Chapter 4
Lessons from History

Resilience has a lengthy history of practice and implementation for events of extreme consequence and high uncertainty. One of the clearest cases of embryonic resilience thinking includes Medieval Venice, which was forced to grapple with the recurring threat of plague that threatened to destroy the fabric of European society and cripple the juggernaut of Venetian maritime trade (Linkov et al. 2014a, b, c; Lane 1973). This early resilience thinking did not fully inoculate Venetian society from the ravages of disease—on the contrary, limitations of medical knowledge and border control allowed for outbreaks throughout the early modern era—yet it did allow Venetian policymakers to begin to address the question of how to combat deadly disease. The cumulative successes in reducing disease incidence and spread throughout the city and its dependent settlements eventually brought policymakers to embrace resilience thinking for other unrelated projects ranging from climate change to land reclamation efforts—all centered on the idea of strengthening Venetian social, economic, and cultural capabilities in the midst of an uncertain future (Vergano and Nunes 2007; Linkov et al. 2014a, b, c). This all goes to show that while resilience thinking and resilience analysis are growing buzzwords in the early twenty-first century, their roots go back centuries before even the printing press or functional medicine.

We can only speculate as to why such principles have centuries-old roots, yet we would surmise this is due to resilience's common sense approach regarding the inherent desire to protect one's way of life. Uncertainty and hazard were as prevalent in 1300s Europe as they are today, where unlikely yet looming threats have the potential to drastically impact a community's ability to conduct business, engage in societal activities, and otherwise build a constructive world safe from unnecessary harms. Though these harms may have been drastically different hundreds of years ago, understanding why and how our scholarly ancestors dealt with issues of perilous risk and all-encompassing uncertainty to construct systemic, state-level resilience is a much needed exercise to fully demonstrate the need for the method in the present and future.

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This chapter focuses on two resilience-driven infectious disease cases but discussion here may be generalized for the field in a much broader sense. The cases of bubonic plague and Ebola below both signify the potential for an unexpected and potentially catastrophic external threat to crop up and wreak havoc upon economic, social, and industrial activity in a much abbreviated time span.

Venice, the Bubonic Plague, and Resilience Thinking: Early Forays to Constructing Communal Resilience

In the latter portions of the Middle Ages, Venice was a city state that enjoyed burgeoning wealth as one of the Mediterranean's premier maritime powers (Chambers 1971). Where many cities of the time were quite small in population by modern standards and maintained only limited access to international trade routes, Venice served as a true linkage between the Catholic states in Western Europe and the Orthodox and Muslim states to the east (Lane 1973). Such Venetian prowess blossomed through the fourteenth and sixteenth centuries—yet was hampered by the recurring arrival of the plague throughout this time span (Lanaro 2006).

Upon its sudden arrival in Venice in 1348, the Black Death (or the initial wave of the bubonic plague that struck Europe from 1346 to 1353 and killed an estimated 30–60% of the population; Alchon 2003) devastated the city (Bernstein 2009; Green 2014). Most victims of the disease died within a matter of days after showing symptoms, which typically included the swelling of lymph nodes into painful and black masses (or buboes) along the body (Boccaccio 1351). Disease control efforts in the earliest stages of the plague were archaic and based largely on superstition (such as a belief in the negative influences of the alignment of certain planets) or even bunk science (the fear of miasmas, or bad airs, in their ability to spontaneously initiate disease). A lack of understanding of modern germ theory prevented medieval governments from instituting top-down plans to manage contagions—leaving populated cities such as Venice exposed to the damage to come.

It is difficult to overstate the consequences of the Black Death on European society. Along with a sudden and massive depopulation of various cities, the disease unsettled Medieval social and economic life by grinding trade to a halt, bringing huge swathes of farmland to fallow, and driving religious zealotry to promote flagellants (or those who practiced acts of public self-mutilation to appease what they thought was an angry God), riots, and other forms of civil unrest (Bean 1982; Ziegler 2013). From a perspective of societal resilience, the disease essentially exposed vulnerable societal, economic, and public health assets in Venice and other medieval cities—leading to millions dead and a society permanently changed (Herlihy and Cohn 1997). While risk management could be a helpful method to mitigate the harms wrought by known or well-understood events, such internationally consequential events as the Black Death and subsequent plague outbreaks with unknown or dramatically misperceived causes, transmission, and treatment leave traditional risk assessment incapable of adequately protecting society or alleviating social and economic hazards (Cohn 2009). This is where resilience thinking comes into play, as such a mindset is primarily focused on peering into the unknown and preparing various systems, societies, and elements of infrastructure to withstand hazards of various risk scenarios (Baum 2015).

