# LLIN DURABILITY

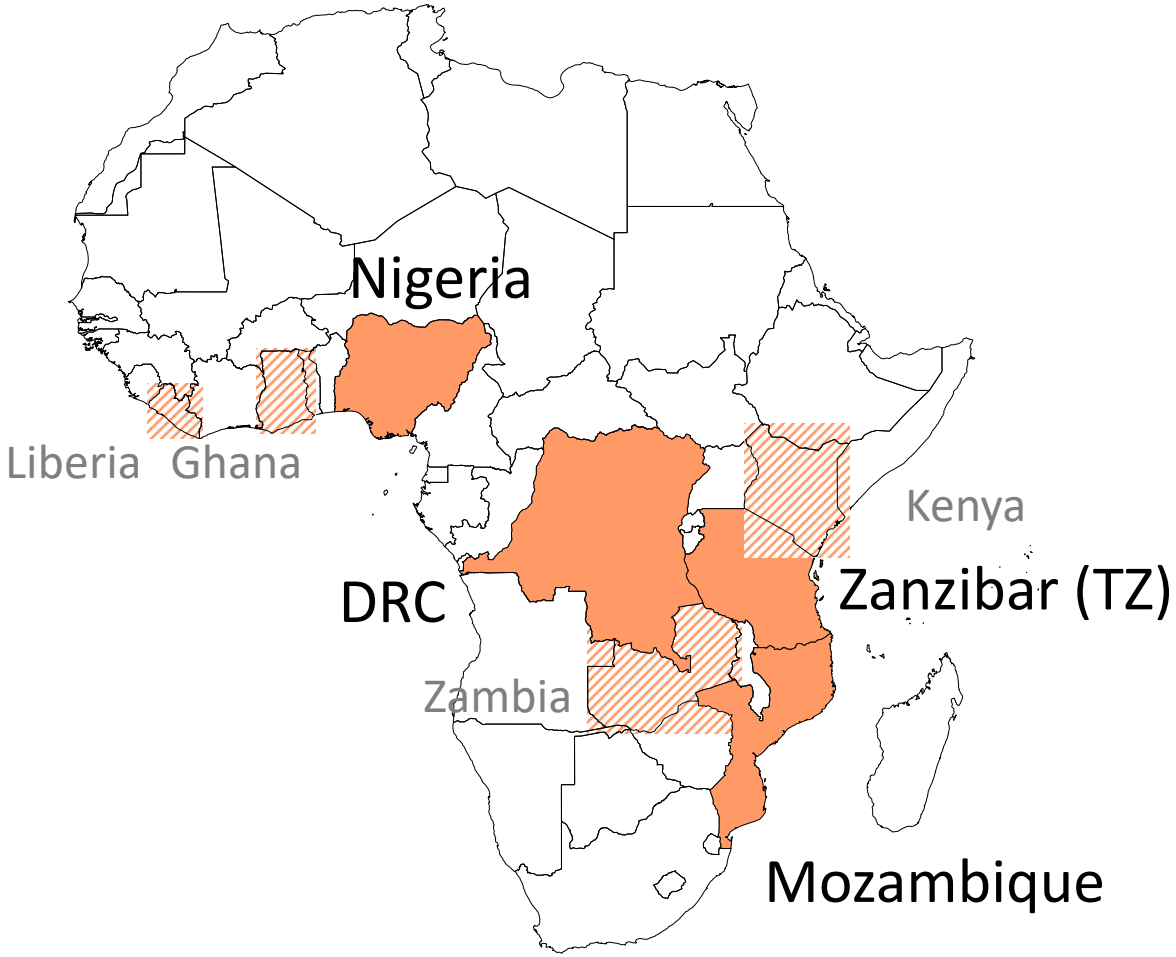
# Objectives

- Monitor durability of LLIN distributed through mass campaigns in 2-3 sites per country
  - Compare same brand – different place
  - Compare two brands – same place
- Better understand determinants that drive LLIN durability
- Strengthen capacity
  - To undertake DM and other surveys
  - Specific DM skills

# VectorWorks produced:

- Standard protocol for prospective cohort approach
- Complete suite of tools for data collection, analysis and reporting
- www.durabilitymonitoring.org

# LLIN Durability Monitoring supported by VectorWorks




# LLIN Durability Monitoring Designs

## Different socio-ecological environment - Same/similar LLIN brand

| | |
|---|---|
| Mozambique | Royal Sentry/MagNet |
| Nigeria | DawaPlus 2.0 |

## Same socio-ecological environment - Two LLIN brands

| | | |
|---|---|---|
| Zanzibar | PermaNet 2.0 | Olyset |
| DRC | DawaPlus 2.0 | DuraNet |
| Myanmar | Dawa Plus 2.0 | Permanet 2.0 |

# LLIN Durability Monitoring Designs

- VectorWorks supports new LLIN durability monitoring activities in 4 countries starting in 2018, handed over at the end of VectorWorks to **VectorLinks**

