The H5N1 Virus

The H5N1 Virus:

Seeking Knowledge Justice in an (In)Secure World

By

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INTRODUCTION

> "This excess of biopower appears when it becomes technologically and politically possible for man not only to manage life but to make it proliferate, to create living matter, to build the monster, and ultimately, to build viruses that cannot be controlled and that are universally destructive. This formidable extension of biopower…will put it beyond all human sovereignty." (Foucault 2003, 254)

In the first two weeks of 2016, three disconnected events occurred that illustrate the arguments of this book. On January 7 and 8, I attended the National Science Advisory Board for Biosecurity (NSABB) meetings to hear presentations on the board's preliminary risk and benefit assessments for "gain-of-function studies of concern" – or research with the potential to generate pathogens with enhanced pathogenicity, transmissibility, and ability to evade public health control measures.[1] The meeting was part of a deliberative policy making process set in motion in late 2014 when the US government took the unprecedented step of pausing all gain-of-function (GOF) funding research on influenza (the Highly Pathogenic Avian Influenza A virus, subtypes H5N1 and H7N9), Middle East Respiratory Syndrome (MERS), and Severe Acute Respiratory Syndrome (SARS) viruses until a new government policy could be developed.[2] While the meeting minimized the potential bioterrorist fears that dominated earlier NSABB meetings in the 2011/2012 timeframe and emphasized the global nature of GOF research, the 2016 risk benefit assessments generally relied on earlier materials-based, technological deterministic models. In fact, the weakness in these models was admitted in the NSABB's working paper, "estimating [biosecurity] risk by understanding consequences without their likelihood is challenging" (NSABB 2015, 15).

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[1] See NSABB's website for the agenda and links to the meeting's presentations and working papers. http://osp.od.nih.gov/office-biotechnology-activities/event/2016-01-07-130000-2016-01-08-220000/national-science-advisory-board-biosecurity-nsabb-meeting.

[2] Gain-of-function research in the life sciences generally refers to laboratory research that increases the pathogenicity or transmissibility of an infectious virus.

On January 13, the National Academy of Medicine (NAM) released a major policy report addressing the global infectious disease crises (GHRF 2016). In a departure from previous reports by international and national public health organizations, the NAM report detailed deficiencies in the way new threats from infectious diseases–Ebola, SARS, Hantavirus, Human Immunodeficiency Virus (HIV), and novel strains of H5N1 influenza–were being "framed." Previous reports by the most powerful actors in the infectious disease story, including various US agencies, the World Health Organization (WHO), and the rest of the United Nations system had focused on one of three predominant framings: public health, human security, and economic growth and stability. As the NAM report pointed out, these framings have produced underinvestments in the global South's public health infrastructure and capabilities at the expense of overinvestments in militarized national security resources and "non-scientifically-based actions" that exacerbate health crises from infectious diseases.

On January 15, the US Department of Agriculture (USDA) activated its emergency response plan when a new strain of avian influenza was confirmed on an Indiana turkey farm. The plan had only recently been drafted in September 2015 in response to the worst outbreak of avian influenza in US history that resulted in the culling of 7.5 million turkeys and 42.1 million chickens (USDA 2015a). A critical component of the plan was guidance to cull all poultry within a 10-km radius, within 24 hours of diagnosis, and either quarantine or severely limit movement of humans and vehicles within the 10-km radius. This meant that USDA and state officials immediately culled over 400,000 chicken and turkeys and enforced cordoned off areas around the farms (Poultry Site News 2016). Significantly, the plan was the first US government document to put greater weight on controlling the known human factors associated with the spread of avian influenza viruses than on previous practices that focused solely on unspecified culling practices.

Previous plans were based on practices that blamed the spread of viruses primarily on wild birds and backyard flocks. But this paradigm was upended in 2015 when less than 10% of the backyard poultry flocks were infected at the same time almost 100% of the commercial farms were infected in Iowa, the state hardest hit by the 2015 avian influenza epidemic (USDA 2015b). This redirection of US policy away from wild birds towards humans was significant to controlling the spread of H5N1 in poultry worldwide because frequently both the Food and Agriculture Organization (FAO) and the World Organization for Animal Health (OIE) use USDA's policies as models and guidance for agriculture policies in the

global South.

I begin with these three disconnected but near-simultaneous events because they highlight recurring themes and their associated questions that I explore in this book. The H5N1[3] virus was first discovered in China in 1996 and has since spread to 73 countries. Unlike its contemporary zoonotic infectious diseases, SARS and MERS, which initially spread quickly and efficiently via the highly interconnected global transportation network, H5N1 spread relatively slowly through a combination of bird migrations, massive investments in centralized poultry production in the global South, and a failure to recognize the importance of humans in farming practices that vary from country to country and within countries. And equally importantly to this book's arguments, unlike SARS and MERS, H5N1 has both an animal and a parallel public health dimension as well as a security dimension.

