

A framework for understanding zoonoses at the livestock-human interface in western Kenya

Dr Eric Fèvre

www.zoonotic-diseases.org

Centre for Immunity, Infection and Evolution, University of Edinburgh
and

International Livestock Research Institute, Nairobi

In collaboration with: KEMRI, Centre for Microbiology Research
Department of Veterinary Services, Kenya

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The logo for Wellcome Trust, featuring the word "wellcome" in a bold, lowercase, blue sans-serif font, followed by "trust" in a smaller, lighter blue sans-serif font.

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What research is needed? - WHO

- **Field epidemiological studies in humans and livestock**
 - the number of cases and number of deaths
 - number of new infections
 - age-and sex-specific disability weights for zoonoses

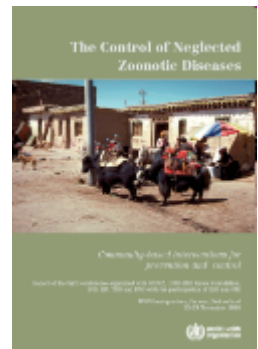
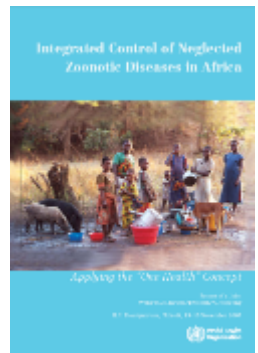
- **Estimates/models of under-reporting**
 - Much recent progress: rabies, sleeping sickness
 - Case studies to gather an evidence-base

- **Multi-disease studies – what is the overall burden of zoonoses as a group on communities**
 - Public health
 - Economics

- **Field-level diagnostics**

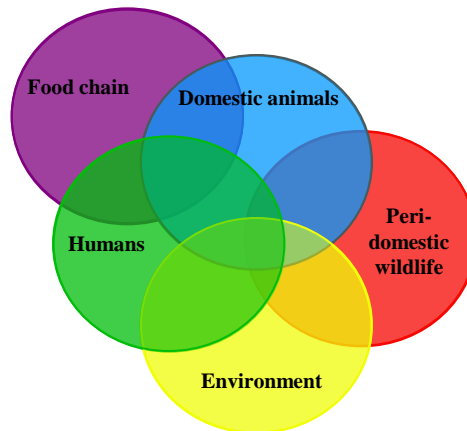
- **Cost-effectiveness studies – dual medical/veterinary benefits**

