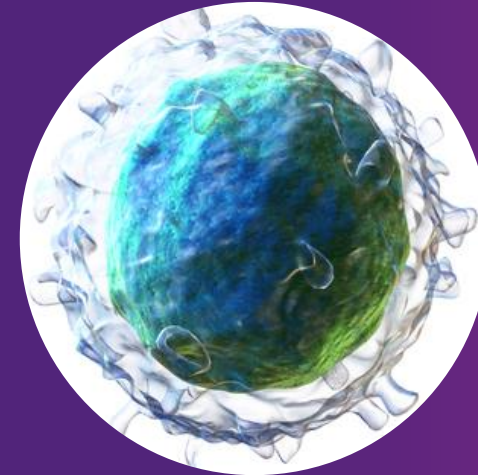
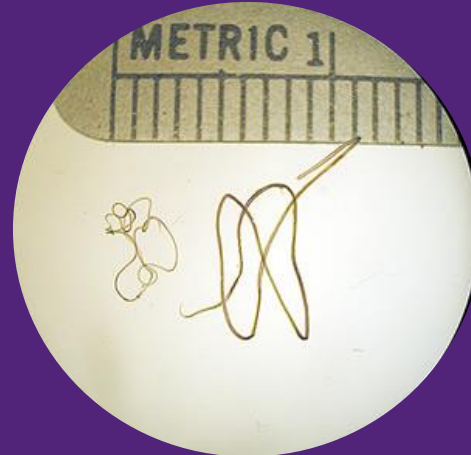


# Examining complementary indicators for lymphatic filariasis surveillance in American Samoa using Bayesian networks

*Helen Mayfield<sup>1</sup>, Patricia M. Graves<sup>2</sup>, Colleen L. Lau<sup>1</sup>*

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## ID-NET

Infectious Diseases Epidemiology



Neglected tropical diseases



Emerging infectious diseases



Travel medicine & vaccinations

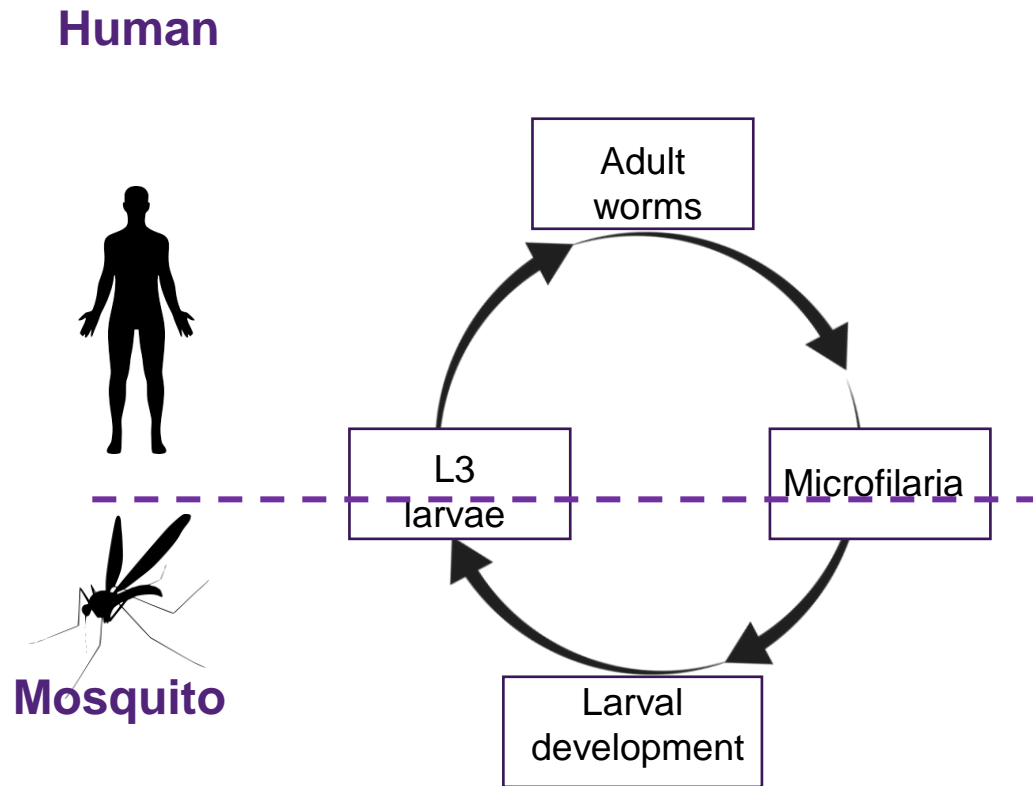
2020 Australasian Bayesian Network Society Conference,  
November 17<sup>th</sup>, 2022



# Lymphatic filariasis

- Widely endemic, mosquito-borne disease caused by infection with parasite
- Symptoms can include irreversible swelling of the lower limbs
- Most infected people are asymptomatic
- MDA is the primary strategy for LF elimination

# Lymphatic filariasis and mass drug administration (MDA)



- Treat the entire population
- Break the transmission cycle



# Surveillance and monitoring

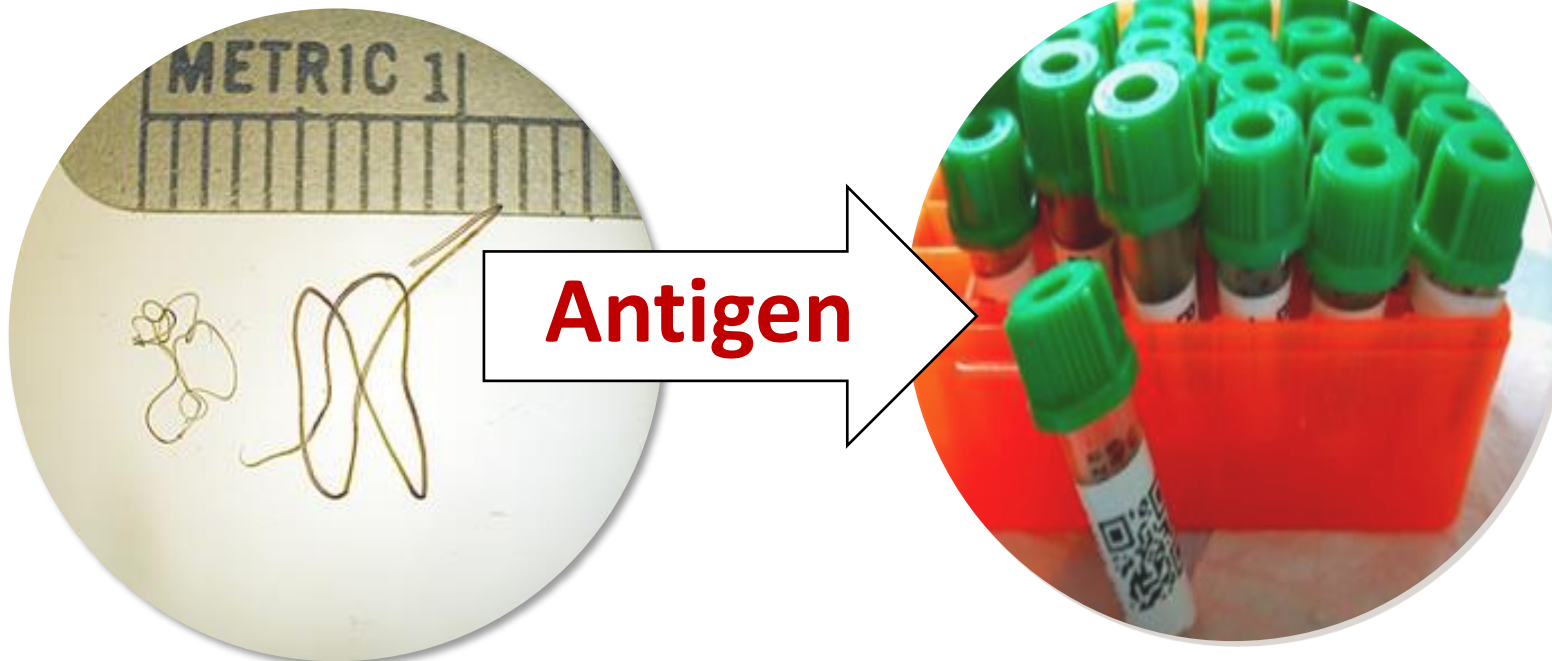
- Crucial components of Neglected Tropical Disease elimination programs
- Commonly rely on serosurveys
- Standard test for LF is Antigen
- Is that enough to make good decisions?