**Different socio-ecological environment - Same/similar LLIN brand**

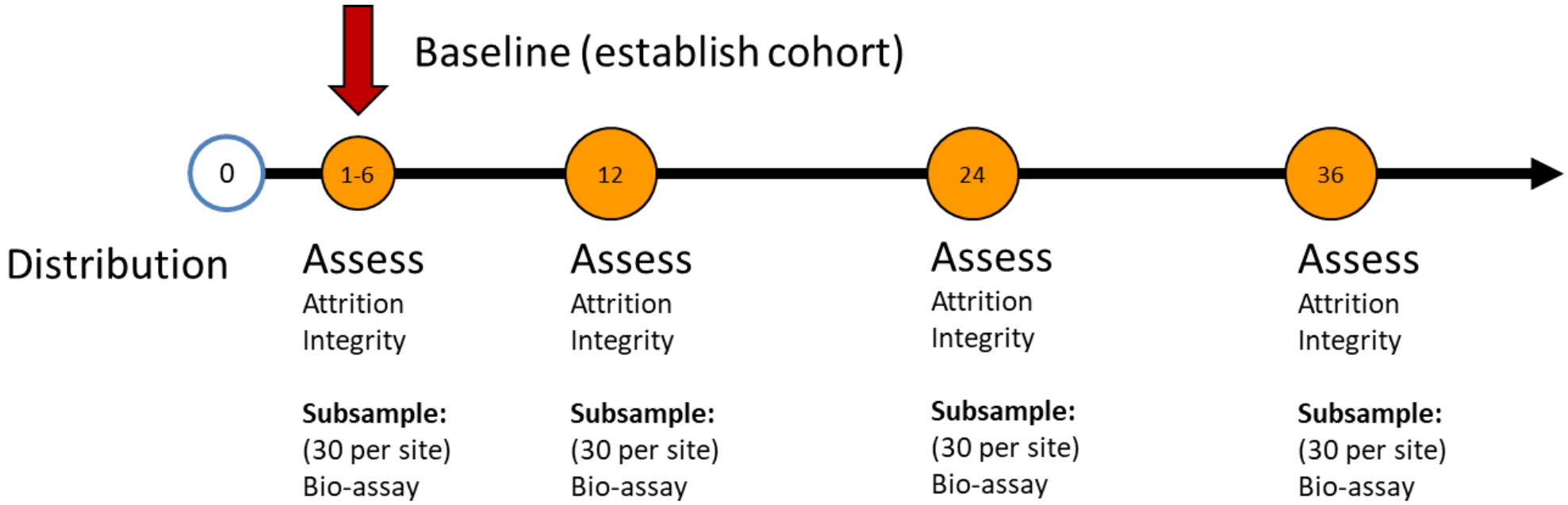
| | |
|---|---|
| Liberia | DuraNet |

**Same socio-ecological environment - Different LLIN brands**

| | | |
|---|---|---|
| Kenya | DawaPlus 2.0 | DuraNet |
| Ghana | DawaPlus 2.0 | Olyset |

