Does urbanization make emergence of zoonosis more likely? – Evidence, myths and gaps

Abstract

Rapid urbanization in the global South is adding epidemiological and nutritional challenges and additional disease and health burdens for citizens. Greater movement of people, animals, food and trade often provides favourable grounds for the emergence of infectious diseases, including zoonosis (diseases that have an animal origin). We conduct a rapid evidence scan to explore what is known and hypothesized about the links between urbanization and the emergence of zoonosis. The bulk of the literature reviewed points to rapid demographic growth, migration and density, increased movement of people and animals, and changes in land uses, as the main processes linked to the prevalence of zoonosis in the urban global South. Yet, we argue that emerging global health challenges like this are deeply connected with the urbanization of poverty and socio-economic inequalities within cities. Thus, understanding and tackling the micro-level causal relationships between urbanization and zoonosis requires urgent attention to poor and inadequate living conditions, as well as to the wider socio-environmental transitions and structural drivers that produce and reproduce risk accumulation in urban settings, due to chronic public disinvestment on protective infrastructures and preventive measures.

Keywords: Urbanization, zoonosis, livestock, health hazards, risk accumulation, urban global South

1. Background and rationale

The publication of *Urban Health in Developing Countries* by Trudy Harpham and Marcel Tanner in 1995 triggered a new generation of scholarship acknowledging the crucial relationship between urbanization, poverty and health in the context of the global South (Harpham, 1997; Eckert and Kohler, 2014; Rocha et al, 2015, among many others). Into the 21st century, increasing urbanization and inequality coupled in some regions with political instability and humanitarian crises bring to the fore the urgent need to reappraise how urban health is understood and tackled as a global challenge. This has also been recognized by the inclusion of Sustainable Development Goal (SDG) 11, to ‘Make cities and human settlements inclusive, safe, resilient and sustainable.’ Part of the urban health agenda has to be a broader understanding of the risks of infectious diseases; as argued by Vojnovic et al. (2019), “growing global interconnections and the speed of travel have transformed the spread of (and
speed of spread of) infectious disease and related epidemic control.” (p. 7). The emergence and re-emergence of zoonotic diseases refers us to the multi-scalar and interrelated drivers that make cities both producers of health vulnerabilities and enablers of improved health. The aim of this paper is to examine what is known and assumed about such drivers and to identify what actual and potential explanations have been side-lined and therefore require greater attention from scholars and policy-makers.

Globally, the share of population living in urban areas has been rising rapidly since the second half of the last century: while 30% of the world’s population was urban in 1950, this share rose to 55% in 2018. By 2050, the urban share of the world’s population is projected to increase to 65%, with almost 90 percent of this growth taking place in Asia and Africa (UN DESA, 2018). Thus, it is not surprising that municipal governments across these regions are struggling to keep pace with the infrastructural improvements and protective measures required, while allocating resources more equitably across all social groups (Satterthwaite, 2010; WHO, 2010). These trends are compounded by unprecedented challenges in urban food security due to global changes in food production and consumption systems (Morgan, 2009). In many urban centers in developing countries (an expression more positively re-framed in the expression ‘the global South’), there is higher demand for meat, dairy products, and more highly processed foods (Delgado & Narrod, 2003; Tacoli, Bukhari & Fisher, 2013). These changing dietary practices have prompted the so-called ‘livestock revolution’ (Delgado et al, 1999). However, as argued by Sumberg and Thompson (2013) this ‘revolution’ has to be reconsidered in light of evolving perspectives and contemporary trends in livestock production and consumption. From 1980 to 2004, meat production doubled, and is set to double again by 2020 (Pearson et al., 2005; Grace, Kang’ethe & Waltner-Toews, 2012a; FAO, 2006). Demand for livestock products is predicted to double from 200 to 400 kilocalories per person in Sub-Saharan Africa and South Asia.
between 2000 and 2050 (Thornton, 2010; FAO, 2006). Traditional practices of domesticating animals that started approximately 10,000 years ago have been gradually replaced with intensive industrialised systems, particularly in Asia, Africa and South America (Thornton, 2010) and this is changing the way food systems work globally and in urban areas.

When compounded with rapid urban demographic growth, the above trends are bringing additional health challenges mainly to the urban poor, who increasingly face a quadruple disease burden, in terms of infectious and chronic diseases, mal- and over-nutrition (Roesel & Grace, 2014; Dominguez-Salas et al., 2016). Various studies in China, East and Southeast Asia and Africa recognise urbanisation drivers and consequent outcomes – such as environmental degradation linked to air and water pollution, higher population density, rural-urban migration, inadequate healthcare provision and changes in peri-urban land uses – as closely associated with many infectious and communicable diseases (Li et al., 2012; Bai et al., 2012; Goryakin, Rocco and Suhrcke, 2017). Many non-communicable diseases, mainly cardiovascular diseases, diabetes, cancers and chronic respiratory diseases are also strongly correlated with the above-mentioned trends as well as with nutritional transitions, unhealthy urban spaces due to air, water and industrial pollution and differential built environment configurations characterised by lack of green, walking and cycling spaces (Goryakin, Rocco & Suhrcke, 2017; Smit et al., 2016; Li et al., 2012; Bai et al., 2012).