# Indicators of infection

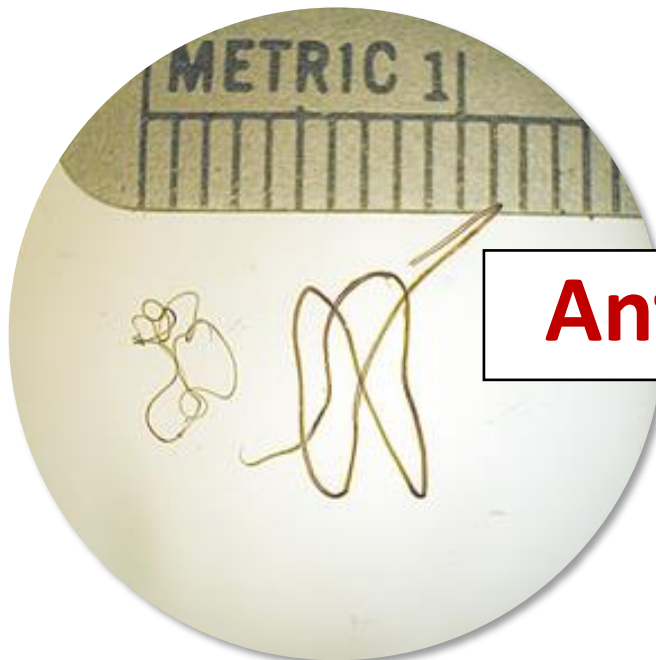


# Indicators of infection



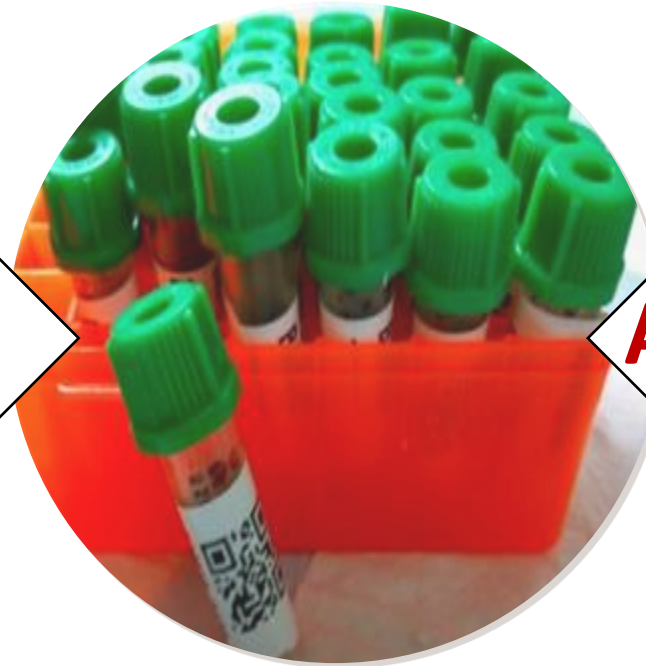
*Wuchereria  
bancrofti*

# Indicators of infection



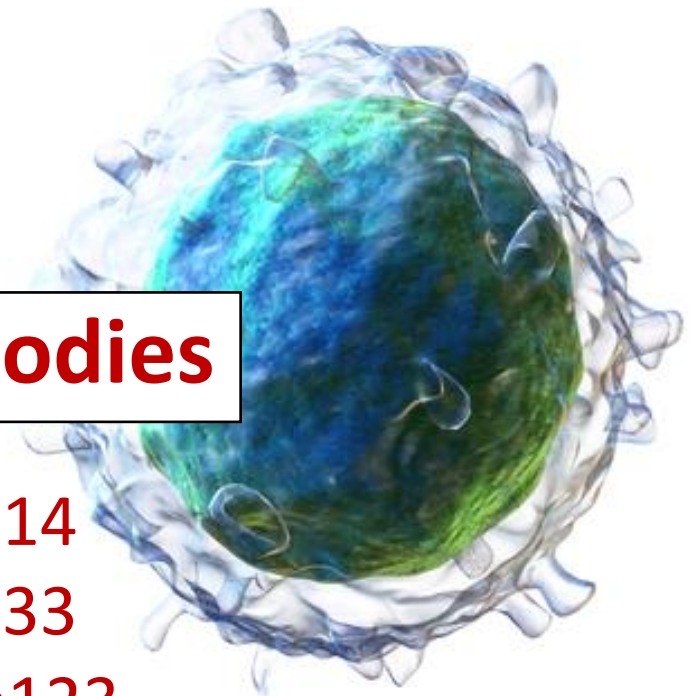
*Wuchereria  
bancrofti*

**Antigen**



**Antibodies**

- Bm14
- Bm33
- Wb123



Immune  
system



# Limitations

- Timeline for antibodies is not known
  - How long does each last?
  - How soon do they appear?
  - At what stage can we detect them?

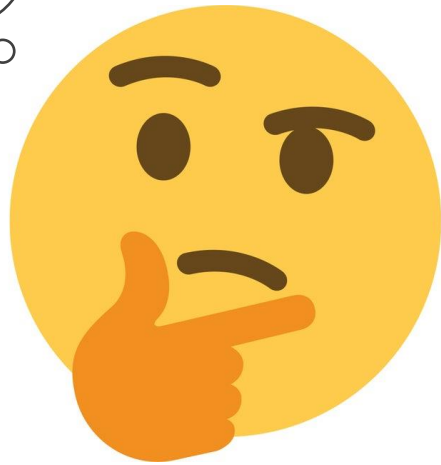




**What's the probability that this sample will be Ag positive?**



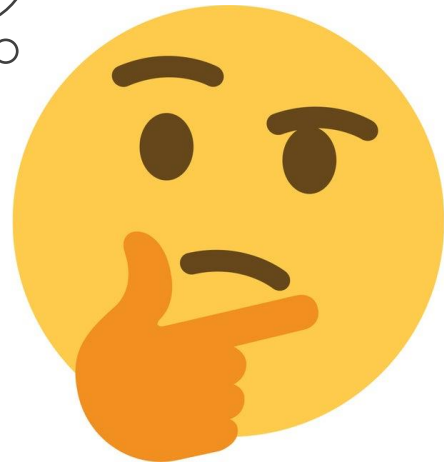
4%



Ag	
Neg	96.3
Pos	3.69



~~4%~~  
1%



Bm14	
Neg	100
Pos	0
0	

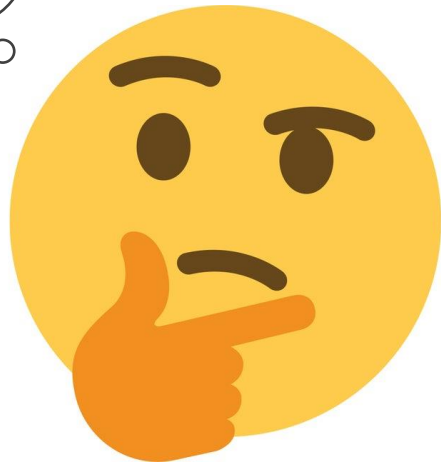
Ag	
Neg	99.1
Pos	0.89

**Evidence !**

Wb123		
Neg	100	
Pos	0	

Bm14		
Neg	100	
Pos	0	

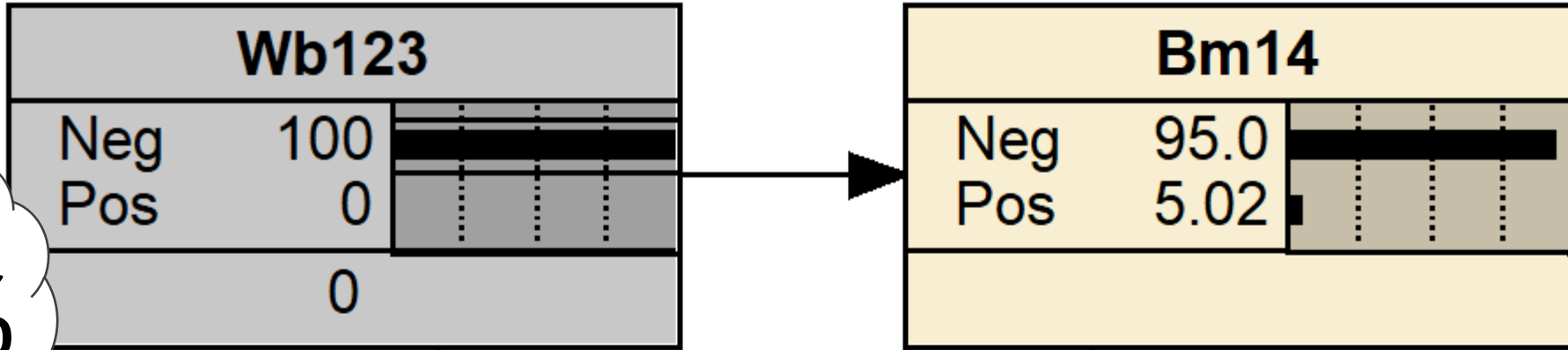
~~4%~~  
~~1%~~  
.5%



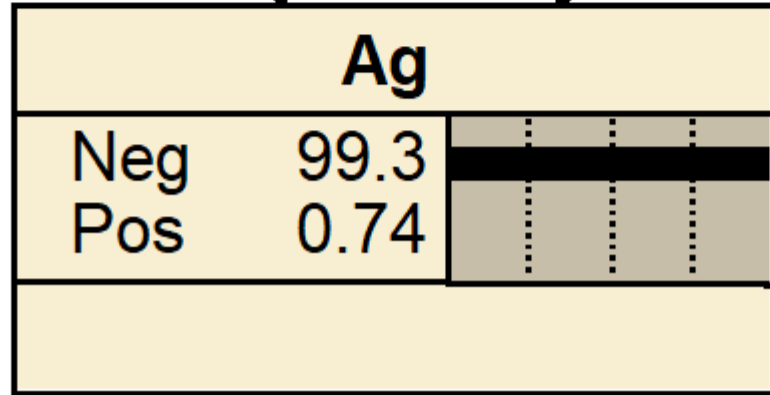
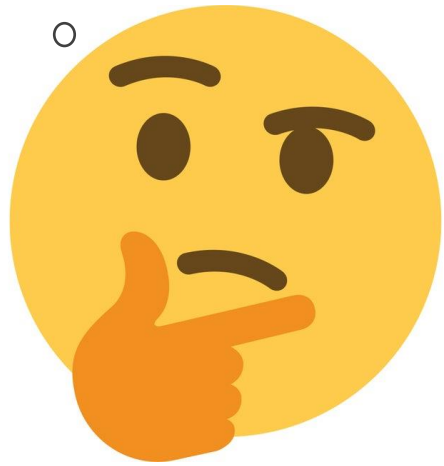
Ag		
Neg	99.5	
Pos	0.53	

