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Diagnosis where? Testing Pigs and Humans for T. solium cysticercosis in Uganda

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Two live pigs being transported to a local butcher in Mukono district, Uganda

Taenia solium is a zoonotic disease shared between humans and pigs. Humans become infected with *T. solium,* also known as the pork tapeworm, when they consume undercooked pork infected with porcine cysticercosis. Human cysticercosis develops when humans ingest *T. solium* eggs. If cysterici travel to the human brain this leads to neurocysticercosis, a leading cause of onset epilepsy in endemic areas (Singhi ?2011). In an effort to control *T. solium*, the International Livestock Research Institute (ILRI) have collaborated with the University of Edinburgh, Arista Inc., and Astel Diagnostics to develop a prototype, pen-side lateral flow assay (LFA). The assay has been designed to detect porcine cysticercosis using blood or serum.

As the LFA enters the late stages of development, the researchers involved are exploring possible intervention strategies and potential users of this kit. At the heart of these discussions is the question of where along

the pig value chain the test should be placed. My ethnographic research, which traced *T. solium* as it travelled through farms, slaughterhouses, pork butcheries and hospitals in central Uganda, reveals the multiple complexities that are likely to arise with the introduction of the LFA in any of these sites. My research also raises critical questions about who diagnostic tests for zoonotic diseases are being designed for. Here, I discuss the opportunities and challenges associated with three potential diagnostic sites along the pig value chain.

Farms: Across Ugandan farms, porcine cysts were contained within pigs' bodies. This meant that cysts in pigs were invisible to farmers, traders and local butchers, with cysts not affecting the value of pigs at the point of sale. A high demand for pork across urban Uganda has created a fast moving value chain where pigs are often sold and consumed within the same day (see Figure 1). Accordingly, farmers regularly cited pigs as being the perfect animal for acquiring 'quick money' (in Luganda; *sente za mangu*). If the LFA was introduced on farms and the test was positive, the farmer would subsequently have to buy the drug oxfendazole, and wait the recommenced 17 days after medicating before reselling (Moreno et al., 2012). For the smallholder farmer, the LFA would therefore reveal an invisible pathogen that demands lengthy treatment. This would impede the pig's ability to provide quick and often emergency money.

Slaughterhouses: Moving from farms into slaughterhouses, the LFA could potentially be integrated into meat inspections. This would prevent infected pork from entering into the food chain. Uganda has only one formal pork slaughterhouse and in discussions with a veterinary epidemiologist at ILRI it was stressed that if the LFA were to be introduced into meat inspections at the slaughterhouse, infected carcasses would be identified, removed and burned. The infected pig would then be traced back to its farm of origin and farmers advised to change their pig rearing practices. This approach overlooks the informal networks of traders and brokers who collect pigs from across the country. These networks complicate any attempt to trace infected pork back to live pigs on farms. Moreover, if identified, farmers could still sell their infected pigs to nearby butchers or to the multiple informal slaughterhouses located across Kampala. Informal slaughterhouses currently have no meat inspection and there is limited meat inspection carried out by veterinarians in butchers.

Hospitals: The example of *T. solium* in Uganda highlights the potential challenges of diagnosing pathogens in animal bodies to prevent them from reaching human bodies. But there is another possibility. There is no reason why a diagnostic test for porcine cystercercosis could not also detect cystercercosis in humans. Despite limited investment in the diagnosis of human cystercercosis in Uganda, epidemiological studies and anecdotal evidence indicate that epilepsy caused by *T. solium* occurs

throughout the country (Alarakol et al., 2017). Neurocysticercosis is currently very difficult to diagnose, with a definite diagnosis requiring specialised brain imaging technologies. The LFA could consequently be used to detect neurocysticercosis in hospitals and clinics, targeting epileptic patients who may require treatment for the disease.

Zoonotic diseases highlight the difficulty of establishing where and in which bodies to diagnose pathogens. But underlying this quandary is the more important question of who diagnostics are for (Researchers? Farmers? Patients?) and what clinical, public health or economic utility they are expected to have.

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