Two stories on Brucellosis in Kenya

Presented by Eric Fèvre

www.zoonotic-diseases.org
Twitter: @ZoonoticDisease

Institute for Infection and Global Health (IGH), University of Liverpool
and
International Livestock Research Institute, Nairobi

Brucellosis in Kenya - Epidemiology and Human Burden of a Neglected Zoonotic Disease

Matilda Brink and Eric Fèvre

(with the collaboration of Eric Osoro and Stella Kiambi, ZDU)

ZDU REPUBLIC OF KENYA ZOONOTIC DISEASE UNIT

UPPSALA UNIVERSITET

Kenya national scale

- Kenya's District Health Information System (DHIS) (www.hiskenya.org)
- All public hospitals and most private clinics
- Number of brucellosis diagnoses on yearly basis was extracted for each of the 286 administrative districts listed in DHIS. Datasets were MOH 705A&B
- 2011 and 2012 (the only years that had a report rate above 70%)
- 286 districts was merged into 157 districts present at 2009 census
- Cases were assumed to have been infected and diagnosed in their district of residence.
- Denominator population: "Rural Urban Population by Age, Sex, and by District – 2009" from opendata.go.ke

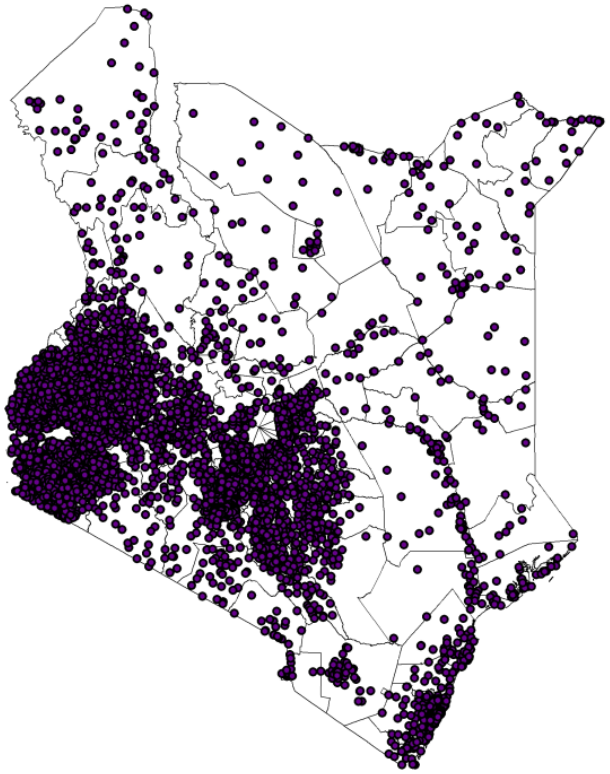
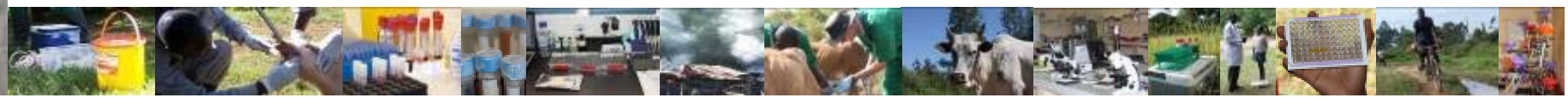


Figure 1. The rapid slide agglutination test used for brucellosis diagnosis in Kenyan hospitals. A) Antigen suspensions for *B. melitensis* and *B. abortus* diagnostics. B) Test reagents being spread in a card for observation of macro-agglutination.



Frequency of districts reporting Brucella in 2012

- 77,973 cases of human brucellosis were reported to the Kenyan Health Information System
- 75,256 of these cases came from the population >5
- Majority of districts reported less than 250 cases (uneven national distribution)

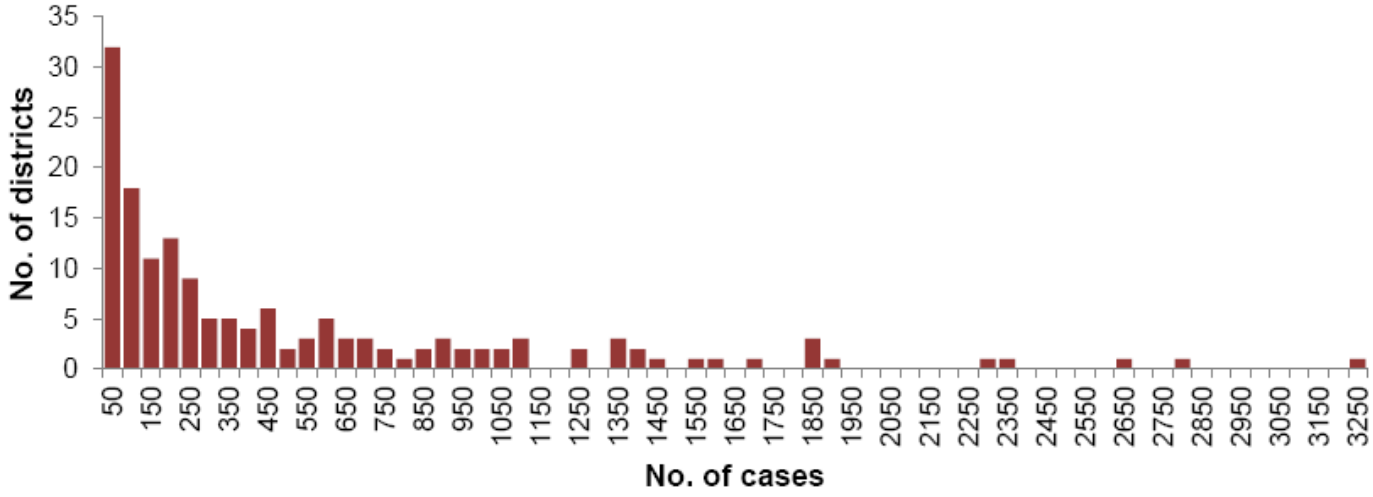
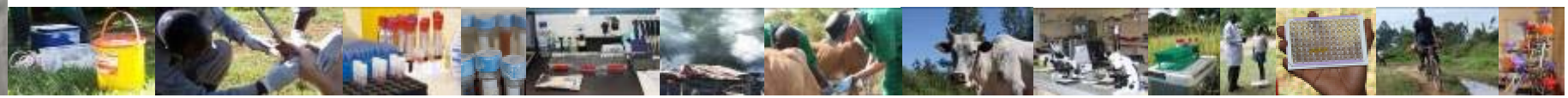
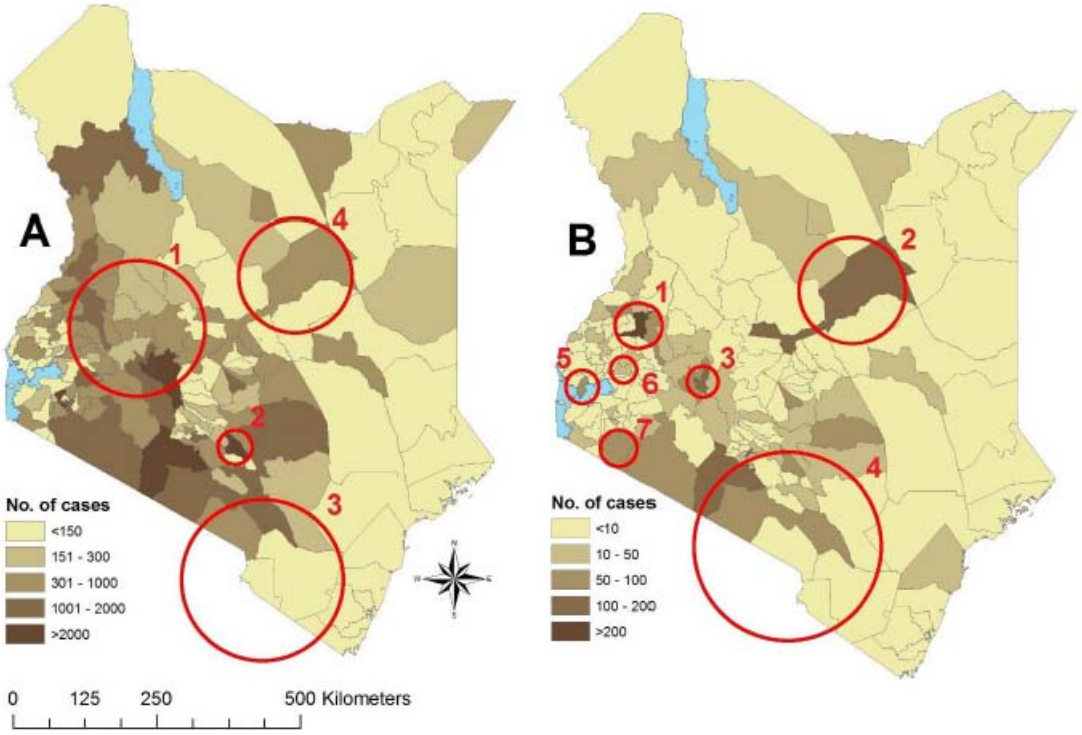


