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One Health for a changing world: new perspectives from Africa

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Introduction

Over the past 25 years, a succession of disease outbreaks has threatened global public health, animal health and biodiversity conservation. From Nipah to SARS to avian and swine flu, and from Ebola to Zika and MERS, diseases of animal origin have caused alarm, both locally and in relation to their global threats. These episodes have shone a spotlight on human-animal interactions, and how they affect the potential for novel disease emergence (Jones et al 2008) and spread. The vast majority of newly emerging human infectious diseases originate in animals (Taylor et al. 2001), with the rate of novel disease emergence accelerating (Woolhouse and Gaunt 2007). Meanwhile, the majority of previously-unknown diseases affecting wildlife have emerged consequent to human activities (Daszak et al. 2001). Increasingly, questions are being raised about the underlying environmental and socio-economic processes of disease emergence – including globalisation, climate change, land use change and urbanisation (Daszak et al. 2000; Jones et al 2013; Watts et al 2015).

Despite their prominence, the impacts of emerging infectious diseases (EIDs) are overshadowed by the massive burdens of endemic zoonoses, which tend to be neglected compared to EIDs. Trypanosomiasis, leptospirosis and brucellosis, for example, undermine the well-being of millions of people, yet do not get the attention of those diseases associated with potential global outbreaks (Maudlin et al 2009; Molyneaux et al 2011; Welburn et al 2015). The burdens of such neglected zoonotic diseases are concentrated in poorer parts of the world, where health and veterinary services are inadequate, and the toll of such diseases is undiagnosed and hidden from view (Grace et al 2012).

The intersections of human, animal and ecosystem health lie at the heart of these public and policy concerns, yet these interactions are poorly understood and little researched. As a result, concerns and responses to them are too often driven by conjecture or faulty assumptions, or by generalisations that fail to fit real-world contexts (Figure 1). This Special Issue helps to redress this situation. The papers in this Special Issue have a particular emphasis on the impacts of zoonotic disease on human poverty and well-being. Many address the way that disciplinary specialisms, sectoral mandates, divided policy efforts and compartmentalised funding flows have limited, particularly in the developing world, attention on why zoonotic diseases emerge, how they affect different groups of people and the identification of appropriate responses.

Drawing on a longer tradition of linking understandings of ecosystems to health impacts, under the banner of ecohealth (Wilcox et al 2004; Charron 2012), a 'One Health' research and policy agenda was advocated in the wake of the avian flu crisis in the mid-2000s Gibbs, 2014). This proposed breaking down siloes, and creating a more integrated approach for research, surveillance and response to emerging and endemic infections, involving medical science, public health, veterinary science, ecology, conservation biology, social science and more (Zinsstag et al 2011, 2015; Coker et al 2011; Wood et al 2012; Bardosh 2016).

Such an integrated, holistic, all-encompassing approach has much theoretical and policy appeal. But how can it work in practice? What are its weaknesses? What are the approaches, methods, organisational and policy arrangements that will make a One Health approach work in a changing world, particularly in Africa and other resource-limited regions where research and response capacities are limited? How can a One Health approach address, rather than exacerbate, issues of

poverty and marginalisation in settings where structural inequalities and deep vulnerabilities make exposure to disease a recurrent feature of daily life?

Emerging as it did out of the contexts of global health emergencies, much One Health discussion has focused on outbreak control, effectively responding to the concerns of richer, northern nations concerning the threats to their economies and public health implications of disease spread to their countries (Scoones and Forster 2010). Much less discussion has centred on poorer settings where zoonotic transmission usually occurs, often associated with rapid environmental and land-use change and the close contact between humans and wild and domestic animals (Okello et al 2014) – albeit taking place in diverse and context-specific ways.