As an animal disease, the H5N1 virus has wrecked economic and social havoc in the global South's poorest countries and on the poorest most marginalized people within these countries due to policies imposed on them from international global animal and public health organizations. These policies were lacking in social justice considerations and heavily focused on considerations of containment and security. As a public health concern, H5N1 ranked at the top of the WHO's list of global pandemic concerns with projected economic and human mortality consequences greater than the 1918 Spanish Flu. While the scientific evidence over the H5N1 virus's actual pandemic potential is highly contentious, the pandemic concern still drives policies in the global North. These broad meta trends have played out against a crosscutting security trend that caught the H5N1 virus in fears of bioterrorism and a resultant associated desire for greater national security. Securitization of H5N1 produced attempts to close down knowledge about the virus or restrict that knowledge to the most privileged countries and dominant actors, created policies of otherness that sought to stop the virus at nation-state borders, and stoked fears of contagion in the popular media and politicians.

The three events described above also highlight another dimension of the H5N1 journey. For all their well-intentioned purposeful statements and actions, these events remain a product of dominant actors in the global North–untouched by the H5N1 virus's dire animal or public health

[3] Throughout this book, I use "H5N1" as shorthand for its scientifically correct reference: Highly Pathogenic Avian Influenza (HPAI) A virus, subtype H5N1, or HPAI A(H5N1); where the A stands for the genus of influenza, H5 stands for the fifth of 16 known types of the hemagglutinin glycoprotein, and the N1 stands for the first of 9 known types of the neuraminidase glycoprotein.

consequences–which are empowered to advise on and direct policies for countries in the global South. For example, in 2016 the NSABB was paralyzed by the dual-use dilemma in its attempts to reconcile security concerns with the need for more research on H5N1, while failing to account for ongoing GOF research programs being conducted in European countries, China, and Vietnam. Even though it acknowledged for the first time in its January 2016 meeting that there was an unaddressed ethics concern in developing regulations that seek to contain knowledge about emerging infectious disease within the US borders, it could not find a way to accommodate that concern with a competing and more vocal speculative securitization concerns. As Melinda Cooper (2006) noted, when biology comes to be known in terms of "emergence" the future can only be "speculative" and political calculation must become "future-invocative" to produce a desired future.

Secondly, the NAM report was useful by lending a critical voice of authority to highlight the failures of previous framings and their associated failed policies and actions. However, NAM's proposed solution was based on wealthy countries in the global North funding more research for vaccines and diagnostics tools, "science is our most powerful weapon in combating infectious diseases" (GHRF 2016, iv). Rather than advocating for policies and funding to promote indigenous scientific research capacities, such as Vietnam's small but promising avian influenza research programs, NAM's "new" framework for countering infectious disease crises was based on flowing more research funding through the already wealthy global North's government and pharmaceutical labs that would ostensibly benefit the world's poorest populations.

The affordability crises created by a similar trickle-down approach to the AIDS pandemic 15 years ago was succinctly summed up by bioethicist David Resnick, "the problem of access to medications goes far beyond the HIV/AIDS pandemic: people in developing nations cannot afford medications used to treat or prevent malaria, tuberculosis, cholera, dysentery, meningitis, and typhoid fever. The affordability problem also extends beyond a lack of access to new drugs designed to treat devastating infectious diseases: 50% of people in developing nations do not have access to even basic medications, such as antibiotics, analgesics, broncho-dilators, decongestants, anti-inflammatory agents, anti-coagulants, or diuretics" (Resnick 2001, 12).

Thirdly, the new USDA policies for controlling avian influenza in the poultry industry were also on their surface a much-needed step in the right direction. With an emphasis on establishing rapid militarized command

and control structures to limit the movement of people and immediately eradicate all possible sources of the virus before it has a chance to spread, the USDA had finally taken a page from Hong Kong's successful approach to stopping the spread of H5N1. In 1997, Hong Kong officials essentially locked down the city and mobilized their military and police forces to kill over a million and a half birds during a five-day stretch effectively stopping the global spread of the virus for six years (Sims and Brown 2009).

The difficulty here is that as I noted above, the dominant international organizations working in this area, such as the WHO, FAO, OIE, and other UN-related bodies, tend to base their policies on US polices. But in the United States there is an extensive network of insurance and government compensation schemes that shield the large corporate farmers from little more than a temporary inconvenience or drop in their stock price when the H5N1 virus invades their factories. This economic security network does not exist in the countries of the global South, or only exists for the benefit of the indigenous corporate farmers. So massive military style culling schemes also produce massive economic and social catastrophe in populations already economically marginalized. As I show, Hong Kong's experience was only successful because it was coupled with a US style compensation scheme for small scale and backyard poultry producers. No other country where the H5N1 virus is endemic has been willing or had the resources to adopt the second part of this eradication equation.

As these three examples show, the H5N1 virus presented scientists, public and animal health professionals, and policy makers with a paradoxical set of intertwined epidemiological, ecological, social, political, and technological challenges. That is to say the science, policies, and technologies designed to secure the borders of the global North's nation-states and their population's wellbeing from the threat of the H5N1 virus have generally served to weaken the security of the global South's nation-states and their population's well being. Thus, the story of the H5N1 virus is also a challenge of justice for marginalized populations of poverty as well as a question of knowledge production. While there is a large body of literature that eloquently describes the strong associations between disease, poverty and social inequalities, I argue that it is important to move beyond the easy linear and deterministic arguments to a deeper understanding of how such inequalities become structurally embodied in societies. As Nguyen and Peschard remind us, "in modern society, inequality becomes embodied biologically, as those lower on the ladder suffer higher morbidity and mortality rates" (2003, 447).

