Brucella infection risk factors for livestock and humans in south-central Tanzania

Caitlyn Wilson[1], C. Kilonzo[1], G. Makingi[2], G. Paul[2], J.K. Mazet[1], B.H. Bird[1], J.K. Lane[1], D.J. Wolking[1], R.R. Kazwala[2], W. A. Smith[1]

[1]One Health Institute, University of California, Davis, CA, USA; [2]Sokoine University of Agriculture, Morogoro, Tanzania

INTRODUCTION

- **Brucellosis** is caused by pathogenic *Brucella* **bacteria** that significantly contributes to the burden of **zoonotic disease** worldwide, especially in pastoralist/agro-pastoralist economies in developing countries
- Species of Interest: *Brucella abortus:* Facultative, intracellular, gram-negative coccobacilli
- Transmission: infected **tissues, blood, lymph, aborted fetuses,** ingestion of contaminated **meat and dairy products,** or inhalation of infected aerosols

Fig. 1. *Brucella* Transmission Infographic, Piktochart

- Signs: **Abortion, infertility**, decreased production
- Symptoms: recurrent fevers, nonspecific
- Vaccines: *Brucella* vaccines for livestock are largely unavailable and ineffective in many developing countries
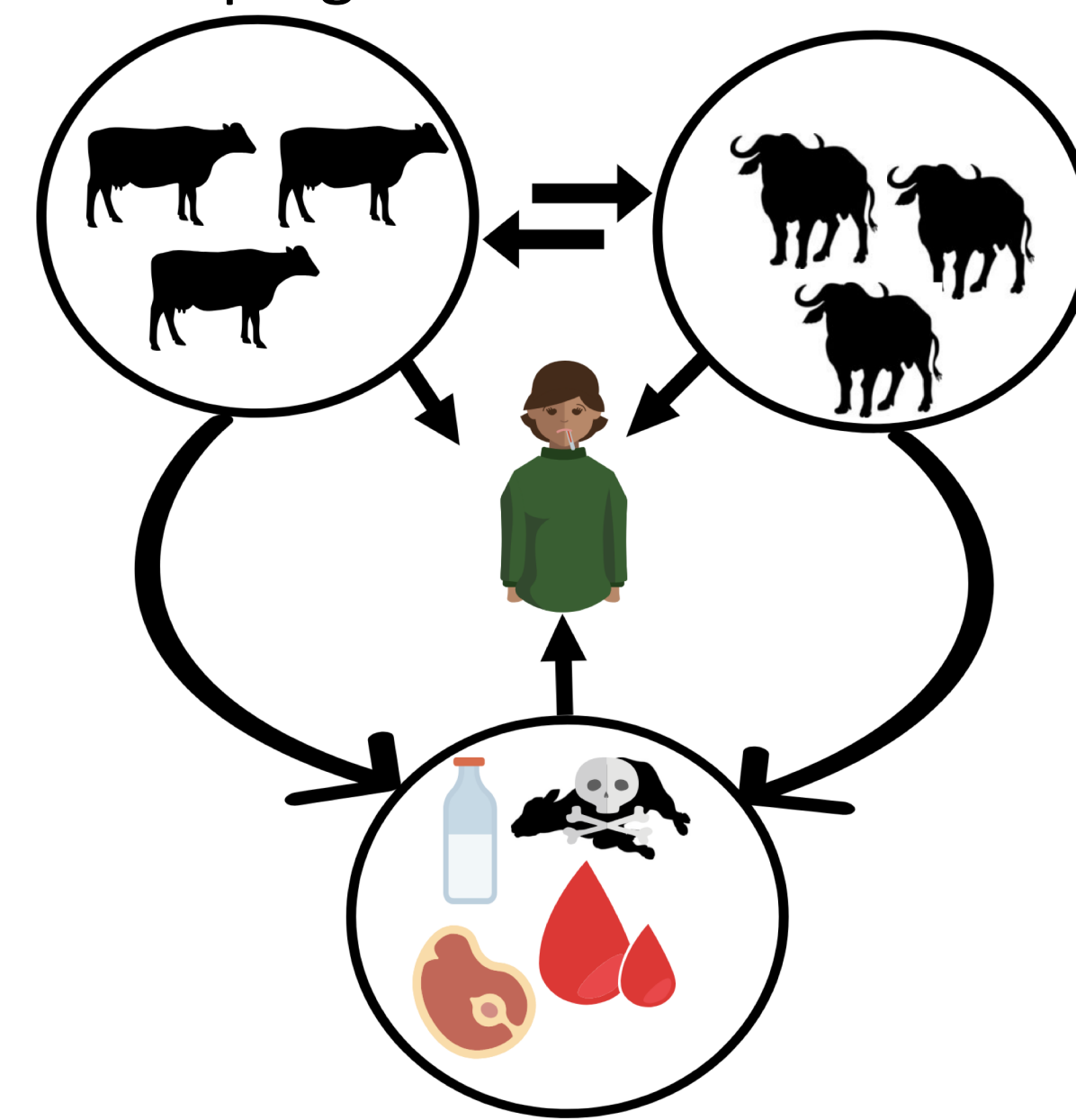
- This study expanded upon research conduct by the **HALI** (Health for Animals and Livelihood Improvement) Project in three south-central Tanzania districts: **Iringa region, and Kilombero River Valley and Ulanga districts in the Morogoro region**. These distinct geographic regions provided unique ecosystems primarily populated by **pastoralists/agro-pastoralists** relying on livestock for livelihood