Figure 6. Frequency of districts reporting variable amount of brucellosis cases 2012 in the population over 5 within 157 districts.

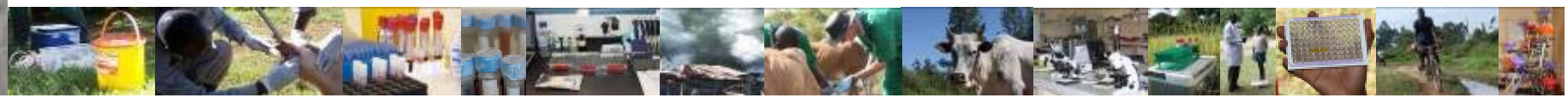


Spatial distribution of reported brucella (2012)



A – over 5s;
B – under 5s

- Spatial scan statistic to detect spatial clustering (and its location)
- Clustering analysis revealed several significant spatial clusters of cases
- In the over-5 age group in 2012, the primary cluster included 26 districts in the Rift Valley area
- Secondary clusters consisted of single districts



Annual incidence

- Could not use data for prevalence – no estimate of population at risk
- **The annual incidence rate of brucellosis diagnosis in Kenya 2012 was 202 per 100,000 people**
- Uneven:
- 0 - 1469 cases per 100,000 people
- Incidence standardized by age structure – no significant impact

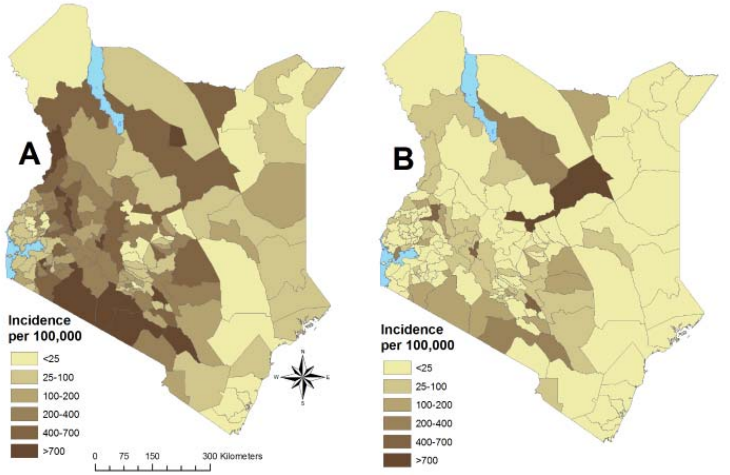
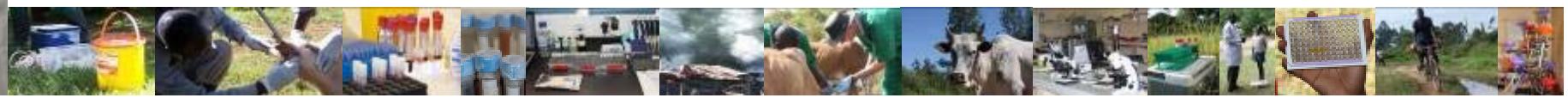


Figure 11. Incidence rate of brucellosis diagnosis in Kenya 2012 per 100,000 people, per district for A) the population over the age of 5, and B) the population under the age of 5.