In this Special Issue we aim to shift the focus from 'outbreak' narratives and top-down global responses, to addressing issues impacting local communities, mobilising local knowledge and action in response to zoonotic disease burdens. We also aim to move away from simplistic, linear assumptions about environment-human-disease interactions, to examine their complex local dynamics in real-world settings. This Special Issue focuses on Africa, exploring the meaning of One Health in these heterogeneous contexts. It draws, in particular, on a long-term, cross-disciplinary research partnership, the Dynamic Drivers of Disease in Africa Consortium[1], involving researchers and practitioners from the UK and Africa, exploring disease emergence and impacts of Rift Valley fever (Kenya), henipaviral infection (Ghana), Lassa fever (Sierra Leone) and trypanosomiasis (Zambia and Zimbabwe). This Special Issue also draws on long-term work in Tanzania, focused on multiple endemic diseases, as well as commentaries from others with important experience in this field. The diverse mix of pathogens and biological characteristics in different geographies, with very different animal-human interfaces, social settings and transmission pathways, reveals both the importance of context-specificity, and a surprising commonality of central policy and response issues.

The 11 papers in the collection relate to four themes. First, a discussion of the complex interactions linking ecosystems, diseases and poverty; second, the often under-played, yet hugely important, social and political dimensions; third, modelling approaches that can help combine perspectives and facilitate conversations between key actors; and finally, asking the question: what should be done to ensure One Health ideals genuinely have an impact on and for the most affected populations through challenging current policies and practices?

Ecosystems, diseases and poverty: complex interactions

Our opening paper (Leach et al., 2017) captures the central importance of understanding who gets sick and why from zoonotic diseases, which requires a grounded understanding of socio-ecological interactions across time and space, also in relation to patterns of social difference within societies (Dzingirai et al 2017). This requires interdisciplinary understanding of disease dynamics and impacts, combining ecology with veterinary and medical science and with social science. Only with such insights can optimal intervention points be highlighted – these may relate to particular sites or times, or may be focused on particular groups of people or behaviours. It is critical to recognise that zoonotic diseases do not affect all people, all the time, everywhere; interdisciplinary research can, the paper argues, result in much more effective, socially and ecologically-attuned targeting.

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Illustrating the argument, Leach and colleagues (2017) highlight responses to Rift Valley Fever in Kenya. Changing land use, most notably the expansion of large irrigation schemes and the settlement of populations, has resulted in major changes in disease dynamics. Formerly Rift Valley fever emerged following particularly heavy rainfall events in the drylands, affecting pastoralists who

[1] http://steps-centre.org/project/drivers_of_disease/

made use of low-lying grazing patches, where mosquitoes, the disease vector, attacked both people and animals. A combination of epidemiological and economic modelling, field surveys and interviews has exposed how dynamics of disease exposure are changing in northern Kenya, and how different groups are increasingly affected, most notably poorer irrigators in new irrigation schemes. The study on trypanosomiasis in Zimbabwe similarly highlights the spatial and temporal heterogeneities of exposure to the tsetse fly vector. After years of investment in clearing tsetse flies from vast tracts of land in the Zambezi valley, the flies and the disease persist, but only in isolated patches, used by certain people at particular times of year. This means that exposure is highly differentiated, focused on herders (often children), wild food collectors (mostly women), hunters (usually young men) and migrants (living on the edges of the settled areas, near wildlife populations).

Methods based on large-scale surveys and generic population and environmental assessments often miss such shifts in land use, the importance of patches and their different impacts on groups of people. A much more fine-grained, field-based analysis, making use of local knowledge and insights, is far more revealing. It is local people who know how ecosystems are changing, where vectors are prevalent, and who is affected by such diseases, and how. These frequently ignored local insights have to be complemented, or triangulated (Catley *et al* 2012), by scientific investigations that trap flies, assess pathogen prevalence through molecular techniques and evaluate vegetation change through satellite technologies; the paper argues that these enquiries are far more effective and focused when conducted through local-level field engagement.