With demographic and nutritional transitions occurring for various reasons, many regions are also experiencing encroachment of wilderness areas and rapid urban land cover expansion, at a rate that globally exceeds by three times the average rate at which national populations become urban (McGranahan & Satterthwaite, 2014). Intense movements of people and foodstuffs, including animal products, are rapidly changing environmental conditions and also generating favourable grounds for the (re)emergence of infectious disease vectors with increasing epidemiological complexities.
These changes suggest the need to critically examine the link between the forces underpinning rapid urban growth and the emergence of zoonotic diseases. Zoonotic diseases are “transmitted via food products such as meat and dairy products and other animal products, water and waste” (Schelling et al., 2007, p. 346). In fact, it is claimed that most infectious food-borne diseases are zoonotic in nature (Jouve et al., 2010). Out of more than 1,400 human pathogens reviewed by Taylor, Latham, & Woolhouse (2001) and Woolhouse & Gowtage-Sequeria (2005), more than half are considered zoonotic. Some zoonoses are called emerging and re-emerging due to their higher incidence in the last two decades with increasing geographical coverage and the potential to spread more frequently in the near future. The World Health Organization (WHO) estimates that 61 percent of all human diseases are zoonotic in origin, while 75 percent of new diseases discovered in the last decade are zoonotic. A recent study claims that 26% of the infectious disease burden (measured in terms of disability-adjusted life years [DALYs]) in developing countries arise from zoonoses, compared with a mere 0.7% in developed nations. However, the first figure is likely to be an underestimation, due to heavy under-reporting and misdiagnosis (Grace, Mutua & Ochungo, 2012c). According to Havelaar et. al. (2015), diarrhoeal diseases are amongst the most common diseases in the developing world, half of which have zoonotic origins. Yet, there is no particular study that examines the key drivers underpinning the relation between what drives urbanisation (which can be understood both as increases in the share of the urban population of a country, and as the physical expansion of cities) and zoonosis in the urban global South.

We have looked into peer-reviewed scholarship to explore what drivers of urbanisation are predominantly hypothesised and are related to the increased prevalence of selected zoonosis in urban centers. In the next section, we explain the methods adopted for our evidence scan review. In the third section, we examine the dominant knowledge narratives that emerge from
the selected peer-reviewed scholarship. Finally, we critically reflect on these findings and explore neglected narratives and drivers that require more attention in future research.

2. Methodology

The study underpinning this article focused primarily on scanning scholarly evidence and narratives on major food-borne and livestock-borne direct zoonosis that are emerging or re-emerging in the urban global South. The sources reviewed include research articles and empirical reports, including grey material. Upon consulting epidemiologists, we initially searched research databases such as PubMed, Google Scholar, Scirus and Scopus using keywords6 (see wordcloud made out of these keywords in Figure 1). Upon scanning some of the key literature, a further search for particular zoonosis-specific evidence was made, both by using keywords and by manual searching that included back-tracking and citation tracking of related articles/reports/books. The following inclusion criteria were used: studies had to be primary research or reviews; published in peer-reviewed outlets; readily available online, in print or from relevant organisations; available in English in their abstract, journal article, or report form; address the key question behind this scan; and situated in the context of the urban global South. The websites of relevant institutes or international agencies were also explored for reports, data, policies and evidence (Figure 1).

[Insert Figure 1 here]

3. Urbanization, health and zoonosis: Evidence and assumptions

In a 2005 systematic review, Woolhouse and Gowtage-Sequeria found that changes in land use or agricultural practices were the primary driver in the emergence or re-emergence of zoonotic diseases. Other important drivers included: demographic change, poor population health, pathogen evolution, contamination of food and water, international travel and trade,
failure of public health programmes and climate change. However, the authors did not look into whether the reviewed trends and correlations differed between urban and rural areas. A more recent study by Mackenstedt et al (2015) argues that “[t]he role of potential hosts for transmission of a zoonotic disease in urban or peri-urban areas cannot be extrapolated from data obtained in rural areas” (p. 71). Allen et al. (2017) argue that our understanding of the demographic, environmental and locational factors underlying the emergence of zoonoses remains rudimentary. What follows from these observations is that the multiple drivers underpinning the transmission of zoonotic pathogens in urban areas are still poorly understood, particularly in the urban global South.