DALY for Brucella in Kenya

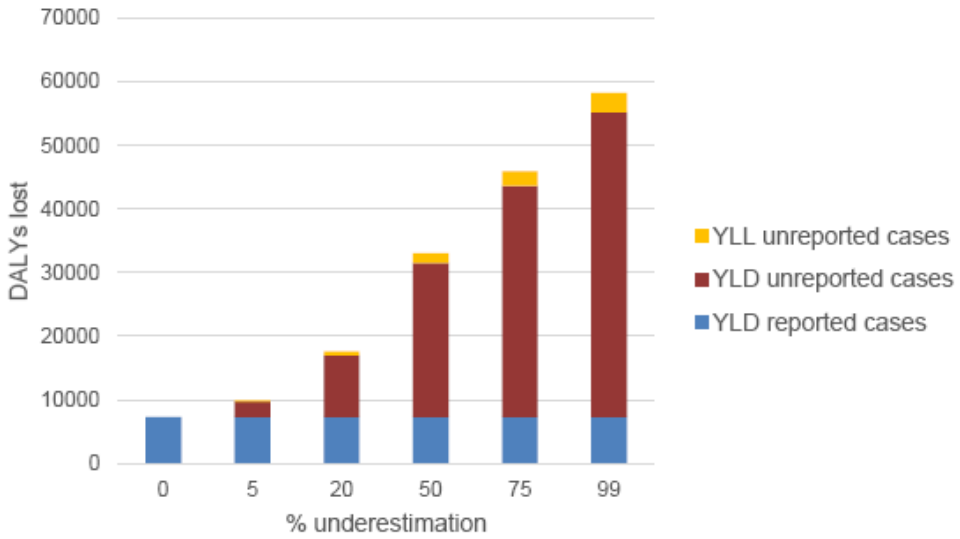
- Based on a reported number of 77,937 brucellosis cases in 2012
- DALYs estimated for males, females and for the total population
- Assuming an average disease duration of six months
- Disability weight of 0.19, but no mortality

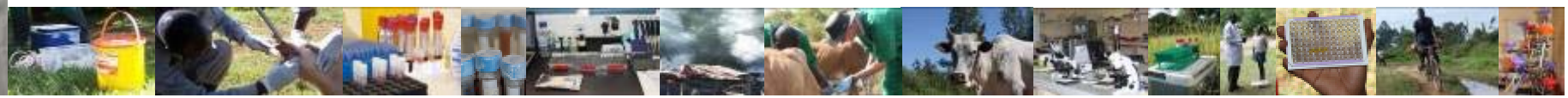


DALY for Brucella in Kenya

- Total DALYs lost were **7352**, or 0.190 DALYs per 1000 people
- Explored DALYs lost with under-reporting estimates
- Under-reported assumed to be in the community and not treated

	DALYs lost	DALYs per 1000 people
Males	4862	0.253
Females	2490	0.128
Total	7352	0.190

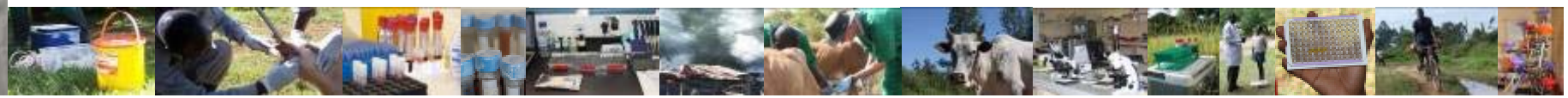




DALY for Brucella in Kenya

- Burden of malaria **2,062,605 DALYs** (9,332,421 reported outpatient cases)
- Typhoid fever **163,440 DALYs** (632,129 reported cases)
- Schistosomiasis **313 DALYs** (35,420 reported cases)

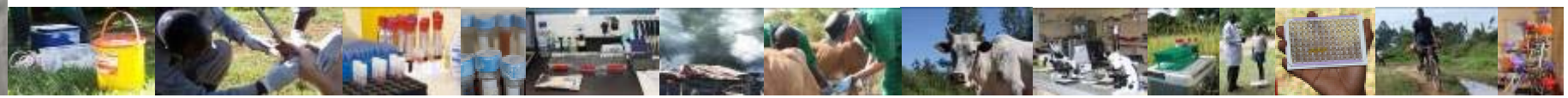
	Degree of underestimation					
	0%	**5%**	**20%**	**50%**	**75%**	**99%**
Number of cases	77973	81872	93568	116960	136453	155166
Number of deaths	0	8	31	78	117	154
DALYs lost	7352	9941	17656	33097	45930	58254
DALYs per 1000 people	0.190	0.257	0.457	0.857	1.19	1.51



DALY for sSA based on Kenya

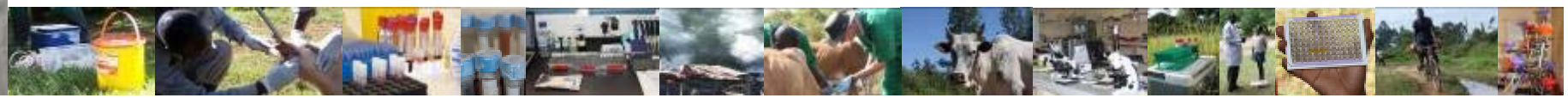
- Extrapolating Kenyan incidence data to sub-Saharan Africa

Disease	Burden in Sub-Saharan Africa (DALYs)
Brucellosis[a] (reported cases only)	140,220
Brucellosis[a] (incl. 50% underestimation)	632,400
Brucellosis[a] (incl. 90% underestimation)	1,114,000
Malaria[b]	30,900,000
Schistosomiasis[b]	1,500,000
Hook-worm disease[b]	377,000
Hepatitis B[b]	355,000
Leishmaniasis[b]	328,000
Leprosy[b]	25,000



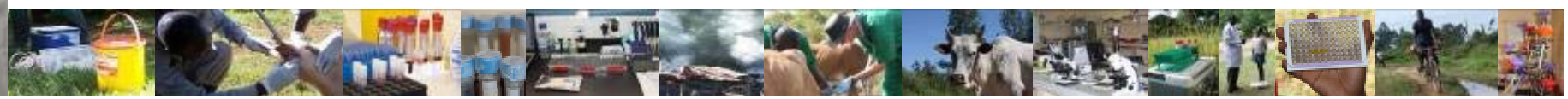
Summary

- Brucellosis widespread in Kenya
- Incidence higher than most countries reported in a recent systematic review (Dean 2012) – but did not report much African data (which is itself a problem)
- Inclusion of Brucella in the DHIS is a great start for passive surveillance
- Some active surveillance is also required for such diseases that are believed to be severely under-ascertained and underreported (WHO, 2011)
  - Report rates in DHIS were 73% in 2011, 90% in 2012
- Work towards a mathematical model of under-detection based on existing data and models (eg rabies, trypanosomiasis….)
- **There is an urgent need to validate the currently available tests against each other**
  - Which test is most appropriate for use under Kenyan conditions
  - Need for guidance on false positives/false negatives and confirmatory test



Caveats

- Numbers reported here regarding cases, incidence and DALYs must be interpreted with caution
- Parameters for DALY calculation remain a little uncertain (duration, disability weight….)
- We need a good spatial dataset to represent the DHIS in the new administrative system!



