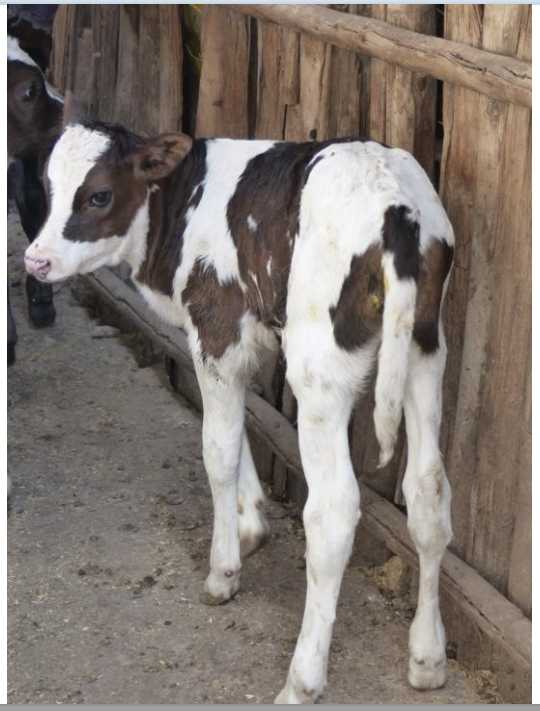

Addressing young stock mortality in smallholder farms and pastoral herds of Ethiopia

October 2016 – Sept. 30, 2020

Principal Investigator

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  University of California, Davis

Co-PI and Collaborators

- Dr. Nigatu Kebede, Addis Ababa University
- Dr. Tsegaw Fentie, University of Gondar
- Dr. Getnet Abie Mekonnen, National Animal Health Diagnostic and Investigation Center, Sebeta
- Drs. Wendi Jackson, Jennifer Lane, Gema Vidal, University of California, Davis

Objectives

1) Collect epidemiologic data on young livestock management, farm factors, feed resources, livestock disease, and socio-demography of livestock producers.
2) Assess risk factors for young livestock mortality in Ethiopia.
3) Evaluate intervention strategies for reduction of young livestock losses that align with the Livestock Master Plan.
4) Build human and institutional diagnostic and research capacities at Addis Ababa University, University of Gondar, and the National Animal Health Diagnostic and Investigation Center.
5) Provide training to extension officers and livestock keepers; and prioritize involvement of women in all study components.

Young Stock Mortality Project Overview

Introduction

Calves and small ruminants under 6 months of age from peri-urban dairy, mixed-crop livestock, and pastoral production systems were enrolled and tested for pathogens and syndromes causing diarrhea and respiratory diseases; household and individual level risk factors for young stock morbidity and mortality were collected and analyzed.

Methods

- Enrolled 1005 Households
- Sampled 3046 Animals
- Performed 4420 Diagnostic Tests

Tests performed:

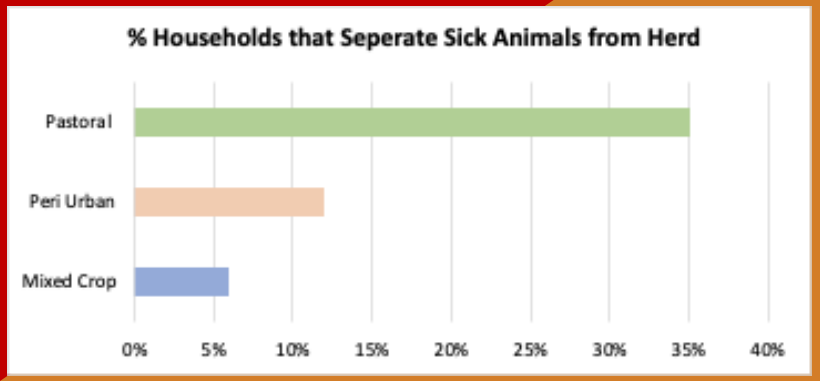
- Pathasure® Enteritis 4 enzyme-linked immunosorbent assay (Rotavirus, Coronavirus, *Cryptosp.*, *E.coli* K99)
- Bacterial Culture & Sensitivity
- Fecal Flotation
- Cytology
- Radial immunodiffusion assay (IgG)
- Serology (IBR, PIV-3, BRSV, ADV, BVDV)
- BVD Ag. ELISA

A variety of pathogens were found with diarrhea and respiratory disease in young calves in Ethiopia. Young livestock also had high rates of failure of passive transfer of immunity.