After experiencing the plague's initial devastation, a few cities such as Venice began to suggest options to ward off the disease. Over time, the Venetian government came to fashion some of the earliest verifiable forms of resilience thinking to guide disease control efforts (Cohn 2002). Specifically, these include the appointment of three government agents (or guardians of public health) to govern disease control efforts, along with the eventual construction of formal quarantine zones to hold those suspected of contact with plague. These efforts were a direct attempt to strengthen societal and economic activities in the midst of a catastrophic threat by limiting potential exposure to risk while offering safeguards to prevent disease-driven disruptions of Venetian daily life. It is important to understand that while such measures may seem like common sense today, these efforts at disease control were quite revolutionary for medieval Europe, and in many cases flew in the face of conventional wisdom as prescribed by medieval scholars and healers.

With respect to Venice's plague guardians, these officials were charged with the exclusive duty to better prepare and protect their city from further plague outbreaks. This was a daunting task for any medieval population center, as aside from mass hysteria and frequent apocalyptic pronouncements from contemporary thinkers, little guidance existed regarding how to stem the flow of virulent disease in a large, dense, urban population with no formal sewage management. Above all else, this is where resilience thinking came into play, where the plague guardians tested a variety of strategies to strengthen communal resilience to infectious disease even in the midst of extreme uncertainty and consequential risk.

One of the significant developments instituted by Venetian plague officials included substantial changes in the way that plague victims received medical attention. Where doctors began to take notice of the debilitating skin lesions and strong odor of illness from the plague victims, treatment of such patients became to reduce physical contact between physicians and patients by having medical personnel don long coats and gloves, and making use of a rod or cane to conduct medical examinations if at all possible. Such efforts gave rise to various costumes and images typical of the era (particularly with the plague doctor visage which consisted of a long-beaked mask which contained a reservoir of vinegar or curative herbs in the belief that malodorous air was responsible for the spread of disease), yet they did at least begin to offer some layer of protection to those seeking to offer medical care yet fearful of contracting the virulent disease themselves. Slow but steady success in reducing plague incidence by following these basic guidelines, which despite occasional failures to prevent all disease outbreaks, did over time help reduce most widespread plague outbreaks in Venice. Using protective clothing and offering guidance on how to treat those suspected of carrying plague, Venetian plague guardians and officials helped to disrupt the physical networks of plague propagation at a municipal level.

Venice came to survive outbreaks of bubonic plague thanks to an instinctive understanding of resilience thinking by state officials. In spite of the plague's swift advancement throughout European cities and villages, Venetian city administrators tracked the disease's spread from ports along the Venetian lagoon. They also knew that those who docked along Venice's ports proceeded further into the old city, through storehouses, and eventually to further maritime trade routes. Using the framework of this general understanding of plague movement and transmission, officials enacted sweeping social, economic, and infrastructural measures to combat the disease's spread—all contributing to the city's efforts at early societal resilience thinking. With regard to efforts at isolating potential sources of infection, Venice's plague guardians first merged the notions of Lazaretto (isolation in space) and Quarantine (isolation in time) (Linkov et al. 2014a, b, c).

Lazarettos were similar to the construction and management of leper colonies in previous centuries throughout Europe, yet such colonies were generally reactive (or constructed on an as-needed basis for smaller levels of disease management) rather than proactive (or movement towards preemptive risk and resilience management for citywide disease prevention and control). For plague management, Venetian lazarettos were generally established on islands (the first, Lazaretto Nuovo Island, gave the practice its name) outside but adjacent to the old city. To further combat the recurring threat of bubonic plague, officials conducted interdiction exercises with incoming ships along the lagoon's outer islands while the ship's occupants and cargo were assessed for potential threats.

The principles of quarantine began as a forced prevention of foreign ships and peoples from entering the city walls for a set period of time, first deployed by the medieval city of Dubrovnik in 1377 (Sehdev 2002; Tyson 2004). This period eventually grew to 40 days, hence the medieval Venetian *quaranta giorni* becoming the norm for the interdiction of foreign travelers and goods prior to approved city entry (Gensini et al. 2004). However, it was not until the formal adoption of quarantine as a disease control mechanism by Venice that the practice became more structured and universally accepted. The evolution of quarantine in Venice and other cities throughout Europe serves as one of the first physical manifestations of resilience thinking, as the quarantine dynamic of isolating potential unknown and little understood dangers until they are identified or are proven inert inherently breaks the mold of traditional risk management in favor of countering emerging threats.