The (short) story of brucellosis in western Kenya

Eric Fèvre and William de Glanville

www.zoonotic-diseases.org
Twitter: @ZoonoticDisease

Institute for Infection and Global Health (IGH), University of Liverpool
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International Livestock Research Institute, Nairobi

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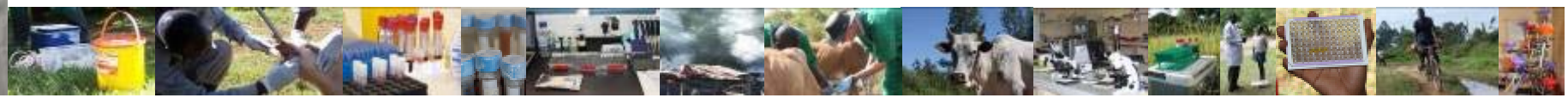


Western Kenya – The People, Animals and their Zoonoses project (PAZ)

Neglected zoonoses

- Under-represented in terms of knowledge, research, policy and funding
  - Lack of epidemiological and other data
  - Lack of adequate technologies and treatments
  - Lack of acknowledgement and attention from professional groups
  - Occur in marginalised communities and individuals
  - Zoonoses with clear link to poverty

Fascioliasis

Rabies

Cysticercosis

Q-fever

Echinococcus

Leptospirosis

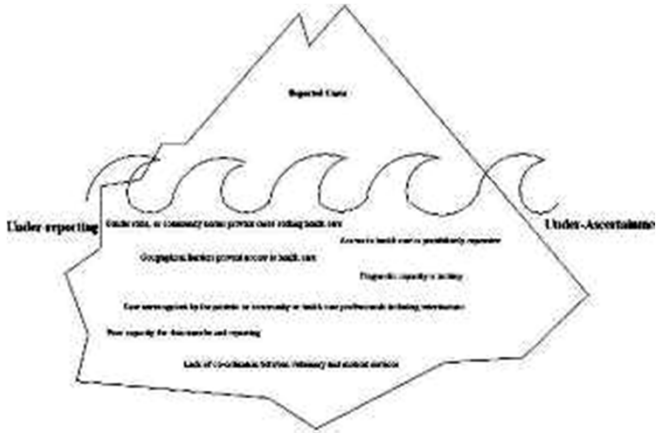
Trypanosomiasis

Brucellosis

RVF

Bovine TB

Anthrax



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

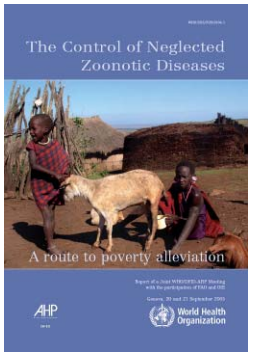
- **Multi-disease studies – what is the overall burden of zoonoses as a group on communities**
  - Public health
  - Economics

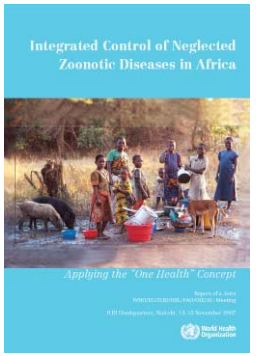
- **Field-level diagnostics**

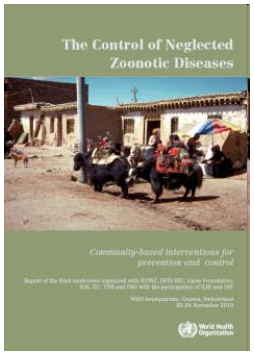
- **Cost-effectiveness studies** – dual medical/veterinary benefits

- **Pathogen and host ecology**

- **(its not just about drugs and vaccines)**

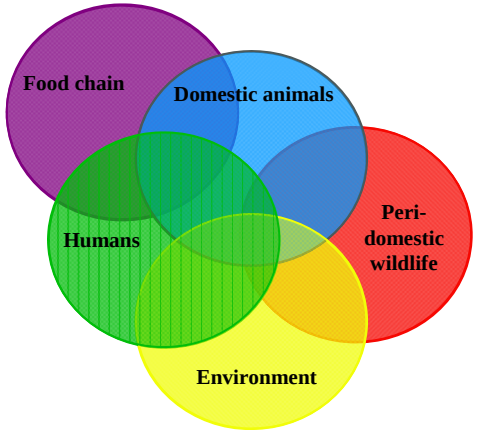






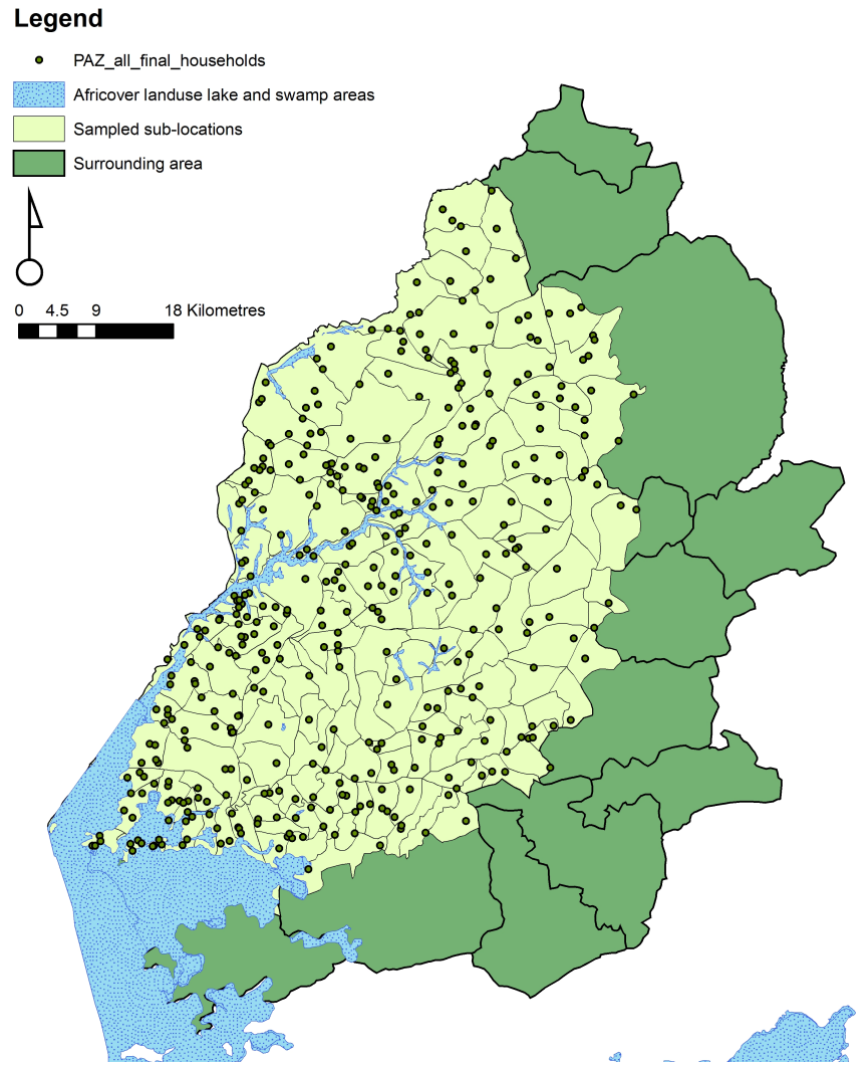
People, Animals and their Zoonoses (PAZ)