Many of these themes are emphasised in two papers on zoonoses and poverty dynamics. Cleaveland and colleagues (2017) focus on endemic zoonoses in East Africa, especially Tanzania, including brucellosis, leptospirosis and Q-fever. These are diseases that do not have the potential for extended human-to-human transmission and transboundary spread, so tend to be overlooked by the developed world, yet they impose serious burdens on the poor, affecting both people and their animals. Poor people are especially affected because of regular exposure to infected animals and the risks of traditional food consumption practices; because access to human and animal health services is limited in remote areas and, because of long-term marginalisation, such communities have limited agency, capacity and political voice to make claims on the state to mitigate and manage disease risk. Cleaveland et al. (2017) argue that focusing on the treatment of human cases of such diseases misses the potential for addressing underlying causes. A focus on animal-human interactions, through a One Health approach to preventive animal health surveillance and vaccination and human behaviour change, for example, may be much more cost effective and poverty-focused. Addressing multiple diseases as part of a complex socio-ecology focussed on prevention, rather than on single disease treatments, is a preferred practical One Health strategy. Building trust through community engagement can help strengthen capacities for local response in the context of a fragile, under-funded health system, making early warning and response to emerging challenges of as-yet unknown diseases more likely in the future.

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Grace and colleagues (2017) focus on the economics of disease response, and the impacts on poverty and well-being; disease-driven poverty traps are evident in contexts where there is a high prevalence of infectious disease and ecological conditions are conducive to pathogen development. There are clear benefits from the control of zoonotic diseases in animals, with benefit:cost ratios commonly around 4:1, but, perversely, most actual expenditure is on curative treatment rather than preventive action. Most of the burden of health care, of both humans and animals, falls on poor households, because of the lack of state services in poor and marginalised communities. A detailed study of health-related expenditures among pastoral communities in Kenya, where risks of Rift Valley fever outbreaks are high and other endemic zoonoses are common, demonstrates a pattern

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of under-investment in preventive care, with reinforcement of a disease-driven poverty trap, affecting nutrition, food security and health. Such traps are frequently made worse by state or external donor-led disease control interventions, where the negative impacts of livestock market restrictions following Rift Valley fever outbreaks are far larger than the actual health costs of the outbreaks. Grace et al. (2017) discuss a bio-economic systems model, encompassing disease spread as well as downstream marketing impacts of different interventions. Such a model helped demonstrate the value to Kenyan policymakers of preventive vaccination in the face of Rift Valley fever threats.

In all these cases, ecosystem change is a major driver of disease emergence and spread. The links with biodiversity are highlighted in a paper by Cunningham and colleagues (2017). This follows a review undertaken by Daszak et al. (2000) that showed how anthropogenic drivers of environmental change lead to infectious disease emergence, threatening both biodiversity and human health. The update concludes that, despite increasing evidence for the importance of anthropogenic drivers of disease emergence, they are largely ignored by policy makers. Even when such drivers are recognised, regulatory structures and measures are either not put in place or are not enforced. The paper focuses on vertebrate wildlife and shows how human activities alter pathogen dynamics, leading to increased zoonotic disease. Protecting ecosystems and biodiversity, therefore, can contribute towards protecting human health. Certain wildlife species are a major focus for disease emergence, with bats in particular being significant reservoirs of novel, untreatable and often-fatal zoonoses. Bats are also key-stone species for ecosystem function through insectivory, fruit tree pollination and seed dispersal. Biodiversity, therefore, is an ecosystem service through the regulation of disease dynamics and emergence. Ecosystem drivers are key to this, with land use and other environmental change, as well as changing patterns of wildlife trade and consumption, being important areas for policy intervention.

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Social and political dimensions

All these wider drivers are influenced by social and political dynamics. A One Health perspective is not just about the technical aspects of human, animal and ecosystem health, but underlying social relations and political processes. This is important in terms of how diseases are understood and responded to; in relation to understanding the structural political, economic and social drivers of disease emergence and spread; and in relation to who is affected, and the impacts on poverty, inequality, vulnerability and well-being (Craddock and Hinchliffe 2015; Leach et al 2010).