In the following sub-sections we examine the dominant narratives found through the bulk of the scholarship reviewed concerning what is known, hypothesised or assumed about the role of rapid urban growth as a driver behind the emergence, incidence and persistence of zoonotic diseases in the urban global South.

3.1 ‘Urban advantage’ as a myth. The belief that health conditions are better in urban than rural areas due to faster economic growth is often misguided, due to the over-emphasis on city-scale aggregate data that tends to disguise intra-city differences among groups of urban dwellers (Rydin et al., 2012). In reality, the so called ‘urban advantage’ that cities can offer residents and recent migrants due to their higher concentration of health services and income-earning opportunities can turn into an ‘urban penalty’ for certain socio-economic groups, particularly in the urban global South. For instance, when the availability of data allows singling-out groups of low-income residents, it has been shown that the incidence of both disability or morbidity arising from malnutrition, and of child mortality due to respiratory and waterborne illness through faecal-oral routes, tend to be higher in some urban neighbourhoods areas than in rural
areas (Moore et al., 2003). A key factor in helping reduce this ‘urban penalty’, by improving health conditions and reducing the gap between wealthier and poorer areas in cities is the availability of reliable basic infrastructure services (clean water, sanitation, well-maintained roads), health services and education, for which local governments often have responsibility (Sverdlik, 2011).

3.2 Intra-city socio-environmental inequalities: As mentioned above, the so-called ‘urban advantage’ is not always experienced by many people in the urban global South, primarily those who are poor and living in poor conditions. This is especially pronounced in many African cities, where a high proportion of the urban population lives in slums or informal settlements – with shares in countries like Sudan and Central African Republic reaching as much as 94% (UN-Habitat, 2010). High socio-economic disparities can also be seen in inadequate access to basic infrastructure services by large proportions of the population; for example, in 2015 two-thirds of the urban population in the least developed countries lacked access to water piped on premises and 53% lacked access to ‘improved’ sanitation (Satterthwaite, 2016).

Unsafe water and inadequate sanitation are two of the prime reasons for the high prevalence of diarrhoeal diseases in cities (Alirol et al., 2011). Open drainage and proximity to refuse dumping sites are often problems for poorer communities, resulting in higher prevalence of rodent and parasite-borne diseases. For instance, there is significant household clustering of the *Leptospira* infection in the slums of Salvador, Brazil and Tamil Nadu, India. This is claimed to be due to increased exposure to sources of environmental contamination such as the presence of open sewers (Maciel et al., 2008; Sarkar et al., 2002), particularly in flood-risk areas and areas near refuse dumps (Reis et al., 2008). Similar drivers are also mentioned for Patna, India (Patel et al., 2009) and for Banda slum, Uganda (Dimoulas et al., 2008). Katukiza et al. (2014) looked into the magnitude of microbial presence through different exposure pathways by which
waterborne disease may occur in Bwaise III informal settlement in Kampala, Uganda. Surface water open drainage channels and grey water hold a much higher pathogen burden (24-39%), while tap water holds a very low percentage (0.02%). The authors estimate that the exposure caused by different bacteria and viruses cost the population in Bwaise III around 680 disability-adjusted life years (DALYs) per 1,000 persons per year (much higher than the WHO reference level of tolerable risk measured in DALYs), with *E. coli* O157:H7 causing the highest share of the mean estimated infections, followed by *Rotavirus* and *Salmonella*.

3.3 *Rural-to-urban migration*: It is also argued that high rural-to-urban migration can increase the risk of zoonoses. According to Alirol et al. (2011), this can arise in three ways:

- Rural migrants bring pathogens with them with roots in rural-wildlife interfaces or through interaction with rural livestock.
- If they are already infected before settling in a city, migrants expose the existing urban populace to diseases (e.g. in Kinshasa, Democratic Republic of Congo, migrants are believed to be responsible for increasing ten-fold the incidence of African Trypanosomiasis).
- Migrants themselves can fall victim of endemic diseases common to places they move in, as reported in Kabul, Afghanistan, where the presence of migrants contributed to the re-emergence of Leishmaniasis (a non food-borne zoonotic disease) that was dormant amongst local people who were immune to it (Reyburn et al., 2003).

