Diseases at the Interface:
An Ecological Inquiry into One Health
With Fieldwork in Peru

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Abstract

This thesis is an anthropological study of ecological reconceptualizations of health and disease in contemporary infectious disease epidemiology, based on inquiry into how the One Health model was incorporated into global health research practices at three different human-animal-environment interfaces at three different field sites across Peru and integrated into a governance tool for global health security. In recent decades, a growing recognition of the shared susceptibility of humans and animals to infectious pathogens has contributed to the adoption and institutionalization of One Health in emerging global health frameworks and several key global health security initiatives. One Health designates an approach to global health that emphasizes the interconnectedness of human, animal, and environmental wellbeing, and it includes a correlative call to examine zoonoses (diseases that spread from animals to humans) vis-a-vis multidisciplinary collaborative efforts that target pathogenic activity at "the human-animal-environment interface". Drawing on extensive fieldwork among epidemiologists, security strategists, and health administrators studying endemic zoonotic and vector-borne diseases in Peru, this thesis examines the epistemological complexities and ethnographic realities that emerge when the problem of human health is situated within a wider biosocial ecosystem.

In this dissertation, I illustrate how the transmission of infectious pathogens across different species interfaces conditioned specific situations of zoonotic disease endemism as well as the emergence of novel forms of epidemiological thought and practice 'at the interface'. The first three chapters each work as distinct case studies wherein I examine how epidemiologists and global health researchers oriented to human-animal-environment interfaces to study zoonoses. I describe the conceptual tools and field techniques they brought and/or invented to address the problems posed by zoonotic and vector-borne diseases, and I critically analyze the ethical and epistemological

challenges that arose contingently amidst their attempts to "control" disease. In the fourth chapter, I historically situate and problematize the integrative tools and systemic logics mobilized to coordinate national and global health security priorities across the region of the Americas, suggesting a resonance between One Health's emphasis on 'the interface' and the contemporary model of global health governance in which, as the saying goes, disease knows no borders.

In sum, the thesis argues that ecological orientations to disease and disease prevention are being actively integrated into contemporary global health research and security agendas, and that adopting an ecological perspective in anthropological inquiry helps to bring global health into view as itself a complex ecosystem composed of interacting relations across species, disciplinary, and national interfaces.

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Introduction

Ecosystemic Thinking

A growing recognition of the shared susceptibility of humans and animals to infectious pathogens has contributed in recent decades to the concept of One Health, which is an integrated response to interspecies health concerns. As an approach to global health, One Health emphasizes the need for increased interdisciplinary collaboration, intersectoral interventions, and international cooperation to address systemic problems of disease that arise through the interrelatedness of humans, animals, and shared environs.

In 2010, the World Health Organization (WHO), World Organization for Animal Health (OIE), and the Food and Agriculture Organization (FAO) published "A Tripartite Concept Note[1]" in which the three transnational agencies elaborated a strategic direction for coordinating global activities to address health risks at 'the human-animal-ecosystems interface'. That same year, an essay entitled "The Emergence of Multispecies Ethnography[2]" was published in *Cultural Anthropology*, marking a watershed moment in the discipline that ushered in a new genre of writing

1 Note, A. Tripartite Concept. "The FAO-OIE-WHO." (2010).
2 Kirksey, S. Eben, and Stefan Helmreich. "The emergence of multispecies ethnography." *Cultural anthropology* 25.4 (2010): 545-576.

and mode of research for studying humans through their entanglements with nonhuman life forms. This dissertation, which explores One Health approaches to human and nonhuman health from an anthropological perspective, is situated amidst these relatively recent endeavors (reminders[3]) to think the human and human health through their inextricable relations[4] and interdependence with animals, ecologies, and pathogens.

This dissertation is about the epistemological complexities and ethnographic realities that emerge when the problem of human health is situated within a wider biosocial ecosystem. With the increased recognition that disease transmission often transpires in the interactions of human, animal, and environmental factors, One Health has emerged in recent decades as what some of its supporters have hopefully described as a emblematic of "a paradigm shift"[5], insofar as it steers the field of global health beyond its conventional preoccupation with the health of human populations towards an ecological reconceptualization of health and disease as transspecies phenomena. From such an ecological perspective, epidemiologists see the "inextricable linkages" between human, animal, and ecosystem health[6] in terms of the interdependent "mutualism" of the health and well-being of humans, animals, and the eco-systems in which they coexist.[7] At this confluence of

3 There were many precedents to One Health that did not go by this term, per se, but nonetheless brought ideas and practices of human and animal health into alignment. For a brief yet critical historical account of this, see: Bresalier, Michael, Angela Cassidy, and Abigail Woods. "1 One Health in History." (2015). Similarly, for a genealogy of anthropological thought on human-nonhuman relations prior to 'the multispecies turn', see Kirskey and Helmreich (2010). Personally, my introduction into what would later be called multispecies thinking was Donna J. Haraway, *When Species Meet* (Minneapolis: Univ. of Minnesota Press, 2008). To be sure, ecologically fashioned investigations in global health have been around since the post WWII period, as seen in the study of trypanosomiasis during the first half the century. A highly ecological set of investigations resulted which drew on entomology, medicine, veterinary medicine and agricultural science to generate a dynamic picture of the disease. See Tilley, H. (2011) *Africa as a Living Laboratory: Empire, Development and the Problem of Scientific Knowledge 1870–1850*. University of Chicago Press, Chicago, Illinois.

4 On thinking the modern figure of Anthropos through relationality, see Strathern, Marilyn. *Relations: An anthropological account*. Duke University Press, 2020.

5 Paul, Gibbs. "The evolution of ONE Health: A decade of progress and challenges for the future." *Veterinary Record 174*.4 (2014): 85-91.

6 Rapport, David J. "Epidemiology and ecosystem health: natural bridges." *Ecosystem Health* 5.3 (1999): 174-180.

7 Lebel, Jean. *In Focus: Health: An Ecosystem Approach*. Ottawa: International Development Research Centre, 2003.

contemporary thinking on health and ecosystems as more-than-human problems, One Health has been gradually embraced by global health actors and codified into key strategic frameworks for reducing risks of infectious disease at human-animal-environment interfaces and for strengthening national capacities to improve global health security worldwide.[8]

"Disease at the Interface" argues neither in support of nor against the claim that One Health is indicative of a paradigm shift in the history of epidemiology or in the relatively nascent field of global health.[9] Rather, this dissertation more modestly describes how the One Health model was incorporated into epidemiological field investigations at three different human-animal-environment interfaces at three different field sites across Peru and integrated into a global health governance tool for systematizing global health security capacities at the national level for countries across "the region of the Americas".[10]

Modern epidemiology is simultaneously an academic science and an applied science. As an academic health science, epidemiology is oriented to systematic, population-level understandings of the dynamics informing patterns of disease occurrence, evolution, and transmission. As an applied science in the service of global health and public health, epidemiology has developed evidence-based techniques for identifying risk factors of disease causation and explanations of disease processes, which can be communicated by epidemiologists to public health officials in order to implement measures, guide interventions, or shape policy decisions. In short, the aims of

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8 "The State of Food and Agriculture." *Food and Agriculture Organization of the United Nations*, (2008); "The FAO-OIE-WHO Collaboration." *The OIE and its Partners,* (2008); Note, A. Tripartite Concept. "The FAO-OIE-WHO." (2010).

9 Kuhn, Thomas S. *The structure of scientific revolutions*. University of Chicago press, 1962.

10 This is an appellation used by the World Health Organization (WHO) to designate to North, South, and Central America – these also being territories that fall under the regualtory purview of the Pan American Health Organization (PAHO).. https://www.who.int/choice/demography/american_region/en/

epidemiology are to generate knowledge of disease and to control its spread, which often necessitates governing populations.

Like any other modern research practice, epidemiology did not come to be what it is today solely through the inheritance of some preordained set of scientific rules and abstract principles. The form and content of epidemiology have been simultaneously guided and constrained by the discipline's entrenchment in the modern university and its institutionalization as an apparatus of governance within the modern nation-state. In this dissertation, I illustrate how epidemiological orientations, especially towards infectious diseases, are evolving in light of increasingly institutionalized imperatives to conceptualize health holistically and to collaborate across borders, inclusive of national, regional, sectoral, disciplinary, and even species borders.

Inherent in the One Health agenda are ecological orientations and systemic approaches that could ostensibly be mobilized in wide variety of global health domains of research and practice. That said, the concept has gained the most traction in the realms of infectious disease epidemiology and zoonotic disease surveillance, in particular. In this dissertation, I situate my conceptual understanding of One Health through a series of fieldwork-based encounters with epidemiologists, security strategists, and health administrators studying endemic zoonotic and vector-borne diseases in Peru. Additionally, I locate the One Health concept in the institutional arrangements within which its approach was gradually systemized and integrated into global health research and governance agendas.

In this dissertation, I chart how One Health rose to popularity in response to emerging zoonotic disease threats and become increasingly institutionalized in the contemporary context of ongoing globalization, that is, at time during which it can hardly be denied that humans live in an

interconnected world. Or rather, that all varieties of biotic earthly beings – human and nonhuman – live in interconnected ecosystems on a shared planet where diseases traverse species barriers as well as national borders. Importantly, One Health has picked up steam at a moment in world history when human travel across borders is generally faster and easier than at any point prior, and therefore, so is the risk of international disease spread. The aphorism "disease knows no borders" – which became practically sloganized in the wake of the Covid-19 pandemic – captures this attentiveness to the shared risk environment among species and nations in a context of global interdependence. I also attend, in this dissertation, to the conceptual centrality of 'interconnectedness' in the One Health approach to global health, particularly for explaining processes of disease transmission ecologically across species interfaces and national borders and for justifying systemic integration, of knowledge and of governance, around these interfaces.

"Disease at the Interface" posits, in broadest terms, that global health researchers and practitioners today increasingly conceptualize disease ecologically and disease prevention systemically. Ecological orientations to disease and disease prevention are the new norm. This is evidenced, I argue, in the operationalization of integrative strategies that focus epidemiological attention on the human-animal-environment interface and that call for extensive implementations of multi-disciplinary, multi-sectoral, and multi-national approaches for addressing complex global health problems under the One Health umbrella.

Figure 1. One Health Umbrella[11]

Many of my interlocuters – proponents of One Health and zoonotic infectious disease epidemiologists – invoke ecological idioms not only to underscore the interconnectedness of human, animal, and environmental health, but also to promote "systemic approaches" to contemporary global health problems. Ecosystem, in this particular rendering, is a composite term (ecology + system) that arises, in my analysis, from the vernacular and "thought styles"[12] of my interlocuters who rely on ecological heuristics to emphasize the importance of attending to 'interconnections' and accelerating the 'integration' of systems of knowledge and governance. To be sure, there is an abundance of literature on the concept of a One Health approach that explicitly

11 The 'One Health Umbrella' developed by the networks 'One Health Sweden' and 'One Health Initiative' to illustrate the scope of the 'One Health concept'. Available on www.onehealthinitiative.com.

12 Fleck, Ludwik. "Scientific observation and perception in general [1935]." *Cognition and fact*. Springer, Dordrecht, 1986. 59-78.

stresses the need to systematically integrate approaches to human, animal, and environmental health and to ecologically study the complex interactions that link the health of humans and animals to the ecosystems in which they coexist.[13,14]

As a technical term, 'ecosystem' designates an organized complex of relationships, practices, actors, landscapes, spheres of activity, their linkages and dynamic interactions at multiple scales.[15] Figuratively, I have to come view global health as an ecosystem – akin to what other anthropologists refer to as an "assemblage"[16] – in which One Health actors and global health security strategists increasingly deal with the complexities of disease transmission at human-nonhuman interfaces via approaches that draw theoretically upon and subsequently actuate systems thinking.[17] Like assemblages, ecosystems are composed of different elements (these can

13 Ecology designates a branch of biology that studies the interactions between organisms and the environment. Disease ecology designates a subdiscipline concerned with how species interactions and abiotic components of the environment affect patterns and processes of disease (Collinge and Ray 2006). Ecological studies in epidemiology refer to investigations that compare disease variables across a series of populations (Carneiro & Howard 2011).

14 Zinsstag, J et al. "From "one medicine" to "one health" and systemic approaches to health and well-being." *Preventive veterinary medicine* 101,3-4 (2011): 148-56.

- Peter, Rabinowitz and Lisa, Conti. "Links among human health, animal health, and ecosystem health." *Annual Review of Public Health,* 34 (2013): 189-204.
- Paul, Gibbs. "The evolution of ONE Health: A decade of progress and challenges for the future." *Veterinary Record 174*.4 (2014): 85-91.
- Gostin et al. "Reimagining Global Health Governance in the Age of COVID-19." *American Public Health Association* (2020).

15 James, Proctor and Brendon, Larson. "Ecology, Complexity, and Metaphor." *BioScience* 55.12 (2005).

16 For conceptualizations and problematizations of 'assemblage' as an anthropological problem space, see:

- Rabinow, Paul, et al. *Designs for an Anthropology of the Contemporary*. Duke University Press, 2008.
- Rabinow, Paul. *Marking time: On the anthropology of the contemporary*. Princeton University Press, 2009.
- Rabinow, Paul. *The accompaniment: Assembling the contemporary*. University of Chicago Press, 2011.
- Marcus, George E., and Erkan Saka. "Assemblage." *Theory, culture & society* 23.2-3 (2006): 101-106.
- Ong, Aihwa, and Stephen Collier. "Global assemblages." *Technology, politics and* (2005).
- Elhaik, Tarek. "What is contemporary anthropology?." *Critical Arts* 27.6 (2013): 784-798.

17 There are significant parallels that can be drawn between epidemiology and cybernetic modeling, as well, particularly when it comes to the insistence on 'control' and notions of causality. Hence, I prefer the term ecosystems and not ecology to describe the technical practices of global health, for it conjures a cybernetic image – one in which One Health is engineering an integrated yet distributed system of global health knowledge and governance at multiple scales.

be concepts, practices, institutions, machines, technologies, people, animals etc.) and, crucially, their interfaces, which mark their relations and render the system dynamic.

Figure 2. Integrated One Health Approach[18]

Ecosystems are neither inherently 'natural' spaces nor do they signify worldly processes separated from the political economy of humans forces;[19] they are assembled through the distributed interfacing of species and specialists, ways of being and manners of becoming, ways of knowing and practicing know-how, experience and expertise, geographies, economies, and institutions in continual feedback. It is in this sense that I affix the term 'ecosystem' to global health to describe the complex terrain of my inquiry.[20] The concept of ecosystem has heuristic value in that it brings

18 The 'Integrated One Health Approach' diagram developed by the 'One Health and Development Initiative' (OHDI), which is a nonprofit organization that works to promote education, advocacy, research, and solutions to interrelated issues of human, animal, and environmental health through an integrated One Health approach. Available on https://www.onehealthdev.org/.

19 By describing global health as an ecosystem, I point directly to the ways in which ecosystems are politically and economically informed. This is obvious by virtue of the fact that 20th-century research and development infrastructures allocate human and animal health to different funding streams, research institutions and internatiomal organizations.

20 Some scholars critically question the completeness implied by ecological portrayals of human and nonhuman behavior that are reliant on the heuristic of 'systems', which do not account for the responsibilities that species have

global health into view as composed of many factors and interfaces, each with their own logics and temporalities and forces.

That which I name the global health ecosystem can be understood in broadest terms as an "institutional landscape"[21] mediated by the interrelations among its participants (e.g., academics, policymakers, healthcare providers, research subjects, publics); state and nonstate actors (i.e., multilateral institutions, bilateral, non-governmental, non-profit organizations, academic institutions, private corporations, philanthropic foundations); their various activities (e.g., research, governance, education, medical care, surveillance, intervention implementation); and the interconnected levels at which global health-related activities are applied (e.g., the local, national, regional, global). The global health ecosystem can be further characterized by its formal modes of interaction (e.g., intergovernmental relations, public-private partnerships, multi-sectoral collaborations, research networks), the sites where global health-related activities are applied (e.g., governments, universities, communities), its discursive formations (e.g., policies, scientific evidence, conceptual frameworks, recommendations), and its values, materials, histories, and visions of the future – to name a few.

But thus far, I have mainly focused on the human aspects of the global health ecosystem. Today, the number of pathogens known to infect humans is increasing, which may partly reflect the increase and improvements of surveillance and detection capacities worldwide, and/or actual increases in the emergence of novel pathogens. Zoonotic pathogens represent approximately 60%

to one another or their "co-becomings" with one another. I discuss this limitation in my chapter on Human-dog-City interfaces. For a similar critique, see Hinchliffe, et al., "Biosecurity and the Topologies of Infected Life: From Borderlines to Borderlands," 2013.

21 Gostin et all. "Reimagining Global Health Governance in the Age of COVID-19." *American Public Health Association* (2020).

of all known pathogens able to infect humans.[22] Zoonotic viral threats, in particular, have become a major source of concern, investment, coordination in recent years. Indeed, border controls to regulate and restrict the spread of zoonotic infectious agents into human populations are continuously being elaborated by experts who have to deal with the problem of biosecurity today.

The occurrence of zoonotic pathogens in humans relies on the human-animal-environment interface, defined as the continuum of contacts between humans and animals, their environments, or their products.[23] The human-animal interface has existed since the first footsteps of the human species 6–7 million years ago, promoting the prehistoric emergence of now well-established human pathogens. Since prehistory, the human-animal interface has continued to evolve and expand, ever allowing new pathogens to access the human host and cross species barriers.[24] These phenomena, and human activities to study and prevent them, are also a part of the contemporary global health ecosystem.

My dissertation attends to the specificities of territorialized configurations in/of the global health ecosystem as assembled betwixt the US and Peru and across the Americas. I detail the situated particularities of contexts wherein multispecies pathogens are investigated and zoonotic disease is thwarted (and sometimes permitted) by global health researchers whose work is conducted across intimate, institutional, and governmental scales. Insofar as my work carefully curates critical attention to the sites of participant-observation, levels of organization, and scales of analysis

22 Gortazar, Christian, et al. "Crossing the interspecies barrier: opening the door to zoonotic pathogens." *PLoS Pathog* 10.6 (2014): e1004129.
23 Ticktin, Miriam Iris. "From the human to the planetary." *Medicine Anthropology Theory* 6.3 (2019).
24 Rees, Tobias. "From The Anthropocene To The Microbiocene." *Noema Magazine* (2020).

through which One Health emerges, my approach to anthropological inquiry could also be described as ecological.[25]

Suffice it to say, the global health ecosystem is imbued with complexity.[26] One Health provides a conceptual framework for dealing with the complexities of international disease spread and pathogen emergence at multispecies interfaces, in part, by promoting the need to integrate systems of global health knowledge and governance at disciplinary, sectoral, interregional, and international interfaces.[27] During my fieldwork, 'the interface' was an object of epidemiological attention, open and multiple, and it was, for me, a conceptual site that not only intertwined my various forays into multiple field sites, but became my mode for doing so (see conclusion). In this dissertation, 'the interface' is a general theoretical construct that mediates the distinct field sites that constitute my collective field of inquiry. 'The interface' is also a device I use for assembling continuities among otherwise unrelated moments of anthropological encounter in multi-sited

25 In many ways, my orientation builds upon key tenets introduced by "eco-epidemiology", albeit applied to anthropology. Eco-epidemiology designates an integrated approach to epidemiological inquiry that conceptualizes disease as the contingent outcome of molecular, organismal, environmental, and temporal interactions. Its practitioners promote investigating disease and its prevention at multiple levels of organization and analysis (Susser & Stein 2009; Susser 2004). It is in its particular sense as a contingent, multilevel, and integrative approach that I consider my orientation to inquiry as similarly 'ecological'.

26 Theorizing disease causation ecologically, it seems, opens up epidemiology to complexity and contingency. If a given disease pattern can be explained with reference to interacting causal pathways at molecular, societal, and environmental levels, then causality itself becomes multidimensional. It also becomes indeterminate. The ability to identify discrete pathways of causation becomes an indeterminate and imprecise endeavor precisely because causal mechanisms are multiple and interconnected across levels, each with their own dynamics and variable laws of organization. A consequence of thinking ecologically about disordered states of health and patterns of disease emergence is that attributions of causation become relative, literally, in relation to biological, social, environmental, and topological scales. Causal factors increasingly resemble correlative (co-relative) factors, thus confounding clear-cut ascriptions of causality.

It increasingly seems, to me, that a concept of causality based on universal laws is no longer applicable for apprehending disease processes epidemiologically, as well. Significantly, when it comes to understanding processes of disease causation and evolution, universal laws do not adequately account for overarching contexts and the interactions between levels of complexity and heterogenous rhythms of temporality within the biological world, including the social worlds of humans and multispecies collectives, influenced as they are by specific material and historical circumstances as well as the mixture of peoples, climates, and topographies that interact and evolve dynamically over time.

27 Coker, Richard, et al. "Towards a conceptual framework to support one-health research for policy on emerging zoonoses." *The Lancet infectious diseases* 11.4 (2011): 326-331.

fieldwork. Whereas for epidemiologists 'the interface' tends to mark sites or modes of human-nonhuman contact in shared environs and/or is invoked discursively to locate probabilities of zoonotic transmission, 'the interface' indexes more abstractly, for me, the necessary condition upon which encounters with difference transpire, whether conceptually, processually, or materially; whether organized in terms of species, disciplines, or nations. Whenever there is an interface, there is a relation. Thus there is a requirement to respond, which is a matter of ethics and of politics.

On this matter, I feel compelled to clarify my position as an anthropologist in/of global health and to be explicit about what this dissertation is and is not. This dissertation focuses, first and foremost, on the integration of One Health concepts and precepts into the study of zoonotic and/or vector-borne disease transmission. To empirically ground this inquiry, I have conducted multi-sited fieldwork across Peru, and my participant-observation at each site informs what critical analysis of global health I may offer. Intellectually shaped by scholarly conversations and traditions in cultural anthropology, medical anthropology, and science and technology studies (STS), I dutifully contextualize the historical conditions and place-based circumstances in which epidemiological investigations were conducted at each field site, and I diagnose what I perceive to be the ethical stakes of situated epistemological reorientations in epidemiology. My mode of diagnosing the anthropological significance of contemporary global health practices stays close to specific problems, namely, epidemiological field practices and the possibilities and limitations, as encapsulated by the One Health approach, for reconceptualizing the modern figures of the human, nature, pathogens – in and through their interrelations.

If it appears to the reader that I curiously overlook or fail to analyze the regional specificities and political economic dimensions of life in Peru and/or in Latin America more broadly, this may be because I did not do that kind of anthropology.[28] For this dissertation, I chose to focus my attention on problematizing the human practices and multispecies ecologies that transpire at 'the interface' and less on characterizing the "Peru-ness" of this research. To be sure, my inquiries are grounded in Peru, and I would certainly not claim that One Health activities in Peru are the same as One Health activities anywhere else in the world. The materialities of history and the particularities of place are important and inextricable from the forms of life and knowledge that abound within it.

Still, I chose to inquire into the One Health approach to global health research as a problem-space in which different ways for thinking about health and disease, humans and nonhumans, either emerge or are thwarted. I did not choose to conduct an ethnography of Peruvian variations of the One Health approach to global health, and my analysis of epidemiological field practices does not insist upon showcasing the "cultural" knowledge of Peruvian researchers and/or research subjects. I learned the language of my interlocuters and lived there for sixteen months, but I do not feign to don any "regional" expertise based upon my work. I chose to approach my field as one that is assembled, one that is a "global assemblage",[29] and one that is dynamically formed through interactions at interfaces. I thus attempt to situate One Health simultaneously amidst while being nonetheless irreducible to the deterritorialized aspects of global health and the territorialized localities of Peru.[30]

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28 On the reasons for pursuing anthropological inquiry that "resists the blackmail of modernity", again see Elhaik, Tarek. "What is contemporary anthropology?." *Critical Arts* 27.6 (2013): 784-798. For anthropological inquiry that does not revolve around the concept of ethnos (which has and continues to organize much medical and cultural anthropology), see Rees, Tobias. *After ethnos*. Duke University Press, 2018.

29 Ong, Aihwa, and Stephen Collier. "Global assemblages." *Technology, politics and* (2005).

30 On the transformations of medical anthropological inquiry over the decades, and struggling with the "moral value" of medical anthropologists for global health problems, Lawrence Cohen writes, "A deterritorialized 'global health'

As such, Peru appears in this dissertation in some ways and not others. All of my interlocuters conduct global health research in Latin America and the Caribbean. Those who conduct research in Peru do so for various reasons: some were born in Peru where they continue to live and practice. Others have dual citizenship in both the United States (US) and Peru as well as joint appointments as faculty at Peruvian and North American universities. They travel regularly to Peru, which constitutes, for them, "the field" of their fieldwork, that is, where they go to collect field data (whether biological samples, survey data, etc.) for their global health projects.[31] Some were born in the US and have ex-patriated to Peru. Others, like me, traveled to Peru for relatively short-term (1-2 years) research stints. Most of my interlocuters consider Peru to be uniquely suited for epidemiological investigations into endemic zoonotic and vector-borne diseases given the area's microbial and biological diversity as well as the robust research infrastructure that allows global health partnerships between US and Peruvian institutions to function.[32] In my dissertation, Peru appears in these infrastructural conditions and in the intimate relationships between global health researchers and their research subjects. I further gesture towards the particularities of contemporary global health research in Peru in my orientation to the histories of colonial contact

will produce productive reconfigurations of disciplines and problems. Anthropology need not only be the insistent voice of reterritorialization". Cohen, Lawrence. "THREE Making Peasants Protestant and Other Projects." *Medical Anthropology at the Intersections*. Duke University Press, 2012. 65-92.

31 One of my interlocuters who was born in Peru but holds a faculty position at an ivy league university in the US, and whose funding for research in Peru comes from the National Institutes of Health (NIH), told me in an introductory interview that "I do not consider myself a global health researcher. I was born in Peru, I am from Peru. But my funding is from the NIH". What this suggests to me is that global health is still very much a growing and amorphously bounded field (hardly complete), made up partially of people who do not even identify as representative parts of the system yet nonetheless inhabit and strengthen the ecosystem.

32 Peru is not necessarily even the most optimal site wherein to explore the emergence of One Health (there are many other countries around the world, primarily in Africa and Southeast Asia, where cohorts of researchers and practitioners are actively transforming into a One Health workforce). My reasons for choosing Peru are reflexively laid out in the conclusion to this dissertation, but for now it suffices to say that fieldwork in Peru permitted me to explore old and new tensions between the national and the international.

and legacies of imperialism that inescapably extend into the present and imbue even the most reciprocal of global health collaborations today.

In this dissertation, I illustrate how the transmission of infectious pathogens across different species interfaces conditioned specific situations of zoonotic disease endemism and the emergence of novel forms of epidemiological thought and practice 'at the interface'. The first three chapters each work as a case study examining how field researchers oriented to human-animal-environment interfaces to study zoonoses, the tools they brought and/or invented to address the problems posed by zoonotic and vector-borne diseases, and how unforeseen ethical and epistemological challenges invariably arose midst their attempts to control disease. At each site, I trace the situated ways in which Peruvian and North American researchers collaborate across some of the manifold disciplines that comprise the field of global health research, including epidemiology, humanitarian medicine, veterinary medicine, biostatistics, anthropology, sociology, environmental engineering, etc. I examine how concepts and research practices (epistemologies) come together at the species interface to precipitate transformations in the activities of practitioners and their orientations towards their objects. In the fourth chapter, I historically situate and problematize the integrative tools and systemic logics mobilized to coordinate global health and national security priorities across the region of the Americas. This collective work is grounded in sixteen months of multi-sited anthropological fieldwork with global health researchers across Peru during 2017-2018 and was supported by a NIH Fogarty Fellowship.

Chapter-by-Chapter Synopsis

Wending through the jungles, seacoasts, high-altitude mountains, and pastoral valleys of Peru, this dissertation is empirically grounded the field-based epidemiological research practices of various multidisciplinary teams, each comprised of North American and Peruvian researchers, studying infectious disease systems in different regions of Peru for different projects and at different human-animal-environment interfaces.

In the chapter entitled "Human-Pig-Valley Interface: Parasitic Unity", I depict a community-based experiment that aimed to educate rural farmers how to surveil and control the spread of an intestinal parasite endemic to their area in Northern Peru. I describe their attempts to reconfigure the ways that farmers interacted with and thought about pigs through the promotion of sustainable sanitary reforms and education campaigns. I also depict their theatrical attempts to precipitate a transfer of knowledge to the farmers regarding the tapeworm's etiology by way of an interactive "evidence workshop" that involved using bile salts to artificially evaginate a porcine cyst and display it as a tapeworm under a microscope. In this chapter, I give form to 'the parasite' as an empirical entity, a figure, and a relation. As an empirical entity, the parasite materializes in northern Peru as a ribbon-like tapeworm that fulfills its life cycle between two animals serving as its 'host-species': humans and pigs. As a figure, the parasite is most commonly and uncritically characterized in global health as an invader of human and animal bodies, invoking an image of hostility. Given its endemicity to northern Peru, the parasite also conditions the possibility for hospitality insofar as the region, itself, becomes a site that hosts global health researchers who bring an influx of material resources and human personnel into the region to study the parasite. As a relation, parasitism is a form of interaction between two organisms, in which the parasite lives on or inside its host. The parasite-host relation is constitutively asymmetrical and reveals relations of power and risk.

In the chapter entitled "Human-Mosquito-Jungle Interface: Endemical Belonging", I describe a multidisciplinary global health research project conducted by epidemiologists, immunologists, and molecular biologists in the Amazonian metropolis of Iquitos. I illustrate how local residents were transformed from would-be recipients of conventional public health intervention into what I call "conscripts of science": human beings who are valued by scientists for their adaptive immune responses to the malaria-causing *plasmodium* parasites in their blood. I chart how families from afflicted communities were recruited and enrolled into epidemiological cohorts, exchanging blood samples for negligible healthcare in order that scientists could culture their parasite-dense blood cultures to test for the anti-malarial properties of possible therapeutics. I show how these study participants' bodies become valuable objects for research precisely because their "local biologies"[33] are pathological, and how this pathogenicity is contingent upon the cyclicity of climate phenomena and enduring yet dynamic events of multispecies encounter over time. I conclude the chapter by developing a concept of "endemical belonging" to name the mode of relationality and form of biosocial inheritance that emerges when local biologies are collected for global health science.

In the chapter entitled "Human-Dog-City Interface: Eco-Epidemiology", I discuss the modeling practices of One Health epidemiologists from North American and Peru, who were studying the reemergence of canine rabies in the high-altitude city of Arequipa. Foregrounding the role of urban landscape in virus' distribution patterns, these researchers harnessed GPS, GIS, and artificial intelligence (AI) technologies to generate predictive risk maps and spatial coverage models to track the movement of dogs through the city's dry water channels. I trace the movement of concepts and

33 Lock, M., Kaufert, P. "Menopause, Local Biologies, and Cultures of Aging." *American Journal of Human Biology.* 13.4 (2001): 494-504.

practices across disciplinary divides (e.g. from veterinary medicine, landscape ecology, animal geography, cybernetics) as they are integrated into epidemiological surveillance models at the human-technology interface. Despite this team's innovative approach to studying rabies as a complex disease ecology, they were ultimately reduced to proposing a conventional biomedical health intervention (dog vaccinations). I highlight the jurisdictional constraints making cross-sectoral, eco-social, and structural interventions difficult to implement despite the promises of theorizing and modelling disease ecologically.

In the chapter entitled "National-Global Security Nexus: Interdependence", I depict my first fieldwork encounters at a global health security workshop in Lima and describe efforts to strengthen global health security and to build national capacities. These efforts are encapsulated in a suite of initiatives, including the Joint External Evaluations (JEE) tool – an enforcement mechanism to ensure transparency in the building of national security capacities and compliance with the IHR; the revised International Health Regulations (IHR 2005)—the international legal instrument in place to prevent and control the cross-border spread of infectious disease;[34] the WHO-OIE-FAO Tripartite – a strategic alignment between the World Health Organization (WHO), the Food and Agricultural Organization (FAO), and the World Organization of Animal Health (OIE) and their collective endorsement of the 'One Health' policy framework; and the Global Health Security Agenda (GHSA)—a framework for accelerating implementation of the IHR. All of these global health governance tools hold governments accountable to their (national) publics and the international community, confounding the borders between them in an

34 "International Health Regulations." *World Health Organization.* 2016.

interconnected world undertaking accelerated coordination and integration in the name of security.

In "Anthropology at the Interface" I conclude by reflecting upon my entry into fieldwork. I describe my positionality and experience of doing "fieldwork in a double mode", which is nothing more than being simultaneously an anthropologist *of* global health and an anthropologist *in* global health.

Human-Pig-Valley Interface: Parasitic Unity

*

"Cuando preguntas a los participantes en una encuesta "¿Por qué enferman los cerdos?", responden que "*dicen que* es porque el cerdo enferma por comer heces. Pero también por la raza"

—Karla, Field Researcher, Proyecto de la Triquina

*

I. Parasite's Orbit

Taenia solium is a zoonotic parasite, a ribbon-like animal that belongs to the cyclophyllid cestode family and is a common intestinal tapeworm of human beings. Human helminthiasis – in pathology, a term for worm infection – and porcine cysticercosis – the infestation of tissue by the larval form of a tapeworm – have both been known since the times of antiquity, as revealed by the writings of Hippocrates, Aristophanes, and Aristotle.[1] Although their medical works contained a great deal of information about diseases clearly caused by parasites, it was not until the middle of the 19th century that the etiology and pathogenesis of diseases caused by *T. Solium* in humans began to be studied systematically. For centuries, natural historians and zoologists widely accepted the doctrine of spontaneous generation, or, belief in the mucosal origin of the parasite in its host. Later, its life cycle was codified in zoological and then biological terms.

1 The first written records of what are almost certainly parasitic infections come from a period of Egyptian medicine from 3000 to 400 BC, particularly the Ebers papyrus of 1500 BC discovered at Thebes. Later, there were many detailed descriptions of various diseases that might or might not be caused by parasites, specifically fevers, in the writings of Greek physicians between 800 to 300 BC, such as the collected works of Hippocrates, known as the *Corpus Hippocratorum,* and from physicians from other civilizations including China from 3000 to 300 BC, India from 2500 to 200 BC, Rome from 700 BC to 400 AD, and the Arab Empire in the latter part of the first millennium. As time passed, the descriptions of infections became more accurate and Arabic physicians, particularly Rhazes (AD 850 to 923) and Avicenna (AD 980 to 1037), wrote important medical works that contain a great deal of information about diseases clearly caused by parasites. (See Cox, Frank EG. "History of human parasitology." *Clinical microbiology reviews* 15.4 (2002): 595-612)

To achieve its corporeal existence over and over again, pigs and humans must live in relative proximity to one another in a shared environment. Adult tapeworms dwell inside human intestines where they may cause minor, if any, perceptible disturbances to their host organism's gastrointestinal functioning. Undetected, the parasite can live for approximately twenty-five years and grow to several feet long inside the human body, producing tens of thousands of embryonated eggs on a daily basis, which are shed into the environment – that is, outside of the human body – whenever an infected host defecates.

Each larval egg (oncosphere), when expunged from the human's intestines into the physical environment via fecal matter, has the potential of becoming a cysticercus (cyst) upon subsequent ingestion by nearby pigs. Once consumed by swine, the oncospheres enter the pig's digestive tract and permeate the mucosal lining of the pig's gut. They penetrate into the pig's bloodstream and course throughout the pig's body until eventually they come to a rest, that is, eventually become lodged somewhere in the pig's muscles or soft tissues. Once localized in porcine flesh, the

oncospheres form into minuscular sacks of puss-like fluid, no larger than the size of a small human finger-nail, and they lay dormant as cysts possessing the potential to become an intestinal tapeworm in ill-fated humans who ingests them.

In the event of human consumption of cystic pork, during which cyst(s) is not destroyed amid the gustatory processes of cooking or chewing, an immediate pathway opens up for the cyst to infect the human who swallowed it. Inside its new human host, the cyst moves once again through the gastro-intestinal system. Bile in the human's gut liquefies the cyst's gelatinous membrane. From inside the sack, the parasite's head (scolex) unfurls and attaches to the lining of the human's small intestine. Sojourned there by a crown of teeth-like suckers, the parasite begins to absorb nutrients and grow. It develops ribbon-like segments (proglottids) that may extend the overall length of the tapeworm to nearly five feet. These segments each contain male and female parts and are thus capacitated to fertilize themselves.

Eventually these segments break off from the tail of the tapeworm and are excreted from within the human's intestinal tract during the host's bowel movements. When contaminated feces are openly dropped into the physical environment, it becomes possible for meandering pigs to find and consume this egg-infested snack. Once more, the embryonated eggs will become infective cysts inside the pig who ingested them. When humans eat the cystic pig meat, the parasite's life cycle begins again inside the human, then via feces into the pig, then into the human, then into the pig, *ad infinitum*.

An Evolutionary Trail

Notably, *T. solium* cannot be found in the intestines of any other animal than the human, which is

why parasitologists and evolutionary biologists describe this particular species of parasitic tapeworm as "host specific" to humans.[2] While *T. solium* must circulate in both humans and pigs, the latter being an intermediate-host species upon whom the parasite most intimately relies in order to facilitate its life cycle, this specific parasite is nonetheless only able to mature from a cyst into an adult tapeworm inside the intestines of the human host. In other words, the larval egg takes the form of a cyst in the body of the pig, and the cyst takes the form of a tapeworm in the body of the human. In this sequence of progression, *T. solium* cysts 'actualize' into another embodiment of their form – the tapeworm – exclusively in human entrails, which is where they grow and dwell and reproduce until their death. In the dynamical system of the parasite's becoming, pigs function as vital media in the form-giving process that moves *T. solium* from 'in potentia' to its adult form (similar to Aristotle's metaphysical notion of *entelechia*, or, the conditions under which a potential thing becomes actualized).[3]

Such is the 'natural history' of *T. solium* in its 'undisturbed life course'. One might presume from such an account that the parasite qua species-being develops according to its intrinsic features, which might explain its steady morphological sequence throughout the tapeworm's life course. From an ecological perspective, however, it is impossible to conceptualize the tapeworm qua biological organism in isolation from its surroundings; organisms are *open* systems that continually interact with their environments and their formation is thus always susceptible to external processes that may influence and modify it coming into being. By its very nature, the parasite *T. solium* cannot achieve existence independently from the corporeal lives of pigs and humans whose bodies the tapeworm inhabits cyclically and sequentially as its vital media if not

2 There are two other species of tapeworm within the *Taenia* genus (*T. saginata, T. asiatica*), that are also found exclusively in humans.
3 Sachs, Joe. *Aristotle's physics: A guided study*. Rutgers University Press, 1995.

world.

Among parasitologists, there is dissent over the evolutionary origins of *T. solium.* An essay from 1940 is commonly referenced in their literature, titled "The origins of Human Tapeworms" by Jean Baer.[4] It hypothesized the following:

- All known species of the genus *Taenia* are parasitic in carnivorous animals, the larval forms being found in herbivorous (or omnivorous) animals
- *T. solium* is only found in human hosts
- If humans had acquired these worms via an "evolutionary route", closely related species should be found today in the higher primates.
- *Taenia* tapeworms in primates are completely absent, therefore the human acquisition of these worms was *not* evolutionary, but secondary and by accident

Baer reasonably supposes that:

> the larger extinct carnivore, such as the cave-lion, etc., which were contemporary to the hominian, could readily have harbored adult tapeworms, the larvae of which lived in wild pigs, the latter being hunted by our ancestors. In this way, the infection of man with *T. solium* was realized and could perfectly well have been maintained in the human species, since the latter also serves as an intermediate host, and the chances of fecal contamination must have been considerable… The pig, domesticated at a much later period [than the dog], lived freely among the human agglomerations and had every chance of becoming 'measly'. In this way, man succeeded in accumulating, unwittingly, within the area of his tribe, both

4 Baer, Jean G. "The origin of human tapeworms." *The Journal of Parasitology* 26.2 (1940): 127-134.

the animal serving as intermediate hosts and the maximum chances of realizing the life cycle of the tapeworm.

In other words, Baer thought that humans acquired *T. solium* through the consumption of wild boars first hunted by early homonids, which they later domesticated as pigs. The hypothesis implies that *T. solium* remained consistently within boars/pigs and switched from cave-lions to humans as its 'definitive' host once human-pig relationality stabilized through agrarian practices. Thus, within an evolutionary frame, human colonization by *T. solium* was secondary and accidental.

A more recently published study, however, contradicts this long-held natural historical hypothesis of *Taenia* tapeworms. Published for The Royal Society in 2000 by E. Hoberg et al.,[5] the essay entitled "Out of Africa: origins of *Taenia* tapeworms in humans" presents phylogenetic evidence indicating that "hominids, on the savannah of Africa, became hosts for *Taenia* prior to the origin of modern humans and substantially earlier than the domestication of bovids and suids and the development of agriculture". In less technical terms: what they argue is that *Taenia* infected humans long before, rather than coeval with, the domestication of pigs.

To prove their hypothesis, Hoberg et al created a *Taenia* parasite tree topology onto which they mapped extant host taxa and established "divergence dates" of phylogenetic events. Premised on a notion of evolutionary time that uses the mutation rate of biomolecules to deduce the time in prehistory when two or more life forms diverged, these dates indicated biogeographical formations of host-parasite relationships. For example, they could determine that the most common ancestor

5 Hoberg, Eric P., et al. "Out of Africa: origins of the Taenia tapeworms in humans." *Proceedings of the Royal Society of London. Series B: Biological Sciences* 268.1469 (2001): 781-787.

of *T. solium* was *T. hyanae*, a parasite that used hyenas as definitive hosts and bovids as intermediate hosts. They concluded that "an omnivorous diet, dependent on scavenging, for pre-human hominids would have promoted sharing of parasites within a guild of carnivores and their bovid prey, thus providing the ecological context for the evolution of *Taenia* specialized in human definitive hosts". In other words, it was by way of scavenging that hominids were colonized by *T. solium* much earlier than the human domestication of animals, noting that "this pattern is consistent with evolution among other *Taenia* spp…".

If this is true, and the parasites jumped from hyenas to hominids before zigzagging between humans and domesticated pigs, then it begs the obvious question: why did *T. solium* eventually stabilize in pigs, and not, say, in dogs or cows or other domesticated animals living in habitual proximity to humans? To answer this question, I suggest that a divergence from the evolutionary framework in which the above scientists have theorized the biography of *T. solium* is required[6].

In the following section, I propose thinking about the parasite-pig relation through an analytic of *involutionary momentum.* The concept emerges from feminist science for exploring interspecies relationality by drawing attention to affectively charged and multisensorial practices that shape ecologies between organisms.[7] I mobilize it here as a supplement to the evolutionary logics outlined above. Working athwart evolutionary models that tend to fetishize functionalist accounts of adaptation and make use of concepts like host-specificity that categorize hosts and parasites as

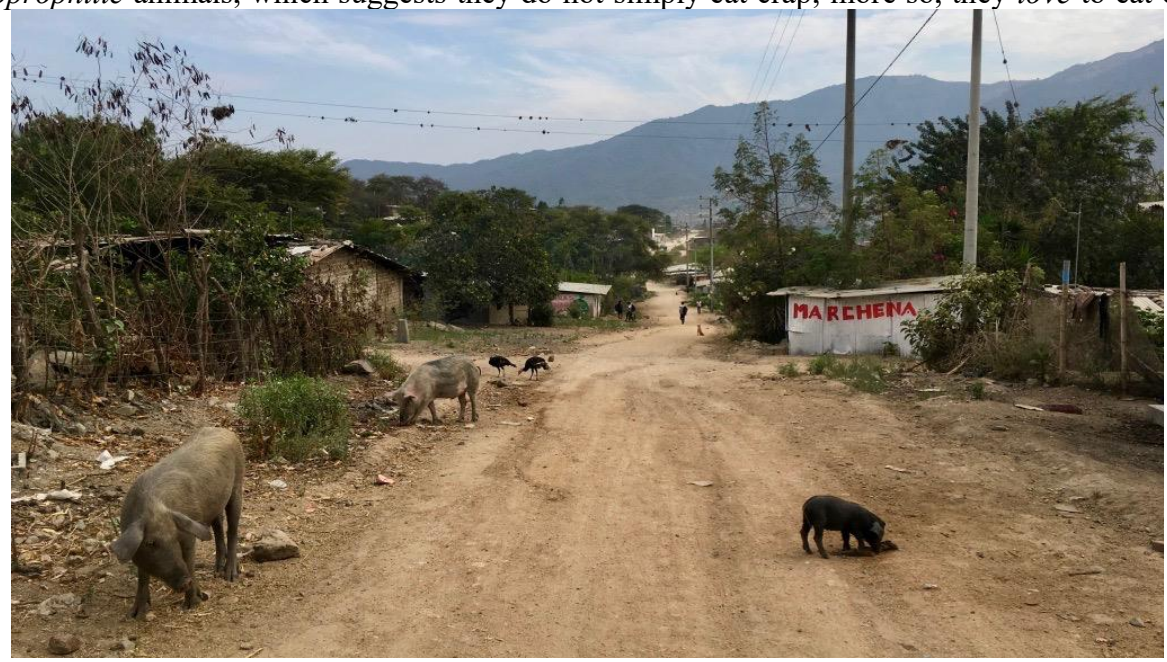
6 In what manner humans came to develop an appetite for raw flesh (and thus the possibility for the consumption of cysts), Baer claims we cannot justifiably know. Playfully, he writes, "Psycho-paleontology is as yet unborn!" My claim is that we can begin to understand how parasites came to prefer pigs by attending to their unique encounter in an involutionary mode that exceeds the limits of evolutionary theory.

7 Hustak, Carla, and Natasha Myers. "Involutionary momentum: Affective ecologies and the sciences of plant/insect encounters." *differences* 23.3 (2012): 74-118.

autonomous organisms in advance, I aim to tell a story of *T. Solium* in terms of aesthetic proclivities, intra-active coevolution, multispecies mattering, and, perhaps even: host-affinity.[8]

Multispecies Involutions

Through an involutionary mode of attention, it becomes possible to conceive of the human-parasite's zoological affinity for pigs by tracing the motions through which the organisms reach toward one another and *involve* themselves in each other's lives. For example, in an ecology of multispecies practices – specifically a situation of open human defecation and free-roaming pig domestication – one of the ways in which a pig comes to encounter and become involved with the parasite *T. solium* is through coprophagy. From the Greek *copro-* ("excrement") and *phagy* ("to feed on"), coprophagy is nothing more than a technical term for *eating poop*. Pigs are said to be *coprophilic* animals, which suggests they do not simply eat crap; more so, they *love* to eat crap.



Infested or not.

8 Elective affinity is a literary-aesthetic concept. See Goethe (1999) but also Wittgenstein (1953).

In northern Peru, across the regions of Piura and Tumbes, *T. solium* is highly endemic. Over half of the rural populations practice agriculture and small-scale farming of cattle, pigs and chickens. Pigs are commonly left to roam semi-freely, often for weeks or even months beyond their pens. Remarkably, these domesticated animals find ways to nourish themselves. They scavenge through trash piles and graze dusty roads, snouts to the ground, sniffing for food amidst the litter. Further into the hills they often amble, eating scraps along well-trod walking paths, drinking from fresh water streams, occasionally stumbling upon delicious feces left by farmers working busily in nearby fields that are far from latrines. Eventually, the pigs return to town (most of them, at least) and are penned for a few weeks, during which time their owners fatten them up so they can sell for a higher cost. If a pig has eaten fecal matter infested with larvae, its body will be grossly infected with parasitic cysts by the time it is slaughtered. In other words, *T. solium* stabilizes in pigs because their coprophagy facilitates the corporeal involution of parasites into their bodies.

Paying attention to the shit is helpful for remembering that *T. solium* traverses not only the internal viscera of pigs and people; it must also navigate the interstitial climes between its two hosts' bounded bodies. As if in interstellar orbit, the parasite is ejected from its human host in a rocket ship of crap until absorbed into a porcine body, a habitable zone through which it travels only to repeat an about-face trajectory back to a human and then to a pig, infinitely, ad nauseum. When the human eats the cysticercotic pig, *T. solium* enters into the person's digestive system. Thus, the parasite stabilizes a synanthropic relationship with pigs and humans, its two hosts, by depending equally upon pigs' predilections for human feces and humans' appetite for pork.

In global health terms, the zones of interaction between two organisms whose materially proximal bodies occupy a shared environment is commonly known as: the human-animal interface. For example, in One Health approaches to global health, 'the human-animal interface' is a standard nomenclature for denoting complex interdependent relationships humans have with co-existing nonhuman animals on whom they depend. Coupling the language of global health to that of science studies renders the *interface* not only a spatial and material term, but also a relative term, somewhat akin to Canguilhem's (1965) notion of *milieu*[9] and von Uexküll's (1957) concept of *umwelt.*[10]

Digestion (ingestion & excretion) is a mutual term that characterizes the parasite's dual interfacial mode of existence, its orbit around and between and through its human and pig hosts, which

9 Canguilhem, Georges. *Knowledge of life*. Fordham University Press, 2009.
10 Von Uexküll, Jakob. *A foray into the worlds of animals and humans: With a theory of meaning*. Vol. 12. U of Minnesota Press, 2013.

collectively comprise a multispecies eco-system. Beginning from the middle, as it were, the parasite emerges through the interface; it crosses one species barrier (i.e. from human body to pig body) in the form of an oncosphere via a medium of fecal matter. Multispecies digestion provides the parasite with enough momentum to cross the species barrier again (this time, from pig to human) in the form of a cyst via a medium of pork meat. Digestion describes the basis of a mutual relation between humans and pigs, as species that heterogeneously nourish (and infect) one another.

Collectively, these carnal practices of defecation and absorption constitute a world for the parasite: together, the interacting bodies of humans and pigs assemble (into/as) environments in which the parasite lives and together form a human-animal-parasite ecosystem. One could say that *T. solium* feeds upon a mutual relation of human-pig digestion as its pathway for subsistence. To remove or alter aspects of this human-animal interface (i.e. enforcing changes in sanitary techniques, dietary shifts, or waste management practices) would therefore be tantamount to eliminating the parasite or else disrupting its transmissibility. This is precisely what global health researchers have in mind.

Pathogenesis as Pathological Genesis

For most global health researchers, the problem is that *T. solium* has the potential to become highly pathogenic for humans. Even though the intestinal tapeworm (Taeniasis), causes minimal harm to its human host, the very same parasite causes a disturbingly different disease in humans known as Neurocysticercosis (NCC). Neurocysticercosis manifests when *T. solium* larvae localize *not* in the digestive tract of its host, but in their central nervous system or soft tissue brain matter.

Preventable, NCC is a gruesome cystic infection of the brain that causes late-onset epileptic seizures in afflicted human hosts.[11]

One way of framing it is that *T. solium* presents a public health problem precisely because it can inhabit the body of its human hosts in two distinct forms: (1) as an intestinal tapeworm that causes Taeniasis, and (2) as a cystic brain infection that causes Human cysticercosis, or Neurocysticercosis when it occurs in a human's brain.

To clarify this difference requires a repetition:

To become a human intestinal tapeworm, *T. solium* must pass through a pig. In epidemiological and zoological terms, pigs are its "intermediate host" because their bodies facilitate the parasite's orbital trajectory from a human's anus to a human's mouth. The pig's role is vital insofar as it *intermediates* the parasite's passage through both ends of the definitive host's digestive system at the correct stages in its life cycle. There is a corporeal correspondence between the parasite's metamorphosis (from larva to cyst to tapeworm) and the organismal-milieus proper to its chronological formations. Definitively, *T. solium*'s lifecycle is "indirect" since to become a human intestinal tapeworm, it must localize sequentially in porcine flesh/intermediate host then human bowels/definitive host.

11 Beam, Michelle, et al. "Barriers to participation in a community-based program to control transmission of Taenia solium in Peru." *The American journal of tropical medicine and hygiene* 98.6 (2018): 1748-1754.

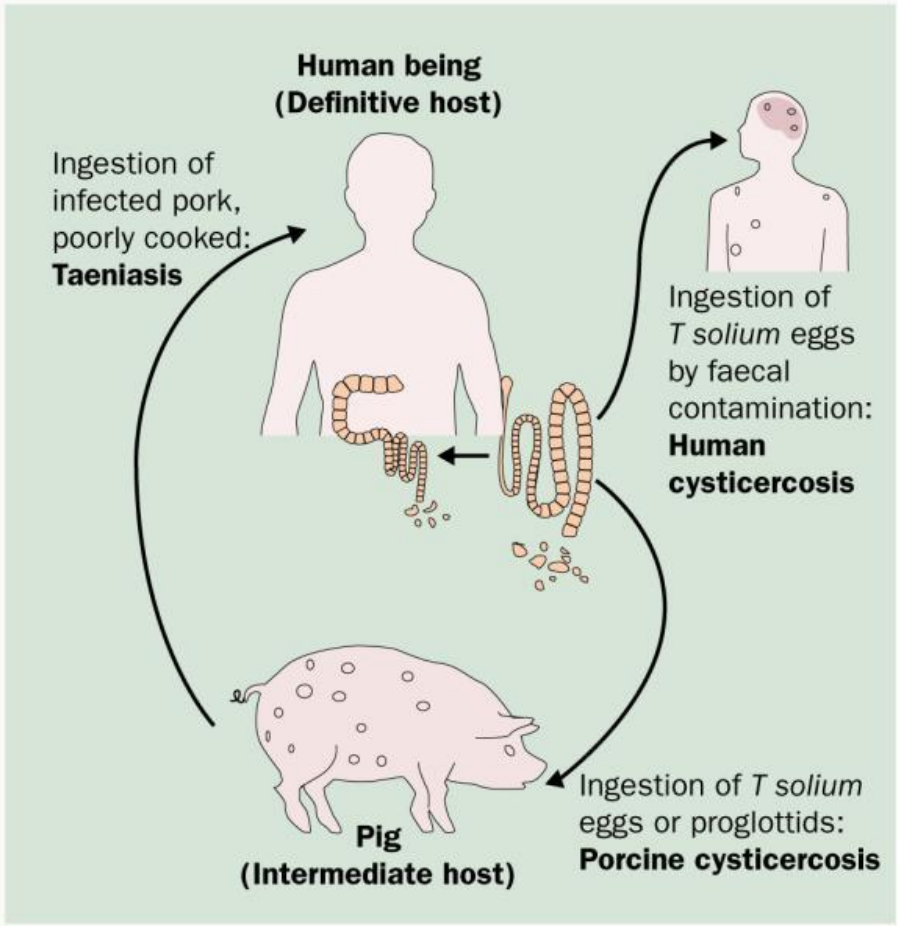


Figure 3. Life Cycle(s) of T. Solium[12]

A fatal slippage occurs when the parasite's definitive host accidentally substitutes for its intermediate host, or in other words, when a human becomes a pig in the *umwelt* of the parasite. This happens when *T. solium* passes *directly* from a human's anus into a human's mouth, as opposed to *indirectly* by way of the intermediating pig. Recall that 'oncospheres' are the embryonated eggs inside human feces, that when eaten by pigs, travel through its blood stream and form cysts. It is only after human ingestion of measly meat that the cysts can begin to develop

[12] Image from one an article by one of Peru's premier NCC working groups. García HH, Gonzalez AE, Evans CA, Gilman RH, Cysticercosis Working Group in Peru. Taenia solium cysticercosis. Lancet (London, England). 2003 Aug;362(9383):547-556. DOI: 10.1016/s0140-6736(03)14117-7.

into intestinal tapeworms inside the human. But if the pig is bypassed and instead the larval eggs are consumed directly by humans, then the oncospheres enter a body-milieu that is improper to them in that form at that time in their life cycle. Not only does the human (as milieu-body) inadvertently *replace* the pig (as milieu-body) in the chronological trajectory of the parasite, but it also *displaces* the vital functionality of the pig (as intermediate-host) in the life cycle of the parasite. When a human re-/dis-places a pig as intermediate host, there is nothing to inter-mediate because the parasite has already reached its final destination in the human.