In this Issue, there is a cluster of papers that address these issues. McGregor and Waldman (2017) focus on how diseases are framed, understood and represented, and how conventional binaries – contrasting, for example, human and animal domains, or wild and domestic spheres – are not always part of local understandings, and the way people live their lives in interaction with animals and pathogens. Animals and people are not seen as separate in many cultural contexts, but integrated as part of interconnected social-natural worlds. This, the authors argue, requires a recasting of how 'One Health' is understood, if local perspectives are genuinely to be taken into account. A globalist, universal, simple technical integration, as suggested by much of the One Health debate, may be inadequate if engagement with local people and their knowledges is to be realised. With others, McGregor and Waldman (2017) therefore ask both 'whose world?' and 'whose health?' Drawing from ethnographic perspectives on human-animal encounters, the authors offer a refreshing, and challenging, perspective, urging One Health practitioners to adopt a more open, culturally-informed approach that challenges a technocratic, interventionist framing, arguing for the need to work with and from existing cultural understandings and embedded practices. Respecting local perspectives and cultures, however, should also take account of how the world is changing. Opportunities for

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human-to-human spread following pathogen spillover have been altered through higher population densities, increased access to roads, motorised vehicles and greater international connectedness. Some traditional behaviours, such as bat hunting, which might facilitate spillover, may have been relatively safe in the past, but now might present unacceptable risks. A local spillover event now has a greater chance of resulting in international consequences, even if that occurrence is of low probability. When considering One Health, we need to take account of a fast-changing world.

The politics of knowledge and how debates are framed of course have major implications for how interventions are designed and funded. The political economy of disease prioritisation is highlighted in many papers in this issue, with the endemic, neglected diseases that impose such health burdens on poor African populations frequently getting ignored in favour of the high-profile transboundary diseases with potentials for major impacts on richer populations in the global North. Mainstream outbreak responses have an emphasis on 'at source', facility-based surveillance and clinical treatment through drugs and vaccines of potentially affected populations, rather than community-based interventions for the prevention of multiple endemic diseases. With prestige and funding being supported by a particular 'outbreak' narrative, other alternatives get missed out, distorting research, intervention and policy (Dry and Leach 2010).

Jephcott and colleagues (2017) highlight the limitations of facility-based surveillance and treatment in African settings, with a case study from Ghana. Clear diagnosis is effectively impossible because of overlapping 'fever-like' symptoms that may not always be malaria and may not even be infectious. They show how misdiagnosis and inappropriate treatment is frequent, missing disease and failing to implement simple treatments. Ignoring or mistreating emergent diseases may result in unnecessary spread and misdiagnosing endemic conditions can hinder future prevention or management. With the professional focus on diagnosis and treatment of individual infections, some parts of the medical profession have been the slowest to embrace a One Health perspective, and physicians and medical researchers remain under-represented in the debate, including in this Special Issue.

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Public health professionals, especially front-line health workers working in clinics for example, are often are unaware of the challenges. To help overcome this, Cleaveland and colleagues (2017) argue that community engagement is essential to increase capacities for early warning surveillance, effective diagnosis and integrated responses across a range of diseases. This must go beyond a focus only on facility-based diagnostics and treatment, as Jephcott and colleagues (2017) point out. This was of course a major lesson from the Ebola epidemic in West Africa. While treatment centres and medical facilities were undoubtedly important, the epidemic was controlled through changes in behaviour animated by community responses, with trust, social solidarity and political dynamics being essential features (Richards 2016).

The paper by Dzingirai and colleagues (2017) puts this argument about the politics of access and response in a wider perspective. They argue that structural features of economy, politics and society create major inequalities that both generate disease risks and affect health seeking options by different people in society. Drawing on the classic work by Paul Farmer (Farmer 2004; Farmer et al 2004), they argue that 'structural violence', rooted in historical, political-economic processes and structural relations of politics and interests, is central. Human vulnerabilities to disease are not just the result of proximate drivers of climate, land use or settlement patterns, for example, but emerge from more deep-seated causes, linked to structural relations of power and control over resources and access to services (cf. Watts 2015).

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A political economy and ecology perspective is advocated, which is seen as missing in much One Health discussion. One Health, it is argued, frequently takes a technical, 'anti-political' form (cf.

