Seroprevalence of Rift Valley Fever virus in Urban Kenya: a Potential Public Health Burden Hiding in Plain Sight

K Gerken, E Migliore, A Kang, F Mutuku, B Ndenga, AD LaBeaud

Stanford University School of Medicine, Pediatrics; Technical University of Mombasa; Kenya Medical Research Institute.

Background and Objective

Rift Valley fever virus (RVFV) is a zoonotic arbovirus that can cause severe infections in both animals and humans and is transmitted by vectors or exposure to infected animal tissues or fluids.

Exposure to sick animals is associated with severe forms of the disease, which manifests as meningoencephalitis, blindness, and hemorrhagic fever. Thus, outbreaks of RVFV have historically been associated with rural pastoralist communities although urban livestock keeping on the African continent is common.

In this study, we aim to document a burden of RVFV in two urbanized communities in Kenya and characterize risk factors related to animal exposures and assess co-infections with other arboviruses.

Study Design and Results

Screening R-01 Cohort RVFV ELISA

Overall Seroprevalence = 1.2% (34/2,779)

Follow-Up Questions Animal exposures

*added to parent study

Exposed/Unexposed

Case-Control

In progress

Screening Demographics

- Coast: n=1,603 West=1,127
- Age: 0-85 years, mean 24
- 62% female, 38% male
- 80% Christian, 20% Muslim

38% (6/16) are kids < 14 years

Exposed Demographics

- Age: 3-66 years, mean 30 (*P*=.04)
- 44% female, 56% male (*P*=.03)
- Children <5: 2.9% of total exposed
- Children 5-17: 17.6% of total exposed
- 87% Christian, 13% Muslim
- 82% are co-exposures with DENV or CHIKV
  - DENV: Kisumu 6%, Ukunda 36%
  - CHIKV: Kisumu 24%, Ukunda 18%

Populations '19 census
Coast (Ukunda) 77,686
West (Kisumu) 721,082

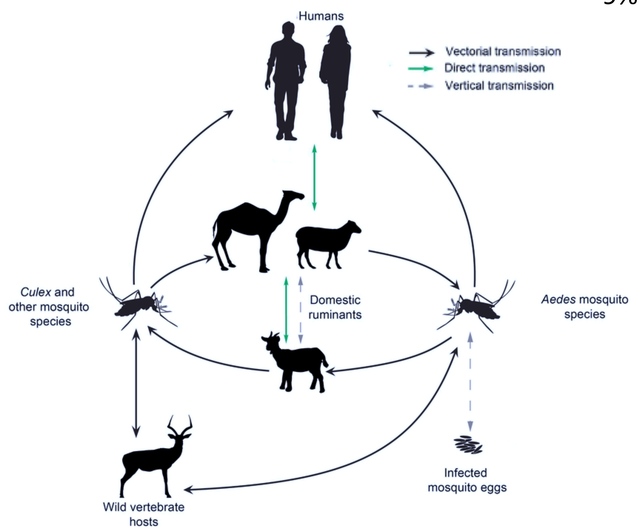
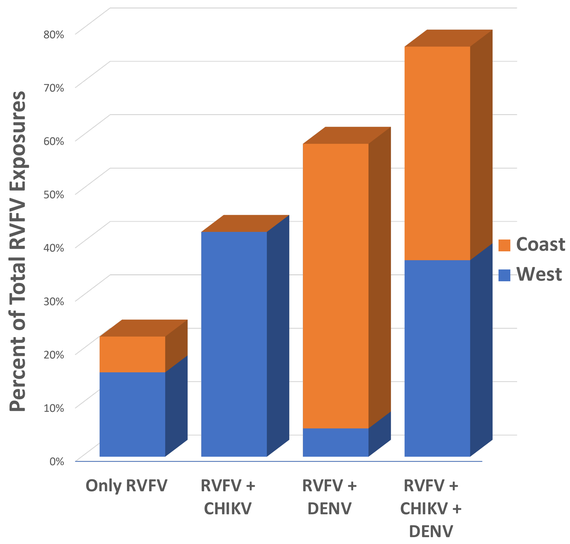


