

LLIN Durability Assessments: What have we learned, and what's next? Evidence-based results from 8 countries

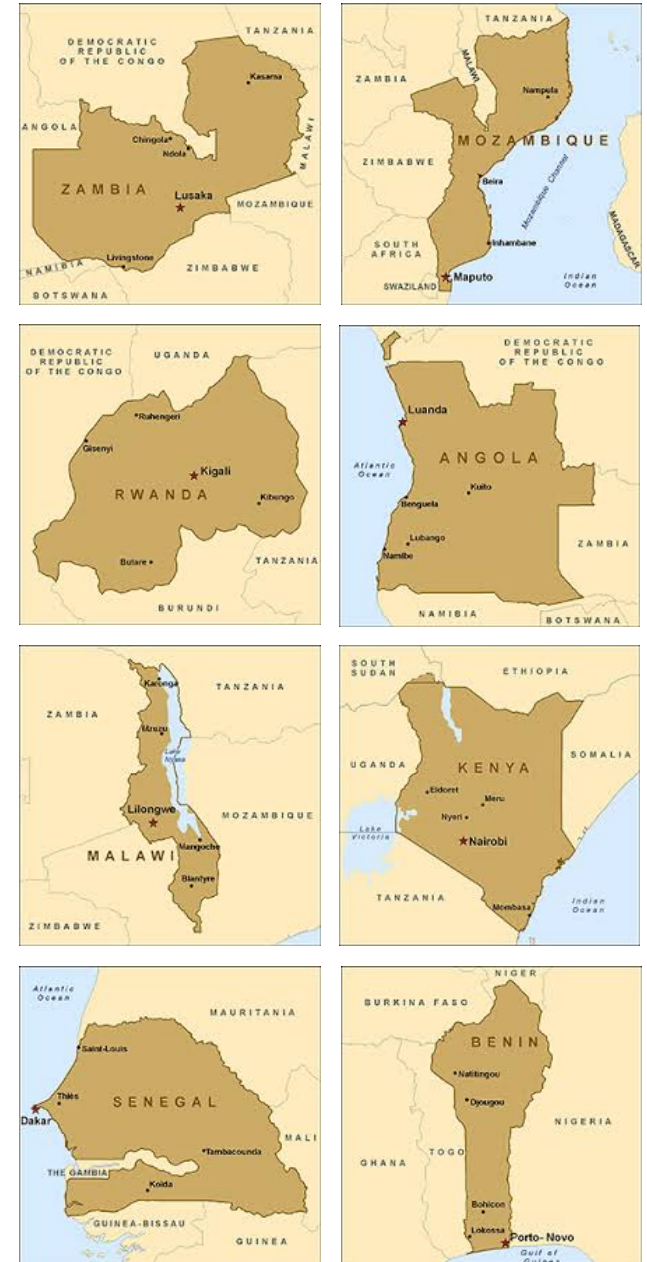
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VCWG LLIN Priorities Workstream

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Introduction: PMI durability studies

- From 2009–2015, PMI has funded a number of LLIN durability studies
- Current project: analyzing all data from 8 countries
- 21,000 LLINs monitored in 37 sites



Varied methodologies

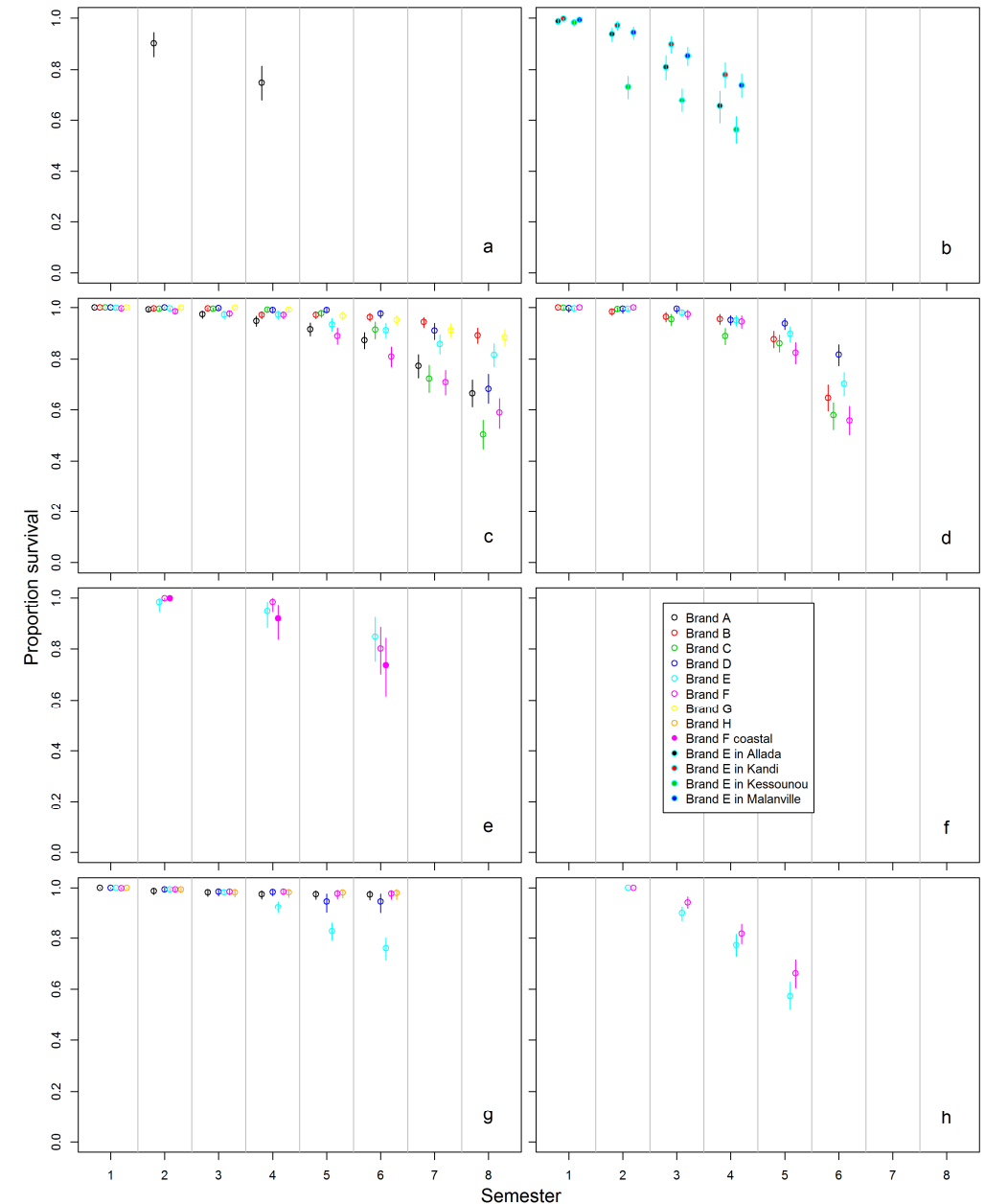
prospective vs. retrospective
cross-sectional vs. longitudinal
different household survey questions
lab and/or field hole-counting
different categories for hole sizes
different approaches for insecticidal content testing
differing levels of (non)randomization