A human-ingested oncosphere will not mature into a human intestinal tapeworm since it was not consumed first as a porcine cyst. Rather, the ingested oncosphere in this pathological configuration directly becomes a human cyst. Indiscriminate to species difference, it acts as it would in an intermediate-host-milieu. It traverses a familiar path through the body: it penetrates the host species' GI tract and flows through the bloodstream until localizing in muscle or tissue where it lays dormant as cyst, waiting to be eaten. Cysts that form in human muscle or brain tissue do not become intestinal tapeworms, unless, of course, consumed by cannibals or humanoid, neurophilic zombies. This is how the parasite diverges from its *entelechial* path and actualizes pathogenically in its relation to human-environments: whereas *T. solium* becomes a tapeworm via the human consumption of cysticercotic pork meat, *T. solium* becomes a cysticercotic infection via the human consumption of oncospheres.

Even though feces are all around us and humans ingest poopy particles more regularly than anyone would care to admit, neurocysticercosis remains a rare affliction facilitated by pathogenic "fecal-oral transmission" in areas where the parasite is endemic. Fecal-oral transmission may happen when, for example, an infected human defecates and does not wash their hands prior to touching

their mouth or shaking someone else's hand or preparing food that is subsequently consumed by themselves and/or their families.[13] Microscopic eggs can be passed effortlessly from fecal matter to human mouths, for example, when a parent does not wash their hands after changing an infected child's diaper. Objects that may carry larval eggs are called "fomites", and not much research has been done on how long eggs persist is such form. The danger is in the ease with which oncospheres can be ingested by humans.

What usually happens when cysts localize in human brain tissue is but a slow process of degeneration that takes approximately ten years. This means a human can ingest larvae and not show any symptoms until nearly a decade later. As the *T. solium* cyst begins to die and disintegrate in the human brain, it may secrete toxins that trigger an immunological response in the human host. Ultimately, the swelling of blood into tissue around the site of the pathogen irritates the brain and causes an onset of epileptic seizures. Even when the inflammation dissipates, the dead cyst remains and may provoke headaches, dizziness, further swelling and rapid-onset seizures as it slowly continues to calcify. Such is the suite of symptoms that patently characterizes Neurocysticercosis.

Pathos for the Pathogen

Up until this point, I have figured the parasite as a sort of multispecies protagonist. My aim has been to establish a sort of identification between the parasite and other forms of life and species

13 A fascinating story: In 1990-1991, four unrelated persons in an Orthodox Jewish community in New York City were diagnosed with neurocysticercosis. None of the patients had eaten pork, since it is forbidden among observant Jews, according to the laws of kashrut. Epidemiological investigation eventually discovered that the affected households shared 'domestic employees' who had recently emigrated from Latin America where T. solim is endemic, all of whom had active infections with the tapeworm, and were most likely sources of infection in the members of the Jewish households. See: Schantz, Peter M., et al. "Neurocysticercosis in an orthodox Jewish community in New York City." *New England Journal of Medicine* 327.10 (1992): 692-695.

being. By treating the parasite as a species in a multispecies assemblage, I hope to illustrate a few things.

First: the manners of entering into and of co-existing in/as a multispecies assemblage are not always symbiotic. Though many multispecies ethnographers focus on the relationships between symbionts, the parasite enters into these discourses as a critical complement.[14] After all, *nothing* is innocent (not even for species engaging in symbiotic relationships).[15] From this critical multispecies perspective, we see how the human, the pig, and the parasite become differentially involved in an overall parasitic relation.

Second: in whichever form – cyst or worm – the parasite affects humans and pigs, disfiguring them from within and negatively impacting their health to varying degrees. From a public health perspective, this is where the problem lies: a parasite effectuating pathological states of health at the population level is enough to warrant a public health intervention. Historically, the objective of such interventions has been *eradication* of the pathogen. This often includes culling the population of nonhuman-animals that host the parasite (see every chapter in this dissertation). Often animals are refigured in global public health discourses as the "source of zoonotic diseases" that threaten human health.[16,17,18] When animal species function as intermediary hosts of zoonotic pathogens, health scientists call them "reservoirs of infection", from which an infectious agent can

14 For anthropological accounts of human-animal relations often celebrate multispecies intimacy and sociality see Haraway 2008; Kirskey and Helmreich 2010; Tsing 2015. See Medical Anthropology Quarterly's Special Issue (2019) entitled "Human Animal Health in Medical Anthropology", for a collection of articles that complicate such narratives.
15 Haraway, Donna. "A cyborg manifesto: Science, technology, and socialist-feminism in the late 20th century." *The international handbook of virtual learning environments*. Springer, Dordrecht, 2006. 117-158.
16 Kruse, Hilde, Anne-Mette Kirkemo, and Kjell Handeland. "Wildlife as source of zoonotic infections." *Emerging infectious diseases* 10.12 (2004): 2067.
17 Wang, L. F., and G. Crameri. "Emerging zoonotic viral diseases." *Rev Sci Tech* 33.2 (2014): 569-81.
18 Chomel, Bruno B., Albino Belotto, and François-Xavier Meslin. "Wildlife, exotic pets, and emerging zoonoses." *Emerging infectious diseases* 13.1 (2007): 6.

be transmitted to a human or another susceptible host.[19] In global public health, organismal reservoirs of infectious pathogens constitute nonhuman populations to be managed and targeted for effective disease control. The techniques for doing so are multitudinous, ranging from vaccinations to cullings.

Third: nonhuman animals come to occupy categories nominally reminiscent of environments. They are viewed as species already entangled ecologically with the pathogens that produce zoonotic diseases as if zoonoses exist *a priori to* their emergence vis-à-vis animals' interactions with humans, rather than as a consequence of the interface that facilitates cross-species spread. In an involutionary mode, however, it becomes a bit easier to see how the human-pig interface is the condition of the zoonotic transmission of the parasite.

Fourth: the interface constitutes something like an 'ecological corridor' or continuum through and across which the parasite orbits in the multispecies assemblage between human and pig that their interface sustains. Indeed, humans and pig play essential roles in maintaining the material lifeworld of the parasite. Collectively, humans, pigs, and parasites co-produce a multispecies milieu. But by privileging the protection of human health, public health interventions make recourse to maneuvers that externalize humans from this multispecies milieu and re-position them in opposition to the dangerous parasites and pigs. Once the multispecies relations are reconfigured in this way,

19 Haydon, Daniel T., et al. "Identifying reservoirs of infection: a conceptual and practical challenge." *Emerging infectious diseases* 8.12 (2002): 1468-1473.

according to a protectionist logic, it becomes seemingly more sensible to defensively kill the other threatening species.[20]

Increasingly I wonder: How might humans learn to live with parasites ('pathogens') and animals ('disease reservoirs') without attempting to eradicate them? After all, they have learned to live with us. From this more sympathetic point of view, I would like to develop something like a pathos for the pathogen. At the very least, I want to point out how easy it is to almost automatically despise the pathogen from a public health and biomedical point of view. I hope that a critical multispecies perspective might facilitate an alternative view towards the pathogen, one that neither deplores it, yearns for its death, nor mourns it. I am not suggesting that we let parasitic infections reign, rather I more modestly gesture towards the possibility of lingering in the uneasiness we might feel once we realize that we needn't equate pathogens with the destruction of health and of life because very often they are actually just other forms of life.[21]

My provocative intervention is: What would resisting an affective indifference to the health of the tapeworm do? Could we resist pathologizing the parasite and rather 'pathologize' neurocysticercosis in a way that enables us to focus on the collective roles each organism (human,

20 For examples of anthropological accounts of farmers rejecting global health biosecurity measures that would require culling animals, either to make the animal population healthier amidst an outbreak or to prevent the risk of zoonotic transmission to humans, see:
- Porter, Natalie. "Bird flu biopower: strategies for multispecies coexistence in Việt Nam." *American Ethnologist* 40.1 (2013): 132-148.
- Lowe, Celia. "Viral clouds: becoming H5N1 in Indonesia." *Cultural Anthropology* 25.4 (2010): 625-649.
- Blanchette, Alex. "Herding species: Biosecurity, posthuman labor, and the American industrial pig." *Cultural Anthropology* 30.4 (2015): 640-669.
- Keck, Frédéric. "8. From mad cow disease to bird flu." *Biosecurity Interventions*. Columbia University Press, 2008. 195-226.

21 See Canguilhem, Georges. *On the Normal and the Pathological*. Vol. 3. Springer Science & Business Media, 2012. In the case of T. solium, this particular tapeworm is a parasitic and not a mutualistic helminth. When it resides in the body as an intestinal parasite, it produces minor symptoms and does not necessarily hurt its host, but does not help either. There are helminths that help regulate immune function and decrease inflammation in its hosts' bodies. My point is that not every species we classify as a pathogenic is deleterious to health, and that if we could learn to care for the health and life of so-called pathogens, they might not become so pathogenic.

animal, parasite) plays in a multispecies ecology that mutually enables the accidental occurrence of neurocysticercosis? In this frame, it becomes possible to ask questions targeted towards different 'levels' of practice and organization, that is, towards multiple species, while simultaneously conceptualizing them as in dynamic relation to one another.

What activities could be cultivated to prevent this disease from presenting a problem in/to/for humans, pigs, and tapeworms? Especially since parasitologists claim that the human-pig interface and *not* the pigs are the "true" evolutionary source[22] of the parasite, then following the modern-day One Health directive to "stop outbreaks at their source" would suggest that interventions into neurocysticercosis should be aimed at pigs and humans, too. I want to suggest that the human-pig-parasite-environment interface in northern Peru constitutes a *multispecies disease ecology*. Reciprocally, pigs and farmers and parasites and their physical environs co-constitute a milieu, in which they all interface multiply.

I wonder: How might an alternately interface-centric reorientation precipitate a divergence from dominant practices in global health aimed at culling the animals and eliminating the parasites? Could cultivating pathos for the pathogen, that is, disaffirming the pathogen as an object and subject of pathogenesis (rather than another kind of genesis) more radically shift what ends up remaining human-centric approaches to multispecies problems in One Health?

In the following section, I chronicle a variety of multispecies practices for responding to neurocysticercosis. Diagnosing neurocysticercosis involves epidemiology, CT scanning, molecular science, biomedical treatment, community-level surveillance and public health

22 Ultimately, research agendas deploying thus the notion of "source" here are too metaphysical and even counter-modern. They function as if the "source" of pathogenesis is the inverted image of a counter-modern search for a theological point of origin. Source has to be submitted here to a nominalistic anthropology.

education campaigns. Preventing neurocysticercosis involves more than human practices, such as protecting pig health (porcine vaccinations, palliative chemotherapies) and culling cystic pigs. There is a way in which neurocysticercosis acquisition in humans is also predominantly a human practice as well as a problem of basic sanitation; though its occurrence in humans would be impossible without the human-pig ecology sustaining the parasite's life cycle, it is solely by way of humans eating their own feces that neurocysticercosis becomes a problem, both for the afflicted humans and the orbiting parasites.

Part II. Epistemic Inheritances

The Pig People

Towards the beginning of my fieldwork, I travelled to Piura, a region in northern Peru, to visit "the pig people" - a colloquial appellation attributed by local farmers to the team of global public health researchers investigating cysticercosis and neurocysticercosis in the provinces.

For nearly 30 years, generations of Pig People have existed. Formally known as the Cysticercosis Working Group in Peru (CWGP), this research initiative was originally formed from a long-term collaborative relationship among several Peruvian institutions (San Marcos University; Cayetano Heredia University (UPCH); Instituto de Ciencias Neurologicas) with the John Hopkins University and the US Centers for Disease Control and Prevention. It has since established newer collaborations with the US National Institutes of Health (NIH), Oregon State University (OSU), Imperial College in London, the ITG in Antwerp, and the University of Melbourne in Australia to become one of the most productive networks in the study of *T. solium* taeniasis/cysticercosis. The

Wellcome Trust, the Bill and Melinda Gates Foundation, USAID, IDRC, to name a few additional international agencies, have also supported this group's research in Peru. A robust research infrastructure has been cumulatively and collaboratively constructed for continuing investigations in cysticercosis, which remains highly endemic to the area.

The Pig People who I visited were descendants, so to speak, of the CWGP consortium; they comprised a smaller and newer collaborative project between UPCH, OSU, and the NIH. My primary interlocuter on this research team was a principle investigator (PI) named Michelle, a 32-year-old NIH Fogarty Fellow and a pre-medical student from OSU. As a junior PI on a small branch of a much larger project into the control of neurocysticercosis, Michelle was responsible for assembling and leading a medium-sized field-research team of variously trained health workers from the city of Tumbes in the education of local peasants (*los campesinos)* from across the Paimas District of Piura regarding the parasite. By design, this pilot project was community-based; Michelle wanted to work collaboratively with the community, to train them to perform their own surveillance of and treatment response to *T. solium*. There was a moral impulse behind the project, which was geared towards implementing "sustainable community-led strategies" by which research participants could learn how to identify and respond to reports of an infected pig more quickly and, ideally, more effectively than various, partially coordinated state institutions (i.e. the Ministry of Health, Ministry of Agriculture, local public health posts).

Funds from the NIH Fogarty Fellowship, plus resources and mentorship from a senior NIH-funded PI with a multi-million-dollar grant, as well as trained personnel and data systems inherited from the Bill & Melinda Gates Foundation by the UPCH satellite campus in Tumbes (today known as the UPCH Global Health Institute) – all supported Michelle's relatively modest pilot project. To

me, it seemed modest because, unlike prior surveillance and control interventions led by various collaborations in the CWGP, hers was not aimed at tapeworm elimination, but rather its control and surveillance. There was something humble, too, about this project's focus on sustainable community-led strategies, which seemed to imply expertise and agency for responding to cysticercosis could and should be expanded beyond the purview of research scientists and public health officials into the everyday lives of rural farmers.

One of the global health research (GHR) team's primary goals was to teach farmers how to identify pigs infected with cysticercosis via a tongue-examination. A few weeks before I first arrived in Piura, the GHR team implemented this kind of instructional exercise in Jambur Alto, a small village of 130 inhabitants. Interestingly, the tongue-examination was originally a technique developed by local farmers for detecting possible infections amongst their pigs before taking them to the slaughterhouse. If a pig were highly infected with tapeworm cysts (*quistes*), it was likely that some of the *quistes* would be visible as white-ish lumps on its tongue. By performing the tongue test, local farmers figured out a way to evaluate which of their pigs were most likely to pass inspection at the slaughterhouse before being cut open. This was an ingenious method on the part of the farmers, because once sliced open, regulatory officials would confiscate infected pigs or force farmers to sell them for a fraction of the price of healthy pigs. By testing their tongues, farmers could determine with increased probability which pigs ought to be sold instead in informal markets or used for home consumption to avoid economic losses at the slaughterhouse. It wasn't until 1990 that epidemiologists first reported in academic journals this technique's non-standardized use by peasant farmers. The tongue-examination method since became a standard diagnostic method in the practice of cysticercosis field epidemiology. It is in this form that the

GHR team was re-teaching the technique to farmers in Piura who may or may not have had acquired this knowledge otherwise.

A community member gives his pig an oral vaccine

One afternoon, several days after I had arrived to the field site, I accompanied the GHR team to Jambur Alto where the farmers were asked to demonstrate their proficiency in the newly-(re)acquired surveillance skill. Readers uninitiated to this form of human-pig interaction should understand how arduous, at times absurdly chaotic, it is to corral free-roaming pigs and manhandle them until they permit you to reach into its mouth and pull out its tongue for close inspection. Across dirt roads and over dilapidated fences, I ran alongside the GHR team as they ran alongside

farmers chasing after pigs that were also being pursued by giddy children and allegiant dogs. By sunset, most of the pigs' tongues were examined, and in exchange for the torturous interlude, the pigs received an annual dose of orally administered porcine-cholera vaccinations (which is much cheaper and more readily available than tapeworm vaccines, and which, as Michelle mentioned to me, frequently produces confusion among farmers who assume the Triquina Project fieldworkers are treating their pigs for *triquina* (tapeworm) and not cholera).

A second goal of the GHR team was to incentivize farmers to medically treat pigs identified as infected, if possible, or otherwise not eat or sell them, at all. Vaccinations for pigs against tapeworm exist, but are expensive and not easily obtainable, let alone sustainable. Therefore, the GHR's efforts were majorly focused on the latter part of the incentive: don't eat or sell infected pigs. Obviously, this behavioral modification was difficult to justify in a market economy characterized by small-scale animal husbandry and sustenance agriculture, in which rearing pigs brings considerable income. In other words, it required a transformation of values: community health over private profit.

Efforts to convince participating communities to value public health at the cost of selling a pig for personal income took form through educational workshops (*talleres)* in which the etiology of the parasite and ways for people to protect themselves and their neighbors were discussed. *Talleres* became organized settings in which the GHR team aimed to cultivate communal curiosity among farmers about the parasitic disease. With visual aids and even role-playing games, community members, including the illiterate, learned how to describe the life cycle of the tapeworm (*tenia)* until it was committed to memory. *Talleres* also offered a town hall-like scene in which involved community members would gather to articulate concerns about parasitic infections and other

matters within their communities, while the GHR team would educate them on the dangers and risks of eating infected pork.[23]

The Anthropologist as (Accidental) Curator[24]

Prior to travelling to Piura, Michelle and I corresponded via e-mail after a mutual colleague suggested we get in touch. I told her about my research interests in collaboration – *what is it?* – in and for global health. She also expressed interest in collaboration, as she envisioned her work with community members in a collaborative frame. She expressed difficulty getting community members to "care" about the parasite in the way the GHR team was hoping they would. They hosted *talleres*, but they weren't capturing enough interest.

I told Michelle about an essay called "Moments in Collaboration"[25] by Anthony Stavrianakis and Trine Korsby, in which the anthropologist-authors discuss the affectual dimensions of having brought a calf-liver into the space of the Labinar at UC Berkeley. This bloody, fleshy object produced affectual conditions in which collective inquiry among multiple participants became possible. I sent her a copy, not knowing that she would take it as a suggestion for re-modeling her workshops. Weeks later, Michelle told me she designed a new workshop, in which her team would teach about the etiology of the parasite not through pictures, but with an actual pig corpse. Inspired by the collaborative purchase of the calf liver in the essay, Michelle and the GHR team would

23 In important ways, these talleres provided a "space of mediation" in which a shared epistemological frame could be cultivated between the farmers and the researchers. See Giordano, Cristiana. *Migrants in translation: Caring and the logics of difference in contemporary Italy*. Univ of California Press, 2014.

24 See Sansi, Roger, ed. *The Anthropologist as Curator*. Bloomsbury Academic, 2019. In this edited volume, anthropologists and artists reflect on curation as a form of mediation. How did I curate the field site I subsequently inhabited? What vision of collaboration did I invite (involve or involute) into the scene??

25 Korsby, Trine Mygind, and Anthony Stavrianakis. "Moments in collaboration: Experiments in concept work." *Ethnos* 83.1 (2018): 39-57.

slaughter an infected pig in front of the famers and use bile salts to facilitate the maturation of porcine cysts into tapeworms for all to see. She called it an "evidence workshop" and invited me to attend.

At this moment, I pause to notice how through an interest in collaboration – not in doing it together, per se, but in thinking about it together – our projects inadvertently converged: I shared with her an excerpt from an experimental mode of anthropological inquiry; she then translated this into an original exercise (evidence workshop) – an experience that I accidentally precipitated and later participated in. I never wanted to intervene in global health as an anthropologist; I wanted to observe it. Yet, I seem to have curiously played a curatorial role in both our field sites and field experiences, insofar as I indirectly participated in the conception of Michelle's design of the very workshop I was subsequently invited to observe.

Overlapping Sites (Para-sites)

Negotiations for the slaughtering (*el sacrificio*) were finalized on September 16th, 2017, nearly two weeks after I arrived to Piura, a province in northwestern Peru. I flew there, from Lima, on a promise from Michelle that I would witness the sacrifice of a pig. The GHR team was eager to sacrifice a pig to more affectively teach the communities in which they were embedded about the parasite's life cycle and transmission patterns. I jumped at the invitation, delighted by the opportunity to participate-observe in what seemed like an uncommon, if not unusual, form of knowledge transfer between global health researchers and rural farmers/trial participants.

I rode with Karla, Roberto, and Fernando, three Peruvian field researchers on the global health team, to the house of Cynthia, one of the *facilitadoras* (community volunteers who were selected

to facilitate dialogue between the GHR team and the farming communities), who had alerted the team that she believed she had identified one of her pigs' tongues as infected. When we arrived to her house, the team thanked her for notifying them and presented her with options: (a) quarantine the infected pig until the following day when the GHR team would return with an anti-parasitic medication, which would effectively treat the pig's cysticercosis by killing the infectious cysts in its flesh. Adherence to this medication would ensure that the pig could become healthy enough again to safely be sold and eaten within a span of three weeks; or (b) donate the pig to the research team so that they could lead another instructional workshop, *aprendiendo haciendo*,[26] in which they would slaughter the pig and perform a necropsy to teach members from the municipal health center about the life cycle of tapeworms.

Ultimately, Cynthia consented to the latter option. She donated her pig, which was itself somewhat of a sacrifice, given that the alternative option to medicate it would have allowed her to sell it for greater economic gain. The team explained to me that, in her community, Cynthia was regarded as an influential person. It became clear to me that the research team greatly appreciated and relied upon her leadership and goodwill as a *facilitadora* in their project. Cynthia's latest act of generosity was a gesture – if not a mutual exchange – of trust that seemed to gratify both parties. The negotiation between Cynthia and the research team was mediated by neighbors; the terms agreed upon for the exchange were non-monetary.[27] Rather, the research team would return in the afternoon with two large bags of feed, which would not only cover the pig's meals until the day of

26 Reminiscent of Whitehead's process philosophy and Ingold on making (hacer). See Ingold, Tim. *Making: Anthropology, archaeology, art and architecture*. Routledge, 2013. Also Whitehead, Alfred North, and Donald W. Sherburne. *Process and reality*. New York, NY: Macmillan, 1957.

27 The researchers and the facilitator engaged in *trueque* (barter or exchange) as was customary in the facilitator's community.

the workshop, at which point they would take the pig, but would contribute to nourishing her other healthy pigs for the rest of the month.

Two days later, we arrived in Paimas, the municipal center in that district's area. We pulled up in front of the building where town hall meetings were typically held and where today the GHR team was preparing to conduct *el sacrificio*.

Aprendiendo Haciendo (Learning by Doing)

I was particularly interested in accompanying the research team to a special sort of *taller* described to me as "*aprendiendo haciendo*" or "learning by doing", in which partakers would slaughter an infected pig; search its flesh for cysts; evaginate[28] said cysts; and then watch the cyst transform into a tapeworm under the lens of a microscope.

I was in attendance of the second rendition of this *taller*, which, I was informed, was going to be more organized than the original. In the coming execution, participants would first look into microscopes, examine slides of infected human feces, and see hundreds of T. solium tapeworm eggs therein. Next, the team would explain to the participants that when they (*los participantes/los humanos*) do not defecate in latrines, but rather in the fields or roads (*por costumbre*), then the pigs eat their feces. Also ingested are the tapeworm eggs, which subsequently infect the pig's flesh. Then, the research team would slaughter the pig and perform a public necropsy so that participants could see the resultant cysticercotic infection. The farmers would then surgically remove the cysts in order for the researchers to evaginate them. Having successfully staged this logical progression

28 To evaginate a cysticercoid in vitro means to artificially induce a progression of the Taenia solium from its larval state (cysticercus, or cyst) towards its adult form (the tapeworm parasite). Basically, it turns the cyst inside-out, so that under a microscope, one could see what is inside the cyst – a tiny, rolled up, alive baby tapeworm.

from eggs (feces) to cysts (pig meat) to tapeworm (microscope slide), the team would conclude by telling the participants that when cysticercotic pork meat is ingested by humans, the cysts grow into tapeworms that live in their intestines and shed microscopic eggs in their feces. And so it goes.

Of this particular *taller*, Michelle told me that "the key part is getting people to realize there are microscopic eggs (that no one can see) in their poop, and that the pigs are eating this, and that they (the humans) are eating this, and that this is what is causing the epilepsy".

We – the GHR team and I – spilled out of the van, all ten of us, and walked into the concrete building. In one corner, Ruth and Fernando began unfolding three plastic tables and wrapped their surfaces in blue plastic sheets secured by tape. Around the tables, they placed approximately 40 chairs. Blue surgical aprons, disposable plastic gloves, cardboard boxes for biohazardous-material waste, disposable face masks, and hair nets were placed upon each of the chairs. In another corner, Geraldo and Juan Jose set up two wooden tables. Atop the smaller table, I noticed three bottles of poison (Ket-A 100[29], Dormi-xyl2[30], Halatal[31]), two knives, two syringes, and a hook. Below the table: a sack of bile salts in a box of ice and an empty red bucket for catching spilt blood. In the third corner of the room, Michelle and Roberto were setting up the microscopes, a power point projector, and equipment to artificially evaginate the cysticerci that were to be removed from the

29 A glass vial of ketamine chlorhydrate, an injectable solution for bovines, sheep, and pigs. It is a quick action general anesthetic indicated for short duration anesthesia. It said it to eliminate consciousness and sensibility to pain.
30 A glass vial of Xilazine chlorhydrate, an injectable sedative analgesic for animals. It is a tranquilizer that relaxes the muscles and depresses the central nervous system in most 'domestic species'
31 A glass vial of Pentobarbital sodium (the same drug used to kill prisoners on death row in the USA). It is a barbiturate anesthetic that acts on the central nervous system producing sedation then total anesthesia. It is also used as an anticonvulsant (what a human with ncc might need).

pig's flesh during the necropsy. In the fourth corner – snacks consisting of orange soda and sweet bread.

Reviewing the litany of surgical items that had been scribbled quickly into my notebook, I realized that I hadn't yet seen the pig! I asked Michelle to tell me where it was being kept. She lifted her head from the microscope and with eyes evermore widened, she smiled benevolently at me, almost abashedly. She placed her hand on my shoulder, as if to brace me, and told me that the pig was in the back room and that they would bring it out momentarily. I recall the gesture and the moment between us as unambiguously sympathetic. I think she sympathized with me out of a sincere concern that, as a newbie to the (her) field site, as well as untrained and unacquainted with the slaughtering of animals, whether in general or for public health reasons, I might become disturbed. Maybe she anticipated or projected a moralistic sense of guilt. Her smile and her touch in that brief interaction, however mundane, impressed upon me a feeling of communion. I don't know what she was thinking or feeling, yet I felt a sense of co-presence and possibly of shared understanding. We were both there. Two *gringas* standing in a room. In northern Peru. About to slaughter a pig. At the altar of biomedical field science.

The Anthropologist as Parasite

It had not been lost upon me that Michelle and I inhabited similar subject positionings in the field – a field that was becoming partially shared; or perhaps, it is that we were simultaneously occupying more-than-one fields, contiguous and overlapping. Michelle and I were both NIH-funded *gringas* conducting global health research of our own designs in Peru. We were both supported by faculty at North American academic institutions in which we were enrolled as advanced graduate students, and we were both receiving mentorship by Peruvian advisors. As

aspiring researchers in the field of global health, we seemed to share a common appreciation for the value of qualitative methods in research, which may have been reflective of the related ways in which we both oriented towards and cared about the people populating our research fields. I was only in Piura because of Michelle's invitation. I stood beside her as her guest, as a colleague, and as a potential collaborator.

One thing that I had noticed upon my arrival to her field site was that Michelle introduced me to her project's board members, and later to the GHR team, as an NIH Fogarty Fellow anthropologist. In presenting me to her superiors and teammates, she emphasized my NIH affiliation and my formal project description – to identify a common definition of global health through interviews and participant-observation. She downplayed what I had told her, offhandedly, was my anthropological interest: to research the global health researchers researching. In other words, Michelle officially initiated me into the field site as a global health researcher. But as an anthropologist of global health research, I was observing everyone, including Michelle, which even included me observing Michelle observing her team as well as Michelle observing me observing her observing them.

I am certain that Michelle somewhat understood and was amused by this when she extended the invitation, as we spoke many times about hypothetical cross-disciplinary collaborations and possible contributions I, or any anthropologist, could make to her project from the unique perspective of a participant-observer. While she was focused on eliminating tapeworm, surveilling cysticercosis, and building capacities at the community-level, I was focused on the production of epidemiological knowledge at the human-animal interface, especially its limitations. I was not there to assist the GHR team in any formal way, nor was I there to help the farmers access better

health services or provide anything to the pigs. I just wanted to know what was happening in this singularly situated multispecies disease ecology and how this GHR team was getting involved in it. I wanted to learn how they conceptualized the human-animal-environment interface and the host-parasite relationship, how their epistemological orientations translated into certain forms of intervention, and vice versa, how their designs to intervene shaped their conceptualizations. Insofar as I offered nothing to my hosts, my relation to my interlocuter, as well as to her field, felt, perhaps, somewhat parasitic.[32]

This dual fieldwork subjectivity – of being anthropologist but also global health researcher – is a theme I brought up in the conclusion to describe doing fieldwork in a double mode. There is a way in which Michelle, or rather our relationship, becomes a preliminary foil for beginning to disentangle these callings ultimately within myself. In many important ways, our different trainings and the respective commitments we have to our disciplines oriented us to ours and each other's fieldwork in strikingly different manners. While Michelle was occupying this field site in name of humanitarian biomedicine, I was also there; but as an anthropologist of contemporary global assemblages, I did not share an interest in local understandings of disease and health in a similar manner to Michelle despite different disciplinary orientations. Rather, I was interested in how global health researchers oriented themselves towards knowing about disease and health (which includes microbes, persons, animals, environments, and the relations between them). Through what categories, knowledge practices, sensibilities, models, representational devices, terminology, logics did they attempt to understand (if at all), intervene into, or generate more information about this parasitic infection of humans and pigs? In other words, the focus of my

32 On the critical consciousness required of fieldworkers located in spaces of power and privilege, see Marcus, George E. *Para-sites: A casebook against cynical reason*. Vol. 7. University of Chicago Press, 2000.

anthropological interrogation was second-ordinal: I was interested in the researchers, the so-called knowers, insofar as they were aiming to know the humans and animals who were suffering from, or at risk of, neurocysticercosis.

In first-order research investigations, researchers often take research subjects, whether human or animal, as their objects of research. In second-order research investigations, the researcher (me), takes the researchers (the GHR team) and their research techniques as the objects of research. In this mode, the GHR researchers are one of many agential-objects in a constellation or ecology or assemblage of agential-objects (including persons, practices, places, animals, and things) that constitute (the object of) my second-ordinal, ethnographic inquiry.

Though we were very much on different paths towards different ends, in this moment of kindness before seeing the sacrificial pig, I felt, to Michelle, especially akin. Then she buried her face into the microscope lens, once again engrossed in bringing feces-smeared slides into focus. Meanwhile, I began moving towards the pig.

I gazed towards the back room, expecting to find the pig perhaps tied to a post in a corner or possibly corralled into some makeshift enclosure. But, when I arrived there, I didn't see or hear anything. After a moment, I noticed on the ground next to a pile of debris, a grey plastic sack. Out of it poked the head of a tiny black-and-grey piglet with a small whiskery snout. I creeped back into the main room, which was skillfully being transformed into a shoe-string operating theatre, and I pulled a plastic glove out of a box. I returned to the back room and squatted beside the pig, who lying on its side, squealed anxiously. As I approached, the first thing I noticed about the pig was its size – it was small and could not have been more than two or three months old. It watched me out of one eye. I looked back at it and began to feel tremendous pity for this bound-up creature

that was writhing on the floor covered in dirt in a shit-smothered sack. I could not believe how deeply *human-like* its eyes appeared, significantly more so, I began to quickly recall, than those of cats or horses or goats or dogs. The likeness unsettled me.

The piglet was palpably scared and, possibly, suffering. I felt almost compelled (by what or whom?) to demonstrate immediate compassion toward it. I thought about gesturing kindly towards the piglet, as if to pet it or tenderly caress it. I wanted to comfort it, to share a moment of co-presence in what I knew were the final moments of its life. I stretched out my hand timidly above the piglet's head and began to lower it, but I could not decide upon the point of impact/contact. Its crusty brown head, its face, snout, and ears, were covered in what appeared to be the foul result of multiple fear- and panic-induced defecations. Amidst my hesitation, the pig jerked its head from the surface of the floor and with tremendous torque, hurled its entire body in the direction opposite of me. I was reactive; I too flinched in fear. If there was one thing that had been communicated to me over the last few weeks, it was that infected feces is infested with millions of microscopic tapeworm eggs that I did not want on my hands. I withdrew my hand and contemplated whether this gestural act of kindness, as I apprehended it, would even be perceived as such by the piglet. How could I be sure that my intention to comfortingly caress this creature wouldn't be experienced as one final act of physical assault? It had already been captured, separated from its mother, tied up by all four legs, tossed into a dirty sack, transported in the back of a pickup truck, and left immobile in its feces on its side in a dark room. If I were the pig—my mind began to stray—and if I were about to be murdered by an animal much larger than me (who also, incidentally, facilitated a cystic infection in my flesh), then maybe I wouldn't want to be touched or stroked by one from that species, even or especially if it thought it was being 'kind'!

This dance of de-identifying, anthropomorphizing, and over-identifying with the piglet carried on for a few more minutes. How it recoiled from my hand, to me, seemed like a rather clear-cut non-vocal response to an uninvited attempt of corporeal contact. Perhaps the piglet became sentient of my own ambivalence and was merely mimicking my trepidation. The whole interaction became aflush with multiple-cross-species messages and meanings, ambiguously shared, if at all. I resigned myself to the possibility of transmitting affection to the pig telepathically. I whispered a prayer for it: partially an apology – for its cystic infection as well as its imminent slaughter; partially a blessing – to commemorate its existence as a living pig before the research team's workshop and as a sacrificial death, for becoming a ritual offering in the community-based scientific learning module.

Just then, Juan Jose walked into the room and observing the pig and me, asked wryly, "*Por que gringa?"* I didn't know what to say or even how to say it…and perhaps I still don't fully understand why I wanted to relate to the pig. To this day, I wonder about that encounter. What ethics of care compelled me to compose and inhabit that scene, to act and respond in the ways that I did? By muttering a prayer, had I turned a blind eye to the pig's actual suffering, opting instead to self-soothe? Had I not rather comforted myself *in lieu of* the pig? Or was refraining from corporeal contact with the pig, itself, a mode of care; and if so, oriented towards whom? Was I motivated to protect myself by avoiding possible contagion through contact, or had I attentively registered and respected the pig's signals? Was I deferential to an irreducible difference; and did I succeed or fail in my attempt to reach across it? Would it have worked, anyway? How could I have shown compassion to a pig?

The Anatomy of Disease Causation

Humans have conducted observations and experiments on animals since antiquity.[33] The philosopher Aristotle dissected animals to learn about the workings of nature; and from this tradition, the activity of 'comparative anatomy' emerged in the 17th century for physicians to identify similarities and differences in the health of humans and animals. In fact, it is from this lineage that the origins of One Health might be historically traced, that is, from experiments with animals suggesting that "medicine is one."[34]

For centuries, disease was explained according to a theory of miasma, which posited that contagious particulates arose from the putrefaction of living matter and, depending upon seasonal and atmospheric conditions, could corrupt the air and cause illness in humans through inhalations. Undergirding the miasma theory of disease was a belief in the animism of matter, the dynamism of nature, and the humoral disposition of individuals, whether human or animal. It was held that disease emerged through the combination of these capacities. It was not until the late 19th century that this explanation of causation was replaced by the germ theory of disease, which has since been reconceptualized in the modern discipline of epidemiology as but one level of organization governing the emergence and unfolding of disease. Today, for example, there is broad consensus among epidemiologists that molecular and biological elements interact with social and environmental determinants, as well, to drive disease. Accordingly, researchers increasingly adopt integrative and multidisciplinary approaches – such as the One Health approach – to investigate the complex determinants and dynamics that drive emergent disease patterns.

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33 Around one-quarter of the surviving works produced by the Greek philosopher Aristotle in the 4th century bc are devoted to animals, most importantly *History of Animals, Parts of Animals* and *Generation of Animals*. . The numerous dissections he conducted in the course of this work illustrated the possibility of learning about humans from animals (Clutton-Brock, 1995).

34 Hannaway, C. (1977) Veterinary medicine and rural health care in pre-Revolutionary France. *Bulletin of the History of Medicine* 51, 431–447.

Nonetheless, the germ theory of disease remains ever present in much medical research today, particularly in investigations of infectious disease and especially in how the GHR team understood and oriented to the parasite. The parasite, in their rendering, was like a germ, an exogenous entity that entered into human and animal bodies to cause disease. Whereas the miasma theory of disease posited that it was the combination of germs, individuals, and atmosphere interacting with one another at certain times to condition disease emergence, the germ theory of disease continues to argue that germs (i.e. infectious agents) cause disease. What I want to demonstrate is how Aristotle's notion of *aitia* (cause) imbued the GHR team's theatrical evidence workshop, through which they sought to explain the causation of zoonoses vis-à-vis the evolution of a parasitic pathogen**.**

To demonstrate the disease etiology, the GHR team decided to perform a surgical necropsy on a pig. Surgery shares the concept of 'theatre' with the performance arts (thematic and methodological proximity). Surgery also shares the concept of 'operation' with the military (both exercise formally analogous intelligence (diagnostic-intervention) practices. Operation depends upon a logic of suspicion, promotes strategies for knowledge of the enemy (the cyst, the parasite, the cancer, the reservoir). Other concepts shared between public health, medicine, and the military – hotspots, response, security, war, eradication, control, enemy, foreign body, campaign. These concepts are based on a priori principle that between the subject and its sickness, only enmity can exist.

For the GHR team, this translates into: to help the farmers means to eradicate the parasite that causes sickness by way of modifying the human-pig interface through re-education campaigns. The parasite is conceived as the enemy, even though its coexistence with humans as an intestinal tapeworm doesn't cause sickness to the humans. Its existence is nonetheless conceived as inimical because it *could* cause sickness, if and when humans eat their own shit (NCC).

From an optics of hostility, the parasite is seen as invasive, an intruder, and it seems self-evident to deal with it defensively and aggressively in the spirit of humanitarian ethics. There is something cruel about the GHR team's evidence workshop – killing the pig and flaying it, exposing its insides also functions as a very dramatic form of ideology-critique. The GHR team is using scientific techniques to mutilate a pig in order to unmask before the farmers, their very own false consciousness. They are simultaneously demonstrating their knowledge about the etiology of the

parasite, including the power to force it to pre-mature life (evagination) in order to affectively coerce the farmers into believing them.

The evidence workshop is designed on the assumption that "evidence" will unify the peasants' interest in the parasite with that of the GHR's. The procedure is imagined ideally as a transfer of affect, a substitution of knowledge, a unity of interest. In the guise of collective inquiry, a very classically coercive form of enlightenment thinking takes place. The scene is arranged around a core belief that scientific evidence will be the most rational and convincing means of converting peasants to forgo their old opinions and adopt the GHR logic of public health education campaigns. It is premised on the use of reason, but not only. It maneuvers by way of affectual transference and a sort of "optical inspiration"; that the surgery, evagination, and the microscopic lens will reveal the truth of the parasite and its transmission.

Juan Jose picked up the sack and brought the pig into the main room where members from the municipality's Centro de Salud were waiting for the workshop to begin. The piglet screamed as Juan Jose carried it upside down and used a rope and hook to weigh it (in order to demonstrate, on behalf of the pig's owner, how much economic value per pound is lost by not selling an infected pig). He injected an anesthetic into the pig's neck, and once it quieted down, he placed it on the table, massaging the injection site (which, in that moment seemed tender, but later I realized was mostly functional, as he was hastening the circulation of the anesthesia). A nurse from the Centro de Salud murmured that it was a shame to sacrifice the pig. But Juan Jose explained that his process was quite humane, especially in comparison to the usual way of slaughtering pigs undertaken by farmers for individual consumption or sale in informal markets: without recourse to syringes and anesthesia, they stab the pigs in the heart. Juan Jose filled a syringe with heart-

stopping chemical and the pig silently died. Geraldo beheaded it with a machete, and gushes of blood spilt from its carcass into the red plastic bucket below the table. The group of participants shuffled closer to see, consolidating the space between their bodies and the pig's. Michelle leaned in and whispered in my ear, "I don't see any cysts… I hope we didn't just kill a healthy pig".

The Engineer as Veterinarian

Earlier in the year, the research team led a similar version of this *taller,* which Michelle referred to as an "evidence workshop," for *los campesinos de Jambur*. The entire GHR team considered it highly successful, one of their most impactful training practicums, which is why they wanted to reproduce it in Paimas for the health post workers. During the first evidence workshop, and in a similar fashion to the *taller* that I just attended, the team had performed a guided necropsy of an infected pig. Though commonly included in the training curricula of medical, veterinary medical, and bio-epidemiological programs, surgical necropsies are less often performed for peasants. I believe the GHR team conducted this demonstration to not only reinforce their epidemiologically-informed message that eating cyst-infected pork meat causes tapeworms to grow and live inside human gastro-intestinal systems; I believe the point of this "evidence workshop" was to communicate, as well as to prove with scientific certitude and transparency, that a cyst *is* a tapeworm. In other words, they desired to harness the theatrical techniques of modern medicine and biology, namely, surgery and microscopy, to put on display the life cycle of *t. solium* - from fecal eggs (oncospheres) to porcine cyst (metacestode) to human tapeworm (cestode).

The first time that they conducted this *taller,* it had a profound effect on the community participants, who, after the evagination process, when looking through the microscopes, could hardly believe their eyes – the head (scolex) of a tapeworm wriggling on a slide where they had

personally just placed the nodular cyst they removed, with their own hands, from pig meat. Ruth told me how after that *taller*, dozens more community members volunteered to be *faciliatadores*, so moved were they to participate in preventing the spread of this "snake-like" parasite that lived in their bodies and shed eggs in their stool. It was with this success in mind that the research team decided to repeat the workshop, this time for the municipal health workers, whose capacitation and support they wanted to foster and perhaps whose minds they too wished to dazzle.

So, what went wrong the second time they sacrificed a pig? Michelle believes they inadvertently killed an uninfected pig. Unlike the first time they identified a pig as positive for cysticercosis via the tongue examination, this time, after they chopped off the piglet's head, a cascade of dislodged cysts did not spew out the neck hole. Interestingly, it is only at this moment (after the cut) that Michelle began to fear that what had been – until that point – an infected pig was, after all, uninfected. In other words, the piglet existed, if only for a few moments, in a liminal space between infection/non-infection, sickness/health, positive/negative, known/unknown, success/failure. For Michelle, the invisibility of viable cysts immediately threw into suspension these conceptual boundaries. For me, this spectacle created a state of indeterminacy akin to "the liminal" so often described in ethnographic accounts of sorcery and ritual.

It's as if the absence of cysts reminded Michelle of something she already knew – this time (unlike the last time) they, or perhaps she, chose not to transport the piglet back to the city of Tumbes where their offices at the Global Health Institute are located and where they run pigs through a CT scanner, which allows the user to see inside an object without cutting, to technologically verify the presence of additional cysts. Instead, this time, they relied solely upon the tongue-examination to

substantiate a positive infection. In this moment, the tongue examination was a hybrid of evidence and belief; they believed the tongue exam offered the possibility of evidence.

So, when the tongue-examination failed to deliver a grossly infected pig on the day of the 2nd workshop, the team began to ask themselves in dread: did we just sacrifice a healthy pig in front of the local health technicians?

The next thing they asked themselves was, "Did we make a mistake?" In question here was their own capacities: surely their diagnosis and identification was flawed, someone made an error. At this point, nobody questioned that the standard biomedical correspondence between inside/outside was possibly, in this instance, inconsistent. Blame for the misdiagnosis was very quickly ascribed to Juan Jose, an agricultural engineer functioning as a junior veterinarian specializing in cysticercosis. He was responsible for corroborating Cynthia's original field diagnosis of her own pig, and he *should have been* able to perform the tongue examination accurately.

I, myself, began to wonder why they had an engineer in the role of a veterinarian. I also wondered why they wanted Juan Jose to confirm the diagnosis in the first place; why not, for example, another recently trained neighbor? Why the façade of expertise – especially if the authority figure wasn't exactly trained in that kind of expertise? Why did they feel comfortable allowing Juan Jose to take the place of a CT scanner (for validating additional cysts)? Surely it was a matter of convenience, but more interestingly, perhaps it was faith/belief/trust (?) at multiple levels: in both his and their capacities, that the demonstration would go as expected (i.e. well), that the clinical examination of a pig's tongue worked consistently as a suitable field surveillance and diagnostic technique, and that they could repeat (if not reproduce) the shift in affect, attention, positionality, and communal understanding that the first necropsy facilitated.

As I said before, I believe they were convinced that by following their protocol, they could perform the ritual sacrifice successfully a second time,[35] and thereby communicate to the local health workers their biomedical scientific (global health) understanding of reality: that the evolution of a cyst into a tapeworm worm could be phenomenologically demonstrated, rendering their epidemiological knowledge of its etiology a shared truth, not a competing knowledge.

Part III. Medical-Humanitarianism as Nihilism

The Medical Humanitarian as Anthropologist

When the team collectively came to realize that the pig they slaughtered was not infected (at least certainly not as infected as the last sacrificial pig), they privately disputed amongst themselves what to tell the health workers attending the workshop. To tell the truth would beget many unfortunate implications. For one, they would lose face in front of the municipal health workers who were already dubious about their 'global health' research, their positioning and intentions. Second, they very gravely negotiated whether they would be obliged to tell and compensate Cynthia, who thankfully was not in attendance. Because if they admitted the truth (that the pig was mistakenly identified as infected/possibly healthy) to the health workers and Cynthia somehow found out, then she might feel deceived or tricked into prematurely selling them a pig that could have grown into a much more valuable source of income. Finally, to tell the truth would throw into question the entire thing, most heavily for the research team, their sense of purpose, and their

35 Note the subtle slippage, however: the first time they did the experiment, they took the pig to the CT scanner in Tumbes. The second time, they relied on the folk tongue technique, deviating from their 'evidence workshop' "protocol".

very reason for being there. It would be to admit that sometimes the tongue-check works and sometimes it doesn't. That sometimes, this time, they were not certain about what they knew.

In the end, they told the group that this particular pig only had one cyst in its tongue, which is why they couldn't find any additional cysts in its flesh. They emphasized how this is common and particularly dangerous, perhaps even more so than a grossly infected pig, because it is much easier *not to see* fewer cysts, and it only takes one to cause tapeworm. My understanding was that Michelle was disturbed by the lack of transparency, but that Ruth, a trained nurse and the field research team leader, who was also originally from a nearby town, made the final judgment call. Partially detached from the truth, though not entirely untrue, this decision rendered a moment of uncertainty within terms that made it seem like the GHR knew what was going on the whole time.

Meta-Medical Anthropology in a Para-Site

In a classic medical anthropology text by Ed Wellin entitled "Water Boiling in a Peruvian Town", the anthropologists introduces the figure of Nelida, 'the hygiene worker' and his collaborator, who was employed by the Ica Department of Health to work with him, the medical anthropologist. Their jobs were, in general, to inform community members on public health matters and to motivate them to apply new public health information, specifically, to motivate Peruvians to boil their water in the service of reducing infant mortality.[36] Because Nelida was Peruvian (and Wellin not), local townspeople would speak more freely with her, and she could more effectively convert, that is, sympathetically manipulate the peasants into boiling their water to kill microbial germs despite their particular humoral ideas of hot and cold. There is a parallel to be drawn between Nelida (in Wellin's account) and Ruth (here in my account). Ruth is like Nelida, most obviously

36 Wellin, Edward. "Water boiling in a Peruvian town." *Health, culture and community* (1955): 71-103.

in that she is Peruvian and knows how to speak with the farmers in ways the gringo cannot. However, Ruth is positioned a bit differently, in that she, too, relies upon the facilitadoras that to be *her* Nelida. In an interview, Ruth told me "They (*facilitadoras*) help us reach the people with their own words, in their own language. They help set up a dialogue in words that the community understands. They also validate our instruments."[37] In this regard, *facilitadoras* are translators; they translate the language of science' into 'folk' language. Ruth and the *facilitadoras* are both similar yet different mediating figures between epistemic cultures – neither of whom are formally trained in techniques of translation.

On their (the *facilitadoras*) importance to the study's efficacy, she added, "They are the axle (*el eje*). They are trusted. If we go to peoples' houses with facilitators, then we are invited in."

Interestingly, it is increasingly common for medical humanitarian researchers to assume many of the roles and sensitivities (without the training) previously afforded to the medical anthropologist, both in the design and implementation of field research. This does not come without consequence. In a chapter entitled "Nervoso", anthropologist Nancy Scheper Hughes described a situation in which casting disease outcomes in biological terms made it very easy for public health officials to ignore how disease is also socio-economic and politically-driven or conditioned.[38] Similarly, I have wondered whether any of these interventions in Piura would be necessary if people had some toilets in their homes! This is to say, in many ways, the disease situation in to which the GHR team is intervening is a sanitation problem warranting, above all else, structural intervention and not

37Compare this to ethno-psychiatrist and critical medical anthropologist in Giordano, Cristiana. *Migrants in translation: Caring and the logics of difference in contemporary Italy*. Univ of California Press, 2014.
38 Lock, Margaret M., and Judith Farquhar, eds. *Beyond the body proper: Reading the anthropology of material life*. Duke University Press, 2007.

necessarily a socio-ecological intervention into pig-human interactions. At the same time, the team is there – attempting to build sustainable community-based practices of surveillance and response – precisely because of the political economic failures of the state to manage the public health of its citizens. In this case study, a socio-ecological orientation to disease prevention arises where political economic solutions have not yet been pursued.

Consultancy in a Para-Site

Half a year later, towards the end of my fieldwork, I went back to the site. Michelle was gone, but I re-joined her team. They asked me to lead a workshop on qualitative methods. But, during the presentation, they interloped me as a consultant. The GHR team told me that they felt their intervention was unsuccessful because farmers insisted upon their beliefs that the parasites were transmitted '*por raza'*, that is, inherited and passed between mother and baby pigs. For this reason, specifically, the GHR team was having difficulty convincing the farmers that the parasites are, in fact, transmitted fecally, which is why they should stop shitting in the streets and start washing their hands.

Two explanatory models for the very same phenomena were at odds. What caused the parasitic infections in pigs and humans? The GHR was certain: disease occurred because humans defecated infested feces, which the pigs ate, and the humans ate infected pigs or else their infested feces. But the farmers were also certain: disease occurred because pigs inherited sickness in their bloodlines, and the humans got sick from eating the sick pigs. If digestion plays a pivotal role in the GHR team's model of disease causation, then inheritance plays as important a role in the farmer's explanatory model.

I asked if there was any way the GHR team could imagine working *with* the farmers' explanation of transmission in order that they more effectively intervene into it. This confused them. Was I asking them to accept as true what they knew to be untrue?

I suggested that truth is not necessarily universal and that "truth" is often an effect of our faculty to use information to make judgments. I described what I perceived as a conflict between two different explanatory models, that is, alternate modes of knowing.

They protested. "But our knowledge is valid…it is based in evidence.

I asked them why they assume their epidemiological knowledge is superior. Yes it was valid and based in evidence, but why did they believe that they speak in the name of truth while the farmers do not?

I asked the team: How do you know something is true?

They replied, "the objective knowledge".

I asked the team: How do the farmers know something is true?

They replied, "through generational knowledge".

In other words, the farmers inherited a way of thinking about disease as inherited and not as zoonotic. Further, they inherited a way of thinking about truth as inherited and not as evidence-based.

In fact, the epidemiologists also inherited a way of thinking about disease, about truth, and about themselves. They truly believe that as members of the public health professions, they have an

important role to play in participatory decision making, not as just another member of society, but as one with special knowledge and training and expertise and, above all, a commitment to public health practice and scientific objectivity. For health scientists, it is commonplace to accept scientific knowledge as objective because there are various mechanisms and systems designed to ensure as much. Health researchers explain things in scientific terms and traditionally have a biomedical ways of knowing (epistemology), but the research participants are also always making knowledge.

Depending how one looks at it, what the farmers were suggesting about the transmission of the parasite was actually also true: Even though the farmers' premises are flawed, they *do* speak a truth: the cycle of parasite transmission *is* sort of hereditary because what is inherited – for the humans, the pigs, and the parasite – is nothing more than the condition of being a part of the cycle. Endemic zoonoses are not single moments in time or space; rather they reflect a recursive and ongoing set of interactions, mediated by the short-term management of acute outbreaks, the long durée of colonial and postcolonial biomedical practice, and the deep timescales of animal, parasite, and microbial co-evolution.

The GHR could take this knowledge – that farmers *know* neurocysticercosis as a disease transmitted through inheritance, rather than through fomites – and they could incorporate into their research practices. In fact, it could very well improve *their* knowledge not only of the disease situation, not only of the participants they aim to help, but also of themselves. At the least it would help them make sense of their obstacles, that is, why their research subjects are resisting the intervention or why there might be lingering issues of distrust. It could inform them as to the limits of their research. It is further possible that the researchers may not know what inheritance is when

the farmers say it, so there could also be epistemic ambiguity. But, this doesn't have to negatively infect their field research practices. They do not need to take the farmers' truth claims as scientifically invalid.[39]

Knowing and Doing – their Difference

One of the things I asked the GHR team to do was to make a distinction regarding the goals of their project. I questioned them:

-do you want to know what the farmers know / do about the parasite?

-do you want to tell them what you know / what to do about the parasite?

-do you want to change what they know / do about the parasite?

It seemed to me that they had arrived at an impasse: were they trying to intervene into the spread of the parasite? Or were they trying to convince the farmers to adopt their epistemological orientation?