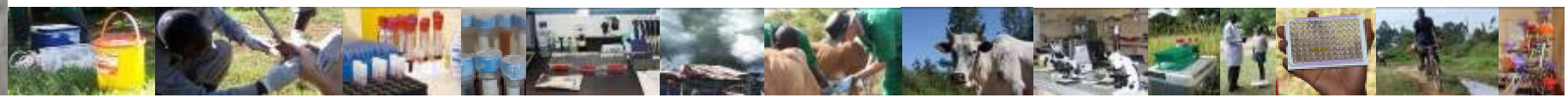
- Integrated research programme that addresses this lack of data and these scientific aims
- Aims to address both (veterinary) public health and ‘biological’ questions
- Epidemiology – population scale
- Framework that can be repeated elsewhere in different communities and ecologies



Study site

- Field site is the Western Province of Kenya
- 2000 km^2 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

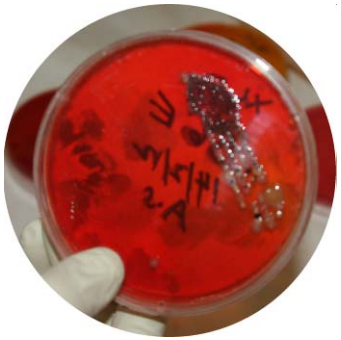




The project is focused on…

Field site (Busia field station)

- Established with Wellcome Trust project funding - diagnostic laboratory in rural western Kenya
- Joint human and animal field teams and laboratories housed together
- Mainly parasitology, microbiology and sample preparation, networked data entry
  - Recent addition of molecular and ELISA capability at the field lab
- High-end laboratory infrastructure (up to BSL-3) in Nairobi



A lateral flow assay was used as primary screening test for brucellosis in sympatric animals and people.

- Rapid and simple
- Good performance
- Animal and human tests
- A bit expensive

We found:

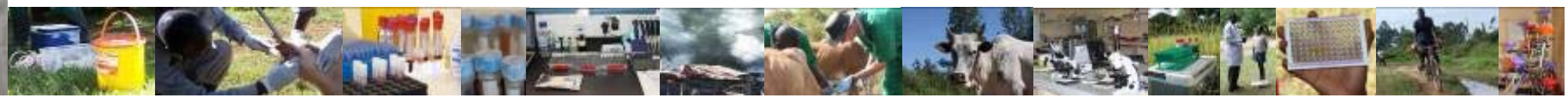
2116 people in 416 homesteads

LFA : 0.71% (95% C.I. 0.38 – 1.17)
RBT : 0.06% (95% C.I. 0.0014 – 0.32)

893 cattle in 230 homesteads

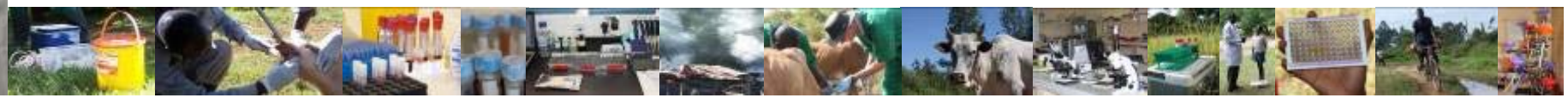
LFA : 0.31% (95% C.I. 0.06 – 0.89)

No relationship between animal and human sero-status at the household level

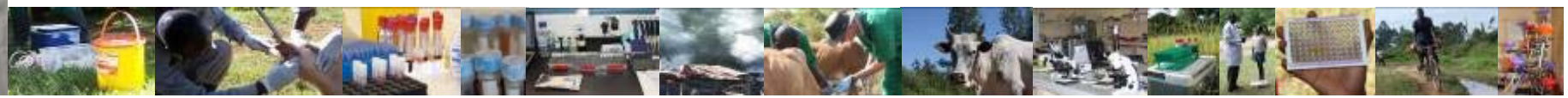


Further surveillance based on central point sampling

Seroprevalence based on RBT < 0.5%



But, brucellosis apparently a common diagnosis in district and sub-district hospitals in study area....

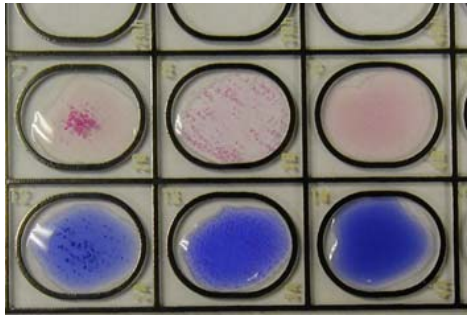


So, we went to investigate.