Results overview

- Causes of net loss
- Survival/Attrition
- Physical durability/hole counting
- Bioefficacy
- Chemical content
- Household questionnaire data
- Net use

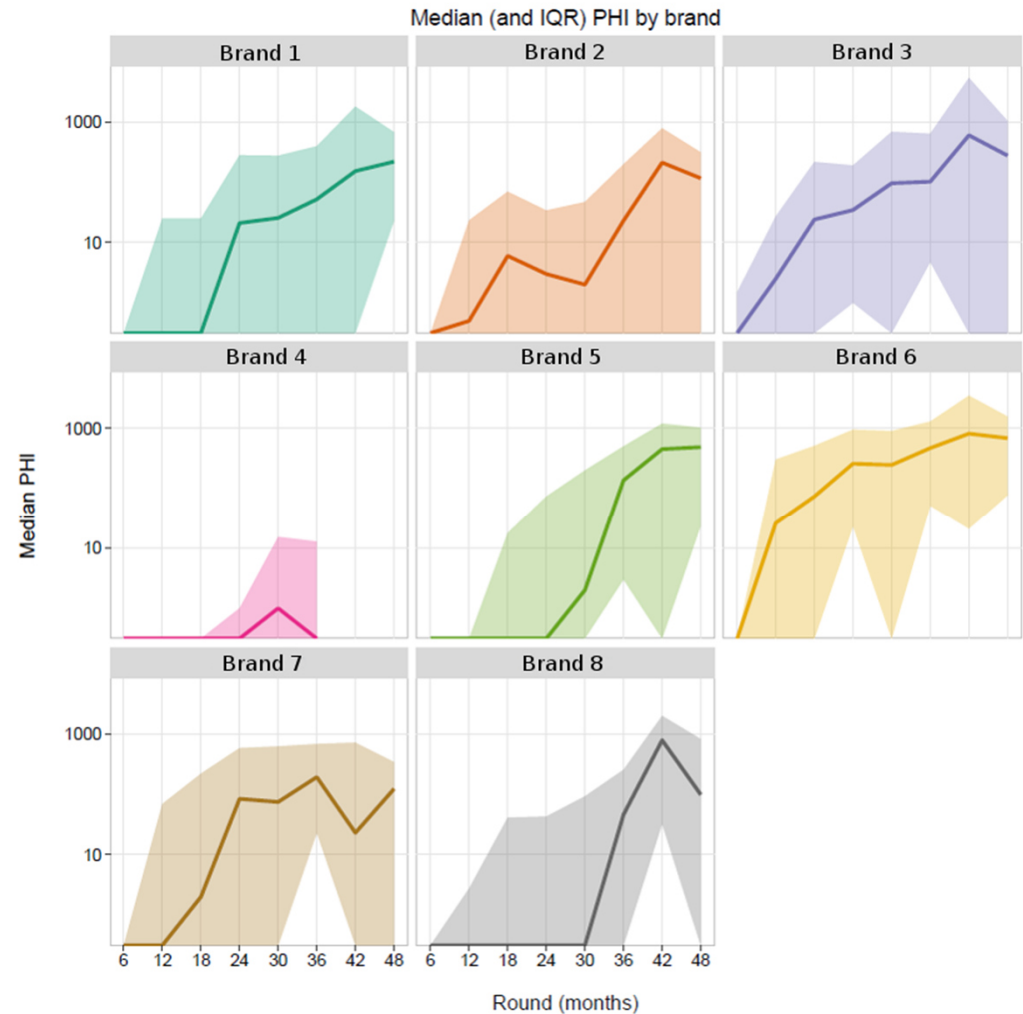
Results: Attrition

- Graph shows proportion survival (1-attrition due to being destroyed (not those lost due to being given away))
- While there is some variation by brand within a country study (possibly due to confounding with study population), there is wider variation in the same brand across different country studies