Production System

Peri-urban	Avg Herd Size	12.9
	Avg # of Calves <6mo	2.8
Mixed Crop	Avg Herd Size	5.8
	Avg # of Calves <6mo	1.2
Pastoral	Avg Herd Size	39.3
	Avg # of Calves <6mo	4.9

100 % of births in pastoral & mixed crop systems & **68%** of births in peri-urban systems occurred in the same area as the herd.



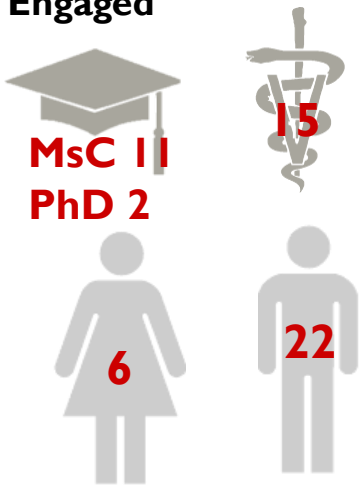
Recommendations

Basic improvements in animal husbandry, housing and colostrum feeding practices should be prioritized as first line measures to address young stock mortality.

Research Gaps & Future Opportunities

- Analyze barriers to adoption of improved colostrum feeding and other husbandry practices
- Scale up disease surveillance activities in tandem with Minimum Intervention Package led by Ethiopian ministry

Graduate Students Engaged



Common Pathogens Causing Neonatal Diarrhea in Peri-Urban Calves in Gondar, Ethiopia

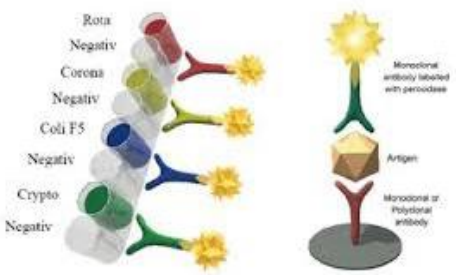
Introduction

- Calf diarrhea causes high mortality, resulting in economic losses and limiting herd expansion
- Impact of major pathogens causing diarrhea is poorly understood across Ethiopia
- Objective: to identify common pathogens causing calf diarrhea, and to evaluate their risk factors

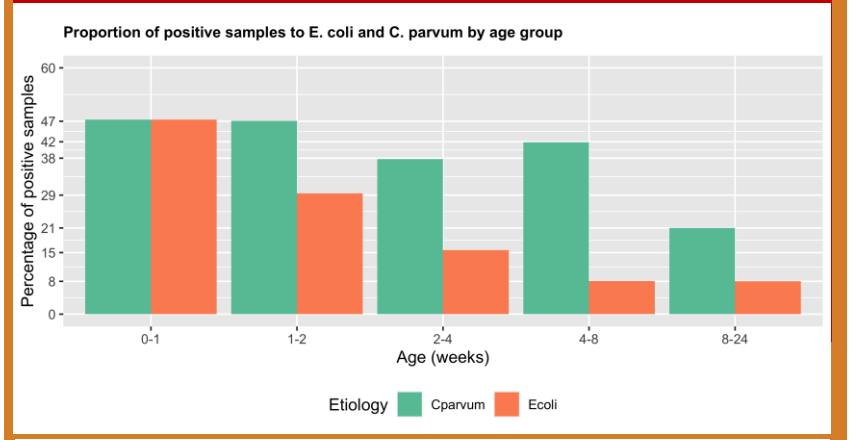
Methods

Animal data and fecal samples were collected from 283 calves less than 6 m of age and tested with Pathasure ELISA test, followed by data analysis.

Results



The most common pathogens detected in calves were ***Cryptosporidium parvum*** (32% prevalence), ***Escherichia coli K-99*** (13%), **Rotavirus** (7.5%), and **Coronavirus** (5.3%). Mixed infections with *C. parvum* and *E. coli* K-99 were detected 21% of the time.