At issue here is a tension internal to epidemiologically-based humanitarian-medical interventions themselves. Epidemiologists insist that their priority should *always* be the discovery of causes of incidence *and* the population strategy of prevention, which often requires wide-ranging changes in social norms of behavior. But, here, the epidemiologists were limited because they premised the

39 In Paul Rabinow's essay "Humanism as Nihilism", he discusses the limits of realism and relativism. Realism: the idea that there is only one real account of how things are. The problem is that it reduces everything that deviates from that account to ideology, myth, or poor knowledge. Relativism: the idea that there are alternate modes of knowing, of embodiment, of being that are all a priori valid. As such, it becomes problematic to assert one mode as more valid than another.

possibility of new ways of doing on new ways of knowing; as if people would act more rationally when provided with the right or true information.[40]

What if we disentangled these things?

Conclusion

I conclude the chapter by suggesting that parasitic relationships between global health researchers and host countries/communities can be avoided, but not via facile adoptions of "cultural sensitivity" or "cultural competence," nor by operationalizing maxims of mutuality and collaboration. Rather, it will require that global health researchers become more intellectually aware of the epistemological limits of biomedicine, the epistemological limits of indigenous knowledge, and the political requirements of conducting global health research in the field, itself. At the limits of knowledge and between different explanatory models there is an interface: the ethical challenge is to find a way of meeting there.

40 Farmer, Paul. *Infections and inequalities: The modern plagues*. Univ of California Press, 2001.
- Good, Byron J. *Medicine, rationality and experience: an anthropological perspective*. Cambridge University Press, 1993.

Human-Mosquito-Jungle Interface

Endemic: Greek ἐν in + δῆμος people > Greek *ἐνδήμιος* of or belonging to a state or people

*

"*Life in Llanchama is so much calmer than Belén. Living here is better, but you get malaria*."

—Iquiteña and study participant who had moved to Llanchama

"*The problem is we always have the relationship between humans and mosquitos*."

—Dr. Helvio, Leader of Proyecto Dengue, NAMRU-6

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Synopsis

This chapter draws upon my fieldwork in Iquitos, Peru where the vector-borne diseases of malaria and dengue are endemic. Through ethnographic portrayal of global health research projects across four riverine communities in the Amazon basin, I chart the ways in which human residents transform from would-be recipients of conventional public health intervention to contemporary "conscripts of science": human beings who are valued by scientists for their adaptive immune responses to the malaria-causing *plasmodium* parasites in their blood. I illustrate how families from afflicted communities are recruited and enrolled into longitudinal research studies, wherein generations of participants literally offer their blood in exchange for diagnosis, palliation, and the possibility of a cure. I follow their biological samples back to *el Centro de Investigaciones de Recursos Naturales de la Universidad Nacional de la Amazonía Peruana* (CIRNA-UNAP) where scientists experiment with immunological and genetic techniques to establish a malaria vaccine and/or drug development. Chemists gather local flora and, back at their labs, isolate its chemical

compounds; these mixtures are tested for their anti-malarial properties upon the parasite-dense blood cultures derived from the study participants' samples.

In this chapter, I explain how the research subjects' bodies become valuable objects for science precisely because their "local biologies" or "situated biologies" [1] are pathological. I show how the pathogenicity of their blood is contingent upon the cyclicity of climate phenomena and enduring yet dynamic events of multispecies encounter in the rural outskirts of Iquitos, the largest metropolis in the Peruvian Amazon. I frame those variables as ecological processes that condition the possibility for malarial pathogenesis in humans, whose being in multispecies coexistence with mosquitos, consequently, becomes integral to the stabilization of malaria as an endemic disease ecosystem. Likewise, I show how infected Iquiteños are themselves becoming endemic not only to the multispecies disease ecologies in and through which their human biologies are informed and re-constituted, but are additionally becoming endemic to the institutional ecology of disease research and knowledge production that profits, locally and globally, from the epigenetic data of their biological pathogenicity. I conclude the chapter by developing a concept of "endemical belonging" to name the mode of relationality and form of biosocial inheritance I observe as emerging in the relation between humans and nature when local biologies are collected for global health science.

Jungle Metropolis

Embanked by jungles and floodplain forests fed cyclically by the Amazon, Nanay, and Itaya Rivers, Iquitos is the largest city in the world that cannot be reached by road – it is accessible only

1 Lock, Margaret, and Patricia Kaufert. "Menopause, local biologies, and cultures of aging." *American journal of human biology* 13.4 (2001): 494-504.

by river and air. Prior to the onset of COVID-19-related travel restrictions, it was a hub for passageway to the millions of people who came to the Peruvian Amazon each year, whether to take a riverboat cruise down the Amazon River to Brazil, to watch exotic birds, backpack through the jungle, or to alter their consciousness and encounter Gaia at an eco-friendly Ayahuasca retreat. Indeed, the *spiritual* resources of the Peruvian Amazon – including its (increasingly popular and commercially available) native shamanistic traditions, which draw upon indigenous cosmologies and bio-psychoactive botanicals – attract foreigners from all around the world to Iquitos, where the region's formal and semi-formal tourist economy is regularly fed by the financial resources they bring with them.

Over a century ago, however, it was a *natural* resource that the British Empire was after when its industry captains chartered steamships up the Amazon River to Iquitos and re-founded the city in the 1880's as a colonial port and administration town for imperial rubber. Rubber trees were abundant across the Amazon Basin as were British rubber barons, who for a brief time swarmed Iquitos' brick-paved streets, all garbed up in their white linens and panama hats, strolling at sunset along a southern European-styled malecón overlooking the Amazon River.

If the British rubber barons prospered, for a time, in converting rubber trees as natural resources into an abundant, imperial industrial commodity, this was only after the Spanish and Portuguese Jesuits established Iquitos in the early 1750's as a convenient encampment from which to convert so-called savage souls to Christianity through missionary work.[2] The political economy of rubber

2 In that time over a century ago, this-worldly conversions of nature to valued commodities are best emblemized by the Peruvian Amazon Company: it was a behemoth, which mobilized indigenous labor, often violently through enslavement and torture, for the ransacking of native rubber trees. Roger Casement, a British military man and lawyer, who had served with Joseph Conrad (the author of *Heart of Darkness*) in the Congo, is a side-bar of anthropology's history in the America's (see Tausig) and a central part of the story of the rubber boom drawing to a close in Peru's

and its material infrastructure in the Peruvian Amazon quickened only a few decades after it had begun as British investiture in its harvest and export ceased; but in that short time, countless riverine communities had been upended and jungle habitats destroyed. Missions, first Catholic and later millenarian and protestant, continued through the 20th century and to this day to modestly provide what service(s) they can in the way of healthcare, education, and sponsorship to communities along the banks of the rivers and their tributaries. In the final decades of the last century, ecolodges, and more recently Aihwaska retreats, have appeared throughout Peru's Amazon, with tourism becoming the largest formal (and also semi-formal) economy in the region as well as its biggest employer. The Peruvian Navy also provides prestige employment to Iquiteños, coordinating in its maritime military authority between the Peruvian state and the United States Navy, whose presence in Iquitos has for thirty years been devoted to the production of data through research about arboviruses and other insect-borne pathogens (the principally Department of Defense funding for which is still secured in the name of saving (U.S.A.) soldier's lives).

Today it is a wholly other order of resource—human biology—that is being cultured in the Peruvian Amazon and sought after by actors, foreign and native, who wager there is great value to be found in its conversion.

Endemic Malaria

Amazon forests. Casement brought charges against the Peruvian Amazon Company for abuses to the native peoples it conscripted as labor for its rubber operations, and he successfully demonstrated the inhumanity of the Company's practices to the British high courts. The Company's founders were charged, imprisoned, and their fortunes confiscated. This coincided, or closely followed, however, the true end to Iquitos' rubber economy. A competitor managed to smuggle rubber seeds illegally out from the Amazon, and royal botanists and horticulturists in London's botanical gardens subsequently learned to cultivate the trees outside their native habitat. These were soon transplanted to commonwealth colonies in British Malaysia and cultivated there on rubber plantations until well-after Malaysia's independence. When the British exited, Indian emigrants were the premiere labor force that worked the rubber taps on plantations increasingly operated through Chinese ownership and capital. Only with the rise of artificial rubber did Malaysian plantations cease rubber manufacture, switching by and large to palm oil

On a humid afternoon in April of 2018 in Iquitos, I am standing in a hallway on the campus of UNAP with Gabriel, my husband and collaborator. One of our interlocuters, Maria, asks us to place protective wear over our shoes before entering one of CIRNA's laboratories. While doing so, I glance at a laminated map that is fastened upon the wall. It portrays rural areas on the western outskirts of Iquitos, designating localities where researchers from *El Proyecto Malaria* are enrolling participants into their study. "Es endémica en esas comunidades," says Maria, gesturing towards the pastel-colored zones on the map before guiding us into the lab. Next, she pulls out a hefty photo-album-looking catalogue and shows us hundreds of microscope slides, each stained with a blot of parasite-dense blood, and then the Western Blot's she's made and analyzed for each. Maria is proud of her work. Of her lab. Of UNAP's capacity to foster molecular biology in the jungle.

When scientists at CIRNA-UNAP say that "malaria is endemic to those communities," they invoke a vocabulary familiar to them from classical epidemiology, which characterizes as endemical diseases with persistent and permanent prevalence to both a certain region and a specific group of people. As a statistical science of disease with deep roots in both state population health administration and military medicine, epidemiology has traditionally sought to territorialize disease pathology by localizing it to the pathogen and delineating areas of its incidence. This all led, in part, to a logic of eradication, which dominated 20th century epidemiology and associated public health efforts/campaigns to eliminate infectious and communicable disease throughout the world by systematically targeting its vectors and reservoirs. While the successes of such efforts at extending the life chances of many peoples around our globe cannot be overstated, the sustainability of such eradication efforts are being called into question by disease researchers

(though not necessarily their funders) today, as the ranks of specialists who research endemic diseases in different parts of the world gradually diversifies.

Throughout my fieldwork in Peru, it seemed to me that contemporary epidemiologists are increasingly situating scientific knowledge about pathology in ecological, or what anthropologists may call, multispecies disease assemblages. Particularly in Iquitos, endemic malaria researchers are certainly not aiming to disentangle parasites, mosquitos, humans, and shared environs from their relational webs. On the contrary, epidemiologists in Iquitos are starting from and engaging these entanglements as precisely that which conditions and sustains endemic malaria and, thus, the local biologies that contingent upon them.

For epidemiologists, *endemic* by and large denotes a quality of enduring, localized disease prevalence and contrasts with *epidemic*, which denotes the unpredictable and periodic intensification of prevalence both within and across regions as well as groups. Before gravitating to the health sciences and taking its mantel as a general characterization of disease typology, the notion of endemicity was first employed, like many concepts for modern biology, to describe characteristic qualities and conditions particular to people and places: the endemic characterized, that is, what was proper to a people in their locale, including disease – what Georges Canguilhem identified as an anthropo-geographical tradition.[3] Endemia meant belonging.

3 Georges Canguilhem, "The Living and its Milieu," in *Knowledge of Life*. Eds. Marrati and Meyers (New York: Fordham, 2008). Canguilhem elaborates this tradition as one in the image of Alexander von Humboldt, Carl Ritter, and Charles Darwin. But it is arguably well aflame in the orientations of early American ethnology to human/environment relations vis-a-vis Franz Boas and several of his students, most notably Zora Neal Hurston and Alfred Kroeber. Boas' notion of "diffusionism" as a critique of the comparative method more broadly is anthropogeographical, an explanation for cultural variety and change from a geographical/distributive rather than evolutionary points of view. For Boas' views on Darwin(ism) for anthropology, see his unpublished lecture from 1909, given at Columbia University on the occasion of the 50th anniversary of the *Origin of Species*: Herbert S. Lewis, ""The Relation of Darwin to Anthropology": A Previously Unpublished Lecture by Franz Boas (1909)," *History of*

By 1820, the moniker had been extended to plants and animals "having their ordinary habit in a certain country," connoting species of organisms indigenous only to a specified area. Notably, endemic (from *endémique*) does not merely describe the abundance of a certain living being in a certain habitat or area: above all, it qualifies the relationship of a life form with a specific environment as one of belonging. Consonant between its usage to characterize people, places, animals, and plants was the notion's sense that with reference to disease, endemicity connoted "habitual prevalence in a certain region due to permanent local causes." Endemicity, whether applied to humans or to animals, to disease or to its associated pathogen, includes an ecological orientation to local causes as well as a description of local conditions: geographical and climatological, biological and medical, and anthropological, as well. Endemics also reveal a certain temporality and epistemological limit: today, endemic diseases (such as malaria worldwide) are typically those which cannot be eradicated by known means, and in many instances, such attempts been given up on.

In the next section, I investigate malaria as a contemporary case of an endemic disease and show how the disease ecology of malaria actively shapes the intertwined biologies of *Anopheles* mosquitos and rural Iquiteños in Llanchama, one of several riverine communities situated in the floodplain of the Nanay River. I heuristically take endemic malaria as a multispecies assemblage comprised of pathogen-vector-host life cycles in ecological conditions permitting all to thrive. This notion frames my understanding of the ways that endemic malaria in Iquitos is reconfiguring the

Anthropology Newsletter 42 (2018): http://histanthro.org/clio/the-relation-of-darwin-to-anthropology-a-previously-unpublished-lecture-by-franz-boas-1909/.

relationship between biomedicine and epidemiology, between life science and public health, between research and intervention, as well as between care and neglect for afflicted communities.

I will begin by showing how the "local biologies" of study-participants infected with malaria in Iquitos are being shaped by intersecting endemicities of malaria – a parasitic disease transmittable in human-mosquito ecologies – and malaria research – a sociotechnical assemblage that, in turn, parasites[4] upon the disease's endemicity.[5] To this effect, I suggest that the situation unfolding today in Iquitos might be doubly characterized as both a multispecies and a multi-*specialist* ecology, the latter being composed of researchers who converge in the processes of tacking back and forth between the lab and the field, between an interest in the pathogen and the humans (and mosquitos) who harbor it, in the pursuit of subjects, samples, knowledge, and profit from enclaves of endemic malaria that pocket the Amazon Basin of Peru's low jungles.

Local Biologies

In the early 1990's, medical anthropologist, Margaret Lock, proposed the notion of "local biologies" to name the manner in which biological and social processes interact continually in ways that precipitate biological differences among and within human bodies across space and time (Lock 1995; Lock & Kaufert 2001; Lock 2017). Since its development, this influential concept has guided anthropological inquiries into biomedicine and helped social scientists critically assess the often underexamined assumptions embedded in biomedical truth claims about the 'body proper',

4 See Michel Serres – The Parasite (I will summarize the meaning(s) of parasite according to Serres in the footnote in the next draft)

5 Margaret Lock, "Cultivating the Body: Anthropology and Epistemologies of Bodily Practice and Knowledge," *Annual Review of Anthropology* 22, 1993:133-55; Margaret Lock, "Menopause, Local Biologies, and Cultures of Aging," *American Journal of Human Biology* 13(4), 2001:494-504. In her 2017 *Annual Review of Anthropology* article, "Recovering the Body," Lock remediates the concept of local biologies for considerations of global health epidemiology in an age of epigenetic science, molecular biology, and the situated biologies emerging in the age of Anthropocene, environmental toxicity, and differential (i.e. local) exposure.

or, the presumptive, generic individual body, reduced to a standardized biology independent of time and place. Without outright dismissing the importance of such an entity for bioscientific and biomedical practices, anthropologists have demonstrated vis-à-vis fieldwork and ethnographic writing that the notion of a universal human biology is constructed and that biological differentiation in humans is materially and historically contingent, that is, local.[6]

In this chapter, I draw upon the concept of "local biologies" to name a set of phenomena, which, I argue, are of particular relevance in contemporary global health endeavors, such as those unfolding in Iquitos. First, local biologies refers to the ways in which the biosocial transmission of plasmodia parasites in human-mosquito ecologies and the medical and scientific interventions that have ensued over time to manage them condition the likelihood of Iquiteños becoming infected with malaria as well as the possibility of their developing adaptive immune responses to the parasitic infection. Second, local biologies refers to the disembodied raw materials (parasite-dense blood, chemical compounds, mosquito genomes) of biological substance – always already local – that are being transported from field to lab and cultured today in accordance with scientific values and political-economic interests, both local and global.

Multispecies Ecology

In the Peruvian Amazon, the human/mosquito relationship is a perennial problem, one understood through the lens of vector-borne disease by epidemiologist, but as febrile lethargy and accidental death by Iquiteños. One afternoon when I had taken refuge from the humidity in the NAMRU-6

6 For medical anthropology on the constructedness of biology, see Brotherton & Nguyen (2013), Garcia (2010), Nading (2014), Nguyen (2010), Stevenson (2014), Yates-Doerr (2017).

mosquito-breeding insectary,[7] one of the few temperature-controlled spaces to be found in Iquitos, the coordinator for *Proyecto Dengue*, Helvio, put it to me like this: The problem is that we always have the relationship between humans and mosquitos. We can't get rid of the mosquitos, nor the humans, because they've both always been there, probably longer than the parasite, in most cases.

Helvio's enunciation of the problem as relational, first-and-foremost, indexes his ecological orientation to an epidemiological understanding of endemic malaria. Translated momentarily into anthropological parlance: malaria is a multispecies phenomenon. This is nothing special…. I pause, however, to note this marked shift in epidemiological orientation from former public health strategies to combat malaria. Decades prior, eradication campaigns by both the ministry of health as well as the military with chemical toxins (DDT) against *Anopheles* and *A. Aegypti* mosquitos (the vectors) were the form public health measures against malaria most commonly took.

Unfortunately these strategies did not succeed, in the long run, at warding off endemic malaria, however they have resulted in a buoy of both of the mosquitos' adaptive biological resistance to industrial insecticides. Meanwhile, an influx of antimalarial pharmaceuticals has simultaneously precipitated an adaptive increase in the malaria-causing parasite's resistance to drugs. Additionally, when malaria is endemic, not only is individual human immunity fortified

7 This was one of two operational insectaries in Iquitos. The official insectary at NAMRU-6 was formally operated according to military protocol and was attached to the department of entomology on NAMRU-6's military research campus in conjunction with the Peruvian Navy. Jose and Maria, both of whom had earned MA's in biology, managed that insectary. The secondary insectary was a more shoe-string space, kitchen sink style, Amy (head of epidemiology and vector born disease research at NAMRU-6) and Helvio had constituted an under-the-radar insectary, "more scientific" than NAMRU's, which they had operated out of the first floor of Amy's home for more than 20 years. Caesar, a Venezuelan immigrant who had previously been employed by the department of public health in Loreto to spray insecticide in open-air spaces and increasingly deforested fields around Iquitos during eradication and vector containment campaigns, now operated the bootleg insectary, lovingly breeding both genetically standardized as well as wild-type *Aedes Aegypti* mosquitos for use in off-protocol experiments that Helvio and Amy continuously run. Caesar loved his work rearing rather than razing mosquito life, which he approached with a ceremonious duty that can only come from care.

but asymptomaticity of disease presentation increases as well. When this leads to an underdiagnosis in cases, as is the case amongst the communities living in endemic zones in the Amazon, infected humans become reservoirs of disease and parasite hosts themselves, their blood feeding back into the life cycle of the *Plasmodium* parasite in its endemious milieu. Lastly, poverty, paucity of health infrastructure, state neglect, and remoteness/isolation also contribute to the perpetuity of tropical disease endemism in general and malarial endemicity in Peruvian low jungle communities, in particular.

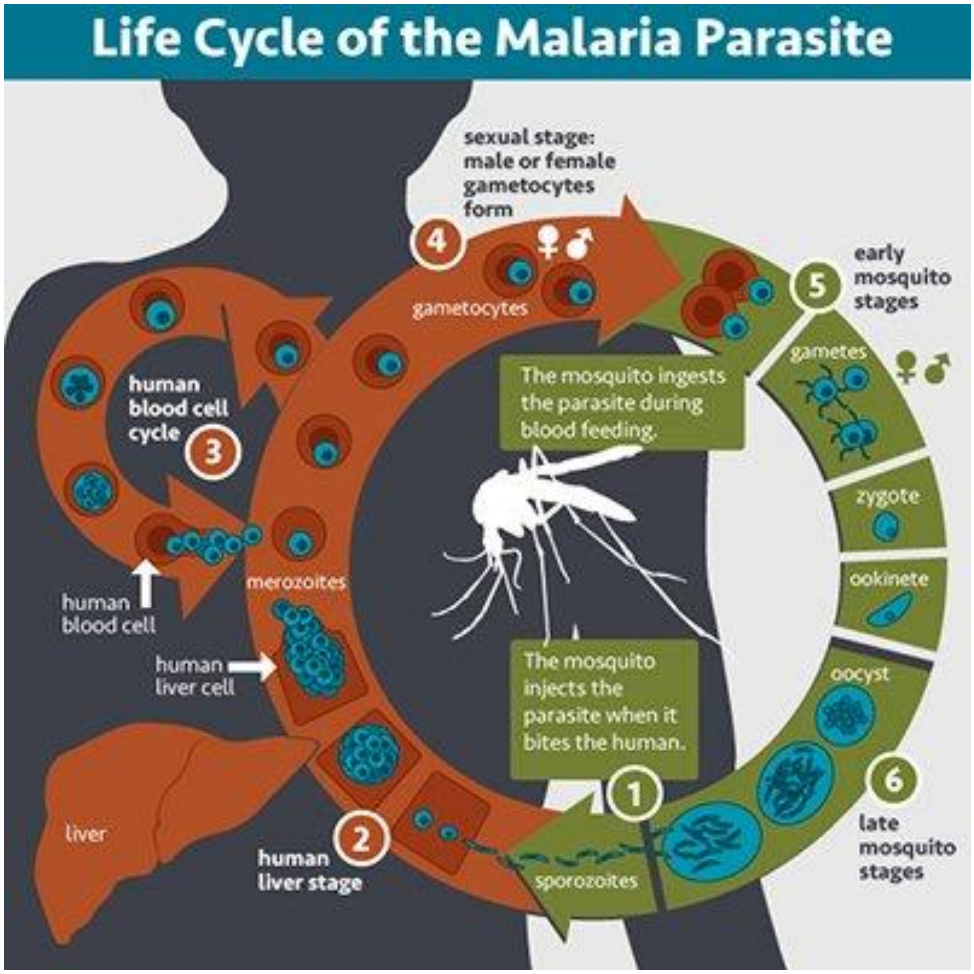


Figure 4. Life Cycle of Malaria Parasite[8]

8 This image was produced by *National Institute of Allergy and Infectious Diseases, National Institutes of Health*

The governance of vector borne and zoonotic disease in the Amazonian tropics of Peru has historically, if unevenly, been the jurisdiction of three overlapping entities: the decentralized Peruvian State's Loreto department of public health, the Department of Defense-supported United States Naval Medical Research Unit (NAMRU-6), and transnational humanitarian NGO's like the Bill and Melinda Gates Foundation. As efforts to eradicate the mosquito have strengthened its resistance to chemical repellents and efforts to eradicate the *plasmodium* parasite have strengthened its own resistance to antimalarial drugs, some people who live in malaria-endemic zones have developed immunities to the parasite itself. These local adaptations to human biology in endemically malarial milieus are of direct interest to bioprospectors: molecular biologists, immunologists, parasitologists, geneticists, and organic chemists interested in the deriving and synthesis of new (perhaps natural) anti-malarial, anti-parasitic compounds for pharmaceutical application in drug and vaccine development.[9]

Multi-specialist Ecology

El Proyecto Malaria was launched in 2018 as part of a multi-institutional initiative to help the Peruvian government eliminate malaria in the region through the generation and use of evidence-based data. UNAP plays a key role in supporting this endeavor through their field researches and on-site analysis of samples collected for the Project. UNAP's institutional capacities have vastly expanded in recent years: since 2016, a triangular collaboration between UNAP, [10] the

and is available on NIH website. https://www.nih.gov/news-events/news-releases/nih-statement-world-malaria-day-april-25-2017.

9 For another example of endemical poverty rendering human disease available for profit, see Das, Veena. *Affliction: health, disease, poverty*. Fordham Univ Press, 2015.

10 A description of CIRNA and UNAP that I helped a colleague from the EMERGE working group write in English for a grant proposal: The Research Center of Natural Resources (CIRNA) at Universidad Nacional de la Amazonia Peruana (UNAP) is one of the most productive institutions of scientific research at Iquitos. Building facilities support highly competitive research, which it is reflected in the increased funding received by their investigators. The Parasitology laboratory includes: dispose PCR thermocyclers, real time PCR equipment, -80°C freezer, incubators,

Universidad Peruana Cayetano Heredia (UPCH)[11] in Lima and the University of Antwerp in Belgium has catapulted UNAP's technical scientific capacities, particularly in the field of molecular epidemiology. Courses given by Antwerp and UPCH professor to students and faculty at UNAP, the continuous training and exchange of students and professors across the three universities, and their performance of joint research, all contribute to UNAP's growth and its overall ability to spearhead increasingly specialized research activities throughout the region.

The Malaria Project has many initiatives and methods: responding to syndromic surveillance; collecting blood as a form of passive surveillance not-reliant upon the presentation of symptoms; and the administering of medications, when necessary. Field researchers also test new rapid diagnostics, spatial movement, and satellite mapping methods and technologies.[12] The Malaria Project additionally assembles an infrastructure for malaria vaccine testing in the field, and the project's overall infrastructure increasingly serves as a platform through which Peruvian scientists can launch successful scientific careers by producing research that circulates in transnational networks of elite, global scientific knowledge.

PCR hoods, autoclave, microcentrifuges, centrifuges, ELISA reader, ELISA washer, and others. Their team consists of remarkable researchers who conduct several studies in malaria, and has helped students to receive mentoring and training in research.

11 A description of UPCH capacities: The Emerging Diseases and Climate Change Research Unit (Emerge) at Universidad Peruana Cayetano Heredia (UPCH) holds offices in two of its four campuses. The Emerge laboratory, which belongs to the UPCH Laboratories for Research and Development (LID), is located in Laboratory 412 on the fourth floor of the UPCH Main Campus (north) in the San Martin de Porres district. It is approximately 733 square feet and furnished with two benches and two isolated areas. Currently, the lab is equipped to support serologic and molecular techniques related to virus research. Viral isolation and culture for arboviruses in biosafety level 2 conditions are expected to be functional by the end of 2018; over the next three years, these capacities will be upgraded to handle biosafety level 3 pathogens. Major equipment includes: a class II laminar flow hood, -80°C freezer, incubators, autoclave, inverted microscope, microcentrifuge, ELISA reader, ELISA washer, thermocycler, PCR hoods, and gel documentation equipment. Smaller equipment includes: a mixer, vortex, -20°C freezers, horizontal cells for electrophoresis and others.

12 For work on satellite test sites, see Cartwright, Lisa. "Reach out and heal someone: telemedicine and the globalization of health care." *Health:* 4.3 (2000): 347-377.

Today, one of the main challenges for malaria control in Peru is the prevalence of *plasmodium vivax,* which has a greater geographical distribution that *plasmodium Falciparum,* (although *Falciparum* has by far the highest fatality rate worldwide). It is important to note that while *vivax* has long been endemic to Peru's northeastern jungles, *Falciparum* is a relatively recent arrival; but its prevalence and co-incidence with *vivax* in the same populations and geographic zones has steadily increased in recent decades. If *falciparum's* fatality rate makes it the most feared malarial killer worldwide, what makes *vivax* particularly menacing for public health workers and scientific researchers is its latent capacity for reactivation in human hosts several months or even years after the time of initial infection. Not only does this latency cause recurrent symptoms and bouts of illness for the afflicted human, but it also triggers asymptomatic relapses of the disease: periods in which the afflicted human becomes contagious once again, but without knowledge of their own pathogenicity nor, therefore, their need to seek medical or pharmaceutical treatment.

Surprisingly, the epidemiology of *plasmodium*-driven malaria relapses has not been amply researched, and so it remains unclear to scientists whether the recurrence of malarial symptoms is due to parasites not having been fully eliminated from the original infection (recrudescence), new parasites emerging from latent hyponozoites in the liver (relapse), or an infection with a new species of parasite sometime after the initial infection (reinfection). The stakes of epidemiological classification, here, are both epistemological and political: recrudesence would imply that current treatment regimens are ineffectively administered, and that better training and technologies are needed. Meanwhile, *relapse* suggests that humans can harbor parasites indefinitely and thus remain capable of maintaining transmission long after initial symptoms disappear; *reinfection* signals possible changes in mosquito prevalence or else yields insight into epidemiological trends of human-mosquito encounter. Since acquired immunity against malaria reduces the periodicity of

its clinical manifestations among individuals living in highly endemic areas, this further confounds the capacities of researchers to determine what specific factors are associated with the recurrence of parasitemia.

Therefore, scientists at CIRNA-UNAP are actively experimenting with immunological and genetic techniques for identifying those factors. Employing microscopic visual, serological, and PCR and other molecular diagnostics in order to detect cases of *vivax* and *falciparum* within biological samples drawn from study enrollees who live in endemic zones (like Llanchama), CIRNA-UNAP represents one branch of the Malaria Project. At their Iquitos campus laboratory, they are, additionally, culturing different species of the parasite—often in whole human blood samples drawn from participants—in order to manipulate the life cycle of the parasite, to chart changes to the parasite's virulence in blood drawn from people with varying degrees of acquired immunity to its presence, and in order to test chemical compounds derived from local, often medicinal, botanicals for their potential anti-malarial properties.

Importantly, their fascinating work signals a distancing from former eradication regimes and public health interventions, which aimed to modify human practices: "use bed nets, bug spray with Deet, burn anti-mosquito spirals, don't leave water standing for more than one day at a time," etc.! Instead, UNAP researchers embrace basic science and pose questions about biology and disease ecology with an eye towards the potential promise that new immunological understandings of malaria may hold for future interventions into the ongoing problem of its endemicity: both at home in Peru and abroad, in the American tropics of Columbia and Brazil, across central Africa, and in the forested expanses of southeast Asia where malaria has also become endemic. Indeed, the researchers at CIRNA-UNAP are doing science, first and foremost, not, as it were, carrying out

public health initiatives like vector control, health care delivery, and prophylaxis-based prevention, all of which are forms of intervention that have organized global health malaria research and public health response to malaria in the past. This is an example of how global health research renders alleviating the suffering of sick individuals secondary to identifyinging infected individuals to collect their blood samples for laboratory analysis.

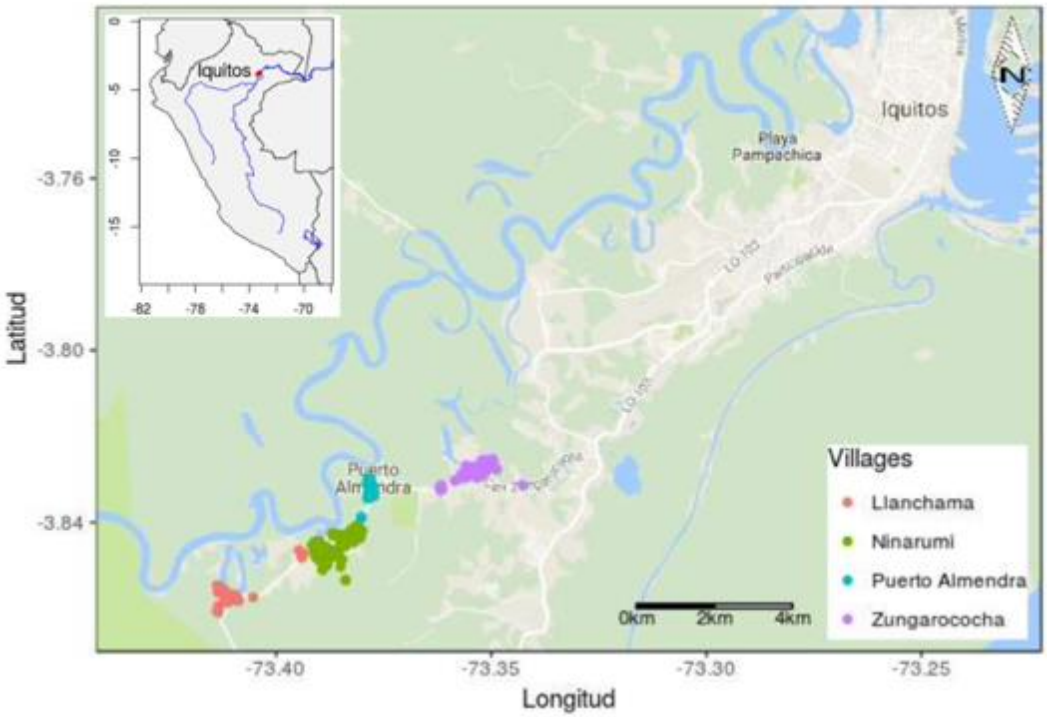
In the next section, I illustrate how research subjects from rural communities on the outskirts of Iquitos, the largest metropolis in the Peruvian Amazon, become endemical "conscripts of science"[13] precisely because their local biologies are pathological.

Humans Living in an Endemic Locality

In April 2018, the Malaria Project team was concluding the data collection phase of a research protocol, which studied the epidemiology and immunology of relapse and reinfection among individuals who live in areas where malaria is endemic and for whom recurrent episodes can be fatal. In those final days of the data collection phase, Gabriel and I accompanied Proyecto Malaria field researchers as they collected blood samples from study participants in the communities of Zungaraocha, Nina Rumi, Puerto Almendra, and Llanchama. This project enrolled 2,000 people from across the four communities, of which Zungaraocha was the largest (half the participants lived here). Llanchama is both the smallest community in the study and the most remote of the

13 David Scott's "Conscripts of Modernity: The tragedy of colonial enlightenment" (2004).

four villages; to reach it during the wet season requires passage—for a sole per person—through flooded marshes in a 3-person dugout canoe.



Relative to Iquitos, Llanchama is both near and far, proximate and remote. During the wet season, when the rivers and estuaries swell and waters rise, one can boat from Iquitos to Llanchama along the Rio Nanay, which snakes southwestwardly from along the contours of the city's peri-urban sprawl and then westward into deeper rainforest reserve. The Proyecto Malaria team, however, travels on land, assembling early morning at the bus depot at the 2.5 km marker for Carretera Iquitos-Nauta, which is the only paved and numbered (103) road in the region. At the station, Maria introduced us to the rest of the field team, comprised that day of two nurse technicians and three undergraduate biology majors at UNAP. Upon arrival in Llanchama, the students would

conduct symptom surveys and administer questionnaires while the nurse technicians would collect blood samples from study participants.

Map of Study Villages surrounding Iquitos, Peru

The team squeezed into two moto-taxis and we drove 25.5 kilometers out of the city. Once south of Iquitos, our moto brigade careened off the carretera and onto a washed-out earth-packed byway. In the steady rain, we passed rubber- booted women walking along the rising rivulets embanking the road. We passed boys and girls in either their bare feet or in the Catholic primary school uniforms of navy trouser or skirts and white cotton short-sleeve button downs or blouses. Occasionally we stalled or spun out in the mud. After a half hour, we were surprised to arrive at a perfectly paved road, one that is not on any map. The road we were on, Maria explained, belonged to UNAP, for the new campus being planned and constructed there, where there is more space to expand and is closer to many of the research sites in which they operate. “The chemistry and

pharmacy schools will be here, the biology and the botany schools…most of UNAP will move here soon," she explained.

This road was the first physical sign of a new infrastructure to be materialized, immanently, in the jungle. For the time however, only the local moto drivers, like ours, were using it. Somewhat under the radar, we should add, for the road was, Maria explained, private: it belonged to UNAP. It was at present but a few kilometers in length, bookended at both its start and its finish by jungle. Occasionally, a bulldozer rested dormant in the center of a razed clearing—downed trees, leafy palm foliage, and other lumbers piled conspicuously beside mounds of dozed mud. This new concrete road to Llanchama linked up with nothing concrete, although it connected many a dot, while thrusting residents of nearby communities, like our driver, upon the realities of mixed-use development and new forms of private/public investiture in regional infrastructures. We slowed to a roll before banking left off of the pavement and back onto a coppery mud-way that broadened to an unassuming clearing midst the canopy: Zungaracocha, on the far side of which was the Rio Nanay. Pushing on, we passed Puerto Almendra, then Nina Rumi. Then, we stopped short…at the edge to a cerulean and turquoise pool, the cumulative flooding of the basin of the Nanay, from which rose, perhaps 150 meters away, the highland now-island of Llanchama. A resident, a pregnant woman in a cap and knee-high galoshes, was waiting in a dugout canoe with a single hand carved oar to chaperone each team member, one or two at a time, to Llanchama.

We reassembled on the far bank of the village—the students with their clipboards and questionnaire's, the nurse tech's each with her cooler of needles, lamina, cotton balls, syringes, and vials on ice.

Llanchama—like many Catholic missionary influenced outposts in the region—was built on the model of a village square: in Llanchama's case, it is ordered so that most of the residential structures—homes that is—back up to either the flooded river basin or the river itself, therefore forming a parallelogram, circumscribed by a footpath encircling the community. The residences themselves, in turn, encircle a village square no larger than a football field: in the center of which is a grammar school (which is roofed) and a defunct stone fountain. The fountain, a colonial aesthetic remnant, is a curiosity for many reasons: but the primary reason is that even though it

doesn't function as a fountain, it's permanent pooling of standing rain-water certainly functions as a perpetual breeding ground for Anopheles mosquitos to deposit their eggs and for larvae to mature.

Angelica: A New Conscript

The first residence upon entry to Llanchama is also the largest, and it houses four generations of community members, three of which have participated in the Malaria studies since their inception almost 20 years ago. Angelica, a two-year-old girl and the eldest of the fourth generation in the home, would be joining the study that day. After her father signs the paperwork for her to become a scientific subject, she'll give—or gift—her blood as the foundational act of enrollment. Today she becomes what I am calling *a conscript of science*. Although the current iteration of Proyecto Malaria, as underwritten and undertaken by UNAP researchers, is new, epidemiological and biological investigation into the immune responses and blood pathology of Llanchaman residents in this endemic zone has persisted for nearly 20 years: the earliest conscription of these malarial Peruvians was pursued by researchers from NYU's Langone School. UNAP's current work is both an elaboration and a continuation of that previous work with this population, albeit with

different stakes for the Peruvian scientists, given the economic and educational futures being forged vis-à-vis UNAP's growth in the region.

A broken moto-taxi sits in the foyer of the family's home. Chickens—noticeably more than most families here—and two geese race around the hard-packed dirt floor, darting outside if one of the toddler's chases it too close. The roof, like most in Llanchama, is hand woven from thatched palm leaves: a traditional roofing that has been eclipsed in Iquitos' suburbs by mismatched paneling of sheet and scrap metals like aluminum and tin. Palm thatching, correctly executed, is more protective from incessant rains and a better insulator in the stifling humid heat than the sheet metals with which it is being replaced; however, it needs to be replaced every 3-5 years to remain waterproof and it takes an abundance of valuable time (and a modicum, at least, of local knowledge) to adequately craft.

As the nurse technicians set up their blood drawing materials at the family table, I sit down on a wood-bench with the elder man of the house to discuss life in Llanchama and his experiences interacting with the malaria researchers. The grandmother and her daughter leave their pots above small wood fires in the open kitchen to complete the surveys and prepare to have blood drawn,

while Maria translates between Gabriel and the daughter's husband, who rehearses who is related to whom, what he does for work (fisherman and sometimes moto-driver), and that he's excited (happy) that Angelica, his daughter has recently turned two years old, and will therefore be the newest member of the family to become a study participant today. Being in the family—their lives in Llanchama, in the malaria endemic zone, that is—means being in Proyecto Malaria. It is a form of belonging. Angelica has not had any febrile illnesses, which includes Malaria, in nearly four months. But remission never lasts for long, and the sooner she's conscripted, the sooner the family will have some access to blood screening and medicines when she next takes ill.

Angelica watches Gabriel, follows the lens of his camera—an unfamiliar sight—giggling angelically when he smiles at her. She is comfortable with the researchers (as well as the anthropologists) in her home, curious at the glass and papers and presence they bring with them. Lifting her up into his arms, her father tells Maria and Gabriel that unfortunately Angelica doesn't know that joining the study means having her finger pricked.

Un-conscripted, or the Ethics of Not Belonging

Gabriel walks out of Angelica's home and meanders down the path. Several homes over, a woman in her late thirties or early forties, who had heard him coming, rushes out of her house and beckons him, with gestures and affect of unmistakable urgency, to come inside, quickly. She's asking for help. Inside the home, her daughter, a woman in her late teens or early twenties is sitting in a rocking chair in a barren front room. She clutches her own baby girl to her chest, rocking in the chair and whispering words of comfort. Her little girl gropes at her mother's collar bones, her flush

face pressed against her mother's chest, and whimpers. The little girl's shoes—likely her only pair—are already on. Her mother too is dressed in denim jeans, a cotton top, and wedges, and she has a small pleather clasp bag on her lap. They've been waiting for "us" to arrive, and they are ready to go: to the health post, a clinic, or the hospital in Iquitos…wherever care can be provisioned. The little girl is, or at least appears to be, malarial, her feverish spell finally subsiding following her third night in a row of violent paroxysm; however quotidian malarial illness may be in Llanchama's endemic zone, her mother is terribly afraid: on the verge of tears herself.

Gabriel assures them he'll be right back, and he races out of their home to fetch Maria: "a family needs our help," he tells her, and she rushes with him back to the grandmother, mother, and sick little girl. Maria comforts the mother and little girl alike before launching into the standard symptom survey widely utilized to ascertain aspects of "illness narratives" of potential diagnostic and epidemiological value. It sure seems to Maria like the girl is suffering from malaria. That she is, her mother, is absolutely certain. But Maria explains, with unjaded compassion, that we cannot take the girl with us to the city hospital for care. Her mother, dazed, is confounded. But both she and the grandmother—and the man in the family as well—are recently conscripted subjects in the UNAP study, which means, they insist, that if one of them presents as malarial, the researchers take them for treatment. That is what the permissions form, as was explained to them, had said. Yes that's true, Maria explained in response; however, the little girl has not been entered as a subject in the study, so provisioning care on her behalf is beyond UNAP's jurisdiction. They'll have to find money for a moto-taxi to the MicroRed health post and a bit more for drugs should her bloodwork be returned positive. In short, they are on their own. But if she isn't yet a subject in the study, let's sign her up right now, take her blood, and get her care right now, her mother protests. I wish we could, Maria explains, but she is only 20 months old. To join the study, a

participant must be two years in age: that is why the little girl's enrollment hadn't been sought initially: but come August, she'll surely be enrolled.

As the little girl continued to whimper against her disbelieving and disempowered mother's chest, we heard Angelica's cry as her finger was pricked and blood samples drawn onto slides with her new ID number several houses down. It was a sound of entry into scientific subjectivation. But her discomfort would subside momentarily, while this little girl—unconscriptable—would continue to suffer no doubt, for some time.

Empathic in the face of the little girl's mother's pleas (and disbelief), Maria brought one of the nurse-techs—herself a local resident of Llanchama—to assess the situation (and to explain the conditions for the constraints upon provisioning care) to the sick girl's mother. They decided that they would informally take a sample of the little girl's blood—just not the little girl nor her mother—back with them to UNAP that day for microscopy (note: this decision was not a violation of protocol). If she was infected, the nurse tech would bring medicine that evening.

That evening, Gabriel and I joined Maria at the Musmuqui Bar just off the malecon that runs along the Amazon river on the eastern edge of Iquitos *para probar tragos y macerados regionales*. After gagging down a shot of brandied pisco that had been infused with *suri* grubs (succulent palm weevil larvae), I asked her, "Were you able to send medicine for the little girl who had malaria from earlier?"

"Oh, she didn't have malaria," Maria said, "the microscopist saw no parasites in her blood." Gabriel squeezed my leg under the table, and I lightly kicked him back with me knee. Maria's response confused us both.

Days earlier, she had explained that one of the most prevalent problems—indeed, a widespread problem that her team's research sought to hopefully help in eventually overcoming—is the high number of false negatives that microscopists, especially in remote areas, produce when diagnosing—or more accurately, misdiagnosing—malaria. The proportion of microscopists producing false negatives drastically increases when training is more limited—like in remote regions like Llanchama—as well as for populations who live in perpetuity with malaria, for endemic infection modifies both the biologies of both parasite and patient alike, making text-book identification of parasitic samples difficult, as these evolving co-presences present (visually) in ways that deviate from the medical norm. Maria knows this, and her doctoral research is a contribution to its documentation. PCR analysis would be far more accurate—and UNAP has the machines for molecular blood analysis; but that would take 6 or more hours and a few thousand dollars in reagents and chemicals. In any case, Maria assures herself and us, the little girl doesn't have malaria.

Conscripts of Science

Conscription is a term that refers to enrollment. From the Latin *com* plus *scribere* (to write), conscript is a relational term, and to conscript means to enlist or draft into a service, for example, militaries across the world may conscript men of a certain age into their ranks by use of force. The individual enrolled, then, is a conscript.

I have come to view these families—these entire communities—of research subjects as 'conscripts of science', individuals who are enrolled into scientific studies that are primarily concerned with analyzing infectious blood rather than alleviating human sickness and/or suffering. While enrollment into these research studies is, of course, voluntary and not compulsory (as per

international IRB standards for codes of ethics, including "informed consent"), I still find the idiom of conscription to be useful for analyzing the situation that is presently unfolding in Iquitos. It enables one to enquire directly into the productive ways in which scientific research shapes the social-material conditions and practices of living with endemic malaria today. Further, it illustrates the relevance of local biology in contemporary global health endeavors, when biological substance – always already contingent – is extracted, mobilized and stabilized in accordance with political-economic interests and culturally informed values, local and global.[14]

Indeed, endemic malaria is nothing new in this region of Peru; for most inhabitants, the entangled relations of anopheles mosquitos, plasmodia, and human hosts in the jungle are a given. In fact, it is because of malaria's persistent endemicity that scientists have become newly interested in what is changing, namely: human immunological responses to plasmodia parasites and the adaptations of plasmodia parasites in human biologies over time. This is what the scientists ultimately aim to understand vis-a-vis the collection of blood samples: the coevolution of a blood-based parasite with participant's haemato-immune response, or the blood antibodies they are evolving to resist succumbing to symptoms of the illness the parasites cause. Research subjects agree to become conscripts of science, in large part, because minimal infrastructure exists otherwise to afford them adequate care in exchange for the provision, their gift, of blood samples. But UNAP can offer a modicum of care, so conscripts consent—as with Angelica's family, often quite enthusiastically with time—to become research subjects with value for scientists (and sometimes meaningfulness

14 See Crandon-Malamud, Libbet. *From the fat of our souls: Social change, political process, and medical pluralism in Bolivia*. Vol. 26. Univ of California Press, 1991.
- Montoya, Michael J. "Bioethnic conscription: Genes, race, and Mexicana/o ethnicity in diabetes research." *Cultural anthropology* 22.1 (2007): 94-128.
- Rajan, Kaushik Sunder. *Biocapital: The constitution of postgenomic life*. Duke University Press, 2006.

for the conscripts) precisely because their ‘local biologies’ are pathological and therefore desirous raw materials for molecular epidemiologists bioprospecting endemic malarial milieus today.

Viewing Llanchamans’ participation as scientific research subjects as a form of conscription for minimal health care enables one to ask: how is this research project conditioned upon endemic malaria and pathological local biologies? And, in turn, how does the research apparatus that is driving these scientific practices—both locally in Peru’s Amazon as well as in the interests of global health and tropical medicine’s global knowledge economy—condition possibilities for

infected and, sometimes, sick, Peruvian research subjects to access care in exchange for their (ecologically contingent) biologies?

Conscription captures the ambivalence of contemporary reconfigurations to these relationships: relationships between biology (as in: immune resistance evolving in communities whose blood is endlessly exposed to the parasites) and ecology (as in: waterlocked communities that border both an overcrowded urban center situated at the increasingly polluted confluences of three Amazonian rivers and expanses of jungle increasingly deforested, razed, or ruined as capital pours into the area for development and capital improvements, including for the expansion of institutions like UNAP and as people pour out from the slums of Belen in the city to try their hand at community life in villages like Llanchama once again). Conscription captures the ambivalence in the relationship between sickness (experiencing febrile illness on account of parasitism) and infection (carrying the parasite), between basic life science research and biomedically-driven public health, and between care and neglect for afflicted communities both in Peru's jungle and the world over as well. In Llanchama, inadequate public health support from the state enables conscription, which becomes a relational form configured around need, neglect, interspecies kinship, and of course, endemical belonging.

Given the ambivalence that conscription captures, a quick note on endemia, as well, as it relates to care and neglect. The endemic holds in contradiction two aspects of health improvement, which are: protecting the health of the local human population AND growing the local health research infrastructure to participate in global economies. This contributes to the way in which local Iquiteño people who belong to communities where malaria is endemic end up becoming, themselves, biologically as well as economically, endemic to local health research science knowledge production. Again, it is the condition of endemia, of living with constant disease presence in multispecies entanglements, that makes their blood a valuable resource: infected or

not, it produces health data for local scientists, as well as emergent forms of care and neglect for conscripted research participants.

There are ways in which conscription into science is experienced meaningfully by the participants as a form of care. When I asked one subject why they gave their blood to the researchers, he replied "they are testing me to make sure I'm not sick". This is partially true. In contradiction to the logic (and ethic) of classical public health intervention, the researchers are not testing participants for sickness so that they (public health researchers or healthcare providers) may intervene into it. Rather, they are testing for infection to extract and produce scientific knowledge about it, and further, to transform this knowledge into a valuable resource that may be exchanged for entry into and power within a worldwide sociotechnical system, or global assemblage, where Iquitos' multi-specialist ecology can be re-made as a vital port in the transnational flows of global capitalism and global health data exchange.

In this contemporary configuration, healthcare is neither the outcome nor the objective, but rather that which is brokered in exchange for raw materials—local biologies—that may make a future market for malaria drugs or vaccines possible.[15] In this context, where infected Peruvian blood samples, mosquito genomes, and jungle fauna are bioprospected as raw materials for global pharmaceutical markets, what short-term incentives exist to eliminate the parasite, to keep people and their milieus disease-free, improve population health or get rid of malaria's endemiousness? And thinking along a longer timescale that, perhaps, corresponds to an anthropological and philosophical line of flight, in its own right: how does this situation, in which humans are likely to

15 See Han, Clara. *Life in debt: Times of care and violence in neoliberal Chile*. Univ of California Press, 2012. Also Petryna, Adriana, Arthur Kleinman, and Andrew Lakoff, eds. *Global pharmaceuticals: Ethics, markets, practices*. Duke University Press, 2020.

go on living amidst enduring endemia, reshape one's understanding of what it means to be a human in relation to multispecies ecologies and multi-specialist assemblages, today?

Multispecies Ecologies and Global Health Economies

In his monograph entitled *Mosquito Trails*, anthropologist of health Alex Nading reports laudingly on entomologists working in urban-endemic dengue zones like his field site in Ciudad Sandino, Nicaragua, who viewed "dengue and the insects and human bodies that carry it" as "dialectical productions," in which "people, mosquitos, and viruses were entangled."[16] Pleased with the orientation of entomological scientists, who considered dengue disease ecology to be driven by multispecies entanglements, Nading questions: "what might such an insight do for theories of biopolitics?"[17] To ground this question, Nading aligns global/public health rationalities for "participatory" control programs and their purported failure amidst continued dengue persistence with what he labels "conventional biopolitical analysis."[18] For Nading, dengue control efforts through community-based health programs are in step with his reading of Michel Foucault's analytic of "security" as an "ordering of the environment that is productive and conservative of 'life," narrowly defined as the vitality of *human populations*."[19]

In support of this position, he writes: "Although dengue is certainly an example of how political and economic processes demolish species borders, global health has centered on a compulsion to redraw the lines between people, bugs, and viruses, often in the name of "biosecurity"".

16 Alex Nading, "Dengue Mosquitos are Single Mothers: Biopolitics Meets Ecological Aesthetics in Nicaraguan Community Health Work," *Cultural Anthropology* 27(4), 2012:584; Alex Nading, *Mosquito Trails: Ecology, Health, and the Politics of Entanglement,* University of California Press, 2014: 231n52.
17 Alex Nading, ibid., 2012: 585.
18 Alex Nading, ibid., 2012: 592.
19 Alex Nading, ibid., 2012: 585.

To counter what he's suggestively framed as Foucault's anthropocentrism (or analytical overemphasis on human living) and global health's speciesism (or analytical overemphasis on humans, animal vectors, and microbial pathogens as distinctive forms of life with discrete roles in disease emergence and transmission), Nading invokes Tim Ingold's assertion that "'life' is not a result of exclusion, negation, or even ordering" and advocates instead for a view of "life as 'becoming,' as something that happens within an environment where things—animate and inanimate—mingle."[20] His point is that an orientation to vector-borne diseases like dengue, leishmaniasis, or malaria as interspecies entanglements "reverses a view of living beings (incl. people) as locked in competition, divided by 'boundaries of exclusion,'[21] and prompts us to question a view of health as *dis*entanglement of peoples, things, vectors, and pathogens"[22] and its "implication for anthropological views of health."[23]

That sounds well and good, certainly. But the *Proyecto Malaria* scientists do not take a view of health that aims to disentangle malarial Peruvians from the flooded and remote—yet peri-urban ecologies they inhabit in places like Llanchama, nor from the anopheles mosquitos who dwell amidst them and migrate from home to home and body to body, nor from the *plasmodium* parasites that flourish between mosquitos' bellies and Llanchaman's bloodstreams. On the contrary, UNAP scientists in malaria-endemic zones are starting from and engaging these so-called entanglements. Critiquing them, like Nading might, as circumscribing the wrong object or perpetuating the wrong (bio)politics wouldn't make sense, given the situation I've observed: a situation, mind you, that concerns health but which is predicated on the acquisition and accumulation of diseased,

20 Tim Ingold, *Being Alive: Essays on Movement, Knowledge, and Description,* Taylor and Francis, 2011: 3-4; in Alex Nading, ibid., 2012: 585.
21 See Ingold, ibid., 2011: 117.
22 Alex Nading, ibid., 2012: 585; see also Alex Nading, ibid., 2014: 132.
23 Alex Nading, ibid., 2012: 591.

pathogenic biology: blood-based biomaterial. It is a situation that contributes to global health knowledge economies, but which is conducted under the auspices of life science research. A situation in which care is, at least minimally, proffered to afflicted communities, but only in the absence of adequate public health intervention and an abundance of medical neglect—and, most importantly, a care which is conditional almost to the point of cruelty, offered *only in exchange for* participation in the research infrastructure of a domestic science that cares above all else about extraction:

Following Georges Canguilhem's, one might say that from the point of view of researchers enacting molecular epidemiology in the jungle, malarial Peruvians are proper to endemically malarial milieus: they are environments to which people with *plasmodium*-prevalent pathogenicity belong today. Endemicity, as I am coming to understand it, is an "involutionary" instantiation of enduring entanglement; it is a relational form of biological belonging —between living beings— that burdens human health as much as it buoys prospects for health science and bolsters the value of local malarial biology for global scientific knowledge economies.[24]

Having conducted research in the context of pandemic emergence of avian influenzas in East Asia, the anthropologist of science Lyle Fearnley observed that "scientists have come to locate pathology in ecological and multispecies arrangements in addition to the virus proper. Anthropological accounts describe scientists situating influenza within a 'biology of context' (Caduff 2012, 344), at the 'frontiers between species' (Keck 2014, 59), or amid 'a multispecies cloud' (Lowe 2010,

24 For the concept of the involutionary, see Carla Hustak and Natasha Myers, "Involutionary Momentum: Affective Ecologies and the Sciences of Plant/Insect Encounters," *Differences* 23(3), 2012: 74-118.

