Journal of the American Planning Association

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rjpa20

Planning for Emerging Infectious Disease Pandemics

Definitions, the Role of Planners, and Learning From the Avian Influenza Outbreak of 2004–2005

James Nguyen H. Spencer, David Marasco & Michelle Eichinger

To cite this article: James Nguyen H. Spencer, David Marasco & Michelle Eichinger (2022) Planning for Emerging Infectious Disease Pandemics, Journal of the American Planning Association, 88:1, 113-126, DOI: 10.1080/01944363.2021.1930107

To link to this article: https://doi.org/10.1080/01944363.2021.1930107

Published online: 26 Jul 2021.

Review Essay

Planning for Emerging Infectious Disease Pandemics: Definitions, the Role of Planners, and Learning From the Avian Influenza Outbreak of 2004–2005

James Nguyen H. Spencer David Marasco Michelle Eichinger

ABSTRACT

Problem, research strategy, and findings: Planners have not paid enough attention to managing the risk of emerging infectious diseases (EIDs), of which COVID-19 is the most recent manifestation. Overlooking aggressive policies to manage this risk of zoonotic viruses reassorting between sick animals and humans misses the greatest opportunity for stopping future disease pandemics. In this study we review several disciplines, outline the scant planning literature on EIDs, and identify the increasing calls from virologists and medical professionals to address urbanization as a key EID driver. Using the case of avian influenza outbreaks in Vietnam in 2004 and 2005, we conceptualize a preventive planning approach to managing the risk of zoonotic transmission that results in EID pandemics.

Takeaway for practice: We make several recommendations for planners. Practicing planners should consider how their plans manage the risk of zoonotic disease transmission between animals and humans through land use planning and community planning. Planning education and certification organizations should develop positions regarding the role of planning for EIDs. Food systems planners should consider the importance of livestock practices in food production as a risk factor for EIDs. Diverse research teams should combine geographic scales, data sources, and disciplinary knowledge to examine how an extended series of upstream and downstream events can result in a global pandemic. Such empirical examination can lead to effective planning policies to greatly reduce this risk.

Keywords: desakota, emerging infectious disease, pandemics, regional planning, zoonotic disease

Planning scholars have not written much about epidemic or pandemic infectious disease. Matthew and McDonald (2006) did discuss how infectious disease outbreaks might generally affect cities, and Takahashi (1997) and Takahashi and Smutny (2001) examined how HIV/AIDS result in community-level stigma and planning at the local neighborhood level. A recent review, however, suggested that the body of planning literature regarding emerging infectious diseases (EIDs) is growing (Murugesan, 2020), and indicated the field's perspectives can contribute toward better understanding major infectious disease threats. EIDs are zoonotic illnesses originating in animals, which points to the importance of the human–animal interface in physical spaces as the origins of EID pandemics, of which COVID-19 is the most recent. In this essay, we argue that EID disease prevention and management is a latent strength of planning. More specifically, we suggest that planners should lead research teams that develop empirical evidence and policy alternatives to determine a) why and where zoonotic disease outbreaks occur and b) what financially and politically feasible steps can be taken to address them before they get out of control.

Our study originated from the primary author's leadership of a 2007–2012 National Science Foundation–funded research project on Coupled Human-Natural Systems (award #0909410; $1.398 million) that investigated avian influenza in Vietnam as an EID threat originating in the human and the natural environment. Building on the literature reviewed for this project, we now update the literature of EIDs since 2007, as well as journalistic accounts since the beginning of COVID-19. We explored the existing body of literature on EIDs and zoonoses, and then looked to information on the 2004–2005 avian influenza outbreak in Vietnam to set up a foundation for planning and policy recommendations. For planning and policy, we examined recent efforts to mitigate EIDs and current planning/policy scholarship. Beyond this general background, methodological differences are defining characteristics of the kind of interdisciplinary work we suggest;

DOI: 10.1080/01944363.2021.1930107

differences in which a "census" can refer to human, livestock, or viral "populations," for example. Thus, one of the major issues resulting from our recommendations is a synthesis and assessment of the data sources and analytic techniques, and units of analysis distinctive of each of these disciplines. For the time being, however, such a discussion is beyond the scope of this essay.

In the following sections, we first outline the biological problem of EIDs that has occupied microbiologists, virologists, and epidemiologists for decades, but mostly within the limiting constraints of animal and human health policy (though we are seeing a planning perspective emerge). Then, we illustrate the substantial planning scholarship on the urbanizing areas of Asia, linking it to the emergence of avian influenza in Vietnam. Next, we propose a conceptual framework articulating "upstream" and "downstream" issues related to EID outbreaks that might better help decision makers identify early and low-cost policy interventions to stem EIDs. In this framework, we argue that the field of planning, with its much wider-ranging scope and attention to spatial dynamics than virology and medicine, has critical perspectives to offer in understanding the basic origins of zoonotic diseases, and what can be done to prevent them. Our concluding thoughts offer several recommendations.

Responding to global challenges requires quick decision making based on incomplete indicators, a clear vision of how one event can lead to subsequent ones, and the likely consequences of those subsequent events. A riparian analogy of upstream (U/S), or closer to the source, and downstream (D/S), reinforces this principle of tightly related sequences of events, and we use U/S and D/S from here on to clarify that our understanding is metaphorical, not literal.

EIDs: Contributions From Virology, Medicine, and Planning

Many disciplines are able to provide advice on how to craft policy to avert pandemics. Health care professionals naturally come to mind because of their direct involvement in the prevention and treatment of human illness. However, much of the health care profession is aimed at D/S problem resolution and known pathogens. In a pandemic, D/S events comprise local intracommunity spread, international/regional spread, and full-blown pandemic status. D/S solutions can be problematic because they occur when an outbreak has already manifested, putting people at risk and magnifying possible costs to society through economic shutdown. U/S events occur prior to community spread, at a time when little is known about a new virus. The most cost-effective way to deal with pandemic threats is to intercept their proliferation as far U/S as possible, but the irony is that so little is known about the virus at that point.[1]

Because one well-known U/S source of novel EID pathogen evolution and transmission is livestock farming (Boni et al., 2013; Burns et al., 2011; McCune et al., 2012; Puzelli et al., 2014), there exists a unique opportunity for a particular group of professionals to become much more involved in pandemic prevention: planners. We believe that the skills of regional planners are needed to ensure that farms and other potential biological hazard sources are placed and managed effectively within societies, with the overall objective to efficiently negate pathogen transmission before it results in exponentially greater costs to society. To do this, planners must have a sense of what virology and medicine indicate about EIDs.

Virologists examine the microscopic patterns and processes associated with viruses and their behavior once inside human bodies. Their experimental evidence is derived from detailed and complex hypotheses about the internal organs of humans and other animals. On the other hand, epidemiologists and public health scientists examine social behavior outside of individual human bodies, and how microscopic viruses—as well as other unseen bacteria and germs—move across bodies through social environments. These disciplines have long been concerned with zoonotic viruses within their disciplinary confines, but neither is designed to study the interaction of humans and animals. It has recently become clear that neither field has the tools to adequately study the physical and disciplinary space where EID public health risk is greatest: the *physical spaces* where human and animal bodies intersect. This is an area that infectious disease experts have come to recognize in broad terms as containing some of the most important research hypotheses regarding EIDs.

Based on their generalized training and disciplinary research on microbes, virologists and medical doctors such as Wilcox and Colwell (2005) and Neiderud (2015), for example, reasonably asserted that EIDs, along with their cousins, the re-emerging infectious diseases (REIDs), result from the triad of urbanization, agricultural intensification, and habitat alteration. They further submit that the convergence of these long-term processes in rapidly developing parts of the world has led to a dramatic increase in EIDs worldwide. Such assertions have been empirically argued using macroscale geographic data on chicken stocks, national exports, and georeferenced outbreaks, for example, to provide intriguing evidence that rapid urbanization in China is systematically linked to EIDs (Wu et al., 2017). Despite these disciplinary and interdisciplinary research teams, their work only initiates a much wider research question because their conceptual and empirical work offers scant specification about what *specifically* urbanization is and how it is managed. Recently, urban-oriented sociologists and other social scientists have engaged with these questions, but still at a broad conceptual scale (e.g., Ahmed et al., 2019; Creighton et al., 2021).