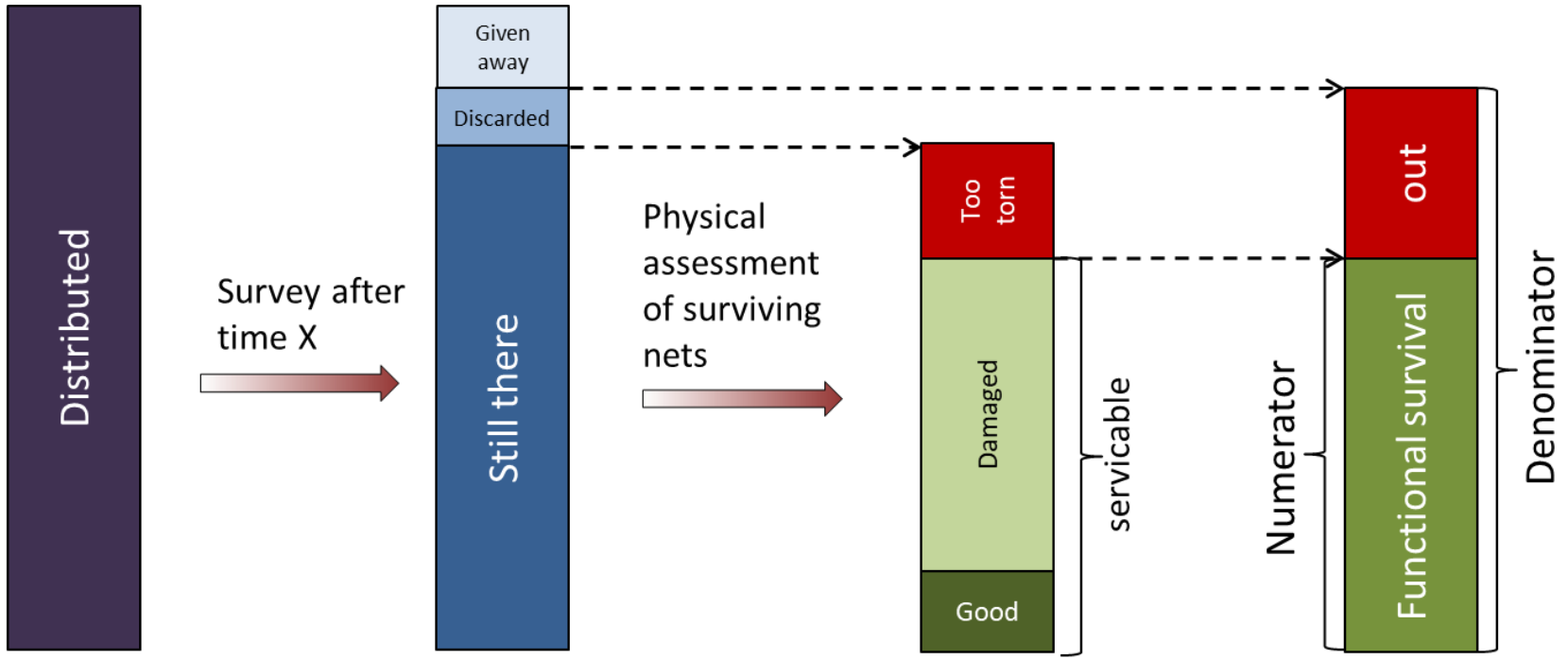
# Design

- Representative, prospective cohort study of campaign LLIN



# Physical Durability - Outcome

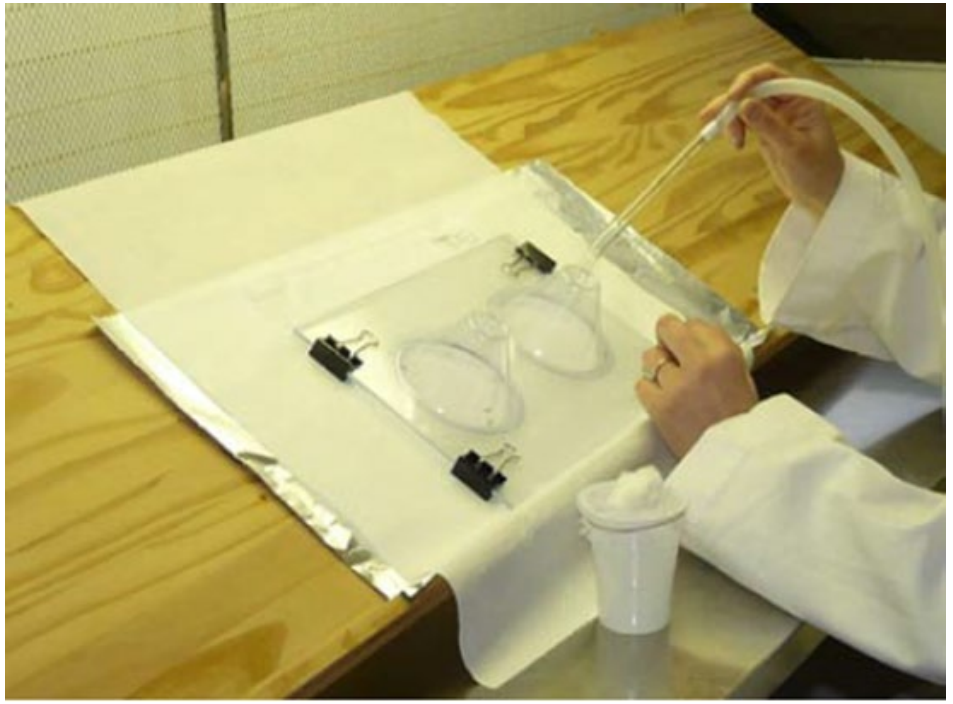
- Combining attrition (nets lost) with integrity (physical condition of net)




$$\%\ \text{surviving to time x} = \frac{\#\ \text{of LN present and "serviceable" at time x}}{\#\ \text{of LN originally received and not given away at time x}} \times 100$$

# Insecticidal Durability - Bioassay

- Insecticidal effectiveness measured by standard WHO cone test
- Also tunnel test for Olyset if failed in cone test