While such measures helped reduce the occurrence of outbreaks while also generally limiting disease incidence when such outbreaks occurred, the plague unfortunately did continue to flare up in Venice and other cities in Europe up through the nineteenth century. Throughout this extended time frame, Venetian officials continually refined their approach to resilience thinking such as with the inclusion of principles of germ theory in disease eradication efforts along with the addition of further lazaretto and quarantine structures. This was conducted in tandem with regular interviews and inspections of ships along with the disinfection of cloth goods with vinegar. Eventually, the 40-day quarantine interdiction policy became more widespread and accepted throughout Europe as a primary course of action to combat the spread of devastating plague.

By imposing quarantine measures on ships containing various goods and personnel that may have been exposed to infection and the development of lazarettos, Venetians introduce a radical break in the historical network of disease proliferation along a regional level. The additional use of easily identifiable (either intentional or not) strange masks and costumes of physicians not only helped protect both those physicians *and* the Venetian population from the spread of plague, but also clearly set physicians as a distinct class separate the general population cemented the role of these "plague doctors" as a network of medical specialists with shared and innovative knowledge of the bubonic plague. While improvements in Venice's resilience thinking for disease control were implemented too late to quell the most devastating wave of plague in the 1340s and 1350s (Thrupp 1966), the growing mechanisms of ship inspection, improved physician protection, lazaretto, and quarantine, continued to refine and bolster Venetian plague defense. Over the coming centuries, Venice and its dependent territories suffered through relatively minor plague epidemics, while other regions of Europe without similar protections would continue to suffer heavy losses in trade and population into the nineteenth century (Konstantinidou et al. 2009).

Venice's success even in the absence of a more modern understanding of germ theory demonstrates that there are clear differences between mitigating risk and promoting resilience. Specific to resilience thinking, the medieval Venetian plague guardians collectively changed their city's physical domain by reworking the movement of incoming traders and their goods, altered the social domain by dramatically changing the style of contact between those stricken with disease and those still healthy, and revolutionized the information domain by observing disease transmission and passively monitoring the various ships arriving at Venetian ports. In the modern era, historians have determined that, at a minimum, two different forms of plague fed the Black Death epidemic, including bubonic plague via rats and fleas, and pneumonic via interpersonal contact and the air. Though such information and theories were not understood in the Middle Ages, it is still important to recognize Venice's efforts to combat plague as "an archetype for resilience management because it was implemented at a systems level," all regardless of the fact that medieval Venetian policymakers and plague guardians did not fully understand why their efforts at sequestration and quarantine were successful in stemming disease incidence (Linkov et al. 2014a, b, c).

Traditional applications of risk management along with resilience thinking have collectively been deliberated as options to meet the growing challenges of other threats such as with climate change, coastal resilience, and modern disease control (Park et al. 2013, 2015). Globally, climate change and flooding continues to serve as one of the great policy challenges of the modern era (Hallegatte et al. 2013), with Venice remaining one of Europe's most vulnerable municipalities to changes in sea level and flooding.

Venetian local government has already sought to take on their resilience thinking efforts of nearly 700 years ago to adopt countermeasures to potentially catastrophic threats to their city and citizens. Specifically, this includes the construction of a $7 billion flood barrier, which is designed to prevent flooding and help control surges in water level due to storms and tidal surge (Singh 2014). In spite of this proactive effort, some risk analysts have noted their concerns regarding the barrier's extended efficiency and capability to withstand extreme climate and flood events well into the future (Poggioli 2009). From a resilience perspective, these concerns are not unfounded, as the multi-billion dollar flood barrier project serves as an example of resilience thinking that accounts for the physical domain yet neglects a thorough consideration of others. Along with considerations of global climate uncertainty and the models used to predict significant climactic trends, this flood barrier project does not fully account for uncertainty regarding the potential impacts that a rise in sea level may have upon social, economic, and cognitive functions within Venice and beyond. To rectify this situation, further consideration of the physical, information, social, and cognitive domains are crucial to uphold Venetian society, commerce, and culture in the face of high uncertainty and potentially devastating ecological risk (Fletcher and Spencer 2005).