On the other hand, some more detailed empirical studies have examined *specific* EID outbreaks from a planning perspective. For example, using comprehensive commune-based data on avian influenza animal outbreaks and census counts of household infrastructure types, Spencer et al. (2020) and Spencer (2013) found that infrastructure "incoherence" (as measured by the relative mix of households on improved water and sanitation systems) was a significant determining factor in where avian influenza outbreaks occurred. Also addressing the outbreaks of avian influenza in Vietnam, Finucane et al. (2014) conducted in-depth interviews with households in periurban areas to assess how perceptions of urbanization affect communities' responses to avian influenza threats. Similar to Spencer et al.'s (2020) use of commune-level census data to investigate the importance of transitional spaces between urban and agrarian communities, Saksena et al. (2015) used these data to demonstrate that land use mix was an important predictor of avian influenza. Such hypotheses and initial findings illustrate the promise of a planning-oriented approach—one that focuses on the land and other physical spaces where animals and humans are most at risk of exchanging viruses—for understanding the origins of EIDs, and potentially including the origins of COVID-19.

This critical link between EIDs and urban planning is relatively isolated in today's planning research, pedagogy, and practice. In part, we believe that the marginalization of planning's potential role in infectious disease mitigation is due to an emphasis on *responses,* an area in which biomedical and technical fields dominate. However, planning is inherently more suited to and concerned with *prevention,* which is characterized by gradual investments, population behavior research, and proactive U/S policy investment. Planners, for example, usually recommend investing in urban design and nonflammable building materials before building more fire departments.

The current novel coronavirus COVID-19, an EID, belongs to a virus category in which the pathogenic origin comes from animals. Animal-to-human infections, including viral, bacterial, parasitic, and fungal, are collectively known as *zoonotic diseases* and are common around the world. Approximately 60% of known infectious diseases and nearly three out of four EIDs originate in animals (Centers for Disease Control & Prevention [CDC], 2019; Taylor et al., 2001). Zoonotic EIDs occur when there is an opportunity for *host switching,* a process in which a disease jumps species. This zoonotic spillover causes the disease to move from an infected nonhuman vertebrate to a susceptible human (Parrish et al., 2008; Plowright et al., 2017).

The importance of proximity between large animal and human populations in the emergence of zoonotic diseases is illustrated by the CDC One Health approach, which recognizes that human health is interconnected with animals as part of a shared physical environment. Because of this, the CDC argues that collaborative work across human, animal, and environmental dimensions is instrumental in prevention, early identification, and control of zoonotic diseases (CDC, 2020). With its simultaneous emphasis on land use planning and community-level dynamics, planning offers an essential perspective in all three dimensions and serves as an appropriate research and policy paradigm for the One Health concept.

The Nexus of Urban and Rural Landscapes in Asia: Potentially Infectious Mixing Bowls

Planning scholars have developed a sophisticated understanding of the rapidly urbanizing environments (e.g., Bunnell et al., 2002; Douglass, 2000, 2002; Douglass & Huang, 2007; Hogan et al., 2012) where One Health is most relevant: the rapidly developing regions of Asia. Many recent EIDs have first become recognized in rapidly developing parts of Asia (e.g., severe acute respiratory syndrome [SARS], avian influenza, Nipah virus), and a planning framework for understanding these types of urban and regional contexts is essential. *Desakota* is a Bahasa Indonesia word for "village-town," and the term captures the fluid nature of developing regions in some Southeast Asian countries (McGee, 1989, 1991). Many modern desakota regions are adjacent to and constitutive of periurban settlements, and they differ from urban transition patterns seen in the West, which have often been characterized by migration from rural areas to urban ones (Sui & Zeng, 2001). These regions are already heavily populated, so land uses gradually transform around the population, thereby highlighting the need for residents to adjust their pre-existing lifestyles to their surroundings. Desakota regions end up connecting periurban fringes to each other, with the predictable result of those merged regions further connecting established urban cores to form a metro area (Sui & Zeng, 2001) characterized by massive regions of combined urban and rural land uses of high intensity. The proliferation of these hybridized communities has meant that their planning agencies have had to address both agrarian and urban community dynamics. It is these kinds of regions where one of the most recent EIDs for which there has been retrospective data and analysis available, H5N1 (the commonly used genetic name of avian influenza), can serve as a model for how planning might contribute to the current understanding of how to respond to the ongoing threat of EIDs.

As with all zoonotic transmission from a wild or a domesticated animal to a human, a virus's most vulnerable moment is when it leaves a familiar host species and is transferred to a new and unfamiliar host species. There are surely many more zoonotic viruses that die during this transition than survive it. However, early in the 21st century, avian influenza *did* survive this transition, and the most effective moment to have developed and implemented policy to stem the evolution of this potential pandemic was at this point.

The Avian Influenza Outbreaks of 2004–2005: Zoonotic Transmission and Planning Questions

On January 13, 2004, the World Health Organization (WHO) announced that several people in Vietnam had been infected by a pathogenic avian influenza virus (WHO, 2004a). By May 21, 2005, at least 52 people had died of H5N1: 36 in Vietnam, 12 in Thailand, and 4 in Cambodia. Of those 52 fatalities, it is thought that 50 were infected through direct contact with diseased chickens or ducks. Only two were infected through direct human-to-human contact and, in these cases, the virus was transmitted by intimate, daily contact between family members (Specter, 2005; Ungchusak et al., 2005). Thus, the absence of a significant number of cases of human-to-human transmission of the disease through casual contact meant that the zoonotic spillover did not manifest in a regional and potentially global pandemic. A retrospective study of the outbreak found that 119 humans in Vietnam had been infected overall, with 59 deaths, yielding an alarming mortality rate of 49.6% (Magalhães et al., 2010; WHO, 2010). Unlike the influenza outbreaks of 1957 and 1968, which *did* give rise to pandemics, the high mortality rate of the 2004–2005 outbreaks allowed for greater detection to arrest mass spreading, and it is the low-pathogenic versions that raised the most concern regarding widespread impact (Peiris et al., 2007). Nevertheless, this very real threat of an avian influenza pandemic in 2004–2005 generated extensive debate and concern at the time among scholars, officials, and the general public about how to deal with a potential H5N1 pandemic (Osterholm, 2005). The abiding concern at the time was the manifestation of a version of the bird flu capable of rapidly spreading through the human population.

The government of Vietnam was not entirely unprepared for the H5N1 outbreak, which might help explain why the virus did not cause more damage. Starting in 2003, Vietnam established a number of agencies to coordinate outbreak countermeasures. The advent of SARS in that year had resulted in the creation of the National SARS Steering Committee, and in turn this yielded the same type of group for H5N1 avian influenza when that disease appeared. This was followed by a national committee for avian influenza in 2004; this committee included the heads of eight different government ministries. These broad regulatory groups fed into subgroups that focused on different influenza types and mitigation tasks like disease monitoring and awareness building (Hai, 2009).

When the avian influenza outbreak hit Vietnam, the government responded with a mass culling and vaccination effort to mitigate the spread of the disease. The first wave in 2004 was stanched by culling around 66 million birds, and then in 2005 governing agencies started to take more preventive measures by making poultry vaccination a legal obligation. This was supplemented by the prohibition of some uses of live poultry and tighter poultry transport controls. These sweeping efforts were successful at stopping the further spread of bird influenza, at least into the beginning of 2006 (Lockerbie & Herring, 2009; McKenna, 2006). In doing so, however, the harsh reaction to the emergent human health threat had disastrous economic consequences for small-scale farmers and likely made future surveillance efforts all the more difficult.

In spite of the implementation of many tight regulations in Vietnam, including the prohibition of urban chicken farming, avian influenza cropped up again in short order in October 2007. This rapid reappearance was likely driven by the ubiquity of poultry farming in the country: more than 50% of all households engage in some form of it (Lockerbie & Herring, 2009). This reality meant that many small-scale, mostly lower-income poultry farmers were swept up in the government's wholesale efforts to prevent/eliminate new outbreaks quickly and decisively, saddling them with the concomitant costs of culling and vaccination (Riviere-Cinnamond et al., 2005). This posed a major economic challenge to all of Vietnam's smaller poultry farmers in perpetuity, and using blanket solutions like culling and vaccination was suboptimal from a regulatory perspective because of how widespread poultry farming is in Vietnam (Lockerbie & Herring, 2009).

In light of outbreak preparedness issues in the Asia Pacific region in general (as identified by Coker and Mounier-Jack in 2006), it is not surprising that Vietnam continued to struggle with avian influenza as it emerged from the 2005 crisis. Specifically, Coker and Mounier-Jack (2006) pointed to some major weaknesses in the disease control and response plans designed by the countries in their study, one of which was Vietnam.