626)."[25] I have taken Fearnley's observation to heart, and think it remains apt for characterizing the Proyecto Malaria researcher's approach.

The interdisciplinary teams of scientists, who pursue *Proyecto Malaria* in the name of global health, similarly situate health and pathology in multispecies entanglements and ecological arrangements. As do I. As do Peruvians living in Llanchama's malaria-endemic zone: like the woman who had moved from Belen said: "life in Llanchama is better than Belen, but you have to have malaria." Endemious ecologies, such as the malarial milieus speckling the Peruvian Amazon's low basin, present interspersions of people, parasites, mosquitos, and jungle flora as prospectively valuable for research in health science, conducted as it is in the name of improving future health outcomes for vulnerable peoples.

Rather than suggest what conceptions of health and pathology anthropologists ought to take, I am more interested in the conceptual yields that encounters with situations of endemic entanglement hold for anthropologists of health, medicine, and science*s*. For folks in Llanchama, for scientists at UNAP-CIRNA, and for an anthropologist of life, the entangled relations of anopheles, *plasmodia*, and Peruvians are already a given. Indeed, it is precisely the "becomings" that come from lives and bodies in endemical relation that are of such interest and potential value for the

25 In Lyle Fearnley, "Wild Goose Chase: The Displacement of Influenza Research in the Fields of Poyang Lake, China," *Cultural Anthropology* 30(1), 2015:12. Fearnley continues, charting the movement from models of disease research predicated upon laboratory models of scientific practice to fields, extra-laboratory sites for science, and to field-based scientific experiment: "As a result, scientific research into avian influenza is now as likely to be conducted in wetlands as in "wet" labs, and often includes wild-bird specialists alongside virologists. Assessing influenza in its milieu rather than analyzing influenza under the microscope, contemporary influenza research is shifting from the setting of experiments from the laboratory to field sites like Poyang Lake. This article shows how this relocation of flue research is changing scientific knowledge production, a transformation that challenges anthropological concepts of scientific practice drawn from the model of the laboratory sciences" (12-13). The para-laboratory, field-oriented, milieu-mindful anthropological accounts of infectious disease research that Fearnley cites, above, are Carlo Caduff, "The Semiotics of Security: Infectious Disease Research and the Biopolitics of Informational Bodies in the United States," *Cultural Anthropology* 27(2), 2012: 333-57; Frederic Keck, "From Purgatory to Sentinel: 'Forms/Events' in the Field of Zoonoses," *Cambridge Anthropology* 32(1), 2014: 47-61; Celia Lowe, "Viral Clouds: Becoming H5N1 in Indonesia," *Cultural Anthropology* 25(4), 2010: 625-49.

researchers who bio-prospect malarial Peruvians in Llanchama. For me, on the other hand, each of the intersecting, partial perspectives that frame malarial human/parasite/mosquito/jungle becomings as multispecies biologies inform situations of what I call *endemical belonging*.

At the dawn of the Human Genome Project, in the early 1990's, the anthropologist Paul Rabinow, playfully put forth what he termed "biosociality," a notion meant to illustrate the degree to which the then newly maturing molecular genetics would never, as some life scientists suggested, explain life nor reductively answer perennial questions of human difference and identity by offering a blueprint of each individual's genetic essence through their disease risk and hereditary health profiles. He intended the notion, in part, to zero in on the way in which "imagined communities" might emerge that would turn shared biological predispositions culled via the new genetics into platforms for social connection, for the "formation of new identities and practices arising out of these new [biological and medical] truths."[26]

Endemical belonging is one ramification of approaches to health through sciences that value the pathogenic biologies sustained through endemious disease ecologies. Emerging scientific investments in endemic malaria—as opposed to either *plasmodia's* or anopheles' eradication—is redrawing relations between care and neglect, disease research and life science, as well as health and biology.

Knowledge of life simply sought relationally or wrought through ecological or multispecies idioms, as Nading advocates for example, is not therefore somehow just sanitized of nefarious power relations. Not killing mosquitos and not eliminating malaria is not tantamount to

26 Paul Rabinow, "Artificiality and Enlightenment: From Sociobiology to Biosociality," *Essays on the Anthropology of Reason,* Princeton University Press, 1996:102.

interspecies inclusivity nor to accentuated care for either precarious Peruvian communities or their preciously biodiverse ecological surrounds. At a minimum, it amounts to the express cultivation of one of the most abundant "natural" resources in Peru's widely impoverished Amazon: *plasmodium* parasites flourishing between mosquito's bellies and malarial Peruvians' blood. Bio-endemical belonging is a sign of science incorporating relational views of life into its purview and its practices; but these relations are literally pathological as well as parasitical. They may make sense biologically, and they carry an abundance of potential value both epidemiologically and pharmacologically: but are they worth it?

Endemical Belonging

Thus far, I have mobilized the concept of local biologies to name the process of biological adaptiveness and internal bodily response to environmental conditions, the manifestations of which are contingent upon yet proper to a specific environmental, historical, and sociopolitical ecology comprised of human-mosquito-parasite-ecosystem relations. In doing so, I hope to have rendered a figure of the human as (a) an ecological being whose biology becomes in response to natural and historical economic processes and (b) a biosocial being whose becoming is delineated by multispecies ecologies and global health economies. In doing so, I attach to Lock's original concept of local biologies a multispecies ecological bent, with hopes to show that no simple relationship exists among local biologies and local cultures, whether nation-states, ethnicities, communities, or even families.

To be sure, local biologies are not uniform across groups of people in a given place nor are they fixed in place and time; they are dynamic and responsive, perennially re-constituted. Nevertheless, as I hope to have illustrated, they are also readily detectable on the basis of biological and/or

ethnographic investigation and are often clustered in specific locations. Local biologies signal a way of being human in multispecies ecologies, here, in disease endemic zones that are not demarcated only by territory nor determined (albeit conditioned) by the environment. Neither are the manifestations of local biologies in human bodies circumscribed by cultural practices, as has often been posited by anthropologists since Lock's introduction of the concept. Rather, they are forged at the interfaces in multispecies ecologies and through dynamic yet steady relations of encounter over time. In Iquitos, local biologies are rendered through modes of "endemical belonging", which is a concept I propose for thinking about multispecies relationality and biosocial inheritance through an ecological lens.

The biosocial inheritance of which I speak refers to the manner in which the Iquiteño people who belong to communities where malaria is endemic are becoming endemic to local global health research science knowledge production. The condition of endemic malaria, of living with and in endemial milieus, makes their blood (local biologies) a valuable resource: infected or not, it produces health data for local scientists. Eendemical belonging is a concept that marks not only a way of life and form of kinship in a local multispecies disease ecology, it also addresses the mode in which people consent to being conscripted into a universalist regime of scientific experimentation. Based on my observations during fieldwork, I have come to understand this endeavor as one that fosters multiple senses of belonging among human conscripts of science: intimately – within one's family vis-à-vis intergenerational enrollment; socially – within one's community vis-à-vis membership into a cohort; civically – to Iquitos and Peru vis-à-vis the production of epidemiological data rendered possible through the exchange of blood for care; and intuitively – to both a local and global humanity that might one day benefit from such an exchange.

Endemical belonging refers to a condition of living made possible by scientific research into malaria as distinct from public health intervention into malaria. In this configuration, providing on-site minimal care justifies enrolling people into their scientific study (presents a problem of ethical variability, in Adriana Petryna's sense[27]). Conscription into science may appear to its participants like a form of public health care, as is exemplified through the quote of a study participant in Llanchama, who told me "they are testing me to make sure I'm not sick". Yet, these researchers are not intervening into human sickness in order to directly heal it. They are searching for infection – and whether or not they find it, valuable data can nonetheless be produced. In this way, study participants in Iquitos become endemic to the research ecology both biologically and temporally. Biologically because their local biologies fuel the enterprise. Temporally in the sense that they become eternal subjects for science by virtue of malaria's endemnicity and the fact that scientific progress (including the translation of bioscientific knowledge into biomedical cures) is slow. In another way, too, the researchers, themselves, are also conscripted – insofar as Maria and others scientists are similarly given a forced choice extract biological resources in exchange for intellectual property.

Taking all of the above into consideration, endemical belonging names, what seems to me as, a unique way of being human in the world today: one that figures the human in the spaces between ecological and biological differentiation,[28] in political-economic inheritances, in the interstices of time, amidst social relations and becomings with nature that have very little to do with culture, but

[27] Petryna, Adriana. "Ethical variability: drug development and globalizing clinical trials." *American Ethnologist* 32.2 (2005): 183-197.

28 In an explicitly non-racialized way, as can be seen in the history of anthropology: see Stocking on Boas and Kroeber

are configured in and through time- and space- specific multispecies ecologies and multispecialist economies.

Conclusion

In this chapter, I wrote ethnographically about the conscription of Iquiteño study-participants and their local biologies into global health scientific research on endemic malaria. I have conceptualized endemic malaria as tied temporally to ecological conditions in which local biologies are constituted in bodily responses to the presence of pathogens. I mobilized a notion of endemia that orients both ecologically to local causes and conditions, and temporally to transition of local causes from dynamic events to habitual phenomena and habituated processes that gradually come to constitute a habitat for disease – a stable ecology. I framed endemic disease as an ecological process formed through biological and social interactions over a long time, as well as in the discrete events of multispecies encounter, in a particular environment. Lastly, I developed a concept of endemical belonging to characterize a particular mode of multispecies coexistence, ecological entanglement, and biosocial inheritance wrought through the newly configured relations between humans and nature that are conditioned upon culturing pathogenicity from local biologies for global health science.

Understanding endemic malaria as proper to a multispecies ecology of disease and thus in terms of endemical belonging – and not in terms of a specific territory nor solely at the level of the body – makes it easier to grasp how and why a multi-specialist assemblage of researchers are prospecting the local biologies of infected humans, mosquitos, and jungle fauna in the outskirts of Iquitos. The *Proyecto Malaria* scientists do not take a view of health that aims to disentangle humans infected with malaria from the flooded and remote—yet peri-urban ecologies they inhabit

in places like Llanchama, nor from the anopheles mosquitos who dwell amidst them and migrate from home to home and body to body, nor from the *plasmodium* parasites that flourish between mosquitos' bellies and Llanchaman's bloodstreams. On the contrary, UNAP scientists conducting research in malaria-endemic zones are starting from and engaging these entanglements.[29] For folks in Llanchama, for scientists at CIRNA-UNAP, and for anthropologists, the entangled relations of anopheles, *plasmodia*, and Peruvians living in malaria-endemic zones are already a given. Indeed, it is precisely the ecological "becomings" that come from lives and bodies in endemical relation that are of such interest and potential value for the researchers who prospect local biologies across Iquitos.

For me, on the other hand, each of the intersecting, partial perspectives that frame malarial human-parasite-mosquito-jungle becomings as local biologies informs the situation of what I call endemical belonging. Endemical belonging, therefore, also critically refers to one ramification of contemporary global health endeavors that scientifically value the pathogenic biologies of humans as beings who partially sustain and are sustained through endemious disease ecologies; importantly, these ecologies also include the parasitic investments of scientific research into endemic malaria that are actively extracting and converting the local biologies of vulnerable peoples into valuable global health data. Endemical belonging is a sign of science incorporating relational views of life into its purview and its practices; but these relations are literally pathological as well as parasitical.

29 Elsewhere, anthropologists of science and medicine have also noticed similar phenomena. Writing from the context of pandemic avian influenza in East Asia, Lyle Fearnley observed that "scientists have come to locate pathology in ecological and multispecies arrangements in addition to the virus proper. Anthropological accounts describe scientists situating influenza within a 'biology of context' (Caduff 2012), at the 'frontiers between species' (Keck 2014), or amid 'a multispecies cloud' (Lowe 2010)" (Fearnley 2015: 12).

Human-Dog-City Interface: Eco-Epidemiology

*

Introduction

This chapter is an ethnography of a One Health approach to a zoonotic virus – canine rabies – an assembly of pathogens, multispecies biosocialities[1], and ecological corridors that transect the urban landscape of Arequipa, Peru. I conducted participant-observation there with a multinational team of veterinary, ecological, biostatistical, and social epidemiologists working collaboratively within a One Health frame to surveil the virus' re-introduction to the city.

Although the re-emergence of canine rabies to areas previously declared free of the virus is a rare event, an outbreak occurred in this high-altitude city in 2015 (coincidentally precisely the same year that PAHO and WHO had projected it could be eliminated from the region). The event marked the first instance of canine rabies' re-introduction to Latin America. Despite swift responses by municipal and public health authorities, including a massive deployment of containment strategies and sprawling citywide canine vaccination campaigns,[2] the virus continued to spread among Arequipa's *perros sin dueños* ('without owners' or 'stray') dog population in the coming five years. In that interim, Arequipa gradually became a site for international One Health efforts to

1 In Paul Rabinow's 1996 essay "Artificiality and Enlightenment: From Sociobiology to Biosociality", he introduced the concept of 'biosociality' as a way to describe the social groupings and experiences that form around biological identity or disease status. For my purposes, multispecies biosocialities refers to the human-dog relationships that contribute to the maintenance of rabies transmission.

2 The Peruvian Ministry of Health conducted mass dog vaccination campaigns and provided, at no cost, post-exposure prophylaxis vaccination to people exposed or potentially exposed to the rabies virus. See: Castillo-Neyra, Ricardo, et al. "Behavioral and structural barriers to accessing human post-exposure prophylaxis and other preventive practices in Arequipa, Peru, during a canine rabies epidemic." *PLOS Neglected Tropical Diseases* 14.7 (2020): e0008478.

surveil and control patterns of viral transmission at the "human-animal-environment interface", which is a contemporary epidemiological phrase for the shifting ecologies where species meet and zoonoses spread. As of 2019, more than 150 rabid dogs have been detected.[3]

One Health has been exceptionally successful in managing canine rabies in different parts of the world where the virus is endemic.[4] Since the re-establishment of rabies in Arequipa, Peru, a team of global health investigators, all of whom are affiliated jointly with various Peruvian and North American universities and partnering research institutions, have been surveilling the unfolding situation in Arequipa. Under the banner of One Health,[5] this multidisciplinary team culls concepts and methodologies from a variety of disciplines and research areas (e.g. public health, human and veterinary medicine, biostatistics and informatics, sociology, animal ethology, statistics, ecology) to understand zoonotic diseases.

Drawing upon quantitative and qualitative methods to elucidate factors contributing to the urbanization of diseases traditionally associated with rural poverty, their team conducts epidemiological studies on Chagas disease and canine rabies, as well as socio-ecological research

3 Castillo-Neyra, Ricardo, et al. "Socio-spatial heterogeneity in participation in mass dog rabies vaccination campaigns, Arequipa, Peru." *PLoS neglected tropical diseases* 13.8 (2019): e0007600.

4For examples of One Health successes around the world in mitigating the spread of canine rabies, see

- Aenishaenslin, Cécile, et al. "Characterizing rabies epidemiology in remote Inuit communities in Québec, Canada: a "one health" approach." *Ecohealth* 11.3 (2014): 343-355.
- Abbas, Syed Shahid, et al. "Rabies control initiative in Tamil Nadu, India: a test case for the 'One Health'approach." *International Health* 3.4 (2011): 231-239.
- Cleaveland, Sarah, et al. "Rabies control and elimination: a test case for One Health." *Veterinary Record* 175.8 (2014): 188-193.
- Häsler B, Hiby E, Gilbert W, Obeyesekere N, Bennani H, Rushton J. A one health framework for the evaluation of rabies control programmes: a case study from Colombo City, Sri Lanka. *PLoS Negl Trop Dis*. 2014;8(10):e3270.
- Lavan, Robert P., et al. "Rationale and support for a One Health program for canine vaccination as the most cost-effective means of controlling zoonotic rabies in endemic settings." *Vaccine* 35.13 (2017): 1668-1674.
- Tan, Jimin, et al. "One Health strategies for rabies control in rural areas of China." *The Lancet Infectious Diseases* 17.4 (2017): 365-367.

5 University of Pennsylvania (UPENN) – UPCH Zoonotic Disease Research Center. PI's are Michzel Z Levy (biostatistical epidemiologist), Ricardo Castillo Neyra (veterinary epidemiologist), and Valerie Paz-Soldan (social epidemiologist).

on disease vectors and animal reservoirs. They are particularly interested in how migration and movement – of human, animals, and pathogens – shape disease transmission condition the spread of urban canine rabies and Chagas disease. Quite explicitly, they promote and utilize the One Health approach as a research framework "to unify different aspects of zoonotic disease and to integrate multiple institutions in charge of the investigation and control of such diseases."[6]

One of the group's objectives is to study the eco-epidemiology of urban canine rabies and to model it as a complex and dynamic system. In other words, they seek to use canine rabies as a system model for understanding how the social and spatial features of cities influence the emergence and persistence of infectious diseases. This modeling endeavor requires that they contextualize the virus' transmission patterns within a network of (theoretically identifiable) biosocial and bioecological phenomena,[7] and environmental constraints that are particular to rabies in Arequipa. Why? Because one of the PI's and my interlocuter, Ricardo Castillo-Neyra, is convinced that "social factors combined with urban ecological processes explain the re-emergence, persistence, and expansion of rabies. Using dog-mediated human rabies in southern Peru as a system model, I integrate mathematical and social approaches to develop optimized control and prevention strategies for urban zoonoses."

In what follows, I use this case study of a One Health approach to dog-mediated human rabies to show how contemporary epidemiologists orient eco-epidemiologically to infectious disease

6 Quote pulled from their website: http://www.chirimacha.com/research.html

7 Anthropologist Michael M.J. Fischer in the Afterword to the edited volume "When People Come First – Critical Studies in Global Health" describes the term 'bioecologies' as a means of probing for the proper identifications and scales of interactions in global health, particularly at molecular, computational levels. This is similar to my framing of the ecological through this dissertation – as a means for attending to and integrating multiple scales of interaction and organization. Biehl, João, and Adriana Petryna, eds. *When people come first: critical studies in global health*. Princeton University Press, 2013.

dynamics in urban environments. I will begin with a brief characterization of the One Health framework, remarking upon the way in which a team of researchers in Arequipa enact it by (a) building upon a *biosocial* notion of health and disease and (b) incorporating concepts and practices from landscape ecology. The term 'biosocial' refers to an awareness of the roles that social, political, and economic forces play in driving the spread of disease and the risk of ill health.[8]

I will suggest that their eco-bio-social orientation to disease enables them to transcend some of the epistemological limitations frequently encountered in more conventional infectious disease epidemiology, some of which otherwise tends towards reductive renderings of health and disease as fundamentally biological problems warranting biomedical interventions. In contrast, the researchers with whom I conducted participant-observation study the *eco-epidemiology* of disease, that is, they adopt a multi-scalar orientation that combines molecular, societal, and environmental analyses to apprehend the complexity of disease phenomena.[9] Furthermore, they adopt an eco-bio-social perspective, which integrates three components including ecology, biology, and society into a composite lens for identifying multi-scalar causative agents of disease burdens in communities.[10]

In the second part of the chapter, I will describe their eco-epidemiological practices – which range from conducting surveys with residents living in homes in peri-urban districts to surveilling the movement of dogs throughout the city's dry water channels, geo-locating perimeters and corridors comprising the built architectures of the urban landscape, and generating predictive risk models to guide disease surveillance or mark strategic locations to place dog vaccination posts – in order to

8 Paul Farmer et al. "Reimaging Global Health." *University of California Press.* (2013).
9 Susser, M., Susser, E. "Choosing a Future for Epidemiology: II. From Black Box to Chinese Boxes and eco-epidemiology." *American Journal of Public Health.* 86.5 (1996): 674-677.
10 Irum Shaikh. "Critically Analyse the Different Approaches of Eco Health, One Health, Planetary Health and Political Economy and Political Ecology of Global Health to Analyse Current Challenges in the Anthropocene." *Journal of Ecosystem and Ecography.* 8.1 (2018): 252.

ethnographically situate the grounded meshwork of elements and processes through which these researchers make Arequipa, presently, a site for One Health and, simultaneously render canine rabies as an infectious disease system model.

Despite their integrative orientation to understanding disease dynamics, however, they encounter difficulties translating eco-epidemiological insights into proposals for eco-bio-social interventions that are not *only* biomedical in nature. In actuality, the reasons for this are surprisingly simple and have a lot to do with matters of funding, jurisdiction, scale, and political-economic needs for quick and cost-efficient interventions. Rather than empirically diagnose the limits of my interlocuters' situation, critique their shortcomings, or even make a classically anthropological argument for the need and value of social medicine, I conclude the chapter in pursuit of a more speculative mode of analysis. I will consider whether the difficulty of translating eco-bio-social analyses of disease epidemiology into eco-bio-social public health interventions is a consequence of how the "human-animal-environment interface" is conceptualized. I engage the following question: how might reconceptualizing the interface as a processual and phenomenological event rather than a spatially locatable site or systems coordinate open up additional possibilities for One Health approaches to global health, specifically when it comes to improving capacities to translate knowing otherwise into doing differently?

Part I. Eco-Epidemiological and Biosocial Concepts of Disease

The One Health Approach to Global Health

One Health is an holistic approach to global health research that emphasizes the interconnectedness between human, animal, and environmental health. Concomitantly, it encourages infectious disease researchers to integrate variables impacting human, animal, and environmental health – and the dynamic interactions between each of these – into their explanatory frameworks of disease emergence and transmission (see figure below). Among my interlocuters – namely, infectious disease epidemiologists – One Health is frequently described as an implementation strategy that guides the design and facilitates the activation of research priorities by promoting multidisciplinary collaboration and cross-sectoral partnerships to achieve better public health outcomes for people, domestic animals, wildlife, and the environments in which they live. In other words, One Health not only shifts epidemiological attention to disease emergence and transmission at the 'human-animal-environment interface' but further influences how this reorientation ought to be enacted, that is, at the interface of multiple disciplines or specializations.

What stands out most to me about the One Health approach is the ecological lens through which disease emergence and pathogenesis are reconceptualized, coupled with its recognition of health as a multispecies problem warranting multidisciplinary inquiry. While some of my interlocuters across Peru suggest that the emphasis on multidisciplinarity is not particular to One Health, but to global health more broadly, several of my interlocuters in Arequipa suggest that One Health is indicative of a paradigm shift in epidemiological thought precisely because rethinking health and disease ecologically, that is, relationally requires new epistemological orientations, affects, concepts, and practices.

Whereas conceptions of health and disease, including population-level mitigation of the latter, have long been pursued primarily if not exclusively as problems for humans and likewise studied

primarily if not exclusively by specialists in departments of life science and human medicine, One Health reconceptualizes health and disease as a more than human problem, that is, as a multispecies problem insofar humans co-exist and interact with fellow nonhuman existents with whom they mediate the transmission of and share susceptibility to disease-causing pathogens. The notion of One Health emerges in this assembling of human-nonhuman interactions, which collectively compose an ecosystem for disease.

By situating the problem of health within a wider biosocial ecosystem and multispecies disease ecology, One Health challenges us to rethink the centrality of the human and the primacy of human health in worlds co-populated by nonhuman others, including disease-causing pathogens. Emphasizing the interconnectedness of humans, animals, and environments is thus a crucial step in thinking ecologically about disease precisely because it shifts the question of health beyond human populations alone and relocates disease in the interfaces between humans, animals, and environments. The correlative call for multidisciplinary collaboration is equally crucial for thinking ecologically about disease because such work does not presuppose the epistemological primacy of any one viewpoint (i.e. human medicine) on how health and disease work.

To think ecologically about disease, in other words, is to recognize the partial distributions of agency amidst a plurality of practices (i.e. species) and points of view (i.e. specialists) that co-participate in the creation of relational worlds. An ecological viewpoint therefore envisions a many-to-many mapping of relations, in which movements and pathways connect and intersect multiple worlds. A multispecies disease ecology, in this sense, might be something like a topography simultaneously composed and traversed by various kinds of practicing agents, things, processes and objects.

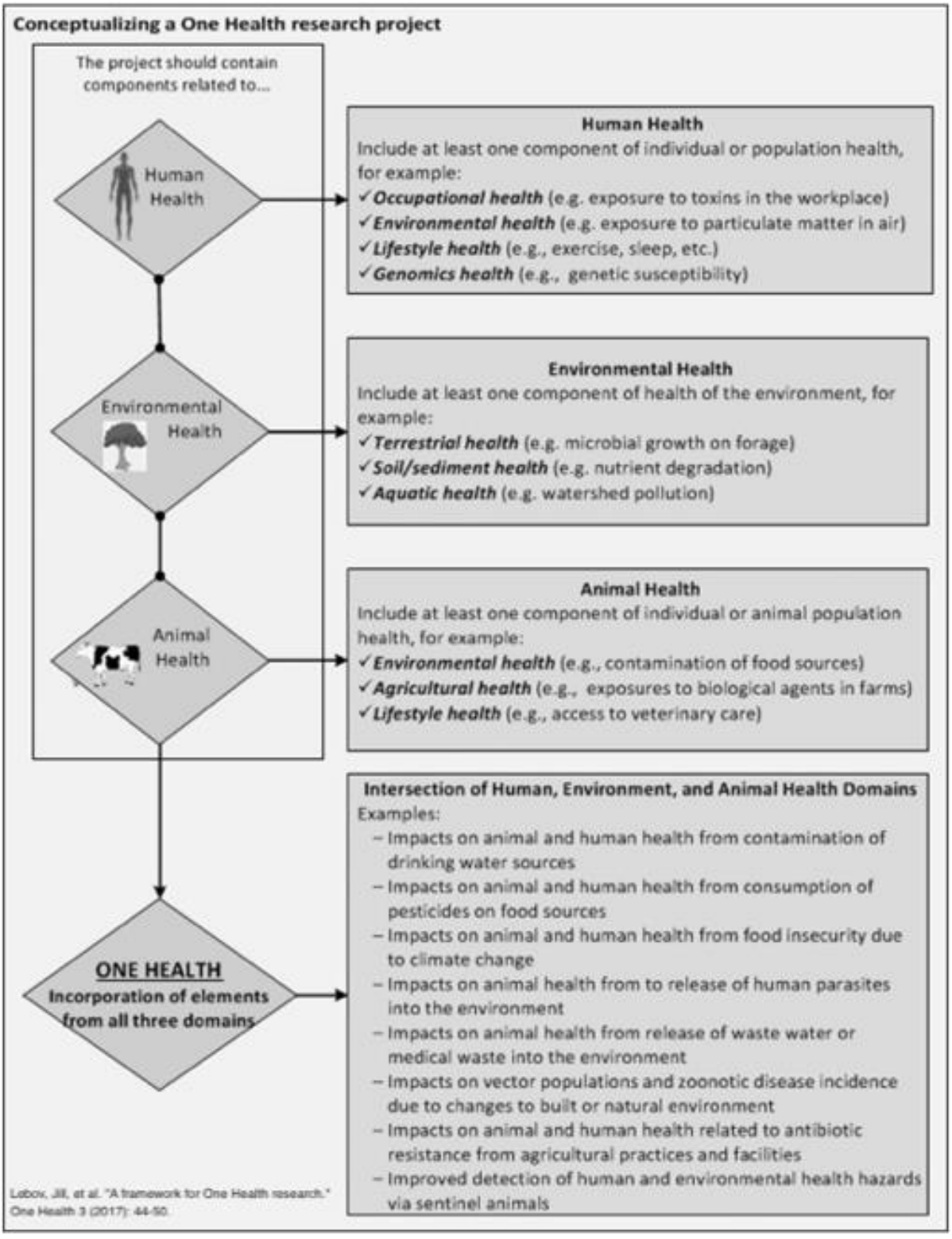


Fig 5. Conceptualization of a One Health research project.

Eco-Epidemiology of Infectious Disease

Before I ethnographically describe some of the epidemiological modelling techniques that my interlocuters use to surveil patterns of rabies distribution in a One Health frame, I must first situate a few more terms and conceptual frameworks.

"Eco-epidemiology" is a thought style that resonates with One Health in that both are premised upon ecological theories of disease causation. Both foreground the relations between and within organisms and localized structures that are otherwise bounded socially, biologically, or topographically. In an eco-epidemiology approach, multiple causative agents – inclusive of their interactions – are assumed to mediate disease emergence and transmission.

Eco-epidemiology emerges from developments in social and life-course epidemiology, multilevel analyses, and other cross-dimensional approaches to infectious disease research. It contrasts with conventional approaches to infectious disease that tend to treat pathogenic agents, host populations, and environments as three distinct levels of organization in the patterning of disease, each of which requires a unique form of specialized inquiry. Eco-epidemiological approaches to infectious disease, on the other hand, treat pathogenic agents, organismal hosts, and the environments in which they are ensconced as three distinct yet interacting levels that collectively comprise a complex disease system. Understanding health and disease, in this eco-epidemiological frame, requires researchers to analyze ALL levels of organizations including their interactions.

From this perspective, any analysis of rabies transmission at the molecular level will provide an important yet incomplete understanding of rabies. Similarly, studying the social determinants of rabies transmission would provide only a part of the picture as would only focusing on the

environmental drivers of rabies. Eco-epidemiology seeks the 'whole picture' by directing attention away from any one level of analysis on its own towards a more holistic comprehension of the multiple ways in which these levels interact with one another. In this regard, eco-epidemiology envisages disease as an interactive system, that is, as an assembly of factors connected with each other in some form of coherent relationship.

In a multispecies disease ecology, for example, eco-epidemiologists might consider the human body as a system composed of circulatory, nervous, and reproductive systems. Multi-species ethnographers might consider the human body, too, as an assemblage composed of human-microbial communities. To be sure, the same could be said for animal bodies. Humans and animal co-existence, so-called social life, comprise complex systems of ordered and dynamic relations, as well. While the universe is a system of vast scale, a molecule is one of miniscule scale.

When my interlocuters suggest that One Health indicates a paradigm shift in epidemiology, I believe such claims are inseparable from eco-epidemiological ways of thinking. My claim is this: both One Health and eco-epidemiology apply systems-thinking to explain disease emergence and transmission in ways require ecological perspectives. Indeed, One Health proponents argue that human health does not exist in a vacuum and, as such, must be studied in relation to animal and environmental health – One Health is the study of health and disease in this multispecies ecology. Similarly, proponents of eco-epidemiology argue that molecules do not exist in a vacuum, nor do humans or environmental phenomena. and that all of them must be studied together – eco-epidemiology is the study of health and disease in this complex ecosystem.

Perhaps nowhere is such attention to *the interfaces* that make up a disease ecosystem and *the relations* between systems enveloped in other systems more visible today than in the One Health

approach to global health research and the eco-epidemiological approach to zoonotic infectious disease epidemiology. One Health and eco-epidemiological approaches overlap in their broad conceptualization of disease emergence as situated within an ecology of multidimensional interrelationships. Indeed, my interlocuters in Arequipa spoke interchangeably about the influences of One Health and eco-epidemiology on their orientation to rabies as a dynamic system whose specificity emerges not through the particularity of any pathogenic agent or host population alone, but through localized host-agent-environment interactions, at biological-social-environmental levels of organization, at molecular-individual-populational scales of analysis, and at human-dog-sidewalk interfaces.

The One Health triad, when compared to the classic epidemiological triad (above), would understand disease causation in terms of multiple species and their shared environs, which collectively constitute any given disease as a system whose specificity emerges not through the inherent particularities of the pathogenic agent nor the environment nor the biosocial practices of its organismal host, but through localized host-agent-environment interactions and interdependencies between humans, animals, and their shared environs. In other words, in eco-

epidemiological One Health approaches, disease is not to be attributed to nor ameliorated at any individual point alone, but in the relational and overlapping dynamics of multispecies and multilevel interactions that constitute the overall disease situation.

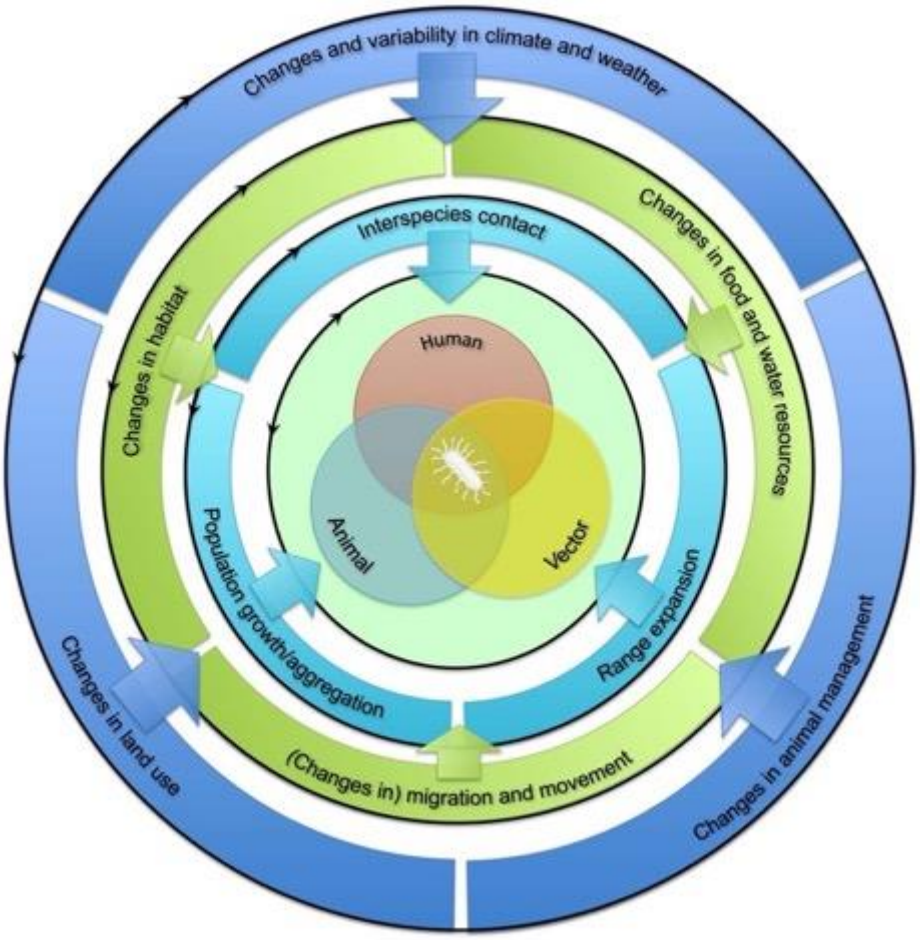


Figure 6. Framework for the classification of drivers of human exposure to animal pathogens (interspecies barrier). doi:10.1371/journal.ppat.1004129.g001

Biosocial Conception of Disease

From the perspective of medical anthropology, both the One Health and eco-epidemiological approaches can be seen as building upon a *biosocial* notion of health and disease. For decades, inquirers in this subfield of cultural anthropology have critically illuminated the tendencies in

biomedicine and global public health research to focus predominantly if not exclusively on biologic causes of disease[11]. A biosocial approach, on the other hand, posits that such biologic processes are inflected by society, political economy, history, and culture – and are thus best understood as interactions of biological and social processes (Farmer et al). In other words, health and disease cannot be reduced to biology because biology is inseparable from the social and ecological processes that condition it. This is not to say that health and disease are socially or environmentally determined, but that health and disease are engendered in and through the complex interactions between individuals and their local contexts.

What biosocial, multispecies, One Health, and eco-epidemiological lenses share in common is this: ecological thinking is required to hold together multi-scalar and polyvalent phenomena including their interactions and the assemblage of actors and practices such interrelationships compose.

What I hope to add to this conversation on the re-conceptualization of health in ecological terms is an analysis of disease in terms of movement and motion, that is, as existing not only in organismal bodies nor in the pathways of transmission between them, but constituted by the very processes of organismal movement and self-other interaction that precipitate moments of encounter between pathogens, species, and environments. I will attempt this in Part III. For now, I seek to illustrate how One Health and eco-epidemiology were enacted in Arequipa, Peru.

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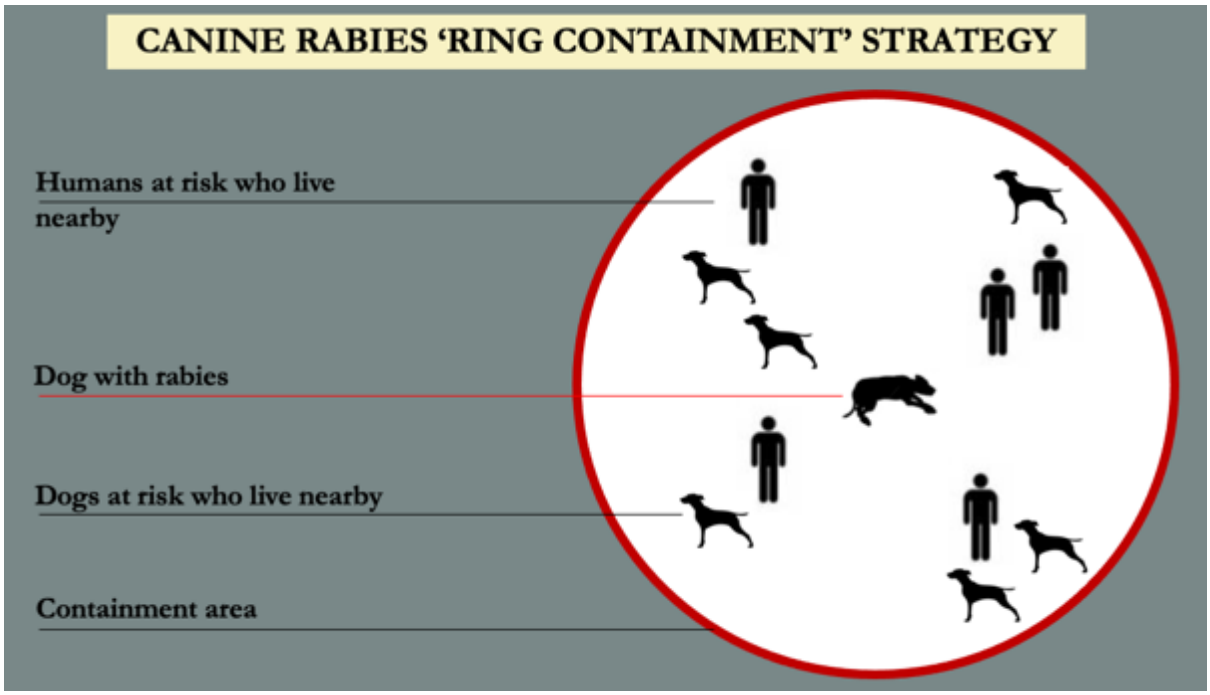
11 On biosociality and citizenship, see: Rose, Nikolas, and Carlos Novas. "Biological citizenship." *Global assemblages: Technology, politics, and ethics as anthropological problems* (2005): 439-463 and Petryna, Adriana. "Biological citizenship: The science and politics of Chernobyl-exposed populations." *Osiris* 19 (2004): 250-265. For medical anthropology ethnographies that critically examine the social situatedness of disease see: Roberts, Elizabeth FS. *God's laboratory: assisted reproduction in the Andes*. Univ of California Press, 2012. Also: Scheper-Hughes, Nancy. *Saints, scholars, and schizophrenics: Mental illness in rural Ireland, updated and expanded*. Univ of California Press, 2001. Also: Giordano, Cristiana. *Migrants in translation: Caring and the logics of difference in contemporary Italy*. Univ of California Press, 2014. To list but a few.

Part II. One Health in the Field

As of 2019, local health authorities in Arequipa had identified more than 150 rabid dogs in 11 out of 14 districts of the city. Fortunately, no human cases have been detected in Arequipa, but several people have been bitten, including by puppies 'rescued' from off the streets and taken home as pets. Since bites from rabies-infected dogs invariably lead to a 100% case fatality rate in humans, the control and elimination of this infectious viral disease among the urban dog population is being treated as a crucial global public health concern.



After a rabid dog in Arequipa is detected, the official public health response is to conduct what is called 'ring containment'. The principle of ring containment is adapted from ring vaccination where all contacts with a positive case are immunized, creating a buffer that is intended to prevent

any further spread of disease. In Arequipa, this entails delineating an area around the body of a rabies-positive dog, typically a radius of 3-5 blocks in every direction. Walking house-to-house, officials prophylactically treat exposed or bitten humans, vaccinate unexposed pets, and kill any potentially exposed dogs (most of which lack discernable owners, but are sometimes people's pets). This highly visible measure is meant to allay community concern in affected areas, but it also disturbs most dog owners. And it absolutely outrages an increasingly-organized contingent of local *animalistas* or animal rights activists. It also frustrates veterinary epidemiologists studying the disease, whose analyses conclude that dog slaughter is not an effective method for the control of dog-mediated rabies.[12]

It has been quantified that up to 75% of dogs-with-owners in Arequipa have outdoor access at various points throughout the day: times where they roam the streets freely. Officials and residents also report that large packs of dogs have been seen moving along the dry water channels that crisscross the city like meshwork. Especially in districts where waste management services are not guaranteed, residents who don't burn their household's trash instead dump it throughout the channels, where the dogs then assemble to feed on the expanses of garbage that humans have disposed there.

During several extended visits to Arequipa, I conducted fieldwork adjacent to a team of veterinarians, biostatistical epidemiologists, and disease ecologists who are studying the situation. They suspect that Arequipa's unique urban landscape, characterized by its large open canals, could be playing a central role in the virus' ongoing transmission. Their hypothesis is that these channels

12 For evidence of this, see: Castillo-Neyra, Ricardo, Michael Z. Levy, and Cesar Náquira. "Efecto del sacrificio de perros vagabundos en el control de la rabia canina." *Revista Peruana de Medicina Experimental y Salud Pública* 33 (2016): 772-779.

are functioning like “ecological corridors,” passages through which both dogs and viral matter move around the city, connecting otherwise spatially separate dog packs, in geographically non-contiguous parts of the city, to one another, thereby facilitating the virus’ variable spatial distribution.

In the next subsection, I describe some of the epidemiological modelling techniques that these researchers are using to surveil the movement of dogs, map the distribution of rabies across the city, and determine whether there is a spatial association between positive rabies cases and proximity to the water channels. In other words, their researches draw attention to the relationships between rabies virus, dogs, and the water channels in order to establish evidence that the dog-environment interface plays a role in the ecology of urban canine rabies.

By focusing on the interface between virus, dogs and water channels, the veterinary epidemiologists in Arequipa approach rabies spatially. They chart the movement of dogs and viral pathogens through the urban landscape, studying the boundaries that built environments facilitate for the movement patterns of pathogens and species therein. In an eco-epidemiological mode, they correlate these findings with molecular analyses conducted in their lab, testing positive viral samples they acquire from the local ministry of health, in conjunction with social scientific research they perform with local residents of Arequipa regarding their dog vaccination practices.

A pack of free roaming dogs crosses an urban street in Arequipa, Peru

Dogs moving through a dry water channel

Water channels traversing Arequipa city are dry most of the year. They accumulate trash and attract free roaming dogs.

Still, what stands out most to me about their eco-epidemiological approach to rabies is the emphasis they place on the built environment's function as more than a mechanism for disease spread, but an active contributor to it, too. In several but not all of their studies, 'environment' is

not reduced to a passive backdrop upon which multispecies interactions between viruses, animals, and humans abound. Rather, as I will illustrate, environment is correspondingly understood as an active participant in processes of disease patterning across human-animal-pathogen interfaces.

Indeed, the observation that dogs move along dry water channels throughout the city led my interlocuters to consider whether these urban structures could be playing a central role in the virus' ongoing transmission. According to them, paying attention to the concrete specificities of these local dog-environment relationships is crucial for understanding the dynamics of rabies transmission in Arequipa, and they are keen to establish how features of the built urban environment co-participate in its spread. As such, they experiment with and increasingly advocate for the incorporation of concepts and practices from landscape ecology into epidemiological models of disease distribution, specifically to assist them in understanding the impact of urban structures on control activities and the persistence of transmission.

Mapping and Modelling Dog Movement

First, the research team created a geographic information system (GIS) with surveillance data pinpointing the precise locations in which rabid dogs were detected by authorities during the first year of the outbreak. To their model they also added the geospatial coordinates of the city's water channels, which they gathered both from satellite data and from walking around the city with GPS device. Based on this information alone, my interlocuters determined via clustering analyses that there is, in fact, a spatial association between positive infections and the proximity of those infections to the water channels. In a statistical spinoff study, they compared their real GIS data of identified rabies cases with simulated Monte Carlo random-labeling data to establish a statistically significant spatial association between the rabid dogs and the channels.

In a more recent study, they attached GPS collars to healthy dogs to track their movements through the city's channels. Then, using a methodology called Time Local Convex Hulls (T-LoCoH), they geospatially mapped the areas dogs roamed on a periodic basis, known as their 'home ranges', which, notably, is a concept from landscape ecology (along with the notion of 'ecological corridors').

The modeling practices of my interlocuters for mapping disease distribution and urban canine movement seem to reflect a reconceptualization of disease in terms of animal-environment interactions and viral movement through space. At the same time, there appears to be a lacuna within spatial epidemiology, between its theoretical models for conceptualizing disease in terms of interrelatedness and its techno-empirical models for spatially mapping movement across landscapes. At least for me, it remains unclear whether they are more invested in mapping the

distribution of the rabies virus *as* dogs-in-environments or whether they are modelling the movement of pathogens along paths?

The conceptual stakes of the distinction (between distribution maps and movement models) are such: the former reinforces a familiarity duality between agent/environment and active/passive insofar as the agent-in-environment relation is rendered hierarchically and insofar as only agents are considered active (*animus*) while environment is rendered passive. The latter formulation, however, seems to collapse the distinctions between agent/environment and active/passive insofar as the movement of agents *through* (distinct from 'on' or 'in') environment ascribes to both terms dynamic characteristics of inter-activity.

To explicate this difference and its conceptual stakes a bit more clearly, I make a slight detour. In the next subsection, I describe a different project conducted by the same research group in Arequipa for modelling Chagas infestations on urban blocks. Then I return to their GPS dog collar project in order to compare their how these different spatial modeling practices differently constrain their ways of thinking about the relationship disease and the interface, itself.

Ecological corridors and permeable barriers

In Arequipa, Chagas disease is caused a vector-borne parasitic infection that has been spreading into more urbanized parts of the city over the last 40 years. The parasitic agent is *Trypanosoma cruzi* and is spread by blood-sucking *triatomine* insects, aka: kissing bugs for their tendency to bite/defecate/transmit the pathogen near sleeping human's mouths. There are some drugs to treat Chagas disease, although they become less effective the longer a person is infected. Additionally, there is variable latency in the presentation of symptoms, which means infected persons may be

contagious but asymptomatic for decades until chronic systems manifest. The lack of a vaccine also means that the most effective way to control the disease is to control the disease vectors.

Since 2003, the regional ministry of health of Arequipa began an inspection and insecticide spray campaign targeting *T. infestans*, which has substantially decreased the prevalence of parasite and vector populations in metropolitan Arequipa. However, *T. infestans* are still occasionally observed and targeted surveillance is ongoing: residents may report infestations while inspectors proactively search households for vectors. To aid in these surveillance efforts, the team of epidemiologists with whom I conducted participant-observation built a statistical model that calculates infestation risk estimates using data from the earlier spray campaign (or control phase) in combination with new data collected during the surveillance phase. Then, they developed this into a mobile app that visualizes the predictive data in the form of a neighborhood map that displays relative risk of re-infestation at the individual house level.

The map is intended to be used by health inspectors annually carry out daily and weekly surveillance, who can incorporate the information into their search strategies – for example, to target high risk houses or to achieve wider spatial coverage in a given locality.

Interestingly, the team established that there is a highly spatial aspect to vector distribution patterns in urban Arequipa: they found that the insects are more likely to move within city blocks than to cross a street. They confirmed this observation through geo-genetic techniques and hypothesized

that city streets function as "semi-permeable barriers[13]" that regulate urban insect vector movement and thus infestation.

For their next modeling project, they endeavored to incorporate the concept of streets as permeable barriers into their risk calculations, as to more accurately predict the probability of vector distribution and infestations for the risk maps. The goal was to develop a geostatistical model that incorporates city streets as permeable barriers and to apply it to data on Chagas disease vectors. To create the risk maps, they used a variant of Gaussian Markov Random Fields (GMRFs), a spatial statistic methodology for modeling small area risk ensembles spatially upon a surface. Geostatistical models that use Gaussian Fields (GFs) assume the data is a continuous stochastic process over a two-dimensional plane upon which locations can be measured as a function of the Euclidean distance between.

In less jargony language: this type of model imagines data points existing on a flat, 2-dimensional, undirected graph. The Markovian Random effect in GF models implicitly specifies that houses (points) which are close together (on the graph) tend to adjust similarly to the log relative risk, which is based on a general assumption that nearby disease risks are likely to be more similar than those further apart. So the modelling challenge was: how to incorporate urban streets - as a heterogeneous and agentive feature of the landscape - into an otherwise homogenous plane such that vector movement between city blocks would be reduced when compared to movement within blocks regardless of the spatial distance between houses on the same block?

13 Streets act as semi-permeable barriers to the spread of *T. infestans* insofar as they significantly affect the relative probability of infestations in the urban landscape. See: Gutfraind, Alexander, et al. "Integrating evidence, models and maps to enhance Chagas disease vector surveillance." *PLoS neglected tropical diseases* 12.11 (2018): e0006883.

They added a parameter to the model that creates additional Euclidean distances between houses on different blocks, while maintaining true Euclidean distances between houses on the same block. By spatially distorting the map, they were able to model the concept of permeable barriers insofar as these barriers functionally influenced the model directly through the spatial covariance structure by widening the streets, or adding distance, between blocks.

By permitting landscape – streets as permeable barriers – to function agentively in the distribution patterns of infestations, they could calculate risks of re-infestation and possibly predict the trajectories of vector movement. These models were probabilistic and stochastic, that is, they established the extent to which an event is likely to occur (as opposed to mechanistic models – i.e explaining how something works). However, by focusing on risk probabilities, the mechanisms of vector movement (the *how of through-ness*) get inevitably black-boxed, that is, their modeling practices account for the agency of landscape in co-constitution of the vector-environment interface, but they do very little to explain the movement of vectors themselves.

What I wish to draw attention to is a pervasive ambivalence regarding the status of landscape and perhaps an inadequacy in language or syntax for describing movement: On the one hand, streets are figured as environmental variables that are agentially inter-related with vector movement: streets *function* as permeable barriers that separate blocks and *reduce* vector movement between blocks compared to within blocks. But, to translate this correlation algorithmically involves distortion – streets get integrated into the equation as additional Euclidean distances between houses on blocks. They are flattened and stretched along a 2D plane, becoming part of the plane itself. Highly local (specific) landscape gets reduced, transformed, counterposed into a general and abstract space measured in terms of distance. In other words, that which is theorized as agential is

incorporated into the model as part of the inanimate spatial background upon which stochastic processes occur. In the processes of modeling their agency, streets lose their agency.

Paradoxically, in order to integrate active landscapes into a geostatistical model, they convert the landscape into geo-space (increase the scalar relationship by 2). This approach is clever methodologically, but it remains conceptually problematic because it obfuscates the relationship between landscape and movement. The original epidemiological question was how to think about the interrelatedness of environment and agent, or landscape and vector movement, but this is translated computationally into risk estimates of vector presence at different locations in geographical space. Movement disappears (cannot be seen nor visualized; it can be interpreted through inference); landscape loses its specificity (abstracted into space) as well as its interrelatedness with vector movement (in the model, it exists as a parameter that describes relations between blocks and distance between houses, not the movement of vectors).