- **Pathogen and host ecology**



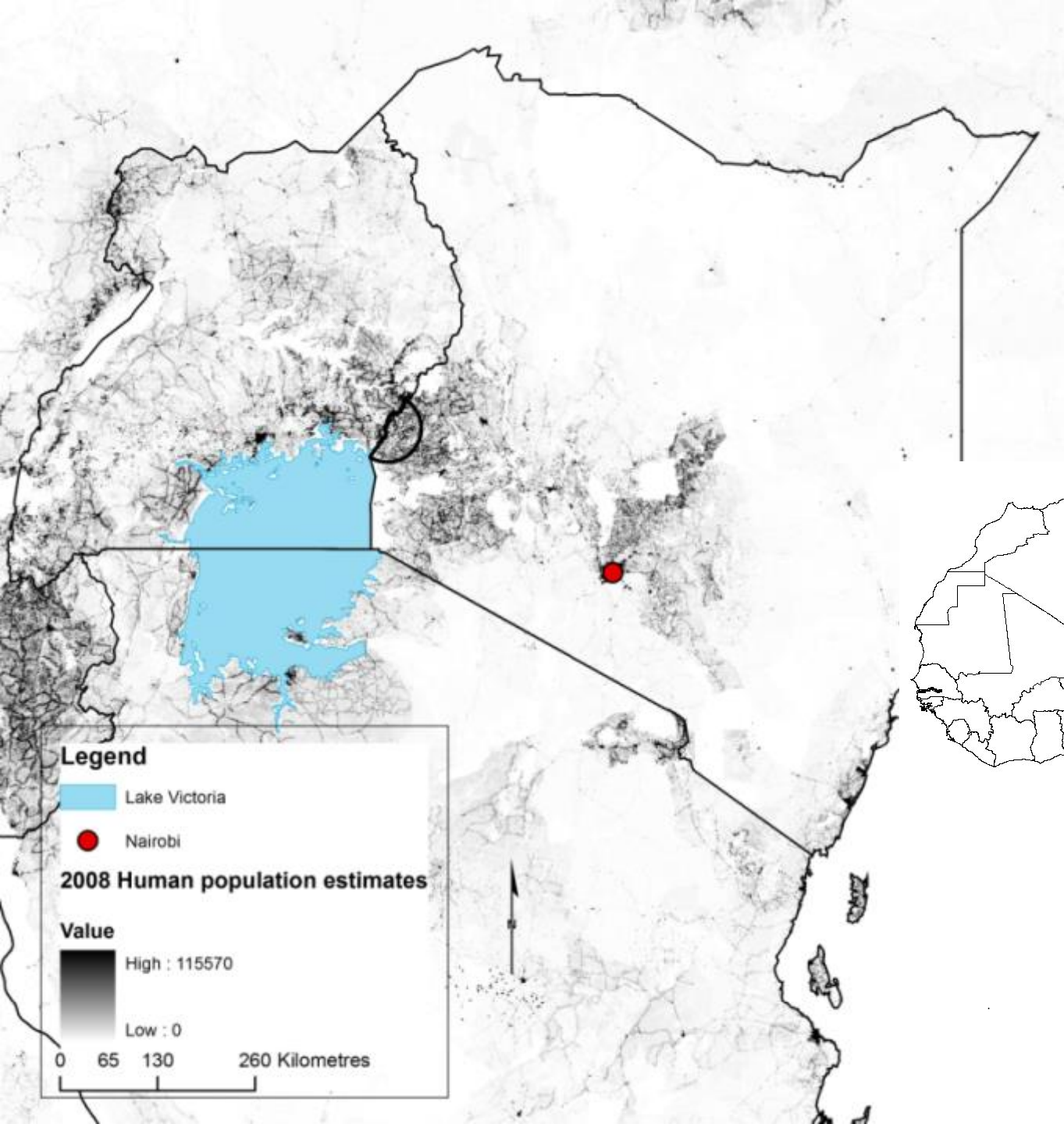
People, Animals and their Zoonoses (PAZ)

- Integrated project that addresses this lack of data and these scientific aims
- Aims to address both (veterinary) public health and ‘biological’ questions
- Epidemiology – population scale
- Framework that can be repeated elsewhere in different communities and ecologies



Aims of study

- Acquire basic field epidemiological data on zoonotic diseases in both humans and animals
- Enumerate co-infections/co-exposure with zoonoses amongst humans and livestock (with 1+ zoonosis; with all pathogens)
- Quantify the human burden of zoonoses and other infections in the study area
- Investigate links between zoonoses and non-zoonotic infections – co-factors (eg – are sick animals better reservoirs?)
- Understand/model the extent to which co-factors predict exposure to zoonoses
- What is the impact of zoonoses on production losses in livestock?
- Understand the role of the wider ecosystem on disease transmission
- Investigate the potential of simple livestock-targeted interventions as a means of improving human public health