In response to Vietnam's vulnerability to zoonoses, a nongovernmental alliance formed to develop leading-edge infrastructure for disease control and tracing. The

Vietnam Initiative on Zoonotic Infections (VIZIONS) brought scholars together from all over the world to help the Vietnamese with their ongoing disease concerns, and the VIZIONS group specifically identified peri-urbanism and agricultural transformation as attributes that put Vietnam at ongoing risk for disease outbreaks (Rabaa et al., 2015). However, VIZIONS as a whole is more generally concerned with medical and pathogenic issues than with urban transition dynamics, so even as this group implied the need for planning reform in their mission document, they stopped short of elaborating on exactly how communities might be better configured to discourage outbreaks (Rabaa et al., 2015). The upshot is that even though the need for innovative planning to discourage outbreaks in Vietnam was largely acknowledged, the agency structure and the stated aims of the government and private actors were not conducive to the realization of such initiatives.

We suggest here that Vietnam's aggressive disease mitigation efforts emphasized D/S responses rather than the U/S prevention of zoonotic transmission, a finding consistent with the aforementioned policies of vaccination and culling. A more pre-emptive approach, for example, would have had to include the major planning institutions as central players. The Vietnamese Ministry of Construction (MoC) is the lead agency for land use planning in Vietnam, and its skill sets were largely absent throughout the avian influenza threat response. In particular, channeling the MoC's technical expertise and planning skills in zoning and basic infrastructure provision such as water and sanitation to those areas where human and animal populations are closest surely would have substantially reduced the background risk of zoonotic transmission. Even though the risk of zoonotic transmission had long been known, policymakers began thinking of ways to address the risk only once an outbreak had occurred; if they had considered interventions prior to the outbreaks, they would have involved the MoC.

Responses Versus Strategies: The Value of U/S Preventive Planning

The technical challenge of the 2004–2005 outbreak was compounded in the policy arena by the issue's newness. Given that these pandemic threats happen infrequently—as illustrated by the 100 years between the influenza pandemic and COVID-19—the normal process of gradual policy learning and evolution (e.g., Lindbloom, 1959; Moyson et al., 2017) is hampered by almost no knowledge of "best practices," a challenge that can be seen in how the 2004–2005 outbreak played out.

Estimates of the spread of the H5N1 virus within populations as densely settled and with limited rural health services as Vietnam at the time suggested to observers that officials would have only weeks to mount a medically based response centered on developing, manufacturing, and distributing vaccines. Consistent with the understanding of top public health officials today speaking about the vaccine time line for COVID-19, an effective vaccine for H5N1 would have taken at least 18 months to develop, by which time thousands would have fallen victim to the disease, an understanding generally accepted by political leaders of the time (Check, 2005; Obama & Lugar, 2005).

Overall, the avian flu virus scare of 2004–2005 pointed toward several related conceptual shortcomings surrounding the global pandemic threat; these shortcomings not only help explain why policy has been so weak in addressing this category of threat, but also point toward the central importance of planners. The challenge of EIDs remains one of policy tradeoffs, with numerous decision points dependent on a complex understanding of policy impact, as well as on the confirmed science about the infection; despite these complications, the decision-making calculus is currently seen as a simple "all or nothing" scenario involving mass vaccination, mass culling, or economic shutdown. Such blanket responses are generally infeasible until definitive, actionable information is available, even when a preliminary consensus exists on the long-term risks posed by an identified EID.

In many ways, this dynamic centers on ascertaining and distinguishing "existing threats" from "anticipated threats," and developing planning and policy responses to a known existing threat that are initially generalized to address an anticipated threat. As other planning scholars have shown (e.g., Berke & Lyles, 2013; Burby, 2006; May, 1991), policy dilemmas must balance technical recommendations with social and political viability. The lack of clarity on this balance for EIDs is high, so any mitigation approaches need to demonstrate political consensus on implementation and utility at interrupting a gradual evolution of EIDs. Community and social planning is particularly well suited to this balancing act.

Planning's Strengths: Anticipating a Threat Versus Responding to One

Although Alterman (1995) outlined a useful four-stage sequence of phases that a planning perspective can adopt in a time of crisis, our point here is that planning's most important role may even lie further U/S than the earliest of her "phases" (shock) in preventing the crisis from occurring in the first place. Much of the literature on how policy should respond to what experts knew about the 2004–2005 avian influenza outbreak centered on human management scenarios that generally commence *after* a pandemic is identified (Baker, 2005; Barnett et al., 2005; Bartlett & Hayden, 2005; Freedman & Leder, 2005; Osterholm, 2005). Although some analysts called for preparative steps to be taken before the outbreak could turn into a pandemic, such recommendations also assumed a worst-case scenario and the investment of major financial and political resources to be deployed without sufficiently convincing scientific evidence.

Management recommendations centered on a strengthening of the medical emergency *post-pandemic response* (e.g., Daems et al., 2005; Fauci, 2005; Laver, 2005; Sandman & Lanard, 2004; Vos & Buckner, 2016). Similarly, "preventive" policy recommendations focused on important response capacities such as early interventions to potentially slow the spread of disease, better personal hygiene, hospital infection control, and other information and practices that would become essential *after* a pandemic had begun (Osterholm, 2005). Though these were important planning contingencies, these potentially costly efforts focused on preventing the human pandemic from spreading rapidly and assumed the worst-case scenario of an actual human pandemic. Because of this emphasis, apparent consensus on the inevitability of a bird-originated human flu led to an implied sense of helplessness regarding effective policy options prior to the beginning of a pandemic; like all pandemics, there was no certainty it would evolve to justify expensive and aggressive interventions. Such recommendations appeared to assume that prevention was to be applied only to the disease *spread,* and not to its actual *development* one step U/S of its spread.

This helplessness placed policymakers in an awkward position. If a pandemic was statistically "inevitable," but not yet present (i.e., it was anticipated), then there was urgency for action but insufficient knowledge of serious policy development. Iskander et al. (2013) highlighted the dilemma of information and future disaster planning as an ongoing issue. On the other hand, if a pandemic had already existed, it would likely have been overwhelming, much in the same way that COVID-19 has been, and planning/policy would have been limited to targeted interventions such as vaccination (as advocated by Cox et al., 2003). Even under the accelerated vaccine development efforts in response to COVID-19, millions died prior to vaccine deployment. Neither scenario should be satisfying for the planner or the policymaker.

When there is no documented and widely recognized human pandemic, a catch-22 exists, leaving the decisions regarding the deployment of financial and other resources to be made today about *preparing to respond* to an actual threat. This option is distinct from *actually* responding to a well-defined health threat through risk mitigation efforts. Defining the policy conundrum as a *threat* of human pandemic several stages D/S of an actual named EID, it is understandable why policymakers and the public were slow to respond to the potential avian influenza pandemic with decisive action, no matter how alarmed the health community and some politicians were (Obama & Lugar, 2005; Sandman & Lanard, 2004). It is hard to mobilize drastic action and investments around the *threat* of a threat.

The limitations in the speed of response to an established human pandemic, whether from avian flu or from COVID-19, suggest that planners and policymakers might also search further U/S in the causal chain for effective interventions, an approach clearly supported by what is scientifically known about zoonotic viruses. Scientists worried—and continue to worry—that a resistant human flu would develop from H5N1 *reassorting* with either a human influenza virus (Stöhr, 2005) or with a pig flu virus (Kolata, 1999; Osterholm, 2005), yielding a highly pathogenic (to humans) virus of zoonotic origin that is easily transmitted from human to human. The scientific consensus is that once virologic mutation and reassortment (and "jumping," if necessary) happen, a flu pandemic will be hard to stop. Even at the time, virologic surveillance statistically suggested that these situations creating the conditions for reassortment had long existed in Asia (Osterholm, 2005; Stöhr, 2005), and some research had commenced on the conditions under which such reassortment might have happened (Stöhr, 2005).

To plan for the prevention of a highly pathogenic avian influenza, it was important to understand not just the epidemiology of how a human pandemic would have developed, but equally the epidemiology of zoonotic, cross-species transmission as described generally above, an area that crosses over from public health to animal health. Although these fields are distinct, planners' emphasis on the physical spaces where outbreaks have occurred, and the (human and animal) activity occurring within them, adds a uniquely useful perspective.