**MORE  
Evidence !!!**

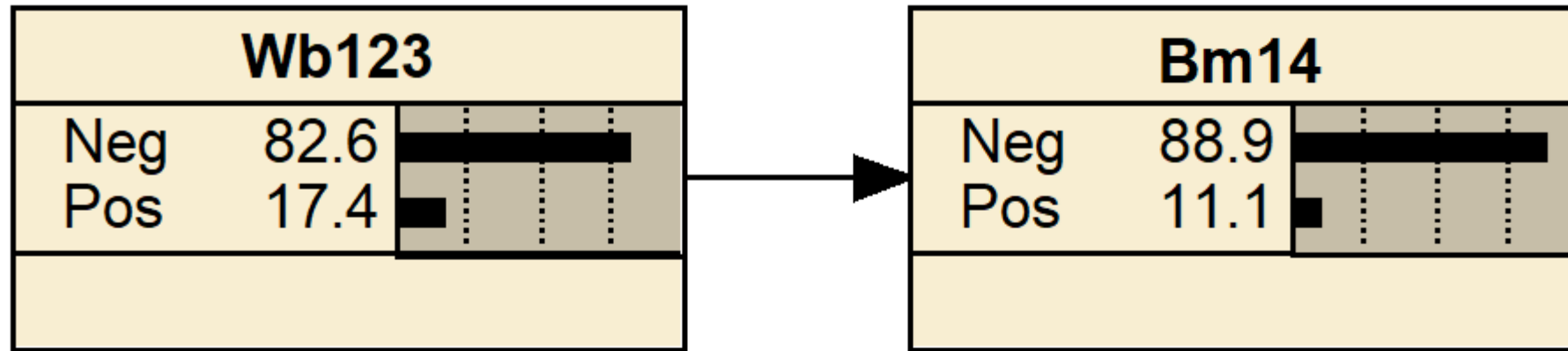




0.75%



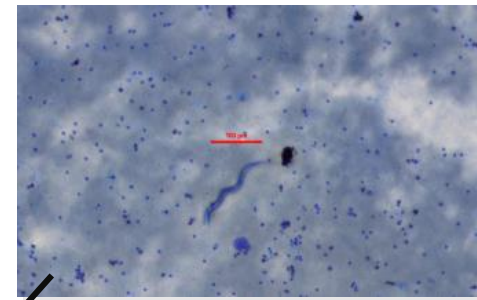
**Partial Evidence**



**Bayesian Network!**

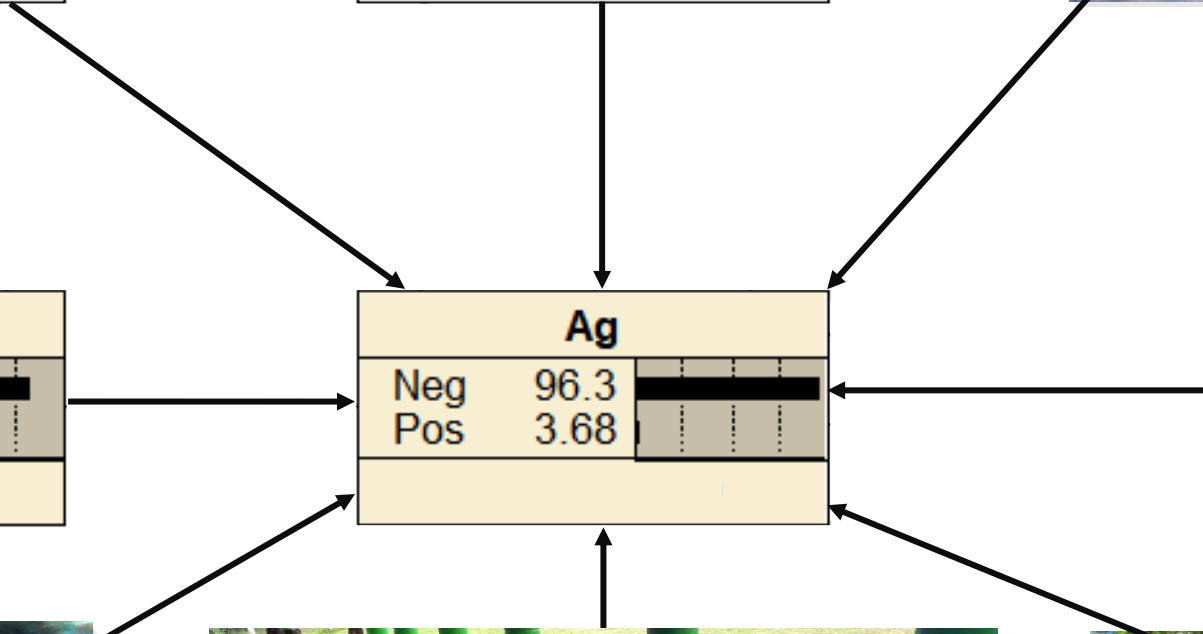
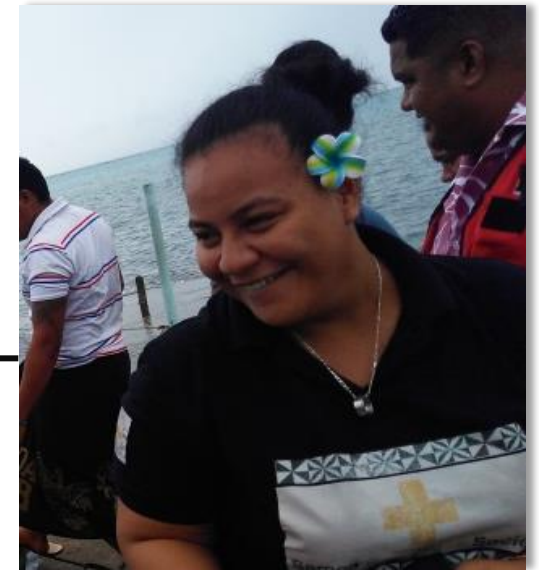
Bm14		
Neg	88.9	
Pos	11.1	