Apart from such risk assumptions attached to migration, high rural-to-urban and circular migration can lead to more intensified urban-rural linkages (Tacoli, 1998; Allen et al, 2015), which can potentially result into more diverse and intense contact with animals. Animals brought to cities through rural-urban migration may have a key role in sparking outbreaks or seeding new genetic strains from rural spaces in high density urban settings.
3.4 Industrialisation and trade of animal and animal-centred food products. Several scholars point to increased movement of people, animals and animal-centred food products at multiple scales. With rapid nutritional transitions across many cities in the global South, there is an increased demand for animal products thus intensifying the trade and transport of live animals and animal products within cities and across national borders. This has ramifications for industrial-scale animal production near or within cities – particularly in the case of monogastric species, such as poultry and pigs, due to their ease of intensification and higher reproduction rates, which in turn enable increased rates of animal-to-human contact along high traffic corridors (Alarcón, Fève, Murungi et al., 2017). This emerging nexus in some major cities and termed ‘peri-urbanisation of industrial animal agriculture’, has the potential to be a major entry point and transmission route for zoonoses (Leach and Scoones, 2013; Slingenbergh et al., 2004). International value chains also have a role to play, as shown from the outbreak of Avian Influenza in South-East Asia in 2004 that was identified to have started in Lhasa, Tibet, when 5,000 live chickens were being transported to Lanzhou, China, some 1,600 kilometres away (FAO, 2007). Similarly, Rift Valley Fever (RVF) was introduced to Yemen when infected animals in large numbers were traded from the RVF-endemic Horn of Africa (Abdo-Salem et al., 2011). Even though, and due to a number of factors that tend to reinforce each other, poor people are more prone to being victims of diseases that stem and propagate from such movements, these can also spread to other groups in the city. Intensive farming, trade, transport and complex value chains within cities add to the complexity of the problem. In 2006/7, disease outbreaks were reported in 29 out of 69 districts in Kenya, mostly concentrated in Garissa, Baringo and Kilifi. In Baringo, animal-to-human transmission can be linked to zoonosis, since most of the human cases occurred close to livestock (Munyua et al., 2010). Increased urban demand for food creates a high degree of cross-over between formal and informal food systems.
(Kiambi et al, 2018), resulting in disease risks to all members of the population regardless of their socio-economic grouping. Despite increased urban food supply, the poor have less choice in their food sourcing and are at greatest risk of disease (Alarcón et al, 2017).

3.5 Land use changes. As mentioned earlier, Woolhouse and Gowtage-Sequeria (2005) considered changes in land-use and agricultural practices to be the main drivers behind the emergence of 177 human pathogens. Most urban centres across the global South experience unplanned and uncontrolled urban growth due to the absence of land-use planning and strategic planning frameworks, or due to the inability to adhere to them, resulting from vested interests (Satterthwaite, 2010; UN-Habitat, 2009). Lack of planning and adequate management in converting agricultural and other non-urban land to urban use (Dewan and Yamaguchi, 2009) has several negative externalities. Firstly, building on flood-prone land that has been drained disturbs the ecosystem resulting in, for example, prolonged water-logging after heavy rainfall, which heightens the risk of water-borne infectious diseases. Secondly, encroachment by agricultural and urban land uses on the natural ecosystem and wildlife will expose humans and their domestic animals to areas with higher risks and a wider range of vectors. For example, habitat destruction and fragmentation brought fruit bats closer to humans and domestic animals, causing outbreaks of Nipah virus infection (Alirol et al., 2011). Based on a recent systematic (1973–2010) and historical (1788–1973) review of infectious disease literature of humans and animals, McFarlane, Sleigh & McMichael (2013) found that 22% of the systematically reviewed emerging infectious diseases are associated with land use and land cover change. Most frequently, natural landscapes have been removed or replaced with agriculture, plantations, livestock or urban development. Historical clustering of vector-borne, zoonotic and environmental disease emergence also follows major periods of extensive land clearing (ibid.). Recent research on the links between land-use and anti-microbial resistance (AMR)\(^7\) in E. coli
in Nairobi offers novel insights into the issue. There is an ecological gradation in patterns of land-use in Nairobi, with wealthier and less densely populated neighbourhoods tending to be more ecologically diverse than poorer, more densely populated areas. The data show that there is also a gradation in AMR along this axis too: while there is more diversity of AMR genes but less virulence in the highly dense populations, there is less AMR diversity but more virulence in the more ecologically diverse, richer neighbourhoods (Hassell et al., forthcoming 2019a and forthcoming 2019b).

4. Reflection on the evidence scan: Focus on marginal narratives

Following the previous section, the most often cited urbanization drivers in relation to zoonoses can be summarised as: urbanisation in the form of rapid urban growth and increased density of land occupation, heightened movement of people, animal and animal-sourced products, rural-to-urban migration, intra-city inequalities and changes in land-use. Yet, in the following sub-sections we argue that misconceptions around urbanization can lead to simplification, which can miss the bigger picture. We discuss the more marginalised narratives, or evidence and arguments that have received limited or no attention in the zoonoses and urbanisation scholarship.