As the first example of recent NSABB deliberations shows, complicating the already difficult discussions on H5N1 and poverty is that the virus has also become the subject of intense debates in the life sciences and security communities as a potential bioterrorist weapon. At the heart of these debates is a relatively simple story promoted by US policy makers. That is to say, since the WHO, CDC, and other international health organizations predicted the H5N1 virus could have apocalyptic pandemic potential should it ever mutate to become readily transmissible between humans, it would naturally be of interest to malevolent actors who would seek to create such a pandemic for malintent. Continuing the linear deterministic logic of this argument, therefore, given the advances in life science technologies which allow anyone to quickly modify life at the molecular level, certain types of knowledge about the virus should either be classified, i.e., only available to the US government, or simply not produced at all.

While loud protests over the United States' attempted assertion of its moral authority to control the production of H5N1 knowledge have been widespread, the debates continued five years later. As a Science and Technology Studies (STS) scholar it is easy to dismiss the underlying flawed technological determinism and duality inherent in this story. But the fact remains that the story has powerful political resonance especially when combined with continuously promoted fears of contagion in the popular media. Therefore, charting a possible pathway away from these binaries of good and evil about the H5N1 virus requires a deeper understanding of how perceptions of risk and their associated political and social consequences become embodied in a society.

This book seeks to contribute to that need for a deeper understanding by tracing the 20-year journey of the H5N1 virus, from 1996 to 2016, while examining three important overarching questions that have not been asked in an interdisciplinary and integrative way: What is H5N1 knowledge? How is it acquired, transferred, secured, and given authority? What facilitates or impedes its development? Exploring these questions demonstrate how nonlinear issues of global public health, human rights, and social justice can quickly become entangled with extreme inequalities when confronted by asymmetric formations of power and knowledge. Exploring these questions also show how difficult it can be to unravel contestations of security and knowledge production, especially when those most affected by the contestations are not party to the discourse.

Section I
Narratives of Disease: following the H5N1 virus from birds to (de)stabilized networks

This book is composed of two sections that examine the H5N1 virus's 20-year journey from 1996 to 2016 through multiple lenses; from the time the virus was first discovered in China to when it largely ceased to be pandemic or bioterrorist concern in the global North. (See **Appendix A**.) The first section explores the three predominant H5N1 narratives (as a bird flu virus, a public health concern, and a source of outbreak fears) using a Foucaultian framework to examine how these narratives can be seen as constructions of biopower by the global North. This section also addresses the gap in Foucault's concepts of security and power created by his human-centric formulations by looking at the exercise of power at the intersection of human and nonhuman agency. Supporting the latter extension of Foucault and extending Latour's actor semiotics, this section introduces a new term, (trans)gressive agent, *transagent,* to describe an actor that crosses the species boundary and thereby multiplies its ontological status functioning as both a nonhuman and within a human assemblage simultaneously. Viewing questions of H5N1 knowledge through the lens of Foucault and seeing the virus as a *transagent* expose a "counter-narrative" (Nye 2003) that charts the ways inequities, social justice, and poverty associated with the virus have become embodied in the global South.

In Chapter Three, I show how dominant actors, both at the global and state levels, sought to prevent the spread of the H5N1 virus in poultry through political policies and veterinary practices that ignored their associated social and economic costs to the marginalized actors most directly affected by their actions. In Chapter Four that discusses the H5N1's public health narrative, I show how another set of actor-networks formed when the virus jumped the species barrier, moving from infecting birds to infecting humans, and became a global public health crisis. Lastly, in Chapter Five of this section, I explore how the outbreak narrative laden with its fears of contagion came to overlay the first two narratives in the global North to promote policies of security and "otherness" that ensured the H5N1 virus remained a part of the global South, and did not invade its Northern borders. Crosscutting each of these narratives are ways in which security and power was linked to control of H5N1 knowledge.

Section II
Application of Knowledge Justice to the Life Sciences

The second section explores the three intersecting dimensions of security, ethics, and justice that are found in the H5N1 GOF research debates. These debates center on the question of how to articulate meaningfully and universally agreed upon principles of regulating dual-use research in the life sciences. The debates expose the difficult problem faced by policy makers of how to balance the desire for open publication of scientific research with the nation's security. This conundrum is known as the dual-use dilemma.

In 2015, we found ourselves with a convergence of events that highlighted the need for social scientists to engage the dual-use dilemma with new critical approaches. The scientific world was split into two polarized camps comprised of life scientists, social scientists, policymakers, and security experts publically debating the advisability and biosecurity issues of ongoing H5N1 research. In one camp, there was the Cambridge Working Group (http://www.cambridgeworkinggroup.org) that opposed the research on the grounds of biosafety risks and advocated for more restrictions on the availability of related research. In the other camp was Scientists for Science, which supported the research on the grounds of its public benefit potential. Each group had several hundred active members. There have also been recent highly publicized failures in biosafety protocols at the Centers for Disease Control (CDC) and other research labs (Young 2014; Nocera 2014; CDC 2015). And, the Ebola crisis in Africa exposed the inherent tensions between a state's right to security and the ethical, legal, and societal issues of life sciences research and humanitarian aid with transnational implications (CDC 2014; MSF 2014).