Legend

 Lake Victoria

 Nairobi

2008 Human population estimates

Value

 High : 115570

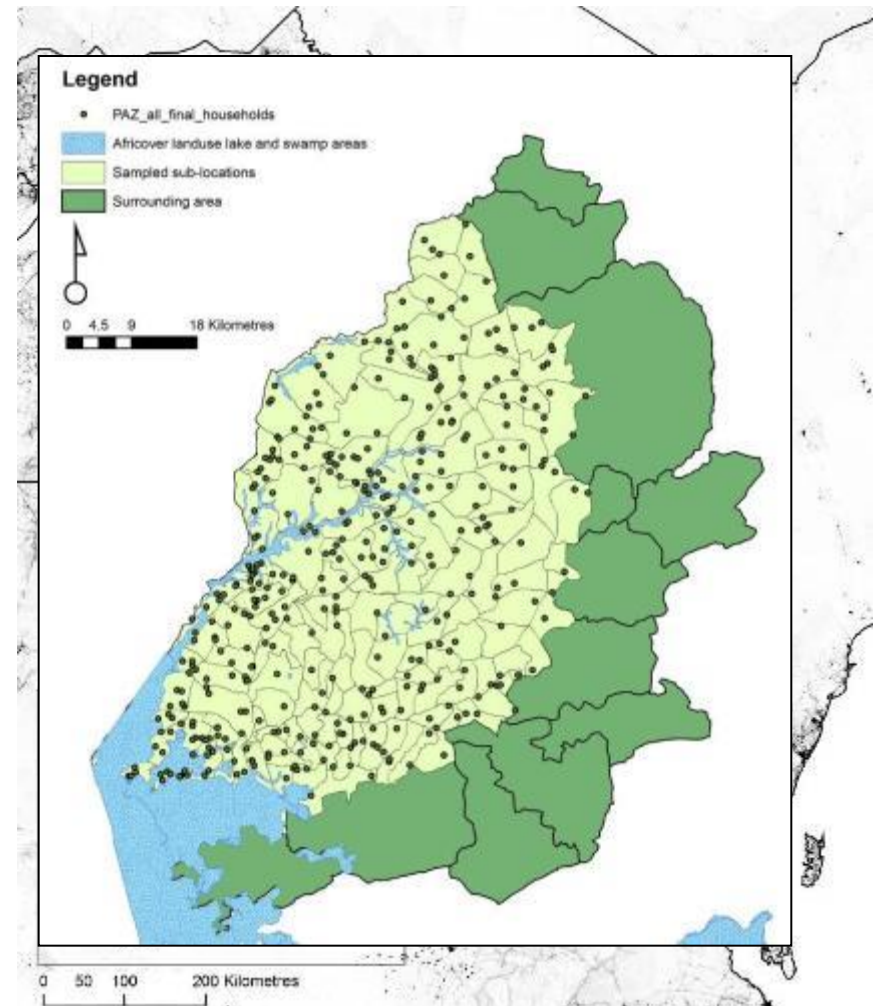
Low : 0

0 65 130 260 Kilometres



Study site

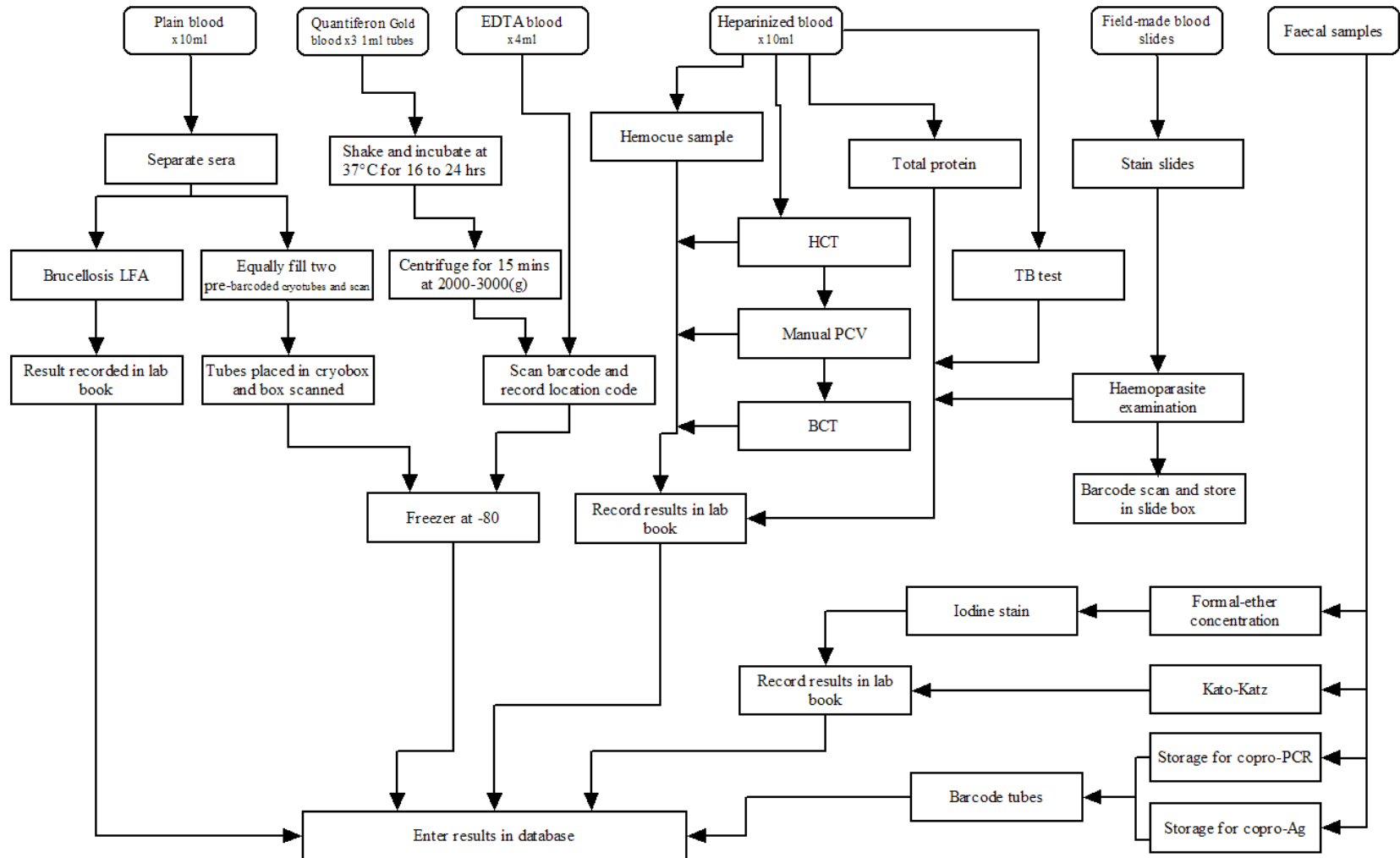
- Field site is the Western Province of Kenya
- 2000 km² zone (500,000 cattle, 67,000 pigs, ~1 million people)
- Small-holder crop-livestock production system in the Lake Victoria Crescent (highest human and livestock densities in East Africa)
- Intensively and comprehensively sampled over 2.5 years
- Cluster design (random household), organised by sub-location units
- All sublocations in the study site to be sampled, proportionally by cattle population distribution