The best guess of epidemiologists is that a series of biotic events might occur that result in a global human pandemic.[2] First, conventional human flu virus, in its normal transmission to other humans, infects a human who also happens to be infected with an avian flu virus, creating the conditions for reassortment. Subsequently, genetic material is exchanged between the human and avian flu viruses in that human to create a dangerous new flu strain. Finally, it is thought the genetic mutations result in a new flu virus that is deadly to humans from the avian strains, and simultaneously easily transmissible among them from the human flu virus strains. These conditions are frequent, and mostly do not result in pandemics. However, every once in a while the right conditions do result in a pandemic (Stöhr, 2005).[3]

Fortunately, for the 2004–2005 predicted avian influenza pandemic the question of a human pandemic remained hypothetical, and although the first event described above may have occurred in isolated cases, it did not result in a genetic exchange that appreciably increased human transmissibility. However, if that had occurred, widespread human infection would have been impossible to avoid. Recent WHO findings suggest this is the most "likely" sequence of events that led to COVID-19 (WHO, 2021). Given this sequence, planning's emphasis on managing the physical proximity of livestock and humans, the physical site of zoonotic transmission between species, is perhaps the most important point to target along this evolutionary sequence because this is where plans and policies might be most effective. It is also the point at which financial and political costs best align with policy effectiveness.

The Costs (and Benefits) of Preparing for Pandemics Upstream and Downstream: Aligning Political Will With Level of Intervention

Health-related policy recommendations for the avian flu, at the time, called for the development of a human vaccine to be rapidly refined and administered in the event of, and even prior to, an avian-originated flu outbreak among humans (Osterholm, 2005). The economic cost of such a policy approach, though significant, came in the form of the costs of medical research and development, as well as administration of the preemptive vaccine. Unlike the policy responses that were implemented, such as the mass culling of domestic chicken and duck flocks, the costs of human vaccine development are borne in a diffuse and indirect way by citizens and governments, not by small-scale farmers, regardless of whether it is funded through national, regional, or global sources. This approach has long been seen as the most "effective."

This approach, however, comes with its own significant and potentially prohibitive political and social costs, as well as potentially deleterious medical and public health costs. Inoculation against hypothetical diseases transmitted through domestic farm animals comes with significant risks that make medical intervention among citizenry against the *anticipated* threat of a human pandemic politically difficult. The example of the threat of a possible swine flu outbreak in the United States illustrates the political sensitivities associated with invasive medical interventions too far U/S, or before an immediate and acutely felt threat materializes. When U.S. president Gerald Ford authorized the vaccination of 95% of the U.S. population against what scientists suspected was an emerging and deadly swine flu pandemic in 1976, he unleashed a flurry of wrongful death lawsuits and attacks against government public health officials due to the asserted risks posed by injection of small doses of a virus into otherwise healthy people (see Kolata, 1999; Sandman & Lanard, 2004). This experience laid bare the political challenges to policymakers of taking invasive medical action, and the associated real and perceived risk of making healthy people sick prior to having overwhelming proof that the negative consequences of such drastic action would be outweighed by those of inaction. In short, the swine flu case taught policymakers that public health responses should be proportionate to the popularly accepted probability of the worst-case scenario occurring.

The policy recommendations in Vietnam also provided limited alternatives for managing the risk of a pandemic occurring in the first place, and for preventing its spread. In general, those promoted were targeted at domestic chicken and duck flocks. Those that were not articulated and debated were those targeted at people. The case of the H5N1 virus development in Southeast Asia, and in particular Vietnam, points toward the inherent problem of centralized and crisis-driven policy. Upon recognizing the scope of the infection of ducks and chickens among its poultry farms, the Vietnamese government ordered the culling of flocks. The country killed more than 60 million animals in an aggressive campaign to rid the stock of infected birds, costing the country 120 million euros (Lockerbie & Herring, 2009; Watts, 2005). Even so, it planned to take further action against the remaining 60 million ducks in the country. Although this preventive action almost certainly reduced the likelihood of H5N1 spreading in Vietnam and elsewhere during the course of the epidemic, the social and human impacts on those affected farmers and producers was staggering, especially in a country where the per capita annual income was only $480 in 2004 and government compensation was minimal. The short-term benefits have almost surely been undermined by the longer-term noncompliance of small-scale farmers.

Thus, top-down policy responses to avian flu threats were limited and almost certainly decreasingly effective in the long term. Because the flu, in both humans and birds, is a seasonal problem, this catch-22 did not augur well for the coming years; avian flu remains a threat even today (WHO, 2020), and a related swine flu erupted in a pandemic in 2009 and 2010 (WHO, 2011). Thus, the dynamic between the characteristics of the problem and this kind of policy response is similar to what is generally accepted about infectious disease and antibiotics: the more one uses the solution to the problem, the more resistant the problem becomes to the solution.

In addition, because other domesticated animals such as pigs can become infected from chickens (Kolata, 1999; WHO, 2004b), there is a need to produce vaccines for multiple species every year, and increasing complexity in this regard means mistakes can happen: Just one oversight can therefore lead to the development of a resistant human–human flu strain.[4] Compounding this long-standing challenge is the fact that formerly "wild" species such as the civet cat, pangolin, and others are now being bred as domesticated animals under conditions increasingly similar to those of long-standing domestic livestock (Standaert, 2020). Specialized vaccine development agencies not only have to develop multiple species-specific vaccines, but also mass produce and distribute them in places such as Thailand, Vietnam, Cambodia, and other large swathes of developing regions. This is a monumental undertaking for any agency; even the CDC suffers periodic shortages of the annual human flu vaccine in a single country (the United States) that is smaller than the sum of the H5N1-affected areas.

These conceptual dilemmas are seen in today's challenges not just of COVID-19 vaccine development, but also in its application. With more than 3 million lives lost to the disease worldwide and 150 million infected in about a year's time (Johns Hopkins University, 2021), the pandemic has created as much urgency as can be imagined. Even so, relatively high levels of skepticism of vaccine safety and effectiveness, logistical slowdowns, and gaps in supply exist. Thus, this most "effective" solution has many limitations that should all point toward the need for more preventive solutions that go well beyond medicine for zoonotic diseases.

A Conceptual Frame for EID Planning and Policy

As described above, the CDC's One Health approach emphasizes the interconnection of humans, animals, and environment as a framework to prevent, mitigate, and control zoonotic EIDs. Planning's role in infrastructure development and in land use planning aligns with and supports this approach with numerous alternatives to support nonmedical preventive measures. Scientists' fears of the worst-case scenario generated serious concern among experts during the avian influenza scare, but their recommendations were relatively isolated from the general public, who did not share these concerns to the same extent. Clearly, there is a need to better align EID interventions with political viability.

Planning, Politics, and Policymaking: Applying Analytic Rigor to Preventive Pandemic Planning and Policymaking

The further U/S in the pandemic's development, the more difficult it is to trigger a policy response because of the large number of interests that will be affected by public health's regulatory efforts, and the less-than-certain probabilities of the worst-case scenario occurring. Moreover, medical interventions such as vaccination are harder to implement the further U/S in the disease's progression that they are recommended. The case of the 1976 swine flu suggests that the inherent risks of such a drastic medical response too early can backfire into a political and policy disaster. Nevertheless, medical responses to pandemic threats dominate policy debate even prior to the culmination of a crisis. In part, this bias toward invasive and medical responses is because the alternative, public health promotion, is successful when it prevents disease, and prevention is hard to prove.

One result of being in the early stages of a possible pandemic, and of the tendency for invasive medical response to trump health promotion responses, is what could be seen in the policy debate surrounding avian influenza in 2004–2005: the conception of risk management as something that targets post-pandemic emergence. This conception led to an insufficient number of planning and policy alternatives prior to widespread and runaway infection, and a bias toward those policies most politically and medically risky and generally acceptable to the public only after widespread recognition of a pandemic. This dearth of options led to what is retrospectively perceived to be policy lethargy; however, a review of policy alternatives attentive to the U/S-D/S continuum and the degree of invasive medical intervention can show how planning alternatives can better match appropriate responses that are proportionate to the real-time knowledge of an evolving EID.

A simple 2-by-2 table of policy alternatives can help decision makers decide what to do and when. Table 1 classifies each type of policy alternative according to two key characteristics: where the point of intervention in the evolution of the hypothetical pandemic falls along a continuum of sequential steps, and how invasive the intervention is. Thus, the vertical axis displays progressively threatening situations in the development of the virus, and the horizontal one progressively invasive (i.e., disruptive to both individual bodies and socioeconomic life) policy responses.

Understanding how intervention methods are related to how far U/S they occur in a pandemic's evolution can help to explain why policy intransigence hinders effective action. A more systematic assessment of coordinated and sequential responses to the overall threat evolution might more effectively manage the current risks than urgent calls for any single approach.