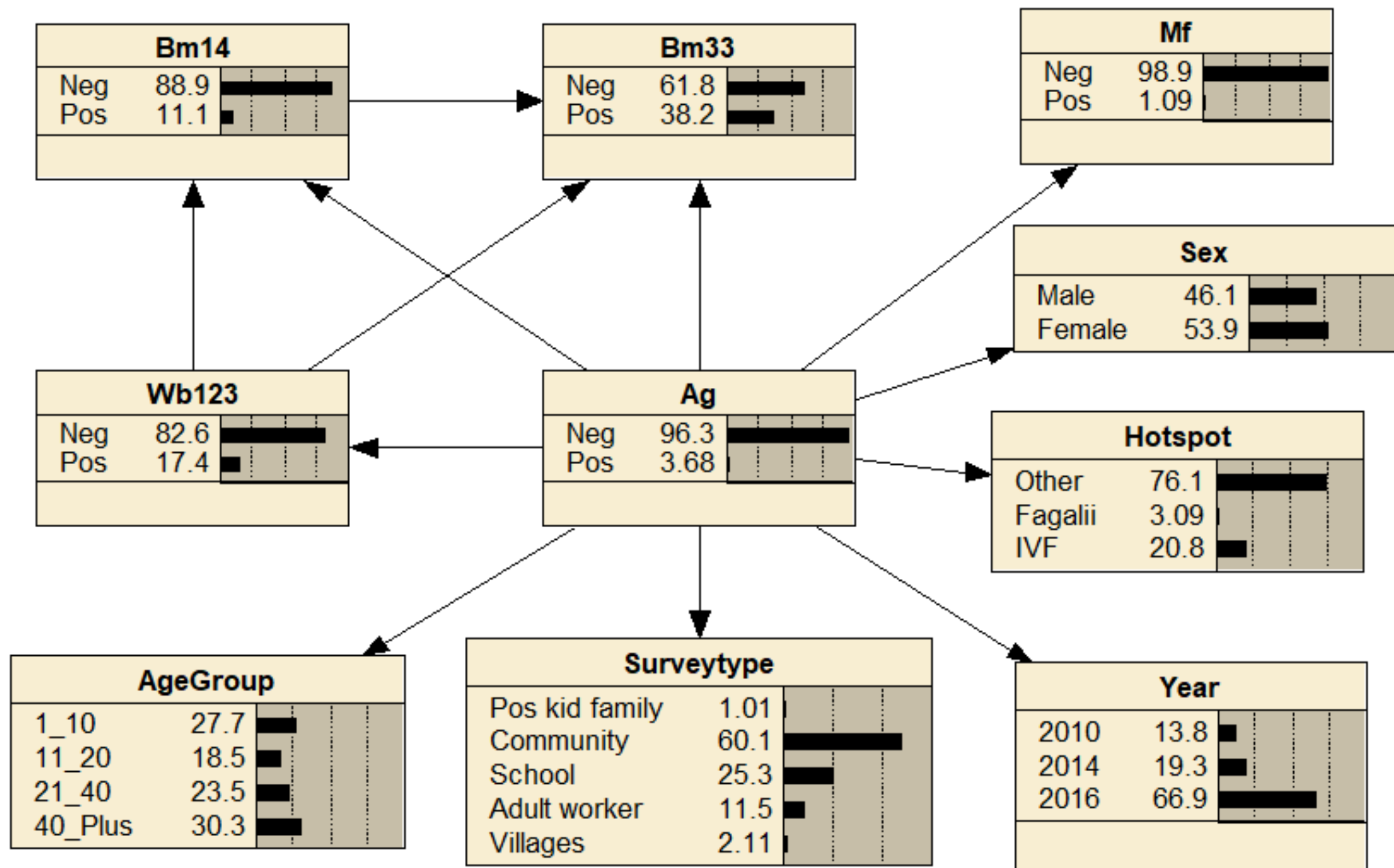
Bm33		
Neg	61.8	
Pos	38.2	



Wb123		
Neg	82.6	
Pos	17.4	

Ag		
Neg	96.3	
Pos	3.68	

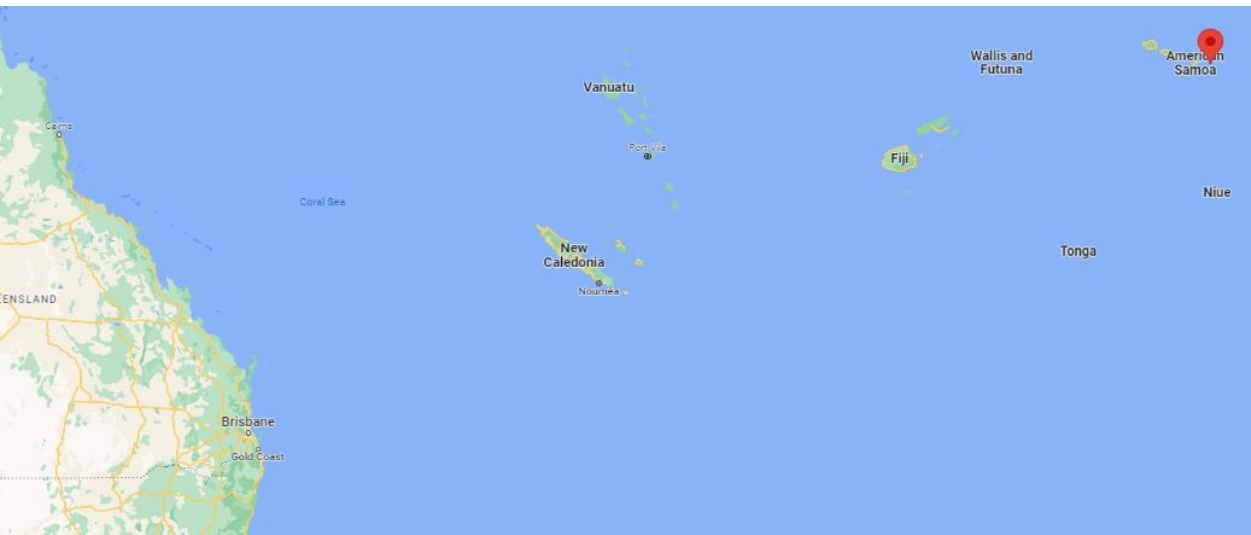




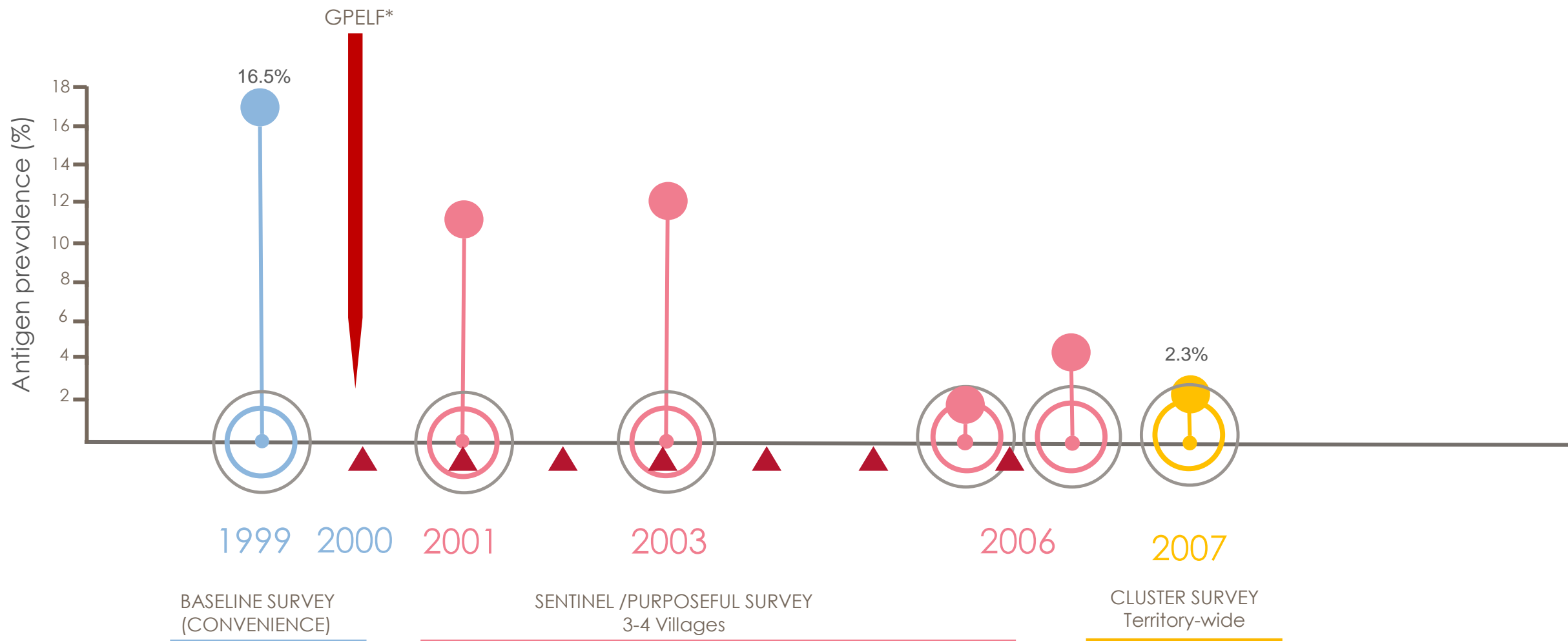


# American Samoa

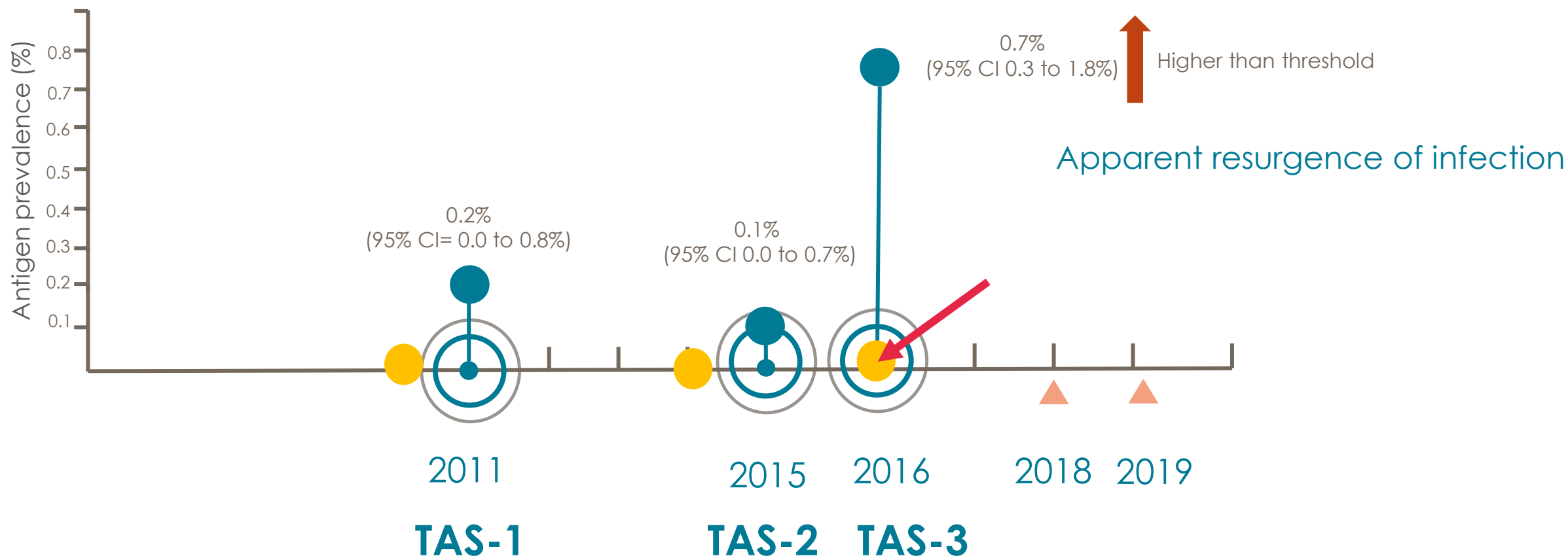
- US territory in the South Pacific
- ~ 60,000 people
- LF parasite is *W bancrofti*
- Main vector is *Aedes polynesiensis* (day-biter) night-biting *Aedes samoanus* (night-biter)