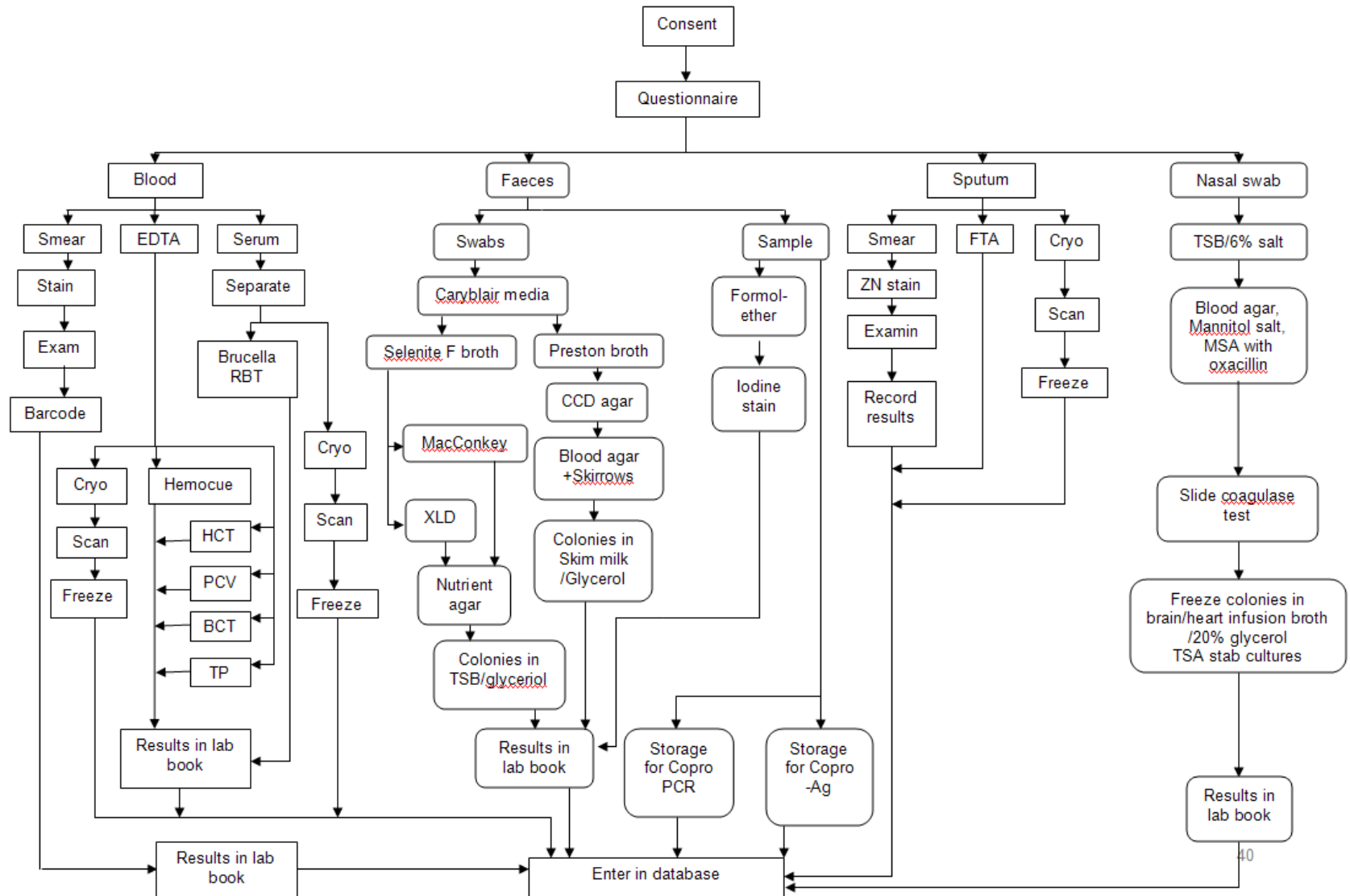
The project is focused on...