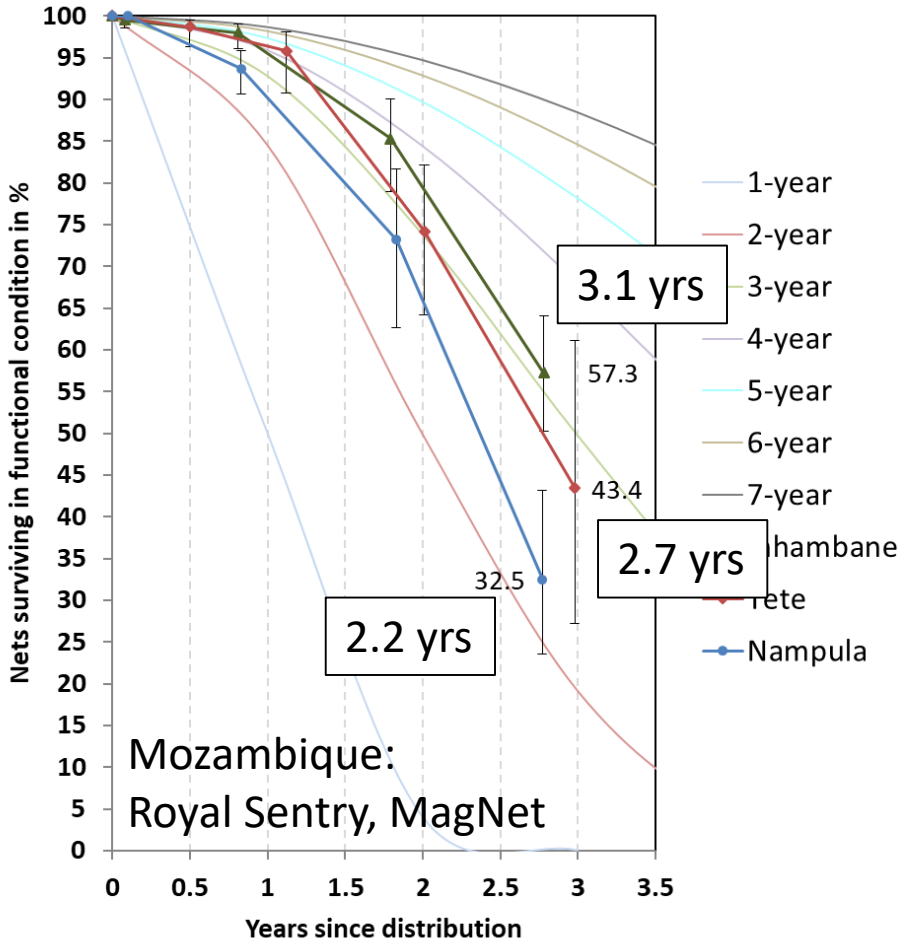


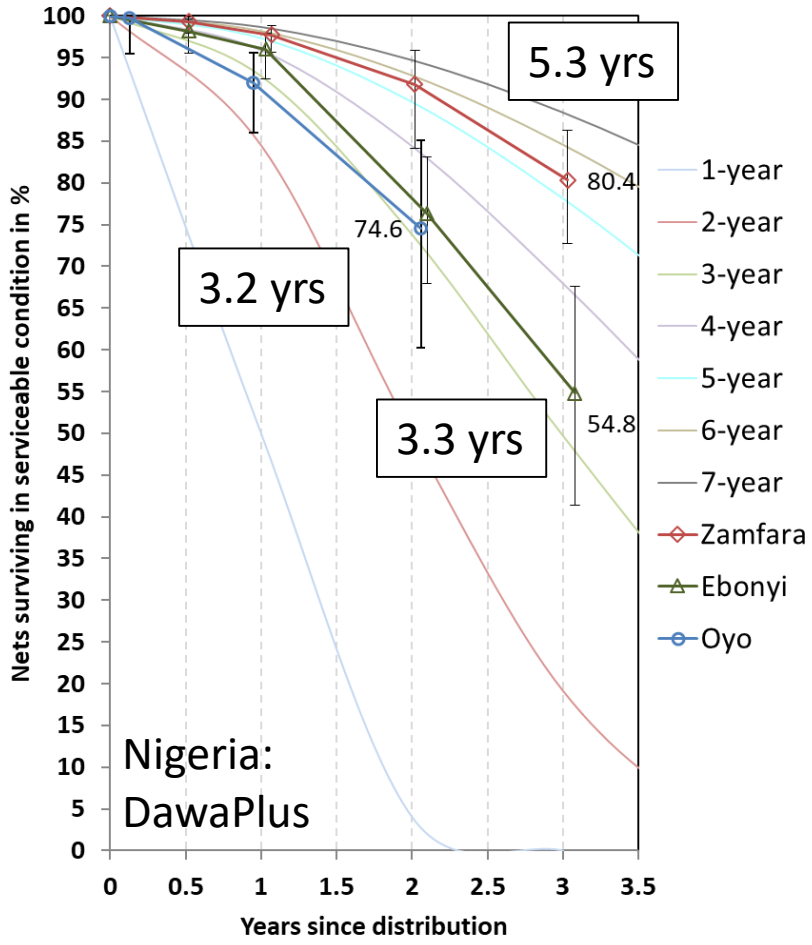
**Optimal effectiveness:**
KD60 ≥ 95% or  24h functional mortality ≥ 80%