Ferguson 1990) that ignores underlying structural dynamics generating vulnerability, addressing only the consequences, and not the causes, of poverty and ill-health. Moving beyond a functional response of institutional and disciplinary collaboration to a more searching, and challenging, perspective that uncovers politics, power and interests is shown to be highly relevant to the understanding of Rift Valley fever, Ebola and Lassa fever as well as trypanosomiasis disease dynamics. These diseases are discussed across a number of papers in this issue in Kenya, Sierra Leone and Zimbabwe. Placing such a political analysis at the heart of One Health uncovers different pathways for response, linked to different visions for development. Issues of health and disease are intimately connected to questions of poverty, inequality, gender relations and ethnicity. We must question who gains and who loses from development. Power and politics simply cannot be ignored if One Health is to contribute in a changing world.

Combining perspectives: new approaches to modelling

Understanding complex, interconnected systems across scales is incredibly difficult, yet is essential in addressing One Health challenges. Such understandings may emerge from different sources, pitched at different scales, and with different types of data. Scoones and colleagues (2017) make the case that conversations between different perspectives – represented as 'models' or ways of understanding the world – can enhance understandings and, in turn, policy and practice. The aim is not to construct an all-encompassing model, with every dimensions covered; instead, the authors argue, a more effective approach is to encourage interactions between three types of modelling practice. These comprise process-based models, that attempt to capture the underlying biological processes of disease dynamics, usually through mathematical abstractions; pattern-based models that explore spatial and temporal patterns of disease drivers and use statistical methods to generate models of risks and impacts; and participatory models, generated through interactions with local people, locating understandings in situated knowledge about landscapes, diseases and differentiated consequences.

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Inevitably, no model is ever 'correct', a perfect representation of reality; all offer perspectives from different standpoints, constrained by their methods, data and structures. Different models also emerge from different disciplinary and institutional settings; each has in this sense a social and political life (Leach and Scoones 2013). Encouraging a conversation between modelling approaches can shine light on a problem from different directions, and allow for strategic integration. This may include, for example, adding a spatial dimension to a process-based disease model, through macro-ecological approaches, drawing on diverse databases, as Redding and Jones (2017) illustrate for Rift Valley fever in a paper that highlights the power of modelling for asking searching questions about future patterns and impacts. Participatory modelling, engaging with local populations through a variety of methods, can challenge the structures and assumptions of quantitative models, testing, questioning and evaluating the effectiveness of results, as illustrated for Lassa fever and Ebola in the paper by Scoones and colleagues (2017).

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All this requires an approach to modelling with genuine engagement with field sites, and interactions with different colleagues from diverse disciplines. An example is the collaborative group systems modelling approach highlighted by Grace and colleagues (2017) from their work in Kenya. An open and transparent approach to modelling for One Health responses, it is argued, will result in greater robustness in policy responses, with less reliance on fragile and uncertain predictions from quantitative models that are often presented with more authority than is warranted (Leach and Scoones 2013).

Embracing uncertainty – and indeed ignorance - and avoiding closing down around narrowly-specified risk predictions, can enhance a more productive debate about alternatives (Stirling and Scoones 2009), allowing, as MacGregor and Waldman (2017) suggest, "a view from different worlds", and not just one. As Waltner-Toews (2017) argues in this Special Issue, when system complexity cannot be reduced to quantitative frameworks, complementary narrative approaches can be useful to uncover uncertainties and complexities, and explore complex processes of change. When narratives conflict or contradict, there is, in turn, space for what he calls "constructive conflict", and the opening up of debate in ways that singular, narrow approaches to modelling, when used on their own, fail to do.

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Collectively, the authors of this Special Issue argue that an effective One Health approach requires integration and collaboration, but not in ways that frequently homogenise and restrict. The full range of modelling styles should contribute – from the very focused, mathematical models to narrative and participatory approaches. The real challenge for One Health is to create the platforms to convene such conversations in ways that all styles of knowledge-making can contribute on equal terms, and so result in a solutions focus that generates action on the ground (Wood et al. 2012). Here, the political structures that often underlie zoonotic disease burden must also be challenged. This is all far from easy, as the experiences of cross-disciplinary collaborative projects in this field, including our own, always show[2]. Developing a basis of trust and understanding for collaborative work, and a language that allows both interaction and structural challenge, is a first important step among research teams, as it is in relation to field and policy work. Instrumental One Health approaches, based on forced disciplinary, sectoral or institutional marriages or limited, constraining methodologies, always fall short.