Effective public decision making should be based on scientific evidence regarding the current threat, or wherever the threat lies temporally in the subsequent evolution of a pandemic. Policy and planning alternatives therefore should be systematically linked to thresholds of evidence that mark key points in that continuum. Sometimes the current science provides a

Table 1. Current policy alternatives and objectives.

	Policy mechanism	
Degree of threat to humans	***Invasive***	***Noninvasive***
Upstream (avian flu)	• Culling flocks • Bird vaccination • Immediate objective: eliminating avian flu	• Managing risk of reassortment • Improved market design • Investment in water and sanitation • Immediate objective: keep avian flu from developing into a resistant human or swine flu
Downstream (resistant human flu)	• Administer human vaccination • Immediate objective: protect humans from infection with a resistant human flu	• Strengthen emergency response infrastructure • Immediate objective: provide necessary health care for those infected with human flu virus and limit spread of the disease

basis for policy action only in the areas furthest U/S in a disease's development; for example, in the case of avian influenza before it became a resistant human flu, evidence justified bird culling (e.g., Puzelli et al., 2014), bird vaccination (e.g., Lockerbie & Herring, 2009), and managing the risks of reassortment (e.g., Burns et al., 2011; Wu et al., 2015), rather than any direct intervention within the human population.

Once the current state of scientific evidence is established, policymakers must consider the political and administrative implications of action, or its feasibility. The likely political acceptance of each policy alternative as well as its administrative limitations also influences decision making. Invasive action against a flu epidemic in birds is initially acceptable because of the clearly identified threat to humans (Boni et al., 2013; Puzelli et al., 2014). On the other hand, an invasive approach of human intervention would be politically infeasible in the absence of a documented resistant human flu strain.

The Principle of Proportionate Response: A Need for Upstream Planning

Managing the spatial relationships between livestock and human communities was an underexplored element of the debate on the risk of avian flu in 2004–2005. There was no major existing human pandemic, though scientists understood that communities were poised for one (Cox et al., 2003). Statistically, then and now, it seemed simply a matter of time before H5N1 or a similar virus reassorted with a human influenza, kickstarting a human flu pandemic. Although less is known about COVID-19, it is more likely than not that such conditions for zoonotic crossover have existed for some time and eventually progressed to COVID-19 (WHO, 2021). If this is indeed the case, how could public policies have reduced the probabilities of such reassortment happening in the first place?

In 2004–2005, the most immediate threat to humans was not that *bird* flu would rage through the population, but that it was the first step in a reassortment chain that *might* lead to a deadly new *human* flu raging through the population (e.g., Wu et al., 2015). This simple point suggests an alternative to economically and politically damaging vaccination and culling campaigns for *managing the risk of an avian-originated human flu*: better land use and regional planning.

Interventions based on a strong understanding of human behavior on farms, management of the built and natural environment, and regional development patterns would have been invaluable tools for minimizing the overall risk of flu reassortment. Such planning policies would likely have had important effects on the evolution of the disease and avoided the economic and political consequences. Such noninvasive measures included, but should not have been limited to, good clean water and sanitation systems; appropriately located and oriented livestock farms; systematic and frequent checks for fevers and other symptoms of human flu; prompt isolation of human flu sufferers from birds; and basic compensation for sick leave among farmers suffering from flu. The first two of these interventions are conventional planning areas ready for direct action that we elaborate on below. The latter three, however, are areas in which planners can help public and animal health experts target their disciplinary interventions more effectively. In each of these direct and supporting roles, planners have useful skill sets to deploy in the interest of managing pandemic threats, even when those threats have not yet reached crisis levels.

The application of conventional top-down planning tools to discourage disease outbreaks U/S in desakota areas is a good starting point. However, given that around

50% of households in Vietnam farm some kind of poultry (Lockerbie & Herring, 2009), there are bound to be outlying rural areas and urban concentrations that also require planning interventions tailored to the highly transitional and informal nature of rapidly urbanizing regions. The Vietnamese government confronted avian influenza by putting tight controls on the location of poultry farming and livestock transport across urban areas (McKenna, 2006), for example, but this did not cover how to deal with contact transmission in situations where small-scale poultry farming went otherwise undetected due to the highly diversified household economies.

This kind of top-down planning often overlooks important alternatives. For example, when investigating hurricane disasters in the United States, Burby (2006) found that disaster losses were reduced when local governments had to regularly submit community planning documents to states. This kind of community-based planning approach places the onus on multiple levels of government to coordinate in ways that reach farther U/S in the process, even before they come to the attention of more centralized authorities.

In the case of avian influenza, community markets are a significant space of contact between large human and animal populations and are therefore often put forward as major sites of zoonotic transmission; however, the relevant characteristics of markets fall well outside the purview of public health interventions. Although health officers often target such sites for testing, treatment, and vaccination, they have little expertise in how to physically design safe interactions between vendors, customers, and livestock. Moreover, such kinds of design features are rarely decided from the "top" (i.e., with large-scale global health concerns in mind) and result from ad hoc planning and construction decisions.

Going forward, these physical spaces need basic infrastructure to minimize virus transmission in tight spaces. Because handwashing and effective containment and isolation of bodily fluids is one of the most important mitigating factors for disease transmission, planners' expertise in water and sanitation is particularly important as an U/S intervention. Although it may not seem to require a particular expertise to suggest the provision of toilets, sinks, and washing stations in markets and other locales of potential virus transmission, resource allocation is often a stumbling block because the state of knowledge on EIDs is so low, and *every* market is a possible transmission site.

The highly diffuse and unknown nature of U/S pandemic threats means that the perceived degree of threat to humans remains low. Thus, for most markets during an U/S phase of a pandemic's evolution, the political and administrative feasibility of shutting a market down is overly invasive, given the economic consequences to the community. In addition, in a nation like Vietnam in the 2000s, the financial burden of building conventional water and sanitation systems in every market was a politically and administratively infeasible alternative relative to the low level of identified threat that zoonotic transmission posed as perceived by the communities. Community planners, however, have particular skills in stimulating community investments in infrastructure that can help minimize these U/S threats at low cost, and all under the guise of providing clean water and sanitation that most residents would like to have regardless of the level of pandemic threat.

A planner's intervention of providing clean water and sanitation infrastructure in a market, for example, would contribute greatly to minimizing zoonotic transmission risks not just in markets, but throughout communities more generally where livestock and humans comingle. Planning scholarship on water access in periurban regions reveals creative approaches for the installation of formal and informal water infrastructure, and a common theme is strong community involvement in determining how water access is realized under challenging circumstances (e.g., Acey et al., 2019; González Rivas, 2014; González Rivas et al., 2014; Spencer, 2008; Spencer & Guzinsky, 2010; Spencer & Meng, 2019). These planning skills center on the collaborative aspects of planning that are especially appropriate for managing EIDs through U/S interventions even though there may be challenging financial and political circumstances. Consistent with this emphasis on local communities in prioritizing abstract and unknown health problems, Spencer (2011), for example, found in periurban Vietnam that local residents investing in new water infrastructure were motivated to do so more by *anticipated* threats of future environmental health concerns than they were by known ones (e.g., diseases that they are familiar with, and may have already survived). This finding illustrates an important point about the suitability of community planning for emerging threats like EIDs, as has been advocated by Berke and Lyles (2013) for the emerging (at the time) issue of climate change: Communities are often motivated to invest in mitigating anticipated threats at levels proportionate to the demonstrated, though often not yet acute, levels of threat.

Concluding Thoughts: Planning for Pandemic Prevention

In light of the damage wrought by COVID-19, planners should now be constantly mindful of the role they can play in disease prevention and mitigation. It should be no surprise that the seminal urban planning issue of infectious disease focused on what was a mysterious EID at the time considered to be the result of "miasma" (e.g., Johnson, 2006). Massive cholera outbreaks in the

1800s led to community-based urban planning research and interventions that proved to have some of the widest-ranging positive impacts on urban human health. Planning scholarship and practice should assert itself in this realm of infectious disease prevention once again, with a focus on better understanding and responding to zoonotic EIDs.

To date, planning scholarship has begun to empirically document planning-related alternatives and suggest noninvasive, alternative approaches to limiting the spread of EIDs. Spencer et al.'s (2020) empirical research, for example, identified communities most at risk of disease outbreaks and recommended the targeting of preventive community interventions such as water and sanitation infrastructure investment, and also surveillance measures that actively engage communities identified as most at risk even if there are currently no known outbreaks. There are surely many more evidence-based recommendations planners can bring to the table. We suggest that better planning attention would be most effectively directed to seven areas. The first three are proposed actions dependent on planning-oriented empirical evidence and related to planning practice and education; the latter four are more general recommendations related to future research frameworks and partnerships.