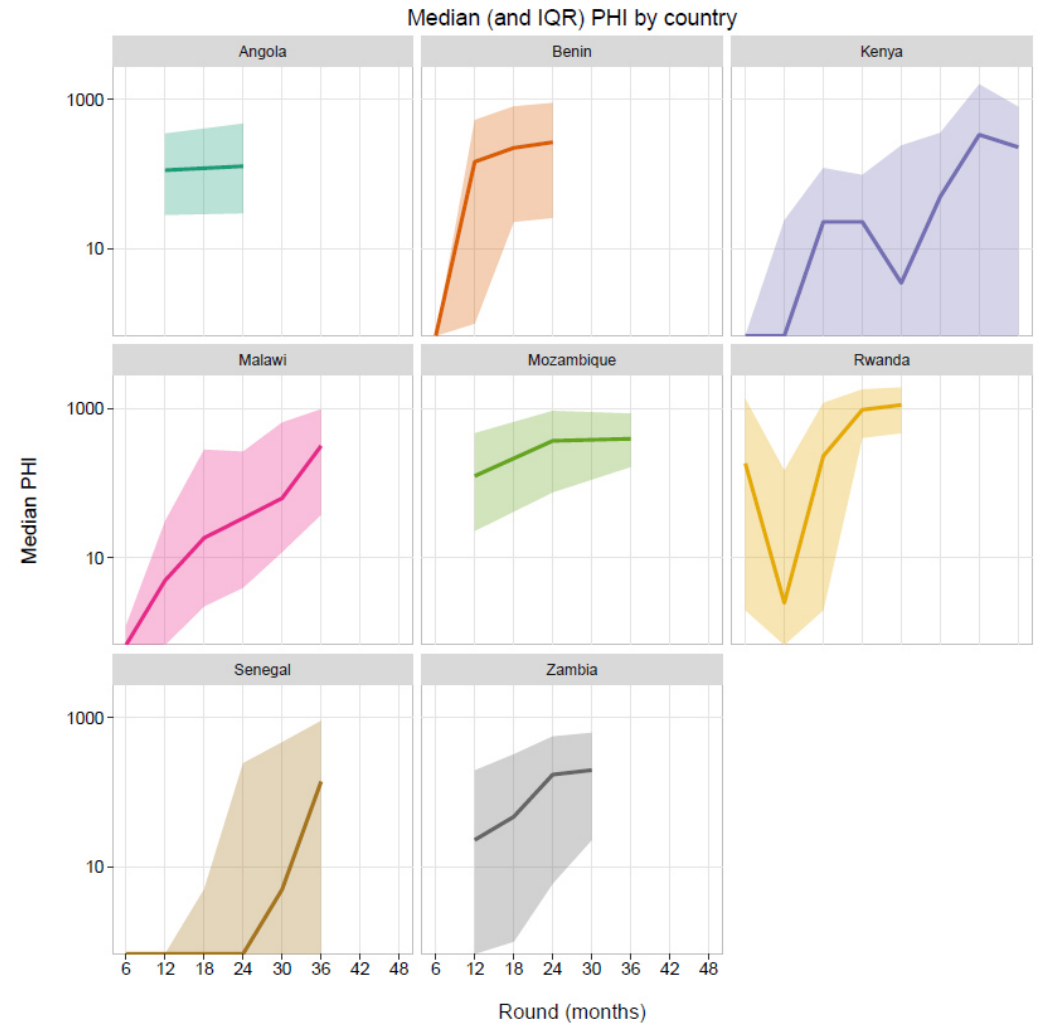
Results: physical durability: by brand

- Holes were counted by size categories, data was used to calculate a proportionate hole index (pHI), shown on a log scale with 95% CI
- Generally, most brands performed equally



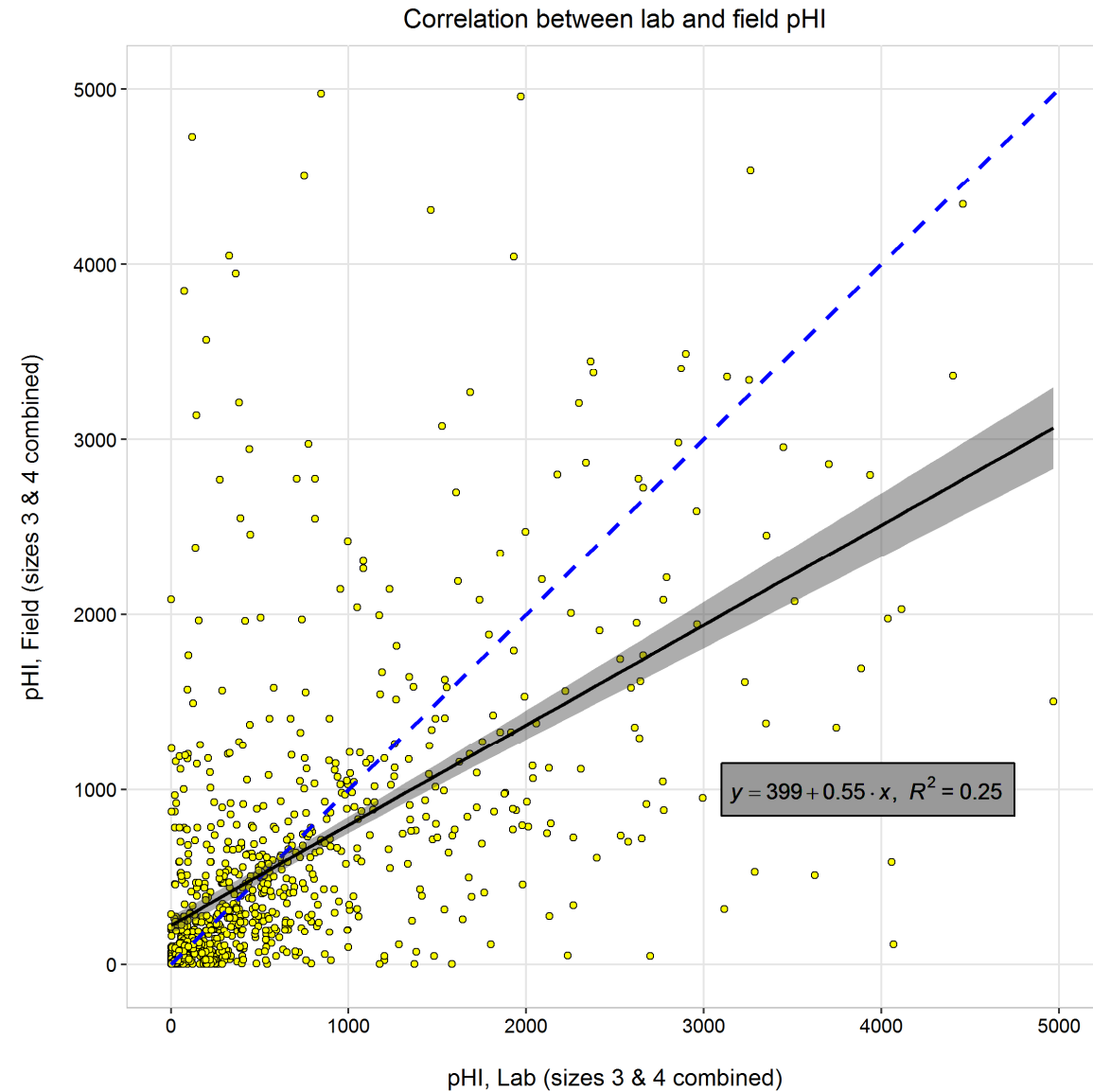
Results: physical durability: by country

- Holes were counted by size categories, data was used to calculate a proportionate hole index (pHI), shown on a log scale with 95% CI
- Variation between countries was much greater than variation by brand