# Long history of LF elimination interventions



▲ \*GPELF: Global Programme to Eliminate Lymphatic Filariasis  
 ▲ MDA: Mass drug administration: Single dose of diethylcarbamazine (DEC) and albendazole



\*TAS: Transmission assessment survey

\*\*Ag: Antigen



Community surveys



MDA with new triple drug strategy: IDA = ivermectin, DEC and albendazole

# Lymphatic filariasis in American Samoa

- Surveys in 2010, 2014 and 2016
- 5850 samples
- Hotspots and random surveys
- Community and household surveys

OPEN ACCESS Freely available online

PLOS | NEGLECTED TROPICAL DISEASES

## Seroprevalence and Spatial Epidemiology of Lymphatic Filariasis in American Samoa after Successful Mass Drug Administration

Colleen L. Lau<sup>1,2\*</sup>, Kimberly Y. Won<sup>3</sup>, Luke Becker<sup>4</sup>, Ricardo J. Soares Magalhaes<sup>1,5</sup>, Saipale Fuimaono<sup>6</sup>, Wayne Melrose<sup>4</sup>, Patrick J. Lammie<sup>3</sup>, Patricia M. Graves<sup>4</sup>

PLOS | NEGLECTED TROPICAL DISEASES

RESEARCH ARTICLE

### Detecting and confirming residual hotspots of lymphatic filariasis transmission in American Samoa 8 years after stopping mass drug administration

Colleen L. Lau<sup>1,2\*</sup>, Sarah Sheridan<sup>1</sup>, Stephanie Ryan<sup>3</sup>, Maureen Roineau<sup>3</sup>, Athena Andreosso<sup>3</sup>, Saipale Fuimaono<sup>4</sup>, Joseph Tufa<sup>4</sup>, Patricia M. Graves<sup>3</sup>

PLOS | NEGLECTED TROPICAL DISEASES

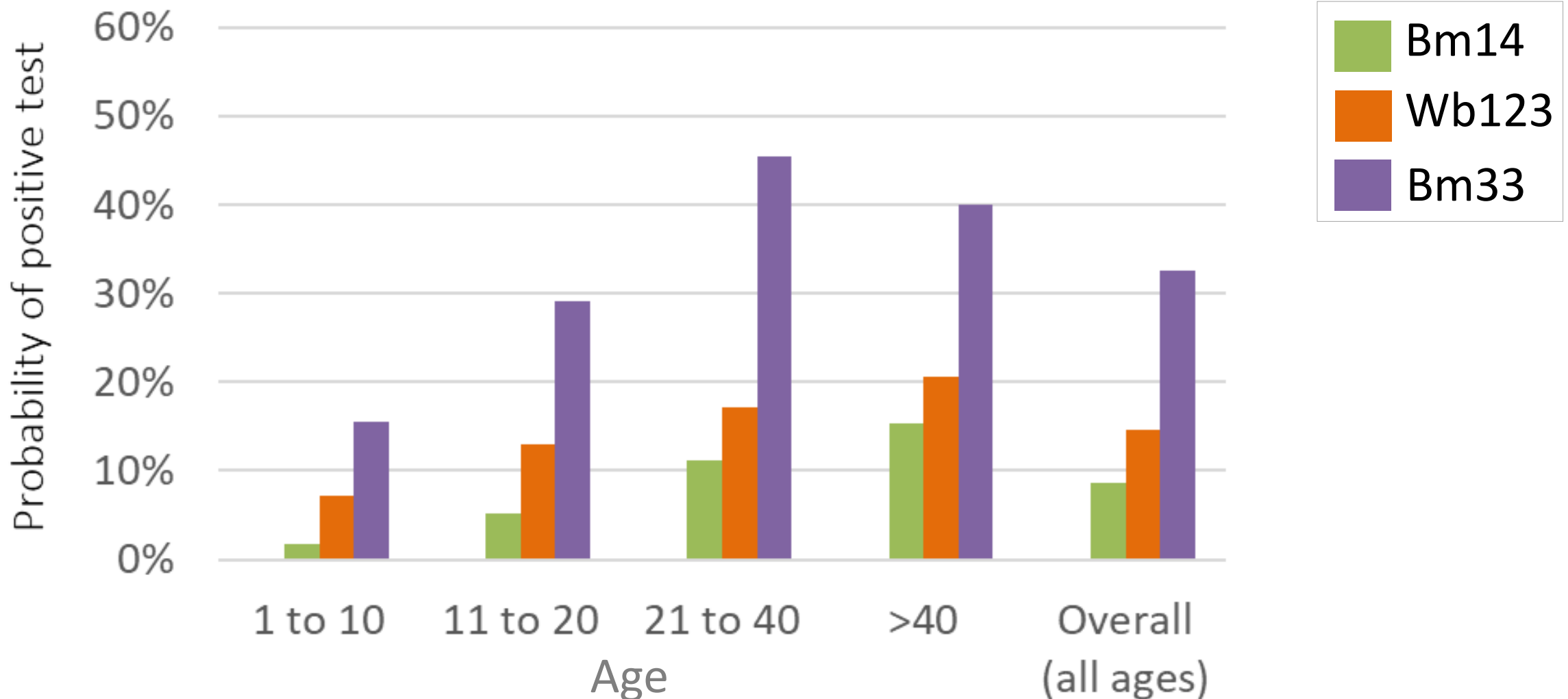
RESEARCH ARTICLE

### Identifying residual transmission of lymphatic filariasis after mass drug administration: Comparing school-based versus community-based surveillance - American Samoa, 2016

Meru Sheel<sup>1,2\*</sup>, Sarah Sheridan<sup>3</sup>, Katherine Gass<sup>4</sup>, Kimberly Won<sup>5</sup>, Saipale Fuimaono<sup>6</sup>, Martyn Kirk<sup>1</sup>, Amor Gonzales<sup>7</sup>, Shannon M. Hedtke<sup>8</sup>, Patricia M. Graves<sup>9</sup>, Colleen L. Lau<sup>3</sup>