Planning Practice and Education Actions

1. Planners in regions transitioning from agrarian communities to urban ones must be consistently intentional about their efforts to manage density among humans, animals, and natural resources. In particular, land use planners should develop their plans and policies in ways that limit host-jumping and rapid pathogen spread among humans.
2. The management of the human–livestock interface requires more than simply better site location decisions, as important as those are. Even where effective siting occurs, social practices at this interface can drastically limit opportunities for virus reassortment, as described above. For example, providing effective financial incentives for farmers to self-isolate at the first sign of illness through community insurance schemes would, in theory, reduce the risk of virus reassortment by 50%.
3. Although the American Planning Association (APA) has policy positions related to agricultural land preservation, tourism, and food systems, there is little regarding land management for human health and disease control. Thus, the APA, the Planning Accreditation Board, and other associations guiding the field should develop principles, guidelines, and working groups to facilitate the recommendations described above. Without formal recognition of the role that planning has to play in EIDs, the field's contributions will be limited, to the detriment of all.

General Recommendations for Future Research

4. The emergent subdiscipline of "food systems" in planning should consider the central importance of their work to managing EIDs. The fields of public health, veterinary health, and virology have little expertise in the management of large-scale physical and biotic spaces, even though the food production system, and particularly its livestock practices, lies at the heart of accepted scientific knowledge of the origins of today's EIDs. If food systems planners do not address this question, who will?
5. The global nature of EIDs illustrates that local disease outbreaks at the animal-human interface can quickly become international and global issues, as COVID-19 has so dramatically illustrated. Likewise, planning scholarship and practice should take a similar geographic scope, one that understands the vital importance of global networks, while simultaneously recognizing how important neighborhood and local dynamics are for maintaining health.
6. Regional planners focus on a broad domain of influence crossing urban, periurban, and rural settings. These scholars should strengthen partnerships with veterinary health and public health researchers and practitioners to coordinate their areas of expertise to predict and address possible disease outbreaks and better align their distinct data sources and methods.
7. More broadly, in all these endeavors, planners should emphasize and assert the utility of their perspectives in better understanding where EID outbreaks occur. Why they occur in some areas and not others, as well as how and why they spread geographically (e.g., Scoizec et al., 2018), are questions planners are well positioned to answer, and these answers might be effectively translated into new policies and practices.

There is no silver bullet for eliminating the risk of EID pandemics. Nevertheless, clearer thinking on *what kinds* of planning and policies to enact and *when* is essential and should be debated today rather than once the next pandemic begins. The analytic framework described here, we hope, will help scholars and decision makers in planning and elsewhere develop appropriate responses proportionate to the established level of threat, and thereby avoid some of the pitfalls and fears of "crying wolf" inherent to any evolving threat.

ABOUT THE AUTHORS

James Nguyen H. Spencer (*jhs@lsu.edu*) *is a professor and vice provost/dean of the Graduate School at Louisiana State University and adjunct senior fellow at the East West Center.* ***David Marasco*** (*david.marasco@alumni.rice.edu*) *is a PhD student in the Department of Urban & Regional Planning at the University of Hawai'i at Manoa.* ***Michelle Eichinger*** (*meichinger@live.com*) *earned a PhD in Clemson University's Planning, Design, and the Built Environment program and is currently a postdoctoral research fellow at Vrije Universiteit Amsterdam.*

NOTES

1. Our extended use of the conventional upstream/downstream metaphor reinforces our overall point that the extended geography and timeline associated with pandemics extend across sociopolitical boundaries governed by riparian rights, and that there is a unidirectional flow, whereby consequences generally only flow in one direction.

2. Though it is very much too early to know the origins and development pathway of the COVID-19 virus, there is scientific consensus that the virus is zoonotic in origin from a host reservoir of bats, and a prevailing hypothesis is that an unknown intermediate species has served as the pathway to human infection.

3. Given the difficulty of testing and measuring infections among humans and animals during this hypothesized sequence of events, it remains a theoretical consensus awaiting new empirical tools.

4. As the definition of "domesticated" animals increases, this challenge of managing animal health multiplies exponentially.

REFERENCES

Acey, C., Kisiangani, J., Ronoh, P., Delaire, C., Makena, E., Norman, G., Levine, D., Khush, R., & Peletz, R. (2019). Cross-subsidies for improved sanitation in low income settlements: Assessing the willingness to pay of water utility customers in Kenyan cities. *World Development*, *115*, 160–177. https://doi.org/10.1016/j.worlddev.2018.11.006

Ahmed, S., Davila, J. D., Allen, A., Haklay, M., Tacoli, C., & Fevre, E. (2019). Does urbanization make emergence of zoonosis more likely? Evidence, myths and gaps. *Environment and Urbanization*, *31*(2), 443–460. https://doi.org/10.1177/0956247819866124

Alterman, R. (1995). Can planning help in time of crisis? Planners' responses to Israel's recent wave of mass immigration. *Journal of the American Planning Association*, *61*(2), 156–177. https://doi.org/10.1080/01944369508975630

Baker, D. (2005). *Bird flu fears: Is there a better way to develop drugs?* Center for Economic and Policy Research. https://www.cepr.net/documents/publications/intellectual_property_2005_10.pdf

Barnett, D. J., Balicer, R. D., Lucey, D. R., Everly, G. S., Jr., Omer, S. B., Steinhoff, M. C., & Grotto, I. (2005). A systematic analytic approach to pandemic influenza preparedness planning. *PLoS Medicine*, *2*(12), e359–e1241. https://doi.org/10.1371/journal.pmed.0020359

Bartlett, J. G., & Hayden, F. G. (2005). Influenza A (H5N1): Will it be the next pandemic influenza? Are we ready? *Annals of Internal Medicine*, *143*(6), 460–462. https://doi.org/10.7326/0003-4819-143-6-200509200-00011

Berke, P., & Lyles, W. (2013). Public risks and the challenges to climate-change adaptation: A proposed framework for planning in the age of uncertainty. *Cityscape*, *15*(1), 181–208. https://www.huduser.gov/portal/periodicals/cityscpe/vol15num1/article9.html

Boni, M. F., Galvani, A. P., Wickelgren, A. L., & Malani, A. (2013). Economic epidemiology of avian influenza on smallholder poultry farms. *Theoretical Population Biology*, *90*, 135–144. https://doi.org/10.1016/j.tpb.2013.10.001

Bunnell, T., Barter, P. A., & Morshidi, S. (2002). Kuala Lumpur metropolitan area: A globalizing city-region. *Cities*, *19*(5), 357–370. https://doi.org/10.1016/S0264-2751(02)00036-7

Burby, R. J. (2006). Hurricane Katrina and the paradoxes of government disaster policy: Bringing about wise governmental decisions for hazardous areas. *The Annals of the American Academy of Political and Social Science*, *604*(1), 171–191. https://doi.org/10.1177/0002716205284676

Burns, T. E., Guerin, M. T., Kelton, D., Ribble, C., & Stephen, C. (2011). On-farm study of human contact networks to document potential pathways for avian influenza transmission between commercial poultry farms in Ontario, Canada. *Transboundary and Emerging Diseases*, *58*(6), 510–518. https://doi.org/10.1111/j.1865-1682.2011.01232.x

Centers for Disease Control and Prevention (CDC). (2019). *Eight zoonotic diseases shared between animals and people of most concern in the U.S.* https://www.cdc.gov/media/releases/2019/s0506-zoonotic-diseases-shared.html.

Centers for Disease Control and Prevention (CDC). (2020). *One health.* https://www.cdc.gov/onehealth/index.html.