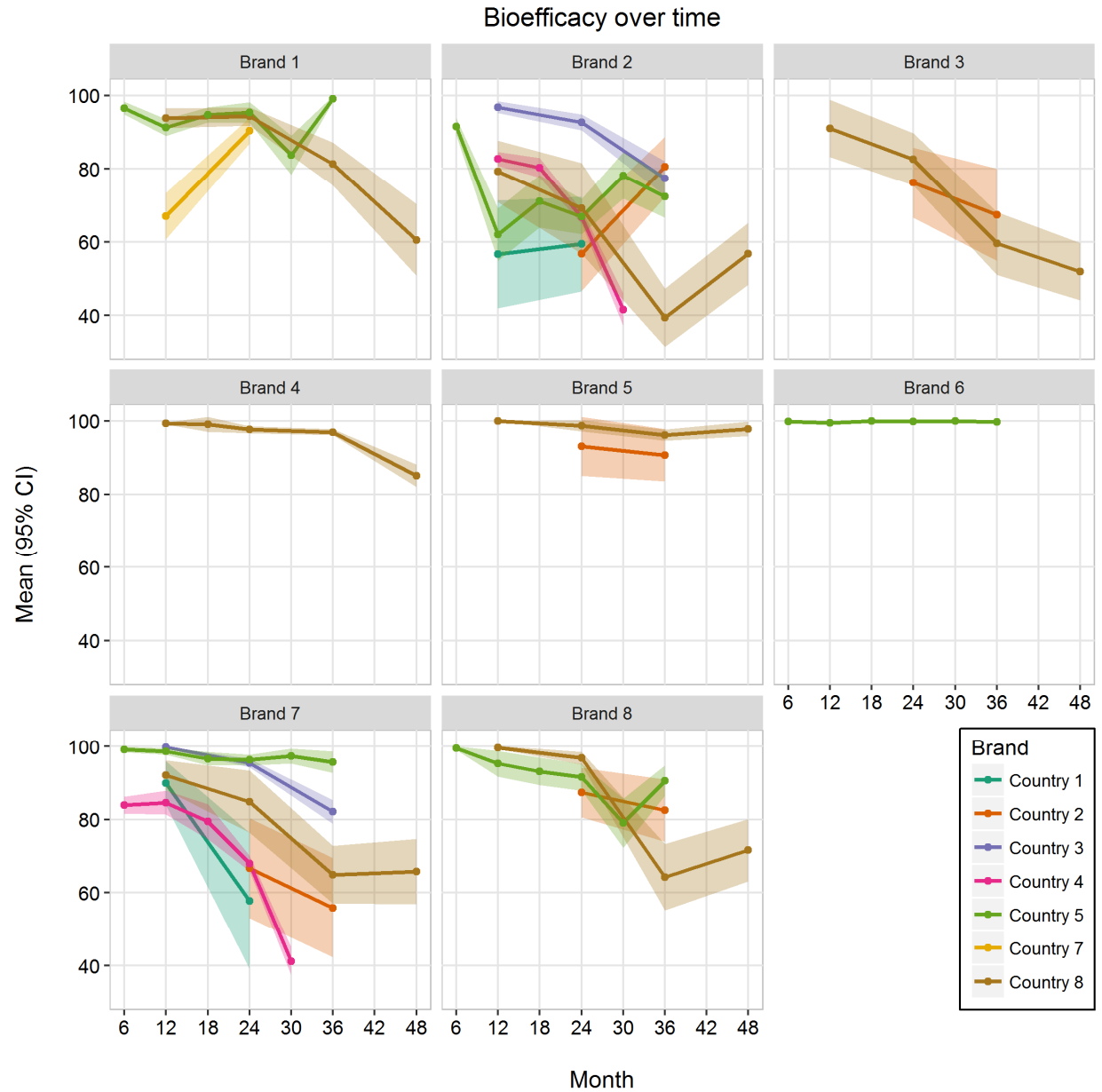
Hole counting methods

- Laboratory and field hole-counting data on the same nets were roughly correlated, but with some wide variation