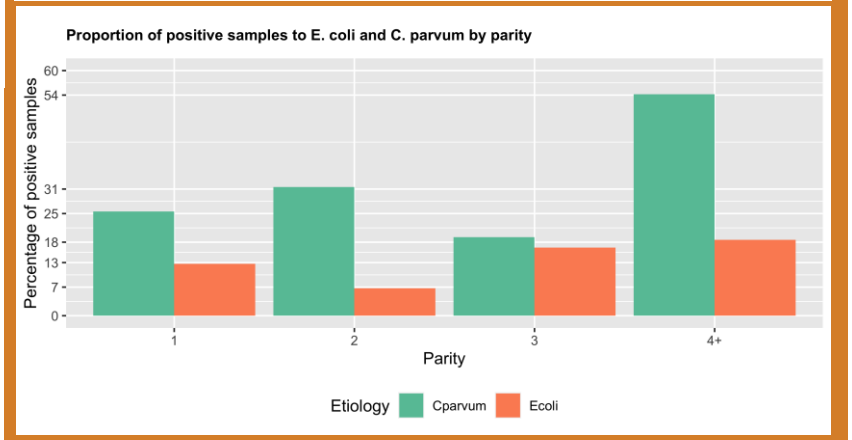


Table 1. Risk factors associated with a positive test to *E. coli* and/or *C. parvum*

Risk Factor	OR	95% C. I.
Age (weeks) ***	0.88	0.84 - 0.92
Bedding ***		
yes vs. no (ref.)	0.21	0.12 - 0.38
Parity **	1.25	1.03 - 1.52
Separate housing *		
yes vs. no (ref.)	0.37	0.14 - 0.97
Type of delivery *		
normal vs. assisted (ref.)	0.52	0.27 - 1

*** P-value < 0.001
** P-value < 0.02
* P-value < 0.05

Recommendations

- Improve husbandry practices
- Better colostrum management
- Diagnostic capacity building for laboratories and veterinarians

Future Research

- Understand the impact of pathogens in other production systems and areas across Ethiopia
- Investigation of health status in dam–calf pairs
- *C. parvum* molecular diagnostics in dams, calves, children, and water supply to address stunting

ETH_Smith_UCD (Reach)

Passive Immunity and Diarrheal Pathogens Among Pastoral Herds in Afar, Ethiopia

Wendi Jackson

Introduction

- Ruminant offspring require passive transfer (PT) of antibodies through ingestion of colostrum to protect them from infectious diseases while their immune system develops.
- Morbidity and mortality in the first 30 days of life is increased in neonates with failure of (PT) = low serum IgG = FPT
- Objective: to understand the prevalence of diarrheal pathogens and FPT in neonatal livestock; and evaluate the association between IgG status and diarrheal pathogens (in calves < 2 weeks of age) in a subset of pastoral calves.

Methods

- 6 Ethiopian grad students collected >1000 samples in Yr 1&2 in Afar region for IgG, diarrhea, or BVD
- Collected fresh feces for diarrheal Pathasure antigen ELISA assay and ear notch to determine BVD PI calves
- Serum collected to determine IgG conc. with radial immunodiffusion assay (RID)

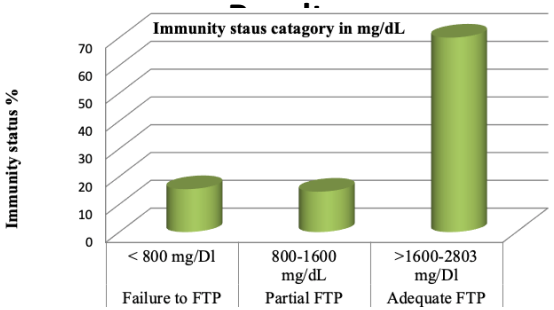


Figure: 1. Description of passive immunity status of calves in Year 1 of YSM project

Majority of calves, lambs, and goat kids sampled in pastoral herds had adequate passive transfer of immunity.

Despite this, calf diarrhea is still prevalent with *E. coli K99* and *Cryptosporidium* the most common diarrheal pathogens in single and mixed infections in sampled calves

Cryptosporidium is a zoonotic pathogen

Table 1: Evaluating the association between failure of passive transfer (IgG ≤ 1600) and individual diarrheal pathogens among a subset of 63 calves sampled in pastoral herds in Afar, Ethiopia.

