

Pigs, zoonoses and antimicrobial resistance in Kenya and Malawi

Author : Catherine Wilson

Categories : [Vets](#), [Welfare](#)

Date : January 9, 2017

One health is at the centre of the Zoonotic and Emerging Disease Group's (ZED) philosophy.



Pigs roaming around a homestead in Busia, western Kenya. Image: Eric Fèvre.

The multinational research team aims to discover more about zoonotic diseases that affect the health of humans, animals and domestic wildlife in some of the world's poor, but biodiverse, areas. In rural areas of developing countries, human and animal lives are often intertwined much more intimately than in parts of the western world, where increased urbanisation and industrialisation has led to intensification of farming and, therefore, segregated lifestyles of livestock and humans.

In sub-Saharan Africa, rural homesteads are often shared by both humans and livestock; animals may be free to roam wherever they please and farming systems are often low intensity. Standards of processing and hygiene of meat, milk, eggs and other animal products intended for human consumption are often very different to those we expect as routine in the UK. This provides a fertile breeding ground for many zoonotic diseases with plenty of opportunity for transmission between species.



Man leading a pig in Busia, western Kenya. Image: Eric Fèvre.

The one health concept is not a recent phenomenon – medical and veterinary professionals, and environmental researchers have been working together for many years. In the rapidly changing scientific world the definition has continued to evolve over time. The snappy term “one medicine” was first coined by Calvin Schwabe in 1984 and has helped bring medical and veterinary clinicians and researchers closer together to create collaborative approaches to investigating zoonotic disease. This may involve mass vaccination strategies with the aim of disease eradication, management of drug development and prescription – in particular, in relation to the development of antimicrobial resistance (AMR) in both humans and animals – or treatment of emerging and re-emerging infectious disease.

The Zoonotic and Emerging Disease Group

ZED (www.zoonotic-diseases.org) is based jointly between the Institute of Infection and Global Health, University of Liverpool, and the International Livestock Research Institute, Nairobi, Kenya. The group studies a range of disease issues affecting humans, domestic animals and peri-domestic wildlife, including cysticercosis in pigs, enteric pathogens, such as *Escherichia coli*, *Salmonella*, *Campylobacter* in domestic livestock, and the presence of *Nipah virus* and *Lyssavirus* in peri-domestic wildlife including bats and rats.



Rural pig slaughter site in western Kenya. Image: Eric Fèvre.

The role of increasing urbanisation in the emergence of pathogenic disease is one subject of investigation and socio-economic studies to discover the current and changing practices of people and animals in affected regions are being undertaken to provide an understanding of factors that influence pathogen emergence and transmission. This work is important as the United Nations has estimated city populations in Africa will increase from 31% to 51% of the total population by 2030, and this developing lifestyle change will obviously impact on zoonotic disease transmission and pathogen emergence.

Among its many projects, ZED also leads one named “Zoonoses in Livestock in Kenya”, which is funded by the UK Research Councils and the Department for International Development under the Zoonoses in Emerging Livestock Systems programme. The aim of this project is to enable livestock and human health authorities to develop an effective surveillance system for a range of zoonoses. Studies have been undertaken on the prevalence of zoonotic diseases, and although many are under-reported and misunderstood, thinking about how their epidemiology will evolve in the future is a priority, particularly in relation to the continuing intensification and commercialisation of livestock. One of the longer-term aims of the group is the closer integration of human and animal health sectors, and a better understanding of a range of diseases.

Non-typhoidal *Salmonella*



A pig awaiting slaughter at Mundika slaughterhouse, Busia County, Kenya.

The author has only recently become involved in the work of the ZED group. As a vet and master's student completing a research taster fellowship, funded by the University of Liverpool Wellcome Trust Institutional Strategic Support Fund, her project investigates the prevalence of non-typhoidal *Salmonella* (NTS) in pigs in Kenya and Malawi in extensive, low-input production systems. The aim is to determine whether invasive NTS are present in the pig population of three study areas – one rural and one urban area in Kenya, and one rural region of Malawi.

In sub-Saharan Africa, NTS is a leading cause of human mortality, particularly in the very young, old, malnourished, or those suffering from co-morbidities, such as HIV or malaria. The main signs of invasive NTS in humans are those of bacteraemia and febrile illness, therefore these non-specific symptoms can easily be misdiagnosed as caused by other endemic diseases, such as malaria or typhoid fever, which are often considered more readily by clinicians (Crump, 2014).

Case fatality rate in children in sub-Saharan Africa has been reported to be as high as 24% (Graham et al, 2000). Here, this bacterium is the most common to be isolated from blood culture of humans presenting with these symptoms (Reddy et al, 2010).

Although human-to-human transmission of NTS has been documented, zoonotic transmission has not been adequately surveyed. An invasive serovar has been found able to cause severe disease in chickens (Parsons et al, 2013); therefore, suspicion is arising that transmission between humans is not the sole route of NTS spread, and zoonotic transmission, especially from pigs, may have a

role to play in the epidemiology of the disease.