Rose Bengal

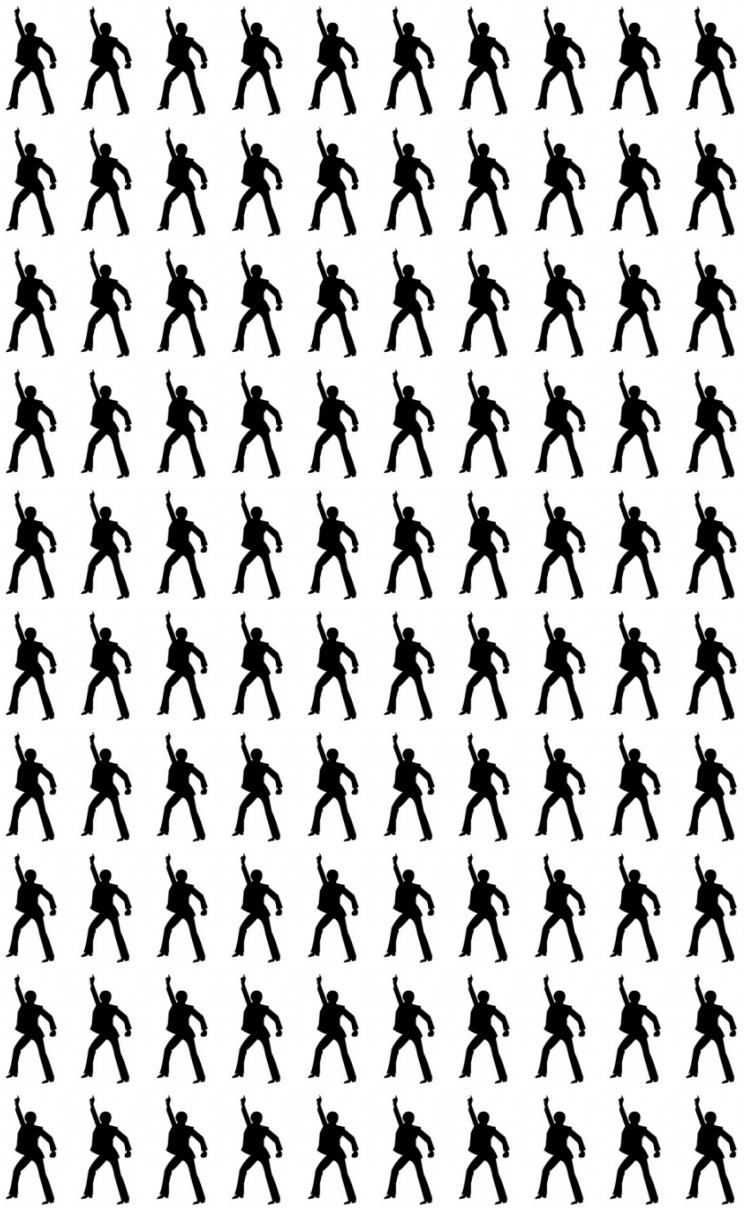
+ve

Lateral Flow Assay



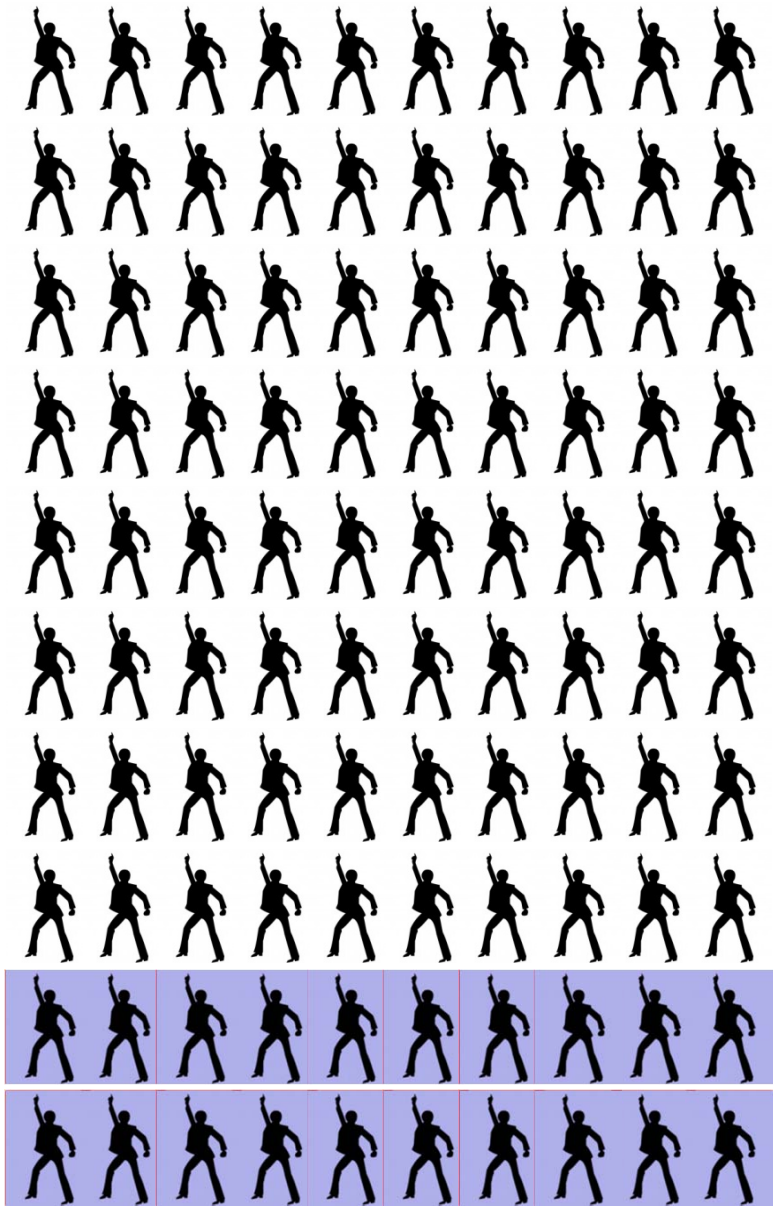
Brucella Agglutination Test

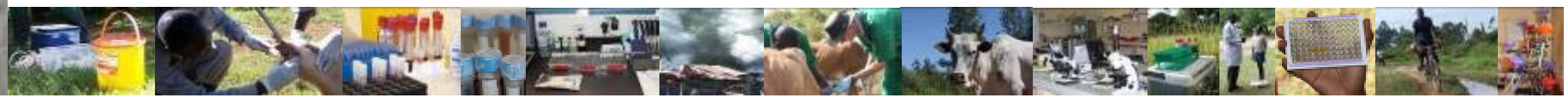
A population of 827 brucellosis suspects