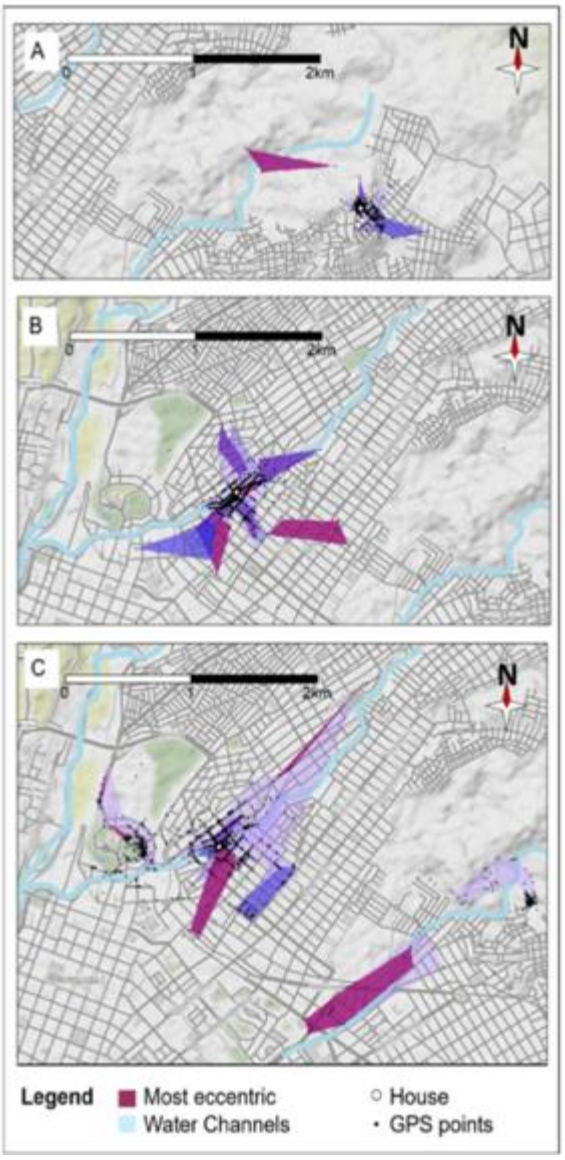
This is not just a matter of Euclidean space and geometrical shapes and densities – similar issues also manifest in non-Euclidean spatial models, for example in the team's GPS collar dog movement study:

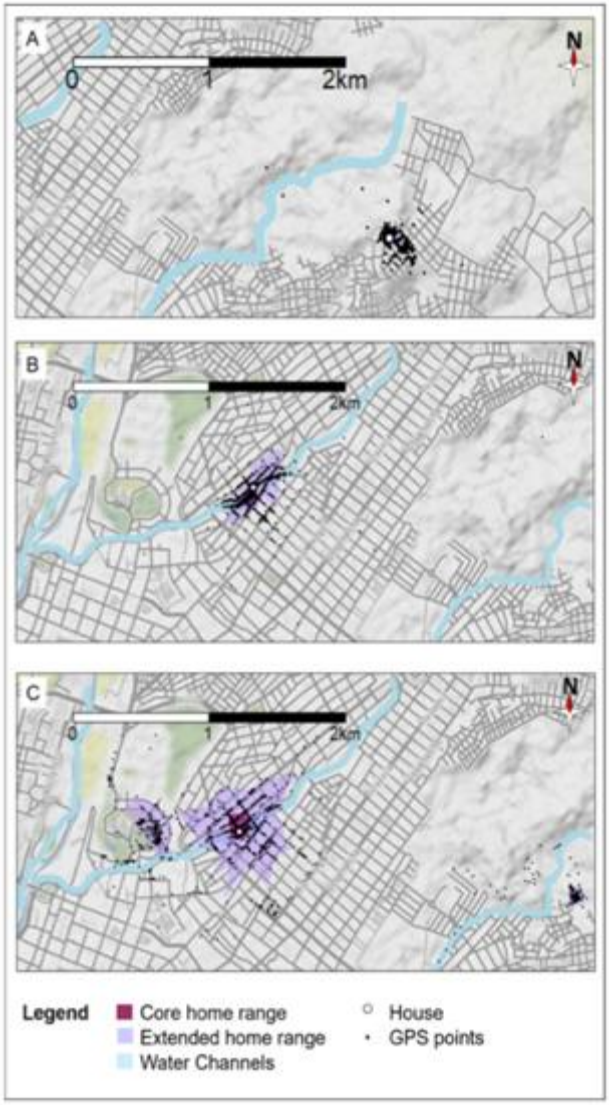
The logic behind the GPS dog collar study was that if rabid dogs are moving through the water channels, then understanding the landscape dynamics supporting dog ecology could play a critical role in understanding, and intervening into, rabies as a disease system. There was a moral impulse behind this study, too, because it could potentially generate evidence that could be used to deter the ineffective and inhumane MINSA protocols, themselves spatially-determined, that included forming a 5km ring around identified rabid dog corpses and killing all potentially exposed dogs in the area. Strategically, the epidemiologists wanted to put an end to this convention due to their

concerns that such practices might actually increase the spread of rabies virus by increasing movement of dogs beyond the slaughter areas, thus increasing the rate of contact between dogs remaining in the area, as well as between dogs in new territories in search of new packs, which could increase fighting, biting, and viral transmission.[14]

Using GPS data from collars they had attached to dogs participating in their study, time-stamped data could be incorporated into the algorithm via an alternative measure of 'distance', called time scaled distance (TSD). Unlike the model for Chagas, this model for Rabies uses TSD rather than Euclidean distance to essentially draw lines between time-stamped data points, resulting in 'hulls', or shells, that are localized in both space and time using the GPS and GIS data. Hulls are then sorted and progressively unioned into isopleths, which look like polygonal shapes indicating the frequency of movement between any two points. Conceptually, TSD transforms the period of time between two points into spatial units by estimating how far the dog could have traveled during the time period, once maximum speed is set as a parameter. This theoretical movement distance is then mapped onto a third axis of space, and distance is calculated using standard Euclidean distance equations.

14 For a literature review with supporting evidence see: Castillo-Neyra, Ricardo, Michael Z. Levy, and Cesar Náquira. "Effect of free-roaming dogs culling on the control of canine rabies." *Revista peruana de medicina experimental y salud publica* 33.4 (2016): 772-779.





In this model, the researchers are interested in the dog-channel relationship, particularly whether they could prove that the channels were functioning like ecological corridors, facilitating the spread of rabies across noncontiguous parts of the city. Unlike the Chagas model for estimating and mapping risks of re-infestation, this Rabies model is mapping areas of movement localized in space and time - territory and periodicity/frequency. The models use different data inputs: For Chagas, they use historical data (previously infested/un-infested houses; fumigated/not-

fumigated), geo-spatial data (house location, distance between locations, and streets as permeable barriers) to create predictive maps of re-infestation risk. For rabies, they use spatio-temporal GPS data to create maps of dog movement along water channels. They use different methods to analyze the data: For Chagas, GFs, INLA, Bayesian inference, all of which are parametric. For rabies, they use the non-parametric method of T-LoCoH, integrating time with space in the construction of local hulls through a scaling that relates distance and time in reference to the individual's velocity. It is not individual points in abstract Euclidean space that are the units of analysis, but localized hulls (or shells) over real landscapes, enabling spatial and temporal metrics for movement, such as direction (distinct from distribution).

What I am trying to draw out is that, despite my interlocuters' theoretical inclinations towards understanding the landscape-based system specificity of infectious diseases, they end up abstracting so much ecological specificity out of their models. By specificity, I suppose I mean reality: the specifics of reality do not make it into the models. As such, the Chagas risk distribution model not only flattens reality but reshapes it in its own image. In the process of flattening urban landscapes into abstract space, they are able to model the characteristic of 'permeability' – by adding distance. They can also model the 'force' of landscape on vector movement.

But none of this constitutes an ecological, as in relational, understanding of disease dynamics. These models do not account for the specific ways in which the spatial characteristics of variables are borne out of their *relations with* one another to produce disease and stabilize disease systems. Contradictorily, they 'configure' their risk geographies according to a 'contamination' model of disease and disease spread. Nowhere in these models can rabies or chagas be seen as a socio-economic disease – riddled with all manners of economic, social and cultural relations (see

Hinchcliffe 2013). Why, in modeling the agency of landscape, do these other variables lose their agency?

In modeling 'the vector-environment interface' as a mappable spatial site, the researchers seem to lose their capacity to account for the specificity of ecological (not environmental) drivers influencing 'human-nonhuman encounter'. The terminological distinction here is disciplinary: the concept of encounter is tied to an anthropological theory of relationality, which does not claim that everything is interconnected (in advance) or that relations have ontological priority over acts of relating. Encounter requires treating relationality technically rather than generally, emphasizing not simply the fact of relatedness but the manners and motions that specific relations may take (see Hustak and Myers). Without attention to encounters, the epidemiologists cannot raise the question of how heterogeneous beings come to matter to each other, not just to human observers. Any understanding of the vital agencies of nonhuman animals and insects – and the dynamics they engender in the disease systems they are modeling – are thus overdetermined by behavioral models and reduced to mechanistic accounts of transmission.[15]

Landscape and Human Movement

Mapping dog movement and modelling dog proximity to the dry water channels are but one part of this team's ongoing effort to ascertain the impact landscape and dog ecology interactions have

15 It would seem that they are not concerned with understanding specific vector-environment interactions (.e.g not concerned with how vectors act **on or with** the streets); but they want to establish some sort of interrelatedness (e.g. how streets relate to vector movement and how vector movement relates to street). What is most interesting to me is that they also do not seem concerned with establishing causality, but of identifying spatially dynamic correlative relations, correlations, co-relations. They are not trying to understand WHY vectors don't cross streets or WHY dogs use the water channels, but they are in some sense modeling HOW animals move across landscape, and they are acknowledging/exploring THAT landscape influences the play of multi-causal factors comprising animal ecology and multispecies disease ecology.

upon canine rabies' endurance in Arequipa. Glaringly – at least to me – what is missing from this innovative, interdisciplinary analysis … are the humans! In particular, those who would here constitute the humans in the human-environment-dog interface: the city residents letting their dogs roam the city, sometimes vaccinating or not vaccinating them, and otherwise discarding their trash in the canals, literally feeding the free-roaming dog population, attracting them to the channels.

In a different yet related study, the researchers conducted a door-to-door survey with more than 6,000 houses in Arequipa to assess the "social determinants" associated with participated in a mass dog vaccination campaign. They found a significant spatial clustering of unvaccinated dogs more than 500 meters from fixed vaccination points, which created pockets of unvaccinated capable of sustaining rabies virus transmission. They also found that dog owners' participation in community-based dog vaccination campaigns was affected by their spatial proximity to the closest fixed vaccination point. In short: if the vaccination points were too far away, people didn't bring their dogs to get vaccinated.

Interestingly, the researchers found that vaccination coverage was more 'patchy' in localities served by mobile vaccination teams, that is, with volunteers driving around with to people's houses rather than requiring individuals to bring their dogs to a fixed location. This was partly due to temporal inconsistency: the same localities are not always served with the same approach (e.g. a locality served with mobile teams in 2015 could be served with fixed point vaccination in 2016). In this instance, inconsistency over time contributes to spatially heterogeneous vaccination coverage, which negatively impacts dog rabies control and the possibility for elimination.[16] What I find fascinating about this aspect of their investigations is that it requires thinking about the dog-

16 Castillo-Neyra, Ricardo, et al. "Socio-spatial heterogeneity in participation in mass dog rabies vaccination campaigns, Arequipa, Peru." *PLoS neglected tropical diseases* 13.8 (2019): e0007600.

human-environment interface *over time*. It adds a temporal dimension to the interface as a process and not just a site of encounter, whether between dogs and viruses or virus-inhibiting vaccines. Moreover, it gestures towards some of the structural barriers (e.g. access to health facilities and vaccination points) that contribute to the maintenance of canine rabies as a complex disease system, in which spatial inequities impacting human-dog relationships (multispecies biosocialities) are as much a part of the urban landscape as the geospatial features of the city itself.

Representing (Ecologically) and Intervening (Biomedically)

As many anthropologists have pointed out before me, the specific models and the concomitant sets of assumptions each carries, concretize respectively different styles of thinking about disease - and the world - and thus lead to different ways of intervening in it. But my interlocuters' modelling practices, interestingly, are not *directly* aimed at intervening into rabies transmission. They are not scenario planning nor estimating magnitudes of future outbreaks. The geospatial data generated by their models *could*, indeed, be leveraged to predict the geographical extent of a future outbreak in the area. But, in terms of intervention, the types of evidence they're producing actually best support intervening into the existing rabies interventions and responses, the ones that rely upon ring containment strategies and mass dog slaughters and inconsistent/intermittent vaccination approaches (i.e. fixed or mobile). For if dogs are, in fact, roaming along these corridors, and their movements connect noncontiguous areas of the urban landscape, then it becomes very apparent that small-scale ring containment measures are highly ineffective.

Between my interlocuters and the Arequipeño health officials, there seems to be two different models both of disease and of space. The public health officials' response-practices correspond to a 'contamination' model of disease and a 'container' model of space – which isolates an infectious

body, circumscribes an enclosed perimeter around it, and decontaminates whomever or whatever is within that area. Th17e epidemiologists, on the other hand, adhere more to a 'configuration' model of disease and a 'connective' model of space that is primarily focused upon the assembly of factors facilitating pathogenesis through the channels as connective corridors.

This leads to important differences, namely, the epidemiologists argue that authorities should take the functionality of the channels as ecological urban corridors into account and recommend against the culling of dogs. Even still, the differences between these approaches are not actually translating into substantially different forms of public health intervention! In fact, the conclusions that the epidemiologists draw from their own analyses and the recommendations they subsequently propose are not too dissimilar from what the local public health ministry already recommends. Despite the innovative insights into the role of environment and space on disease dynamics and vaccination campaign participation, ultimately, they all reiterate the need to increase dog vaccination coverage to halt canine rabies transmission in the city.

Versions of Biosecurity

Another significant difference arises in the tension between the official public health protocols and the global health epidemiologists' recommendations, here, with regards to the question of biosecurity 'best practices'. Culling has been widely recommended by the WHO and FAO as "the first line of defense" for containing certain zoonotic viruses, for example, avian influenza, particularly in the immediate aftermath and vicinity of a confirmed outbreak. The protocols carried out by the Ministry of Health (MINSA) in Arequipa, in this regard, are entirely aligned with global health security strategies proposed by some of global health's most powerful transnational actors.

17 Anderson, Warwick. "The history in epidemiology." *International journal of epidemiology* 48.3 (2019): 672-674.

At the same time, the global health epidemiologists' suggestions against culling are also leveraged in the name of security, albeit a more configuration-centric version that is concerned less with the boundary-securing practices that imbue ring containment than with the viral circulation-management version of security.

In other words, a number of different ways of viewing and doing security are operating in Arequipa, and they do not always operate consistently within themselves or in contradistinction to one another. For as much as the eco-epidemiologists lambast the perimeter-securing practices of MINSA as ineffective and possibly dangerous given the movement of dogs and the circulation of rabies virus across large swaths of territory, they nonetheless also concede to a territorial version of security aimed at demarcating certain spaces (e.g. water channels). While MINSA may appear to be policing the boundaries 5km around an positively identified rabies case, the eco-epidemiologists are monitoring canine proximity to and movement through the water channels as connective interfaces. In Arequipa, borders and interfaces – despite their conceptual distinction – are nonetheless oriented towards by public health and global health experts as similarly spatial, that is, territorially locatable and mappable aspects of a controllable environment.

Every year, the MINSA in Arequipa organizes annual mass canine rabies vaccination campaigns, which are widely viewed as the most effective, evidence-based strategy to eliminate canine rabies and canine-mediated human rabies. In July of 2018, I joined the epidemiologists as they assisted the Arequipa MINSA in offering free, voluntary vaccinations across the city, promoting the campaign by knocking on doors and shouting from trucks using megaphones. MINSA protocol requires that human owners bring their dogs to vaccination points voluntarily; health personnel cannot seek out and vaccinate unattended dogs, even though dogs-without-owners comprise a large

portion of the dog population that is most susceptible to rabies infection. This presents an obvious problem for achieving the threshold necessary to build herd immunity through vaccination coverage.

There is a characteristic register of technoscientific pragmatism in these proposals to intervene at the level of the dog's body – chiefly, that dog vaccination campaigns are considered the gold standard of rabies prevention and intervention. They have been proven to work. Immunizing dogs *en masse* increases 'herd immunity' among the virus' main reservoir population, tempers the virulence threshold that permits canine infection, and ultimately constrains the possibility for

pathogen transfer between dog bodies and, potentially, to human bodies. Paradigmatically, however, this definitely harkens to a biomedical more so than an ecological approach to disease transmission; for it represents only one level of epidemiological response among many other possible responses, namely those aimed at social and/or environmental loci for intervention.

Remembering that the virus, the dogs, and the humans share an environment that mutually comprises an ecosystem for urban canine rabies transmission, then an eco-epidemiological framework *could* shift attention beyond the dogs / the animal-pathogen interface / or the host-agent relation as the primary locus of intervention. An eco-epidemiological approach might *also* target the humans, the environment, and the human-environment relations as additional, critical

sites of strategic intervention. Practices that link humans to built environs (such as, disposing waste in the dry water channels, polluting them with trash and food scraps), practices that link environments with dog (such as, dogs socializing, breeding, foraging and fighting and sometimes biting each other over food), and practices that link dog to human (such as, the common ownership habits of letting pets roam freely) all constitute additional determinants of this disease situation, and they thus ought to be taken into consideration when shaping intervention as well.

Indeed, my interlocuters are focusing on animals/dogs not as one 'factor' in the disease ecology, but as an entire system. Indeed, they are not just observing dogs, but urban dog ecology, made up of individual doggy immune systems, population dynamics, appetites for trash, and the social organization patterns of forming dog packs, *including* relations with owners and the packs' movements through the urban environment. Without a doubt, they do approach the dogs ecologically, taking into consideration the biological, social, and environmental aspects influencing their lifeworld. They are explicit in wanting to better understand the functionality of the water channels in the spread of disease. But their models for mapping and tracking the distribution of rabies cases are still primarily focused on the dogs alone. These models do not yet account for dog-human interfaces nor human-environment interfaces. Furthermore, by conceptualizing dogs as eco-bio-social agents on the move, they revert to a conceptualization of the channels through which they move as a passive environmental backdrop.

I wonder: if the veterinary epidemiologists were to not only model whether the dogs are using the channels, but also how the dogs become *involved* with the water channels, then perhaps that subtle shift might force them to reckon with the problem of malodorous trash that is, arguably, luring the canines into a problematic agent-host-environment relationship, to begin with. Perhaps the

researchers would be capacitated to subsequently propose a socio-ecological intervention, as well, beyond the biomedical interventions leveled at animal bodies. My claim is that there something about the way in which they conceptualize movement through space that presents an epistemological limit or horizon to their epidemiological terrain.

My point is that by foregrounding the agency of dogs, they end up modeling agential dog movement on empty space. This limit translates into their proposed interventions, which also, become limited insofar as they only target the animal. The problem, as I see it, is that their proposed intervention strategy —vaccination-- externalizes large swaths of the human and environment ecologies that are intimate to the dog ecology in Arequipa and which continues to actively sustain the spread of rabies there. But what surprises me even more here is that their modeling practices DO take the dog-environment interface into account, yet their intervention practices do not target the relational dynamics of (a) the human-environment interface (b) the human-dog interface and how these impact (c) the dog-environment interface in ways that sustain the vitality of rabies in a complex multispecies disease ecosystem.

I'd like to consider the following scenario: say the epidemiologists agree that additional interventions targeting more interfaces are indeed worth pursuing. Say they build a multivariate model to predictively determine the efficacy of different sorts of interventions targeting the human-environment and human-dog interfaces. Say they can establish statistically significant evidence that intervening into human waste practices would alleviate the rabies burden in Arequipa. Then what? As stewards of public health but not other public services like trash collection, waste disposal, or zoning – it becomes organizationally and politically very difficult to translate epidemiological evidence into nonbiomedical interventions that require the participation of non-

health sectors. This is certainly part of why my interlocuters limit their recommendations to vaccinating – it is something that they believe is within their purview.

Of course they collaborate with Arequipa's regional ministry of public health, but 'public health' in Arequipa does not include municipal planning or waste management, which are managed under different bureacratic directorates. To complicate matters, Arequipa is infamous in Peru for its political resistance to 'taking orders' from Lima (it is akin to Texas in America; both seriously contemplated secession at some point in national history). As such, incentives to improve cross-sectoral communication and collaboration would have to come from the ground up and not imposed normatively from 'the center'.

My wager is that this problem will persist as long as infectious disease epidemiology is wedded to public health as an autonomous sphere of governance responsible for disease interventions. Currently, in most towns, cities, and nations, public health researchers and professionals, their practices, and their ethical obligations to serve the sick constitute one ministry or sector or department in an institutional assemblage of social and political sectors, most of which are never even called upon, however needed they may be, to effectively address health and disease as systemic problems. Public health activities are clustered into isolated departments, as Campbell might say. A similar problem presents itself: how to integrate and/or strategically align cross-sectoral commitments to public health?

Part III. Towards More Dynamic Interfaces

Concepts of the Interface

I would like to draw attention to multiple meanings of the interface and ways for conceptualizing about it.

One. A human-animal-environment interface can refer to a locatable and species-specific multispecies interaction, such as a human-mosquito interface (see chapter on Iquitos) or the human-duck interface at a poultry farm in China (see Fearnley 2020) This type of interface designates an interactive site of potential pathogenic transmission between two species co-existing in proximity to one another. The interface is in the field (not the lab). The interface, here, can be explored anthropologically through an investigation into human practices like fishing at sunset, sleeping outdoors without mosquito nets, or agriculture and husbandry of ducks and geese. We can say that the interface causes viral evolution and transmission. Disease emerges at this interface because of biological continuity between species that encounter one another over time.

Two. The interface can denote a relation between species that emerges through other, environmental interactions that are not inherently induced by man. An example would be the human-cow interface after El Nino phenomena in northern Peru, which swept away animals, and their corpses grew anthrax, which infected the humans who stumbled across them. Disease emergence at this type of interface results from a dynamic process involving weather patterns and response efforts (or lack thereof). The emergence of this kind of interface is conditioned by external phenomena and the accidental collision of things.

Three. The interface can signify a conjuncture between two other signifieds. In the human-animal interface, there are three signs: human, animal, and their interface. The interface does not merely connect the other two as in a binary, but constitutes a third space/thing. The interface has a content

of its own, while also it links the other two. It can plotted and mapped, modelled as an individual and agential unit.

Four. The interface results from a dynamic process and is a multispecies dynamic. It thus acquires a temporal dimension. It becomes possible to conceptualize the interface not so much as the site where zoonotic pathogens spread between organisms in an environment, but as a process of contagion and the condition of possibility for zoonotic contagion. Thinking with feminist scholars like Strathern [on the relation],[18] Barad [on intra-actions],[19] and Grosz [on temporal continuity],[20] the interface can be thought of as the pathogen's manner of emerging.

Five. The interface is the dynamic infrastructure of multispecies disease ecologies. It constitutes the landscape of infectious pathogens. It situates humans, animals, environments, and pathogens in open-ended connections with each other in a wider biosocial ecosystem, and facilitates transformations and mutations at the level of their relationships. The interface as a means of transmission, a matter of transformation, a marker of change.

Conclusion

One Health frameworks have encouraged a wide range of experts to begin unprecedented field investigations into emerging zoonotic diseases. These researchers often describe the One Health approach as integrating a wide variety of disciplines around a common question, contrasted to 'reductionist' understandings of disease that tend to focus only at one level of organization, for example, a pathogenic agent disentangled from its relationships with host and environment. On

18 Strathern, Marilyn. *Relation*. Prickly Pear Pamphlets (North America), 1995.
19 Barad, Karen. "Meeting the universe halfway." *Meeting the universe halfway*. Duke University Press, 2007.
20 Grosz, Elizabeth. *The nick of time: Politics, evolution, and the untimely*. Duke University Press, 2004.

the contrary, One Health experts investigate multispecies relationships ecologically to understand relations that contribute to the transmission of diseases across species and spatial boundaries. How those categories and relationships are conceptualized and where those boundaries are drawn matter for how we come to imagine and live with other forms of life. How interfaces are approached matters for where epidemiological attention is focused and not focused, and for how disease processes are conceptualized and researched.

I have tried to chart how this team of One Health epidemiologists reoriented to the human-dog-environment interface in ways that displaced human populations as the primary unit of epidemiological analysis and resituated the problem of human health within a wider biosocial ecosystem. At the same time, this team implicitly reinscribed modernist notions of space, human agency, and control through their proposals for increased biomedicine-based public health intervention into otherwise ecological and multispecies health problems.

In conclusion, my question is: how to scale up epidemiology beyond the domain of public health? Or, inversely, how to extend the problem of health beyond the purview of epidemiologists alone? There seems to be a lag between the emergence of – on the one hand – reconceptualizations of health demanding more non-biomedicalized interventions into disease; and – on the other hand – the infrastructural capacities of governments to intervene ecologically into the health of human and nonhuman populations.

National-Global Security Nexus: Interdependence

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Part I. Image of Entry

I had been in Lima for all of two days before stepping out of the taxi in San Isidro and nervously into the global health security workshop. The conference room filled with directors of health departments, senior leaders of various South American governmental institutions, and other global health organizations. The esteemed group gathered in Lima that day to discuss improving human and animal health security in our increasingly interconnected world, and because of my affiliation with the NIH, I had a front row seat.

Still, I opted for a seat in the back and tucked myself into a corner behind a long table adorned in navy blue drapery. Toward the front of the room there was a podium and a projector screen, flanked on three sides by very long tables forming an angular U-shape that extended along the walls and surrounded the room. Atop the tables had been placed in front of each attendee's seat: a note pad and ball-point pen, a personal carafe of water and a glass, a laminated itinerary listing the plenary sessions and workshops scheduled to transpire over the 2-day conference, and a set of headphones that plugged into a box through which interpreters, sitting in a plastic booth beside the podium, would translate the speakers' presentations between English and Spanish.

I searched the room for a familiar face – Willy's.

Willy, a Peruvian epidemiologist with expertise in global epidemiology and disease control, had always struck me as a softhearted man despite his overt ambition and appetite for control. He

already had a decades-long research career spanning several institutions all in the service of global public health under his belt by the time I first met him in 2015. At the time, he was an associate professor at UPCH with adjunct appointments at Tulane, John Hopkins, Wake Forest, and Texas Medical Branch universities. At UPCH, he led a research group comprised of Peruvian postgraduate students in epidemiology and public health. The group, EMERGE, an acronym for *Unidad de Investigación en Enfermedades Emergentes y Cambio Climáctico*, was involved in several research projects investigating emerging infectious diseases and climate change. When I returned in 2017, their largest project was examining the impacts of the *El Niño* weather phenomena upon the mental health of populations in Lima and Piura whose livelihoods had been devastated by flooding.

Between 2002 and 2015 Willy also directed the Public Health Training Program and Department of Parasitology at the US Naval Medical Research Unit No. 6 (NAMRU-6) in Peru, which is an American military base headquartered in Lima. In fact, it was the existence of NAMRU-6, and Willy's involvement there, that initially attracted me to Peru as a potential field site for my inquiries. Since NAMRU-6 is one of only five overseas infectious disease laboratories run the US Navy and Army, I thought it represented an obvious entry point from which to explore the entangled histories of global health, international development, military expansion, and imperialism. But more on this later.

By the time I formally began my fieldwork, Willy was no longer working at NAMRU-6 (terms of his departure: obscure), and he had just taken a leave of absence from his faculty position at UPCH to assume a government position at the Ministry of Health (MINSA) as Director General of the newly formed Peruvian National Center for Epidemiology, Disease Control, and Prevention (CDC

Peru). Specifically, within the CDC Peru, he was charged with leading the Unit on outbreak, response, detection, and surveillance.

Representatives/participants in the IHR JEE workshop. I am all the way in the back, top left corner, not looking at the camera, concealed by my hair and short stature. Willy is front, center wearing a teal tie.

Regarding his new position, "it might be a short stint," he told me earlier that week when we spoke over Skype. I asked him to explain why he thought so. He flatly said, "Politics".[1]

1 PPK was president before resigning in March 2018 due to the Oderbrecht scandal and loss of trust from Congress. Garcia was Health minister (July 2016- Sept of 2017), succeeded by D'Alessio (an ex-*almirante* from the navy) and later in the cabinet of reconciliation in January.. replaced by Abel Salinas Rivas. PPK pardoned Fujimori. Willy's post was reassigned a few months after he started.

Part II. Assembling Security

On the day of the GHSA conference, Willy was dressed in a dark suit and wore a teal colored tie. I spotted him standing at the front room alongside Patty Garcia, the recently appointed Peruvian Minister of Health. Dr. Garcia welcomed everyone. Willy then ascended the podium and directed our attention to the program, which read:

> This workshop will allow countries in the Americas to share experiences and challenges in the application, implementation and enforcement of the International Health Regulations (IHR); promote inter-ministerial discussions on infectious risks; share experiences with tools such as the Joint External Evaluation (JEE), which aims to help countries refine their planning and financing mechanisms to ensure the sustainability of essential public health functions; and promote regional and national best practices to effectively detect, prevent and respond to public health threats in the Americas.

The IHR and the JEE were two among several tools aimed at establishing partnerships – at global, regional, national, and sectoral levels – to better prepare the world against infectious disease threats that "know no borders". Other initiatives included the WHO-FAO-OIE Tripartite, formed in 2010 as a strategic alignment between the human, animal, and food sectors (a) to manage and respond to health risks emerging at human-animal-ecosystems interfaces, (b) to promote cooperation between human and animal surveillance systems and the timely sharing of epidemiological and pathogen data across sectors, and (c) to develop normative standards and field programs to achieve One Health goals.[2] The Global Health Security Agenda (GHSA), launched on February 2014, was

2 After outbreaks of highly pathogenic avian influenza in 2003 presented a challenge for organizing a coordinated response among specialized bureaucratic institutions, the three agencies most closely associated with the tracking and control of avian flu, the World Health Organization (WHO), the Food and Agricultural Organization (FAO), and the

another multilateral, multisectoral effort designed to accelerate progress toward the application, implementation, and compliance with the IHR.

The JEE tool, however, was directly linked to the IHR and eventually incorporated into its formal framework as a mandatory component.[3] In the following subsections, I provide some historical context for the JEE and why it was designed.

International Health Regulations (IHR) & Joint External Evaluations (JEE)

Several anthropologists and historians of science and medicine have written about the IHR system, dating from the 1851 International Sanitary Law, which defines states' mutual obligations in the event of an outbreak of a dangerous communicable disease. Historically, its function has been to guarantee the continued flow of global commodities in the event of such outbreaks, ensuring that countries do not take overly restrictive measures in response to the threat of infection.[4] At the same time, the IHR instituted legal obligations for nation-states to accept international intervention in a world seen as under threat from pathogens circulating ever more rapidly. In 2017, at the GHSA, this worldview was in full-effect. Willy's presentation on Global Public Health Risks in the 21st

World Organization of Animal Health (OIE), jointly endorsed a 'One World, One Health' (OWOH) policy framework for guiding international responses to avian influenza and other zoonotic infectious diseases (Chien 2012). The FAO-OIE-WHO tripartite was formed, which cross-institutionally aligned protocols for developing standards for managing emerging zoonotic diseases.

3 The JEE was added to a revised draft of the IHR Monitoring and Evaluation Framework, published in May 2016.

4 Responding to the unprecedented growth of international trade triggered by colonial expansion, European leaders sought to reduce trade barriers, including quarantine, while preventing what was seen as a new vulnerability—the international spread of infectious diseases. To tackle these issues, European nations got together in a series of international sanitary conventions. These conventions led to the emergence of an international health security regime, institutionalized with the creation of the WHO in 1948 and codified with the adoption of the International Sanitary Regulations in 1951, which were renamed the International Health Regulations in 1969. This "classical regime" (Fidler 2005) required states to notify each other of the presence of a number of specific diseases in their territories, and to implement standardized and appropriate measures to control disease entry at their borders. Cooperation thus rested on the goodwill of states to share information and implement preventive measures that did not excessively disrupt international travel and trade.

Century, for example, began with such an example: “We can travel anywhere in the world in 36 hours, which is less time than many incubation periods for the pathogens we carry. This is the basis for saying ‘diseases know no borders’”.

In 2005, revisions to the IHR were signed into agreement by the 58th World Health Assembly, in large part to expand the list of diseases to which the regulations might apply. For when they were drafted in the 19th century, the range of events warranting intervention were limited to cholera, yellow fever, and plague. With the revised IHR, any disease outbreak that could be classified as a ‘‘public health emergency of international concern’’ (PHEIC)—such as SARS, H5N1, Ebola virus, Zika – would be covered by the IHR regulations. Furthermore, member states agreed that, in the event of a potential health emergency, they would provide epidemiological information to the WHO and let investigators enter their borders. Furthermore, the new IHR required that states build national capacities for infectious disease surveillance and response; and it committed member parties to coordinate with other governments to prevent disease events from becoming PHEICs in the first place.

Crucially, then, the revised IHR marked an instrumental shift in the conceptualization of pathogenic threats: not only could pathogens spread in ways that that challenged the significance of sovereign borders in an interconnected and globalized world, but it was possible, through continuous international cooperation, to limit those risks by setting up global surveillance mechanisms and rapid response capacities. The creation of the CDC Peru, for example, which I will describe below, was exactly the sort of national ‘capacity’ that the new IHR obliged countries to develop, that is, national public health institutes modeled on the US CDC that would make

possible a distributed global network, one that relied on the coordinated functioning of standard surveillance nodes in each country.

According to the legal scholar David Fidler (2005),[5] the IHR revision was ‘‘one of the most radical and far-reaching changes in international law on public health since the beginning of international health co-operation in the mid-nineteenth century.’’ For anthropologist Andrew Lakoff, the IHR revision is “best understood as a significant element in an emerging apparatus of global disease surveillance and response—what the World Health Organization called ‘global public health security’.” For those in attendance at the JEE workshop in Lima, the IHR presented a problem:

The purpose of the IHR was to facilitate public health response to the international spread of disease in ways that avoided unnecessary interference while satisfying the needs of global disease surveillance. As such, the revisions placed an emphasis on the need for individual nation-states to advance and strengthen their essential public health capacities - described in Annex 1 of the IHR. As Lakoff notes, this approach contrasts from the developmentalist model of health infrastructure:

> IHR’s reliance on national health systems did not necessarily imply strengthening governmental capacity to manage existing disease; rather, it sought to direct the development of outbreak detection systems according to the needs of global disease surveillance.

As one document suggested: ‘‘It is proposed that the revised IHR define the capacities that a national disease surveillance system will require in order for such emergencies to be detected, evaluated and responded to in a timely manner.’’ WHO gave countries until 2016 to fulfill this

5 Fidler, David P. "From international sanitary conventions to global health security: the new International Health Regulations." *Chinese Journal of International Law* 4.2 (2005): 325-392.

obligation. However, it was unclear where the resources would come from to make it possible to implement systems for detecting rare diseases in poor countries that already had trouble managing the most common ones.6

But there was another problem: although the WHO set 2016 as a benchmark for achieving IHR compliance, nowhere in the new revisions had a mechanism been formulated to ensure that countries would actually implement the new requirements (e.g. define their capacities).

To be sure, Annex 1 of the revised IHR provided a checklist of indicators that countries should use to define their existing core capacities and to monitor their progress in the development of those capacities. And Annex 2 of the revised IHR even provided a decision-making instrument that countries could use to assess and to notify the WHO of events potentially constituting a PHEIC (Figure 1). The problem, however, was that neither of these instruments stipulated a formal enforcement and/or oversight mechanism. They relied on the goodwill of countries to comply.

As such, the JEE tool was invented expressly as means to address this problem of enforcement. It was designed to facilitate objective measures of each country's national capacities and progress in working to achieve the minimum requirements described in the 2005 IHR. Moreover, it doubled as a tool for ensuring transparency and mutual accountability in the international community: it shifted the onus of auditing from any individual nation-state to the international community. It called for a move from processes of exclusive self-evaluation to that of joint external evaluation.

The purpose of the JEE, as described in the welcoming packet we received at the workshop, was to establish baseline measurements of the country's capacity and capabilities by "working

6 Andrew, Lakoff. "Two Regimes of Global Health." *Humanity.* 2010.

together" through a joint process of evaluation, during which "a team of national experts first prepares a self-assessment supplied to the external team prior to the on-site visit, and the external team uses the same tool for their independent evaluation, working together with the national team in interactive sessions". In many ways, it intended to work as a sort of 'peer-review process' for assessing capacities according to communal criteria.

Some of the speakers at the workshop described the JEE as "a stress test" that allows countries to clearly and unambiguously identify the most urgent needs within their public health system and establish national plans to address those needs using common metrics (see Appendix). It provides – often for the first time, they touted – a clear "roadmap" that any country can follow to strengthen its ability to address biological threats, whether naturally occurring, deliberate, or accidental. External assessments they argued, are a vital tool to measure progress toward increased capacity. Furthermore, a continued, transparent, objective assessment process would be necessary to ensure the collective success of the IHR. The need for joint external evaluations, proponents of JEE argued, was that they could be used to strengthen countries' own efforts in the detection, prevention, and control of communicable diseases and biological threats, as well as provide a mechanism to match gaps in capacity to the direction of resources needed.

"The beauty of this tool," Dr. Ernesto, the former director of Peru's National Institute of Health (INS) and organizer of the GHSA workshop said, "is that it is designed to show you what the gaps are so you can make actions to address them. It's a self-assessment first, and someone is coming to work with you later, not to do an inspection, but so that you can together improve what you

have found in the gaps. Learning the gaps means you can make improvements not only for your country, but you also contribute to the security of other countries".

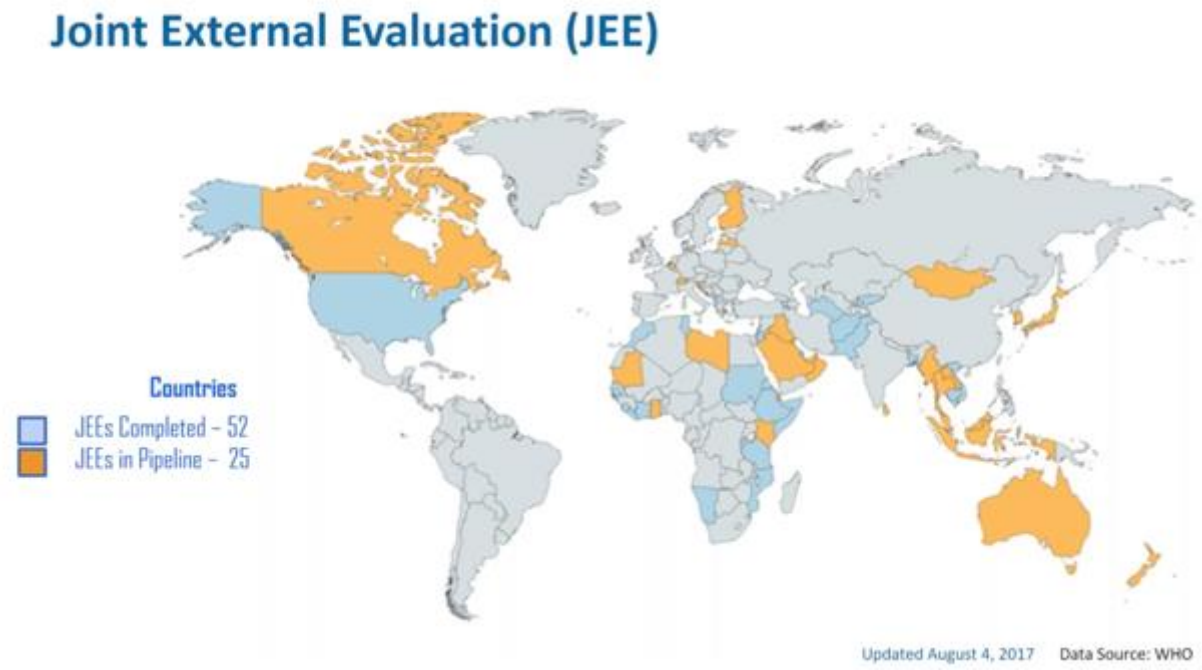


Figure 7. JEE across the world

Thus, the JEE had at least three explicit functions:

1) To produce metrics of national capacity and core capabilities in accordance with the requirements of the revised IHR
2) To ensure transparency and accountability in implementing the IHR collectively and as voluntary members of the UN international community
3) To identify gaps within a country's health security system and to prioritize opportunities for enhanced preparedness, e.g. to direct resources to where they are needed most

An implicit function of the JEE, of course, was that it facilitated the operationalization of global health security norms and values conceived as universally shared. Whereas the IHR

institutionalized a norm of global collaboration when it came to epidemic control, one which was based on a logic of rapid detection and response to outbreaks events and placed under the authority of the WHO,[7] the JEE tool incorporated other norms and values – namely, those of continuous surveillance, intersectoral coordination, and transparency – into the IHR.

"JEE is the way to make the IHR real," Dr. Ernesto told me. "Because, now, what the IHR asks you to do is a self-assessment and send to the WHO. Nobody needs to know about it. Countries need to report outbreaks, of course, but with the JEE, you have transparency and external confirmation."

Tripartite Commitment (WHO-FAO-OIE Collaboration)

The IHR (2005) revisions were made two years after worldwide outbreaks of highly pathogenic avian influenza (HPAI) presented challenges for organizing a coordinated response. Many bureaucratic institutions and inter-governmental organizations rushed to develop control and prevention policies against H5N1.[8] Yet contradictions regarding policy prioritization immediately appeared.[9] The three agencies most closely associated with the tracking and control of avian flu,

7Davies S. and Jeremy Youde. "The Politics of Surveillance and Response to Disease Outbreaks: The new Frontier for States and Non-State Actors." *History, Political Science and International Studies.* (2016).

8 For anthropological accounts of: HPAI viral clouds in Indonesia, see: Celia, Lowe. "Viral Clouds: Becoming H5N1 Indonesia." *Cultural Anthropology.* 25.4 (2010): 625-649; bird flu in Vietnam, see: Porter, Natalie. "Bird flu biopower: strategies for multispecies coexistence in Việt Nam." *American Ethnologist* 40.1 (2013): 132-148; interspecies health, see: Steve, Hinchliffe. "More than One World, more than One Health: Re-configuring interspecies health." *Social Science Medicine.* (2015):28-35; birds as sentinel devices in Hong Kong, see: Keck, Frédéric. "Sentinel Devices: Managing Uncertainty in Species Barrier Zones." *Modes of Uncertainty: Anthropological Cases* (2015): 165-181.

9 For example, the WHO prioritised the necessity to strengthen pandemic preparedness for a potential outbreak, while the OIE and FAO were more concerned with eradicating viruses in poultry, a problem they considered to be imminent. FAO official Phil Harris, for example, stated that 'it is clear that avian influenza remains a potential risk to humans but a real risk to animals' (emphasis in the original). In addition, tensions often escalated due to the divergent professional expertise of these agencies. For instance, public health experts at WHO and agricultural economists at FAO and OIE disagreed on large-scale culling of potentially infected birds. While WHO encouraged this strategy to avoid human infection, FAO and OIE became less willing to do so due to its impact on the food system and market. Yu-Ju, Chien. "How did International Agencies Perceive the Avian Influenza Problem? The adoption and manufacture of the 'One World, One Health' Framework." *Sociology of Health and Illness.* 35.2 (2012): 213-226

the World Health Organization (WHO), the Food and Agricultural Organization (FAO), and the World Organization of Animal Health (OIE), responsible for public health, food safety, and animal health, respectively, each had a stake in and thus shared responsibility for controlling risks associated with zoonotic pathogens and diseases of animal origins, yet they all governed separate sectors and seldom shared jurisdiction.

By 2007, the FAO and the WHO aspired to see a "harmonization and integration" of approaches to biosecurity by attempting "joined up thinking" to bring various matters of concern of biosecurity into a single problem space.[10] Indeed, it gained momentum. In late 2008 a significant policy shift took place, when WHO, FAO and OIE, along with the United Nations Children's Fund (UNICEF), United Nations System Influenza Coordination (UNSIC), and the World Bank, jointly endorsed a 'One World, One Health' (OWOH) policy framework. OWOH represented a unified and holistic approach to health that formally took shape in 2004 at a New York meeting hosted by a US conservation organization, the Wildlife Conservation Society (WCS), where the 12 'Manhattan Principles' defining OWOH as a cross-sectoral and integrated approach to human, domestic animal, and wildlife health were laid out (see appendix) The conclusion to the Manhattan Principles read:

> It is clear that no one discipline or sector of society has enough knowledge and resources to prevent the emergence or resurgence of diseases in today's globalized world. No one nation can reverse the patterns of habitat loss and extinction that can and do undermine the health of people and animals. Only by breaking down the barriers among agencies, individuals, specialties and sectors can we unleash the innovation and expertise needed to

10 United Nations, Food and Agriculture Organization, *Biosecurity Toolkit* (2007), http://www.fao.org/docrep/010/a1140e/a1140e00.htm.

> meet the many serious challenges to the health of people, domestic animals, and wildlife and to the integrity of ecosystems. Solving today's threats and tomorrow's problems cannot be accomplished with yesterday's approaches. We are in an era of "One World, One Health" and we must devise adaptive, forward-looking and multidisciplinary solutions to the challenges that undoubtedly lie ahead.

The OWOH was readily taken up by the WHO, FAO and OIE where practitioners and policy-makers could see the advantages of working on health and disease problems in ways that defied established institutional boundaries. Taking the concept from WCS, the WHO, FAO, and OIE (re)defined OWOH as a cross-sectoral and interdisciplinary approach that recognized "risks at human-animal-environment interfaces".[11] OWOH, later officially called 'One Health,' became a shared guiding principle for integrating global disease prevention and control systems and was eventually incorporated into the GHSA and IHR-JEE criteria.

Most significant about the FAO-OIE-WHO tripartite was that it cross-institutionally aligned protocols and standards for managing emerging zoonotic diseases across the human, food, and animal sectors; and it provided a basis for enhanced international collaboration and globally coordinated activities for addressing health risks at human-animal-environment interfaces. As an organizing concept, One Health proved flexible enough to encompass very different languages, ideas and working practices, yet coherent enough to enable communication across disciplinary and organizational divides.[12] As the sociologist Yu-Ju Chien points out, One Health successfully

11 Note, A. Tripartite Concept. "The FAO-OIE-WHO." (2010).
12 Yu-Ju, Chien. "How did International Agencies Perceive the Avian Influenza Problem? The adoption and manufacture of the 'One World, One Health' Framework." *Sociology of Health and Illness.* 35.2 (2012): 213-226

functioned as a 'boundary object'[13] strategically used by the WHO, FAO and OIE to transform tensions between disparate agencies with dissimilar focuses, to encourage coordination, and to promote an integrated vision:

> [An] "unwavering commitment to addressing challenges through multi-sectoral collaboration in order to provide leadership in global health security".[14]

In the next sections, I describe the events leading up to the creation of the GHSA as well as the challenges it poses to independence and national sovereignty 'in an era of "One World, One Health'".

Global Health Security Agenda (GHSA)

In 2014, the WHO reported that more than 70 percent of countries were not adequately prepared to address epidemic threats. That same year, the US Government together with 30 countries, launched the GHSA "with the vision of achieving a world safe and secure from infectious disease threats through building our collective capacity to prevent and control outbreaks whenever and wherever they occur".[15]

The GHSA represented an international commitment, one which built upon the WHO-OIE-FAO tripartite and the goals of the IHR, to work together to achieve specific goals and targets that would

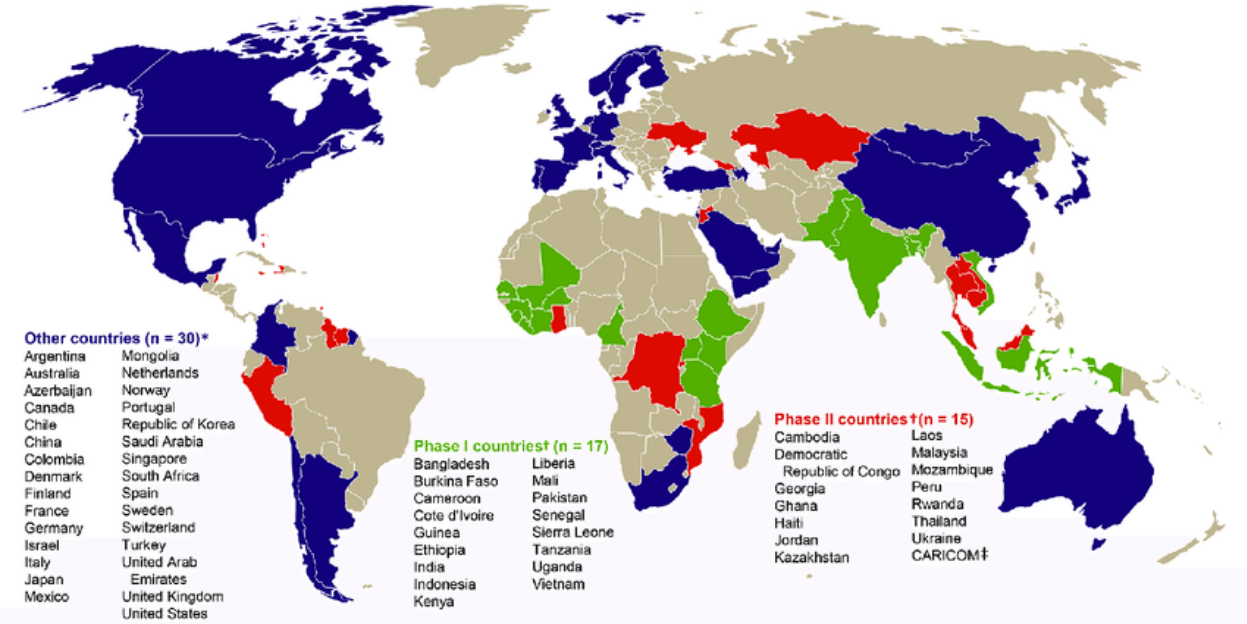
13 In the essay "Institutional Ecology, 'Tranlations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39" (1989), Susan Leigh Star and James Griesemer define boundary objects as "plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites" (Star and Griesemer 1989).
14 FAO/OIE/WHO (2017) The Tripartite's Commitment—Providing multi-sectoral, collaborative leadership in addressing health challenges. FAO/OIE/WHO.
15 Statement by the Chair of Global Health Security Agenda of the White House available here: https://obamawhitehouse.archives.gov/the-press-office/2014/09/26/statement-chair-global-health-security-agenda-white-house-event-septembe.

increase national capacities to: (1) prevent avoidable catastrophes, (2) detect threats early, and (3) respond rapidly and effectively. Within these three broad goals, the GHSA delineated specific targets that countries would be required to commit to enhancing. These included:

- countering antimicrobial resistance
- preventing the emergence and spread of zoonotic disease
- advancing a whole-of-government national biosafety and biosecurity system in every country
- improving immunization
- establishing a national laboratory system
- strengthening real-time biosurveillance
- advancing timely and accurate disease reporting
- establishing a trained global health security workforce
- establishing emergency operations centers
- linking public health, law and multi-sectoral rapid response
- enhancing medical countermeasures and personnel deployment.

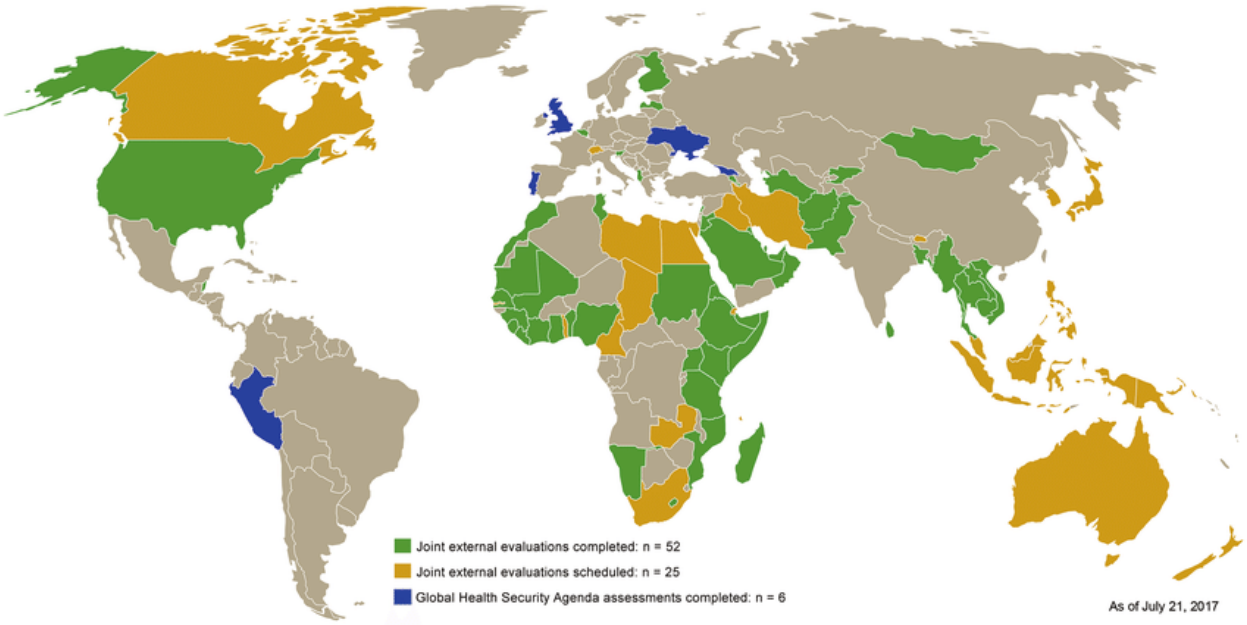
Quite overtly, the GHSA would function as an accelerator of the IHR. Whereas the IHR brought various international actors and institutions into a common strategic framework to prevent, detect, and respond to emerging infectious disease threats, the GHSA sought to enforce compliance with the requirements of the IHR by providing clear-cut targets and mechanisms for assessing each member state's infrastructural capacities to do so. The JEE tool was a third but related instrument

that manifested as a result of the GHSA and included the targets agreed to by GHSA member countries to fulfill IHR (it's all interconnected).



Above. Figure 8. Global Health Security Agenda (GHSA) member countries as of July 2017. https://www.ghsagenda.org/members).

Below. Figure 9. Country progress with independent Global Health Security Agenda and Joint External Evaluation assessments through 2018.



At the workshop in Lima, a representative from the US Department of Health and Human Services told me, informally, that the "GHSA is an enforcement tool. Otherwise, the IHR doesn't do anything. It's just words on a piece of paper if countries don't comply". In the very same breath, this person lamented to me what she perceived as abundant misperceptions around the GHSA and JEE tool. "These are not coercive; they are supposed to help streamline what we're all supposed to be doing already".

Hardly a month after the GHSA was signed into existence, the first cases of Ebola were detected in West Africa, an outbreak that ultimately infected over 28,000 people and resulted in over 11,000 deaths. Although global health responders (FN: largely, military, see LIMN16) were able to contain the spread to the African continent, the threat posed by Ebola to international health and security imbued the world once more with a sense of urgency. Were the outbreak to have happened elsewhere, perhaps along a busier international travel route, would other national systems have been able to respond as or more effectively in preventing international spread?17

In hindsight, Ebola revealed a troubling discrepancy between the relatively early detection of an emerging disease and the very late arrival of an international public health response.18 In "Ebola's

16 WHO was first notified of Ebola virus disease cases in Guinea in March 2014 and immediately deployed support. An emergency committee on Ebola virus disease was convened under the International Health Regulations (2005) and met on four occasions: on 6–7 August, 16–21 September, 22 October 2014 and 20 January 2015. Following its first meeting, the Director-General determined that Ebola virus disease in West Africa constituted a public health emergency of international concern (PHEIC) and issued temporary recommendations to support countries in their efforts to bring the epidemic under control and prevent international spread. (Implementation of IHR WHO 2015 document)

17 After the outbreak, the US Department of Defense (DOD) Defense Science Board (DSB) commissioned a simulation to test whether the USA would have been able to contain a similar virus had it happened there. Theirs and other independent reports found that a coordinated domestic response system, as recommended consistently by the WHO, had yet to be realized in the USA (https://dsb.cto.mil/).

18 Prior to the 2014 outbreak, Ebola had stabilized as a dangerous but fairly manageable virus whose pattern of transmission was understood and for which methods of containment had been developed and standardized. In April

Ecologies", Issue Number Five of *LIMN*, a scholarly journal and art magazine, social scientists examined how the unfolding Ebola epidemic signaled significant infrastructural limits to global health preparedness. Anthropologist Lyle Fearnley wrote that these limitations laid "not in the ideas of disease surveillance or preparedness itself, but in the disregard for linking disease surveillance with public health and medical infrastructure, and in the neglect of their coordination at the same scales, locales, and jurisdictions".[19] Fearnley's point was that during the Ebola outbreak and response, there was a lack of coordination between global preparedness initiatives and the infrastructure of everyday public health practice in the sites where the pathogen proved the most unwieldy to containment efforts. This realization – of the inseparability of the global and local – was symbolized via the mobius strip in the photo from the conference in Lima. Indeed, the JEE tool was designed in response to these 'lessons learned' from Ebola, that is, in response to the perceived need to strengthen the links between detection and response capacities at a national scale in coordination with global health security requirements.