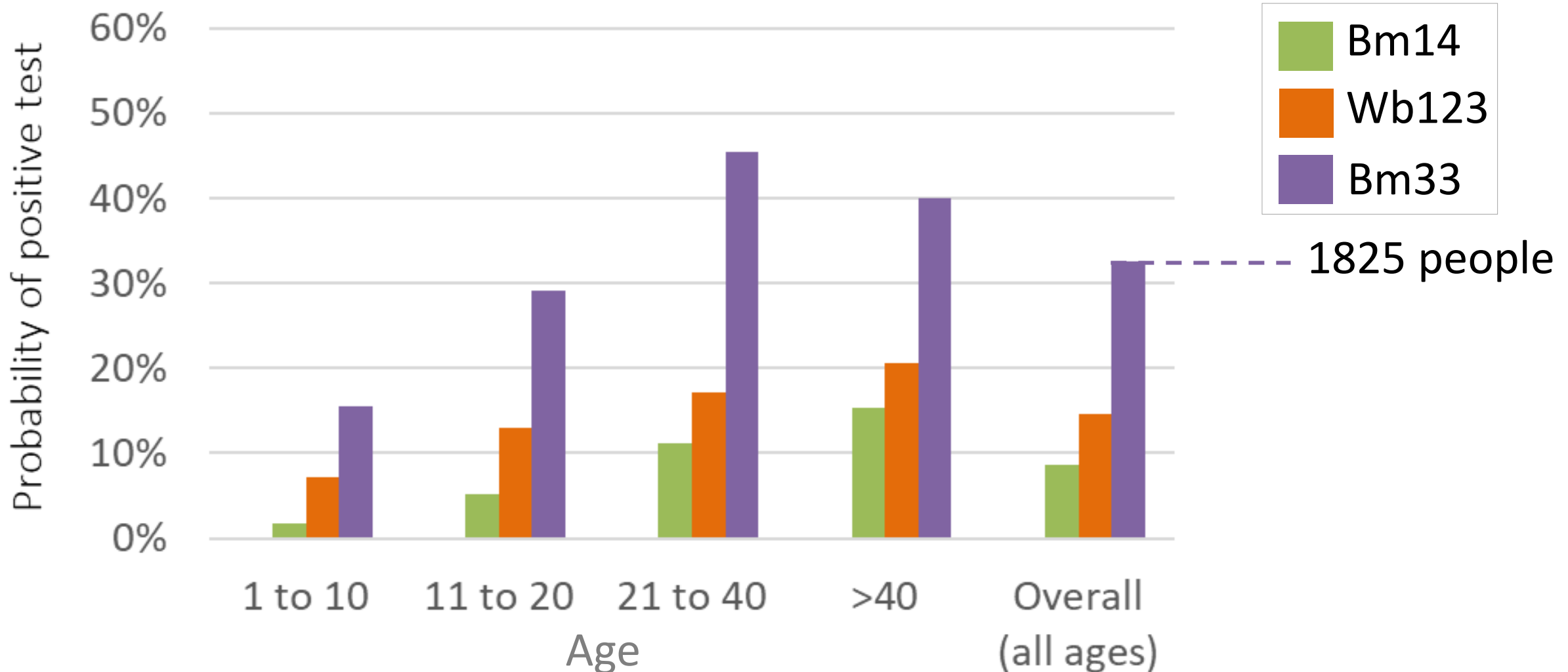


# Proportion of positive antibody results for Ag negative samples (n=5616)



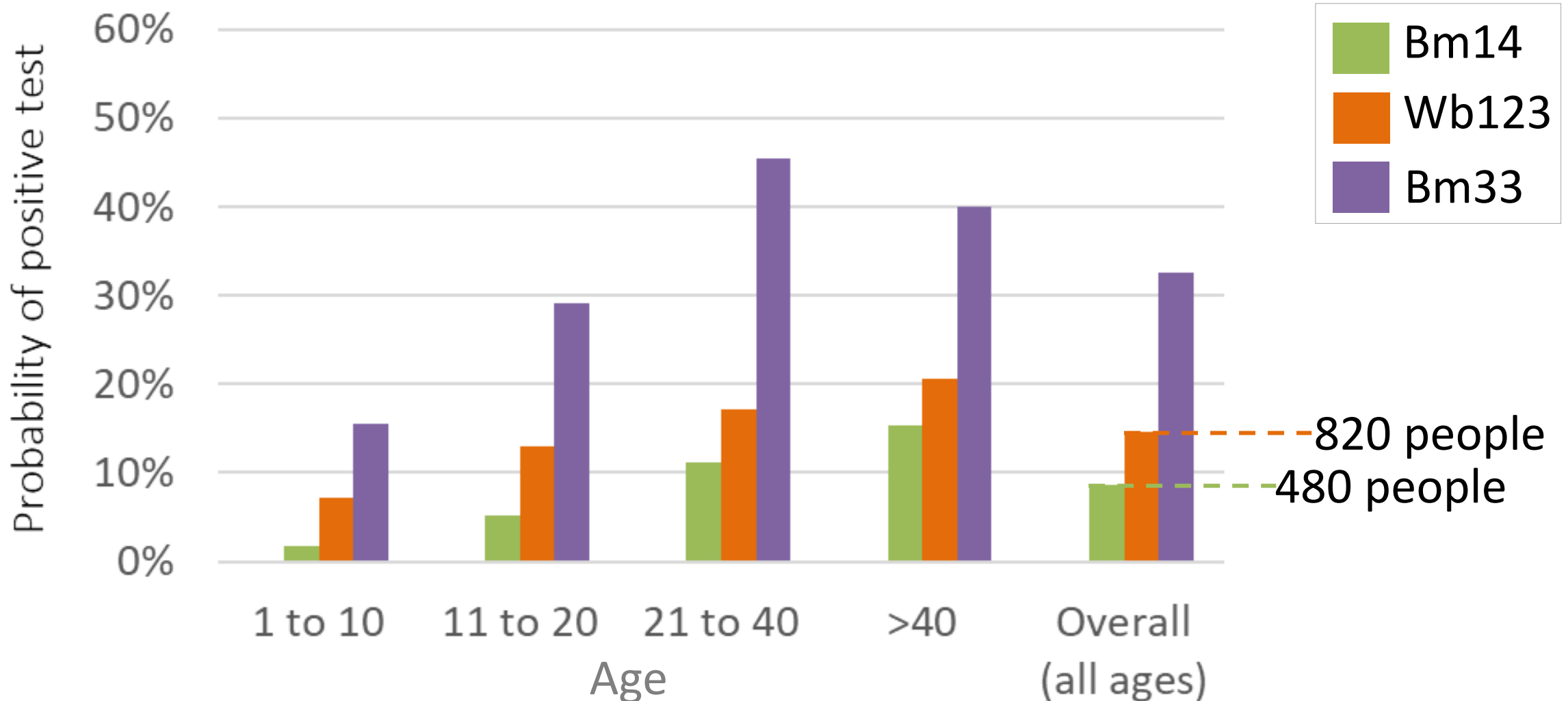
- High prevalence of **Bm33**
- Probably long lasting, so not a good indicator of infection

Proportion of positive antibody results for Ag negative samples



- Higher prevalence of **Wb123** positives than **Bm14**
- Possibly a better option than **Bm14**

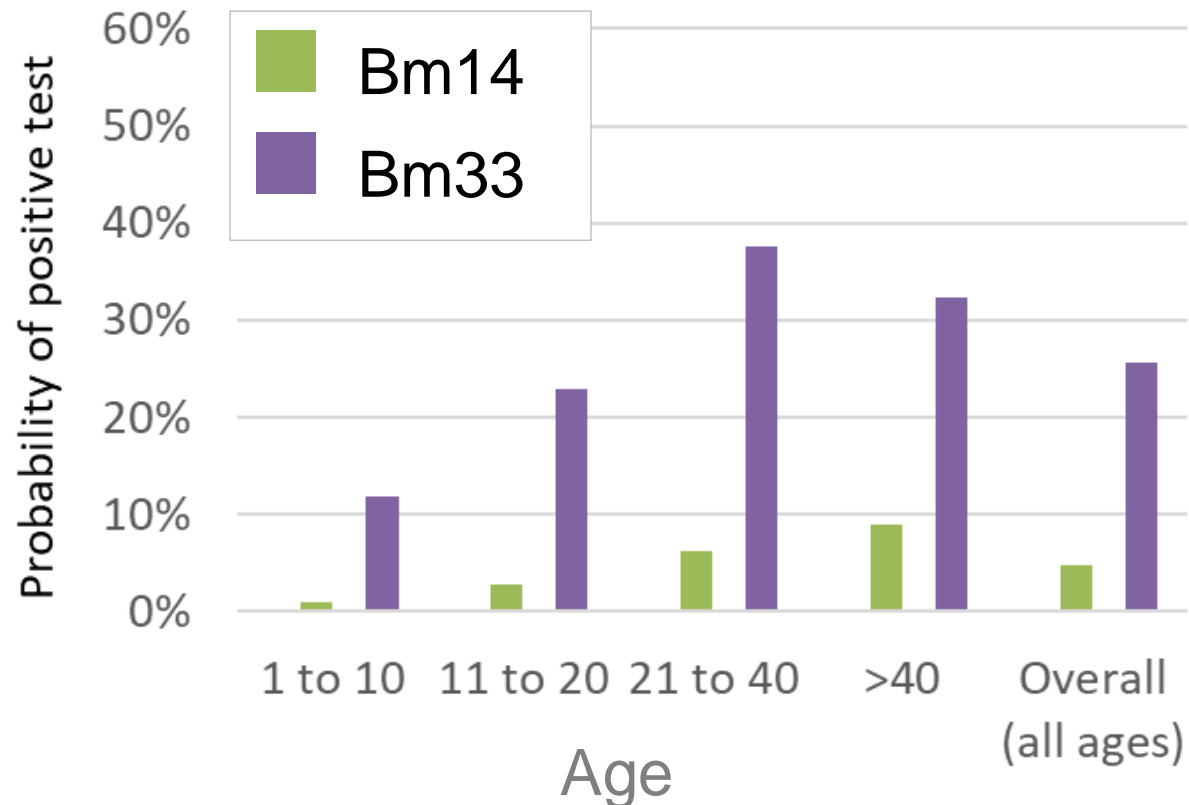
Proportion of positive antibody results for Ag negative samples



# Which combination gives the most information?

## Adding Wb123

Ag negative and **Wb123** negative (n=4620)