4.1 Interaction of zoonosis with urbanisation drivers is a ‘wicked problem’ operating in a complex system. Zoonosis itself is a ‘complex problem’, as the many drivers that are likely to influence the emergence, persistence and/or prevalence of zoonotic diseases are interconnected, ingrained with multi-level multi-scalar complexity. In most of the studies reviewed, scholars recognise zoonoses as a complex problem but then base their analysis mostly on quantitative probabilistic models which in turn restricts presentation of results, outcomes and likelihoods to embrace the full complexity and diversity of conditions in which urbanization and zoonoses are interrelated (Leach, Scoones & Stirling, 2010a). Also common in the literature are references
to the control and prevention of zoonoses as a ‘wicked problem’, meaning that we lack both a clear definition of the problem and of the solution (van Woezik et al., 2016, p.2). We looked into a few studies that explored the relation of urbanisation drivers to non-communicable diseases, where scholars in general recognised that many of these drivers are crosscutting and could be placed in a continuum. This highlights that “pathways through which urbanisation affects health are complicated and multifactorial” (Bai et al., 2012, p.438), as interactions of humans with their urban environments are ‘multi-faceted, diverse, dynamic, complex and evolving’ (op.cit., p. 465). Drawing on Gatrell’s take on salient features of complex systems for health (Gatrell, 2005, p. 2662), we can gather that the relations of urbanization or city life have many features reminiscent of classic complex systems. But Gatrell’s notion of complex system is different from the classic system-based approach, as he emphasises explanation and understanding rather than prediction and control (see Gatrell, 2005)). Use of such a lens allows for a critical reading and understanding of the wider context, which is not reductionist or positivist in nature, nor is it a simple, linear system-based approach. This should essentially be the case for zoonoses, given its reliance on complex urban transitions and the food-animal-human-environment nexus. For zoonoses, risk of disease emergence is also ‘emergent’ and ‘uncertain’ (e.g. meat handling behaviour, and practices at slaughter houses and by consumers). Those uncertainties yet are mostly treated as individual behaviours, ignoring system-wide implications that explain why they cannot be ‘summed’ or ‘averaged’ to know or predict system-wide behaviour. Similarly, collective health outcomes of a neighbourhood cannot be summed up from individual outcomes, missing the importance of spatio-temporal multi-scale interactions within the food-animal-human-environment nexus. Again, such complex systems with non-linear feedback loops can have butterfly effects; such as when a ‘blip’ of pathogen overload can lead to disease outbreak with differential implications to different people. This means that hard to diagnose diseases like those of zoonotic origin are more likely to pose higher
risks to those living in informal settlements. Many of these settlements host systemic pathogenic environments manifested in ubiquitous higher endemic multiple disease burdens and poorer health profiles when compared with the rest of the city, making them perfect breeding grounds for zoonoses and other infectious disease outbreaks. Yet, we are not learning much from the horrific lessons of the Ebola epidemic in West Africa, and the risk of infection for the poorer communities by many other zoonoses remains significantly neglected in the context of the urban global South.

4.2 A techno-scientific approach dominates knowledge production and policy narratives. The majority of studies reviewed in this particular field rely on realist or techno-scientific (statistical or modelling) approaches for knowledge generation and focus on particular zoonotic diseases. This in turn often leads to certain knowledge generation pathways that can only produce apolitical knowledge outcomes; those that can be measured independently of wider socio-economic processes. Hence, it is reasonable to conclude that the literature and evidence we looked into often ignores underlying social-economic and environmental forces associated with urbanisation in the global South. With a few exceptions (see for example Leach, Scoones and Stirling, 2010b; Stirling & Scoones, 2009 and a special issue in the Philosophical Transactions of the Royal Society B edited by Cunningham, Scoones & Wood, 2017), over-reliance on a scientific apolitical view to issues or propositions behind zoonotic emergence for policy narrative generation can be problematic. As highlighted by Craddock and Hinchliffe: “Who gets sick and where, are not simply ecological or demographic outcomes. Often forces of a political and economic nature create disease, and more crucially, determine the manner of its management and control. Development interventions can displace people to marginal places, making them vulnerable to disease.” (Craddock and Hinchliffe, 2015, p.2). Much of the outbreak narratives driven by scholarship situated from the global North, often focus on the consequences and not causes of ill-health. Neglected causes are in many cases political and
economic factors that generate the accumulation of disease risk and vulnerabilities. These factors are often linked to historical patterns of underdevelopment, and hence perpetuate poorer health outcomes for the urban poor. The recent Ebola outbreak in the Sierra Leone-Liberia-Guinea border region is a good example to manifest the importance of political economy perspectives in understanding the drivers of health risk accumulation (as put by Dzingirai et al. (2017):

