pool.

The Society-Epidemiology Interplay

The shared history of man and infectious microbes is one of coevolution. Ever since humans moved from being hunter-gatherers to farmers, then to urban workers, and eventually to present-day global nomads, pathogenic agents have developed in partnership with changing human behavior. Social practices, religious and cultural dos and don'ts, the advancing and accelerating combination of travel and commerce, developments in science and medicine, industrialization and urbanization, improved standards of hygiene, and wars have either profited microbes in their colonization of human hosts and encouraged them to adjust accordingly (mutate, change vectors, or transmission routes) or helped to contain them. For example, the zoonotic mutation of HIV, which enabled its human-to-human transition, coincided with the changes in human ecology in Africa: urbanization and related demographic shifts, expanding interconnectedness, greater mobility (the construction of roads that linked many previously isolated communities), and the sexual revolution. Hence the transformations in human habitat and lifestyle paved new transmission paths for the virus.

When the Spanish flu struck the world, the global population was 1.9 billion; it is 7.6 billion today. In 2017 there were 47 urban agglomerations exceeding 10 million residents. Overpopulation, the rise of megacities, and internal migration lead to higher demographic density, which heightens the risk of new diseases emerging and propagating rapidly. Population growth means additional zoonotic risks, as nourishing more people requires significant increases in livestock, intensified farming, and global trade in animals. In short, alterations in lifestyle patterns have been instrumental in microbial evolution and circulation. Wayne and Bolker graphically catch the essence of this shared evolution of humans and microbes: hosts and parasites resemble "Alice and the Red Queen in *Through the Looking Glass*: they have to run as fast as they can to stay in the same place. Hosts and parasites are locked in a race, with the host evolving to escape the parasite and the parasite counter-evolving to keep up with the host" (2015, p. 29).

The Ecology-Epidemiology Link

Global climatic change and the degradation of the biosphere can severely affect epidemiological patterns in several ways. They may foster pathogens to evolve and adapt, provoke the emergence of new microorganisms, and expand the range of the existing diseases. Rising temperatures and humidity have encouraged disease-carrying mosquitos to colonize new habitats, thus prompting the geographical spread of malaria, dengue fever, and most recently the Zika virus. With water temperatures continuing to increase, cholera will migrate to new habitats. As epidemiologists and ecologists are troubled in attempting to envision the future impact of climatic variables on epidemic dynamics, historians begin to reveal this interplay in the past. Research suggests, for example, that the periodic rise in temperatures in central Asia and the arrival of plague in Europe in the late medieval period were causally linked. In the future, climate change will pose challenges to global security not only directly but also by affecting patterns of disease prevalence and infectivity.

The Globalization of Pathogens

The pace and the expanding spectrum of global trade and travel benefit pathogens, as their expansion hinges on the mobility, speed, and range of their hosts and vectors. A global pandemic may originate almost anywhere, with a local outbreak circulating rapidly and hitting populations in any part of the world. In 2009, H1N1 spread around the globe faster than any epidemic disease in history. To sweep as widely as H1N1 did in just 6 weeks, the viruses which caused flu pandemics in the past required more than 6 months. Nowadays, each airline passenger is a potential epidemiological ticking bomb. An individual incubating a germ, such as Ebola, can board a jet plane, travel over 10,000 miles, and globalize it, as happened with the arrival of just this virus in North America and Europe in 2014. What is more, this interconnectedness will only continue to develop further: while in 2017 as many as 4 billion people traveled by plane, by 2034 the figure is expected to nearly double to 7.8 billion (IATA 2017).

The power of globalization to facilitate the dissemination of epidemics is, however, hardly surprising. The awareness of close links between infectious diseases and the commerce-travel-migration triad became all too evident already in the 1830s with the cholera pandemic which traveled from India to Europe. *Vibrio cholerae*'s rapid march around the globe was favored by the accelerating agents of the industrial revolution: steamships and locomotives. The growing understanding of the international character of the problem fostered cooperation, so in 1851 the International Sanitary Conference was launched. The French delegate to its meeting aptly captured the globalization-epidemics nexus:

> Add now the communications between the peoples, today so numerous and more and more rapid; the navigation by steamship, the railways, and on top of that this happy tendency of the populations to visit each other, to mix, to merge, a tendency that seems to make of different peoples a sole and large family, and you will be forced to admit that (. . .) cordons and quarantines are not only powerless and useless, but they are, in the very great majority of cases, impossible. (Cited in McMillen 2016, p. 62)

Add airplanes to ships and railways, and the very same – although with a much greater order of magnitude – could be said of the present-day world.

One way in which globalization challenges nation-states is by supercharging infectious diseases to disrupt notions of sovereignty. This interdependence of vulnerability was fully recognized in 1997 when public health leaders noted: “the idea that the health of every nation depends on the health of all others is not an empty piety but an epidemiological fact” (Al-Mazrou et al. 1997, p. 750). By catalyzing the escalation capacity of infectious diseases, globalization has immensely shortened the distances between all the respective epidemiological “levels of analysis,” subsequently increasing the security risks involved.

Conclusion

Is the threat of a natural or human-made epidemic that abruptly develops into a lethal global pandemic merely a horror or science fiction scenario? How serious is the prospect of a zombie-like apocalypse provoked by a novel pathogen of unknown etiology, which erupts rapidly and hits indiscriminately?

If anything kills ten million people in the coming decades, it is unlikely to be an act of organized violence – it will rather be a malign pathogen. It is alarming that epidemiological models of a future influenza pandemics assume exceptional virulence and estimate a dreadful toll of 20–100 million victims (Tansey 2017, p. 208). Pandemic influenza occurs three to four times a century. It is thus as inevitable and inexorable as it is a great unknown. The pathogen-epidemic-pandemic trajectory is nonlinear. Epidemic growth curves are largely unpredictable, and the epidemics-security nexus is shaped by a complex set of manifold factors which interconnect in myriad ways and in variegated contexts. Scientists are still powerless in predicting if, when, and where any particular subtype of an animal virus might gain the potential to jump to humans and generate a crisis. What the majority of epidemiologists tend to agree is that in the next two generations a "super-disease" pathogen will develop. It will be capable of rapidly climbing upward through the Waltzian image levels to induce a devastating global pandemic. Thus the unsettling combination of the contagiousness and the unpredictability of epidemics and their social, economic, political, and psychological ramifications do present risks in all dimensions of security: human, local, national, international, and global.

Cross-References

- ▶ Air-Borne Diseases
- ▶ Antimicrobial Resistance
- ▶ Avian Influenza
- ▶ Biosecurity and Biodefense
- ▶ Bioterrorism
- ▶ Bubonic Plague
- ▶ Cholera
- ▶ Contagion Mechanisms
- ▶ Dengue Fever
- ▶ Ebola
- ▶ Emerging Diseases
- ▶ Global Pandemics
- ▶ Health Security
- ▶ HIV/AIDS
- ▶ Infectious Diseases
- ▶ Malaria
- ▶ Measles
- ▶ Severe Acute Respiratory Syndrome (SARS)
- ▶ Sexually Transmitted Diseases (STDs)
- ▶ Swine Flu (H1N1)
- ▶ Tuberculosis
- ▶ Vaccination
- ▶ Zika Virus
- ▶ Zoonosis and Zoonotic Infections

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