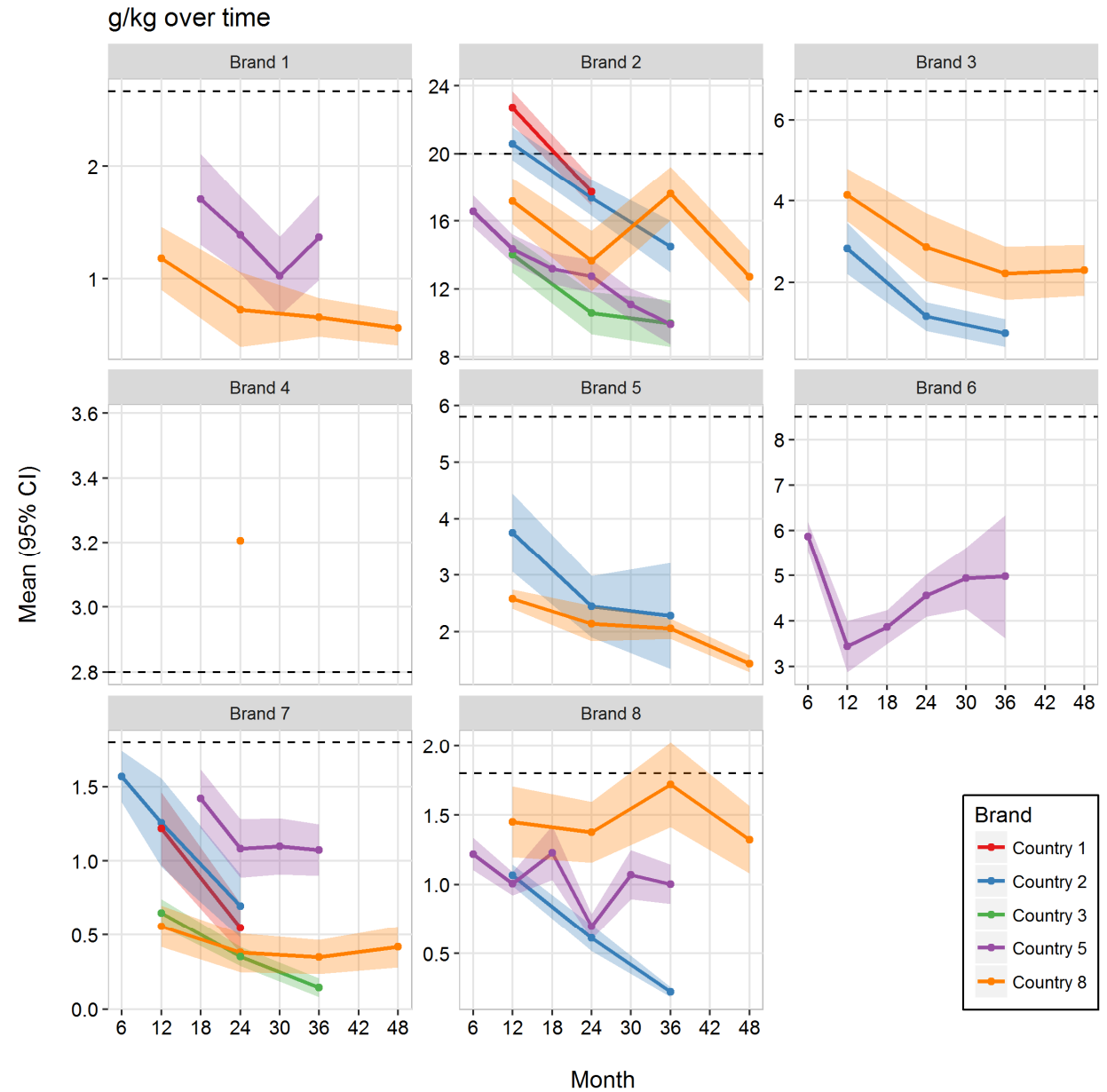
Bioefficacy

- Proportion of mosquitoes killed in a WHO cone test, from nets sampled at different time points
- Same method used in all countries (although strains differed)



Chemical content

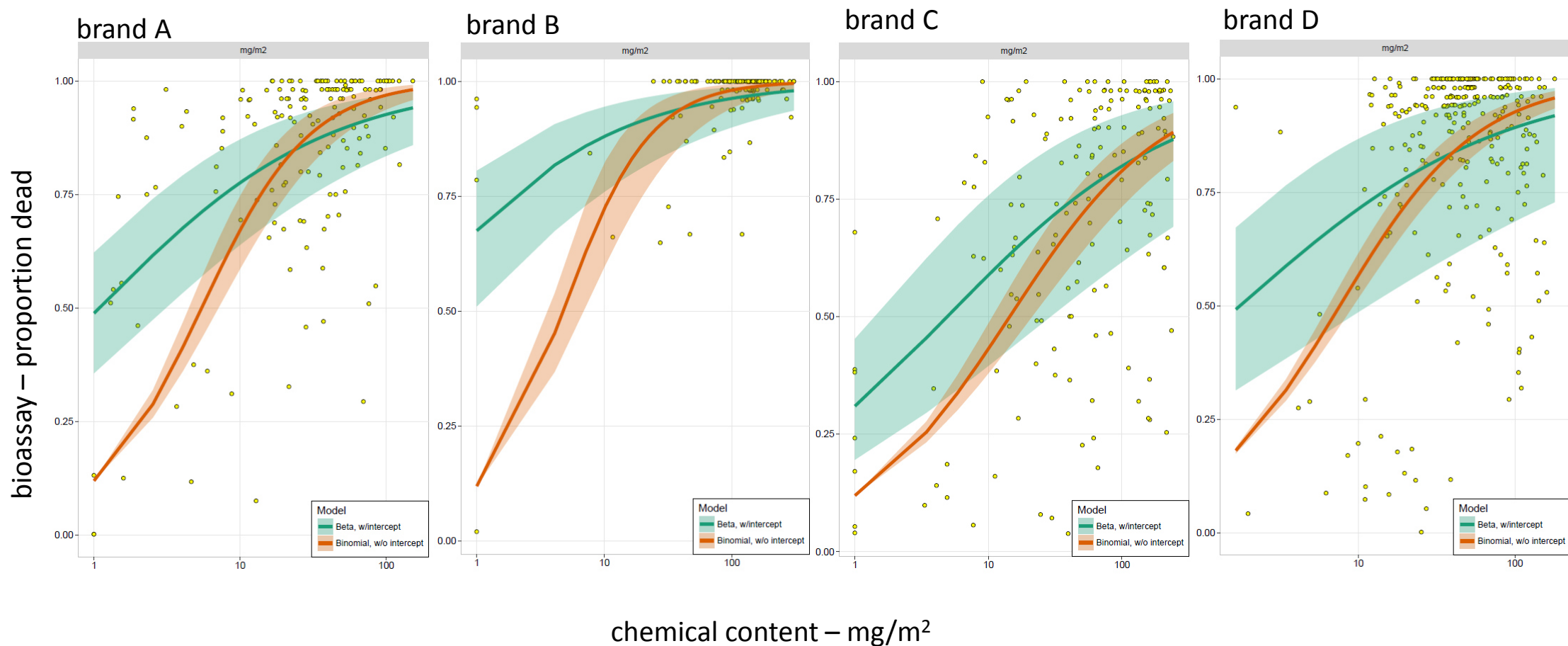
- Total active ingredient content in the net, measured by GC or HPLC
- Dotted line = target dose based on specifications
- Again, more variation by country than by brand



How well do bioassays relate to chemical content?

- Ongoing debate over how best to measure insecticide content:
 - Total chemical content by HPLC/GC includes active ingredient that is within netting fibers, may or may not be bioavailable on the surface
 - Cone bioassays can have high variation when done by different labs
 - As this is possibly the largest field data set comparing bioassay results and chemical content, we wanted to do a comparison of these two methods of measuring efficacy