2014, global public health agencies had not considered Ebola an "emerging disease" of international concern, but understood it rather as a "neglected disease" that afflicted marginal populations, and which had never killed more than a few hundred people. It was not until August that the WHO officially declared Ebola a PHEIC, "a technocratic classification that activated a system of anticipatory monitoring and response that hopefully would staunch the disease's spread along the circuits of global interconnection" (Lakoff 2015). Lakoff's distinctions are important: it was not that the pathogen became more biologically virulent or transmissible between March and August, but actually that the mechanisms for classification in the International Health Regulations (IHR) as well as the conditions of the local public infrastructure in which the pathogen appeared had together exacerbated its spread. In other words, Lakoff sees a failure in not recognizing how technocratic mechanisms and socio-economic conditions, in addition to the pathogenicity of any agent, configure epidemics. It would seem that such awareness has made its way into the IHR vis-à-vis the JEE tool, which aims precisely to figure out which technocratic mechanisms need strengthening as not to worsen the management of public health crises.

19 Lyle Fearnley, "Wild Goose Chase: The Displacement of Influenza Research in the Fields of Poyang Lake, China," *Cultural Anthropology* 30(1), 2015:12.

GHSA workshop, Lima, Peru, August 16, 2017. A mobius strip is projected on the screen to symbolize the continuity between global and local health systems.

What the Ebola outbreak indicated for political leaders and public health authorities around the world was, despite global acceptance of and commitment to the IHR, the broad inability to gauge whether individual nations had strong enough public health systems, reliable enough laboratories, enough well-trained public health workers, and ways to quickly gather and disseminate vetted information during a public health emergency, could directly influence the trajectory of an epidemic with pandemic potential. In other words, public health capacities and infrastructural weaknesses at the national level could become possible causes of international disease spread as much as the transmissibility of the causative pathogen itself.[20] Ebola brought public health into

20 I made a similar point in a recent essay published to Somatosphere in a forum on the topic of the search for SARS-Covid19's origins, entitled "Pandemics are not only caused by viruses only" (2021).

the epidemiological frame.[21] This reflexive recognition is, from my perspective, part of why there has been such a deliberate effort over the last several years to promote more accountability and transparency in the global health security regime.

Indeed, in the wake of Ebola, parties to the IHR and GHSA further committed to building, measuring and maintaining improved global health surveillance systems with foundations in *national* health systems – including laboratory networks, workforce training, interoperable systems for disease detection in real time, national biosecurity and biosafety systems, national action plans for combating antibiotic resistant bacteria, and emergency operation centers. The guiding logic and ethic behind the implementation of these global health security initiatives is that sovereign nations should be held responsible for increasing their capacities to efficiently counter, prepare for, respond to, and endure infectious disease threats; and that the way to achieve this is not to strong-arm nations into compliance, but to otherwise incentivize sovereign nation-states to invest in building their own public health capacities through integrated, whole-of-government approaches.

What I aim to point out is this: the global health security framework of the 21st century operates not by imposing a hegemonic agenda on all of the world, but by *superimposing* a global health security agenda onto national security priorities. In other words, the contemporary global health security regime obliges nation-states to strengthen their detection and response capacities as a matter of both national and global health security. The JEE tool was designed to help nation states

21 "In other words, epidemiology is the study in populations of the relation on the one hand between varying states of health considered as *effects* and, on the other hand, the possible *causes* influencing those states (not excluding purposeful medical and public health intervention" (Susser & Stein 2009; p 10).

account for extant gaps[22] in their public health infrastructures in order that any weaknesses could then be addressed as a means to improve both national and global health security capacities simultaneously or synergistically.

When held together, the GHSA, WHO-FAO-OIE tripartite, and the IHR-JEE can be seen as three major components of an emerging 21st century global health security apparatus, one that operates vis-à-vis the intra-national coordination of sectors and the inter-national integration of systems of governance. In this regime, it appears that improving the burden of disease for human populations constituted as public wards of nation-states is derivative to the unification of global and national security agendas. In other words, it is by strengthening national biosecurity and global health security capacities that population health and welfare may be safeguarded – and not the other way around.

At the Global-National Nexus: Sovereignty and Political Will

A gentleman from Mexico was most vociferous in his reaction to the JEE procedure. Although he recognized the need for and value of compliance with the IHR, he nonetheless expressed resistance if not opposition to the JEE tool's requirement for countries to publicly report and thereby expose to the rest of the world the existence of governmental 'gaps' or systemic 'weaknesses' internal to the domestic jurisdiction of any state. He understood how it was, on some level, a matter of

22 On blind spots in global health, see: Keshavjee, Salmaan. *Blind spot: how neoliberalism infiltrated global health*. Vol. 30. Univ of California Press, 2014. For accounting in global health see: Adams, Vincanne. *Metrics: What counts in global health*. Duke University Press, 2016 and Strathern, Marilyn, ed. *Audit cultures: Anthropological studies in accountability, ethics, and the academy*. Psychology Press, 2000.On systems performance in global health see: Arah, Onyebuchi A., et al. "Conceptual frameworks for health systems performance: a quest for effectiveness, quality, and improvement." *International journal for quality in health care* 15.5 (2003): 377-398.

transparency and fairness – values he shared, especially between countries when communicating potential outbreaks or health threats – but it appeared glaringly as a threat to national sovereignty.[23]

He articulated this tension through a series of rather practical questions: who would finance the sorts of 24/7 epidemiological intelligence surveillance that the new IHR-JEE tool necessitated? Implementing the IHR as a national priority would require financing, infrastructure, human resources, cultural authority, public-private partnerships, and political will, he said. What they were asking for far exceeded the responsibilities of the public health sector alone, though only public health representatives were in attendance at the workshop. Countries with more developed economies would probably be able to adapt the international regulations to their national laws more easily than lower-middle income countries; would potential inabilities to comply as successfully further stigmatize so-called developing countries in the eyes of the world? Couldn't such failures impact national politics?

"What if a government is evaluated as being 'in bad shape' according to these JEE criteria?" the representative from Mexico asked. "What happens at reelection?" Directing attention to the representatives from PAHO and the WHO, his questions grew a bit more forceful. "Why is there so much pressure? Why do you want to know what we have?"

"It seems there's a conflict, but there isn't," the representative from the WHO responded. "We want countries to be safer and stronger. We don't come in as investigators, but as observers and advisors. This is not just about identifying national weaknesses, but also capabilities. This is about

23 Processes of globalization transformed the classical notion of a sovereign national territory as a bounded geographical space. When people say "disease knows no borders", this is partly what they mean. Indeed, globalization has contributed to the deterritorialization of many of the classical functions of national borders, including the capacity of any individual nation-state to prevent the spread of diseases across their borders. At the same time, the mobility and migration of humans across borders abounds, as have means for regulating that movement.

international cooperation and contributing simultaneously to national security and global health security. It has a forcing function, yes: it forces institutions to come together as part of their own country. The JEE tool identifies *gaps between sectors* so that countries can strengthen coordination and strategize how to get their sectors – agriculture, defense, foreign affairs, tourism, customs, etc. – to care about public health as an *intersectoral problem* and not just a health-sector problem," he said, echoing the representative from Mexico's own observation: expanding security concerns and response capacities beyond the jurisdiction of public health alone and to the whole of government was precisely the *point*: both the means and the end. "Sovereignty comes first," he added. 'There is no punishment for not participating in this. It's about responsibility".

A representative from Costa Rica chimed in. "If we make public health an issue of national security, we have a commitment to our country and to the world to respond, to be responsible. It's not a matter of status or pride, but a question of ethics".

Seemingly unsatisfied by their moralism, the representative from Mexico countered, "But why would countries share this information? You talk about sovereignty, but it is not clear your position regarding these evaluations. You offer no solutions for funding issues. Who will fund these evaluations? If there are no funds for these evaluations, are there funds to implement the recommendations they'd lead to?"

A balding representative from the US DHHS quoted an adage he had learned from his time in the US Marines: "If you're not supplying solutions, you're only admitting the problem".

The representative from Mexico replied "The gringos want to know everything," then chortled, "but they already know everything."

I spent days trying to figure out what may have been at the root of this gentleman's concerns. It seemed to me that he was alluding to at least two important points, only one of which was directly addressed at the workshop. Both he and WHO representative agreed: the IHR-JEE and GHSA highlighted the interdependency that needs to exist between sectors to demonstrate and ensure national security capacities. But the representative from Mexico viewed this as a problem of political will: how do you expect public health officials to convince all parts of the government they represent to turn an international obligation into a national priority? Second, he seemed to gesture even more critically to another possible, unintended consequence: given global inequalities, how could anyone assure that a lower-income country would not be condemned after being transparent about any systemic weaknesses, especially in cases where incapacities to meet the JEE criteria were less a matter of willingness than of financial inability and structural disadvantage?[24]

Later that week, Dr. Ernesto told me privately when recounting that heated exchange that the workshop was designed precisely to elicit those kinds of reactions. "It was a matter of sovereignty" he confirmed, referring to the representative from Mexico. "Those comments are important because this is not just philosophy; we have to do something".

Twenty-First Century Global Health Security – Not Just Philosophy

24 I might add (anachronistically) to this litany of concerns the following: given global power politics, how could anyone assure that an economically powerful country would not be condemned for being transparent about weaknesses or missteps, especially in cases where incapacities are a matter of political unwillingness, instability, and/or government-led censorship of scientific data? Joy Zhang writes on such tenuousness between national interests and global science in China in *The Cosmopolitinization of Science* (2012). In 2021, as China tried to stall the WHO's investigation of the COVID-19 origins, we are reminded that this tension ought not be taken for granted. In the past Latin America might have had a better chance of doing this than the US- but neo-liberalsim. I would have been furious. I think indiciating that Latin America was more intersectoral in the 19th and 20th century than the US is useful and important.

What is the philosophy of global health today? Of global health security? And what are some things being done in its name? How is global health security framed and made?

My modest aim thus far has been to describe how, in 2017, a global health security framework was operationalized in the Americas through workshop-based discussions regarding the implementation of national-capacity building processes. In the contemporary global health security framework, nation-states are conceptualized as sovereign entities forming the modern international system, which is itself underwritten by a principle of sovereignty and non-interference, as enshrined in the treaty of the United Nations (UN),[25] an intergovernmental organization in which the WHO and PAHO operate as increasingly specialized organs, in addition to increasingly privatized entities.

Historians trace the basic legal principles underlying the modern nation-state system back to the Treaty of Westphalia in 1648, from which the doctrine of independent states with sovereign power over their territories – and theirs alone – emerged in the West. By the 18th century, the principle of sovereignty began to consolidate as the organizational model of European state-systems along with the principle of non-interference in other nation-state's domestic affairs, laying the groundwork for what we describe in geopolitical terms today as the international system of modern nation-state.[26]

Whereas the 'Westphalian' system conceptualized nation-states as independent agents, in the world order that emerged after the end of the Cold War (some scholars call it 'post-Westphalian'),

25 The UN charter states, "nothing ... shall authorize the United Nations to intervene in matters which are essentially within the domestic jurisdiction of any state".
26 Rosenberg, J. "Follies of Globalization Theory" *Verso.* 2003.

the modern international system began to operate increasingly by principles of interdependence. At the risk of sounding trite, processes of globalization gradually shifted the character of nation-states and the relations between them, which began to be rhetorically recast in terms of mutual responsibility and dependency.

For decades, historians, economists, and scholars in the field of international relations and globalization studies have discussed the transformative nature of globalization upon the practical capacities of nation-states to maintain their political sovereignty in the face of an increasingly interconnected world. The cross-border flows of money, commodities, labor, technologies, and information through global financial circuits, the expansion of overseas markets and international trade conducted on a world scale, the cross-cultural exchange of ideas, values, and identities, the international standardization of policy tools, humanitarian objectives, development goals, and scientific research agendas – all of this, in some shape or form, have gradually deterritorialized many of the classical functions of national boundaries, e.g. to safeguard the health of human populations living under the ward of national governments.

Indeed, the majority of the problems that the global health security framework seeks to address ultimately stem from this corresponding recognition that infectious disease threats don't respect the geopolitical borders that humans rely upon to order the system of relations between and in nation-states, on the one hand, and that globalization has already and continues to significantly transform the jurisdictional capacities of nation-states to prevent/contain transnational disease spread on their own. This presents a major limitation of the 21st century global health framework insofar as it maintains a commitment to national sovereignty and global health equity.

At least this is how I have come to understand the stakes of Dr. Ernesto's statement ("this is not just philosophy; we have to do something") as well as the concerns expressed by the representative from Mexico. Because political sovereignty, economic equality, technocratic capacity, and microbial biodiversity are unevenly distributed across diverse regions of the world, so are the capacities that any individual nation-state might be able to build to address complex health issues that cut across national borders.

I have no doubt that the proponents of the GHSA and IHR-JEE tools are aware of these limitations and even more so that they would agree.[27] It is precisely this tension between national sovereignty, global health security, and historic inequality that they intend their initiatives to resolve. Given the fact of globalization, of interdependence, of national sovereignty, of international inequities, and of the consequences that each of these phenomena dynamically pose to and for the others – the 21st century global health security framework emerges as a contemporary model for geopolitical governance, at once transnational, technocratic, scientific, economic and morally-driven.[28] I am hardly the first anthropologist to draw out such a development, but what I hope to add to any diagnostic analysis of the present situation, based on my field observations, is this:

1. The current global health security regime seeks to reconfigure systemic relations within 'national systems' and between 'the national' and 'the global' levels according to a bifold

27 "Perhaps globalization was not the best tool for integrating markets, but it's what we're left with now," a representative from the US DHHS told me during a lunchbreak.

28 Anthropologists of global health security saying as much include: Adams, Biehl, Blanchette, Briggs, Caduff, Cueto, Collier and Ong, Hinchcliffe, Farmer, Fearnley, Keck, Lakoff, Nading, Redfield, Samimian-Darash. Their interventions are crucial for helping me draw attention to the ways in which global health security frameworks function as evaluative tools that measure the health (performance) of national systems without necessarily measuring the extent to which those improved capacities effectively distribute opportunities for actual attainments of health within any national populace.

logic of coordination and integration applied recursively at intra- and inter-national scales.[29]

My claim is that the current global health security framework is being configured today in relation to a different (not necessarily new) imaginary – less as defense against bio-terrorism and more in defense of one world-ism.[30] In this vision of the 'new world order'[31], nation-states are conceptualized as governing-systems composed domestically of sub-systemic parts (e.g. sectors and gaps) that need to be internally and externally coordinated to secure health in a global system composed of sub-systemic parts (e.g. nation states). By softly forcing sovereign countries to strengthen the links between different sectors intra-nationally (i.e. internal to national system), global health security initiatives like the GHSA and JEE doubly function as means for restructuring the modern international system vis-à-vis the multi-scalar integration of its parts (i.e. extra-nationally).[32]

29 In 2007, the WHO issued a report entitled, "A Safer Future: Global Public Health Security in the 21st Century". The report simultaneously conjoined infectious disease and national defense concerns while distinguishing global health as a space transcending the national organization of both biodefense and public health. As Collier and Lakoff recount, the proposal argued for securing health by developing national systems of detection and response not only to stop biological threats at national borders but to coordinate with other national systems should disease events occur across international borders. Here we can see the beginnings of the process I am describing: systems internal to nations to improve systems external to nations.

30 Steven Hinchcliffe traces the one world language of One Health and OWOH back to the Apollo space missions and the famous image of planet earth, the Blue Marble. Others trace the idea of 'One World' (OW) to mid-20th-century debates about international relations and the formation of UNESCO (Sluga 2010)

31 I do not use this term to suggest a conspiracy theory, for example, of WHO at the apex of some global totalitarianism. I use it as an ideological notion of world governance in the sense of new collective efforts to identify, understand, or address global problems that go beyond the capacity of individual nation-states to solve.

32 Strangely, it seems that global health governance today relies on neoliberal rationalities deployed recursively to reorganize global and national orders by obliging states and citizens to *internalize* the (Cold War) logic of *international* interdependence thus to reproduce it, intra-nationally, as *intersectoral* interdependence as a way to strengthen global health security through coordinated, integrated parts. (see Wendy Brown 2019, Michel Foucault 1991, Salmaan Keshavjee 2014). In this vision of geopolitics, all 'margins' are central to the functioning of global health (Veena Das and Poole 2004).

Again, I am hardly the first scholar to point out how globalization and logics of security challenge the established institutional jurisdictions and conventional conceptual distinctions through which we have come to order the world.[33] But what I want to suggest is:

2. To achieve global health security, the current global health framework seeks to unify national-level and global-level health security concerns according to the rationale that stronger nation-level security systems will improve global-level security. This rationale seems to be premised on principles and concepts from a general systems theory and recursive logic. In this systems model, the world is imagined as an integratable system comprised of dynamically interrelated subsystems interconnected through multi-scalar interfaces.
3. There are major metaphysical, epistemological, ethical, and political claims implied in and promoted by these efforts.

In sum, it increasingly seems to me that the current global health security regime is actively and continuously reorganizing inter- and intra-national relations through integrated approaches to health and health security. This integration is and has been pursued in a variety of familiar forms: the production and exchange of knowledge-related global public goods (e.g. original research, guidelines, research and development of new technologies, comparative policy analysis and evaluation); the deployment of standardized instruments (e.g. surveillance and information-reporting platforms); and the normalization of a global health security concept premised on an

33 Writing of the new global health security regime of the 21st century, scholar says it challenges "the traditional distinctions between local-global, traditional-human security, and domestic-international health" (Davies et al. 2015: 16). Similarly, this is reflected in the idea that the implementation of biosecurity reconfigures a whole set of boundaries – biological, geographical, social and political (Enticott, 2008; Blanchette 2015; Keck 2008). To this I add: it also challenges the national-global as scales of governance, and sectors-nations as parts of larger systems.

ethic of responsibility and the value of transparency conceived (that is, packaged) as universally shared.

At the Global-National Nexus (again): The Mobius Strip of National Security and Global Governance

The incorporation of global health priorities under the rubric of 'national security' has been an object of anthropological scrutiny and problematization throughout the first three decades of the 21st century. In 2003, anthropologists Stephen Collier, Andrew Lakoff, and Paul Rabinow (2003)[34] framed "the contemporary problem of biosecurity in the US" as an emerging domain of enquiry, or space of problematization, one with technological, political, and ethical stakes that would require the implementation of new methods and conceptual tools to identify and understand. They approached the problem of biosecurity by situating it within two major developments - the break-up of the Soviet Union and the birth of genomics – and proceeded to trace how emergent forms of political analysis and techno-scientific practice linking health and security operated in relation to imaginaries of bioterrorism.

Particularly in the wake of the 9/11 attacks on the World Trade Centers, there was a flurry of US biodefense measures to prepare the nation against the threat of possibility of a future biological attack. The CDC, for example, distributed over $1 billion in annual funds for what they called 'preparedness activities'. By the end of 2004, over one hundred states operated some sort of disease

34 Collier, Stephen J., Andrew Lakoff, and Paul Rabinow. "Biosecurity: towards an anthropology of the contemporary." *Anthropology today* 20.5 (2004): 3-7.

surveillance.[35-36] Within ten years of the attack, the federal government allocated an estimated $62 billion for electronic surveillance networks and IT initiatives for biodefense (FABF 2011). Additionally, the Bush administration launched and funded Project BioShield[37] to speed up the development and acquisition of new medical countermeasures against biological agents. Collectively, these practices increased the US government's capacities to prepare for and prevent against the spread of potentially hazardous pathogens, whether purposefully weaponized or inadvertently borne zoonotically from human-animal interfaces, into the human population.[38]

In a statement released by former President George W. Bush's press secretary, Dana Perino, in April 2004, the administration wrote,

> While the public health philosophy of the 20th Century .- emphasizing prevention .- is ideal for addressing natural disease outbreaks, it is not sufficient to confront 21st Century threats where adversaries may use biological weapons agents as part of a long-term campaign of aggression and terror. Health care providers and public health officers are among our first lines of defense. Therefore, we are building on the progress of the past three years to further improve the preparedness of our public health and medical systems to address current and

35 For example, the establishment of initiatives the CDC's Global Disease Detection program; the Department of Defense's (DoD's) Global Emerging Infections Surveillance and Response System (GEIS); and WHO's Global Outbreak Alert and Response Network, which are all assisted by regional coordination and subregional networks of surveillance.

36Sosin, D. and J., DeThomasis. "Evaluation Challenges for Syndromic Surveillance" *Morbidity and Morality Weekly Report. (*2004):125-129.

37 These types of initiatives prompted high-expenditure, technology-intensive programs and practices like anticipatory research in the molecular sciences, the stockpiling of antiviral drugs, heightened regulation of laboratories, the development of real-time surveillance technologies, scenario planning, and the construction of information and processing centers around the world designed to serve as command and control centers in the event of positively identified disease events. One might mark this period in the history of global health and global health governance as the shift in priority from medicine to technology, from improving healthcare delivery to strengthening biosecurity.

38 Nick Binghamd., Gareth, Enticott., Steve, Hinchliffe. "Biosecurity: Spaces, Practices, and Boundaries." *Environment and Planning.* 40. (2008): 1528-1533.

> future BW threats and to respond with greater speed and flexibility to multiple or repetitive attacks.
>
> Private, local, and state capabilities are being augmented by and coordinated with Federal assets, to provide layered defenses against biological weapons attacks. These improvements will complement and enhance our defense against emerging or reemerging natural infectious diseases.[39]

If the early public health philosophy of the 21st century was characterized as one of biodefense and preparedness, then the global health philosophy of the 21st century is one of systems coordination and integration. Ongoing efforts to improve preparedness and strengthen response capacities, like those I've described thus far, can thus be seen as but recent continuations of a several decades-long global project (spearheaded by U.S. and transnational health and security agencies) to assemble global security. Today the idioms through which global health security are sought are interconnectedness and integration.

This new way of apprehending global disease threats and of doing things to address has been termed "global health governance," and is characterized by a strengthening of and increased coordination between the WHO, FAO, and OIE as well as GHSA member countries.

After the Ebola outbreak began in 2014, former President Barack Obama's press secretary released a statement by the chair of the GHSA (*italics* in original, **bolds** are mine):

> President of the United States Barack Obama, National Security Advisor Rice, Assistant to the President for Homeland Security and Counterterrorism Monaco, and Secretaries

39 Full text here: https://fas.org/irp/offdocs/nspd/hspd-10.html

Burwell, Kerry and Hagel met today with Ministers and senior officials from 43 other countries and leading international organizations to make concrete commitments to advance the Global Health Security Agenda. The escalating Ebola epidemic in West Africa highlights the necessity to establish global capacity to prevent, detect and rapidly respond to biological threats of any origin. The group also affirmed the imperative to **build, measure and maintain systems**—including laboratory networks, workforce training, **interoperable systems** for disease detection in real time, national biosecurity and biosafety **systems**, national action plans for combating antibiotic resistant bacteria, and emergency operation centers—so countries can efficiently counter biological threats through an **integrated, whole-of-government** approach…

Our vision is clear and urgent: We must accelerate progress towards a world safe and secure from infectious disease threats through our collective capacity to prevent and control outbreaks whenever and wherever they occur…

Today we affirmed:…

A biological threat anywhere is a biological threat everywhere, and it is the world's **responsibility** to respond as **one**.

Infectious disease outbreaks are a national security priority. They threaten peace, stability, and the economic prosperity of our world; the consequences of not acting are unfathomable.

We have the tools and the political will to assist nations that are not yet prepared. Today, we made concrete commitments to support other nations to achieve the objectives of the GHSA. We call on all nations to act now to provide needed capacity around the world, including what is needed to prevent, detect, and rapidly respond to infectious disease threats across West Africa. This is an urgent need and it includes achieving the core capacities of the International Health Regulations and the Performance of Veterinary Services Pathway…

> *All nations share the GHSA responsibility.* We call on nations around the world to join us in addressing biological threats as a national priority and accelerating action toward a world safe and secure from all infectious disease threats.[40]

If the public health philosophy of the Bush administration was characterized by investments in national biodefense and preparedness, then the global health philosophy of the Obama administration inherited that project and took it up a level, so to speak, by taking a systems-approach to national capacity-building, at home and abroad, as a means to strengthen security through internal and external systems coordination on a global scale.

Obama's global health security philosophy and policies, one could say, were characterized by an understanding of 'the global' in terms of interconnectedness and interdependence. The GHSA was not about fortifying national borders against the invasion of foreign infectious disease threats coming from *elsewhere* (as it may have been when described by Lakoff (2010) in the essay 'Two regimes of global health'); rather, the GHSA was about strengthening capacities *everywhere* to prevent threats from emerging *anywhere* ("A biological threat anywhere is a biological threat everywhere," as it was literally written). The global health ethic Obama incorporated into his national security policy was this: given our global interconnectedness, each nation shares a responsibility to protect themselves and one another. For the US, investing in national capacity-building at home and abroad was justifiable insofar as these efforts would collectively provide the critical infrastructure required to achieve global health security more globally, while maintaining the US' position as a global leader.

40 Full text here: https://obamawhitehouse.archives.gov/the-press-office/2014/09/26/statement-chair-global-health-security-agenda-white-house-event-septembe

In a press release from 2016, aides from the Obama administration wrote in a statement, "Our connectedness … poses serious challenges with implications for our health security and for the stability and security of our populations. That is precisely the world for which the GHSA was created".[41]

Obama was not the first, and assuredly will not be the last, US politician to argue that the protection of global health from biological threats and infectious disease outbreaks must be treated as a top tier national security issue. However, it would take four and a half more years, a massive failure on behalf of the US government to centralize and coordinate the pandemic response efforts of each state, and nearly 3 million deaths lost globally to the novel coronavirus (Covid-19) for the US to resume a position of international leadership in the global health arena and to fully activate the full extent of its own domestic capacities for coordinating an adequate national response in the face of emergency.

Part III. Integrating Systems

In the previous section, I described the context in which the IHR-JEE, GHSA, and One Health initiatives were formulated in order to integrate national capacities and priorities into an overarching global health security framework. In Part III, I ethnographically depict some of their on-the-ground operationalizations by drawing from my experiences amidst fieldwork in Peru. Ever attentive to the multi-scalar dimensions of the global health endeavor, I situate my observations of

41 Full text of executive order available here: https://obamawhitehouse.archives.gov/the-press-office/2016/11/04/executive-order-advancing-global-health-security-agenda-achieve-world

capacity-building initiatives in Peru at three levels of political organization: intra-national, national, and trans-national.

Surveilling: CDC Peru

A week and half after the GHSA workshop, I went to the Lima CDC where Willy was working. He brought Guillermo, a doctoral student from UPCH to work there with him as a research assistant. Guillermo was my friend, who successfully applied for the GloCal Fellowship the year after I had won it.

When I got there, I received a photo ID badge. The building was inconspicuous from the sidewalk and there was a security guard in the hallway. Entering the building, you walk into a wood paneled entry hall and then further into an open, sunken courtyard in the middle of the house (this building was likely someone's fancy home back in the day). There were plants on the first floor and a balcony on the second floor that wrapped around the edges of the courtyard. On the second floor, the Health Situation Analysis office was in one corner, Outbreaks in another corner, Surveillance in another, and Admin the other.

The Peru CDC was modeled after the US CDC, although, as Ernesto, the former head of the Peruvian National Institute of Health, told me, the entity that garnered approval by the Peruvian government, the one that Willy was now directing, was quite different from the one they had proposed. As such, calling it the CDC was a bit of a misnomer. In its present form, the Peru CDC had two major units: Surveillance and Outbreaks. The Surveillance unit was responsible for preparedness and detection, while Outbreaks was responsible for control and response. These latter

capacities were limited given Peru's decentralized government. In other words, there were no control and response capacities.

Willy was busy on the phone in his office when I got there, and when he freed up, he invited me into the room, an office he shared with Cesar.

One of the first things Willy asked of me was to develop some sort of cultural anthropology guidelines that public health officials could use as a sort of rapid assessment amid outbreaks. For example, there was a relatively small outbreak of meningitis in the military that people were afraid of. Could an anthropologist help them understand the source of their fear? Could someone like me figure out what important 'cultural systems' public health folks should pay attention to or take into account? Could I design a protocol or guidelines on how to ask questions? I entertained the possibility, feeling quite unsure of myself. He'd like a short set of guidelines for people working in the Response unit of the CDC to read and understand.

I wanted to help, that is, to make myself of use or to produce something for Willy in return for his generosity in allowing me to come to the CDC, but I also didn't want to pretend that I was the kind of anthropologist that he had in mind. That is, an anthropologist who collects data on 'culture' so that it can be studied as an identifiable variable that could explain human behavior or else try to be overcome by public health personnel with agendas of their own. I told him that I'm more interested in the practices of the people he works with and that I would like some time to get a sense of what they do first before I develop tools to assist them.

Could I run some surveillance on his staff, then? He asked me. Like, why do people fill out forms and what are the reasons that people don't fill out forms? He would like for health workers to fill

them out more systematically, that would be his goal, and if I could help them approach this in a structured and scientific way to facilitate its becoming standardized practice, that would be of value.

I would need some time, but it was possible, I assured him. In my mind, I felt unsure about the assignment, as if I was being used, almost like a tool myself, for fine-tuning their auditing tools. Was he fashioning me into a JEE-incarnate? I told him I would have to learn more about their process before I even considered proposing ways to improve it. For example, how do people in his office become alerted to an outbreak event? What happens when they do? What variables do they look at? What are extant protocols for intervening? What limits do they face? How do they conceptualize culture and social relations? Do they only look at humans to study social determinants? These questions would take time for me to get a sense of, I tried to tell him. I could sense his disappointment, as if he experienced me as resistant. (I probably was and he probably did.) If I could figure out how people's biases and assumptions interfere with their experiences when filling out forms or responding to meningitis, that would be great, he finished.

Maria *actually* worked in Surveillance. I asked her to give me a broad picture of their surveillance system, how it is structured, how they get surveillance information. She explained it in the form of a hierarchy: At the top was MINSA, Peru's Department of Public Health, what everyone called "central". Though she explained it like a ladder, a list from top to bottom, the language she used suggested a circle, with MINSA in the center, and the outer/lower levels forming concentric circles around it, increasingly decentralized. The next level below MINSA consisted of the State departments, "regional" public health offices. The next level down was RENACE, or the "networks". Below were the hospitals or "units" that collected syndromic surveillance. And

finally, the clinics or "primary level", where people went when feeling ill but not ill enough to be hospitalized. The surveillance system was organized according to the levels of the healthcare system as different sources of surveillance data.

Maria showed me the CDC's surveillance website and described their many "apps". She logged into *Vigilancia Epidemiologica CDC* and showed me how they can enter cases individually or grouped/consolidated. For example, we can type in "diarrhea" or "respiratory" and see where the cases are and if there are clusters.

I asked her to tell me more about the chain of command and CDC's relationship to MINSA. She explained that within MINSA, there is the general office (OFE) which reports information to the general direction (DGE) which reports information to the CDC. At present, 80 people worked at the CDC. She told me "We are in a transition right now because we have a new norm". What did that mean? "ROF" she reply, "Rules for Organization and Functions". The acronym she offered was the name of the new norm. I wrote it down, then slightly rephrased my question. "Great! But, what do *you* mean when you said what you said?" She told me that when ministers change, functions of the department change.

Later that day when I returned home, I wrote in my notebook, repeating ideas that came to my mind when sitting in Willy's office: I would need to spend a few weeks and months at the CDC to learn how I might be able to contribute or give something back. I would need to do some observation first, interviews and then I could talk to Willy and Caesar about what I could give. I would need to use my own techniques and observations to understand what they need (not just what Willy says they need) in order to give feedback of any significance. They kind they deserved. I'll come three times a week, I wrote to myself, as if a promise. I'd like to introduce myself and

get a sense of the situation. After a few weeks or months, I'd revisit the question of filling out forms. Maybe I could write a memo or a pamphlet of guidelines.

I also wrote to myself: I don't start with a solution. I start with questions – others' questions. Only then can I make meaningful judgments for improvement. I had a line from an essay by medical anthropologist Stacey Pigg in mind: "We had an answer for a problem that had not already been defined".

Constructing a Process: Health Situational Analysis

The next day at the CDC, I scheduled an interview with Alfredo who worked in Health Situation Analysis, a sub-unit that analyzed local health data at the levels of districts and provinces. Alfredo had a very handsome face with prominent cheek bones. He dressed almost daily in a cardigan and wool pants. He wore a carabiner attached to a belt loop with keys dangling from it.

He brought four booklets to our first interview and explained what his group had been working on for the last two years. Alfredo lamented that the problem in Peru was that they don't have enough information at the district level to analyze the health situations (burdens, disparities). There is plenty of information on provinces and departments (higher levels of organization), but less for each district therein with which to perform qualitative and quantitative analysis. In 2015, MINSA changed their methodology to compare disparities of disease burden across districts. Before then,

there wasn't even a variable for disparity, he told me. They didn't even try to measure it. Socioeconomic determinants didn't have an identifier in their system, either.[42]

Interestingly, Alfredo told me that qualitative data derived from focused surveys is better/stronger for understanding health situations at more local levels (e.g. district levels). Otherwise, they have to rely on Census data, which is typically incomplete and low-level (demographics).

Each District puts together a report and submits it to the CDC. Alfredo checks how they construct their report before they give it to local governments (regions) to design programs. He and his team liaison with them, provide them with feedback, usually in the form of recommendations to collect better information or present it more effectively. He also has trained public health officials at these district levels how to describe and collect data and prioritize it. It's a bottom-up approach: officials who live in these districts compile the dossier, they identify the "roots", the "root ideas" for what is the problem in their area. They present the problems/roots for clinicians to read, as well as the CDC to analyze, which can help make the Minister of Health make better decisions.

In 2015, he was in charge of 70% of the training courses. Public health workers from the districts would come to the Lima CDC offices for training, but since the CDC can't give them money for travel (decentralization laws), they've stopped coming. Another barrier, one that echoes the

42 In her book, *Second-wave neoliberalism: Gender, race, and health sector in Peru*, (2011) Christina Ewig describes the history of the emergence of Peruvian public health sector, including the intellectual, economic and scientific milieu in which it arose was influenced, and how these movements and surrounding discourses resulted in racialized, sexed, and classed public health infrastructures. Her major claim is that the public health system in Peru was created by 'internal colonialism' – a process by which interior portions of a single national territory are dominated culturally and economically by a dominant elite. In the case of early Peruvian public health, sanitation campaigns targeted indigenous populations who were to be "cleaned" and "bettered" through public health measures, which incorporated the objective of national betterment through better health. I refer to it here because only recently a new process is emerging in Peru to (literally) account for and consider how cultural and economic differences impact disease burden beyond Lima.

rhetoric I heard during the GHSA workshop, is that people from the regions no longer want to participate anymore in national 'capacity building' workshops because it require them to admit or expose their problems to authorities at the "central level" – for which there is neither enough time nor appropriate financial support to adequately address. At a workshop co-hosted by the CDC, MINSA, and PAHO one weekend in Lima, a virology student earning his Masters in Public Health at UPCH anxiously raised this conundrum, as well: "In a decentralized government, how do you get people from the regional governments to share their information with the central government? How can you build a public health network without trust?"

Alfredo explains to me that the document is an instrument to join the people through health promotion and identification of the roots. He is interested in "constructing a process" that enables local public health workers to systematically collect data according to a methodology and to evaluate the data according to that methodology.

A question that Alfredo grappled with – one that he is neither the first nor the last to fixate on – was the following: why treat the population if their living conditions don't change? He was a proponent of investigating the social determinants of health and how the former influence the latter. He understood that inequity and poverty contributed to health outcomes in critical ways. Further that outcomes could not be explained by one's social position or individual behavior; rather, these themselves were effects of macro-economic factors and sometimes even policies. He reminded me of Rudolf Virchow, who studied the social origins of poor hygiene and disease, which led him to the concept of social determinants of health. Alfredo wanted the CDC to take SDH's seriously as markers and indicators of health outcomes, and to measure them. This is part of what Health Situational Analysis (ASIS) did: it provided tools for showing the implications of such

determinants in the health status of the population in order to define priorities that could be incorporated into the broader public health agenda.

In a situation room with a team from the CDC in Lima who was dispatched to Ica Region on a 3-day investigation into reports of a Zika outbreak

Responding: Outbreaks Unit

The next day, I met with Manuel who worked in the Outbreaks unit. He explained to me that districts must report outbreaks via a software program called SIG-EPI to the national CDC. He told me about a recent outbreak of Dengue after the El Niño flooding in the nort. Two people from the CDC went to Piura for 4-6 weeks to train personnel in how to intervene/respond, and then they

reported back to the CDC. He repeated something that I had heard in the GHSA workshop, which is that the CDC is the office of epidemiology within MINSA, but that there are other offices that deal specifically with disasters.

His team is comprised of six people: 3 epidemiologists, 2 doctors, 1 biologist, and 2 nurses. Their goal is to enhance local capacities to respond to outbreaks. If outbreaks in the regions are small, the CDC doesn't participate in response (again, due to decentralization). Although, he has elaborated a request to be able to respond, which he gave to Willy for review. When people from the regions contact his team in the CDC for help, they request qualitative information on how to evaluate the outbreak. They train people at the local levels how to manage outbreaks and they indicate what actions must be taken to stop outbreaks. They don't and can't provide supplies, solely expertise.

Training: A CDC Workshop for RENACE

Two weeks later, the CDC held a training workshop at the Costa del Sol hotel in Magdelena. It was a weeklong conference during which 'the center' aka: the CDC and the Ministery of Health (MINSA) in Lima would impart public health expertise to 'the regions' aka: RENACE - a network of Peruvian epidemiologists spanning the various regions within the country. The emphasis was on surveillance and its technologies - different virtual health rooms for sharing information, new GIS mobile platforms for reporting outbreaks, and another platform for visuaizing surveillance data. Guillermo told me that Congress had changed five ministerial positions, ousted Patty Garcia, the former Minister of Health, and that Willy would likely be fired from his position at the CDC.

In the conference room, I quickly got the sense that the planners anticipated twice as many people to attend than actually showed up, given how half of the tables and chairs in the room were left unoccupied. Those in attendance were epidemiologists and doctors from different regions of Peru. They are the ones who report epidemiological data to the CDC: cases and basic surveillance information gathered from the forms that primary health workers fill out in clinics and hospitals.

One day at lunch, I sat next to Cesar and I asked him why exactly they were hosting this conference. He told me that the central government was attempting to train representatives from the regions in "best practices" to strengthen regional public health.

"You notice how everyone is complaining about funding" he asked me, referring to the regional public health administrators in attendance. "Part of the problem is that before decentralization, the state would provide funds for epidemiological research. But after decentralization the regions each get funding for themselves and don't spend it on public health prevention measures (like vaccines). Maybe they spend it on roads or other things that will help them stay in office, like building a hospital and hiring more nurses and doctors. Regional leaders are way more political than national leaders. The problem is that they think health is the responsibility of the national government, but it's not. It's up to them. They get funds to spend on health, but they divert it towards other things. Then, when there is an outbreak, they ask the national government for more money. Sometimes we can give it and they still may not spend it on health. And they certainly don't spend it on disease prevention".

Later that evening I had dinner with Maria. She explained to me part of this problem is that there is no explicit clause or line in the Peruvian constitution that portions out the funds for regional government in specific and enforceable ways. Under decentralization, there is a lump sum that is

distributed to the regions for "health" but nothing specified within. As such, she alleged, it's easy to divert funds away from what they may be intended (i.e. prevention, education etc.).

Decentralized Peru

I define the various functions of "borders" in much detail in the following chapter/concept note. For now, it suffices to describe borders as delimiting the margins of sovereign territories, both geographically and politically. They may also subdivide the jurisdictional boundaries of governmental units within a nation-state. In the decentralized Peruvian system of government, for example, the national territory is divided into 26 units: 25 regions (regiones) and the Lima Province, which is where the city of Lima, the nation's capital, is located. The regions themselves are divided into provinces (provincias), which are composed of districts (distritos), administered by governors, mayors, and municipal councils respectively. Within the national context, these territorialized borders also represent administrative limits. In the case of Peru, they function to decentralize power and limit jurisdictions from "the center" (Lima) by extending political authority to elected leaders in the regions.

When the decentralization began in Peru in 2002 after the presidency (1990-2000) of Alberto Fujimori, it was part of an initiative to re-democratize the country through participatory institutions that transferred functions from the center to "local authorities" in the regions. I briefly pause to note, here, that there is an interesting resemblance between the processes of decentralization and "glocalization", in which power is distributed from one 'place' to another, adapted to and exercised in new localities, and transferred back in ways that constitute a nexus between scales (i.e. global-local, center-regions). Both processes make use of a relative 'local': if the thesis of glocalization is that the local makes the global work, then in decentralization, the local makes the national work.

Because the regions of Peru are so different from one another, decentralization was pursued to allow each to govern themselves as fit. Yet this has been and continues to be a problem for public health because of the obstacles it presents to the coordination of surveillance, prevention, and response strategies at a national level. Cesar told me, "the problem is that local politics get in the way". The political division between regions and the central government run counter to the processes of integration required to secure public health more globally (i.e. nationally).

"So, then how do you integrate regional and national health priorities in a decentralized government?" I asked Cesar.

To this question, Cesar responded that there are, in fact, mechanisms for integrating national priorities and regional ones. And, contrary to Maria's suggestion, there are mechanisms for enforcing the correct expenditure of financial resources distributed from the central government to the regional governments, but that nobody [43]actually applies these mechanisms. And because of this, national politicians and academics are thinking really hard about whether decentralization works for health or if they need to return to an older model of national governance and oversight.

What I understood from Cesar's comments was a crucial distinction between the existence of mechanisms (for integration) and the enforcement of those mechanisms. Perhaps this is why Peru was so receptive to the JEE tool. Like the representative from the DHHS said, the IHR existed on paper, but did it really exist if countries didn't comply? At the GHSA conference, there were several national representatives who vocalized their hesitancy and resistance to the idea of an external evaluating body running "checks" on their public health systems, but at the same time,

43 Who is this nobody?

this oversight was what Cesar seemed to gesture towards, as well, as necessary at the central-regional nexus.

Part IV. Failing to Collaborate

The U.S. Naval Medical Research Unit (NAMRU-6) in Lima, Peru is co-hosted by the Peruvian Navy and Ministries of Health in partnership with the US Navy with funding from the US Department of Defense (Sueker et. al. 2010). Research is focused on the epidemiology and pathogenesis of acute viral, parasitic and bacterial diseases. According to their website,

> NAMRU-6 currently has separate but complementary scientific efforts. First is research on infectious diseases of military importance that is funded primarily by the U.S. Military Infectious Disease Research Program (MIDRP). Additional research funds are obtained from the U.S. Army Medical Material Development Agency (USAMMDA), cooperative agreements with industry and collaborative grants with US and Peruvian universities. The second major scientific effort is public health surveillance through the Department of Defense's Emerging Infections Diseases (EID). This highly successful effort utilizes the DoD's overseas labs as extensions of US government surveillance for infectious diseases.[44]

In 2008, the U.S. Department of Defense Global Emerging Infections Surveillance and Response System (DoD-GEIS), which had been originally established in 1996, became a Division of the

44 Excerpt from http://www.med.navy.mil/sites/NAMRU6/

Armed Forces Health Surveillance Center (AFHSC).[45] This internal institutional reconfiguration centralized DoD-wide healthcare surveillance initiatives with domestic and overseas laboratory surveillance efforts.[46] Today, the NAMRU-6 EID program is a component of the DoD-GEIS project, which incorporates international and national research facilities in a network designed to survey and monitor global trends in emerging and re-emerging infectious diseases.[47] With DoD funding, public health researchers at NAMRU-6 conduct surveillance and their research efforts remain recognizably entangled with, if not governed by, the biosecurity interests of the United States. From this perspective, NAMRU-6 can be seen as part of a "global assemblage"[48] that superimposes US and Peruvian global health security concerns.

Prior to 2016 when Trump took office, the US government could help Peru build public health capacities, but during Trump administration NAMRU-6 had to change their 'mission vision' to focus only on improving the health of US soldiers, whether at home and abroad, and to terminate US-Peru partnerships, radically transforming the nature of their relationship to their host country and undermining their justification for being there. Nobody likes working there anymore, except for the fact that they have amazing equipment and pay well.

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45 Although their geographic locations have changed through time, five AFHSC laboratories were in operation in 2009: Cairo, Egypt; Nairobi, Kenya; Bangkok, Thailand; Jakarta, Indonesia; and Lima, Peru.45 In 2009, AFHSC-GEIS "provided direction, funding and oversight to a network of 39 partners at approximately 500 sites. Ninety-two countries were impacted with either active surveillance, capacity-building initiatives or participation in training exercises" (Russell et. al. 2011).

46 Russell, Kevin L., et al. "The Global Emerging Infection Surveillance and Response System (GEIS), a US government tool for improved global biosurveillance: a review of 2009." *BMC Public Health* 11.2 (2011): 1-10.

47 In 2010, the US DoD determined Pathogen Research Priorities for Infectious Diseases research funds. NAMRU-6 aligns its strategic interests with this list to deliver products for the warfighter that have most greatly impacted troops during times of conflict as well as having tremendous financial and public health impact on partner nation militaries and communities in South America. Today NAMRU-6 surveillance for emerging pathogens focuses on areas in the Peruvian Amazon at the highest risk for zoonotic disease emergence. The goal is to move the country away from a reactive post-outbreak response to a proactive approach in which pathogens of pandemic potential are discovered at their source before diseases have the opportunity to spillover.

48 Ong, Aihwa, and Stephen Collier. "Global assemblages." *Technology, politics and* (2005).

In the late 1990s and early 2000s, NAMRU-6 was a leading institution, but that all of that changed when Donald J. Trump was elected to the American presidency. The mission of NAMRU-6, as an integral US organ of the global health research and security ecosystem abroad, shifted from building partnerships and capacities with its host country and actively narrowed its 'niche' to military interests, specifically. A lot of the collaborative work and relationships that had established with Peruvian institutions over decades slowly began to become undone. A lot of good Peruvian researchers, who had begun to be given positions of authority at NAMRU, and who collaborated with the American guests, left.

V. Conclusion

In his last months before leaving office, President Obama gave a final address to the United Nations General Assembly. Referencing the then unfolding epidemic, he declared: "We can't combat a disease like Zika that recognizes no borders - *mosquitos don't respect walls* - unless we make permanent the same urgency that we brought to bear against Ebola by strengthening our own systems of public health, by investing in cures and rolling back the root causes of disease, and helping poorer countries develop a public health infrastructure".[49] His quip about mosquitos elicited chuckles from the audience, as it unmistakably alluded to his successor to the presidency, Donald J. Trump, who had built his contentious campaign upon a pledge to erect a wall spanning the entirety of America's southern border to prevent illegal immigration and "secure the Nation's border".

49 Address by President Obama to the 71st Session of the UN General Assembly available: https://obamawhitehouse.archives.gov/the-press-office/2016/09/20/address-president-obama-71st-session-united-nations-general-assembly

In my estimation, Obama's riposte was not aimed at deriding the wall, per se, nor was it a comment on the ethology of mosquitos. Rather, it expressed an absurdity: it is literally a joke to believe, today, in the 21st century, that the borders erected by nations to police their sovereign territory and to spatially govern the movement of humans could be possibly imagined as an adequate means of protection against the movement of pathogens.

It was also a shrewd warning against the geopolitical idiocy (if I may) of believing that the same technologies that worked for preventing the movement of men would just as well work for keeping out nonhuman actants, be they insects or microbes or mutating viral strains. The joke gestured towards Trump's limited political imaginary (his idea of progress was so backwards-oriented, anyway, i.e., "Make America Great *Again*"). More specifically and, indeed, more importantly, his comment railed against the notion that it'd be possible to protect domestic health against the international threat of disease by adopting a defensive nationalist preoccupation with what happens *at* the borders between sovereign states without any concern for the governance of health on *this side* and, crucially, *that side* of any border, as well.

Obama understood that we live in an interconnected and interdependent world. "No one nation can achieve health security on its own," said Beth Cameron, a member of his administration who wrote the Pandemic Playbook and directed the Global Health Office for Biosecurity and Pandemic Preparedness before the Trump administration dismantled it. Obama's snarky little joke spoke seriously to the reality that contemporary global health threats increasingly exceed old ways of thinking about national security.[50]

50 Legal and illegal foreigners, like infectious pathogens, are often portrayed as 'threats' to national security. But what works for the former does not work for the latter. For example, at borders humans are treated as political subjects, who are expected to act in obedience to established rules for international travel and laws for legally doing so, but

Today in 2021, we are still responding to Covid-19 pandemic and reeling from Trump's America First policies. Now we know firsthand, as many have before us, that defending global health security as if nation-states existed as independent entities in an otherwise wholly interdependent world, does not work. Many humans around the world, especially those in the USA, have learned a lesson that my interlocuters in Peru have known for a long time: decentralized efforts do not work for mitigating public health crises. For all the flaws and dangers manifest in the geopolitics of any emerging security regime that aspires to global hegemony, we have also seen how failing to coordinate, both across or within national borders, is also disastrous. What happened when the US adopted nationalistic, protectionist policies and walked away from global institutions, abdicating its responsibility to the global community as well as its position of leadership – this impacted much more than the US population alone. It disrupted stability and security beyond our borders. Given our position.

pathogens exceed and oft elude those measures, which do not apply to them. For me to suggest that borders work for governing the movement of humans but not for governing the movement of pathogens implies two key distinctions: (1) a fundamental difference between humans and disease-causing pathogens; (2) an inseparability between humans and disease-causing pathogens, nonetheless. 'Man and microbe' cohere, and almost paradoxically, this biological coherence is often incoherent for apprehension at political borders. This alone suggests a new conceptualization of disease beyond the binary opposition of human/nonhuman, biology/politics ought be pursued. For works of translation required to recognize and integrate immigrants into the state in Italy, and for the politics is opened up, see Giordano, Cristiana. *Migrants in translation: Caring and the logics of difference in contemporary Italy*. Univ of California Press, 2014. In the way that recognition can only come from an 'other', I wonder how we might further reconceptualize the interface in such a frame, that is, in the tete-a-tete (Levinas 1985) encounter with difference.

Anthropology at the Interface

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I received via e-mail an invitation to attend the upcoming Global Health Security Agenda (GHSA) workshop in Lima, Peru. Formally billed as "Preventing, detecting, reporting, and responding to public health emergencies: Workshop on tools, best practices, and challenges in the Region of the Americas," the event was to be sponsored by the Pan American Health Organization / World Health Organization (PAHO/WHO), along with the Peruvian Ministry of Health and the United States Government. I finagled the invite through a contact I made at the US Embassy in Peru the summer prior.

Exactly one week later, on the morning of August 16th 2017, I was in Lima in the backseat of a dusty black Uber headed to the Hotel Delfines in the upscale neighborhood of San Isidro. The heavy-footed driver punched through traffic, propelling us in a generally north direction up and down the streets of Miraflores, another well-to-do and tourist-friendly neighborhood along the coastline of the capitol city. I clutched the grab handle on the door beside me and gawked out the window: nearly a dozen parasailers soared through the air, each with a rainbow parachute in tow. Speedboats bounced beyond the break, clear of the surfers waiting their turns to ride the waves back to the shoreline. Massive palm trees lined the malecón, foregrounding these acrobatic flights both above and in the water. I rolled down the window and inhaled the sounds of waves, the salty air, the vastness of the Pacific Ocean, the pastel-colored façades of store fronts and motley architecture lining the esplanade. A thick morning fog rose from the sea, rolled inland and off into the distance. Crossing what seemed like a six-way intersection, we pulled up alongside a park where pedestrians in stylish athletic wear ran and walked their dogs (many of the pups were also

adorned in clothes). Cars and combi's honked away, and I thought to myself: Lima sort of reminds me of what I imagine Los Angeles might have been like in the seventies…

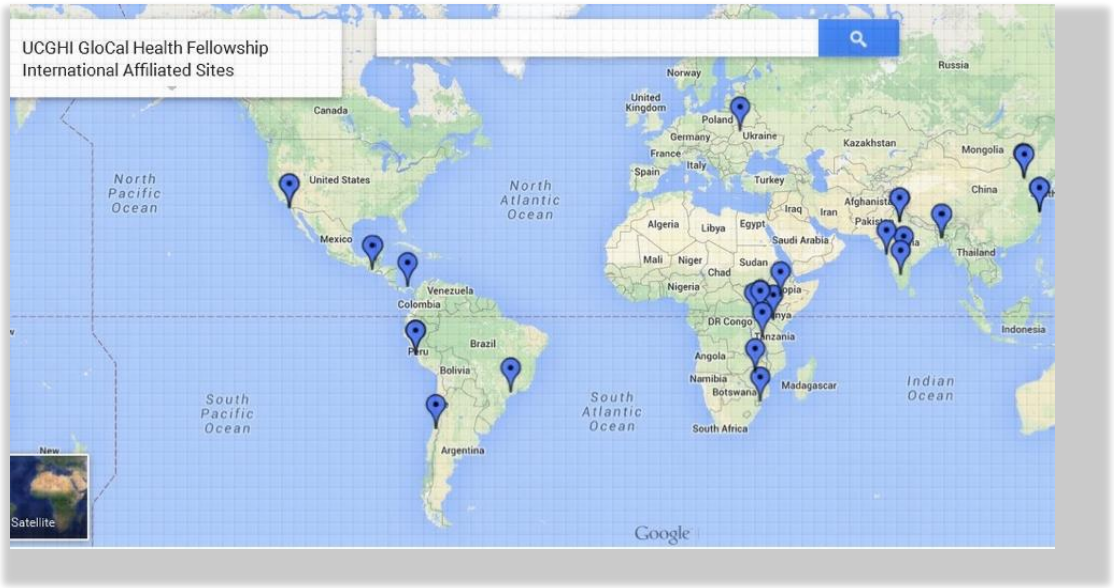
I do not know why that association occurred to me nor why that particular image assembled itself in my mind, then and there. I had never been anywhere in the 1970's, let alone Los Angeles in the decade prior to my birth. Still, I conjured that image – both foreign and familiar – before exiting the taxi and stepping into the scene of my first formal fieldwork encounter. Perhaps the imaginary connection allowed me to quickly, instantaneously, make some sort of sense out of my new surroundings, which also seemed strange albeit vaguely familiar, modern while anachronous, slightly idyllic though hardly exotic. I knew (saber) of Lima, Peru and had been there on several occasions before for months at a time, but I did not really know (conocer) it yet.

The series of events that facilitated my mid-August arrival to Lima in 2017 and that likely colored my impressions of this new milieu on that particular day felt somewhat fantastical. Perhaps even my depiction of it, here, in the opening paragraph rings of romance. The truth is that I had never yearned for Peru prior to my arrival. I had never experienced any powerful feelings of nostalgia or wanderlust that would have drawn me there to begin with, nor had I felt compelled by any personal connection to the place or its inhabitants to conduct research *there.* No swelling sensation of belonging swept me to the shores of Peru, in particular.