“[Post-colonial] development pathways have fostered inequality and failed to address corruption or elite capture of resources, combined with a systematic under-investment in state institutions precluding the establishment of resilient health systems, livelihoods and living conditions… [Even] before Ebola, many people decided against formal healthcare facilities, favouring instead traditional healers and informal vendors with their more personal approach and pluralistic understandings of disease and therapy… [A] mix of conflict and limited opportunities in rural agriculture has seen the capitals of Liberia and Sierra Leone grow rapidly. Poorly planned, with limited sanitation and lacking essential services, these dense urban areas proved fertile ground for the virus… [Neglected] health services combined with growing gaps between the elites and governments who followed non-inclusive development strategies, and the rural and urban poor whose trust and livelihoods are undermined by them, has compromised responses to outbreaks… [Rumours] that Ebola was manufactured to make money, or kill people, provoked widespread fear, violence and avoidance. The plausibility of these rumours is rooted in people’s experiences of acutely unequal and deadly political economics, from slavery to modern day corruption, where extraordinary wealth has been generated for some at the expense of others” (pp.4-5).

Similar long-term conditions or events, such as war and previous or historical conflicts and the continuity of colonial legacies affect the right to health of a vast majority of urban dwellers. Africa has been the epicentre of over 100 armed conflicts between 1989 and 2000,
with an estimated 40 million people displaced during this period becoming vulnerable to deadly diseases such as *Ebola virus* and *Meningitis* (Wallensteen & Sollenberg, 2001).

### 4.3 Informality or informal and cultural practices are often blamed as a prime driver of zoonoses.

Informality as a driver of the (re-)emergence of zoonoses has been seldom explored in health scholarship, yet it is common among policy makers to blame and condemn informal practices, for instance, through the decommissioning of livestock and products in informal settlements and markets. We found a few cases that shed light on informal markets selling animal-sourced foods or products, the domestic practices adopted and subsequent health outcomes (Alarcón et al, 2017). Informal practices of live/wet markets for cattle and poultry, are deeply linked with meat processing industries in many cities of the global South. Many livestock products are sold in informal markets, where food safety regulations are poorly implemented, with traditional processing and retailing practices dominating over official guidelines and standards; sufficient infrastructure services (roads, water, sanitation) and storage (refrigeration) options are lacking, while not much assistance from the State or the non-governmental sector is available (Grace et al., 2012a, 2012b; Roesel & Grace, 2014). Many of these informal markets are also highly varied in nature, yet self-organised as a complex system with complex systems of governance and control. The dominant narrative amongst city regulators and policy makers is that these are places of high risk to exposure to zoonotic diseases, and with low food quality due to the aforementioned reasons and conditions. For example, moderate to high prevalence of *Campylobacteriosis* was identified in Morogor, Tanzania, affecting both human and poultry; an intensive production system with poor hygiene and management practices were argued to be responsible (Mdegela, Nonga, Ngowi, & Kazwala, 2006). Yet, studies showed that in East Africa, Northeast India and Vietnam, “food sold in formal markets, though commonly perceived to be safer, may have lower compliance with standards than informally marketed food” (Grace, 2014, p.2. While draconian measures are
often enforced to govern the system, policy makers and city managers often overlook the fact that informal markets are and will remain the main source of animal-sourced food in Africa and Asia. Furthermore, they offer cheaper, fresh, local produce from local breeds, and provide lifelines to local communities that are tightly linked with such small enterprises- simply based on trust, credit and other social network services (Roesel & Grace, 2014). Likewise, although the hazard of contaminated meat and milk exists from pathogens like E. coli, Salmonella and Cryptosporidium (Grace et al, 2008a,b), perceptions of zoonotic risk are often misguided. For example, some studies in the settlement of Dagoretti in Nairobi (Kenya) found that eating vegetables was riskier for Cryptosporidium than consuming meats and milks (Kangethe, et al., 2012; McDermott, et al., 2012). Consequently, out of fear or misconceptions, top down campaigns against the wrong targets often adopted during disease outbreaks, drive consumers to stop buying products from the informal traders, which in turn put the livelihoods of these marginalised small enterprises under serious threat (Grace et al., 2012a, b; Roesel & Grace, 2014; Ahmed et al., 2015; Muloi, 2018).

Dominant traditional or cultural practices like consumption of raw milk, closer contact with animals near food production and consumption areas and poor food hygiene are often considered responsible for any zoonotic disease prevalence. But the presence of high exposure does not always result in hazards; for example, Grace (2014) argues that it is often ignored that “in Urban East Africa… almost all consumers boil their milk before drinking it, the presence of germs in milk presents little risk.” (p.2). Furthermore, human mobility patterns within urban centers and across urban and rural areas determine divergent epidemic dynamics and pathways (Dalzieli et al. 2013).

