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Situated knowledge of pathogenic landscapes in Ghana: Understanding the emergence of Buruli ulcer through qualitative analysis

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ABSTRACT

Successfully addressing neglected tropical diseases requires nuanced understandings of pathogenic landscapes that incorporate situated, contexualized community knowledge. In the case of Buruli ulcer (BU), the role of social science is vital to investigate complex human–environment interactions and navigate different ways of knowing. We analyze a set of qualitative data from our interdisciplinary project on BU in Ghana, drawing from participatory mapping, focus group discussions, semi-structured interviews, and open-ended survey questions to explore how people in endemic and non-endemic areas see themselves embedded in changing environmental and social landscapes. We pay particular attention to landscape disturbance through logging and small-scale alluvial gold mining. The results from our participatory research underscore the holistic nature of BU emergence in landscapes, encapsulated in partial and incomplete local descriptions, the relevance of collective learning to distill complexity, and the potential of rich qualitative data to inform quantitative landscape-disease models.

1. Introduction

At a time when fear and misinformation about uncommon diseases have become a fixture of our global dialogue, the opportunity is ripe to re-evaluate our understanding of health crises as they relate to society as a whole. Buruli ulcer (BU), an aggressive infection that degrades the skin, soft tissue, and bone of affected individuals, represents one such poorly-understood and stigmatized disease. Caused by the bacterium *Mycobacterium ulcerans* (MU), BU typically begins with painless swelling or a small nodule that, if left untreated, results in large ulcers, most commonly on legs and arms. The bacterium itself secretes a cytotoxin that damages tissues and inhibits immune response. In severe cases, patients are left with extensive scars, deformities, or amputations; in rarer instances, the infection can be fatal. While only 15 countries have actively reported BU cases regularly over the past decade, the World Health Organization (WHO, 2014) tracks cases in >30 different countries, predominantly in the tropics. Most cases of BU occur in Africa; the exceptions among high-income countries are Australia and Japan. In 2013 alone, the countries with the highest number of new cases were Côte d'Ivoire (1039), Ghana (550), and Benin (378), although underreporting is widespread (WHO, 2013).

While *M. ulcerans* is from the same family of agents that cause tuberculosis, the mode of transmission for BU is unknown. BU ranks among the WHO's list of 17 neglected tropical diseases (NTDs) along with leprosy, dengue, rabies, and schistosomiasis. Like most other NTDs, BU is an 'infectious disease of poverty' (WHO, 2012).

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NTDs are described as "both drivers and manifestations of poverty and inequality in developing countries" (Bardosh, 2014: 1–3) reflecting "not only individual risk factors, but larger structural inequalities in access to health services, infrastructure, food security, education, political voice and markets that drive poverty and maintain social and economic exclusion."

Increasing scientific evidence suggests that environmental factors play important roles in BU transmission. What remains contested is where in the environment MU resides. Hypotheses range from small environmental niches to a wide diversity of environments (see Landier et al., 2014; McIntosh et al., 2014). Potential BU risk areas include settings transformed by deforestation, mining operations, rice cultivation, wetland modification, human settlement near water, the damming of streams, irrigation systems, and flooding (Hausermann et al., 2012; Wu et al., 2015). Organisms, including aquatic insects (Portaels et al., 2009), non-insect aquatic invertebrates (Benbow et al., 2008), vertebrates such as fish and amphibians (Willson et al., 2013), and certain terrestrial biting insects (Merritt et al., 2010) may serve as hosts for MU within aquatic and nearby terrestrial environments. Recent research indicates an association of BU transmission with deep punctures or lacerations, rather than existing wounds, again suggesting insect vectors (Williamson et al., 2014).

In this paper, we contribute to emerging perspectives on NTDs by exploring human–environment interactions in the context of BU in Ghana, namely by expanding understandings of 'pathogenic landscapes' (Lambin et al., 2010) to include contextual community knowledge. We analyze a set of qualitative data, drawing from participatory mapping, focus group discussions, semi-structured interviews, and open-ended survey questions to explore how people in endemic and non-endemic areas see themselves embedded in changing environmental and social landscapes. We are particularly interested in landscape disturbance through logging and small-scale gold mining. This situated knowledge approach, being local and embodied, allows us to gauge how such positioning shapes particular sets of knowledge, practices, and behaviors. Our aim is to underscore the role of social science and place-based understandings of disease emergence and show the need for navigating different ways of knowing in a larger interdisciplinary investigation. By employing qualitative network models, we aim to unpack the 'black box' of complex social-ecological systems studies that underpin interdisciplinary research (Pujadas Botey et al., 2014).