Cross sectional sample flow (field lab)



Slaughter house sample flow (field lab)











Livestock cross sectional survey

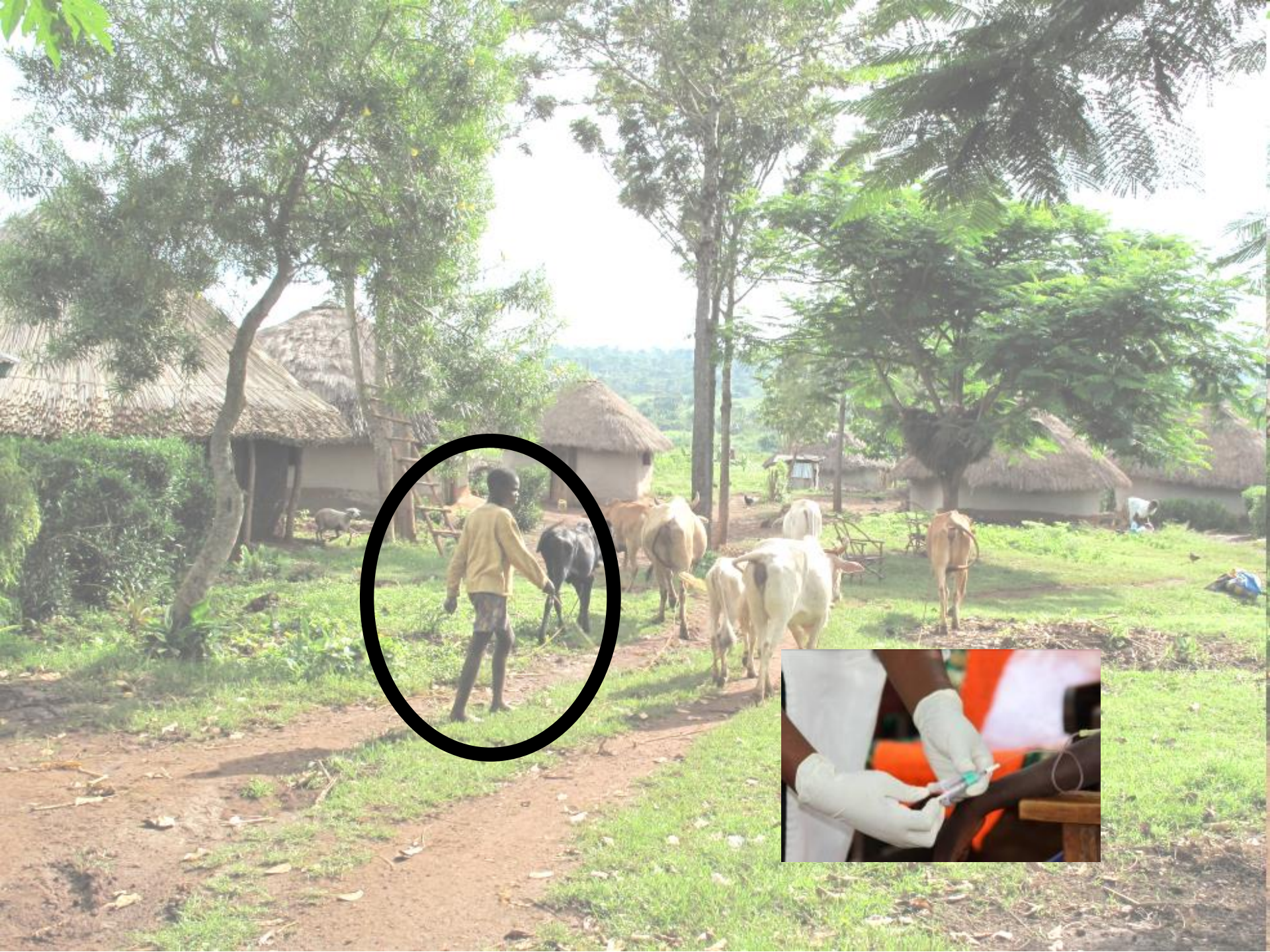


- Infections with zoonotic diseases and other pathogens in cattle, pigs, goats
- Sampling 1100 cattle in ~ 450 households
- All cattle, pigs, goats in each home sampled
- Comprehensive individual level questionnaire covering a diversity of socio-economic, spatial and biological risk factors (c.100 item questionnaire)
- Process
 - Field examination/full clinical exam, collection of blood, serum, faeces
 - Parasitological screening, sample processing, some serologic diagnostic assays in field lab
 - ELISA and PCR at central lab
 - Biobanking + material for livestock genetics



Pathogens and conditions considered (first pass)

Organism/condition	Test type	Sample type	Sample volume
State of health	Clinical examination		
Blood-borne parasites (<i>Plasmodium</i> , <i>Rickettsia</i> , <i>Trypanosoma</i> microfilariaem , microfilariae, <i>Theileria</i> , <i>Anaplasma</i> , etc)	Microscopy	Thick and thin blood smears; possibility of testing some rapid tests	100µl
Various intestinal parasites (<i>Ancylostoma</i> , <i>Trichuris</i> , <i>Strongyloides</i> , <i>Ascaris</i> , <i>Necator</i> , <i>Hymenolepis</i> , <i>Taenia</i> , <i>Schistosoma</i> , <i>Coccidia</i> , <i>Crypto</i> , <i>Giardia</i> , <i>Fasciola</i> , <i>Entamoeba</i> ...)	Kato-Katz concentration, formol-ether concentration, microscopy	Fresh faeces	10g
Haemoglobin	PCV and direct measurement	Whole blood	10µl
<i>Coxiella burnetii</i> (Q-fever)	Serology	Serum	**
<i>Brucella</i> spp. (Brucellosis)	Serology	Whole blood in anticoagulant	**
<i>Mycobacterium bovis</i> (Bovine TB)	Serology (Gamma-interferon)	Peripheral Blood Mononuclear Cells from whole blood	8mls
Rift Valley Fever	Serology	Serum	**
<i>Trypanosoma brucei rhodesiense</i> (sleeping sickness)	Microscopy and PCR	Whole blood in anticoagulant	**
<i>Taenia solium</i> (pork tapeworm)	Copro-PCR, serology and microscopy	Stool, serum	** Faeces – 10g
<i>Taenia saginata</i> (beef tapeworm)	Microscopy serology and Copro-PCR	Stool	10g
HIV	Serology	Whole blood in anticoagulant	**
Leptospirosis (?)	Serology	Serum and whole blood in anticoagulant	**