A population of 827 brucellosis suspects

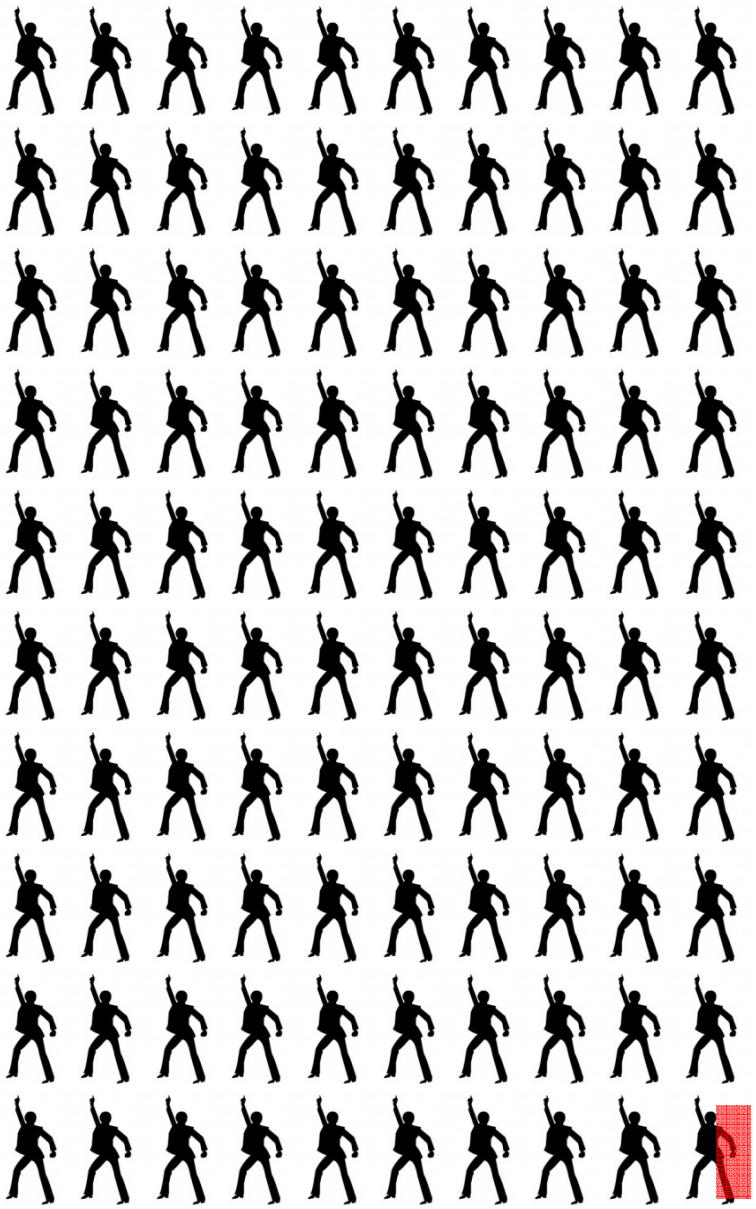
BAT: 19.7%

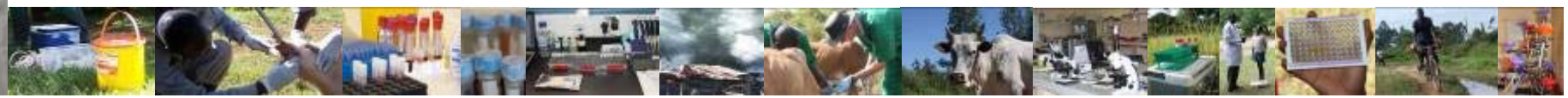


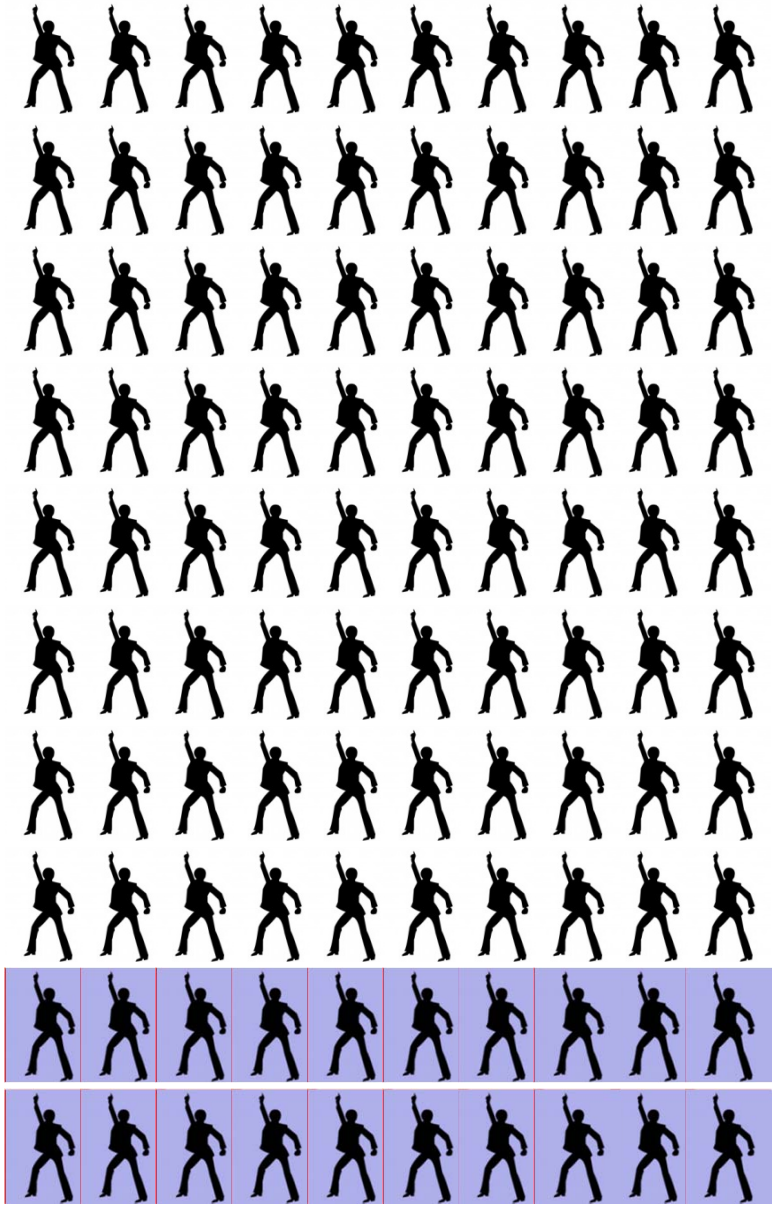


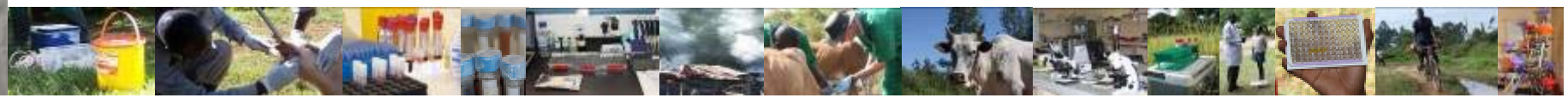
A population of 827 brucellosis suspects