4.4 Most practices and disease prevalence evidence are often understood as being gender neutral
Scholarship examining zoonotic diseases from a gender perspective is still rare. This requires adopting a more critical lens to understand women and men’s roles, rights (access to and control of resources), division of labour, interests and needs, and particularly how gender roles affect exposure to hazards, as well as the capacity to reduce, prevent and manage risk (Grace, Roesel & Kabui, 2015). Yet, we found a few exceptions in recent scholarship. In a study in Nairobi, Kenya, significant gender differences were observed for cases with Cryptosporidiosis (Kangethe, et al., 2012; McDermott, et al., 2012; Kimani et al., 2012). Along with farm workers, women at home are more exposed to certain pathogens due to handling of raw milk and cattle caring, but are also more knowledgeable about Cryptosporidiosis and risk mitigation practices than men, irrespective of socio-economic differences (Kangethe, et al., 2012, McDermott, et al., 2012). In another study in Ibadan, Nigeria, gender differences came out as a significant marker for improved food safety practices, as butchers’ associations with more women had better safety practices, better quality of meat, and less gastro-intestinal illness amongst consumers (Grace, 2014, p.3; Roesel and Grace, 2014). Similarly, the majority of informal vendors selling ready-to-eat chicken and its by-products in Tshwane, South Africa are found to be women who follow good basic hygiene practices, yet the environments in which they operate, were found to be the primary sources of contamination affecting their food. The same applies to the marketing of camel milk in Nairobi (Muloi et al., 2018). Being located in open areas near drains, roads, prone to have exposure to flooding and dust, dirty water source, rat infestation and so on means faecal and environmental contaminants like E.coli and coliform are likely to find their way through the food chain (Oguttu et al., 2015). Yet, female vendors often adopt effective strategies to mitigate microbial risks associated with their products, for instance by preparing ready-to-eat chicken in small amounts at any given time. Such practice reduces the amount of left-over that need storage or to be carried over for sale on the following day (ibid.). Also, Grace found that differential access to food has been linked to a higher exposure
to food-borne disease in Ibadan, Nigeria, where women are more likely to consume Offal while men enjoy better access to high value muscle meat (Grace et al., 2012d).

4.5 The role of urban planning in disease prevention and mitigation has received scant attention. Although urban planners and public health officials worked together mainly in the 19th and early 20th centuries to defeat infectious diseases in the rapidly changing but unsafe living conditions in US and European cities, we have seldom witnessed similar concerted efforts across much of the urban global South. Beyond discriminatory approaches such as the colonial segregation acts to separate communities from white colonial settlers or administrators on public health grounds (Njoh, 2012), more recent and positive action has largely been limited to the Healthy Cities Movement. Initiated by Trevor Hancock and Leonard Dahl in 1991, the Healthy Cities project was unable to mainstream a health perspective sufficiently into city planning, due to the inadequate financial and institutional impetus behind such an approach (Corburn, 2009; Harpham, Burton, & Blue, 2001). Moreover, where they exist, current global public health and planning discourses, are essentially aligned to non-communicable diseases like respiratory and obesity-related diseases, and thus mostly seek to align planning, urban form and design principles that tend to advise more active and green spaces, cycling networks, and so on (for examples on city planning processes and human health impacts, see table 3.2 in Corburn, 2013, p.71). Infectious diseases, particularly zoonoses, have only rarely been the focus of similar efforts mainstreamed into urban planning and design discourses.

Public health policy and practices are often disconnected from urban planning and development efforts, which allows narratives on the history of settlement formation and inequality, migration, city form and spatial segregation to be overlooked. Thus, historically entrenched differential access to resources or ‘deep distribution’ (as described by Levy, 2013) may have a significant role in creating disease outbreak tipping points through a ‘mutually reinforcing
nexus’; i.e. continued existence of public disinvestment leading to the continued decay of social and physical capital and health-enabling elements, particularly within poorer marginalised communities (Wallace & Wallace, 1997, p.798). Interaction and movements of animals, goods and people that often rely on past behaviour and social networks can also be affected by the ‘lock-in’ effects of mega-transport projects (Watson, 2014) that significantly alter agricultural and natural habitats.