Diarrheal Pathogen (n=63)	IgG ≤ 1600 case	IgG > 1600 control	Univariate OR (95% CI)	p
E. coli K99				
Negative (ref)	8 (12.6%)	47 (74.6%)	--	0.45
Positive	2 (3.2%)	6 (9.5%)	0.51 (0.08-2.98)	
Coronavirus				
Negative (ref)	8 (12.6%)	51 (80.9%)	--	0.08
Positive	2 (3.2%)	2 (3.2%)	0.15 (0.02-1.27)	
Cryptosporidium				
Negative (ref)	8 (12.6%)	39 (61.9%)	--	0.67
Positive	2 (3.2%)	14 (22.2%)	1.43 (0.27-7.59)	
Rotavirus				
Negative (ref)	7 (11.1%)	51 (80.9%)	--	0.01*
Positive	3 (4.7%)	2 (3.2%)	0.09 (0.01-0.65)	
Salmonella enterica				
Negative (ref)	6 (9.5%)	50 (79.4%)	--	0.01*
Positive	4 (6.3%)	3 (4.7%)	0.09 (0.01-0.50)	

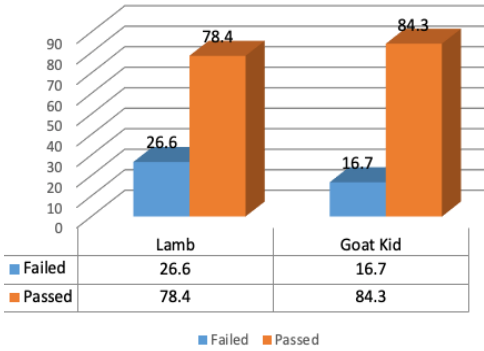


Figure 2: Lamb and goat kid passive immunity status in Yr 2 of YSM project

- FPT was associated with increased morbidity and mortality in calves during a study in Yr 1
- Of 589 calves born during a longitudinal study in Yr 1 35% developed diarrhea, and 18.5% died during the 6-month follow-up period
- Highest incident rate of diarrhea in calves born in April and Feb.
- Pastoralists in the study area often house large number of animals together in communal houses. Excreta is not cleaned allowing survival of the pathogens and probable transmission among calves

Recommendations

- Having adequate passive immunity alone isn't sufficient to protect against disease
- Husbandry, hygiene, and adequate plane of nutrition also critical

Future Opportunities

- Additional longitudinal studies to characterize other infectious and husbandry related causes of disease.
- Utilizing RT- PCR diagnostics

Reproductive Losses and Calf Morbidity & Mortality in 5 Districts of Ethiopia

Erdachew Yitagesu

Introduction

- Abortion, calf morbidity & mortality are major constraints to optimizing livestock production in Ethiopia.
- BVDV is one of the most economically important cattle disease world-wide (prenatal and postnatal calf losses, cost for diagnosis)
- Objective: to estimate prevalence of abortion, calf morbidity & mortality, and BVDV persistently infected (PI) calves across 3 production systems

Methods

- 293 household heads sampled and interviewed across 5 districts
- 786 calves included for morbidity prevalence; 1,090 live born in one year for mortality prevalence
- 918 ear-notch samples were collected from calves < 6 months of age and tested with BVDV Ag ELISA test to determine BVDV persistent infection

Results

- BVDV PI calves have low prevalence in study areas

Highest calf morbidity prevalence in mixed production system (Dalocha)

Highest calf mortality and abortion prevalence in pastoral production system (Awash Fentale)

No BVDV tested calves were positive for persistent infection

Amibara district had lowest calf morbidity; also have better quality water (underground supply) and grazing

Table 1: Abortion prevalence by district based on cow pregnancies and abortions in the previous year

Districts	Number of pregnancies	Number of abortions	Prevalence (%)	SE	95% CI
Sululta	442	11	2.4	0.7	1.3 - 4.4
Dalocha	172	2	1.1	0.8	0.2 - 4.5
Amibara	355	19	5.3	1.1	3.4 - 8.2
Awash Fentale	169	15	8.8	2.1	5.4 - 14.2
Gondar town	108	3	2.7	1.5	0.9 - 8.2
Total	1,246	50	4.0	0.5	2.9 - 5.2