Bioassay vs. chemical: examples from 4 brands



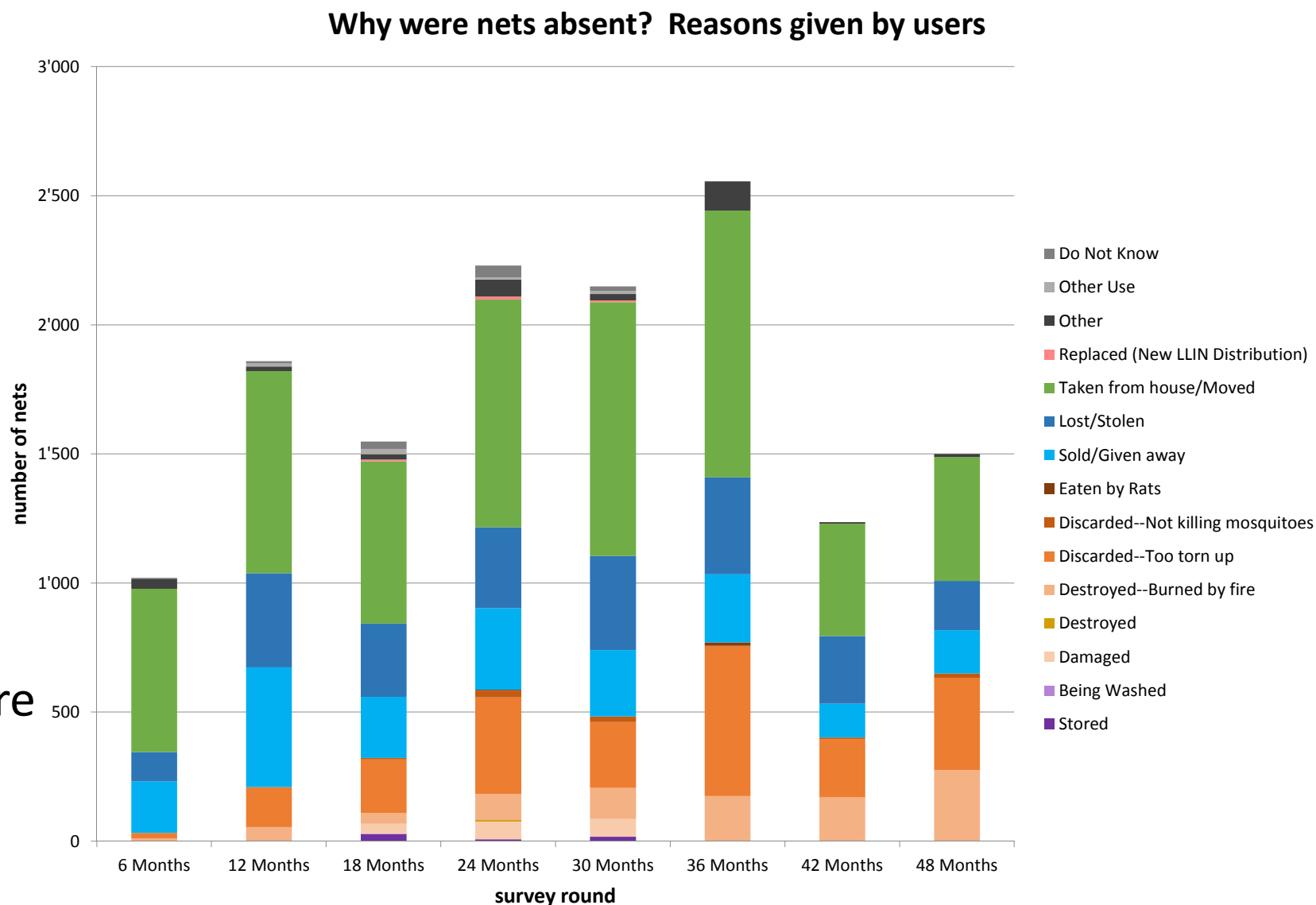
Questionnaire data

- All countries asked at least some questions on social, behavioral, socio-economic status, but little agreement between studies
- Even for the same questions, potential answers varied, limiting comparability

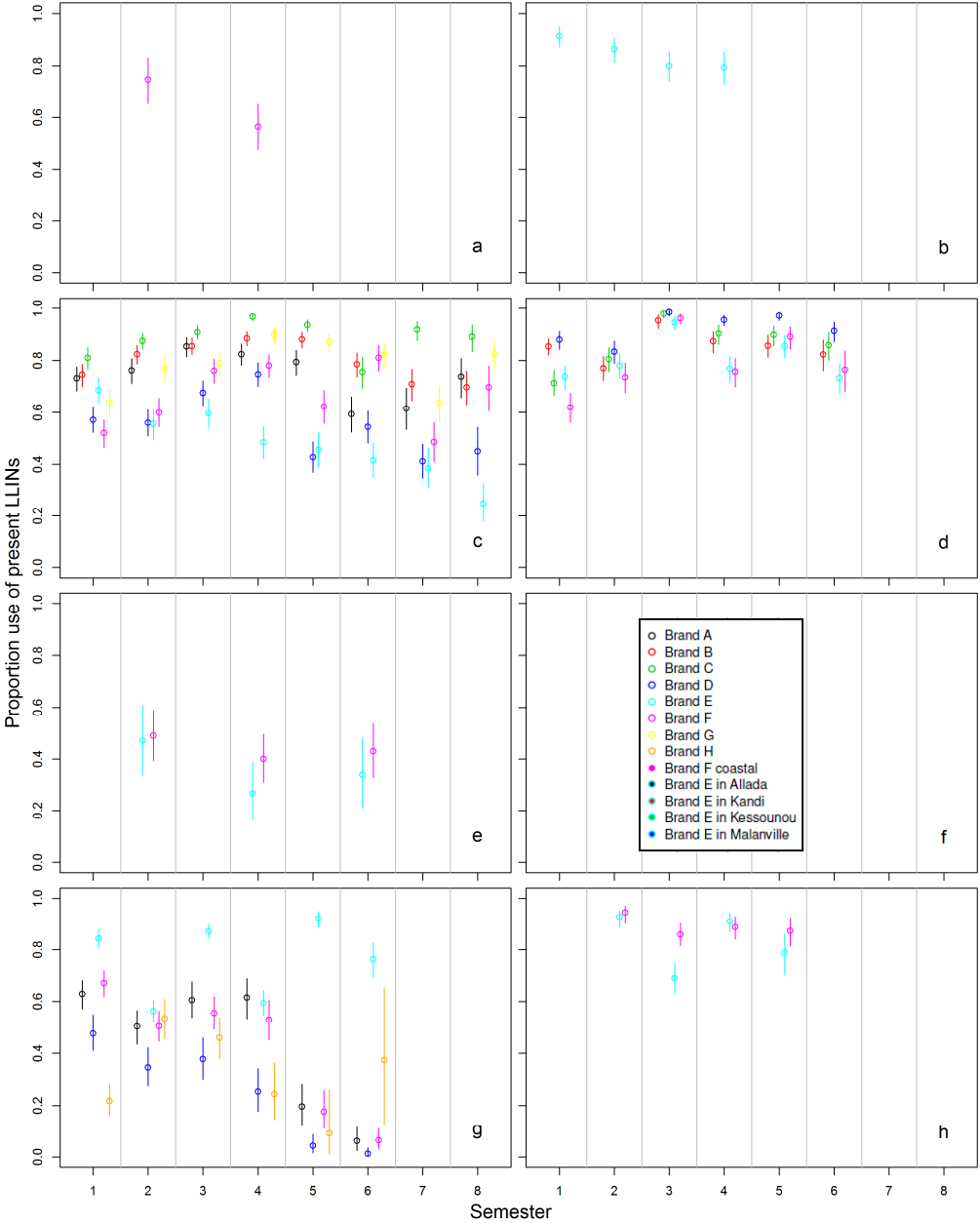
Questions common to at least 4 countries:

Question	Angola	Benin	Kenya	Malawi	Mozambique	Rwanda	Senegal	Zambia
Is the net present	X	X	X	X	X	implied	X	X
Reason net is absent	X	X	X	X	X			X
Was the net washed	implied	implied	implied	implied	implied		implied	X
How often is the net washed	X	X	X	X	X		X	
What type of soap is used when washing the net	X			X	X		X	X
Where is the net washed	X			X	X		X	
Was the net scrubbed on rocks	X			X	X		X	X
How was the net dried (flat, hanging, etc.)	X			X	X		X	
Where was the net dried	X			X	X		X	X
Type of bedding where net is used	X	X	X	X				X
How often is the net used	X	X	X	X	X		X	X
Was the net used last night	X	implied	X	X	X		X	X
Where is the net kept during the day (observed the day of the interview)		X	X	X	X		X	X

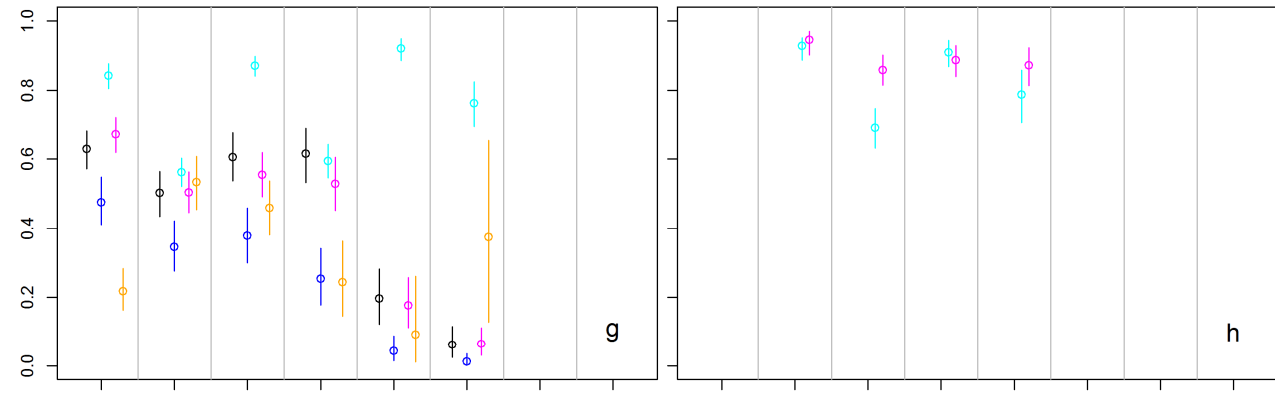
- Major reasons nets were absent:
 - moved to another location
 - lost/stolen/sold
 - discarded due to damage
- Discarded due to damage was <50%; all-cause attrition isn't a good measure of loss due to damage



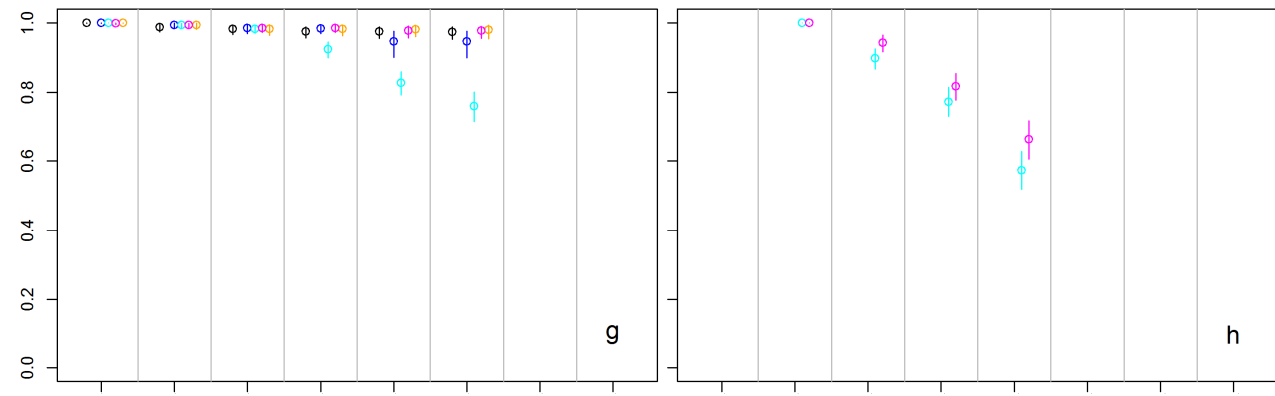
Use of study nets:



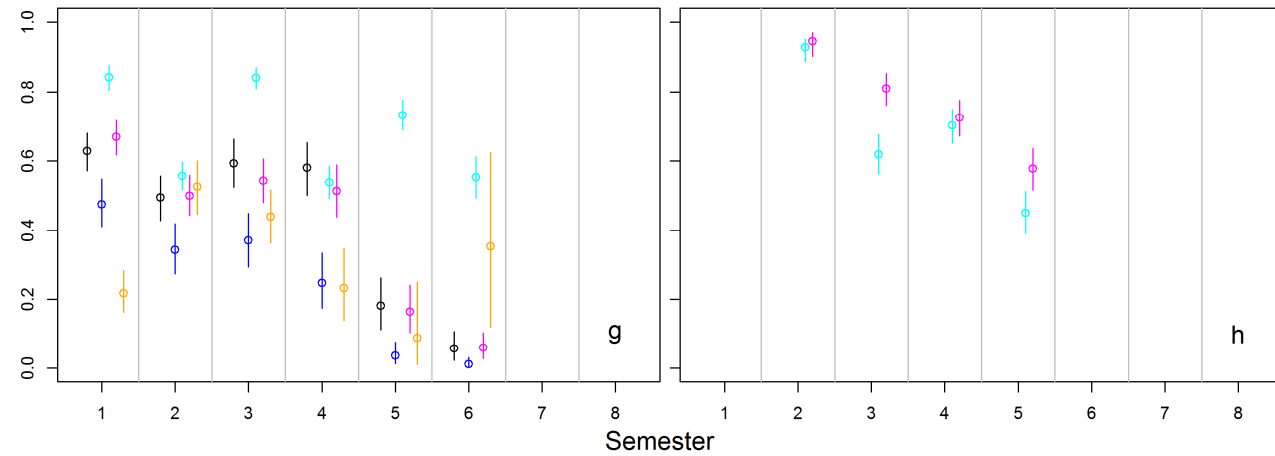
Use



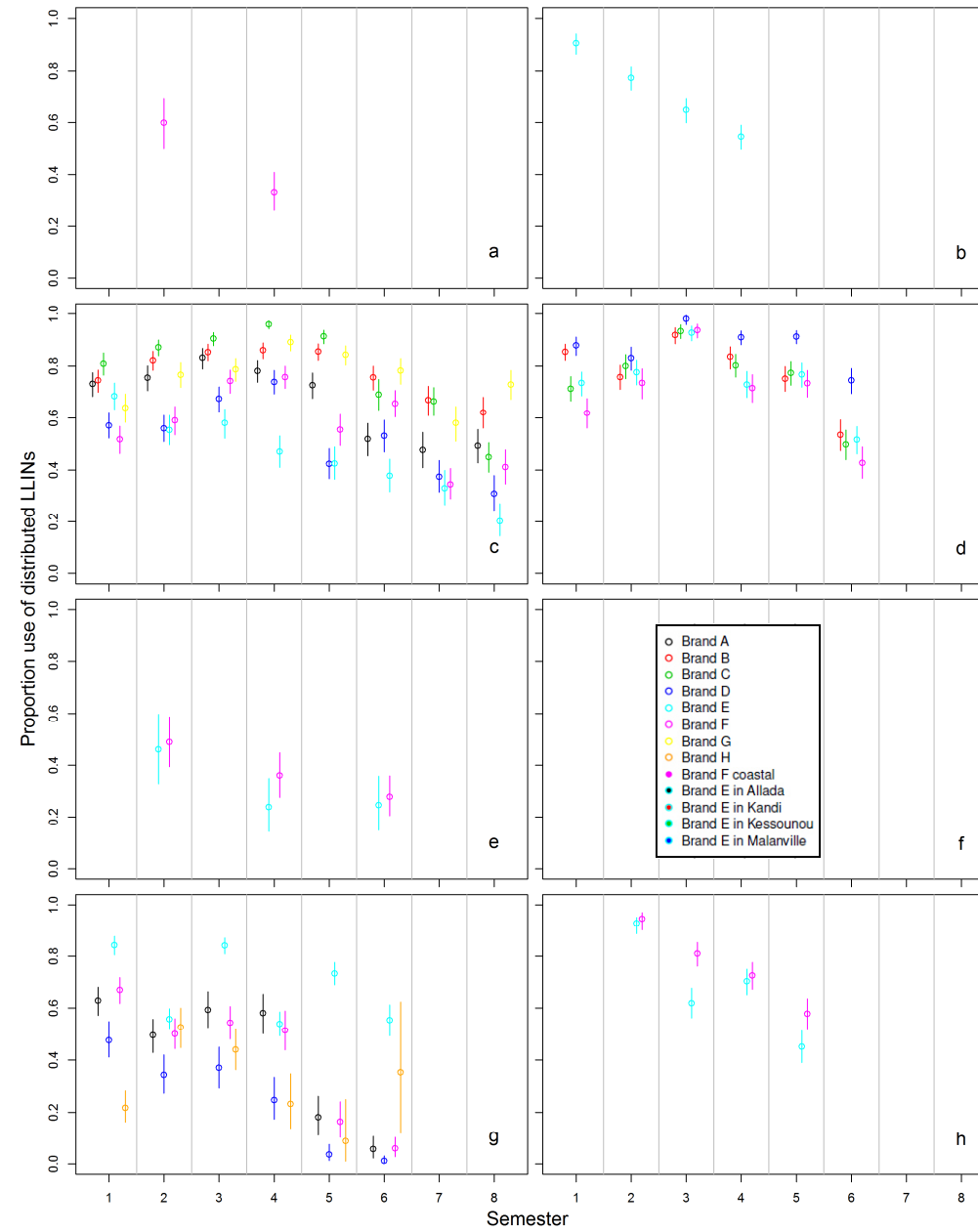
Survival



Use*Survival



Use*Survival



Conclusions

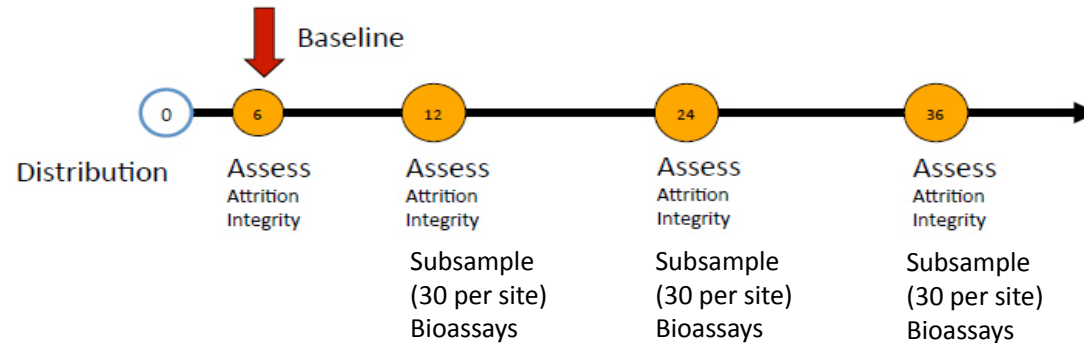
- Site variability > brand variability
 - Remaining questions: what are the major drivers?
- While some previous studies have shown worryingly short median lifespans, the data from Kenya and Senegal show that under good conditions, it is possible for nets to last the estimated 3 years between mass campaigns
 - need for better SBCC for net care?
 - effect of repeated visits in longitudinal design?
- Need for a better gold standard to measure bioefficacy/surface insecticide
- Potentially worrying cone bioassay results in some countries

Future Directions

- Final cleaning and re-running analyses
- Combine effects of holes, insecticide and use to estimate impact on transmission over time from distribution to replenishment in malaria model.
- Present final results at ASTMH & publish
- Long term: follow up with analysis of PMI durability monitoring data

PMI durability monitoring

- Prospective, longitudinal cohort design of nets distributed in mass campaigns



- Data collected on attrition, physical integrity, insecticidal activity, chemical content
- Questionnaire on behavior, household use, attitudes about net care, and socioeconomic status
- **12** countries currently carrying out monitoring, **15** funded for 2017
- Currently collecting 6-24 month data

Acknowledgements

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Questions and Discussion