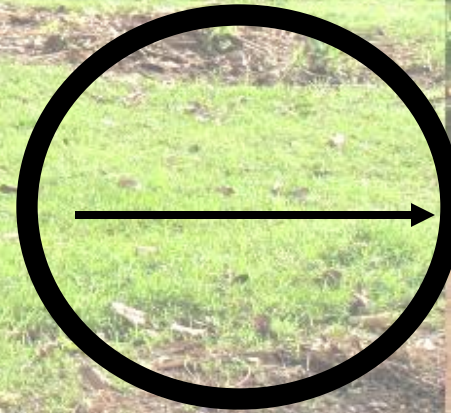


Human cross sectional survey

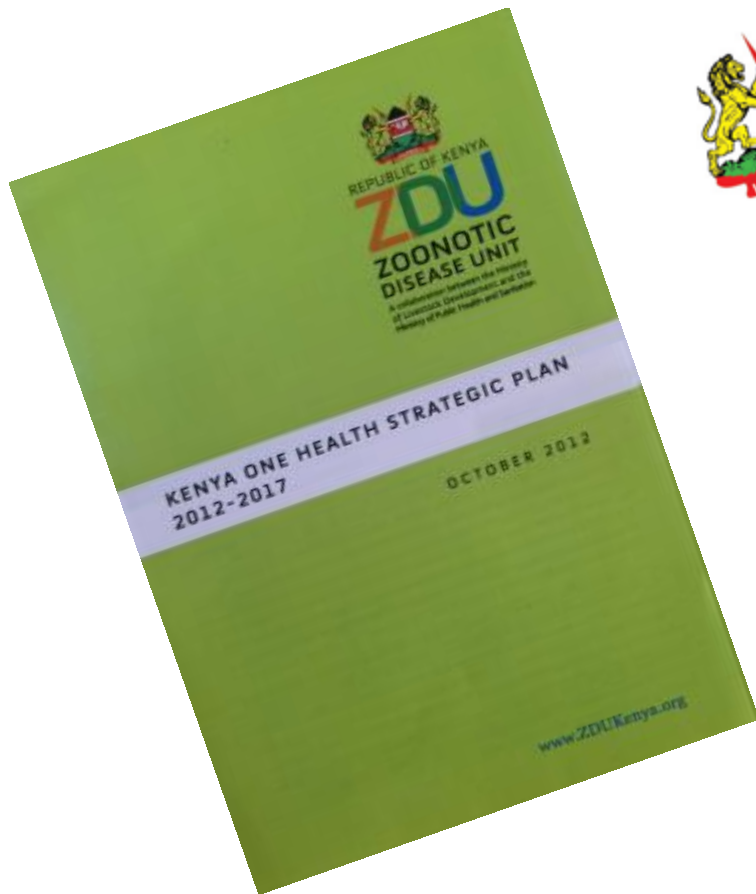


- Same principle as livestock element, but in humans; 120 item questionnaire
- Collaboration with Centre for Microbiology Research, KEMRI
- Two strata - households that keep cattle and those that do not – target 2500 patients sampled
- KEMRI ethical approval
- Process
 - Field examination and clinical exam, collection of blood, serum, faeces
 - Sample processing, parasitology, some serologic diagnostic assays in field lab
 - ELISA tests and PCR at central labs
 - Biobanking of serum and blood for further analysis
- Reporting back and free treatment of parasites









ZDU REPUBLIC OF KENYA
**ZOONOTIC
DISEASE UNIT**

- Scientific data on epidemiological parameters in the study population and design of targeted interventions
- Mapping disease distributions and risk
- Modelling transmission and the role of co-factors in zoonotic disease spread
- Co-investigation of all humans and livestock in the sampling unit gives a uniquely comprehensive understanding
- Will provide data to address gaps in NZD knowledge identified by WHO
- Country- and regional- scale policy outputs with a wider regional relevance

Fin

Thanks for your attention!

Eric Fèvre

Email: Eric.Fevre@ed.ac.uk

Web: www.zoonotic-diseases.org

tel: +44 (0)131 208 32 35

tel: +254 (0) 722 545 345

Centre for Infection, Immunity and Evolution
School of Biological Sciences
University of Edinburgh
Ashworth Labs
West Mains Road
Edinburgh EH9 3JT
UK

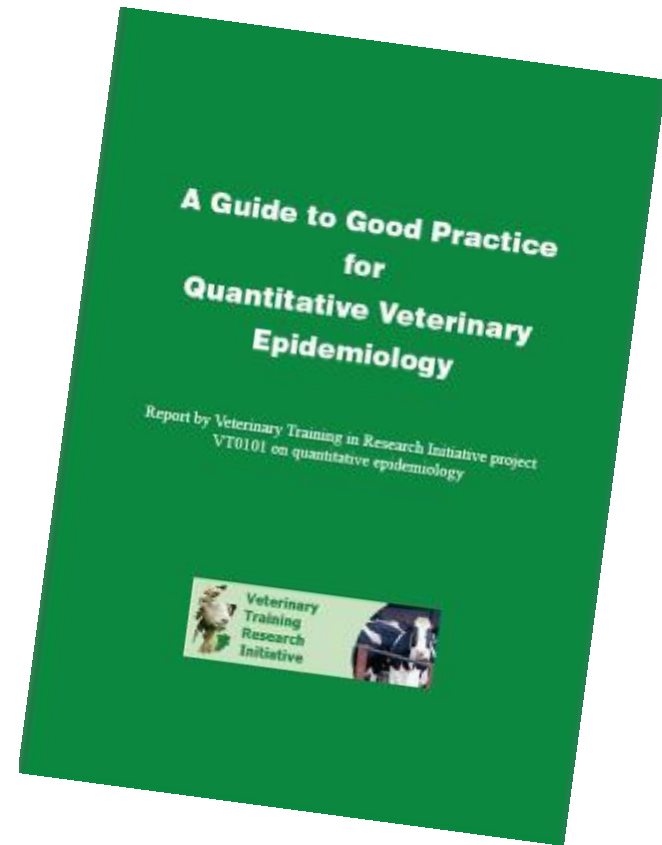


International Livestock Research Institute
Old Naivasha Road
Po Box 30709-00100
Nairobi
Kenya