RBT: 0.6%

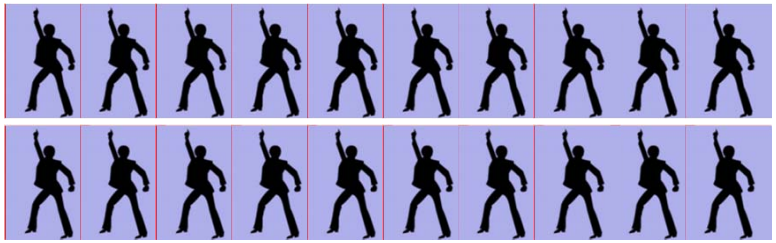


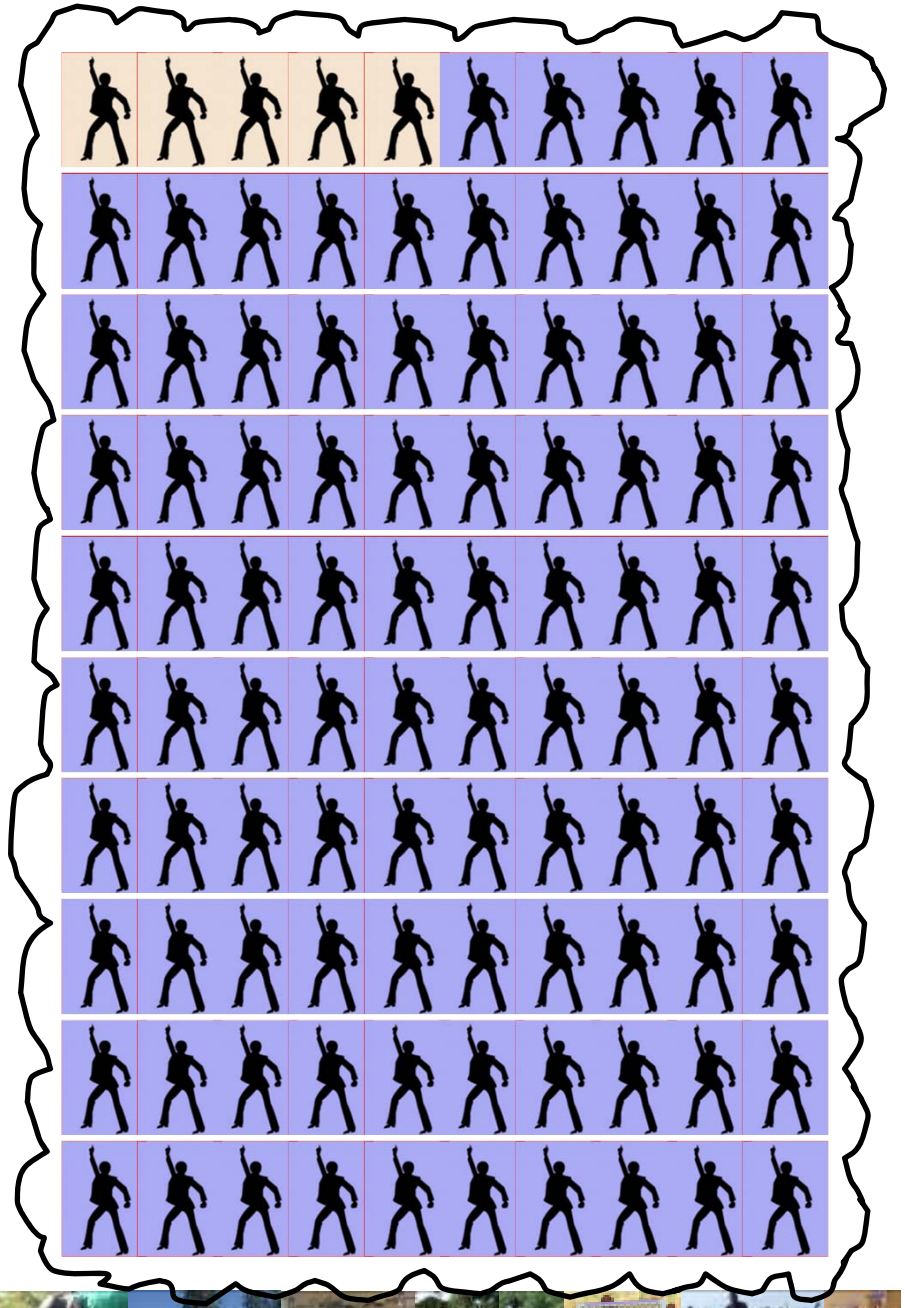


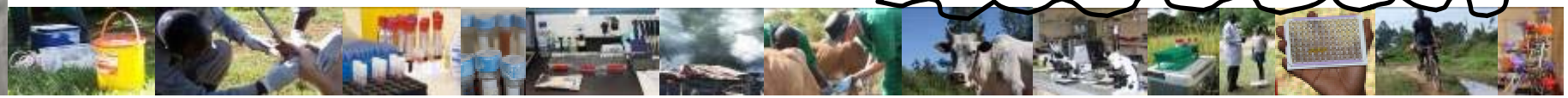




5% of reactive BAT confirmed on LFA



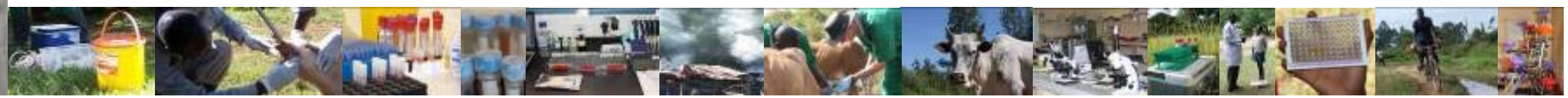


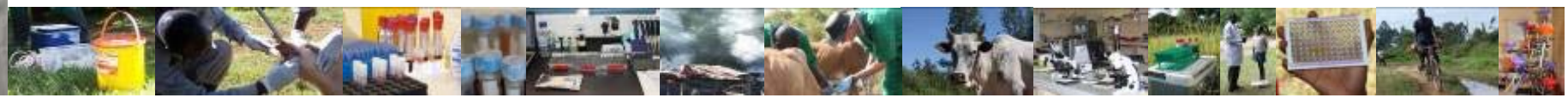


So, brucellosis *appears* to be rare and over-diagnosed using current diagnostic approaches in western Kenya.

Limits use of people as ‘sentinels’ for zoonotic disease in animals.

..... ‘one-health’





Thank you.

Eric Fèvre eric.fevre@liverpool.ac.uk
Will de Glanville w.a.de-glanville@sms.ed.ac.uk

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