Resilience Thinking in Modern Disease Control: Ebola in West Africa

While twenty-first century society may not have many instances of world-altering disease incidents as with the fourteenth century saw, disease control remains a critically important priority in several regions throughout the globe (Fauci 2001). Indeed, the continued development of rapid transportation networks along with an increasingly interconnected international society makes disease control efforts progressively complex, and often require intimate levels of international collaboration and research in order to adequately protect societies from emerging biological threats. In other words, where in centuries past the pace of disease transmission was hindered by geographic and transportation capabilities of a pre-modern society, the growth of international air and shipping travel has dramatically facilitated the spread of virulent diseases unknown to much of the world—requiring constant and continually evolving vigilance to monitor and control disease spread in heavily populated areas (Tatem et al. 2006).

A similar issue facing today's epidemiologists and researchers of infectious disease includes the uncertainty regarding where future threats may arise with respect to viruses and pathogens (Jones et al. 2008). Such diseases are continually evolving due to interactions with their environment along with their hosts' immune system, indicating that certain viruses or bacteria may evolve in unexpected fashions along a relatively rapid pace (Altizer et al. 2003; Suk and Semenza 2011). Given this, those engaged with infectious disease research are required to make assessments regarding what they believe will serve as future threats to human or animal health, while also making a determination regarding the relative severity of health consequences associated with a potential outbreak. With limitations to money and manpower, disease control efforts can become an increasingly complex task that can introduce additional issues of justice and equality in allocating resources (Berkelman et al. 1994).

Further complicating this task is the heavy disparity in resources available to conduct ongoing disease surveillance in addition to directly treating the disease burden (Murray and Lopez 1997; Jamison et al. 2006). Differences exist in the types of disease endemic in various parts of the world, with much of the developing world currently experiencing greater levels of disease burden from infectious diseases like dengue fever, malaria, cholera, and other tropical diseases (Mabey et al. 2004; Colwell 1996). With fewer resources available to operate disease surveillance programs along with the already limited ability to treat and care for the afflicted, the public health systems of developing countries may quickly become overwhelmed in the face of an emerging and virulent epidemic (Beaglehole and Yach 2003). This may be further exacerbated in cases where the host government and civil society is limited in its ability to execute policy or quickly meet challenges within its borders (Fourie and Schönteich 2001).

One alarming case is the Ebola virus disease, which causes a violent and painful hemorrhagic fever with an average mortality rate of 50% or greater (Pourrut et al. 2005). First concretely identified in 1976 in two villages along the Ebola River (WHO 2014a, b), the disease lacks a vaccine or formal treatment protocol aside from oral rehydration therapy, leaving even many of those who receive medical treatment unlikely to survive the precipitous drop in blood pressure and further disease complications. Up until 2013 the disease had been relatively contained to remote tropical locations in Sub-Saharan Africa, with an approximate 24 distinct outbreaks contributing to 1716 cases from 1976 to 2013 (CDC 2014).

Even those who recover from Ebola are often faced with the daunting challenge of reintegrating into society. Survivors often face health, social, and commercial problems after release from a hospital, leaving them in a vulnerable state as they seek to get back on their feet. From a health perspective, survivors are often afflicted by a variety of conditions such as muscular pain, liver inflammation, fatigue, and long-term weight loss, placing survivor health in question in the intermediate term (Magill 2013; Tosh and Sampathkumar 2014). The World Health Organization notes that survivor's health even a few years after recovery requires strict monitoring to ensure more severe complications do not arise—a luxury often unavailable in Sub-Saharan Africa (WHO 2015a, b). Continuing health problems are exacerbated by social and economic factors surrounding patient recovery, where social discrimination against survivors alongside difficulties finding and keeping regular and reliable employment can lead to isolation and economic hardship (Lee-Kwan et al. 2014; Levin-Sparenberg et al. 2015; Curson 2015). From a resilience perspective, Ebola thus can indirectly contribute to a fraying of social communities.

It is worth noting that the severity of the disease in terms of human health and the extreme levels of damage—collectively to health, trade, and social order—that the disease could cause upon its spread to larger population centers. While a more widespread Ebola outbreak has not yet occurred, the 2013–2016 West African Ebola Outbreak demonstrated the true ferocity of the virus and the consequences of not maintaining resilient societies and responses to disease control. Our central argument here is that the institution of resilience thinking across each of the primary resilience domains is required to meet the challenge of Ebola—just as medieval Venetian physicians sought to stem the tide of plague centuries ago.