**Minimal effectiveness:**
KD60 ≥ 75% or 24h functional mortality ≥ 50%

# What we found – physical durability

- Comparing same or similar LLIN brands in different settings

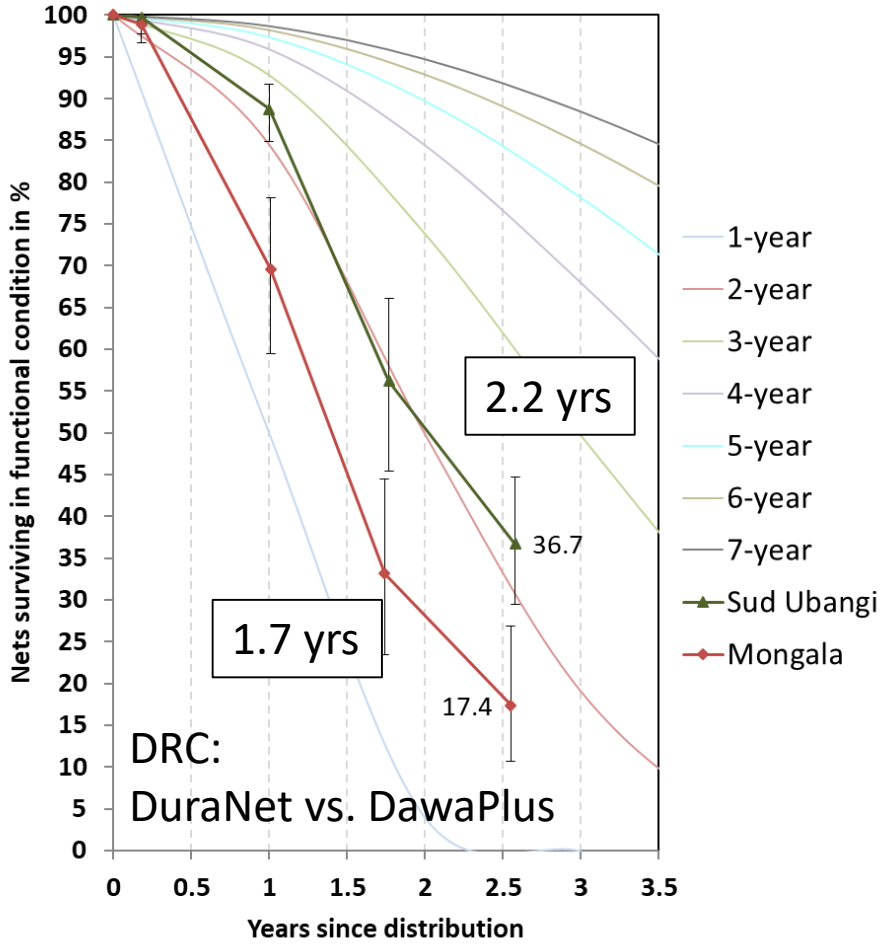


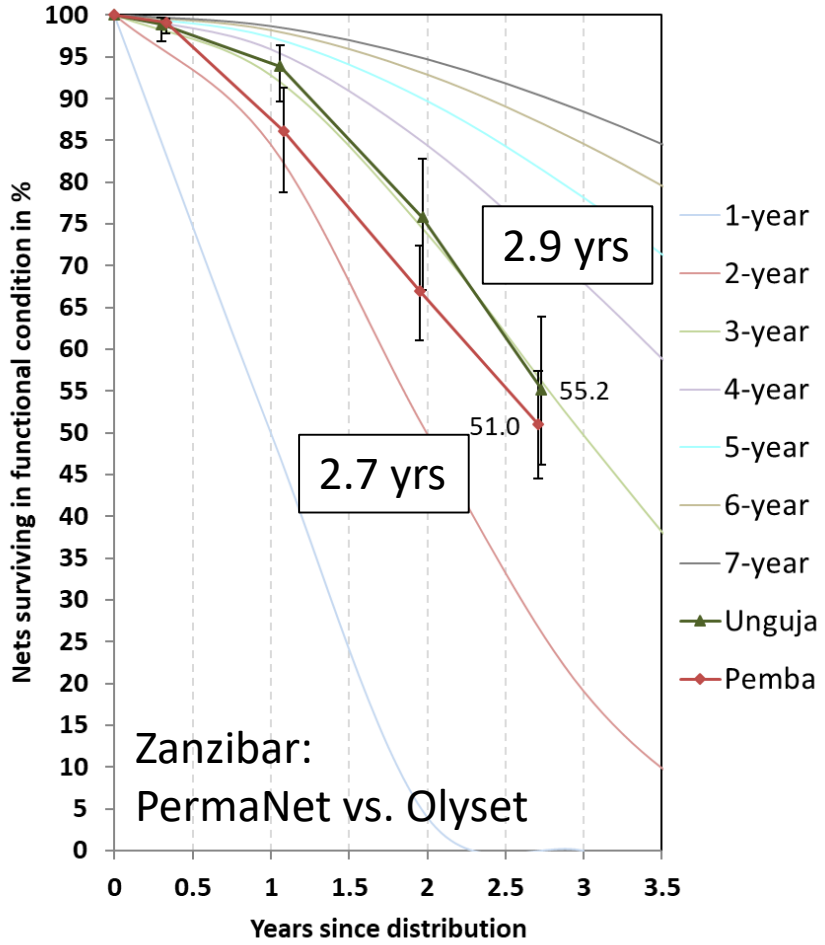




- Survival analysis confirms:
  - Nampula lower than Tete or Inhambane
  - Zamfara higher than Ebonyi and Oyo