My desire to pursue fieldwork, in general, was undoubtedly informed by my vocational commitment to anthropology and to its traditions of 'setting out' to engage otherness. Indeed, I was compelled to seek out and enter into relationships with interlocuters and in doing so to formulate experientially-based insights into the topic of my research – in broadest terms: the

"global assemblage"[51] increasingly known as global health. In many ways mirroring, that is to say, in the face of global health as a largely deterritorialized[52] field of research, I approached the task of field site selection less in geographically-specific terms than as a matter of relative strategy. Quite un-romantically, I settled on Peru after clicking 'it' on an interactive map and preferring its profile over other potential 'research sites' that were catalogued as 'partners' for the fellowship I sought to acquire.

I basically *Tinder*-ed my field site.



A screen grab from google maps of UCGHI partner sites.

51 Ong, Aihwa, and Stephen Collier. "Global assemblages." *Technology, politics and* (2005).

52 Lawrence Cohen in 'Making Peasants Protestant and Other Projects' writes of deterritorialization and its consequences for medical anthropology. In the early 1990s, he writes, anthropology graduate students were being informed that 'the era of area studies was over' in large part because the *cultural* specificity of situations – in its Boasian conceptualization as tethered to place – no longer seemed adequate to their understanding. Area studies as an approach had been particularly challenged by postcolonial historicist critiques of anthropological knowledge formation and by political economy perspectives replacing 'civilization' with 'the world system' as the vehicle for scaling up. The area studies model, he says, became less relevant to mainstream conversation in the social sciences as the dominant logic of internationalism shifted from 'development' to 'globalization'. In my dissertation, I similarly trace how this shift in logic conditioned the possibility of distinguishing the global health – as an area of study, research, and practice informed by social justice principles – from its prior iterations as international health and development aid.

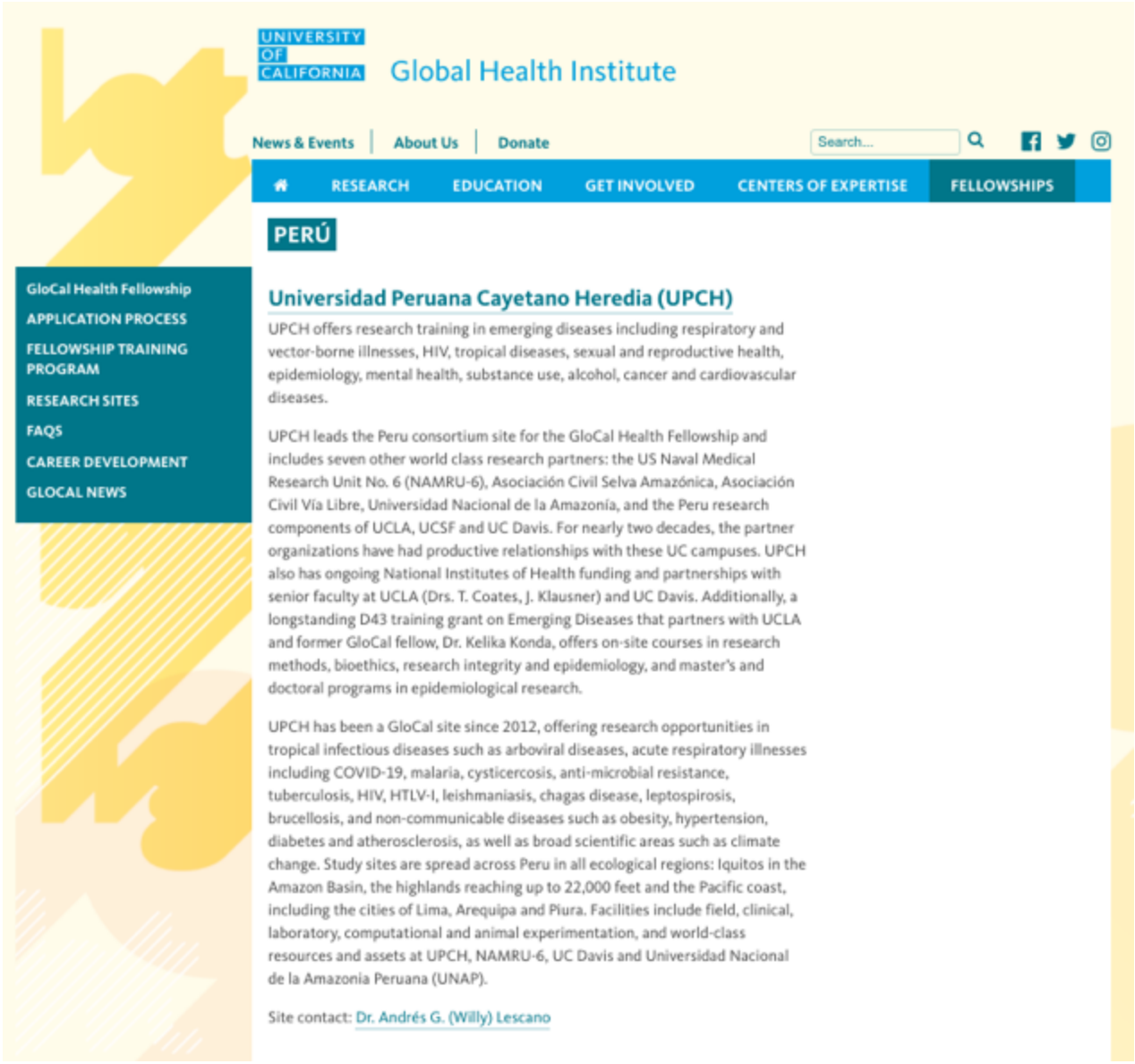
Three screen grabs from website of UCGHI

(above and below)

OUR PARTNERS

UCGHI, its Centers of Expertise and its GloCal Health Fellowship program undertake local and global partnerships as an essential element of all areas of its work.

- Action Research and Training for Health
- Advancing New Standards in Reproductive Health
- Aga Khan University
- Centro de Justicia para las Mujeres (CEJUM)
- CHG Climate Hazards Group
- Congo Basin Institute
- Conservation International
- Family AIDS Care and Education Services (FACES) Program
- Foundation for Professional Development, South Africa
- Defensores de la Naturaleze
- GBV Prevention Network
- GESMujer
- Global REACH
- Hanoi Medical University
- Hesperian Health Guides
- Infectious Diseases Institute , Uganda
- International Centre for Diarrhoeal Disease Research, Bangladesh
- International Centre of Insect Physiology and ecology
- Just Detention International
- Kenya Medical Research Institute
- Kinshasa School of Public Health (KSPH): UCLA DRC Health Research and Training Program
- Makerere University, Infectious Diseases Research Collaboration, Uganda
- Muhimbili University of Health and Allied Sciences
- Muso
- Nelson Mandela African Institute of Science and Technology
- Oasis Initiative
- Partners in Hope, Malawi
- Promundo
- Public Health Foundation of India
- Public Health Research Institute of India
- Raising Voices
- Seed Global Health
- Sexual Violence Research Initiative
- Sokoine University of Agriculture, Tanzania
- Sonagachi Research and Training Institute
- Sonke Gender Justice
- St. John's Research Institute, India
- Stellenbosch University
- UC San Diego Center on Gender Equity and Health
- Universidad del Valle de Guatemala
- Universidad Nacional Autonoma de Mexico (UNAM)
- Universidad Peruana Cayetano Heredia
- Universidade Eduardo Mondlane, Mozambique
- University of Botswana
- University of California CARE offices
- University of Ghana
- University of Zimbabwe College of Health Sciences
- Upstream Alliance
- Women's Foundation of California



An aspiring anthropologist of science and health, I had wagered that fruitful opportunities for research and career development might be found in the pursuit of anthropological fieldwork at the intersection of, if not formally within, the still-evolving, explicitly interdisciplinary, and increasingly well-funded field of global health.

The approach was calculated. Still, I envisioned myself akin to the sociologists of scientific knowledge a generation or two before me, or to the turn-of-the-century anthropologists of science and medical anthropologists of lore, who – as these stories go – poured liquids into pipettes or agreed to "collaborate", so exchanging technical labor for participant-observational access into otherwise inaccessible laboratories. In my rendition, I would play the jester, the oppositional intellectual at the disciplinary margins of 'critical' and 'engaged' anthropology, simultaneously inside and outside of global health, "pulling at loose threads, deconstructing key concepts, looking at the world from a topsy-turvy position" (Scheper-Hughes 1990). I would propose to conduct a qualitative study that promised to make valuable contributions to the global health field, itself, while securing, for myself, the financial and symbolic capital that I felt would allow me to pursue anthropological research on an adjacent topic in the same domain.

In the University of California Global Health Institute (UCGHI), I found my benefactor. The UCGHI is a UC-wide initiative that was founded in 2009 by Haile T. Debas MD, Chancellor Emeritus, UC San Francisco, to forge "authentic partnerships" with global collaborators and local communities, to promote global health research and education, and to "train future global health leaders". After generating $13 million in its first few years, the UCGHI launched the GloCal Health Fellowship program, co-sponsored by the US National Institutes of Health and the Fogarty International Center (NIH-FIC). Since its inception, the GloCal Health Fellowship has awarded several millions of US dollars in scholarships and fellowships to UC students, faculty, and postdocs. I was in the Anthropology Department at UC Davis, and this fellowship felt like my surest bet.

I applied for the GloCal Health Fellowship in 2016 with a proposal to study practices of interdisciplinary collaboration, itself. I had become very interested in "One Health", an increasingly popular conceptual framework and implementation strategy in contemporary global health research that emphasizes the interrelatedness of human, animal, and environmental health along with the concomitant need for greater collaboration across the human, health, and life sciences.

The UCGHI had established a Center of Expertise (COE) in One Health on the UC Davis campus, and UC Davis also hosted the One Health Institute in its School of Veterinary Medicine. I rode my bicycle from my office in Young Hall to the other side of campus, where the agriculture and veterinary schools were located, quite a few times to speak with folks who worked in One Health. One of my first interlocuters, who has since become a deeply cherished mentor, was Dr. Patricia Conrad DVM, a veterinarian and protozoologist who helped to create the One Health Institute at UC Davis. In our early meetings, we discussed One Health as a concept, why I was drawn to it, and I listened to her consider aloud what it would require to "actualize" this idea in global health research. She encouraged me to apply for the GloCal Health Fellowship.

The first time I applied, I was motivated by questions like: what practices constitute collaboration in the One Health approach to global health research? And what kinds of new evidence emerge from these practices? How does infectious disease epidemiology change when practiced in collaboration with veterinary and environmental sciences?

To my mind, these were important anthropological questions regarding emergent forms of knowledge that spoke to changing human practices in the health sciences and possibly to new ways of knowing and thus relating to disease. I do not remember how I framed the stakes of the project

in the grant proposal, but I was unsuccessful in making it beyond the first round of consideration. I applied again the following year, this time with the help of my mentors in global health who explained to me some of the basic requirements of the global health grant proposal – for it is, indeed, a genre of writing of its own. They equipped me with specific language and syntax to use like "primary sample" and "opportunities and barriers" and "this project addresses the gaps in -" and "employs multiple methods from empirical social science research" and "these findings can be operationalized to -".

In the days leading up to the deadline, I exchanged drafts two or three times with my mentors, each of whom gave me direct feedback until the proposal was cumulatively polished. (I include this, here, in the dissertation as a testament: I honestly do not know how anyone wins grants without the interactive oversight of and personalized support from mentors who have successfully done so before them).

I proposed a project that sought to identify commonalities and differences in the conceptualization of "global health" among NIH-funded researchers across North and Latin America and the Caribbean. I suggested that extant definitions of global health tended to homogenize the variety of perspectives and practices that shape the field as it is and as it could be. I argued that it was important to recognize particularities among and between countries with different social, political and economic contexts when defining global health, determining its priorities, and designing educational curricula. By interviewing practitioners and students across Latin America and the Caribbean, I might help compose a more 'polyvocal', 'inclusive', and 'global' definition of global health, one that would be built 'from the ground up' while amplifying 'non-US-centric' and regionally 'diverse' viewpoints. Plus, my findings could be leveraged to improve 'best practices'

in global health training programs and promote 'bi-directionality' of student exchange between international research partners thereby decreasing some of global heath's structural inequities.

I tried to hit everything.

I won the fellowship on my second try. And the following year, I entered my fieldwork in Peru under the auspices of an up-and-coming global health researcher, that is, as a member[53] of the 2017-2018 cohort of doctoral and post-doctoral students becoming "the next generation of global health leaders".[54] As a GloCal Fellow, I would compare conceptualizations of 'global health' and 'One Health' while pursuing additional questions I knew not how to convey in the NIH grant proposal, which revolved around the issues of global health governance, the geopolitics of US-Peru research relations including its colonial legacies, and the ethics of multispecies relationality in emergent forms of epidemiological inquiry. To be sure, I separated out the questions driving my GloCal project from those more critical or esoteric aspects compelling my broader dissertation research. That said, the lines distinguishing my global health research project from the anthropological fieldwork I considered necessary to write the dissertation I wanted to write were hardly anything but fuzzy and confused.

Anthropology at the interface – as I would like to call this practice of situating oneself at the edges of critical and applied scholarship and betwixt disciplinary domains of research entirely – required that I learn to navigate such ambiguity. On the one hand, I stepped *into* global health by committing

53 Anthropologist Nicholas Langlitz entered his field site as a test subject in the neuro-psychedelic experiments he sought to anthropologize. Anthropologist Joshua Craze entered his field site in Sudan as a humanitarian journalist in order to pursue his inquiries. There are several additional examples, as well, of fieldwork-in-a-double-mode. Liz Roberts entered her field site in Mexico City as a NSF-funded PI on an interdisciplinary public health project doing socio-environmental epidemiological studies.

54 I still wore my "Malinowski vest" whenever I went into the field, that is, with my interlocuters into their fields. Quite literally I wore a green fishing vest and called it my anthropology vest. Throughout fieldwork, so many individuals wore vests into their respective fields, figuratively and literally.

– genuinely and in good faith – to conduct research in its name. On the other hand, global health was a domain that the critical medical anthropologist inside of me had righteous intentions to subvert. Importantly, I promised my funders – and Peruvian hosts – that I would conduct a conventional qualitative health study. At the same time, I devised the project as an express means for doing something else, as well. Anthropology at the interface, for me, has involved reflecting upon and accepting this generative divergence.

Pursuing fieldwork in a double mode demanded that I attend to multiplicities at every turn. Within myself, I wrestled with periodic bouts of imposter-syndrome (a reflexive flipside of playing the trickster?). Within the space of anthropology, which term in the pair – participant-observation – situated my activities?[55] Aware of myself in the global health *dispotif*,[56] I straddled positions of first- and second-order participant-observation, and I was frequently confused by my role in the interconnections that bounded and grounded me to others.[57] Conducting research in a zone of 'adjacency' – not only to what I thought global health was or might be, but also to my conception of what anthropology is or could be – tugged me interminably in different directions. [58]

55 In Reflections on Fieldwork in Morocco, Paul Rabinow writes "Rabinow says that "however much one moves in the direction of participation, it is always the case that one is still both an outsider and an observer" (79).

56 Gabriel Coren writes of "composition by field", that is, of conceptualizing 'the field' not only as a place that exists 'on the ground' but equally as an affective and conceptual terrain that we construct or compose as the conditions for anthropological inquiry. We actively cultivate the worlds we inhabit and inquire into. We artfully participate in the realities we may perceive as natural or represent as given.

57 On second order observation, see: Luhmann, Niklas. *Observations on modernity*. Stanford University Press, 1998. Also see: Rabinow, Paul. *Marking time: On the anthropology of the contemporary*. Princeton University Press, 2009.

58 What I am calling 'anthropology at the interface' is akin to what the anthropologist of science, Paul Rabinow, describes as anthropological inquiry in a mode of adjacency. "Adjacent: in close proximity. May or may not imply contact but always implies absence of anything of the same kind in between" (2008; p39). Fieldwork experiences in a zone of adjacency connote, as Rabinow writes, "a space of objectivity in the sense of disinterestedness: the anthropologist has neither the same interconnections, nor the same stakes, nor the same pressures that the [interlocuters] do" (ibid, p47). This may not fully capture *my* experience, though the notion of 'sameness' did emerge as an important theme and challenge, for me, during fieldwork. I wonder to what extent I (un/consciously) manufactured this impossibility of experiencing identical sameness (either with global health or anthropology), perhaps as a condition for 'disinterestedness'.

Early on in my fieldwork, for example, an interlocuter at the Peru CDC asked me to collect behavioral data for a research project they thought might interest me. They wanted me to find out why health care workers in local clinics didn't fill out forms, presumably so that they could design guidelines or incentives to make them do so (since the information provided on forms feed into databases for monitoring syndromic surveillance). Taken at face value, this was an interpolation, perhaps, an invitation to translate my anthropological skillset and sensitivities into something useful that my host thought he needed and, given the assumptions and imaginaries he had likely inherited about medical anthropology, that he thought I was equipped to impart. They didn't work with that many anthropologists in his office and were excited to have me join them. Respectfully, I suggested that the project was interesting and important, and I understood why he thought I might want to team up that project, but it did not quite capture my interests. In truth, I thought it sounded insanely boring.[59] But, the crux of the matter was that I, frankly, did not want to comply with this reduction of anthropology to the brokering of 'culture' data.[60]

At the same time, a part of me *did* want to participate with my colleagues in Peru, on their terms, simply as a matter of principle. Not doing so would have felt uncollaborative and risked signaling a tacit complicity with other broader legacies of extraction and exploitation that plague the histories both of anthropology and of international health development. What if they experienced my noncompliance as intransigence, as self-righteous self-exclusion, as willfully denying them of a capacity that they thought I had and that they wanted, but that I personally refused to share? My

59 Lucy Suchmann on workflow and interfaces from the 1980s and 1990s did inspire me as a student. It's just not the kind of fieldwork I wanted to pursue.

60 In the same conversation, this interlocuter asked me to write up a set guidelines that public health practitioners could refer to in order to learn about 'cultural competence'. I ultimately obliged, worked on it for several days intently, and was dismayed that he never circulated it or referred to ever again. See appendix. In a similar vein, another interlocuter in a different institution entirely told me why he was interested in anthropology: to investigate why people ignore the recommendations of public health officials during Dengue outbreaks. Indeed, this attempted mis/use of anthropological insights to control human behavior has been a topic of much critical medical anthropology for decades.

resistance risked reproducing negative power relations, the sorts of which have long imbued 'partnerships' between health researchers from the so-called Global North and South.

One afternoon, I met with a different interlocuter at the CDC and requested whether I "could attach myself to a specific zoonosis for which they were just getting protocols up and running – rabies surveillance, for example – and sort of observe the life cycle of the process?" I was already describing research in naturalized ways and verbalizing my mode of relation to the research as one might a parasite.

A conversation with a Peruvian friend, Oliver, helped ease this tension for me. We were sitting on a bright-red, modernist ceramic bench in the shape of a bean on the top floor of the library at his university. For weeks, he had been trying to take me on a tour of the Pontifical Catholic University of Peru (PUCP) campus, where he was earning his Master's degree in economics. It was much prettier than the main campus of Cayetano Heredia University (UPCH), where I was affiliated through my fellowship, and where Oliver and I had first met in Willy's graduate student working group. Sipping on coffees we had procured earlier when walking around the quad, we discussed how our training in two different sub-domains of the social sciences – anthropology and economics – shaped our interests in epidemiology. We found that our academic affinities converged in a shared familiarity with development discourse and dependency theory.

"You know, these topics come up a lot in the interviews I'm doing for the Fogarty project," I told him. "A lot of folks try to distinguish global health from international health precisely on these points. They'll say international health was characterized by the flow of resources from the developed to the developing world, whereas global health is more bi-directional and also more concerned with capacity-building – you know this phrase – because," I went on, "it will make

developing countries less dependent on international aid for solving public health problems. What do you think?"

He leaned forward and pressed two fingers to his chin – a gesture of contemplation. "Of course," he said before pausing again. "But in this case, you are assuming that dependence is bad".[61,62] I learned that Oliver did not exactly share my skepticism of the structural dependencies that continue to link North-South. Referencing the United Nations Economic Commission for Latin America and the Caribbean[63] (CEPAL), he told me that he saw global health, historically and today, as a system of (a) donors and (b) receivers of funds, and that he thought this interdependence was a necessary relation – neither inherently good nor bad. The issue, for him, was not so much that donor-receiver relations were built upon colonial infrastructures that persist into the present, nor that the occupancy of these positions tends to be fixed. Asserting the mutuality of interdependence between USA and LAC – they both need each other for different things – Oliver cared more about how to capacitate so-called receivers into becoming better receivers.

I got the sense that he was trying to disentangle North-South and donor-receiver relations from equating to active-passive positions. In other words, he wanted administrators in the South to be more savvy with the resources they accepted from the North. He wanted to game out comparative

61 I have zero inkling to psychoanalyze Oliver, but I wonder: was his provocation not somewhat self-accommodating? Did Oliver uncritically accept dependence as a given? Or did he remind me to *problematize* it, rather than lament it? Foucault defines problematization as a term that suggests a particular way of analyzing an event or situation: not as a given but as a question. As Michel Foucault writes, "a problematization does not mean the representation of a pre-existent object nor the creation through discourse of an object that did not exist. It is the ensemble of discursive and non-discursive practices that make something enter into the play of true and false and constitute it as an object of thought (whether in the form of moral reflection, scientific knowledge, political analysis, etc.)" (excerpt from Rabinow's 2002 essay *Midst Anthropology's Problems*).

62 On dependency not being bad – Liz Robert's forthcoming work on 'vital dependencies'

63 Oliver told me about the United Nations Economic Commission for Latin America and the Caribbean, known as CEPAL in Spanish, and how foreign trade was crucial for the industrialization of Peru's economy after WW2. Yes, it facilitated policies of "unequal exchange" between the "North" and "South" that reappear today in some of the structural relations that give form to the realm of global health. Too, this history resurfaces in discussions among economists regarding what role the state ought to play in the governance of markets and citizens, budgets and credit.

advantage, not upend histories of structural dependence that contributed to unequal power relations on a global scale, the type of which I worried I wasn't actively undoing through my anthropology-at-the-interface.

Later, I revisited Michel Foucault's essay "What is Enlightenment?", one of my favorites. In the essay, Foucault problematizes man's relation to himself and to his present; and he characterizes the attitude of modernity as a philosophical ethos "consisting in a critique of what we are saying, thinking, and doing through a historical ontology of ourselves". Historical ontology, in this particular context, meant critically investigating the events that have led us to constitute ourselves and recognize ourselves as subjects – subjects who are bound by the limits imposed upon us (i.e. historically determined) yet also capable of going beyond them (e.g. singular, creative, free [to become]).[64]

The reminder was this: in a reflexive mode, critical inquirers may attend to the historical contingencies that have made us what we are and that constrain what we know, including what we think can be known. But in an experimental mode, we can creatively put those critiques to the test of reality; we can imaginatively and rigorously push upon the limits that bind us, seeking more room, allowing slightly more capaciousness, opening ourselves up to both giving and receiving, catalyzing little mutations to our horizons of possibility, for structuring our experience in and of the present. Foucault indicates,

64 Foucault writes, "This entails an obvious consequence: that criticism is no longer going to be practiced in the search for formal structures with universal value, but rather as a historical investigation into the events that have led us to constitute ourselves and to recognize ourselves as subjects of what we are doing, thinking, saying… This critique… is not seeking to make possible a metaphysics that has finally become a science; it is seeking to give new impetus, as far and wide as possible, to the undefined work of freedom."

> "What is at stake, then, is this: How can the growth of capabilities be disconnected from the intensification of power relations?"

What this profound insight translated into, for me, and for the very narrow purposes of my humble fieldwork, was this: since interdependence is presently a condition of existence, reciprocally imbuing and imbued by knowledge/power relations at many scales, my challenge as anthropologist would be to find ways to work with my colleagues in global health research, thereby increasing my own and they their capabilities, while not simultaneously increasing the negative power relations that bind us.[65]

This is how I chose to face fieldwork, how I learned to reconcile my positioning as anthropologist at the interface, to pursue fieldwork in a double mode that did not feel duplicitous, and to conduct myself in a world that preceded me and will succeed me, yet for a moment – distinct and open-ended – involved me.

At least it was a start.

65 Foucault also writes, "This philosophical ethos may be characterized a limit-attitude. We have to move beyond the outside-inside alternative; we have to be at the frontiers. Criticism indeed consists of analyzing and reflecting upon limits". This is *precisely* where I imagine anthropology at the interface is to be situated.

Appendix

Title: Defining Global Health: Findings from a Systematic Review and Thematic Analysis of the Literature

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Word Count: 5,725

Key Questions

What is already known?

- Debate around a common definition of global health has seen extensive scholarly interest within the last two decades; despite the abundance of literature, ambiguity still persists around its precise definition.
- No systematic reviews with thematic analysis have been conducted to explore extant definitions of global health nor to contribute to a comprehensive definition of global health.

What are the new findings?

- We compile and thematically analyze extant definitions of global health and propose grounded theoretical insights into what might be seen as relevant for establishing a common definition of global health moving forward.
- The need for a clear and concise definition of global health has the highest stakes in the domain of global health policy governance.

What do the new findings imply?

- Stakeholders tend to define the "what" of global health: its spaces, objects, and practices. Our findings suggest that the debate around definition should shift to more pragmatic and reflexive questions regarding "who" defines global health and towards what ends.

Abstract

Introduction: Debate around a common definition of global health has seen extensive scholarly interest within the last two decades; however, consensus around a precise definition remains elusive. The objective of this study was to systematically review definitions of global health in the literature and offer grounded theoretical insights into what might be seen as relevant for establishing a common definition of global health.

Method: A systematic review was conducted with qualitative synthesis of findings using peer reviewed literature from key databases. Publications were identified by the keywords of "global health" and "define" or "definition" or "defining". Coding methods were used for qualitative analysis to identify recurring themes in definitions of global health published between 2009 and 2019.

Results: The search resulted in 1363 publications, of which 78 were included. Qualitative analysis of the data generated four theoretical categories and associated subthemes delineating key aspects of global health. These included: (1) global health is a multiplex approach to worldwide health improvement taught and pursued at research institutions; (2) global health is an ethically oriented initiative that is guided by justice principles; (3) global health is a mode of governance that yields influence through problem identification, political decision-making, as well as the allocation and exchange of resources across borders; (4) global health is a vague yet versatile concept with multiple meanings, historical antecedents, and an emergent future.

Conclusion: Extant definitions of global health can be categorized thematically to designate areas of importance for stakeholders and to organize future debates on its definition. Future contributions to this debate may consider shifting from questioning the abstract "what" of global health towards more pragmatic and reflexive questions about "who" defines global health and towards what ends.

Keywords: global health, public health, definition, thematic analysis, systematic review

INTRODUCTION

Debate around a common definition of global health has seen extensive scholarly interest within the last two decades. In 2009, a widely-circulated paper by Koplan and colleagues aimed to establish "a common definition of global health" as distinct from its derivations in public health and international health.[1] They rooted the definition of public health (PH) in the mid-19th century social reform movements of Europe and the United States, the growth of biological and medical knowledge, and the discipline's emphasis on population-level health management. Similarly they traced the evolution of international health (IH) back to its colonial roots in hygiene and tropical medicine through to the mid-20th century with its geographic focus on developing countries. Global health (GH), they argued, would require a distinctive definition of its own to be "more than a rephrasing of a common definition of public health or a politically correct updating of international health". Their intervention built upon prior research noting confusion and overlap among the three terms and thus a need to carefully articulate the important differences between them.[2-5] Additional stakeholders have since elaborated varied definitions of GH, yet consensus around its precise definition remains elusive.

To determine how global health is presently defined and to identify whether a common conceptualization has been established, we conducted a qualitative systematic literature review (SLR) of the global health literature between 2009 and 2019. SLRs are a methodology used "to identify, appraise and synthesize all the empirical evidence that meets pre-specified eligibility criteria to answer a given research question".[6] Unlike unsystematic narrative reviews, SLRs use formal, repeatable, and transparent, procedures for identifying, evaluating, and interpreting available research, thus ensuring robust coverage of the current literature while reducing the biased

presentation of available evidence.[7-9] Medical researchers and policy makers have long relied on SLRs because they integrate and critically evaluate current knowledge to support decisions about important issues.[10] However, very few SLRs exploring aspects of GH have yet been published,[11-13] and no SLRs focusing on extant definitions of GH have been conducted. This paper fills that gap by exploring the thematic components of extant definitions and thereby contributes towards a comprehensive definition of GH.

AIMS AND OBJECTIVES

The aim of this review is: (a) to examine how global health has been defined in the literature between 2009 and 2019, (b) to systematically analyze the core thematic categories undergirding extant definitions of global health, and (c) to offer grounded theoretical insights into what might be seen as relevant for establishing a common definition of global health.

METHODS

Aiming to capture definitions of global health (GH) in literature between 2009-2019, our team conducted a systematic review of the peer-reviewed literature following PRISMA guidelines.[14] The sequential steps of our review process included:

1. Search Strategy: Identify papers and relevant databases

Search technique

The terms "global health" AND "define" OR "definition" OR "defining" were queried when they appeared in the title, abstract, or keyword of studies. Published studies were identified through comprehensive searches of electronic databases accessible through the authors' university library

system (Web of Science, Scopus, Embase, PubMed, EBSCO). Citation tracking through Google Scholar was also completed.

Study selection criteria

Articles published in international peer-reviewed journals, including conference papers, book chapters, and editorial material, were reviewed. The studies included were written in English and published between 2009-2019. The year 2009 was chosen as a starting point because this is the year in which Koplan et al. published "Towards a Common Definition of Global Health". For this review, the team excluded news articles, theses, book reviews, and published papers that were not written in English.

2. Assessment Strategy: Appraise which papers to include in review

The protocol-driven search strategy required that articles included in the review must: (a) contain the keywords "global health" and "definition" and/or "define"; (b) be in the English language; (c) be published between 2009-2019. The number of articles containing these keywords was recorded, and all the titles uncovered in the search were imported into Mendeley, a software for managing citations. Duplicates were identified and removed, after which abstracts were screened to assess eligibility against the inclusion criteria. Full text articles were retrieved for those that met the inclusion criteria and three team members read a designated number of the articles selected for full review. To be included in the data extraction sheet, each article needed to: (a) focus on and explicitly name GH, (b) offer an original definition or description of GH, and/or (c) cite an already-existing definition of GH. Articles that mentioned the query terms without any relation to these requirements (e.g. did not provide a definition of GH or descriptive data to support interpretations

of a GH definition) were excluded. Assessment for relevance and content was conducted by 2 investigators who reviewed all identified articles independently. Disagreements were resolved by consensus with a third investigator.

3. Synthesis Strategy: Extract the data

Based on the research goals, the team designed an initial coding template in Google Sheets as a method of documentation, with the following coding variables: author, title, typology, definition(s), conclusions, and conceptual dimensions. To achieve a high level of reliability, the review team open-coded the same five articles, compared their coding experiences, and reconciled differences before adopting a final coding template and evenly dividing the remaining articles to be analyzed. Extracted data included: the type of study or research paradigm of each publication, the location and disciplinary affiliation of each study based on the contact information of the corresponding author, definitions and descriptions of GH, and specialized dimensions of GH. Whenever articles contained more than one definition or description of GH, those items were organized line-by-line under the author on the data extraction sheet.

4. Analysis Strategy: Analyze the data

The team conducted thematic analysis of the data to understand how GH has been defined since 2009. Our approach to thematic analysis was based on the guidelines described by Thomas and Harden[15] and further informed by principles in grounded theory.[16] Our strategy consisted of 3 main stages: Initial Coding – remaining open to all possible emergent themes indicated by readings of the data;[16,17] Focused Coding – categorizing the data inductively based on thematic

similarity at the level of description;[17] and finally, Theoretical Coding – integrating thematic categories into core theoretical constructs at a higher level of analysis.[18]

In the first cycle, open descriptive codes were generated (e.g. differences between public health or international health, GH education requirements, social justice values) directly from the definitions and descriptions of GH found in the articles. Individual sentences defining or describing GH were treated as unique line items on the data extraction sheet and coded accordingly in order to generate a range of ideas and information upon which to build.

In the second cycle, a focused thematic analysis was carried out to identify general relationships and patterns among definitions in the literature and to confirm significant links between the openly coded data. Thematic phrases (e.g. GH is multidisciplinary, GH promotes equity) were developed and re-applied to coded definitions on the data extraction sheet. Team members wrote and attached analytic memos to each coded datum – reflecting on emergent patterns and further "codeweaving",[18] which is a term for charting possible relationships among the coded data. At this stage, additional coding techniques were utilized. Attribute coding was applied as a management technique for logging information about the characteristics of each publication.[19] Data segments coded in this manner were extracted from the main data extraction form and reassembled together in a separate Google Sheet for further analysis. The team also coded extracted definitions of GH by type: (a) original definition, (b) cited definition, (c) original description to track possible relationships between citational practices and developments in the conceptualization and definition of GH.

In the third cycle, thematic phrases were ordered according to frequency then commonality and abstracted for overriding significance into theoretical categories. At this stage, the conceptual level of analysis was raised from description to a more abstract, theoretical level leading to a grounded theory. This resulted in the construction of four thematic categories, which are presented below with their supporting subthemes.

PATIENT AND PUBLIC INVOLVEMENT

Patients and public were not directly involved in this review; we used publicly available data for the analysis.

RESULTS

The search strategy retrieved bibliographic records for 1363 papers. The assessment strategy resulted in the elimination of 1237 papers after the removal of duplicates. Consequently, 78 papers were subjected to our strategies of synthesis (data extraction) and analysis.

Figure 1. PRISMA Flow Diagram of Citation Analysis and Systematic Literature Review[14]

1. CHARACTERISTICS OF STUDY

A variety of studies were included in this review. The majority (27) were commentaries, viewpoints, or debates.[1,20-48] Twenty-four were grouped as review/overview articles.[45-68] There were twenty-five original research articles, of which thirteen used qualitative methods,[69-81] eleven used mixed-methods,[82-92] and one[93] used quantitative data from a survey to proffer definitions of GH. Two studies included in the review were book chapters.[94,95]

The typologic, geographic, and disciplinary distribution of the studies in this review are shown in Table 1. Most studies were authored in North America (40),[1,23-25,27,20-31,39-41,43,46,47,50,54,55-58,61,63,66,68,70,73,74,76-80,83,84,86,87,89-91,94] followed by European countries (29),[22,26,28,32,34-38,42,44,45,48,51,52,59,62,64,65,67,71,75,82,85,88,92,93,95,100], countries in Asia (2),[33,72] Latin America and the Caribbean (2),[60,81] and New Zealand (1).[20] Disciplinary fields represented in our sample included: health (56); [20,22-27,30-32,34-40,42,43,45-51,54-56,58-61,63-69,72,74,75,77-79,82-84,86,88-91,93,95] law, social and cultural professions (19);[1,20,28,29,33,41,44,52,53,57,62,70,71,73,76,80,81,87,92,94] and education (2)[20,31].

Table 1. Summary of Characteristics of Retrieved Publications

Study Type	**Publications (n=78)**
Perspective/Commentary	27
Review/Overview Article	24
Mixed Methods	11
Qualitative Methods	13
Quantitative Methods	1
Book chapter	2
Study Setting (Region/Country)	
North America	n=40

US	30
Canada	10
Europe	n=29
England	16
Netherlands	1
Switzerland	2
Germany	6
Norway	2
Croatia	1
Spain	1
Belgium	1
Africa	n=3
South Africa	3
Latin America & Caribbean	n=2
Brazil	1
Caribbean, Trinidad & Tobago	1
Asia	n=2

Bangladesh	1
Israel	1
Oceania	n=1
New Zealand	1
Authors' Departmental Affiliation	
Health	n=61
Medicine	27
Global Health	10
Public Health	10
International Health	6
Nursing	3
Tropical Medicine & Hygiene	1
Global Public Health	1
Epidemiology	1
Other (health science, health admin, etc.)	3
Legal, Social, Cultural	n=14
Policy/Political Science	6

Anthropology	4
Sociology	3
Law	1
Education	n=2
Engineering Education	1
Medical Education	1

2. ATTRIBUTES OF DEFINITIONS

All 78 studies under review defined, described and/or cited extant definitions of GH. The 34 papers shown in Table 2 included descriptive definitions of GH that were formulated distinctly by its authors, that is, they were presented as original and without direct reference to other definitions.

Table 2. How Global Health Has Been Defined by Academics Since 2009

Year	Reference	Author	Definition
2009	[1]	Koplan et al.	Global health is an area of study, research, and practice that places a priority on improving health and achieving equity in health for all people worldwide. Global health emphasizes transnational health issues, determinants, and solutions; involves many disciplines within and beyond the health sciences and promotes interdisciplinary collaboration; and is a synthesis of population-based prevention with individual-level clinical care.

2009	[56]	Janes & Corbett	Global health is an area of research and practice that endeavors to link health, broadly conceived as a dynamic state that is an essential resource for life and well-being, to assemblages of global processes, recognizing that these assemblages are complex, diverse, temporally unstable, contingent, and often contested or resisted at different social scales.
2010	[20]	Beaglehole & Bonita	Our proposed definition for global health is collaborative trans-national research and action for promoting health for all.
2010	[22]	Bozorgmehr	The field is about building and rebuilding, researching and analyzing, teaching and learning the links between social determinants of people's health anywhere in the world.
2010	[49]	Crump & Sugarman	Multiple disciplines and multiple activities take place under the umbrella of global health including in the clinical, public health, research, and education arenas.
2010	[50]	Frenk et al.	Global health is the goal of improving health for all people in all nations by promoting wellness and eliminating avoidable disease, disability, and death. It can be attained by combining population-based health promotion and disease prevention measures with individual-level clinical care (US Institute of Medicine, 2009).
2010	[27]	Fried et al.	Global health and public health are indistinguishable. Both view health in terms of physical, mental, and social wellbeing, rather than merely the absence of disease. Both emphasize population-level policies, as well as individual approaches to health promotion. And both address the root causes of ill-health through a broad array of scientific, social, cultural, and economic strategies.
2010	[51]	Haffeld et al.	The term "global health" implies a globally shared responsibility to provide health as a public good through an expansive number of initiatives.

2010	[76]	Lakoff	Global Health is a contested ethical, political, and technical zone whose contours are still under construction.
2011	[46]	Arthur et al.	Global health issues of the modern world require coordinated multisectoral, multidisciplinary, and multinational efforts to achieve effective resolutions to new multidisciplinary multinational health challenges produced by globalization
2011	[70]	Brada	"Global health" is an argument, a position, as much as, if not more than, a thing-in-the-world. The terms of ''global health'' are best understood as chronotropic, and demonstrate how actors orient themselves and others spatio-temporally, morally, and professionally
2011	[89]	Redwood - Campbell et al.	The eleven defining values and principles for global health are: social justice, sustainability, reciprocity, respect, honesty and openness, humility, responsiveness and accountability, equity, and solidarity.
2012	[23]	Campbell et al.	The primary characteristics of a global health definition - that it crosses borders, has a multitude of causes and involves a range of means and solutions – implies the need for multiple professionals and disciplines in addition to medical professionals... but may not always be needed. A multidisciplinary approach is often, but not always, needed and beneficial and is therefore not an essential component of the field of the definition.
2012	[78]	Peluso et al.	The definition of global health must be rooted in health equity and focus on the collaborative and multidisciplinary nature of global health, with an emphasis on cross-cultural interactions.
2013	[86]	Garay et al.	We articulate principles that should apply to collective action on global health. These three principles are health for all (for all people worldwide), health by all (by a representative range of stakeholders and actors) and health in all (multi-sectoral efforts to increase health, with special attention to social determinants of health).
2012	[32]	Rowson et al.	Global health is a field that is characterised by vast differences in the phenomena that can be studied, stretching from economic, political and social

			relationships to biological processes and even to the technologies that deliver health-sustaining resources such as water, sanitation and agricultural improvements.
2013	[94]	Farmer et al.	Global health is not yet a discipline but rather a collection of problems. The authors of this volume believe that the process of rigorously analyzing these problems, of working to solve them, and of transforming the field of global health into a coherent discipline demands an interdisciplinary approach.
2013	[25]	De Cock et al.	The New Global Health concerns health in all countries and encompasses poverty alleviation, universal health security, and delivery of appropriate public health and clinical services, including for the increasing prevalence of noncommunicable diseases.
2013	[33]	Margolis	Global Health cannot be defined precisely, but several different authoritative bodies have agreed on key elements to a valid definition. These four key elements – (1) equity, (2) global preventive medicine, public health, and primary care, (3) cross cultural sensitivity, and (4) interaction of medicine and supporting disciplines, e.g. anthropology, engineering, health care administration, agriculture, etc. – can be used to guide curriculum development.
2014	[45]	Aluttis et al.	Worldwide improvement of health, reduction of disparities, and protection against global health threats (The European Commission, 2009).
2014	[95]	Haines & Berlin	The term 'global health' describes the phenomenon of determinants of health transcending national boundaries due to unprecedented growth in international travel, global trade and investment, and an increased flow of information and technology having a pervasive impact on the determinants of health, the spread of disease and the functioning of health systems
2014	[31]	Kuhlman n	[T]he term "global health" seeks to convey that health issues are universal, that health issues transcend national boundaries, and that diseases can and often do spread quickly (and often without respect for political boundaries)

2014	[60]	Nascimento et al.	Global Health, formerly 'International Health', involves numerous aspects of health policies, epidemiology, prevention, diagnosis and therapy for neglected diseases and is not restricted to low resource regions. It is supported by four main bases: (A) clinical decision based on data and evidence; (B) population-based rather than individual focus; (C) social goals; (D) preventive rather than curative care.
2014	[91]	Rowthorn & Olsen	Global health is by definition and necessity a collaborative field; one that requires diverse professionals to address the clinical, biological, social, and political factors that contribute to the health of communities, regions, and nations.
2014	[43]	Steeb et al.	Similar to public health, global health focuses on preventive measures, population-based care, and health equity, including social and economic determinants of health.
2015	[26]	Engebretsen & Heggen	By adding 'global' to 'health' we presume that there is a universal health standard. Thus, global health does not only allude to supranational dependency within the health field but refers to a norm or vision for health with global ambitions. It implies a homogenization of a world view of health with someone in the role as Cosmotheros (world viewer).
2015	[87]	Gostin & Friedman	Global health entails ensuring the conditions of good health—public health, universal health coverage, and the social determinants of health—while justice requires closing today's vast domestic and global health inequities.
2015	[35]	Marten	Whereas public health acknowledges the state as a dominant actor, global health recognizes the rise of other actors like international institutions, civil society and the private sector affecting health and health policies transcending states.
2016	[21]	Benatar	Global health, appropriately understood as an ecocentric concept, embraces the idea of healthy people on a healthy planet. This notion goes beyond anthropocentric considerations on health to include the importance of the interconnectedness of all life-forms and human well-being on an ecologically threatened planet.

2016	[67]	Wernli et al.	We propose here a definition of global health based on six core principles: 1) cross–border/multilevel approach, 2) inter–/trans–disciplinarity, 3) systems thinking, 4) innovation, 5) sustainability, and 6) human rights/equity
2016	[68]	Wilson et al.	We define global health as health problems, issues, and concerns that transcend national boundaries, may be influenced by circumstances or experiences in other countries, and are best addressed by cooperative actions and solutions.
2018	[75]	Haveman n & Bösner	Global health comprises aspects of (tropical) medicine, international health, public health and other disciplines. Additionally, it includes global aspects in the sense of "global as supraterritorial".
2018	[28]	Horton	Global health is not about equity. It is about power.
2018	[59]	Mews et al.	The following three core elements form a working definition of global health and constitute an innovative and necessary perspective for medical education: health as a human right; global perspective; interdisciplinarity

Several scholars engaged directly with the Koplan et al. definition of GH[1] to stipulate definitions of their own. For example, some authors proposed amendments to Koplan et al. that would place greater emphasis on inequity reduction and the need for collaboration,[20] particularly with institutional partners from developing countries.[73] Others were more critical of the broad yet weak conceptual idealism[86] of Koplan et al. and recommended detaching normative objectives from its definition,[26] such as the value-laden concept of equity, which could compromise the definition's technical neutrality by rendering it ideological.[91] Other authors sought to analytically clarify the meaning of 'the global'[26] in the definition provided by Koplan et al., distinguish it more clearly from international health,[78] or dispute their distinction between global health and public health.[27] Indeed, the impact of the definition of GH proposed by Koplan et. al's has been substantial. It was variously adopted by the Consortium of Universities for Global Health,[47] the Canadian government,[23] Global Health for Family Medicine,[89] the

German Academy of Sciences[75] and the Chinese Consortium of Universities for Global Health.[77]

In general, GH was defined as a term,[37,51,95] and in particular, an umbrella term[49,75] or a concept;[69] and more broadly as a zone[76] or field [32,48,91,94] or area of research and practice,[1,56] as an achievable goal,[50] an approach,[48,82] a set of principles[45,83], an organizing framework for thinking and action,[100] or a collection of problems.[35,94] Global health was frequently contrasted to IH [32,35,68,69,94,95] and PH[20,21,31,32,35], or else seen as indistinguishably from PH and IH.[27] Additionally, several papers explicitly specified and subsequently defined certain dimensions of GH, such as "global health governance",[32,33,35,38,42,51,52,58,69,80,81,87] "global health diplomacy",[24,28,95] "global health education",[36,39,46,47,48,49,59,70,74,75,77,78,82,89,93] "global health security",[26,41,76,88,92,97] "global health network",[41,81] "global health actor",[52] "global health ethics",[69] "global health academics",[64,67] and "global health social justice"[61] (see Table 3).

Table 3. Frequently Defined Facets of 'Global Health' with Exemplary Definitions

Defined dimensions of global health (GH)	No. of publications defining this dimension	One exemplary definition for each dimension
GH governance	12	Global health governance refers to 'trans-border agreements of initiatives between states and/or non-state actors to the control of public health and infectious disease and the protection of people from health risks or threats', it involves multilateral and bilateral agencies, scientific and public health epistemic communities, private philanthropists, the private sector and public-private

		initiatives, and a range of community and international non-governmental organisations.[52]
GH diplomacy	3	There is also growing activity in the field of global health diplomacy which 'brings together the disciplines of public health, international affairs, management, law and economics and focuses on negotiations that shape and manage the global policy environment for health'. It encompasses interdisciplinary study of the two-way relationship between diplomacy and foreign policy on the one hand and health on the other and promotes education of diplomats in global health together with educational initiatives to improve mutual understanding with a special focus on the negotiation process – particularly the interface between technical and political issues that arise in global health agreement.[95]
GH education	14	We propose an accepted definition of pediatric GH tracks as "a longitudinal area of concentration dedicated to global child health, offered within a residency program, which includes a formal curriculum and mentorship with required scholarly output for a defined cohort of pediatric residents".[74]
GH security	6	The World Health Organization (WHO) defines global health security as: The activities required, both proactive and reactive, to minimize vulnerability to acute public health events that endanger the collective health of national populations, as well as collective health of populations living across geographical regions and international boundaries.[41]
GH network	2	Global health networks are webs of individuals and organizations linked by a shared concern to address a condition that affects or potentially affects a sizeable portion of the world's population.[41]
GH actor	1	Accordingly, a global health actor is defined as an individual or organization that operates transnationally with a primary intent to improve health.[54]
GH ethics	1	A new shared paradigm for global health ethics would increase capacity for all decision-makers involved in global health research and practice by combining moral and scientific starting points for research with a more comprehensive relationship model inclusive of solidarity and social justice.[69]

Academic GH	2	We propose the following definition of academic global health: Within the normative framework of human rights, global health is a system–based, ecological and transdisciplinary approach to research, education, and practice which seeks to provide innovative, integrated, and sustainable solutions to address complex health problems across national boundaries and improve health for all.[67]
GH social justice	1	Defining attributes of social justice in global health include (a) equity in opportunity for health, and (b) caring and cooperative societal relationships.[61]

3. GROUNDED THEORY APPROACH BASED ON THEMATIC ANALYSIS

Definitions and descriptions of GH were aggregated into nine thematic codes reflecting the contents and scope of GH definitions, the functionality of those definitions, and/or perceptions about defining GH. Codes were: (1) GH is a domain of research, healthcare, and education, (2) GH is multifaceted (disciplinary, sectoral, cultural, national), (3) GH is rooted in a commitment to equity, (4) GH is a political field comprising power relations, (5) GH is problem-oriented, (6) GH transcends national borders, (7) GH is determined by globalization & international interdependence, (8) conceptually, GH is either similar or dissimilar to PH, IH, and tropical medicine (TM), and (9) GH is perceived as definitionally vague.

These codes were grouped selectively into higher analytical categories or theoretical statements as grounded in the literature: (1) GH is a multiplex approach to worldwide health improvement and form of expertise taught and researched through academic institutions, (2) GH is an *ethos* (ethical orientation and appeal) that is guided by justice principles, (3) GH is a mode of governance that yields degrees of national, international, transnational, and supra-national influence through political decision-making, problem identification, the allocation and exchange of resources across

borders, (4) GH is a polysemous concept with many meanings and historical antecedents, and which has an emergent future (Table 4).

Table 4. Defining Global Health with Grounded Theory Analysis – Table of Themes, Code Categories, and Quotes from Text

Key Themes	**Selective Codes**	**Quotes from Literature**
Global Health is a multiplex approach to worldwide health improvement and a form of expertise taught and pursued through research institutions	research, healthcare, education multi-(disciplinary, cultural, sectoral, national)	"Global health remains a diffuse and highly diverse arena of scholarship and practice"[56] "Because global health is composed of, and relies on, multiple disciplines and sectors of society – which work from different languages, values, motivations and perspectives – it is important that at the very least there be a clear communication of what each actor is referring to when they use the term global health"[23] "The term Global Health has become increasingly used over the last decade; whilst some debate remains about its meaning and how it has emerged, there is a growing consensus that it applies to the health needs of all the people on the planet and the socio-economic frameworks that influence these"[37]
Global Health is an ethical initiative that is guided by justice principles	values of equity & social justice	"The goal of global health is to improve health and achieve equity in health for all people worldwide"[77] "These (global health principles) can be summarized as health for all people, through health by all actors, and health in all policies"[86] "More today than ever, global health is in need of a renewed ethic, the ethic of universal rights, so that every human being may have an opportunity to achieve his or her full potential"[66]
Global Health is a mode of governance that yields influence through political decision-making, problem identification, the	power & politics identifying problem & solutions	"At the bottom line: 'global health', research, education and practice are nested in a highly 'politicised' environment, locally as well as supraterritorially. All areas accommodate their own, but interdependent political economy"[22] "A strong internal frame unifies the policy community through an agreed-upon definition and

allocation and exchange of resources across borders	transcends national borders globalization & international interdependence	cause of the problem as well consensus on the preferred solutions"[29] "Unprecedented growth in international travel, global trade and investment, and an increased flow of information and technology are having a pervasive impact on the determinants of health, the spread of disease and the functioning of health systems. As a consequence it is increasingly recognised that many determinants of health transcend national boundaries and the term 'global health 'is increasingly used to describe this phenomenon"[95]
Global Health is a vague yet versatile concept with historical antecedents and an emergent future	dis/similar to PH, IH, and TM literally defined as "vague" and/or in need of further definition	"The term global health is relatively new and overlaps with the preexisting fields of international health, public health, and tropical medicine"[57] "There are multiple expressions of global health in the international literature, and it is useful to review selected examples, because they call attention to diverse dimensions of global health."[64] "There has been a tremendous amount of discussion about global health without rooting the term itself to a common definition. Countless books and journal articles have been written and university programs have been designed around global health without a definition of the term. There are numerous examples of work being done in this field without a clear definition in place. Indeed, it is often not clear how people and organizations engaged in global health are using the term"[23]

3.1. Theme: Global Health is a multiplex approach to worldwide health improvement taught and pursued through research institutions

Subtheme: GH is a domain of research, healthcare, education

GH was repeatedly defined as an active field of knowledge production that is composed of the following key elements: research, education, training, and practice related to health

improvement.[1,20,21,23,32,33,35,38,40,44-49,52,55-57,58,61,63,64-69,72,74,75,77,78,80,82,90-92,94] Few authors defined GH as a new, independent discipline within the broader domain of medical knowledge,[17,33,38,46,63,74,80,82,90] and some outlined discipline-specific competencies that were considered integral to the definition of GH, at least in curriculum development; for example: clinical literacy,[80] medical humanities,[82] cross-cultural sensitivity,[33,38,46,59,63,80,90] experiential learning,[47] and critical thinking skills.[72,82] Several authors defined GH as a diffuse arena of scholarship that spans an array of academic disciplines, including anthropology, engineering, law, agriculture, and healthcare administration.[44,56,59,63,64,65,78,91,94] Others defined GH explicitly as a "transdiscipline" that seeks to transcend the restricted gaze of any single discipline and consequently integrate knowledge from a variety of sources.[67,94] Several authors explicitly defined GH as a necessarily collaborative field.[1,20,22,24,36,43,47,45,57,61,63,68,77,78,80,91]

Subtheme: GH is multifaceted (disciplinary, sectoral, cultural, national)

The prefix 'multi-' was consistently applied in definitions of GH to describe a perspective that focuses on the multitude of interrelated factors, dimensions, values, and features that underpin health as well as efforts to improve and study it. There was broad agreement that multidisciplinarity is a defining characteristic of GH.[1,23,25,32-34,36,38,40,45-47,49,52,55-57,59,60,64-69,72,75,77,78,80,82,91] However, there was some debate whether multiple disciplines are always needed and beneficial – and therefore essential – to the definition of GH.[23] One author argued that the multidisciplinary nature of GH is precisely what differentiates it from PH and IH.[68] Although some claimed that GH, with its focus on social and economic determinants, is inherently "predisposed to include aspects of the liberal arts and social sciences",[75] others critically

observed that most GH educational opportunities still cater predominantly to medical students,[32,35,48,72] which suggests that greater efforts will be required to achieve multidisciplinarity in the field moving forward.