While none of these events are directly related, their indirect temporal conflation across the scientific, policy, and social environments reinforced the critical need for an alternate voice of justice that can slip between the horns of the dual-use dilemma. The dual-use dilemma in the global North research and policy community over H5N1 research is not sustainable or practical and creates increasing opportunities for unintended consequences of large systems failure in the global South, whether they be social, economic, or cultural. Additionally, as we saw in the Ebola crisis, large systems failures in the global South have a tendency to boomerang back to the global North.

Using two highly publicized H5N1 GOF virus research studies as a touchstone for their larger unaddressed and invisible social justice questions, this section develops the concept of *knowledge justice* to

describe the social justice issues created when knowledge is framed in a way to obscure justice issues. I examine how STS scholarship, especially the role of tacit knowledge in research, can be applied to counter arguments that frame the H5N1 debates in the mantle of security. It also examines why the discourse of bioethics has been lacking in its ability to ask questions on the rightful ownership of knowledge when confronted with unchallenged presumptions of security. Both examinations are useful in avoiding the technical and political framings that reduce debates on research to simplistic arguments of securitized binaries while allowing for a more globally inclusive discussion of justice.

In the chapter, The H5N1 Debates and Myth of Easy Replication, I explore how the policy makers and technical experts framed the H5N1 from the very beginning to produce a contested environment in the related science and security policies. I briefly trace the avian virus's journey from its first appearance in 1996 in China to its position as a global pandemic threat and the laboratories of the world's two leading virologists, Drs. Fouchier and Kawaoka. Along the way, the virus was both the subject of bioterrorism in the United States as well the subject of intense public health interest in countries like Vietnam that suffered tremendous economic and social losses from the virus. The pandemic threat was framed initially by unquestioned acceptance of the World Health Organization's (WHO) methodologies for calculating mortality rates. It was subsequently framed by a normative acceptance of a linear deterministic model of technology that presumed published scientific research was always easily reproducible. Both framings are fertile ground for STS scholarship, especially on tacit knowledge, to expose the flaws their arguments.

In Bioethics of Silence, I explore the relationship of these framings to a lack of serious ethical reflection on the subject of H5N1 and the dual-use debate. As bioethicist Michael Selgelid has pointed out, "it is noteworthy that most of the debates about the dual-use dilemma have primarily involved science and security experts rather than ethicists…bioethicists have had relatively little to say about security in general, or the dual-use dilemma in particular" (Selgelid 2009, 722). In this chapter, I point to two considerations when examining the bioethics community's general silence on the subject of dual-use in the life sciences, especially since 9/11. The first consideration reflects the actions of a "risk society" when confronted with unknown fears. The second reflects the coincident growth of corporate university structures, funded by the unprecedented reprioritization and increase in life sciences research funding, with the slowly emergent transition of the bioethics field away from its historical technology-centric orientation.

The silence in the bioethics community provides a segue to this book's final chapter, The Thorny Problem of Justice and Securitized Knowledge. In this chapter I develop the concept of knowledge justice to extend existing justice theory as an alternative approach away from the existent technical and political framings in the dual-use dilemma. My conceptualization of knowledge justice is an integrative approach drawing on the existing theoretical underpinnings of John Rawls, Nancy Fraser, and David Schlosberg. At its core, the dual-use dilemma is a contestation of knowledge and exists because it is based on utilitarian principles. Hence, addressing the dual-use dilemma as a matter of justice requires an alternative framework of justice that Rawls provides through his doctrine of fairness.

I argue that knowledge is a primary social good to be distributed fairly. But whereas Rawls saw the distribution of fairness between two parties, the dual-use dilemma has framed knowledge to exclude an important third party–those silent implicated actors. Thus, if knowledge is a social good and there is an unrecognized silent party deserving an equal seat at the table, Fraser's thoughts on the injustices of misrepresentation, maldistribution, and misrecognition are very useful. She argues that justice for these three dimensions cannot be achieved in a nation-state framing, and that the frame itself becomes a question of justice. While Fraser would have us dismiss the dual-use dilemma frame all together as being the original source of knowledge injustice, I argue that the frame exists and must be accommodated. To this end, I'm drawing on the plurality of Schlosberg's environmental justice theory. As long as cultural and institutional aspects of justice are addressed in dealing with policy issues, environmental justice theory accommodates a plurality of governance structures–*whatever works is what works best.* The dual-use dilemma is still framed as a technical and political question of the nation-sate, but I offer that a concept of knowledge justice can be a useful way out of its paralytic state while offering a consideration of justice to those most in need of the H5N1 knowledge.

In the Epilogue, I conclude with a very brief discussion of the Zika virus crisis and its parallels to the H5N1 journey. While the public health and security deterministic predictions about the H5N1 virus were never realized, it doesn't mean that there aren't valuable insights to be gleaned from the virus's journey that can be useful in the future STS scholarship. The Epilogue points to some of those insights, and offers hope that we aren't doomed to a future of repeated social construction failures in the face of each new infectious disease crisis.