Check, E. (2005). Avian flu special: Is this our best shot? *Nature*, *435*(7041), 404–406. https://doi.org/10.1038/435404a

Coker, R., & Mounier-Jack, S. (2006). Pandemic influenza preparedness in the Asia-Pacific region. *The Lancet*, *368*(9538), 886–889. https://doi.org/10.1016/S0140-6736(06)69209-X

Cox, N. J., Tamblyn, S. E., & Tam, T. (2003). Influenza pandemic planning. *Vaccine*, *21*(16), 1801–1803. https://doi.org/10.1016/S0264-410X(03)00076-8

Creighton, C., Keil, R., & Ali, S. H. (2021). Extended urbanisation and the spatialities of infectious disease: Demographic change, infrastructure and governance. *Urban Studies*, *58*(2), 245–263. https://doi.org/10.1177/0042098020910873

Daems, R., Del Giudice, G., & Rappuoli, R. (2005). Anticipating crisis: Towards a pandemic flu vaccination strategy through alignment of public health and industrial policy. *Vaccine*, *23*(50), 5732–5742. https://doi.org/10.1016/j.vaccine.2005.10.011

Douglass, M. (2000). Mega-urban regions and world city formation: Globalisation, the economic crisis, and urban policy issues in Pacific Asia. *Urban Studies*, *37*(12), 2315–2335. https://doi.org/10.1080/00420980020002823

Douglass, M. (2002). From global intercity competition to cooperation for livable cities and economic resilience in Pacific Asia. *Environment and Urbanization*, *14*(1), 53–68. https://doi.org/10.1177/095624780201400105

Douglass, M., & Huang, L. (2007). Globalizing the city in Southeast Asia: Utopia on the urban edge—The case of Phu My Hung, Saigon. *International Journal of Asia Pacific Studies*, *3*(2), 1–42. https://ijaps.usm.my/?page_id=204

Fauci, A. S. (2005, May 25). Race against time. *Nature*, *435*(7041), 423–424. https://doi.org/10.1038/435423a

Finucane, M. L., Nghiem, T., Saksena, S., Nguyen, L., Fox, J., Spencer, J. H., & Thau, T. D. (2014). An exploration of how perceptions of the risk of avian influenza in poultry relate to

urbanization in Vietnam. *EcoHealth*, *11*(1), 73–82. https://doi.org/10.1007/s10393-014-0906-2
Freedman, D. O., & Leder, K. (2005). Influenza: Changing approaches to prevention and treatment in travelers. *Journal of Travel Medicine, 12*(1), 36–44. https://doi.org/10.2310/7060.2005.00007
González Rivas, M. (2014). Decentralization, community participation, and improvement of water access in Mexico. *Community Development*, *45*(1), 2–16. https://doi.org/10.1080/15575330.2013.868817
González Rivas, M., Beers, K., Warner, M., & Weber-Shirk, M. (2014). Analyzing the potential of community water systems: The case of AguaClara. *Water Policy*, *16*(3), 557–577. https://doi.org/10.2166/wp.2014.127
Hai, D. T. (2009). *Vietnam's framework of pandemic preparedness*. S. Rajaratnam School of International Studies. http://www.jstor.com/stable/resrep05905.12
Hogan, T., Bunnell, T., Pow, C., Permanasari, E., & Morshidi, S. (2012). Asian urbanisms and the privatization of cities. *Cities*, *29*(1), 59–63. https://doi.org/10.1016/j.cities.2011.01.001
Iskander, J., Strikas, R. A., Gensheimer, K. F., Cox, N. J., & Redd, S. C. (2013). Pandemic influenza planning, United States, 1978–2008. *Emerging Infectious Diseases*, *19*(6), 879–885. https://doi.org/10.3201/eid1906.121478
Johns Hopkins University. (2021). *COVID-19 dashboard*. Center for Systems Science and Engineering (CSSE), Johns Hopkins University. https://coronavirus.jhu.edu/map.html
Johnson, S. (2006). *The ghost map: The story of London's deadliest epidemic—and how it changed the way we think about disease, cities, science, and the modern world*. Penguin Books.
Kolata, G. (1999). *Flu: The story of the great influenza pandemic of 1918 and the search for the virus that caused it*. Farrar, Straus, and Giroux.
Laver, G. (2005). Influenza drug could abort a pandemic. *Nature*, *434*(7035), 821. https://doi.org/10.1038/434821a
Lindblom, C. (1959). The science of "muddling through." *Public Administration Review*, *19*(2), 79–88. https://doi.org/10.2307/973677
Lockerbie, S., & Herring, D. A. (2009). Global panic, local repercussions: Economic and nutritional effects of bird flu in Vietnam. In R. A. Hahn & M. Inborn (Eds.), *Anthropology and public health: Bridging differences in culture and society* (pp. 556–586). Oxford University Press.
Magalhães, R. J. S., Pfeiffer, D. U., & Otte, J. (2010). Evaluating the control of HPAIV H5N1 in Vietnam: Virus transmission within infected flocks reported before and after vaccination. *BMC Veterinary Research*, *6*, 31. https://doi.org/10.1186/1746-6148-6-31
Matthew, R. A., & McDonald, B. (2006). Cities under siege: Urban planning and the threat of infectious disease. *Journal of the American Planning Association*, *72*(1), 109–117. https://doi.org/10.1080/01944360608976728
May, P. (1991). Addressing public risks: Federal earthquake policy design. *Journal of Policy Analysis and Management*, *10*(2), 263–285. https://doi.org/10.2307/3325175
McCune, S., Arriola, C. S., Gilman, R. H., Romero, M. A., Ayvar, V., Cama, V. A., Montgomery, J. M., Gonzales, A. E., & Bayer, A. M. (2012). Interspecies interactions and potential influenza A virus risk in small swine farms in Peru. *BMC Infectious Diseases*, *12*(1), 1–10. https://doi.org/10.1186/1471-2334-12-58
McGee, T. G. (1989). Urbanisasi or kotadesasi? In F. J. Costa (Ed.), *Urbanization in Asia: Spatial dimensions and policy issues* (pp. 93–108). University of Hawaii Press.
McGee, T. G. (1991). The emergence of desakota regions in Asia: Expanding a hypothesis. In N. Ginsburg, B. Koppel, & T. G. McGee (Eds.), *The extended metropolis: Settlement transition in Asia* (pp. 3–26). University of Hawaii Press.
McKenna, M. (2006). *Vietnam's success against avian flu may offer blueprint for others*. University of Minnesota Center for Infectious Disease Research and Policy. https://www.cidrap.umn.edu/news-perspective/2006/10/special-report-vietnams-success-against-avian-flu-may-offer-blueprint
Moyson, S., Scholten, P., & Weible, C. M. (2017). Policy learning and policy change: Theorizing their relations from different perspectives. *Policy and Society*, *36*(2), 161–177. https://doi.org/10.1080/14494035.2017.1331879
Murugesan, V. (2020). How can urban planners address emerging zoonoses? A scoping review of recommended interventions. *Urbana*, *XXI*, 44–64. https://doi.org/10.47785/urbana.4.2020
Neiderud, C. (2015). How urbanization affects the epidemiology of emerging infectious diseases. *Infection Ecology & Epidemiology*, *5*(1), 27060–27069. https://doi.org/10.3402/iee.v5.27060
Obama, B., & Lugar, R. (2005, June 6). Grounding a pandemic. *New York Times*. https://www.nytimes.com/2005/06/06/opinion/grounding-a-pandemic.html.
Osterholm, M. T. (2005). Preparing for the next pandemic. *The New England Journal of Medicine*, *352*(18), 1839–1842. https://doi.org/10.1056/NEJMp058068
Parrish, C. R., Holmes, E. C., Morens, D. M., Park, E., Burke, D. S., Calisher, C. H., Laughlin, C. A., Saif, L. J., & Daszak, P. (2008). Cross-species virus transmission and the emergence of new epidemic diseases. *Microbiology and Molecular Biology Reviews*, *72*(3), 457–470. https://doi.org/10.1128/MMBR.00004-08
Peiris, J. S. M., de Jong, M. D., & Guan, Y. (2007). Avian influenza virus (H5N1): A threat to human health. *Clinical Microbiology Reviews*, *20*(2), 243–267. https://doi.org/10.1128/CMR.00037-06
Plowright, R. K., Parrish, C. R., McCallum, H., Hudson, P. J., Ko, A. I., Graham, A. L., & Lloyd-Smith, J. O. (2017). Pathways to zoonotic spillover. *Nature Reviews. Microbiology*, *15*(8), 502–510. https://doi.org/10.1038/nrmicro.2017.45
Puzelli, S., Rossini, G., Facchini, M., Vacarri, G., Di Trani, L., Di Martino, A., Gaibani, P., Vocale, C., Cattoli, G., Bennett, M., McCauley, J. W., Rezza, G., Moro, M. L., Rangoni, R., Finarelli, A. C., Landini, M. P., Castrucci, M. R., & Donatelli, I. (2014). Human infection with highly pathogenic A(H7N7) avian influenza virus, Italy, 2013. *Emerging Infectious Diseases*, *20*(10), 1745–1749. https://doi.org/10.3201/eid2010.140512
Rabaa, M. A., Tue, N. T., Phuc, T. M., Carrique-Mas, J., Saylors, K., Cotten, M., Bryant, J. E., Nghia, H. D. T., Cuong, N. V., Pham, H. A., Berto, A., Phat, V. V., Dung, T. T. N., Bao, L. H., Hoa, N. T., Wertheim, H., Nadjm, B., Monagin, C., van Doorn, H. R., … Baker, S. (2015). The Vietnam initiative on zoonotic infections (VIZIONS): A strategic approach to studying emerging zoonotic infectious diseases. *EcoHealth*, *12*(4), 726–735. https://doi.org/10.1007/s10393-015-1061-0
Riviere-Cinnamond, A., Cuc, N. T. K., & Wollny, C. (2005). *Support policy strategy for avian influenza emergency recovery and rehabilitation of the poultry sector in Vietnam [Paper presentation]*. Conference on International Agricultural Research for Development, Stuttgart-Hohenheim. https://www.researchgate.net/publication/236647649_Support_policy_strategy_for_Avian_Influenza_emergency_recovery_and_rehabilitation_of_the_