2. Types of knowledge approaches to infectious disease emergence

2.1. Landscape-level approaches

Recent studies in disease ecology, particularly those of infectious diseases, have emphasized the complex linkages between land-use/land-cover change, climatic change, disease vectors, and people's activities. These approaches focus on the interaction between altered or disturbed landscapes and humans as drivers for increased risk, generating concepts such as 'unhealthy landscapes' (Patz et al., 2004) and 'pathogenic landscapes' (Lambin et al., 2010). Lambin et al. (2010) suggest a dynamic view of such 'pathogenic landscapes' that highlights spatial and temporal interactions between agents (vectors, animal hosts, human hosts, multiple habitats and land use) at multiple scales, including preferred habitats of vectors and hosts at the natural community level and the interaction of humans with these terrains of risk at the population level.

In the case of BU, examining spatial and temporal variations in disease incidence across heterogeneous landscapes allows for identifying the spatial and temporal aspects of transmission. Landier et al. (2014) combine BU case data with land-use/land-cover information from remotely-sensed imagery and topographic data for Cameroon. Their results illustrate an intricate mix of endemic and non-endemic villages, suggesting highest BU risk in landscapes with abundant wetlands and forested areas modified through clearing and agricultural use. In Victoria, Australia, van Ravensway et al. (2012), using network analysis coupled with hierarchical modeling, find highest risk at low elevations with forested land cover, and a sequence of warm and wet conditions followed by a dry period. Most recently, Wu et al. (2015) demonstrated the close linkage between BU and mining and agricultural disturbance in Ghana.

Despite significant advances in quantitatively assessing and modeling such 'pathogenic landscapes', these approaches have been predominantly expert-led, quantitative, and top-down. The advantage of such spatial-temporal analyses is that they allow for identifying emergent behaviors at higher levels (e.g. incidence of BU in a particular region or country). The disadvantage is that, despite fine-grained pictures of spatial heterogeneity, at-risk activities often remain grossly generalized, devaluing the pathology that BU victims and others associated with the landscapes in which they live and the experiences that result from day-to-day interactions. This gap limits the exploration of complex positive and negative feedbacks between the social and the ecological that govern system resilience (Cumming et al., 2015). It also hampers the ability to use qualitative information in interdisciplinary studies to better understand disease risk.

2.2. Situated knowledge approaches

Expanding observations to include people's lived experiences requires an appreciation for the complementarity of different ways of knowing (Leach and Scoones, 2013). Research and prevention programs on NTDs have been criticized for neglecting social and contextual drivers (e.g. Allotey et al., 2010; Bardosh, 2014). Combining multiple models, modeling expertise, and sources of evidence has proven useful, for example, in the context of zoonotic diseases, such as Ebola and H5N1. Such a combination is best achieved when embedded in dialogic processes across distinct datasets and expertise, and when framing assumptions, system descriptions, and cultural perspectives are deliberated, rather than merely integrated. Dialogue between anthropologists and epidemiologists, for instance, overcame narrow epistemological assumptions and led to more nuanced understandings of human behavior and disease emergence (Trostle and Sommerfeld, 1996). This process of navigating approaches and data between multiple ways of knowing opens up space for contextual relevance. In addition, incorporating lay experiences in disease studies can add new insights into complex disease ecologies.

Participatory epidemiology (e.g. Catley et al., 2012), and participatory geographies of disease more generally (e.g. Leung et al., 2004), have increasingly demonstrated the value of collaborating with lay people in epidemiological studies to foster the co-production of knowledge. Participation in health research typically entails processes of action and reflection, with and by local people, acknowledging human agency and power differentials (Cornwall and Jewkes, 1995). Recent participatory efforts that address NTDs include, for instance, community mapping of dengue risk in Malaysia (Dickin et al., 2014) and community knowledge of Chagas disease in Mexico (Rosecrans et al., 2014).

We use the term 'situated knowledge' to underscore the importance of lived experiences of people in day-to-day interactions with pathogenic landscapes, and to encourage inclusion and joint reflection relevant for investigating complex disease emergence. The term 'situated knowledge' was introduced by Donna Haraway (1988, 1991) to emphasize the position of subjects, including researchers themselves, and unequal power relations in the production of knowledge. Following Haraway, subjective perspectives and