Changing policy and practice: what should be done?

Many policy priorities are thrown up by the papers in this Special Issue. They range from those focused on the drivers of disease emergence and spread, to those focused on social and poverty impacts, to those highlighting questions of knowledge and politics. All emphasise the importance of interdisciplinary working and integrating local understandings of disease dynamics and impacts as part of mobilising local community responses.

In terms of policy conclusions, Cunningham and colleagues (2017) focus on drivers, highlighting the importance of policy interventions around regulating the wildlife trade and the need to carry out appraisals of investments and development projects, in relation to environment-disease impacts. In addition, they advocate long-term, strategic surveillance to gain insights into directions of change in key drivers. Other papers (e.g. Cleaveland et al. 2017 and Grace et al. 2017) emphasise the importance of focusing on links to poverty, and the importance of systemic preventive approaches, particularly when considering multiple, endemic neglected diseases together, as an alternative to a policy emphasis on technical interventions for individual disease diagnosis and treatment (Jephcott et al. 2017). Detailed understandings of local disease-human-ecosystem dynamics can offer innovative entry points, including a focus on agricultural pest control to address Lassa Fever transmission and more finely-tuned targeting, such as a focus on particular landscape patches and vulnerable groups in Trypanosomiasis control (Leach et al 2017). Other papers highlight the need to make the politics of One Health explicit when considering policy interventions, and emphasise the underlying structural vulnerabilities that cause disease burdens and impacts in the first place (Dzingirai et al. 2017). Asking "whose world" and "whose health" policy is aiming at focuses

[2] http://steps-centre.org/2016/blog/research-collaboration-for-global-challenges-why-its-really-hard/

attention on gender dynamics and wider social inequalities, as well as the cultural and social dimensions of disease response and health seeking behaviours (MacGregor and Waldman 2017).

Such responses, in turn, require changes in the way science and development are practised if a One Health approach is to gain traction in the real world, particularly in Africa. As Waltner-Toews (2017) argues in his provocative essay, conflict, contestation, dissent and debate must be at the heart of an effective One Health discussion; one that takes uncertainty and the politics of knowledge seriously. Bland, lowest common denominator collaboration is not enough. Conflict can and should be constructive, helping to open up debate, exposing controversy and shining light on difficult, challenging areas where politics and interests inevitably play out.

Drawing on interviews with a number of participants at the symposium on 'One Health for the Real World' held at the Zoological Society of London in 2016[3], Bardosh and colleagues (2017) draw out some of the take-home messages for policy and practice in the final paper in the collection. They argue for going beyond the easy rhetoric and simplistic hype of 'One Health' to ask searching questions about how expertise is deployed, and to seek ways of 'democratising' scientific practice. This may occur through more open modelling approaches, through participatory engagements in the field, and through subjecting analyses to wider scrutiny, accepting that all engagements of science with policy are political.

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Through strengthening the platforms for multi-sectoral coordination and interaction at local, national and international levels, and expanding One Health collaborations beyond a narrow group centred on a few northern institutions with a predominance of veterinarians (Galaz et al 2015), the paper argues for an approach that builds on what works, capitalising on informal collaborations that already exist, and focusing on upstream prevention where humans, animals and ecosystems intersect, an agenda widely shown to demonstrate significant returns to investment (Rushton et al 2012). Practical lesson learning and sharing, rather than high-flown policy proclamations, are seen as the way forward. And at the heart of a One Health in and for Africa in particular must be a focus on community engagement, where social difference, politics and interests and diverse perspectives and knowledges are put centre-stage.

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Figure 1: Real world contexts mean that different social groups, including children, live in close proximity to animals. (Photo: ILRI\Niels Teufel CC BY-NC-SA 2.0).

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