In sub-Saharan Africa, most pigs in rural areas roam freely around homesteads, owned by individual farmers, but survive on food scraps and rubbish around their local environment (Thomas, 2013) until they reach an adequate slaughter weight. As such, these pigs provide a very low cost and low-input production system, and their husbandry reflects a close-living relationship between humans and animals; an ideal shared environment for the transfer of zoonotic disease among humans, peri-domestic wildlife, such as rats, and domestic animals.

Should this invasive strain of bacteria be found in pigs, the author will assess whether the same serovar clinically affects humans in the same geographical location, using data already gathered from human hospitals. A correlation between the two would indicate zoonotic transmission may be occurring.

AMR and invasive NTS

Multi-drug resistant strains of NTS present a major health concern in several African countries. In affected humans NTS-resistant strains have worryingly been found in the third generation cephalosporin ceftriaxone and fluoroquinolones, as well as the more commonly used and cheaper antibiotics chloramphenicol, co-trimoxazole and ampicillin (Gordon et al, 2008, Kariuki et al, 2005). In sub-Saharan communities where health care resources are scarce, this poses a problem as more effective antimicrobials may be unaffordable or unavailable to the majority of patients. No commercially available vaccine exists for disease caused by NTS.



Pig carcass preparation at Bumala slaughterhouse, Busia County, Kenya.

The final part of this project will assess the presence of drug resistance in the strains of NTS

isolated from pigs and whether this bears any correlation to a similar AMR pattern of NTS to that previously detected in humans in the same area. Should AMR be detected, other management techniques for the swine, such as alterations in husbandry and hygiene, may be trialled. In the longer-term, vaccination development may be a possibility as an important method of preventing zoonotic disease transmission in the study areas, for which research is in the very early stages.

This project will forge additional links between the Institute of Infection and Global Health at the University of Liverpool, the International Livestock Research Institute in Nairobi, Kenya and the Malawi-Liverpool Wellcome Trust centre in Blantyre, Malawi. It will serve not only to further the science of AMR in *Salmonella*, but also further the collaborative links between these institutes – all of which have a mandate to carry out high quality research for the benefit of Global Health.

The author hopes the results will provide an evidence base to demonstrate the prevalence and epidemiological characteristics of this specific invasive disease, and, therefore, allow changes in livestock management to be advocated, in an effort to decrease human mortality and morbidity caused by invasive NTS.

Acknowledgements

Thank you to Eric Fèvre and Gina Pinchbeck for their help with this article.

References

- Bresalier M, Cassidy A and Woods A (2015). One Health in history. In Zinsstag J, Schelling E, Waltner-Toews D, Whittaker M and Tanner M (eds), *One Health: The Theory and Practice of Integrated Health Approaches*, CABI: 1-15.
- Crump JA (2014). Time for a comprehensive approach to the syndrome of fever in the tropics, *Transactions of the Royal Society of Tropical Medicine and Hygiene* **108**(2): 61-62.
- Gordon M, Graham S, Walsh A, Wilson L, Phiri A, Molyneux E, Zijlstra, Heyderman R, Hart C and Molyneux M (2008). Epidemics of invasive *Salmonella enterica* serovar Enteritidis and *S enterica* serovar Typhimurium infection associated with multidrug resistance among adults and children in Malawi, *Clin Infect Dis* **46**(7): 963-969.
- Graham SM, Molyneux EM, Walsh AL, Cheesbrough JS, Molyneux ME and Hart CA (2000). Non-typhoidal *Salmonella* infections of children in tropical Africa, *Pediatr Infect Dis J* **19**(12): 1,189-1,196.
- Kariuki S, Revathi G, Kariuki N, Muyodi J, Mwituria J et al (2005). Increasing prevalence of multidrug-resistant non-typhoidal salmonellae, Kenya, 1994-2003, *Int J Antimicrob Agents* **25**(1): 38-43.
- Laupland K, Schønheyder HC and Kennedy KJ et al (2010). *Salmonella enterica* bacteraemia: a multi-national population-based cohort, *BMC Infect Dis* **10**: 95.
- Parsons BN, Humphrey S, Salisbury AM, Mikoleit J, Hinton JCD, Gordon MA, Wigley P (2013). Invasive non-typhoidal *Salmonella typhimurium* ST313 are not host-restricted and

have an invasive phenotype in experimentally infected chickens, *PLoS Neglected Tropical Diseases* **7**(10): e2487.

- Reddy EA, Shaw AV and Crump JA (2010). Community-acquired bloodstream infections in Africa: a systematic review and meta-analysis, *Lancet Infect Dis* **10**(6): 417-432.
- Schwabe C (1984). *Veterinary Medicine and Human Health* (3rd edn), Lippincott Williams and Wilkins, Baltimore, Maryland
- Thomas L, de Glanville WA, Cook EA and Fèvre EM (2013). The spatial ecology of free-ranging domestic pigs (*Sus scrofa*) in western Kenya, *BMC Vet Res* **9**: 46, DOI 10.1186/1746-6148-9-46.