**Missed  
infections**

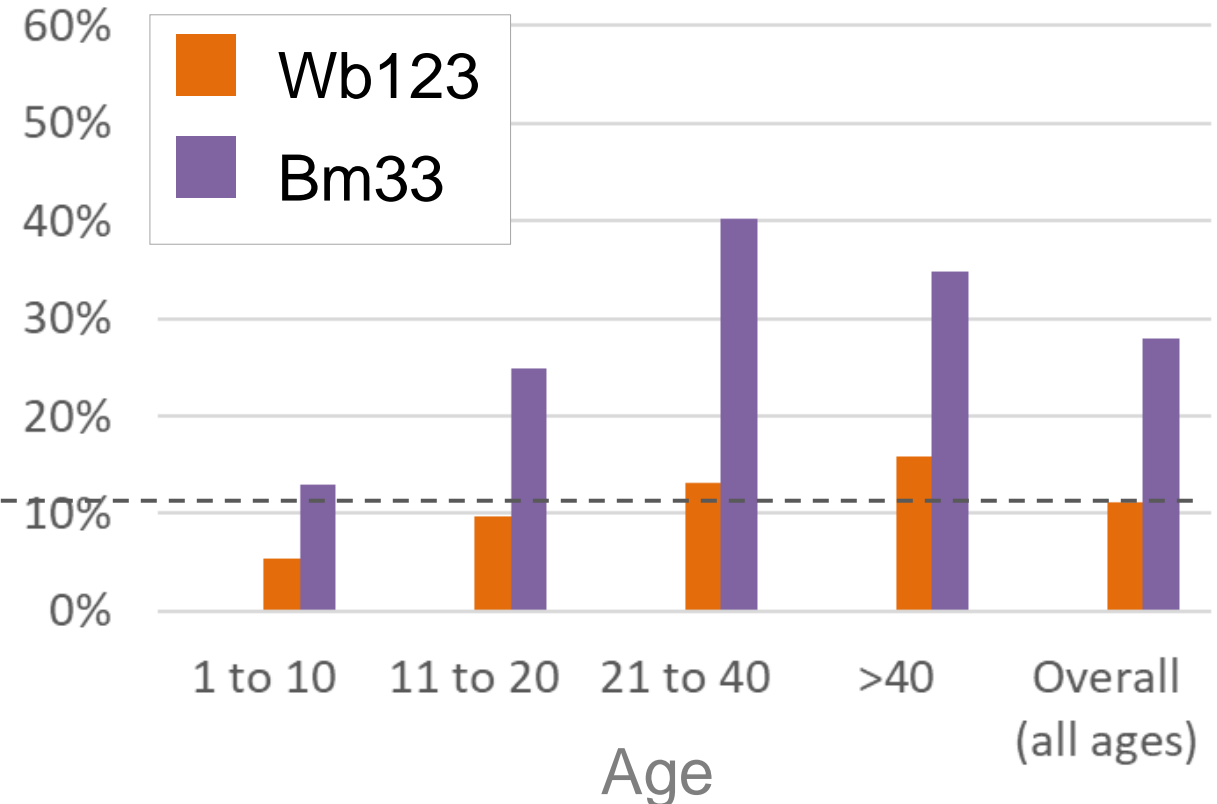
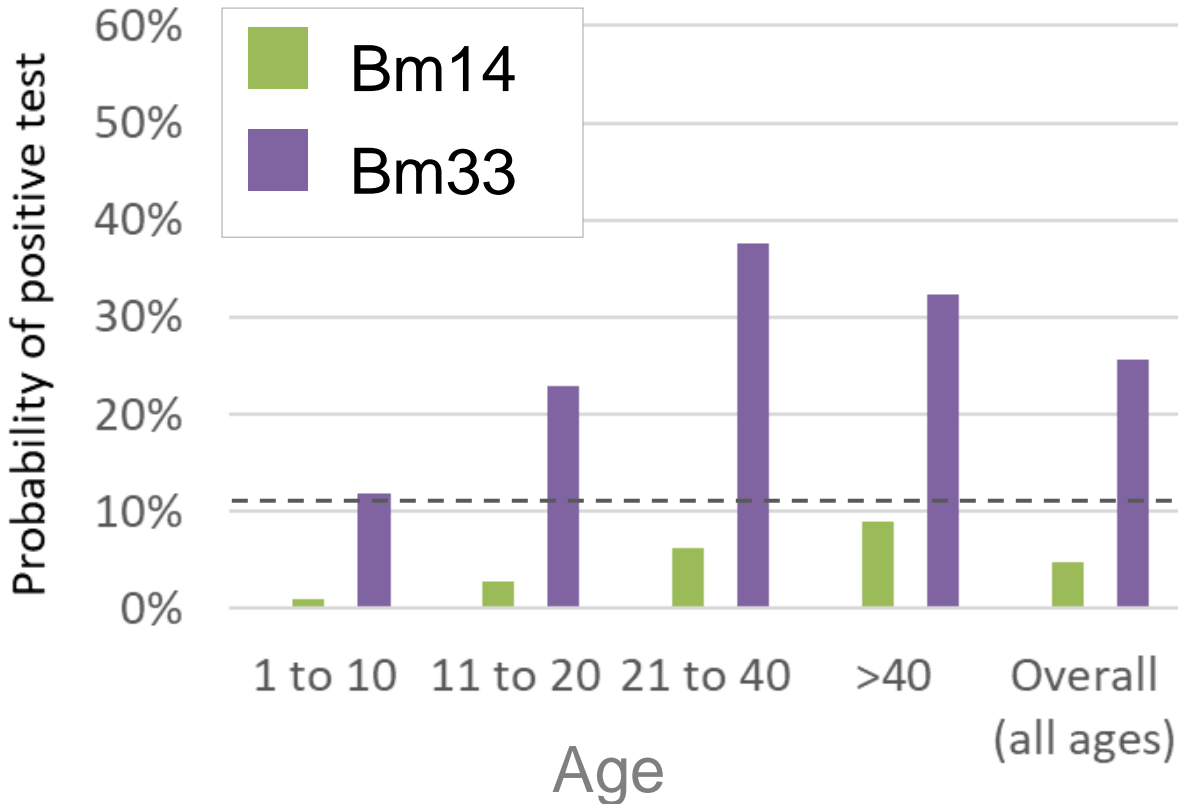
We miss fewer infections if we test for **Ag** and **Wb123**

Adding **Wb123**

Adding **Bm14**

Ag negative and **Wb123** negative (n=4620)

Ag negative and **Bm14** negative (n=5108)