# What we found – physical durability

- Comparing two different LLIN brands in similar settings



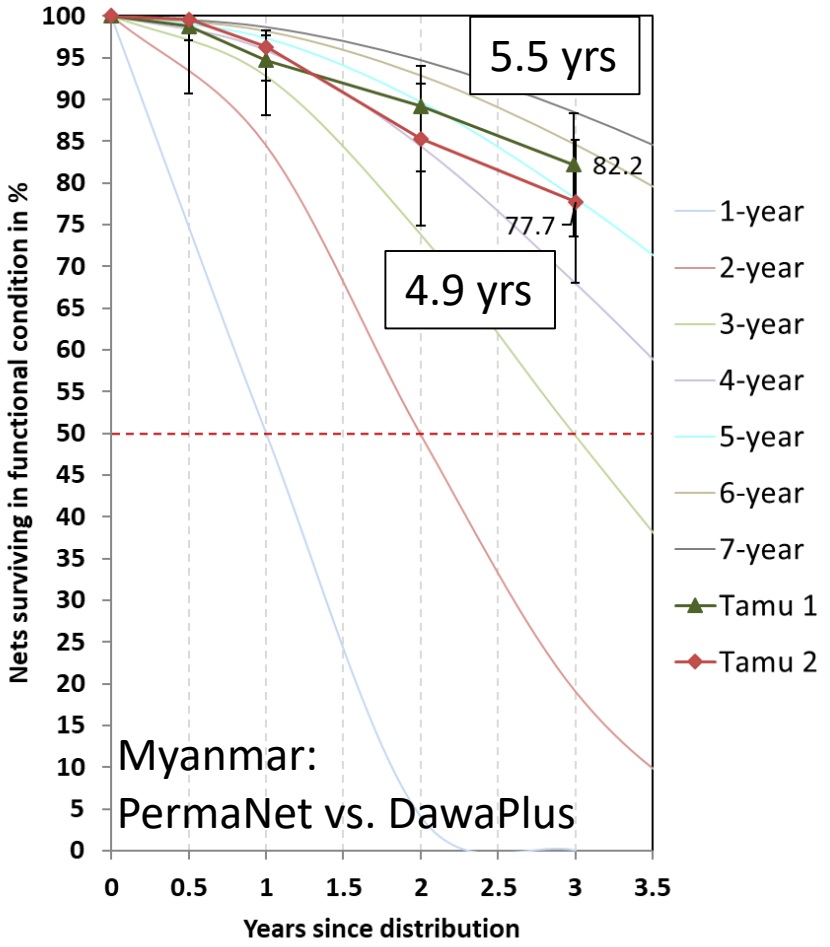




- Survival analysis confirms:
  - DuraNet in DRC better than DawaPlus 2.0
  - Olyset in Zanzibar worse than PermaNet 2.0

# What we found – physical durability

- Comparing two different LLIN brands in similar settings

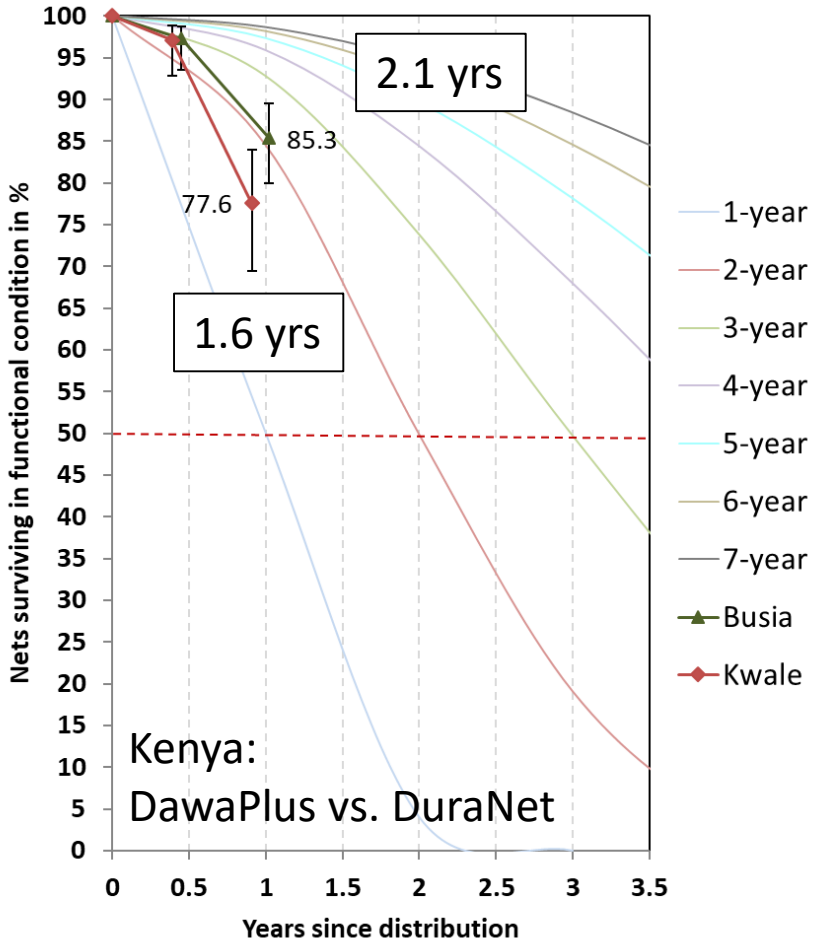
- 94% of households had non-cohort nets (56% untreated)
- Of cohort nets 81% ever used
- But at each time point only 43% to 53% hanging
- Ever hanging nets were only found hanging 60% of times seen