Fig. 2. Africa, Tanzania Highlight. Courtesy of JCDecaux

- Determining animal husbandry, demographic, and spatial risk factors for brucellosis will help **increase Tanzania's ability to mitigate brucellosis** and implement **One Health biosafety** practices

AIMS

1. **Determine epidemiological risk factors** associated with *Brucella* infection in livestock and humans using logistic regression analyses.
2. **Gain hands-on experience** collecting blood samples, performing Rose Bengal Plate and ELISA testing, and learning statistical analysis methods.

METHODS

- Utilized **HALI data** collected and archived in a cross-sectional study on brucellosis prevalence in livestock and humans and potential infection risk factors over the past 3 years
- **4,464 livestock** blood and serum samples taken from **193 livestock herds** in the Iringa and Kilombero River Valley Regions
- **4,792 human** blood and serum samples collected from **five health clinics in Iringa** rural district and **four health clinics in the Kilombero and Ulanga** districts
- **Demographic information** was collected and **structured questionnaires** were administered to assess human participants' and livestock's exposure risk factors
- Serum was screened for *Brucella* antibodies using **the Rose Bengal Plate Test** (RBPT). Confirmatory testing for RBPT positive samples was performed using **Rivanol** testing for human samples, and **ELISA** testing for livestock samples
- Data analyses were done using STATA statistical software
- Determined *Brucella* **human seroprevalence, individual animal seroprevalence, and herd seroprevalence**
- **Exposure risk factors** were assessed for humans, individual animals, and livestock herds using logistical regression analysis

Fig. 3. Blood collection from a domestic goat

RESULTS

Table 1. Mixed-effects multiple logistic regression model for factors associated with *Brucella* seropositivity in febrile human patients.

Variable	Odds Ratio (CI)[a]	P Value
Region		
Morogoro	1.0	
Iringa	8.6 (1.7-43.6)	0.004
Sex		
Female	1.0	
Male	8.6 (2.7-27.3)	0.01
Disposes of aborted livestock fetuses to dogs		
No	1.0	
Yes	4.6 (1.8-11.8)	0.01
Feeds cooked aborted livestock fetuses to dogs		
No	1.0	
Yes	5.2 (1.1-25.2)	0.002

[a] Reference categories = 1.0

Table 2. Mixed effects multiple logistic regression model for factors associated with *Brucella* seropositivity in individual livestock animals.

Variable	Odds Ratio (CI)[a]	P Value
Sex		
Male	1.0	
Female	4.3 (1.5-12.1)	0.05
Age		
<1 year	1.0	
1-2 years	1.2 (0.09-17.4)	0.872
>2 years	14.2 (1.6-124.2)	0.02

[a] Reference categories = 1.0

Table 3. Mixed effects multiple logistic regression model for factors associated with *Brucella* seropositivity in livestock herds.

Variable	Odds Ratio (CI)[a]	P Value
Purchasing livestock from neighbors	3.4 (1.0-10.2)	0.03
Sold animals that aborted	3.9 (1.4-10.4)	0.01