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PART I

NARRATIVES OF DISEASE: FOLLOWING THE H5N1 VIRUS FROM BIRDS TO (DE)STABILIZED NETWORKS

CHAPTER ONE

CREATION OF NARRATIVES

> "What seems to us more important, more painful, and more unendurable is not really what is more important, more painful, and more unendurable but merely that which is closer to home. Everything distant which for all its important moans and muffled cries, its ruined lives and millions of victims, that does not threaten to come rolling up to our threshold today we consider endurable and of tolerable dimensions" (Solzhenitsyn, 1970 Nobel Lecture).

In February 1976, two soldiers at Fort Dix, New Jersey came down sick with flu like symptoms. Subsequently, over 200 other soldiers also became sick. The Center for Disease Control (CDC) identified the flu as being H1N1, similar to the flu virus that caused the 1918 Spanish flu pandemic, and better known as "swine flu." In an attempt to avert a potential pandemic the Ford Administration and Congress rushed through legislation creating a National Influenza Immunization Program to vaccinate "every man, woman, and child." The program began on October 1 and was suspended on December 16 after reports of at least 54 cases of Guillain-Barre syndrome resulting from the vaccine and no evidence of a flu pandemic.[4]

In 1978, Secretary of Health, Education, and Welfare (HEW), Joseph A. Califano, commissioned a study in an attempt to develop lessons learned following the much criticized attempt by the Ford Administration to vaccinate the entire US population against a projected epidemic of swine flu that never materialized. In setting up the study, Secretary Califano asked the authors two remarkably reflexive sets of questions that echo loudly to this day:

> First, how shall top lay officials, who are not themselves expert, deal with fundamental policy questions that are based, in part, on highly technical and complex expert knowledge—especially when that knowledge is speculative, or hotly debated, or when "the facts" are so uncertain? When

[4] See Sencer and Millar (2006), the program's two principal architects, for a reflexive firsthand account of why the vaccination program failed.

> such questions arise, with how much deference and how much skepticism should those whose business is doing things and making policy view those whose business is knowing things—the scientists and the experts?
>
> Second, how should policymakers—and their expert advisers—seek to involve and to educate the public and relevant parties on such complicated and technical issues? To what extent can there be informed and robust public debate before the decision is reached? (Neustadt and Fineberg 1978, 3).

Almost 35 years later, national policy makers were still wrestling with influenza-related questions, but this time their focus had shifted from public health to public security with an even more threatening influenza virus. In March 2012, Paul Keim, Chairman of the National Science Advisory Board for Biosecurity (NSABB) announced his decision to recommend full publication of two highly controversial articles on the H5N1 virus. The controversy sharply divided the life sciences world between experts and policymakers concerned about bioterrorists potentially replicating research for malevolent reasons and experts and policymakers advocating for the sanctity of openly published scientific research. In his announcement that reversed his earlier unprecedented decision to censor the papers, he said, "Why should the NSABB be telling the world what to do? Why has not the world already had these discussions and debates?" (Keim 2012, 2).[5] The intervening 35 years

[5] In November 2011, the NSABB took the unprecedented action of recommending that two publically funded scientific research papers should be censored. Two teams of scientists conducted the research: Ron Fouchier of Erasmus Medical Center in Rotterdam and Yoshihiro Kawaoka of the University of Wisconsin-Madison. Both teams independently developed mutant strains of the H5N1 virus that could be aerosolized and passed between mammals – something previously considered impossible to create in the laboratory.

In 2011, the H5N1 virus was thought to have about a 60% mortality rate based on the few reported cases of animal-human transmission (compared to the 1918 Spanish flu pandemic mortality rate of ~5%). The H5N1 virus is the World Health Organization's (WHO) singular most important pandemic concern (WHO 2005) due to the fact that the human population lacks any protective immunity against the H5 and N1 proteins. However, there is no evidence of naturally occurring mutations that allow for animal-human or human-human aerosolized H5N1 transmission.

News of the research sparked an intense debate about whether the two teams' work should be published in full to aid global pandemic preparedness or censored to prevent misuse by potential bioterrorists. In February 2012, the WHO concluded the scientific value of the papers outweighed any security concerns and they should

between the H1N1 pandemic scare and the H5N1 publishing controversy reflect an evolution in US policymaking that on one hand acknowledges the global nature of animal-human transmissible H5N1 virus but on the other hand also reflects the difficulty of identifying appropriate forums, participants, and agendas when confronted with competing claims of expert knowledge and representation.

The global journey of the H5N1 virus is a story of evolving political economies of knowledge (Harding 1993a; Weiler 2009; May and Perry 2011). The journey begins with the H5N1 virus in its localized natural state as a nonhuman actor, confined to its avian hosts, [6] and moves to its

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be published in full. In March 2012, the NSABB reversed its previous recommendation and the two papers were published in the journals, *Nature* and *Science*. Both journals have devoted extensive coverage to this ongoing controversy. Excellent comprehensive timelines and links to hundreds of related articles can be accessed at: http://www.nature.com/news/specials/mutantflu/index.html (*Nature*); and, http://www.sciencemag.org/site/feature/data/hottopics/biosecurity/index.xhtml (*Science*).

[6] The earliest and most widely quoted date for the beginning of the recorded history of avian influenza is from an 1878 paper by Perroncito in which he described a disease with high mortality rates in chickens and other poultry in Italy. Initially, the disease was referred to as "fowl plague," but in 1981 this was changed to "highly pathogenic avian influenza." See Alexander and Brown (2009) for a history of highly pathogenic avian influenza.