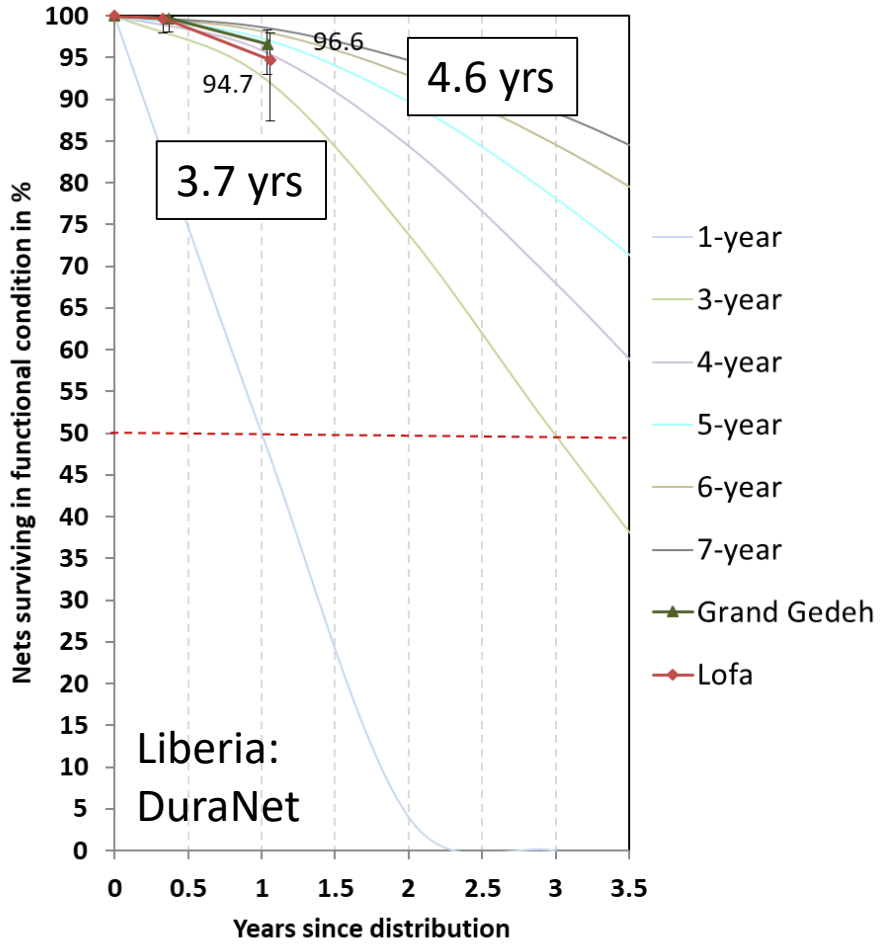



- Survival analysis shows:
  - Some evidence of difference between brands
  - Estimated median survival **4.2 and 3.9** years

# What we found – physical durability

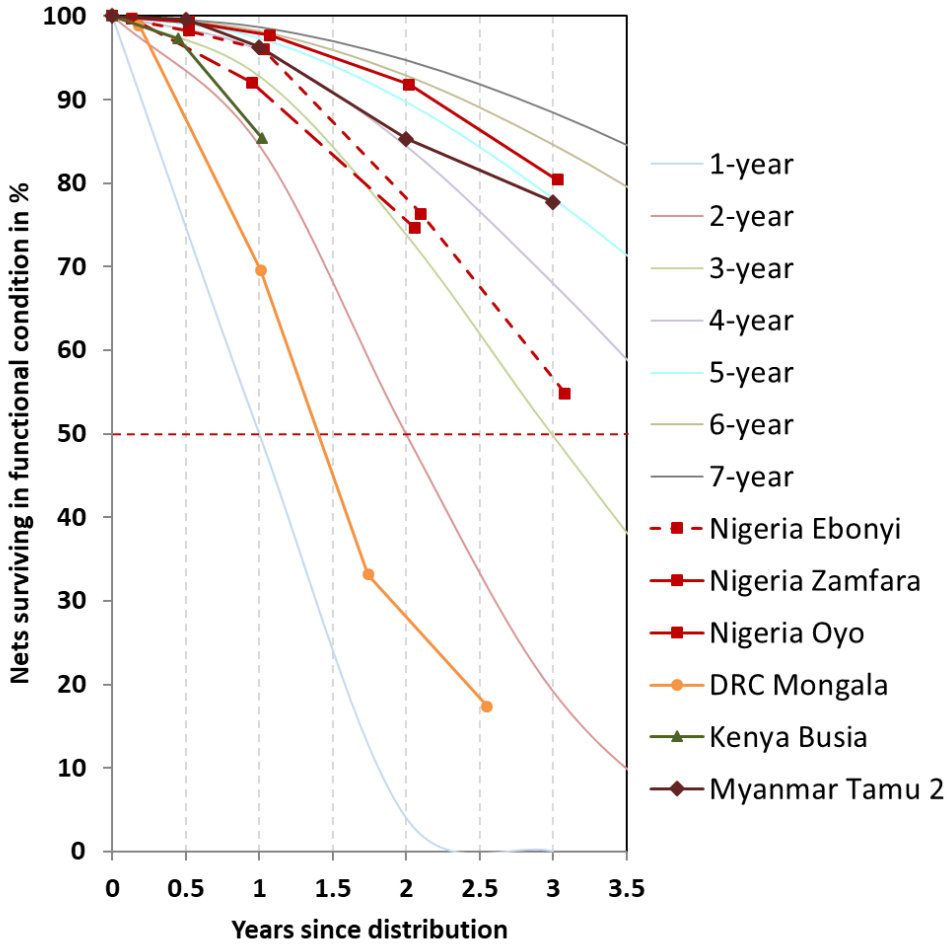
- Two different LLIN brands
- Same LLIN brand