For instance, in Nairobi, Kenya’s capital, we found that one of the current drives to make the city ‘world class’ and thus more attractive to foreign investors is to introduce modern bypasses and highways to decongest the city and connect the central business district with suburban middle- and high-income residential areas, but rarely catering for the needs of the majority who do not have access to private cars and depend instead on the provision of public transport that seldom uses such infrastructure and is starved of public investment. Coffee farms and other agricultural lands are being converted to residential and commercial land uses along the north and western road corridors, altering the local livelihood base while land grabbing and speculation artificially heightens land values. According to local stakeholders’ experience and perceptions, urban agriculture, particularly livestock keeping in Nairobi and its periphery, is unable to sustain such disproportionate increases in land value; land owners thus opt for utility-maximising behaviour in the form of multi-storey buildings with large tracks of agricultural lands accommodating Nairobi’s ‘push out’ urbanisation drives. Livestock keeping survives – in decreasing plot sizes as increasing valuable land is sub-divided and sold to more profitable ventures – by shifting to zero-grazed forms e.g. poultry. In consequence, livestock and their material flows (i.e. meat, dairy and poultry) tends to move further away from Nairobi (Ahmed and Davila, 2016, p.53).

5. Concluding remarks: From wicked problems to transformative knowledge
From the evidence scan, the direct or indirect role of urbanisation drivers in relation to zoonotic diseases can be said to arise from rapid urban growth and increased density of human occupation, increased movement of people, animals and complexity in the value chains around animal-sourced products, rural-to-urban migration, intra-city inequalities and land-use changes. Yet, we find that epistemological biases can miss other locally grounded drivers at play. This is because most of the peer-reviewed studies included here were heavily reliant on technoscientific realist models that often determine disease outcomes based on individualist determinants, side-lining ‘upstream’ factors like wider structural socio-economic issues, urban planning issues like the lock-in factor of development (e.g. introduction of highways and housing in rural or peri-urban agricultural areas and water bodies that are irreversibly converted to urban uses) and poor living conditions in certain places partly due to low productivity levels, lack of public investment and social inequalities. Besides, insufficient allowance for informality and local, culturally-embedded practices within the scholarship allows for a perpetuation of perceived risk to dictate politically-defined dominant local policy narratives around the risks underpinning such diseases. As discussed earlier, studies reveal that perceived risks are not always in line with the evidence. For example, rearing chickens is not responsible for diarrhoea in Kampala, and similarly in some contexts, eating vegetables might carry more risks than eating dairy products from the same systems, as reported by Grace, Kangethe & Waltner-Toews (2012a), Dimoulas et al. (2008) and Alarcón et al. (2017). Many knee-jerk reactions from national or local policy makers in favour of large-scale formal enterprises while seeking to limit the action of smaller informal ones are mostly based on a global narrative that associates unsafe food with informal markets. However, such assumptions are rarely locally contextualised, grounded or tested for evidence; in other words, they are mostly based on a ‘matter of concern’ instead of a ‘matter of evidence’ (Grace, 2014).
As health and equity become substantive issues in the post-2015 development agenda (Ruano et al., 2014), we need to use the transition platform offered by the Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs) not only to recognise the right to health as part of an holistic agenda (beyond health care access for all), but also as an equitably healthy social and physical environment for all, that protects marginalised communities more than others (Ooms et al., 2013). With more people living in urban areas than ever before, the goal of pursuing socially and environmentally just urban development (one that aims for social justice and equity, while improving human well-being and keeping environmental integrity) is becoming increasingly complex.

**Figure 1: Methodology followed in reviewing the literature**

**References:**


**Endnotes:**

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2 The term ‘zoonosis’ was coined by Rudolph Virchow in 1855 to describe diseases transmitted between vertebrate animals and humans (Greger, 2007; Taylor, Latham & Woolhouse, 2001; Woolhouse & Gowtage-Sequeria, 2005).

3 The term ‘emerging’ includes not only newly appearing zoonotic diseases but also those that are spreading to new territories. Re-emerging diseases are those that appear in significantly more virulent forms after a decline or after a long period of low incidence (Alemayehu, 2012; Pearson et al., 2005).

4 DALY or Disability-adjusted life years, is a well-known indicator to calculate the burden placed by disease upon a given population.

5 According to Prasad et al. (2015), fever-causing zoonoses such as brucellosis and trypanosomiasis are often wrongly attributed to malaria.

6 Urban, peri-urban, urbanisation, urban growth, urban planning, urban development, city, urbanicity, urban health, well-being, urban poverty, slums, informal settlements, vulnerability, contact networks, social networks, social determinants, environmental determinants, drivers, spatial, linkages, exposure, socio-economic, environment, physical environment, built environment, Environmental health, living conditions, disease emergence, re-emergence, infectious diseases, zoonotic diseases, zoonoses, human-animal interface, land-use, disease burden, livestock, food, agriculture, risk.

7 Anti-microbial resistance is the ability of a microbe to resist the effects of a drug that once might have successfully treat the microbe. This is a growing problem around the world, partly linked to increased and indiscriminate consumption of antibiotics.