There are three genera of influenza viruses: A, B and C. Only influenza viruses of genus A are naturally found in birds. Genus A influenza viruses are further divided into subtypes based on the antigenic relationships in the surface glycoproteins hemagglutinin (HA) and neuraminidase (NA). There are currently 16 HA subtypes (H1-H16) and nine NA subtypes (N1-N9). Each virus has one HA and one NA antigen, in any combination. (Recently, Tong et al. [2012] isolated an avian influenza virus (IAV) from little yellow-shouldered bats in Guatemala and based on a large divergence with all of the other known HAs and NAs, the HA of the bat virus was designated as H17 and the NA as N10. But the resultant new numbering schemes are not in the general literature yet.)

To date, only the H5 and H7 subtype viruses have been shown to develop into highly pathogenic avian influenza, but not all H5 and H7 viruses are highly pathogenic. Low pathogenic avian influenza viruses are very common in birds, especially waterfowl, and are generally benign rarely resulting in symptoms. But low pathogenic avian influenza viruses tend to rapidly mutate to highly pathogenic avian influenza forms of H5 and H7 when acquired by poultry resulting in 90-100% mortality rates in the poultry within 48 hours. Additionally, only highly pathogenic avian influenza forms of H5 and H7 have been able to cross the species boundary into mammals, including humans (DG SANTE 2000; Webster et al. 2007). It is important to note however, that not all highly pathogenic avian influenza H5 viruses are harmful to humans. For example, the 2015 outbreaks of

representation as a human assemblage actor in a (de)stabilized actor-network of global science and politics that promote fears of contagion and politics of otherness. The H5N1 journey illustrates the complex and confusing trade-offs involved in formulating and implementing governance policies for a globally heterogeneous group of actors with competing political, economic, and scientific interests. The journey also illustrates how little power and knowledge the largest group of actors in the network—the silent, "implicated actors" (Clarke 1998) who make up the majority of the populations in the global South—have over matters fundamental to their health and safety.

This latter group of implicated actors are primarily impoverished "backyard poultry"[7] farmers who have been largely excluded from the H5N1 discourse given the three predominant narratives that define the problem of containing or eradicating H5N1 and its associated suggested solutions. By examining these normally disassociated narratives, it is possible to see how they have been strengthened by a close association between the mass media and science and policy makers since the H5N1 virus first crossed the species barrier in 1997 infecting 18 people with 6 resultant deaths (Claas et al. 1998; Subbarao et al. 1998). The narratives exist in parallel, shaping the actions of different sets of heterogeneous

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highly pathogenic avian influenza H5N2 and H5N8 viruses in the United States that resulted in the deaths of more than 48 million chickens and turkeys are not considered threatening to humans.

[7] "Backyard" is not a universally used term and tends to be used most frequently used in the United States. It corresponds to the Food and Agriculture Organization of the United Nation's (FAO) Sector 4 classification of poultry production systems (FAO 2004). More commonly used terms worldwide are "scavenging poultry" or "village poultry" (Conan et al. 2012; FAO 2008a) to refer to free grazing flocks of chickens or ducks, comprised of unselected breeds of various ages and species, and in flocks of 100 animals or less that are raised by a family, household, or village in rural or peri-urban areas. Approximately 70-80% of all poultry in the global South is raised in these types of flocks (Branckaert et al. 2000; Sonaiya 2008; Pym et al. 2006).

Similarly, "poultry" is also not a universally used term and can denote many different types of birds. In the United States, the term is commonly used to refer to homogenous flocks of chickens or turkeys. But elsewhere in the world, and particularly in the global South "backyard poultry" may consist of mixed flocks with any combination of mixed breeds of chickens, turkeys, ducks, geese, quail, pigeons, pheasants, ostriches, guineafowl, partridges, and even rabbits (FAO 2007). For the purposes of this book though, I am using "poultry" as shorthand for any type of bird flock raised in a noncommercial environment by rural or peri-urban farmers.

actors, some of which continuously move between the narratives forming new networks.

Prior to 1997, there was no such set of narratives and outbreaks of highly pathogenic avian influenza diseases in poultry were relatively rare and treated as a standard veterinary procedure without international-scale political, economic, or social linkages.[8] But for reasons that I explore in this book, narratives subsequently became a useful tool for political and scientific experts to assert their agendas in the face of conflicting scientific evidence surrounding the H5N1 virus. As Wald notes, "They [narratives] influence how both scientists and the lay public understand the nature and consequences of infection, how they imagine the threat, and why they react so fearfully to some disease outbreaks and not others at least as dangerous and pressing" (Wald 2008, 8).[9] As such, narratives become a necessary shaping element of H5N1's socially constructed knowledge. Understanding the role of narrative in constructing knowledge exposes counter-narratives that can lead to a more effective, just, and compassionate response than those available for addressing the problems posed by the H5N1 virus on the segment of the world's population least empowered to address those problems.