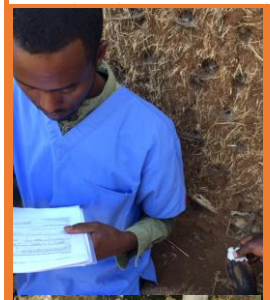


Table 2: Crude morbidity prevalence by district

District	Number of Calves (diseased)	Crude morbidity %	95% CI
Sululta	303 (24)	7.92	5.14 – 11.56
Dalocha	183 (21)	11.48	7.25 – 17
Amibara	218 (2)	0.92	0.11-3.27
Awash Fentale	82 (4)	4.89	1.34 – 12.02
Total	**786 (51)**	**6.49**	**4.87 - 8.44**

Table 3: Crude mortality prevalence by district

District	Number of calves born (died)	Mortality prevalence %	95% CI
Sululta	431 (30)	6.96	4.75 - 9.79
Dalocha	169 (7)	4.14	1.68 - 8.35
Amibara	336 (22)	6.54	4.15 - 9.75
Awash Fentale	154 (50)	32.46	25.15 – 40.47
Total	**1090 (109)**	**10.0**	**8.28 – 11.93**

The figure shows the geographical location of the study districts in their Zones and Regions.

- 83% (217/261) farmers reported feed shortage
- ~ 25.9 % (76/293 households) feed supplement to their pre-weaning calves
- ~55 % 128 /234, reported providing water to calves only once per day
- Higher body condition score was protective against disease

Recommendations

- Develop interventions to ensure animal feed availability year-round, especially during drought and in pastoral herds
- Extension outreach to communicate importance of adequate clean water and supplemental feed for calves

Future opportunities

- Investigate causes of abortion among pastoral herds
- RT-PCR testing for respiratory pathogens

Minimum Intervention Packages & Evaluation Results

Ciara Vance, Meritxell Donadeu

Introduction

- SEBI (Supporting Evidence Based Interventions, U. of Edinburgh) provided Monitoring & Evaluation (M&E) support for the implementation of the Minimum Intervention Packages (MIPs).

Methods

- With guidance from SEBI, the YSM consortium developed an M&E Framework.
- Questionnaires for the households (HH) were developed based on the indicators selected. Same HH were interviewed before the start of the project (baseline), and 12 months later (final evaluation).
- MIP, with a major focus on management and husbandry interventions, were implemented in 900 HH for 12 months across 3 different farming systems.

Mortality was reduced in calves, lambs & kids and camel calves in 6 areas of Ethiopia following 12 months implementation of Minimum Intervention Packages

		Calf mortality		Lamb/kid mortality		Camel calf mortality	
Area	Farming system	Baseline	Final evaluation	Baseline	Final evaluation	Baseline	Final evaluation
Gursum	Pastoralist	16.7%	7.0%	24.6%	9.9%	48.2%	13.8%
Awash Fentale	Pastoralist	45.6%	16.2%	44.2%	16.7%	39.8%	17.0%
Siyadebere & Wayou	Mixed - crop	6.4%	3.8%	14.6%	2.6%	N/A	N/A
Dalocha	Mixed - crop	13.8%	5.8%	27.7%	6.2%	N/A	N/A
Gondar	Peri-urban	17.9%	11.0%	N/A	N/A	N/A	N/A
Sululta	Peri-urban	24.3%	12.8%	N/A	N/A	N/A	N/A

N/A: Not Applicable (Livestock species not included for that system)

Acknowledgements: Professor Alemayehu Lemma (AAU-CVMA) and Dr Veronica Nwankpa

Number of HH in each area: 150
Baseline: March – August 2019
Final evaluation: 12 months later (2020)

Developing the M&E Framework
Ethiopia, February 2018

Results

- Management of young livestock and their dams was improved.
- The number of animals receiving colostrum, milk replacers, water and/or supplementary feed increased
- Diarrhea and pneumonia prevalence was reduced in young animals
- **Young livestock mortality was reduced in all areas for all species following implementation of MIPs**

Research gaps or future opportunities

- How can the MIPs be refined and scaled?