Table 4.1 Reported cases and fatalities of Ebola in selected countries during the 2013–2016 outbreak

Country	Ebola cases reported	Ebola fatalities reported	Fatality rate (%)
Liberia	10,666	4806	45.1
Sierra Leone	14,122	3955	28
Guinea	3804	2536	66.7
Nigeria	20	8	40
Mali	8	6	75
Total	28,620	11,311	39.5

The 2013–2016 West African Ebola Outbreak serves as the largest and deadliest recorded in history. The affected countries, Sierra Leone, Guinea, Liberia, and Nigeria, struggled to contain and to mitigate the outbreak, leading to small numbers of cases reaching Western Europe and the United States. Casualty rates are thought to be over 40% although specific numbers are difficult to acquire due to inaccuracies in accounting for disease incidence as well as a persistent refusal by some of the afflicted to seek medical attention upon infection. Table 4.1 notes the number of reported cases of Ebola in countries where endemic disease was acknowledged, as well as the fatalities resulting from infection. Additional reported cases due to transport of infected individuals include the United States (4 cases, 1 death), Italy (1 case), the United Kingdom (1 case), Senegal (1 case), and Spain (1 case). Despite the best efforts of World Health Organization officials, several note that the number of cases and number of fatalities are likely much higher (Dalziel et al. 2018).

Traditional risk-based approaches to Ebola management have proven to be difficult and expensive—no matter how much effort is taken to minimize exposure potential, unknown threat scenarios via a mobile host (humans) and high consequences associated with infected individuals collectively result in an inability to control risks to larger populations. An additional challenge to traditional disease control efforts is the heightened level of risk faced by health workers, who are by nature of their positions required to come into close contact with infectious bodily fluids. Particularly during 2014, healthcare workers were estimated to contribute to 10% of confirmed cases of Ebola, greatly complicating ongoing disease monitoring and treatment efforts. This may be traced to a variety of causes, including few experienced staff in the early stages, inadequate supplies, and a reliance upon hastily constructed field hospitals. This is not to denigrate the groups and personnel that treated thousands of cases—on the contrary, they should be commended for their courage in conducting medical care in dangerous conditions—but instead to clearly elucidate how the existing risk paradigm and disease governance strategies deployed in West Africa were incapable of stemming the tide of the Ebola outbreak. Further, other authors have commented upon the indirect consequences associated with certain policy responses related to the Ebola outbreak, ranging from social disorder, to economic dysfunction, and mistrust of public health authorities by local at-risk populations (Bonwitt et al. 2018; Brown et al. 2017; Massaro et al. 2018).

Unlike risk management focusing on hardening individual components of the disease propagation network, resilience management provides network configurations across collections of components that are efficient for fast recovery from infection. For Ebola, this includes a mixture of adaptive governance to quickly scale medical response to future outbreaks along with shifting protocols to better protect medical personnel and reduce incidence between the infected and the healthy. One specific example includes adaptive measures at air traffic control, airport security, and passenger biocontainment, which sought to prevent the spread of Ebola within and across affected countries and to neighboring countries. The Center for Disease Control released Guidance on Air Medical Transport (AMT) for patients with active Ebola virus that utilizes a variety of measures to scale against the transmission of the disease to other plane passengers (physicians, nurses, crew, etc.) as well as upon arrival within a new jurisdiction (CDC 2015). Similarly, Massaro et al. (2018) indicate how at-risk populations may be modeled via network science approaches in order to quantify the likely path and virulence of a contagion as well as the various policy mechanisms available to stem its spread. Massaro et al. (2018) conclude that, while a risk-based approach such as the total shutdown of transport within and between affected countries might seem a logical conclusion during an Ebola outbreak, more flexible containment schemes and mitigation policies that seek to mitigate the disruption posed by endemic disease are socially, medically, and economically preferred.

Additional resilience thinking regarding the potential for a previously unknown outbreak to occur would also dramatically improve disease response, since Ebola's rare historical occurrence in West Africa made it difficult for early medical personnel to identify the disease for several months after its first set of cases in Guinea (Baize et al. 2014). Much like where plague guardians and officials in medieval Venice sought to identify ways to better treat the sick while reducing overall disease incidence through innovative methods at disrupting transmission, risk governance for Ebola must seek to take a robust, innovative, and cross-cutting approach that leverages all available government resources to resolve future outbreaks.