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[8] Between 1959, when the first reported highly pathogenic avian influenza outbreak caused by a virus of the H5 subtype was diagnosed, and 1996, there were 25 reported outbreaks of the H5 subtype virus (Alexander and Capua 2008). These outbreaks were very isolated, created minimal financial or other impacts, and were eradicated in a very short time. However, since 1996 when the H5N1 virus was first discovered in farmed geese in Guandong Province, China, there have been thousands of outbreaks in 73 countries. Unlike earlier forms of the H5 subtype virus outbreaks, the post-1996 form has not been successfully eradicated in any country it has appeared (see the OIE web portal at: http://www.oie.int/animal-health-in-the-world/web-portal-on-avian-influenza/.)

[9] Emery Roe (1991) was one of the first critics of the global North's health and rural development policies. He used narratives to frame the negative consequences of the North's dominant actors in the global South. For Roe, narratives are simple stories with beginnings that define the problem, middles that elaborate its consequences, and endings that celebrate solutions. Narratives are created and promoted by particular actors, networks, and institutions. Narratives therefore, suggest and justify particular kinds of actions, strategies, and interventions by dominant actors. These narratives, in turn, come to be supported by institutional and political translations in the actor-network that define and shape particular directions in which interacting social, technological, and environmental networks co-evolve. Following Roe, my intent in examining these narratives is not to overthrow them, but to examine ways in which they may be improved.

In the first section of this book, I briefly discuss my theoretical framing of these narratives that extends Foucault's concepts of power to address its application to nonhumans and several Latourian theoretical elements that are also useful in this framing. Since its introduction in *The History of Sexuality* (Foucault 1978), "biopower"[10] has permeated research in the social sciences, including STS, and particularly in the ways scholars think about the knowledge production of disease. Foucault's (2003) later development of biopower and his sense of security itself is also useful because biopower includes not just the exercise of power by nation-states and their militaries, but also by populations and their associated political, technological, and social networks.

For Foucault, biopower represents a crucial shift in the politics of power in the modern era; individuals and populations can now be seen as assemblages of natural processes that can be defined and controlled. Foucault also understood power as a cluster of relations as well as a wide range of instruments, techniques, and procedures (Foucault 1995, 215). In this book I use three Foucaultian concepts, which he repeatedly returned to in his discussions of both biopower and power, to frame the ways power has been produced and maintained across the three H5N1-related narratives discussed in this book: discourse, knowledge production, and technologies. Cutting across all three narratives are Foucault's (1973; 1995) conceptualizations of security at both the nation-state and population levels as well as Collier and Lakoff's (2015) conceptualizations of vital systems security. Additionally, I extend Foucault's human centric conceptions of biopower to include its application to nonhuman actors to address the ways power is performed at the intersection of human and nonhuman agency.

[10] Bruce Braun (2007, 8) described Foucault's use of the general term "biopower" as a way to designate new forms of power that took the capacities of bodies and conduct of individuals as their concern. But Foucault (1978) also distinguished between two more specific forms of biopower. He used the term "anatomo-politics" for those disciplinary techniques that sought to maximize the body's forces and integrate it into efficient systems, such as through proper training, or through rationally organizing workplaces, armies and domestic economies. Foucault (2003) also used the term "biopolitics" to designate those political technologies that took the biological existence of the nation as their object, understood as a population imbued with mechanisms of life (birth, morbidity, mortality, longevity, vitality) and knowable in terms of statistical norms. In doing so, he defined biopolitics by contrasting it with the juridico-legal power of classical sovereignty. In this book, I use "biopower" as a shorthand way of describing both forms of biopower: disciplinary techniques and political technologies.

To support the latter extension of more traditional conceptualizations of biopower, this book extends Latour's semiotics with the addition of a new term (trans)gressive agent, or *transagent,* to describe an actor that crosses the species boundary while residing on both sides of the human and nonhuman boundary simultaneously. In doing so, it exercises a unique form of biopower. Thinking about a nonhuman agent as having agency allows us to avoid black boxing the H5N1 virus and render visible its species boundary transgressions and human associations.

This book also adopts an actor-network sensibility to follow the chains of these heterogeneous actors and their associations. I adopt the term "sensibility" from Law and Singleton, rather than the more frequently used terms and analytical approaches, such as theory, methodology, or framework, who describe the process of investigating actor-networks as "best understood as a sensibility, a set of empirical interferences in the world…that cherishes the slow process of knowing rather than immediately seeking results or closure" (2013, 485).

Adopting an actor-network sensibility within a Foucaultian framework also allows us to broaden the lens, away from a strictly flat ontology to see the network's environments that include both the winners and losers. Or, as Scott Frickel observed in his actor-network analysis of nuclear submarine development, a sociological explanation of heterogeneous networks requires a consideration of the "social contexts in which actor networks are embedded" (1996, 48). Viewing the H5N1 virus through the lens of Foucault and seeing the virus as a *transagent* exposes a "counter-narrative" (Nye 2003)[11] that charts the pathways of inequities, social justice, and poverty in the global South—excluded in the following three predominant narratives.

The first narrative is one that links veterinary concerns with agriculture and livelihood issues. I refer to this narrative as the bird flu narrative (virus to disease). This narrative is centered on either draconian culling practices

[11] I am following David Nye's use of this term that he coined in his book, *America as Second Creation: Technology and Narratives of New Beginnings*. He uses the term to describe the narratives of marginalized peoples, such as the impoverished, unpowered, and/or native peoples, who are generally unacknowledged or whose positions are not considered important enough to figure into the narratives told by dominant white male empowered actors. Nye shows how these dominant actors use narratives of technology and security to explain and justify their actions and how the resulting events come to be as they are. In contrast, "counter-narratives resist or reimagine technological change and seek to ground identity not in machines but in other cultural artifacts or values" (2003, 14).