[a] Reference categories = 1.0

Fig. 4. Percent Seroprevalence of *Brucella*

Human (n=4,792): 0.5%
Individual Animal (n=4,464): 1.6%
Herd (n=193): 15.0%

- **Human males had 8.6 times the odds** of having *Brucella* infection compared to females
- Human participants who **disposed of aborted fetuses** had 4.6 times greater odds of *Brucella* seropositivity
- **Feeding cooked aborted livestock fetuses to dogs** increased the likelihood of human seropositivity by 5.2
- **Older cattle** were more likely to be exposed to *Brucella* than younger, and **females had 4.3 times greater odds** to be seropositive than male cattle
- Cattle with a **history of abortion** had 9.2 times the odds of being seropositive than those cattle who did not abort
- **Trading of livestock that had aborted previously** was also associated with increased seropositivity
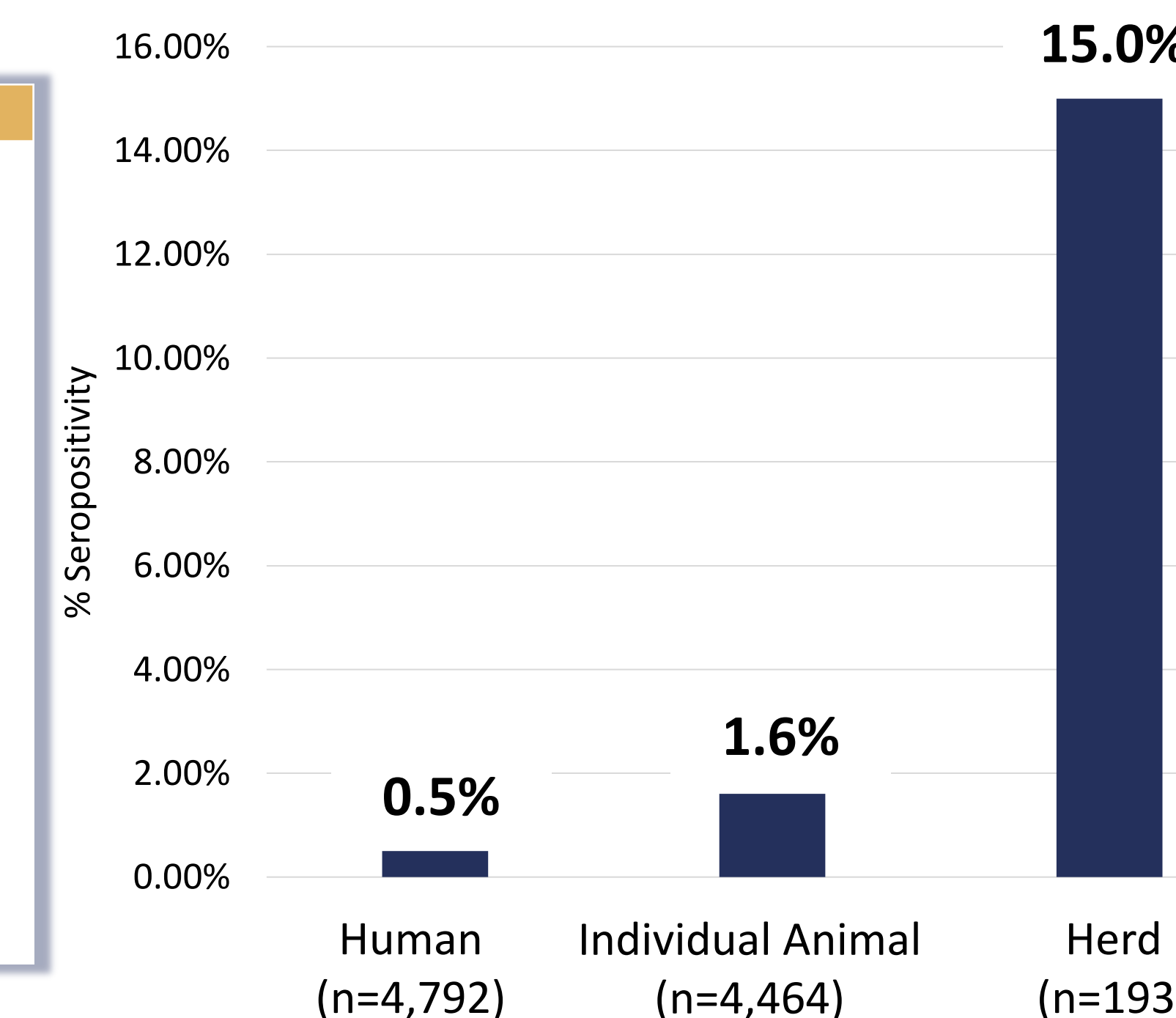
DISCUSSION & CONCLUSION

- **Human males may be at greater risk** for exposure than females due to **traditional gender-specific roles** regarding livestock keeping
- Increased odds of human *Brucella* exposure through contact with **aborted livestock fetuses and feeding of cooked livestock fetuses** to dogs may be attributed to the **action of handling fetuses**, as it is possible that the bacteria gain entry into the bloodstream through scrapes on the skin
- The association of **sex, age, and abortion** history in livestock may be attributed to **the biology of *Brucella*,** as well as variation in **animal husbandry**
  - *Brucella* can infect and replicate within cows' placenta, which can lead to abortion and expulsion of the bacteria, equating to a greater possibility for a **longer antibody response in females**
  - **Older livestock have higher sex steroid hormones & erythritol** levels which can increase growth of *Brucella*
  - **Male livestock** tend to be kept for **shorter periods of time**, thus having less opportunity for exposure from other herd members
- **Trading** infected livestock is a principal component in **introducing *Brucella* to new herds**
- This study did not find a positive association between consumption of raw milk and brucellosis; however, this has been reported as a primary risk factor for brucellosis. This finding may be attributed to participant recall bias, or lack of accurate information collection from participants
- These findings can help identify areas for **economically-reasonable intervention** in related demographic regions i.e. **sub-Saharan African countries** with impoverished **pastoralist/agro-pastoralist** communities living in **close contact with livestock**
- I developed skills in field data collection, laboratory work, and data analysis which I will be able to utilize and build upon throughout my career

ACKNOWLEDGEMENTS

Fig. 5. Performing Rose Bengal Plate Test at SUA