poultry_sector_in_Vietnam_Deustcher_Tropentag_Paper_presented_at_the_Conference_on_International_Agricultural_R
Saksena, S., Fox, J., Epprecht, M., Tran, C. C., Nong, D. H., Spencer, J. H., Nguyen, L., Finucane, M. L., Tran, V. D., & Wilcox, B. A. (2015). Evidence for the convergence model: The emergence of highly pathogenic avian influenza (H5N1) in Viet Nam. *PLoS One*, *10*(9), e0138138. https://doi.org/10.1371/journal.pone.0138138
Sandman, P. M., & Lanard, J. (2004). Pandemic influenza risk communication: The teachable moment. http://www.psandman.com/col/pandemic.htm.
Scoizec, A., Niqueux, E., Thomas, R., Daniel, P., Schmitz, A., & Le Bouquin, S. (2018). Airborne detection of H5N8 highly pathogenic avian influenza virus genome in poultry farms, France. *Frontiers in Veterinary Science*, *5*, 15–17. https://doi.org/10.3389/fvets.2018.00015
Specter, M. (2005, February 21). Nature's bioterrorist. *The New Yorker*. https://www.newyorker.com/magazine/2005/02/28/natures-bioterrorist-2
Spencer, J. H. (2008). Household strategies for securing clean water: The demand for piped water in Viet Nam's peri-urban settlements. *Journal of Planning Education and Research*, *28*(2), 213–224. https://doi.org/10.1177/0739456X08321793
Spencer, J. H. (2011). Community and household perceptions in urban services demand. *Journal of the American Planning Association*, *77*(4), 354–367. https://doi.org/10.1080/01944363.2011.611099
Spencer, J. H. (2013). The urban health transition hypothesis: Empirical evidence of an avian influenza Kuznets curve in Vietnam? *Journal of Urban Health*, *90*(2), 343–357. https://doi.org/10.1007/s11524-012-9719-1
Spencer, J. H., Finucane, M., Fox, J., Saksena, S., & Sultana, N. (2020). Emerging infectious disease, the household built environment characteristics, and urban planning: Evidence on avian influenza in Vietnam. *Landscape and Urban Planning*, *193*, 103681–103614. https://doi.org/10.1016/j.landurbplan.2019.103681
Spencer, J. H., & Guzinsky, C. (2010). Periurbanization, public finance and local governance of the environment: Lessons from small-scale water suppliers in Gresik. *Environment and Planning A: Economy and Space*, *42*(9), 2131–2146. https://doi.org/10.1068/a42387
Spencer, J. H., & Meng, B. (2019). Resilient urbanization and infrastructure governance: The case of the Phnom Penh Water Supply Authority, 1993–2007. *Water Policy*, *21*(4), 848–864. https://doi.org/10.2166/wp.2019.211
Standaert, M. (2020, February 24). Coronavirus closures reveal vast scale of China's secretive wildlife farm industry. *The Guardian*. https://www.theguardian.com/environment/2020/feb/25/coronavirus-closures-reveal-vast-scale-of-chinas-secretive-wildlife-farm-industry
Stöhr, K. (2005). Avian influenza and pandemics-research needs and opportunities. *The New England Journal of Medicine*, *352*(4), 405–407. https://doi.org/10.1056/NEJMe048344
Sui, D. Z., & Zeng, H. (2001). Modeling the dynamics of landscape structure in Asia's emerging desakota regions: A case study in Shenzhen. *Landscape and Urban Planning*, *53*(1–4), 37–52. https://doi.org/10.1016/S0169-2046(00)00136-5
Takahashi, L. M. (1997). The socio-spatial stigmatization of homelessness and HIV/AIDS: Toward an explanation of the NIMBY syndrome. *Social Science & Medicine*, *45*(6), 903–914. https://doi.org/10.1016/S0277-9536(96)00432-7
Takahashi, L. M., & Smutny, G. (2001). Collaboration among small, community-based organizations: Strategies and challenges in turbulent environments. *Journal of Planning Education and Research*, *21*(2), 141–153. https://doi.org/10.1177/0739456X0102100203
Taylor, L. H., Latham, S. M., & Woolhouse, M. E. J. (2001). Risk factors for human disease emergence. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, *356*(1411), 983–989. https://doi.org/10.1098/rstb.2001.0888
Ungchusak, K., Auewarakul, P., Dowell, S. F., Kitphati, R., Auwanit, W., Puthavathana, P., Uiprasertkul, M., Boonnak, K., Pittayawonganon, C., Cox, N. J., Zaki, S. R., Thawatsupha, P., Chittaganpitch, M., Khontong, R., Simmerman, J. M., & Chunsutthiwat, S. (2005). Probable person-to-person transmission of avian influenza A (H5N1). *New England Journal of Medicine*, *352*(4), 333–340. 10.1056/NEJMoa044021 https://doi.org/10.1056/NEJMoa044021
Vos, S. C., & Buckner, M. M. (2016). Social media messages in an emerging health crisis: Tweeting bird flu. *Journal of Health Communication*, *21*(3), 301–308. https://doi.org/10.1080/10810730.2015.1064495
Watts, J. (2005). Vietnam needs cash to stave off future outbreaks of avian flu. *The Lancet*, *365*(9473), 1759–1760. https://doi.org/10.1016/S0140-6736(05)66565-8
Wilcox, B. A., & Colwell, R. R. (2005). Emerging and reemerging infectious diseases: Biocomplexity as an interdisciplinary paradigm. *EcoHealth*, *2*(4), 244–257. https://doi.org/10.1007/s10393-005-8961-3
World Health Organization (WHO). (2004a). *Avian influenza A(H5N1) in humans and poultry in Vietnam*. https://www.who.int/csr/don/2004_01_13/en/
World Health Organization (WHO). (2004b). *Avian influenza: H5N1 detected in pigs in China*. https://www.who.int/csr/don/2004_08_20/en/
World Health Organization (WHO). (2010). *Avian influenza: Situation in Vietnam–update 11*. https://www.who.int/csr/don/2010_04_21/en/
World Health Organization (WHO). (2011). *Implementation of the international health regulations (2005): Report of the review committee on the functioning of the international health regulations (2005) in relation to pandemic (H1N1)* 2009. (No. A64/10). https://apps.who.int/gb/ebwha/pdf_files/WHA64/A64_10-en.pdf
World Health Organization (WHO). (2020). *Increase in 'bird flu' outbreaks: WHO/Europe advice for handling dead or sick birds*. http://www.euro.who.int/en/health-topics/communicable-diseases/influenza/news/news/2020/01/increase-in-bird-flu-outbreaks-whoeurope-advice-for-handling-dead-or-sick-birds
World Health Organization (WHO). (2021). *WHO-convened global study of origins of SARS-CoV-2: China Part*. https://www.who.int/publications/i/item/who-convened-global-study-of-origins-of-sars-cov-2-china-part
Wu, D., Zou, S., Bai, T., Li, J., Zhao, X., Yang, L., Liu, H., Li, X., Yang, X., Xin, L., Xu, S., Zou, X., Li, X., Wang, A., Guo, J., Sun, B., Huang, W., Zhang, Y., Li, X., … Shu, Y. (2015). Poultry farms as a source of avian influenza A (H7N9) virus reassortment and human infection. *Scientific Reports*, *5*, 7630–7638. https://doi.org/10.1038/srep07630
Wu, T., Perrings, C., Kinzig, A., Collins, J. P., Minteer, B. A., & Daszak, P. (2017). Economic growth, urbanization, globalization, and the risks of emerging infectious diseases in China: A review. *Ambio*, *46*(1), 18–29. https://doi.org/10.1007/s13280-016-0809-2