(with their implied ethical judgments about the value of human and nonhuman life: it is assumed that animals can be killed on a massive scale to avert a possible human disease even if the risk to humans is unknown) or costly veterinarian control measures, primarily animal vaccines, to control epizootic outbreaks of the virus before they become panzootic. The narrative features an actor-network based on policies that promote restructuring the global poultry industry in favor of large-scale international corporate poultry producers.

This is a human actor dominated network, but I refer to it as the bird flu narrative to highlight the most important actors missing in the narrative: the predominant nonhuman actors, the H5N1 virus and its avian host. They exist only as black boxes – subjects of eradication. The World Organization for Animal Health (OIE) (OIE 2004; 2010; OIE/FAO 2007) and the FAO (2008b; 2013) have been the two primary proponents of this narrative with not unsurprising support from large national and international poultry corporations. Initially, the WHO also engaged with this narrative through its promotion of economically devastating mass culling practices to prevent the spread of H5N1 to humans (WHO 2004; 2005). More recently, confronted with the mounting ethical and economic failures of this promotion, WHO adopted the "One Health" agenda (Zinsstag et al. 2011; Vandersmissen and Welburn 2014) while continuing to pursue a different pathway with the next narrative.[12]

[12] The "One World, One Health" or now more simply just, "One Health," agenda is based on the framework outlined in the FAO et al. (2008) document, *Contributing to One World, One Health: A Strategic Framework for Reducing Risks of Infectious Diseases at the Animal–Human–Ecosystems Interface*. Developed as a holistic response to the global spread of H5N1 and other emerging infectious diseases (EID), the framework "focuses on EID at the animal–human–ecosystems interface, where there is the potential for epidemics and pandemics that could result in wide-ranging impacts at the country, regional and international levels. The objectives and outputs…focus on some of the major drivers for emergence, spread and persistence of EID. The approach…builds on lessons learned from the response to ongoing HPAI H5N1 infections" (2008, 5).

Initially, the idea of holistically addressing zoonotic EIDs was published by the Wildlife Conservation Society in 2004 in what has become known as the Manhattan Principles, but was quickly adopted by the primary global public and animal health organizations resulting in the 2008 strategic framework (Gibbs 2014). Although the "One Health" agenda remains the official joint policy framework for responding to H5N1 and other EIDs by the WHO/FAO/OIE (FAO 2009a), its implementation has been widely regarded as ineffectual and criticized for being a simple repackaging of the top-down, one-size-fits-all previous approaches which previously failed to account for the enabling underlying social

The second narrative focuses on the human public health pandemic preparedness aspect of H5N1. It is the prevailing narrative adopted by the public health experts to assert their own agendas and influence the actions of policymakers. I refer to this narrative as the public health narrative (disease to crisis). The actor-network in this narrative features human and nonhuman actors linked by policies to promote a combination of vaccines and behavior changes—again, primarily in the global South—when the H5N1 transgresses the species boundary and ceases to just be a "bird flu" problem for veterinarians. Some have observed the actions of the actors in this narrative have sought to stabilize their networks in such a way as to free those in the global North from any responsibility for the economic exploitation of the global South that actually created the epidemic conditions in the first place (Wald 2008, 269-270). The WHO (2015), the United Nations Children's Fund (UNICEF) (UNICEF 2008; 2012), most international public health non-governmental organizations (NGO), and the Centers for Disease Control and Prevention (CDC) (CDC 2015a) have been the primary authors of this narrative.

The third narrative is focused on the deterministic inevitability of pandemic outbreaks based on the presumptive inevitability that the H5N1 virus will continue to mutate either in nature or helped along through biosecurity failures and become a source of global pandemic not unlike the 1918 Spanish flu pandemic that killed an estimated 50 to 100 million people (Taubenberger and Morens 2006). I refer to this as the outbreak narrative (crisis to [de]stabilized networks) (Wald, 2008).[13] In many ways it can be viewed as an overarching narrative that combines the actor-networks of the first two narratives in a more powerful way since it is amplified and has greater visibility because of mass popular culture. This narrative has been popularized in works such as Richard Preston's (1994) Ebola-based nonfiction thriller *The Hot Zone* and subsequent movie, *Outbreak,* based on the book, Laurie Garrett's (1994) *The Coming Plague: Newly Emerging Diseases in a World Out of Balance*, and Mike Davis's (2005) bestseller *The Monster at Our Door: The Global Threat of Avian Flu*. More importantly, this narrative has been the one most frequently

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and economic conditions of H5N1 and other EIDs (Craddock and Hinchliffe 2014).

[13] Although the term and concept of outbreak narratives are not original with Wald (Altman 1989), I am using Wald's general characterization: "The outbreak narrative–in its scientific, journalistic, and fictional incarnations–follows a formulaic plot that begins with the identification of an emerging infection, includes discussion of the global networks throughout which it travels, and chronicles the epidemiological work that ends its containment" (2008, 2).