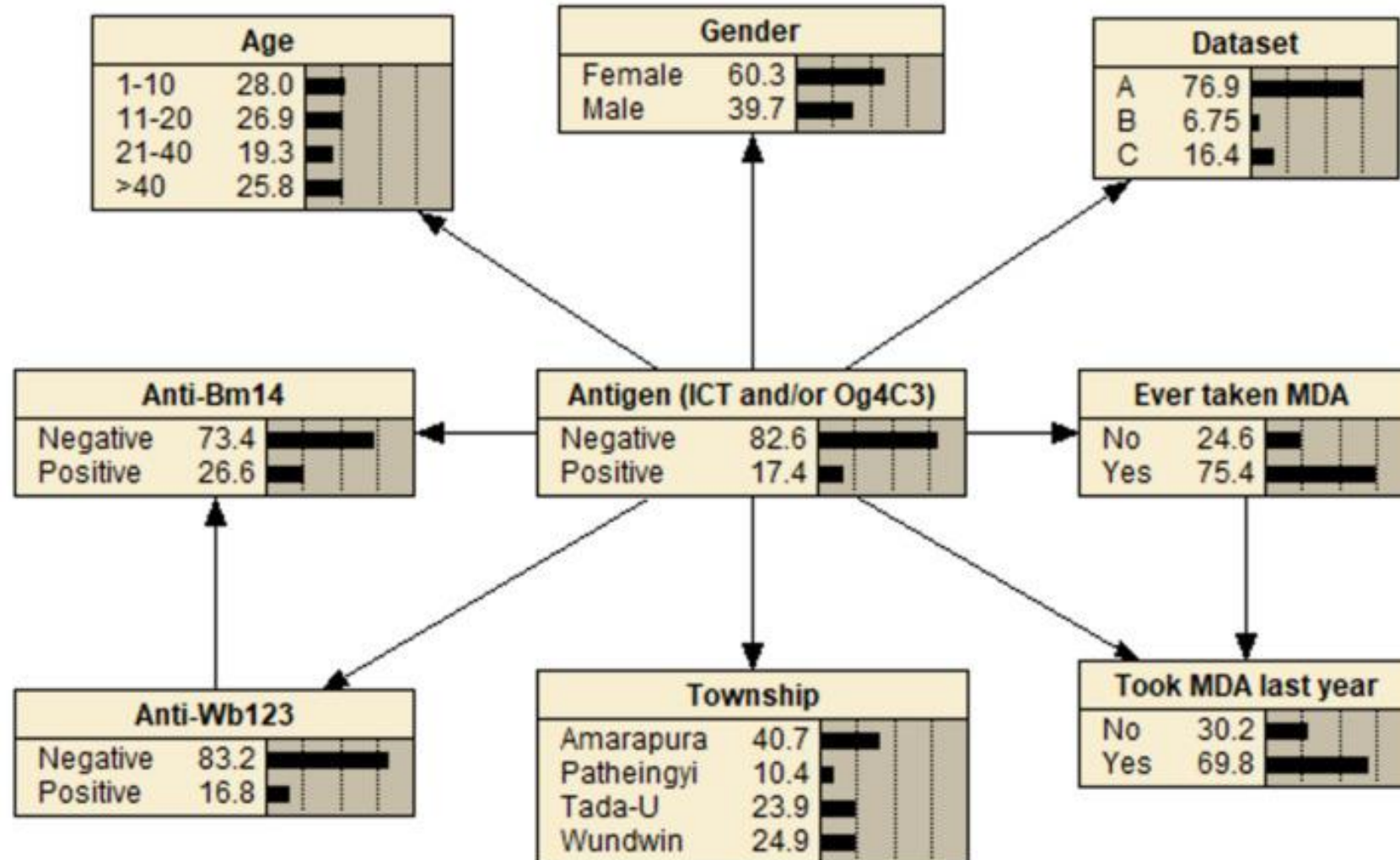


# Myanmar

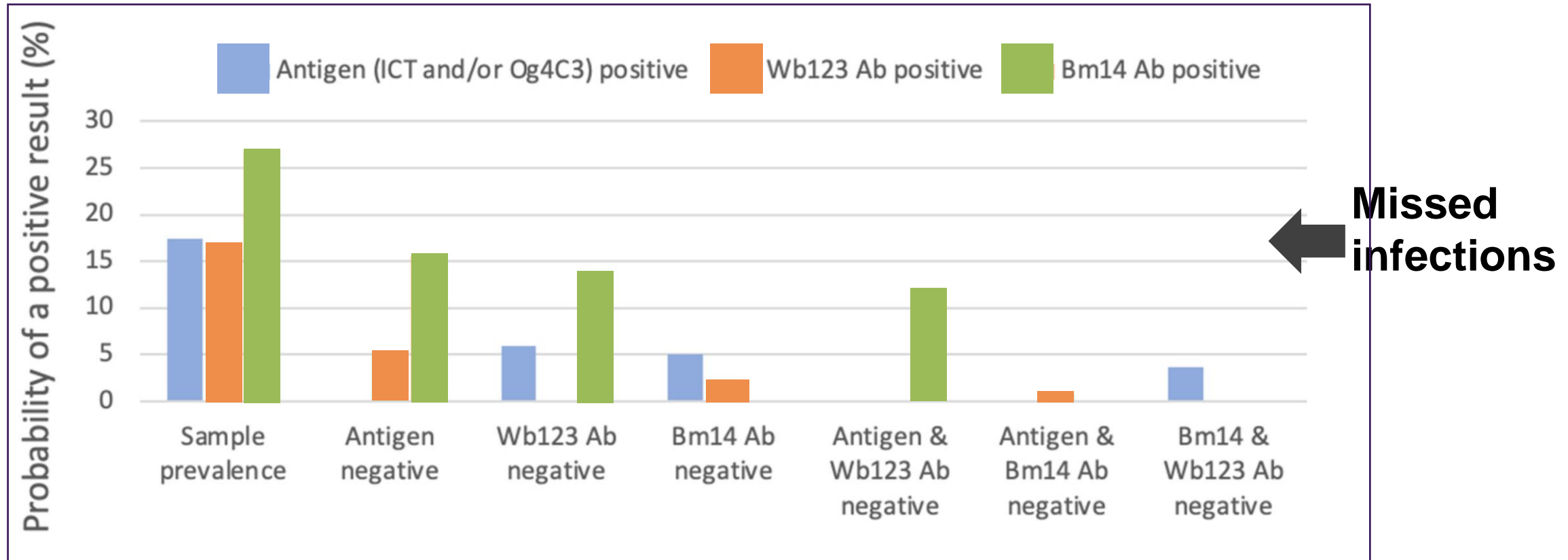
- LF parasite is *W bancrofti*
- Main vector is *Culex quinquefasciatus*
- Six non-consecutive rounds of MDA from 2004 to 2014
- 41 million (80% of the population) at risk of LF



# Bayesian networking used to detect probability of detection using antigen and antibody in Myanmar

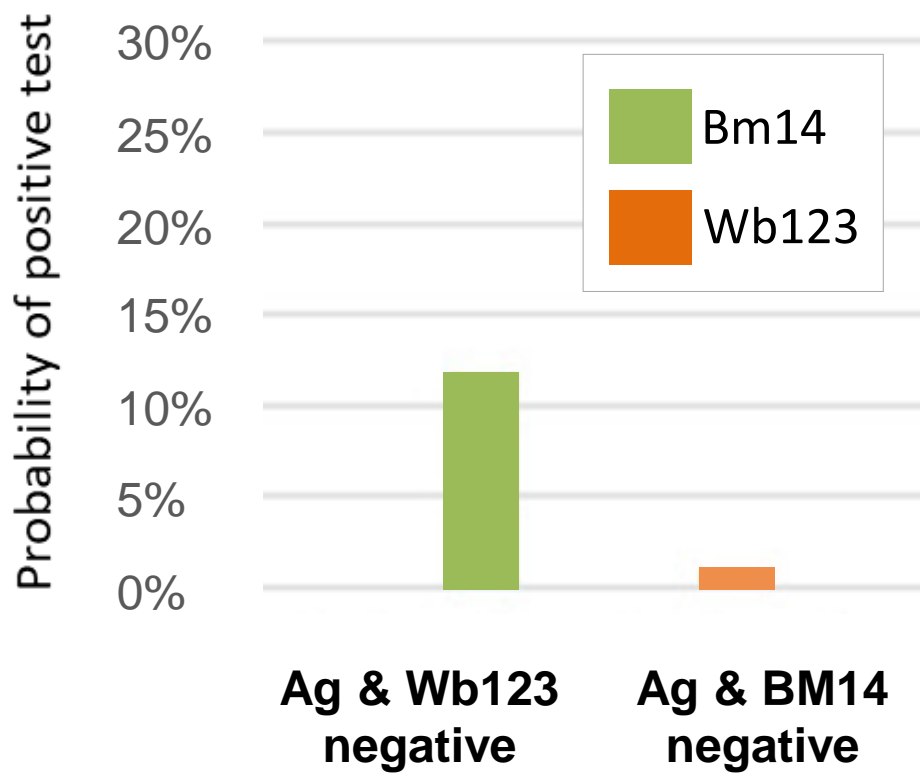
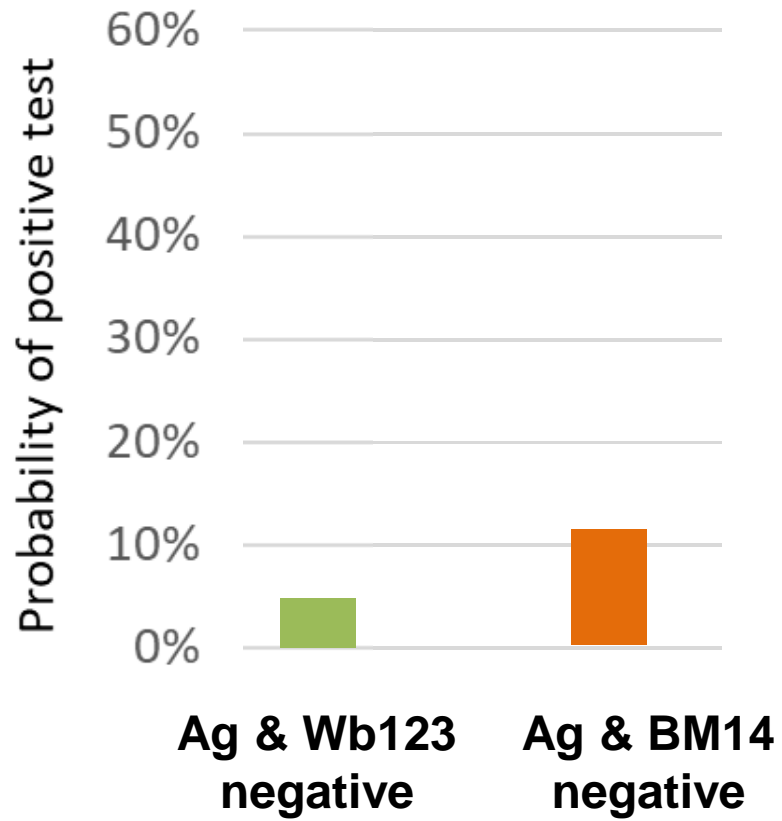


## Proportion of positive antibody results (Myanmar)



- When antigen and **Wb123** test were negative, the probability of a positive **Bm14** results antibody positive cases was 11.5%
- When antigen and **Bm14** testing were negative, the probability of a positive **Wb123** result was lower 0.88% of cases missed





# Conclusion

- Concurrent testing of antigen and antibodies helps create a bigger, more dynamic, picture of seroprevalence within the community
- Adding **Wb123** potentially provides the most information in American Samoa
- Adding **Bm14** potentially provides the most information in Myanmar
- More work is needed on what each antibody tells us





# Acknowledgements

## Funders



BILL &  
MELINDA  
GATES  
*foundation*

## In-country partners



**Public Health**  
Prevent. Promote. Protect.  
**American Samoa**  
Department of Health



**World Health  
Organization**

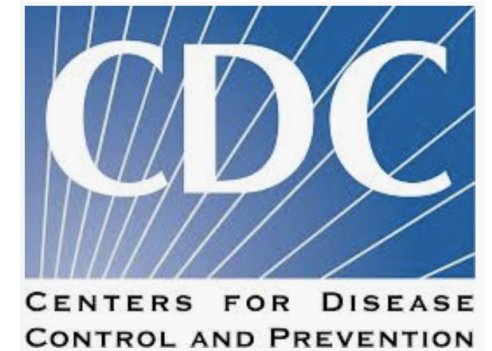
## Collaborators



Australian  
National  
University



**JAMES COOK  
UNIVERSITY**  
AUSTRALIA



# Questions?

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**@helenmayfield**

## ID-NET

Infectious Diseases Epidemiology



Neglected tropical diseases



Emerging infectious diseases



Travel medicine & vaccinations