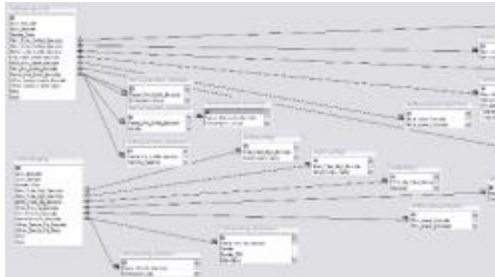
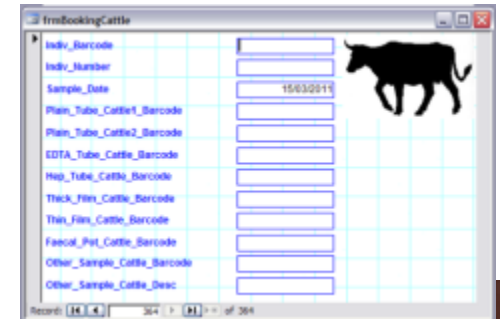
Good Practice in Quantitative Veterinary Epidemiology

Woolhouse, M.E.J., Fèvre, E.M., Handel, I., Heller, J., Tildesley, M.J., Parkin, T., & Reid, S.W.J. (2011). *Guide to Good Practice for Quantitative Veterinary Epidemiology* (<http://www.qve-goodpracticeguide.org.uk/>). VTRI0101, Universities of Edinburgh and Glasgow.



<http://www.qve-goodpracticeguide.org.uk/>

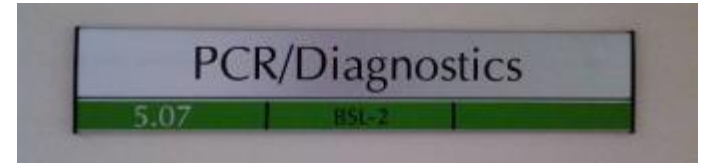
Data management





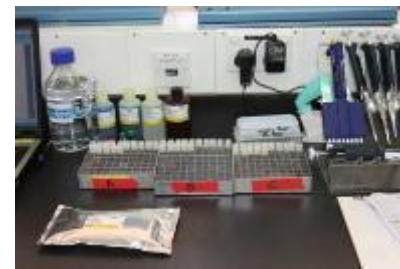
Facilities

- Full scale “district level” parasitology and microbiology **diagnostic lab** for human and animal samples
- **Post-mortem room** for animals (pathology)
- International Livestock Research Institute Health and Safety and equipment **laboratory maintenance standards**
- International **supply chain** and cold chain
- Water, electricity, **broadband internet**
- **Excellent relations** with DVS, local leaders, government officials and the wider community
- **Access to field** (incl 4x4 transport)
 - among highest human and livestock population densities in Eastern Africa
 - geographical gradation from the Lake Victoria in the south to the lower slopes of the Mt Elgon uplands in the north



List of current equipment

- 3x long wheelbase land cruisers for fieldwork
- Large refrigerated centrifuges x2
- 37C incubators x3
- Water bath
- Incubator shaker
- Stomacher
- Shakers
- Micro-Haematocrit centrifuges
- Autoclave
- Deionizer
- Dissecting microscopes
- Compound microscopes
- Balances
- Automated haematology analyser
- Hemocue
- 2x Laminar air flow hoods
- 2x UV cabinets
- Fridges
- Biomedical freezers to -40 and -80
- Computing facilities and wireless internet access
- Large generator
- Robust real-time PCR machine
- ELISA reader
- LAMP PCR equipment
- Various standard equipment for parasitology processing



Studies currently under way

- Large cross-sectional survey of 450 households investigating epidemiology of endemic **zoonoses** and co-infections
- Zoonoses risk amongst slaughterhouse workers
- **MRSA** in pigs and people
- Food chain risk assessment of porcine **cysticercosis** and **brucellosis**
- Molecular epidemiology of brucellosis
- Development of pen-side diagnostics for cysticercosis
- **Pathogen discovery** in peridomestic rodents and bats