



Livestock form an integral part of people's livelihoods, particularly in rural areas of the developing world. Tiziana Lembo. University of Glasgow.

Invisible and ignored: lifting the lid on the problems of endemic zoonoses

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Worldwide the lives of billions of people are affected by zoonoses – diseases transmitted from animals. These diseases have the greatest impacts in developing countries, but are poorly recognised and largely ignored as human health problems. Improved clinical management of human cases and preventive interventions targeted at animal populations have the potential to achieve major improvements for both human health and livelihoods.

Humankind has long depended on animals for their livelihoods, nutrition, trade and protection.

The relationships between people and animals are multi-faceted, but on balance, these interactions are overwhelmingly positive. Unfortunately, the close association of humans and animals also provides opportunities for the transmission of zoonoses, which account for two-thirds of all human infectious diseases.

The animal sources of zoonoses are varied, and include the companion animals in our homes, the rats in our sewers, the livestock that feed us, and the wild animals that enrich our natural world. The zoonotic pathogens that attract media attention are normally those that are described as emerging and raise concern of global spread. These include, for example, Ebola virus, Middle East respiratory syndrome (MERS) and severe acute respiratory syndrome (SARS) coronaviruses, and highly pathogenic influenza viruses. In contrast, there is surprisingly little awareness of the considerable burden which endemic zoonoses impose day in, day out.

Although endemic zoonoses occur worldwide, they are particularly problematic in the developing world, where hundreds of millions of people live in close contact with animals and where animal disease control strategies are often insufficient. In contrast to the zoonoses with pandemic potential that receive the greatest global attention, many less visible endemic zoonoses, such as rabies, leptospirosis, leishmaniasis, Japanese encephalitis and human African trypanosomiasis, exert a much higher global death toll. Many others, including cysticercosis, echinococcosis and brucellosis are



Small stock are an important livestock resource for women in traditional livestock-keeping systems in rural Africa. Maasai woman tending to a flock of goats in Tanzania. Tiziana Lembo. University of Glasgow.

highly debilitating diseases that cause prolonged suffering and disability.

The invisibility of zoonoses

Why are endemic zoonoses invisible? Very few zoonoses have distinctive diagnostic signs, making clinical diagnosis impossible for both human and animal infections. Non-specific symptoms and signs in humans, such as fever, fatigue, muscle pain, joint pain, malaise, lack of appetite, weight loss and generic neurological signs can be caused by a range of zoonoses. There

are currently insufficient diagnostic tests available to accurately and rapidly identify the cause of these non-specific clinical presentations. Furthermore, many zoonoses have complex ecology and epidemiology, which limits our ability to clearly observe and understand their infection dynamics. As a result, zoonoses suffer ongoing neglect in terms of training, research and surveillance efforts, and raising awareness.

There are also strong associations between zoonoses and poverty and the populations most afflicted by these

diseases are the same populations that have least voice. Poor people often lack political agency and are rarely able to mobilise resources or galvanise action to control these diseases. The diseases themselves are diagnostically challenging, particularly at more chronic stages of infections, which is when people from poor and remote communities are mostly likely to reach health facilities.

The multiple impacts of zoonoses

There is growing recognition of the impacts of zoonoses on both people and animals that extend beyond clinical disease to a wider socio-economic

context. An often overlooked feature of zoonoses is their effect on livelihoods, owing to the impacts they have on the health and productivity of the animals on which humans depend. Brucellosis and leptospirosis, for example, cause reductions in growth and milk yield, and also affect the fertility of livestock.

Only a limited number of studies have robustly quantified the multiple impacts of a given zoonosis. A recent study that estimated the global burden of endemic canine rabies is one of the few studies to have addressed these knowledge gaps. Considering the direct health impacts first, rabies is the most deadly viral disease, killing almost 100%



Raw animal products may be a source of exposure to zoonotic pathogens. Maasai woman milking a cow in northern Tanzania. Tiziana Lembo. University of Glasgow.

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of people affected. The vast majority of human rabies deaths, around 59,000 per year, result from dog-transmitted rabies in Asia and Africa. A similar death toll has been estimated for human leptospirosis, with a particularly high incidence of cases in Oceania, South-east Asia, the Caribbean and East Africa.

Like many other zoonoses, rabies exerts substantial economic burdens. The estimated overall economic cost of canine rabies is ~8.6 billion US Dollars (USD) per year. Much of this cost (2.27 billion USD) arises from lost economic productivity – a result of the premature deaths caused by this disease. Following a bite by a suspect rabid animal, the administration of post-exposure prophylaxis (PEP) can save lives. However, direct global expenditure on PEP is approximately 1.7 billion USD, with a further 1.3 billion USD lost from the incomes of those travelling for multiple doses of PEP, which often has poor local availability.

We have the tools to control zoonoses

The wider value to controlling zoonoses is in the multiple health and wealth



Diseases of animal origin pose increased risks to human health in areas where people and animals live in close proximity. Pastoralist farmer herding cattle in Tanzania. Tiziana Lembo. University of Glasgow.

gains for both populations at risk and governments. The maximum benefits are realised when preventive strategies tackle the disease problem in animal reservoir populations, and so address the problem at the source. The tools exist to prevent animal infection with many zoonoses – vaccination and mass treatment approaches have been used successfully to control zoonoses in higher income countries.

Preventing human African trypanosomiasis by treating cattle can provide substantial benefits in terms of human lives and treatment costs saved, as well as improved livestock productivity. For rabies, investment in the control of disease in domestic dog populations – by mass vaccinations – saves human lives and can eliminate rabies as a human health problem entirely. This is very well illustrated by the situation in Latin America and the Caribbean, where dog vaccination programmes, regularly implemented since the 1980s, have reduced human deaths by >99%.

Conclusions – seek and you shall find

The relative impacts and importance of different zoonoses vary between different countries and regions. Communities that keep a range of animal species are vulnerable to different sets of pathogens. However, it is invariably the case that when efforts are made to quantify the prevalence and impacts of one or more zoonoses in communities with close human–animal associations, substantial disease burdens are revealed.

Many tools to control endemic zoonoses exist, and have been applied successfully in higher income countries. Unveiling the magnitude of the existing problem of endemic zoonoses is a crucial first step in increasing awareness about and action towards minimising the multiple impacts of these zoonoses. By revealing and adding up the true burdens of endemic zoonoses we strengthen the case for sustained efforts to reduce the global impacts of these zoonoses, on both humanitarian and economic grounds.

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Further reading

Hampson, K. & others (2015). Estimating the global burden of endemic canine rabies. *PLoS Negl Trop Dis* **9**, e0003709.

World Health Organization & Department for International Development (2006). *The control of neglected zoonotic diseases – a route to poverty alleviation*. Report of a joint WHO/DFID-Animal Health Programme meeting with the participation of FAO and OIE, Geneva 20 and 21 September 2005.