At an international level, a growing challenge for practitioners of risk assessment and resilience thinking includes preventing the spread of Ebola and other infectious diseases via international air travel. Virtually every country is connected in a continually growing web of international air travel, which increases the capabilities for new and emerging disease epidemics to jump political borders in a matter of hours. From the perspective of resilience, those managing air traffic are required to maintain anticipated air transportation as much as possible while still preventing the spread of disease. This challenge requires a variety of disease screening at airports along with judgment calls with regard to temporarily shutting down routes into disease heavy regions. Many nations generally responded well to air traffic concerns in West Africa although establishing best practice standards and offering resilient yet efficient measures at the onset of a future outbreak will make disease control efforts all the more effective.

While air traffic control was generally handled well in the 2014 Ebola outbreak, land border control served as a serious weakness for West African nations seeking to stem the tide of disease during the early months of the epidemic. After starting off in Guinea around December 2013, the disease spilled over into neighboring Liberia and Sierra Leone in early 2014, leading to hundreds of cases in an abbreviated time span (WHO 2014a, b). No one factor can be blamed for this failure in border control, yet weak governmental institutions, extreme poverty, an inability to recognize the disease in its early stages, and mistrust among the local population of both local physicians and government officials to adequately deal with the crisis should all be considered (NBC 2014).

Effective resilience actions will require local government officials to adequately resolve each of these concerns in a rapid fashion. This is much easier said than done, particularly with resolving weak government institutions without significant international assistance. However, steps can be taken to bolster disease monitoring and management systems while promoting system and societal resilience, such as with providing streamlined guidance and protocol to identify and isolate those infected with Ebola while also stocking up on much needed supplies to protect medical personnel from unnecessary risk. Structuring Ebola outbreaks as a challenge to physical, social, information, and decision-making domains will help stakeholders and policymakers offer simple, inexpensive, and efficient policy solutions to begin to reduce the harms associated with an outbreak while also limiting longstanding social and commercial harms experienced by an outbreak.

For the physical domain, resilience to Ebola outbreaks requires a well-functioning medical supply system alongside the ability to quickly respond to outbreaks in their earliest stages via secure ambulances and triage centers. Additionally, secured physical borders that are equipped to identify and triage suspected Ebola cases to nearby field hospitals are an absolute necessity to bolster physical resilience, as otherwise the disease is able to run rampant throughout the region. Such improvements in the physical domain in terms of infrastructure for medical triage and border security will also help frame future improvements to the social, information, and decision-making domains, where a robust physical domain will signal to the general population that the government will take a direct and decisive action in meeting the challenges of the disease and bringing their population back to normalcy.

Improving the physical domain of Ebola resilience management is a critical first step towards disease control, yet by itself will not be successful in bringing affected countries back to full social functionality and economic performance. Additional efforts at improving resilience here includes opening up better channels between government officials and the public regarding disease incidence, medical response, and plans for recovery. In other words, by taking an active stance in offering improvements to the information domain of Ebola resilience, affected countries may help improve the social and cognitive domains by developing trust with the local population and reducing social uncertainty and unfounded fear during the disease recovery process. Without this parallel action, attempts to secure the borders and provide medical treatment will be undermined by distrustful citizen who look for clandestine transportation routes and alternative healing that can actually extend the duration and spread of the epidemic. This is a lengthy process that will require years for those in countries that have experienced a lifetime of war, corruption, and extreme poverty, yet moving in the direction of transparency and effectiveness in disease control may at least begin to reduce disease incidence throughout West and Sub-Saharan Africa.

Ebola disease management is an inherently complex process. Among infectious diseases, it ranks among the most debilitating and deadly, where even in medical research it may be handled in only the most secure research labs. For governments in West and Sub-Saharan Africa, adequately responding to a disease that has been misunderstood and stigmatized throughout society is all the more difficult, yet can be made at least slightly more effective by engaging in resilience thinking to respond to future outbreaks.

Ebola is not the only emerging contagion of concern. Various threats, such as severe acute respiratory syndrome (SARS), Zika virus, avian influenza, and various other viruses or bacteria are recurring threats not only to international public health, but also international economies and social well-being. Resilience-based approaches cannot fully prevent such threats from arising in the first place, but they can offer more adaptive and systemically effective approaches for minimizing the disruption posed by these threats as they materialize. Learning from examples as diverse as Medieval Venice to modern West Africa, strategic deployment of resilience thinking can help alleviate the strain that serious endemic disease places upon society (Massaro et al. 2018).