There was a correspondence between GH definitions citing multidisciplinarity and cultural competency.[32,33,38,48,49,56,78,82,90] Curiously, multisectorality was less frequently mentioned than multidisciplinarity in definitions of GH, though it was referenced in some papers.[20,22,43,52,66,83,86,95]

3.2. Theme: Global Health is an ethical initiative that is guided by justice principles

Subtheme: GH is rooted in values of equity and social justice

Equity and social justice were the two most commonly and explicitly referenced values undergirding GH definitions and goals. Equity was repeatedly framed as a "main objective"[60] and core component of GH research and practice.[23,25,53,43,46,48,66,67,77,78,84] However, it remains unclear whether the authors in our sample share the same meaning of equity. Velji & Bryant defined equity broadly as "ensuring equal opportunities and resources to enable all people to achieve their fullest health potential".[66] Meanwhile, others rooted their conceptualization of equity more specifically in the principles of social justice [30,61,69,88,89] or the human rights concept of equality,[54,62,67,83,86] which asserts that "all people are equal in regard to dignity and rights, regardless of their origin and all biological, social or other specific differences".[59] This postwar sensibility echoes the 1978 Alma Ata Declaration of 'health for all',[20,24] as well

as a traditional humanitarian ideal, even if now associated with principles grounded in national and global security.[24,54,88]

Occasionally, the terms ‘equity’ and ‘equality’ were used interchangeably, suggesting they possess a commonly shared valence and reciprocal relationship despite slight differences in signification. Whereas equity refers to the provision of resources and opportunity based on specific needs, equality connotes providing the same level of resources and opportunities for all.[86] Nevertheless, other scholars questioned whether equity or equality should be included in official definitions of GH, at all,[27,48,75] insofar as what counts as ‘equitable’ for one country may be different for another.[26,32,48]

3.3. Theme: Global Health is a form of governance that yields national, international, transnational, and supra-national influence through political decision-making, problem identification, the allocation and exchange of resources across borders

Subtheme: GH is a political field comprising power relations at multiple scales

Numerous papers defined GH as embedded within a political field comprising power relations at multiple scales [20,22-24,26,28,29,31-33,35,41,42,45,48,51-54,56,58,60,63,66,70,72,76,79,87,95]. ‘Political field’ refers here to a sphere of influence and jurisdiction wherein institutions determine governing modalities (e.g., laws, policies, instruments) to assure a range of activities, such as: determining priorities, coordinating stakeholders, regulating funding mechanisms, establishing accountability, allocating resources, and providing access to health services for the general public. ‘Power relations’ refers to the capacity of institutions,

individuals, instruments, and ideas to affect the actions of others; and 'at multiple scales' refers to levels of analysis (i.e. worldwide, regional, national, local, etc.).

Within the literature on GHG and GH security, authors argued the need for a universal definition of GH to shape policy frameworks that ensure compliance with international health law.[32,45,51,88,95] Here it is important to note that the ability to shape GH policy is, itself, an exercise in power: some GH actors, defined as "individuals or organizations that operate transnationally with a primary intent to improve health",[56] are more capacitated than others to impact the formulation of policies and amount of attention and resources that certain GH issues receive.[32,41,45,52,95] For example, several papers discussed how 'GH actors' like the World Bank and the World Health Organization shaped discussions around the response to Ebola, leading to refined definitions of GHG[35,87,88] and GH security.[41] Similarly, definitions of GH in line with the 2015 United Nations Millennium Development Goals, were also commonly referenced,[25,35,45,51] reflecting the influence of certain GH actors upon the conceptualization of GH.

Subtheme: GH is determined by globalization & international interdependence

Numerous authors linked interdependence and accelerating globalization (the process of integrating governments and markets, and of connecting people worldwide) with the need for a cohesive definition of GH, particularly to address issues of governance.[24,32,35,45,68,88] Global health governance (GHG) and global health diplomacy (GHD) were outlined as two influential sub-domains in which the interconnections between globalization, foreign policy, and international relations were viewed as indispensable to definitions of GH. Two articles quoted David P. Fidler's

definition of GHG as “the use of formal and informal institutions, rules, and processes by states, intergovernmental organizations, and nonstate actors to deal with challenges to health that require cross-border collective action to address effectively”.[35,58] Elsewhere, GHD was described as “bringing together the disciplines of public health, international affairs, management, law and economics and focuses on negotiations that shape and manage the global policy environment for health”.[95]

Subtheme: GH issues transcend national borders

Across several papers, we observed a common refrain that GH ‘crosses borders’ and ‘transcends national boundaries’.[1,20,23,42,45,52,60,67,68,74] Authors frequently described GH concerns as those exceeding the jurisdictional reaches of any individual nation-state alone.[34,42,45,51,52,54,77,95] One paper claimed that GH is “transnational by definition”,[74] and others characterized GH problems as those experienced transnationally.[20,32,48,50,68]

Studies focusing on GH research and training frequently referenced specific diseases and health risks that ‘transcend national borders’ alongside parallel recommendations to include an international component in the development of GH curricula.[16,48,49,63,74,93] While crossing national borders to research and promote health for all is widely perceived as an historical condition for GH[24] that has led to GH’s emergence as an academic discipline,[63] several scholars argued that GH should also focus on domestic health disparities[1,27,38,46] and for local issues to be simultaneously understood as universal or worldwide[48,74,75] to the extent they may occur anywhere[22] and are almost always impacted by global phenomena.[56]

Subtheme: GH is problem-oriented

Medical anthropologists, Arthur Kleinman and Paul Farmer, described GH as a collection of problems rather than a distinct discipline.[35,94] Several authors in our review delineated GH problems through identification of specific diseases, such as HIV/AIDS, malaria, TB, Zika, and Ebola.[24,29,30,35,45,83] Lee and Brumme noted that it has become common for experts to define GH problems by identifying their objects, namely diseases, population groups, and locations.[58] Indeed, some authors outlined GH problems as the set of challenges "among those most neglected in developing countries",[86] among them: emerging infectious diseases and maternal and child health;[43,65] diabetes, cardiovascular disease, and other noncommunicable diseases in "local" communities;[25,63] and even neurological disorders among refugees arriving in Europe.[93] How these types of object-based definitions of GH problems come to shape GH agendum is important to note.

Clark made a compelling argument against the definition of GH problems in terms of specific diseases, writing that such 'medicalization' may "prove detrimental for how the world responds and resources actions designed to alleviate poor health and poverty, redress inequities, and save lives".[72] Brada also argued against defining GH problems geographically and instead urged experts to consider how the processes by which GH and its quintessential spaces, namely "resource-limited" and "resource-poor settings", are actively constituted, reinforced, and contested.[70] Several authors similarly suggested that focusing on the social, political, economic, and cultural forces contributing to health inequity and diseases of poverty better captured the scope of GH problems than naming any particular set of diseases or places in the world.[33,43,56,58,69,72,73,86,92]

Lack of consensus regarding what counts as a 'true' GH problem was linked to the lack of a clear and concise definition of GH. Indeed, several scholars argued that the current inability to define GH made it difficult for stakeholders to define precisely what the 'problem' is.[44,45,48,86] Furthermore, the diagnosis of GH problems determined what types of GH 'solutions' were proposed in response. For example, when GH problems were defined as universally shared and transnational, then cross-border solutions were developed; when GH issues were framed epidemiologically in terms of distributed risk, then actions targeting specific determinants and burdens were proposed.[1,20,23,67,68,92] When GH problems were framed as threats to inter/national security, strategies were formulated to protect borders, economies, health systems, and to improve surveillance mechanisms.[41,45,54,76,80,88] When the problem of inequality drove definitions of GH, recommendations to alleviate poverty, food insecurity, poor sanitation, etc. were proposed.[32,53,60,72]

Although Kuhlmann suggested that GH tends to over-prioritize problem-identification to the detriment of critical solution-oriented work,[31] our analysis suggests that the type, scope, and quality of solutions proposed are contingent upon the elaboration of problems. Similarly, Campbell wrote, "Unlike a science or an art, the field of global health is very much about providing solutions to current problems. As such, it would be short-sighted not to consider the causes of global health problems in order to better formulate the solutions. The causes ought to be included in a comprehensive and complete definition of the field".[23]

3.4. Theme: Global Health is a polysemous concept with historical antecedents and an emergent future

Subtheme: GH is conceptually dis/similar to PH, IH, and TM

GH was consistently traced back to and compared with PH, IH, and TM.[1,20,27,32-34,43,57,69,71,75,84,86,88] Disagreement or confusion regarding the degrees of similarity and difference between these domains seemed to stem from a shared understanding that GH, in fact, evolved to a varying degree from each of these fields and does not, therefore, denote a clear-cut break with nor full-blown departure from any of them.[84,94]

Several authors argued that the scope and scale of GH is distinct from PH [1,20,32,69,71]. Some argued that "public health is equated primarily with population-wide interventions; global health is concerned with all strategies for health improvement," including clinical care;[20] and that "public health acknowledges the state as a dominant actor, [while] global health recognizes the rise of other actors like international institutions".[35] GH was also seen as placing a greater emphasis on multidisciplinarity and promoting a more expansive conceptualization of 'health', itself, compared to PH.[69] Beyond the prevention of and response to biomedicalized health risks at the population level, Rowson defined GH as oriented towards the "underlying determinants of those problems, which are social, political and economic in nature."[32] It is questionable, however, to assume similar notions of health have not also been pursued in PH. Meanwhile, opposing views found GH and PH conceptually indistinguishable,[27,43,86] either as terms that could be used interchangeably,[95] or else as co-constitutive of one another, such that PH could be understood as a descriptive component of GH.[33,86]

Differences between GH and IH echoed those drawn between GH and PH. For example, GH was characterized as more attentive to multidisciplinarity while IH was said to implement a more limited biomedical approach to healthcare and health research.[1,69,95] Undergirding a major point of distinction between GH and IH was the belief that IH focuses on health problems in developing countries [1,22,32,43,45,48,54,83,86,93] and relies upon "the flow of resources and knowledge from the developed to the developing world",[32] whereas GH either is, or should be, more bi-directional.[1,45,84] In other cases, GH was described as comparable to IH, for example, when countries link GH efforts with development aid.[86] This is because the emphasis on delivering aid to poor countries reinforces an image of the world's poor as needy subjects and, therefore, marks a continuation of IH and its sentiments under the guise of GH.[35]

Lastly, the field of TM was referenced to describe the evolutionary track of GH, particularly that GH is a modern-day product of the former.[20,25,57,69,75,84] A few authors critically pointed out that although GH has generally replaced TM and IH as terms embedded in histories of colonial power relations, many of the contemporary structures for governing and/or facilitating GH between countries today have remained largely the same,[25,48,54,62] suggesting that distinguishability between these terms too often occurs at the level of semantics.

Subtheme: GH is still vaguely defined

While GH was often described as a popular and well-established term, another key attribute repeated across the literature was its enduring vagueness.[23,25,26,31,33,43,45,48,52,62,74-77,81,86] Indeed, most papers commented upon the term's defiance of easy definition, its

ambiguity, and the lack of clarity regarding how people and organizations engaged in GH are using (or not using) the term to describe their interests. For example, Beaglehole & Bonita pointed out that research centers in low- and middle-income countries are often engaged in GH issues but under other labels.[20] Some authors viewed the present lack of a clear and common definition as an obstacle endangering the coherence and maturation of the field.[33,35,45] For others, this indistinctness was thought to be precisely what gives GH such wide applicability, a certain degree of currency, and political expediency.[45,76,81,86]

A major concern cited was the lack of guidance for defining the term "global" in GH.[26,34,43,48,75] As Bozorgmehr has outlined, the term is often used interchangeably within the GH community to mean “worldwide”, “everywhere”, “holistic”, and/or “issues that transcend national boundaries”.[48] This trend was noticeable within our review, as well. Engebretsen emphasized that GH “does not only allude to supranational dependency within the health field, but refers to a norm or vision for health with global ambitions”.[26] This view suggests that because the planet is populated by a multiplicity of positionings, perspectives, and diverse world views, there can never be a truly a universal definition of ‘the global’ nor a global consensus around the definition of GH.

Finally, among studies that conducted original research into the definition of GH, several reported that study participants could not reach consensus on a definition.[52,74,75,77] Many thought it would be difficult if not impossible to arrive at a single, unified theoretical definition of GH, yet considered it important to formulate an operational definition of GH for guiding emerging activities related to GH.[23,45,77]

DISCUSSION

This is the first study to systematically synthesize the literature defining global health (GH) and analyze the definitions found therein. All of the articles included in this study were published in peer-reviewed journals since 2009 indicating recent and steadfast interest in the topic of GH's definition. This review examined GH definitions in the literature, and our thematic analysis focused on identifying recurrent themes across different definitions of GH.

Of the 78 articles included in this study, approximately one-third utilized empirical research methodologies to posit definitions of GH or else directly contribute towards the establishment of a common definition. Another one-third of papers summarized and discussed previously published definitions of GH (e.g. reviews/overviews), while the remaining one-third suggested definitions of GH that were less grounded in analysis of empirical data than in the perspectives of its authors (e.g. editorials, viewpoints). This systematic analysis indicated that the question of GH's precise definition marks a point of controversy across fields of expertise. The variety of GH definitions posited by diverse experts in search of a common definition indicate that GH is multifaceted and polysemous.

In its broadest sense, GH can be defined as an area of research and practice committed to the application of overtly multidisciplinary, multisectoral, and culturally-sensitive approaches for reducing health disparities that transcend national borders. Indeed, it was most commonly defined across the literature in such general terms.

More specific definitions of GH were, of course, proposed by and considered valuable for many stakeholders in our review. Our analysis indicates that the precise definitions proposed by different experts were devised to serve particular functions. For example, narrow and concise definitions of

GH were most frequently sought in the domains of governance and education, primarily for steering the development of policy frameworks and curricula, respectively. The imperative for an exact definition of GH in these subfields may be linked to bureaucratic demands for demarcating a technical term under which to classify specific activities, standardize certain functions, administer funds and direct workflow accordingly. It is also in this domain that authors most vociferously decried the absence of a unified and concise definition of GH, arguing this lack has led to ineffective initiatives, elusive methods for establishing accountability, and instances of resource allocation based on ad hoc criteria—attractiveness to donors, public opinion, development agendum, foreign, economic or security policy priorities and so on—rather than via transparent mechanisms for adjudicating health need.[28,54,58,65,83] In contexts where health needs and upstream challenges were articulated, the lack of an agreed-upon definition oft impeded the policy process because stakeholders could not discern which GH issues among the multitude of different problems labelled as important were, in fact, the most pressing.[24,45,52] Because political indecision ramifies disproportionately for publics in countries where reliance on GH aid is a matter of life and death, establishing a clear definition of GH seems most crucial for the domain of governance.

We also found that detailed descriptions of GH's specific conceptual and functional dimensions tended to reflect the specializations or discipline-specific priorities of their authors. For example, definitions of GH stipulating the primacy of 'cultural competency' and 'multidisciplinarity' were more commonly proposed by interdisciplinary professionals in the literature on GH education than in journals of health policy, where definitions of GH were oriented more toward 'security' and 'governance' concerns. This suggests a correspondence between the subjective, experiential positions of the definers and the vocabulary they used to define or frame the need to define GH.

Unsurprisingly, we found that health professionals proposed the majority of definitions of GH in the literature. Additionally, the majority of publications and their authors were from higher-income countries. Several authors in our review critically observed that GH has become institutionalized at a faster rate in higher-income countries compared to lower- and middle-income countries.[20,48,63,72,77,82] Their observations combined with our findings suggest that extant definitions of GH published in the literature or otherwise circulating in academic and professionalized spaces may unevenly reflect the interests and priorities of stakeholders from higher-income countries. This suggests a need for greater diversity and inclusion in the debate on GH's definition, as well as further reflexivity regarding who is defining GH, their means and motivations for doing so, and what these definitions put into action.

Interestingly, several articles published since 2019 have extended the debate on this topic of GH's definition by directly engaging questions of geography and positionality: a recent commentary by King and Kolski (2020) defining GH "as public health somewhere else" was met with pushback by those who argue that spatial definitions of GH are limited and limiting.[101-104]

LIMITATIONS

To determine how GH is defined by experts in the literature, we ensured that the selection criteria developed for this study were broad enough to include a wide range of perspectives. Therefore, we included articles with varying degrees of evidentiary support, such as viewpoints, commentaries, and editorials. Consequently, the results may be influenced by some of the primary researchers' assumptions, projections, and biases. Backward citation tracking was used to add relevant articles to the review that had not been initially identified through database searching. This ensured that the review was exhaustive, however it also means that some conclusions drawn in the thematic analysis may have been influenced by this manual search strategy. By applying

qualitative methods, this review provided a robust analysis of the thematic categories undergirding extant definitions of GH. A major limitation of this form of analysis is the extensive time required to develop and establish a code book and standardize the three coders' use of the code book. However, this was deemed necessary to ensure consistency of judgment and inter-coder reliability at each stage in the analysis. Another limitation of this study is that only articles written in English were included. To enhance the generalizability of results, future reviews should include data from non-English articles, especially if an inclusive, common definition of GH is to be achieved. Finally, this review was finalized prior to the emergence of the novel coronavirus. As such, future research should take into account new definitions of GH that emerge in light of the pandemic and lessons learned.

CONCLUSION

Between 2009 and 2019, global health (GH) was most commonly defined in the literature in broad and general terms: as an area of research and practice committed to the application of multidisciplinary, multisectoral, and culturally-sensitive approaches for reducing health disparities that transcend national borders. More precise definitions exist to serve particular functions and tend to reflect the priorities of its definers. The four key themes that emerged from the present analysis are that GH is: (1) a multiplex approach to worldwide health improvement taught and researched through academic institutions; (2) an ethos that is guided by justice principles; (3) a mode of governance that yields influence through political decision-making, problem identification, the allocation and exchange of resources across borders; and (4) a polysemous concept with historical antecedents and an emergent future. Findings from this thematic analysis have the potential to organize future conversations about which definition of GH is most common

and/or most useful. Future discussions on the topic might shift from questioning the abstract "what" of GH to more pragmatic and reflexive questions about "who" defines GH and towards what ends.

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REFERENCES

1 Koplan JP, Bond TC, Merson M. Towards a Common Definition. *Lancet.* 2009; 373:1993-1995.
2 Macfarlane SB, Jacobs M, Kaaya EE. In the name of global health: trends in academic institutions. *J public health policy*. 2008 Dec;29(4):383-401.
3 Kickbusch I. The need for a European strategy on global health. *Scand J Public Health.* 2006;34:561-565.
4 Lee K. Globalization and health: an introduction. Springer; 2003 Dec 9.
5 Jain SC. Global health: emerging frontier of international health. *Asia Pac J Public Health.*
6 Dewey A, Drahota A. Introduction to systematic reviews: online learning module. *Cochrane Training.* 2016. Retrieved from https://training.cochrane.org/interactivelearning/module-1-introduction-conducting-systematic-reviews
7 Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JP, Clarke M, Devereaux PJ, Kleijnen J, Moher D. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *J Clin Epidemiol*. 2009 Oct 1;62(10):e1-34.
8 Piper RJ. How to write a systematic literature review: a guide for medical students. National AMR, Fostering Medical Research. 2013;1.
9 Mengist W, Soromessa T, Legese G. Method for conducting systematic literature review and meta-analysis for environmental science research. *MethodsX*. 2020 Jan 1;7:100777.
10 Carver JC, Hassler E, Hernandes E, Kraft NA. Identifying barriers to the systematic literature review process. *ACM/IEEE International Symposium on Empirical Software Engineering and Measurement* 2013 Oct 10 (pp. 203-212). IEEE.
11 Harmer A, Xiao Y, Missoni E, Tedioso F. 'BRICS without straw'? A systematic literature review of newly emerging economies' influence in global health. *Global Health* 2013;9:15.
12 Bills, CB, Ahn, J. Global health and graduate medical education: a systematic review of the literature. *J Grad Med Educ* 2016;685-691
13 Hau, DK, Smart LR, DiPace JI, Peck, RN. Global health training among US residency specialties: a systematic literature review. *Med Educ Online* 2017;22(1).
14 Moher D, Shamseer L, Clarke M, et. al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement *Syst Rev* 2015;1;4(1):1.
15 Thomas J, Harden A. Methods for the thematic synthesis of qualitative research in systematic reviews. *BMC Med Res Methodol* 2008;8(1):45.

16 Corbin J, Strauss A. Strategies for qualitative data analysis. Basics of Qualitative Research. Techniques and procedures for developing grounded theory. Thousand Oaks, CA: Sage Publicating 2008;3.
17 Charmaz K. Coding in grounded theory practice. Constructing grounded theory: A practical guide through qualitative analysis.Thousand Oaks, CA: Sage Publicating 2006:42-71.
18 Saldaña J. The coding manual for qualitative researchers.Thousand Oaks, CA: Sage Publicating 2015.
19 Bazeley P. Computerized data analysis for mixed methods research. Handbook of mixed methods in social and behavioral research 2003;1(4):385-422.
20 Beaglehole R, Bonita R. What is global health? *Glob Health Action,* 2010;3(1).
21 Benatar S. Politics, Power, Poverty and Global Health: Systems and Frames. *Int J Health Policy and Manag* 2016;5(10),599–604.
22 Bozorgmehr K. Rethinking the "global" in global health: A dialectic approach. *Global Health,* 2016;6(1).
23 Campbell RM, Pleic M, Connolly H. *T*he importance of a common global health definition: How Canada's definition influences its strategic direction in global health. *J Glob Health* 2012;2(1).
24 Chattu VK. The rise of global health diplomacy: An interdisciplinary concept linking health and international relations. *Indian J Public Health* 2017;61(2),134–136.
25 De Cock KM, Simone PM, Davison V, Slutsker L. *The new global health. Emerg Infect Dis* 2013;19(8):1192-1197.
26 Engebretsen E, Heggen K. Powerful concepts in global health. *Int J Health Policy Manag 2015;4(2),115–117.*
27 Fried LP, Bentley ME, Buekens P, et al. Global health is public health. *Lancet* 2010; 535-537.
28 Horton R. Offline: Liberty vs equity in global health. *Lancet* 2018;1134
29 Johnston BD. Injury Prevention as a global health initiative. *Editor Injury Prevention, BMJ Journals,* BMA House, Tavistock Square, London WC1H 9JR, UK 2008;146-146.
30 Jordan K, Marten R, Gureje O, Daelmans B, Kruk ME. Where is quality in health systems policy? An analysis of global policy documents. *Lancet Glob Health* 2018.
31 Kuhlmann A, Ionnotti L. Resurrecting international and public in global health: Has the pendulum swung too far?*" Am J Public Health* 2014104(4):583–585.
32 Rowson M, Willott C, Hughes R, et al. Conceptualising global health: Theoretical issues and their relevance for teaching. *Global Health* 2012; 8(36)
33 Margolis C. Evaluating Global health Education. *Med Teach.* 2013;35(3)
34 Marten R, Kadandale S, Nordström A, Smith RD. Shifting global health governance towards the sustainable development goals. *Bull World Health Organ* 2018;96(12):798–798A.
35 Marten R, 'Global health warning: Definitions wield power: Comment on "navigating between stealth advocacy and unconscious dogmatism: The challenge of researching the norms, politics and power of global health. *Int J Health Policy Manag* 2015 5(1)207-209.
36 Marusic A. *Glo*bal health-multiple definitions, single goal. *Ann Ist Super Sanità* 2013;49(1):2-3.
37 Piachaud J. Global health and human security. *Med Confl Surviv* 2008;24(1)1-4.
38 Pitt MB, Moore MA, John C, et al. Supporting global health at the pediatric department level: Why and how. *Pediatr* 2017;139(6)2016-3939.

39 Quissell K. Additional Insights Into Problem Definition and Positioning From Social Science Comment on “Four Challenges That Global Health Networks Face.” *Int J Health Policy Manag* 2017; 7(4),362–364.
40 Ridde V. Need for more and better implementation science in global health. *BMJ Global Health* 2016;1(2).
41 Shiffman J. Four Challenges That Global Health Networks Face. *Int J Health Policy and Manag* 2017;6(4)183-189.
42 Speakman EM, McKee M, Coker R. If not now, when? Time for the European Union to define a global health strategy. *Lancet Glob Health* 2017;5(4)302-393.
43 Steeb DR, Joyner PU, Thakker DR. *Exploring the role of the pharmacist in global health. J Am Pharm Association* 2014;54(5):552-5.
44 Tosun J. Polycentrism in Global Health Governance Scholarship Comment on “Four Challenges That Global Health Networks Face.” *Int J Health Policy Manag* 2017;7(1)78-80
45 Aluttis C, Krafft T, Brand H. Global health in the European Union - a review from an agenda-setting perspective. *Glob Health Action* 2014;7(SUPP.1),1–6.
46 Arthur MAM, Battat R, Brewer TF. Teaching the basics: core competencies in global health. *Infect Dis Clin* 2011;347-358.
47 Battat R, Seidman G, Chadi N, et al. Global health competencies and approaches in medical education: a literature review. *BMC Med Educ* 2010;94.
48 Bozorgmehr K, Saint V.A, & Tinnemann P. The “global health” education framework: A conceptual guide for monitoring, evaluation and practice. *Global Health* 2011;7.
49 Crump, JA, Sugarman J. and Working Group on Ethics Guidelines for Global Health Training (WEIGHT). Ethics and best practice guidelines for training experiences in global health. *Am J Trop Med Hyg* 2010;83(6)1178-1182.
50 Frenk J, Chen L, Bhutta ZA, et al. Health professionals for a new century: transforming education to strengthen health systems in an interdependent world. *Lancet* 2010;1923-1958.
51 Haffeld J, Siem H, Røttingen JA. Examining the Global Health Arena: Strengths and Weaknesses of a Convention Approach to Global Health Challenges. *J Law Med Ethics* 2010;614-628.
52 Harman S, Davies SE. President Donald Trump as global health's displacement activity. *Rev Int Stu* 2019;45(3)491-501.
53 Heywood M. Drug access, patents and global health: 'Chaffed and waxed sufficient', *Third World Q* 2002; 23(2):217-231.
54 Hoffman SJ, Cole CB. Defining the global health system and systematically mapping its network of actors. *Global Health* 2018;38.
55 Hunter A, Wilson L, Stanhope M. et al. Global health diplomacy: An integrative review of the literature and implications for nursing. *Nurs Outlook* 2013;61(2):85-92.
56 Janes CR, Corbett KK. Anthropology and Global Health. *Annu Rev*. 2010;38:167-183.
57 Jogerst K, Callender B, Adams V, et al. Identifying Interprofessional Global Health Competencies for 21st-Century Health Professionals. *Annu Global Health* 2015;81(2),239–247.
58 Lee K, Brumme ZL. Operationalizing the One Health approach: The global governance challenges. *Health Policy Plan* 2013.
59 Mews C, Schuster S, Vajda C, et. al. Cultural competence and global health: Perspectives for medical education – Position paper of the GMA committee on cultural competence and global health. *GMS J Med Educ* 2018;35(3).

60 Nascimento BR, Brant LCC, Moraes DN, Ribeiro ALP. Global health and cardiovascular disease. *Heart* 2014;100(22),1743–1749.
61 Nemetchek B. A concept analysis of social justice in global health. *Nurs Outlook* 2019;67(3), 244–251.
62 Šehović AB. Towards a new definition of health security: A three-part rationale for the twenty-first century *Glob Public Health* 2019.
63 Steenhoff AP, Crouse HL, Lukolyo H, et al. Partnerships for global child health. *Pediatr* 2017;140(4).
64 The International Health Regulations (IHR). 10 years of global public health security. Wkly Epidemiol Rec 2017;92(36),534–536.
65 Van Belle S, Mayhew SH. What can we learn on public accountability from non-health disciplines: A meta-narrative review. *BMJ Open* 2016;6(7).
66 Velji A, Bryant JH. Global Health: Evolving Meanings. *Infect Dis Clin North Am* 2011; 299–309.
67 Wernli D, Tanner M, Kickbusch I, et al. Moving global health forward in academic institutions. *J Glob Health* 2016;6(1).
68 Wilson L, Mendes IAC, Klopper H, et. al. 'Global health' and 'global nursing': proposed definitions from The Global Advisory Panel on the Future of Nursing. *J Adv Nurs* 2016;1529-1540.
69 Benatar S, Daibes I, Tomsons S. (2016). Inter-Philosophies Dialogue: Creating a Paradigm for Global Health Ethics. *Kennedy Inst Ethics J* 2016;323–346.
70 Brada B. "Not Here": Making the Spaces and Subjects of "Global Health" in Botswana. *Cult Med Psychiatry* 2011;35:285-312.
71 Brown Tim. 'Vulnerability is universal': Considering the place of 'security and 'vulnerability within contemporary global health discourse. *Soc Sci Med* 72. 2011;319-326.
72 Clark J. Medicalization of global health 1: has the global health agenda become too medicalized? *Glob Health Action* 2014;1-6.
73 Crane JT. Scrambling for Africa: AIDS, expertise, and the rise of American global health science. *Cornell University Press* 2013.
74 Haq H, Barnes A, Batra M, et al. Defining Global Health Tracks for Pediatric Residencies. *Pediatr* 2019;144(1),1-10.
75 Havemann M, Bösner S. Global Health as "umbrella term"–a qualitative study among Global Health teachers in German medical education. *Global Health* 2018;14(1),1-14.
76 Lakoff A. Two regimes of global health. *Humanity: An International Journal of Human Rights, Humanitarianism, and Development* 2010;1(1),59-79.
77 Li Q, Gloyd S, Xu D, et al. Global health education in Chinese universities and potential for collaboration with schools of nursing: A qualitative study. *Int J Nurs Sci* 2017 Jan 10; 4(1): 12–18.
78 Peluso MJ, Encandela J, Hafler JP, Margolis CZ. Guiding principles for the development of global health education curricula in undergraduate medical education. *Med Teach* 2012;34(8),653–658.
79 Sacks E, Swanson RC, Schensul JJ, et.al. *Community Involvement in Health Systems Strengthening to Improve Global Health Outcomes: A Review of Guidelines and Potential Roles. Int Q Community Health Educ* 2017 Jul;37(3-4):139-149.

80 Sienko KH, Young MR, Kaufmann EE, et. al. Global health design: Clinical immersion, opportunity identification and definition, and design experiences. *Int J Eng Educ* 2018;34(2B):780-800.
81 Tirado F, Gómez A, Rocamora V. The global condition of epidemics: Panoramas in A (H1N1) influenza and their consequences for One World One Health programme. *Soc Sci Med* 2015;129,113–122.
82 Aulakh A, Tweed S, Moore J, Graham W. Integrating global health with medical education. *Clin Teach* 2017;14(2),119–123.
83 Chi YL, Bump JB. Resource allocation processes at multilateral organizations working in global health. *Health Policy Plan* 2018;33,i4–i13.
84 Daibes I, Sridharan S. Where theory and practice of global health intersect: the developmental history of a Canadian global health initiative.Glob Health Action 2014;24;7:23974.
85 Erondu NA, Martin J, Marten R, et al. Building the case for embedding global health security into universal health coverage: a proposal for a unified health system that includes public health. *Lancet* 2018;20;392(10156):1482-1486.
86 Garay J, Harris L, Walsh J. *Global health: evolution of the definition, use and misuse of the term. Face à Face.* 2013;12.
87 Gostin LO, Friedman EA. A retrospective and prospective analysis of the west African Ebola virus disease epidemic: robust national health systems at the foundation and an empowered WHO at the apex. *Lancet* 2015;1902-1909.
88 Heymann LD, Chen L, Takemi K, et al. Global health security: The wider lessons from the west African Ebola virus disease epidemic. *Lancet* 2015;385(9980):1884-1901.
89 Redwood-Campbell L, Pakes B, Rouleau K, et al. Developing a curriculum framework for global health in family medicine: Emerging principles, competencies, and educational approaches. *BMC Med Educ* 2011;11(46):1-8.
90 Rees CA, Keating EM, Lukolyo H, et al. Host clinical preceptors' perceptions of professionalism among learners completing global health electives. *Int J Med Educ* 2018;9:206–212.
91 Rowthorn V, Olsen J. All Together Now: Developing a Team Skills Competency Domain for Global Health Education. *J Law, Med Ethics* 2014;42(4):550–563.
92 Schäferhoff M, Fewer S, Kraus J, et al. How much donor financing for health is channelled to global versus country-specific aid functions? *Lancet* 2015;12;386(10011):2436-41.
93 Sauerbier A, Macerollo A, Györfi O, et al. Insufficient global health education in European neurological post-graduate training: a European Association of Young Neurologists and Trainees survey. *Eur J Neurol* 2016;23:1680-1683.
94 Farmer P, Kim JY, Kleinman A, Basilico M. Reimagining global health: An Introduction. *Univ of California Press*; 2013.
95 Haines A, Berlin A. Global Health. *Manson's Tropical Infectious Diseases* 2014; 9-15.
96 Piachaud J. Global health and human security. *Med Confl Surviv* 2008;1(24)1-4.
97 Herath C. "A comparative study of interprofessional education in global health care: A systematic review." *Med* 2017;96(38):7336.
98 Copi, IM, Cohen C, McMahon K. Introduction to logic. *Pearson Educated Limited;*2014:83-85.
99 Phillips DC. Operational definitions in educational research. *Australian Journal of Education* 1968;12(3):311-23.
100 Taylor S. 'Global health': meaning what?. *BMJ Global Health* 2018;**3:**e000843.

101 King NB, Koski A. Defining global health as public health somewhere else. *BMJ Global Health*. 2020;5(1):e002172.
102 Turcotte-Tremblay A-M, Fregonese F, Kadio K, Alam N, Merry L. Global health is more than just 'Public Health Somewhere Else'. *BMJ Global Health*. 2020;5(5):e002545.
103 Herzig van Wees S, Holmer H. Global health beyond geographical boundaries: reflections from global health education. *BMJ Global Health*. 2020;5(5):e002583.
104 Fischer SE, Patil P, Zielinski C, et al. Is it about the 'where' or the 'how'? Comment on Defining global health as public health somewhere else. *BMJ Global Health* 2020;5:e002567.

Works Cited

Abbas, Syed Shahid, et al. "Rabies control initiative in Tamil Nadu, India: a test case for the 'One Health Approach." *International Health* 3.4 (2011): 231-239.

Adams, Vincanne. *Metrics: What counts in global health*. Duke University Press, 2016.

Aenishaenslin, Cécile, et al. "Characterizing rabies epidemiology in remote Inuit communities in Québec, Canada: a "one health" approach." *Ecohealth* 11.3 (2014): 343-355.

Aihwa, Ong and Collier, Stephen. "Global assemblages." *Technology, politics and* (2005).

Anderson, Warwick. "The history in epidemiology." *International journal of epidemiology* 48.3 (2019): 672-674.

A Tripartite Concept Note. "The FAO-OIE-WHO." (2010).

Baer, Jean G. "The origin of human tapeworms." *The Journal of Parasitology* 26.2 (1940): 127-134.

Barad, Karen. "Meeting the universe halfway." *Meeting the universe halfway*. Duke University Press, 2007.

Beam, Michelle, et al. "Barriers to participation in a community-based program to control transmission of Taenia solium in Peru." *The American journal of tropical medicine and hygiene* 98.6 (2018): 1748-1754.

Biehl, João, and Adriana Petryna, eds. *When people come first: critical studies in global health*. Princeton University Press, 2013.

Binghamd, Nick., Enticott, Gareth., Hinchliffe, Steve. "Biosecurity: Spaces, Practices, and Boundaries." *Environment and Planning.* 40. (2008): 1528-1533.

Blanchette, Alex. "Herding species: Biosecurity, posthuman labor, and the American industrial pig." *Cultural Anthropology* 30.4 (2015): 640-669.

Bresalier, Michael., Cassidy, Angela., and Woods, Abigail. "1 One Health in History." (2015).

Briggs, Charles L. "Communicating biosecurity." *Medical Anthropology* 30.1 (2011): 6-29.

Brotherton, Sean and Nguyen, Vinh-Kim. "Revisiting Local Biology in the Era of Global Health." *Medical Anthropology.* 2013.

Brown, Wendy. *In the ruins of neoliberalism: the rise of antidemocratic politics in the West*. Columbia University Press, 2019.

Caduff, Carlo. "The Semiotics of Security: Infectious Disease Research and the Biopolitics of Informational Bodies in the United States," *Cultural Anthropology* 27(2), 2012: 333-57

Canguilhem, Georges. *Knowledge of life*. Fordham University Press, 2009.

Canguilhem, Georges. *On the Normal and the Pathological*. Vol. 3. Springer Science & Business Media, 2012.

Canguilhem, Georges "The Living and its Milieu," in *Knowledge of Life*. Eds. Marrati and Meyers (New York: Fordham, 2008).

Cartwright, Lisa. "Reach out and heal someone: telemedicine and the globalization of health care." *Health:* 4.3 (2000): 347-377.

Castillo-Neyra, Ricardo, Michael Z. Levy, and Cesar Náquira. "Effect of free-roaming dogs culling on the control of canine rabies." *Revista peruana de medicina experimental y salud publica* 33.4 (2016): 772-779.

Castillo-Neyra, Ricardo, et al. "Behavioral and structural barriers to accessing human post-exposure prophylaxis and other preventive practices in Arequipa, Peru, during a canine rabies epidemic." *PLOS Neglected Tropical Diseases* 14.7 (2020).

Castillo-Neyra, Ricardo, et al. "Socio-spatial heterogeneity in participation in mass dog rabies vaccination campaigns, Arequipa, Peru." *PLoS neglected tropical diseases* 13.8 (2019): e0007600.

Chien, Yu-Ju. "How did International Agencies Perceive the Avian Influenza Problem? The adoption and manufacture of the 'One World, One Health' Framework." *Sociology of Health and Illness.* 35.2 (2012): 213-226

Chomel, Bruno B., Albino Belotto, and François-Xavier Meslin. "Wildlife, Exotic Pets, and Emerging Zoonoses." *Emerging infectious diseases* 13.1 (2007): 6.

Cleaveland, Sarah, et al. "Rabies control and elimination: a test case for One Health." *Veterinary Record* 175.8 (2014): 188-193.

Clutton-Brock, T., Parker, G. "Punishment in Animal Societies" *Nature.* 375(1995). 209-216.

Cohen, Lawrence. "THREE Making Peasants Protestant and Other Projects." *Medical Anthropology at the Intersections*. Duke University Press, 2012. 65-92.

Coker, Richard, et al. "Towards a conceptual framework to support one-health research for policy on emerging zoonoses." *The Lancet infectious diseases* 11.4 (2011): 326-331.

Collinge, Sharon and Ray, Chris. "Disease Ecology: Community Structure and Pathogen Dynamics." *Oxford University Press.* 2006.

Cox, Frank EG. "History of human parasitology." *Clinical microbiology reviews* 15.4 (2002): 595-612.

Crandon-Malamud, Libbet. *From the fat of our souls: Social change, political process, and medical pluralism in Bolivia*. Vol. 26. Univ of California Press, 1991.

Das, Veena, et al. "Anthropology in the Margins of the State." *PoLAR: Political and Legal Anthropology Review* 30.1 (2004): 140-144.

Davies, Sara and Youde, Jeremy. "The Politics of Surveillance and Response to Disease Outbreaks: The new Frontier for States and Non-State Actors." *History, Political Science and International Studies.* (2016).

Eben, Kirksey and Helmreich, Stefan . "The emergence of multispecies ethnography." *Cultural anthropology* 25.4 (2010): 545-576.

Elhaik, Tarek. "What is contemporary anthropology?." *Critical Arts* 27.6 (2013): 784-798.

Ewig, Christina. *Second- wave neoliberalism: Gender, race, and health sector in Peru*, (2011).

Farmer, Paul. *Infections and inequalities: The modern plagues*. Univ of California Press, 2001.

Farmer, Paul et al. "Reimagining Global Health." *University of California Press.* (2013).

Fearnley, Lyle. "The Pandemic Epicenter: Point from Viruses to China's Wildlife Trade" *Science, Medicine and Anthropology* 2020.

Fearnley, Lyle. "Wild Goose Chase: The Displacement of Influenza Research in the Fields of Poyang Lake, China," *Cultural Anthropology* 30(1), 2015:12.

Fidler, David. "From International Sanitary Conventions to Global Health Security: The New International Health Regulations"*Chinese Journal of International Law.* 4.2(2005):325-392.

Fleck, Ludwik. "Scientific observation and perception in general [1935]." *Cognition and fact*. Springer, Dordrecht, 1986. 59-78.

Foucault, Michel. *The Foucault effect: Studies in governmentality*. University of Chicago Press, 1991.

García HH, Gonzalez AE, Evans CA, Gilman RH, Cysticercosis Working Group in Peru. Taenia solium cysticercosis. Lancet (London, England). 2003 Aug;362(9383):547-556. DOI: 10.1016/s0140-6736(03)14117-7.

George E. Marcus., and Saka, Erkan. "Assemblage." *Theory, culture & society* 23.2-3 (2006): 101-106.

George E. Marcus. *Para-sites: A casebook against cynical reason*. Vol. 7. University of Chicago Press, 2000.

Gibbs, Paul. "The evolution of ONE Health: A decade of progress and challenges for the future." *Veterinary Record 174*.4 (2014): 85-91.

Giordano, Cristiana. *Migrants in translation: Caring and the logics of difference in contemporary Italy*. Univ of California Press, 2014

Goethe, Johann. "Elective Affinities" *Oxford University Press.* (1999).

Good, Byron J. *Medicine, Rationality and Experience: An Anthropological Perspective*. Cambridge University Press, 1993.

Gortazar, Christian, et al. "Crossing the interspecies barrier: opening the door to zoonotic pathogens." *PLoS Pathog* 10.6 (2014): e1004129.

Gostin et al. "Reimagining Global Health Governance in the Age of COVID-19." *American Public Health Association* (2020).

Grosz, Elizabeth. *The nick of time: Politics, evolution, and the untimely*. Duke University Press, 2004.

Gutfraind, Alexander, et al. "Integrating evidence, models and maps to enhance Chagas disease vector surveillance." *PLoS neglected tropical diseases* 12.11 (2018).

Han, Clara. *Life in debt: Times of care and violence in neoliberal Chile*. Univ of California Press, 2012.

Hannaway, C. (1977) Veterinary medicine and rural health care in pre-Revolutionary France. *Bulletin of the History of Medicine* 51, 431–447.

Haraway, Donna. "A cyborg manifesto: Science, technology, and socialist-feminism in the late 20th century." *The international handbook of virtual learning environments*. Springer, Dordrecht, 2006. 117-158.

Haraway, Donna. *When Species Meet* (Minneapolis: Univ. of Minnesota Press, 2008).

Häsler B, Hiby E, Gilbert W, Obeyesekere N, Bennani H, Rushton J. A one health framework for the evaluation of rabies control programmes: a case study from Colombo City, Sri Lanka. *PLoS Negl Trop Dis*. 2014;8(10):e3270.

Haydon, Daniel T., et al. "Identifying reservoirs of infection: a conceptual and practical challenge." *Emerging infectious diseases* 8.12 (2002): 1468-1473.

Hinchliffe, et al., "Biosecurity and the Topologies of Infected Life: From Borderlines to Borderlands," 2013.

Hinchliffe, Steve. "More than One World, more than One Health: Re-configuring interspecies health." *Social Science Medicine.* (2015):28-35.

Hoberg, Eric P., et al. "Out of Africa: origins of the Taenia tapeworms in humans." *Proceedings of the Royal Society of London. Series B: Biological Sciences* 268.1469 (2001): 781-787.

Hustak, Carla, and Myers, Natasha. "Involutionary momentum: Affective ecologies and the sciences of plant/insect encounters." *differences* 23.3 (2012): 74-118.

Ilona, Carneiro., Howard, Natasha., Lucianne, Bailey. "Introduction to Epidemiology" Open *University Press.* 2011.

Ingold, Tim. *Being Alive: Essays on Movement, Knowledge, and Description,* Taylor and Francis, 2011: 3-4; in Alex Nading, ibid., 2012: 585.

Ingold, Tim. *Making: Anthropology, archaeology, art and architecture*. Routledge, 2013.

"International Health Regulations." *World Health Organization.* 2016.

Keck, Frédéric. "From mad cow disease to bird flu." *Biosecurity Interventions*. Columbia University Press, 2008. 195-226.

Keck, Frederic. "From Purgatory to Sentinel: 'Forms/Events' in the Field of Zoonoses," *Cambridge Anthropology* 32(1), 2014: 47-61

Keshavjee, Salmaan. *Blind spot: how neoliberalism infiltrated global health*. Vol. 30. Univ of California Press, 2014.

Korsby, Trine Mygind, and Anthony Stavrianakis. "Moments in collaboration: Experiments in concept work." *Ethnos* 83.1 (2018): 39-57.

Kruse, Hilde., Kirkemo, Anne-Mette., and Handeland, Kjell. "Wildlife as source of zoonotic infections." *Emerging infectious diseases* 10.12 (2004): 2067.

Kuhn, Thomas S. *The structure of scientific revolutions*. University of Chicago press, 1962.

Lakoff, Andrew. "Two Regimes of Global Health." *Humanity.* 2010.

Lakoff, Andrew. "Two states of emergency: Ebola 2014." *Limn 5: Ebola's Ecologies* (2015).

Lavan, Robert P., et al. "Rationale and support for a One Health program for canine vaccination as the most cost-effective means of controlling zoonotic rabies in endemic settings." *Vaccine* 35.13 (2017): 1668-1674.

Lebel, Jean. *In Focus: Health: An Ecosystem Approach*. Ottawa: International Development Research Centre, 2003.

Leboeuf, Aline. "Making Sense of One Health: Cooperating at the Human-Animal-Ecosystem Healther Interface." *Health and Environment Reports.* 2011

Levinas, Emmanuel, and Philippe Nemo. "Ethics and infinity." (1985).

Lock, Margaret. “Cultivating the Body: Anthropology and Epistemologies of Bodily Practice and Knowledge,” *Annual Review of Anthropology* 22, 1993:133-55

Lock, Margaret. “Recovering the Body.” *Annual Review of Anthropology.* 46 (2017): 1-14.

Lock, Margaret. “Transcending Mortality: Organ Transplants and the Practice of Contractions.” *Medical Anthropology Quarterly.* (1995): 390-393.

Lock, Margaret and Kaufert, Patricia. "Menopause, local biologies, and cultures of aging." *American journal of human biology* 13.4 (2001): 494-504.

Lock, Margaret M., and Judith Farquhar, eds. *Beyond the body proper: Reading the anthropology of material life*. Duke University Press, 2007.

Louise, Curth. “The Care of the Brute Beast: Animals and the Seventeenth-Century Medical Market-Place.” *Social History of Medicine.* 15.3(2002): 375-392.

Lowe, Celia. "Viral clouds: becoming H5N1 in Indonesia." *Cultural Anthropology* 25.4 (2010): 625-649.

Luhmann, Niklas. *Observations on modernity*. Stanford University Press, 1998.

Medical Anthropology Quarterly’s Special Issue. “Human Animal Health in Medical Anthropology” 2019.

Monatschrift, Berlinische, and Was ist Aufklärung. "Michel Foucault. What is Enlightenment." *The foucault reader* (1984): 32-50.

Montoya, Michael J. "Bioethnic conscription: Genes, race, and Mexicana/o ethnicity in diabetes research." *Cultural anthropology* 22.1 (2007): 94-128.

Nading, Alex. *Mosquito Trails: Ecology, Health, and the Politics of Entanglement,* University of California Press, 2014: 231n52.

Nading, Alex “Dengue Mosquitos are Single Mothers: Biopolitics Meets Ecological Aesthetics in Nicaraguan Community Health Work,” *Cultural Anthropology* 27(4), 2012:584

Nutton, Vivian. “Ancient Medicine.” *Routledge.* 2013.

Ong, Aihwn and Collier, Stephen. “Global Assemblages: Technology, Politics, and Ethnic as Anthropological Problems.” *Blackwell,* 2007.

Onyebuchi A., et al. "Conceptual frameworks for health systems performance: a quest for effectiveness, quality, and improvement." *International journal for quality in health care* 15.5 (2003): 377-398.

Petryna, Adriana. "Biological citizenship: The science and politics of Chernobyl-exposed populations." *Osiris* 19 (2004): 250-265.

Petryna, Adriana. "Ethical variability: drug development and globalizing clinical trials." *American Ethnologist* 32.2 (2005): 183-197.

Petryna, Adriana, Arthur Kleinman, and Andrew Lakoff, eds. *Global pharmaceuticals: Ethics, markets, practices*. Duke University Press, 2020.

Porter, Natalie. "Bird flu biopower: strategies for multispecies coexistence in Việt Nam." *American Ethnologist* 40.1 (2013): 132-148.

Proctor, James and Larson, Brendon. “Ecology, Complexity, and Metaphor.” *BioScience* 55.12, 2005.

Rabinow, Paul. “Artificiality and Enlightenment: From Sociobiology to Biosociality,” *Essays on the Anthropology of Reason,* Princeton University Press, 1996:102.
Rabinow, Paul. "Midst anthropology's problems." *Cultural anthropology* 17.2 (2002): 135-149.
Rabinow, Paul, et al. *Designs for an Anthropology of the Contemporary*. Duke University Press, 2008.
Rabinow, Paul. *Marking time: On the anthropology of the contemporary*. Princeton University Press, 2009.
Rabinow, Paul. *The accompaniment: Assembling the contemporary*. University of Chicago Press, 2011.
Rabinow, Paul. *Reflections on fieldwork in Morocco*. University of California Press, 2016.
Rabinowitz, Peter., and Conti, Lisa. “Links among human health, animal health, and ecosystem health.” *Annual Review of Public Health,* 34 (2013): 189-204.
Rajan, Kaushik Sunder. *Biocapital: The constitution of postgenomic life*. Duke University Press, 2006.
Rapport, David J. "Epidemiology and ecosystem health: natural bridges." *Ecosystem Health* 5.3 (1999): 174-180.
Redfield, Peter. "6. Vital mobility and the humanitarian kit." *Biosecurity Interventions*. Columbia University Press, 2008. 147-172.
Rees, Tobias. "From The Anthropocene To The Microbiocene." *Noema Magazine,* 2020.
Rees, Tobias. *After ethnos*. Duke University Press, 2018.
Roberts, Elizabeth FS. *God's laboratory: assisted reproduction in the Andes*. Univ of California Press, 2012.
Rose, Nikolas, and Carlos Novas. "Biological citizenship." *Global assemblages: Technology, politics, and ethics as anthropological problems* (2005): 439-463
Rosenberg, Justin. “Follies of Globalization Theory” *Verso.* 2003
Russell, Kevin L., et al. "The Global Emerging Infection Surveillance and Response System (GEIS), a US government tool for improved global biosurveillance: a review of 2009." *BMC Public Health* 11.2 (2011): 1-10.
Sachs, Joe. *Aristotle's physics: A guided study*. Rutgers University Press, 1995.
Salm M. Pandemics are not only caused by viruses. *Somatosphere*. 2021. Available at: http://somatosphere.net/forumpost/pandemics-are-not-only-caused-by-viruses/. Accessed May 16, 2021.
Samimian-Darash, Limor. "Governing through time: preparing for future threats to health and security." *Sociology of Health & Illness* 33.6 (2011): 930-945.
Sansi, Roger, ed. *The Anthropologist as Curator*. Bloomsbury Academic, 2019.
Schantz, Peter M., et al. "Neurocysticercosis in an orthodox Jewish community in New York City." *New England Journal of Medicine* 327.10 (1992): 692-695.
Scheper-Hughes, Nancy. *Saints, scholars, and schizophrenics: Mental illness in rural Ireland, updated and expanded*. Univ of California Press, 2001.

Scheper-Hughes, Nancy. “Three Propositions for a Critically Applied Medical Anthropology.” *Social Science and Medicine.* 30.2 (1990): 189-197.

Scott, David. “Conscripts of Modernity: The tragedy of colonial enlightenment”, 2004.

Shaikh, Irum. “Critically Analyse the Different Approaches of Eco Health, One Health, Planetary Health and Political Economy and Political Ecology of Global Health to Analyse Current Challenges in the Anthropocene.” *Journal of Ecosystem and Ecography.* 8.1 (2018): 252.

Sluga, Glenda. "UNESCO and the (one) world of Julian Huxley." *Journal of World History* (2010): 393-418.

Sosin, Daniel and DeThomasis, J. ``Evaluation Challenges for Syndromic Surveillance" Morbidity *and Mortality Weekly Report. (*2004):125-129.

Star, Susan and Griesemer, James. “Institutional Ecology, ‘Translations’ and Boundary Objects: Amateurs and Professionals in Berkeley’s Museum of Vertebrate Zoology, 1907-39” (1989).

Stephen, Collier., Andrew Lakoff., Paul Rabinow. “Biosecurity: Toward an Anthropology of the Contemporary” *Anthropology Today.* 20.5 (2004):3-7.

Strathern, Marilyn, ed. *Audit cultures: Anthropological studies in accountability, ethics, and the academy*. Psychology Press, 2000.

Strathern, Marilyn. *Relations: An anthropological account*. Duke University Press, 2020.

Sueker, Jeremy et al. “Influenza and Respiratory Disease Surveillance: The US Military’s Global Laboratory-based Network.” *Influenza and Other Respiratory Viruses.* 4.3 (2010): 155-161.

Susser, M., Susser, E. “Choosing a Future for Epidemiology: II. From Black Box to Chinese Boxes and eco-epidemiology.” *American Journal of Public Health.* 86.5 (1996): 674-677.

Susser, Mervyn, and Zena Stein. *Eras in epidemiology: the evolution of ideas*. Oxford University Press, 2009.

Tan, Jimin, et al. "One Health strategies for rabies control in rural areas of China." *The Lancet Infectious Diseases* 17.4 (2017): 365-367.

Ticktin, Miriam Iris. "From the human to the planetary." *Medicine Anthropology Theory* 6.3, 2019.

Tilley, Hellen. (2011) *Africa as a Living Laboratory: Empire, Development and the Problem of Scientific Knowledge 1870–1850*. University of Chicago Press, Chicago, Illinois.

“The FAO-OIE-WHO Collaboration.” *The OIE and its Partners,* 2008.

“The State of Food and Agriculture.” *Food and Agriculture Organization of the United Nations*, 2008.

United Nations, Food and Agriculture Organization, Biosecurity Toolkit (2007), http://www.fao.org/docrep/010/a1140e/a1140e00.htm.

Von Uexküll, Jakob. *A foray into the worlds of animals and humans: With a theory of meaning*. Vol. 12. U of Minnesota Press, 2013.

Wang, L. F., and G. Crameri. "Emerging zoonotic viral diseases." *Rev Sci Tech* 33.2 (2014): 569-81.

Wellin, Edward. "Water boiling in a Peruvian town." *Health, culture and community* (1955): 71-103.

Whitehead, Alfred North, and Sherburne, Donald. *Process and reality*. New York, NY: Macmillan, 1957.

Wilkinson, R. “Income Distribution and Life Expectancy.” *The British Medical Journal.* 304.6820(1992): 165-168.

Wittgenstein, Ludwig. *Philosophical Investigation*, 1953.

Zhang, Joy Yueyue. *The cosmopolitanization of science: stem cell governance in China*. Palgrave Macmillan, 2012.

Zinsstag, J et al. “From "one medicine" to "one health" and systemic approaches to health and well-being.” *Preventive veterinary medicine* 101,3-4 (2011): 148-56.