Fig1 Seroprevalence by Zone

West (Kisumu) 1.7%		
A	3/206	1.5%
B	7/223	**3.1%**
C	6/283	**2.1%**
D	1/169	0.6%
E	1/150	0.7%
F	1/116	0.9%
Coast (Ukunda) 0.9%		
J	2/226	0.8%
K	5/309	1.6%
L	2/259	0.8%
M	2/156	1.3%
N	0/63	0.0%
P	2/345	0.6%

Fig 2. Co-exposures with Other Arboviruses



Animal Exposure Results from Follow-Up

- Low overall animal ownership, but higher rates of seeing animals around home for seropositive participants. (Fig 3)
- 85% of seropositive participants report daily mosquito bites (*P*=.1)
  - 69% daytime, 87% nighttime
- Of the participants that had a fever in past 6 months, those with RVFV exposure less likely to seek medical care (*P*=.04)
- Seropositive participants more likely to consume raw milk (*P*=.01)
- Beef was heavily consumed and sourced primarily as cuts from butchers
- 9% of cohort handling animal blood for consumption

Fig 3. Proportion of Seeing Animals Around Home

RVFV ELISA	Neg	Pos	*P*=
Dairy Cows*	16%	23%	.4
Cattle*	23%	35%	.2
Goats*	43%	70%	.02
Sheep *	7%	6%	.8
Poultry	46%	71%	.04

*Important for maintenance

Conclusions

- Co-infection rates with RVFV other arboviruses is common (Fig 2)
- Animal contributions to viral circulation may not be through direct ownership in the urban setting
- Raw milk and beef consumption may be important risk factors in urban settings
- Consumption of animal blood is practiced in urban areas
- Children in Western Kenya may be exposed to RVFV at higher rates (Fig 1)

Discussion and Next Steps

- Underappreciation of the urban potential of RVFV undermines total global burden and is a missed opportunity for preventive measures
- High rates of co-exposures (Fig 2) with other arboviruses and seeing more animals around seropositive households (Fig 3) could indicate that there are localized hotspots between animal hosts and vectors within small geographical areas in urban zones
- Urban risk factors may differ from previously identified rural risk factors and more in-depth investigation will be achieved through the planned case-control study

Key References

1. Alarcon P, Fèvre EM, Muinde P, Murungi MK, Kiambi S, Akoko J and Rushton J (2017) Urban Livestock Keeping in the City of Nairobi: Diversity of Production Systems, Supply Chains, and Their Disease Management and Risks. Front. Vet. Sci. 4:171
2. Grossi-Soyster EN, Lee J, King CH, **LaBeaud AD**. (2019) The influence of raw milk exposures on Rift Valley fever virus transmission. PLoS Negl Trop Dis. 2019 Mar 20;13(3):e0007258. doi: 10.1371/journal.pntd.0007258.
3. Gray GC, Anderson BD, **LaBeaud AD**, Heraud JM, Fèvre EM, Andriamandimby SF, Cook EA, Dahir S, de Glanville WA, Heil GL, Khan SU, Muiruri S, Olive MM, Thomas LF, Merrill HR, Merrill ML, Richt JA. Seroepidemiological study of interepidemic Rift Valley fever virus infection among persons with intense ruminant exposure in Madagascar and Kenya. Am J Trop Med Hyg. 2015 Oct 12. PMC: 4674260
4. World Health Organization (WHO) (2018). Rift Valley Fever Key Facts. https://www.who.int/csr/don/18-june-2018-rift-valley-fever-kenya/en/

Acknowledgements

Thank you to the wonderful field teams in Kenya that successfully and safely restarted work after national Covid-19 lockdowns, especially Said Malumbo and Karren Nyumbile Shaita who are leading RVFV data collection, and to our funders NIH, R01 AI102918 (ADL) and NIH Global Health Equity Scholars Program