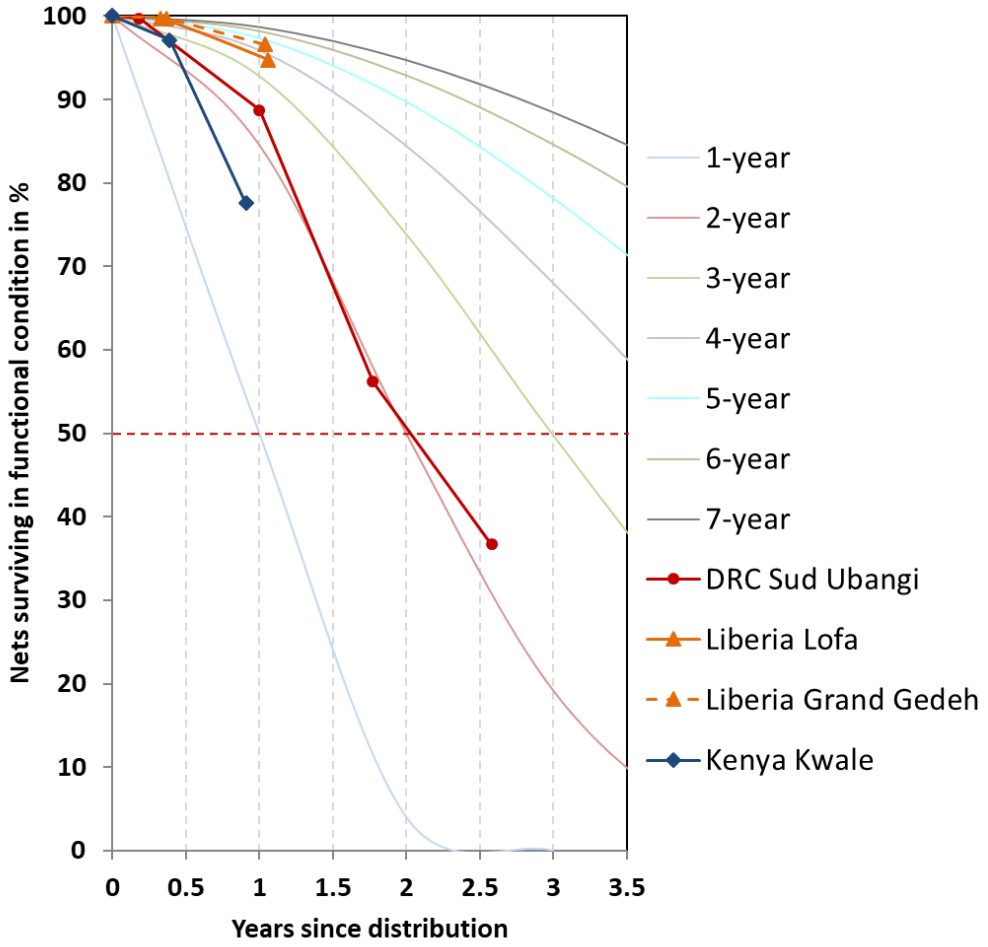



# What we found – physical durability

DawaPlus 2.0

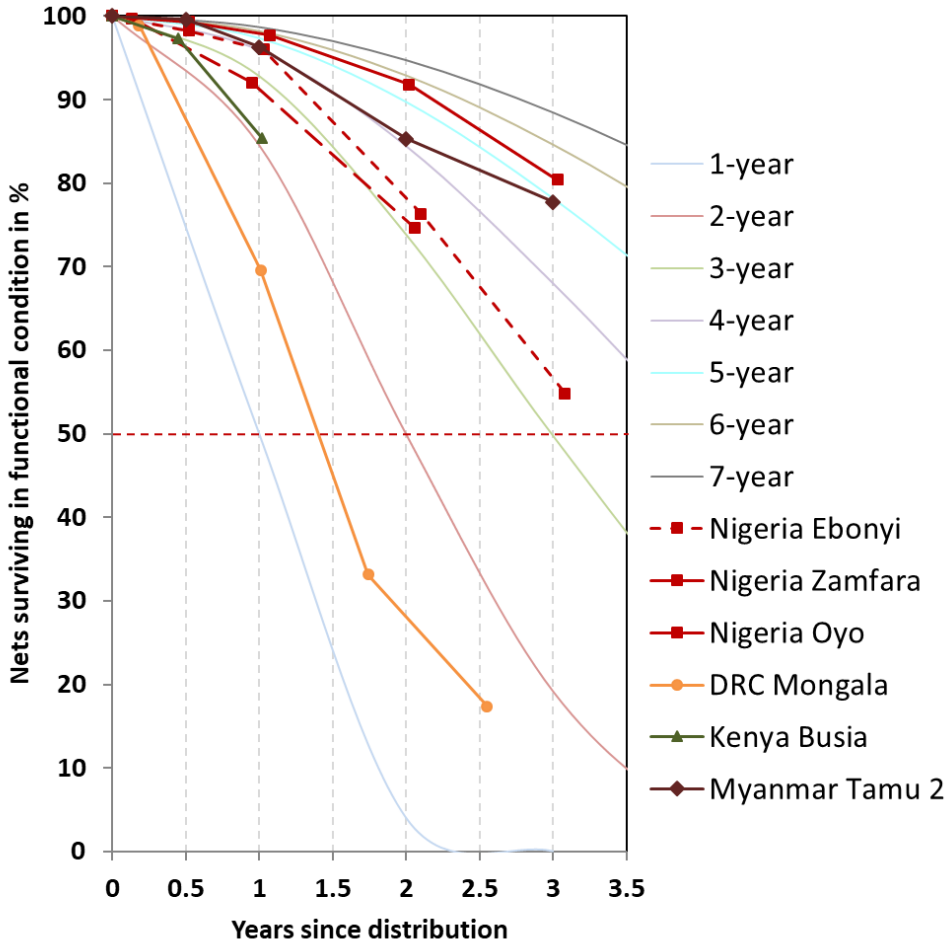



DuraNet

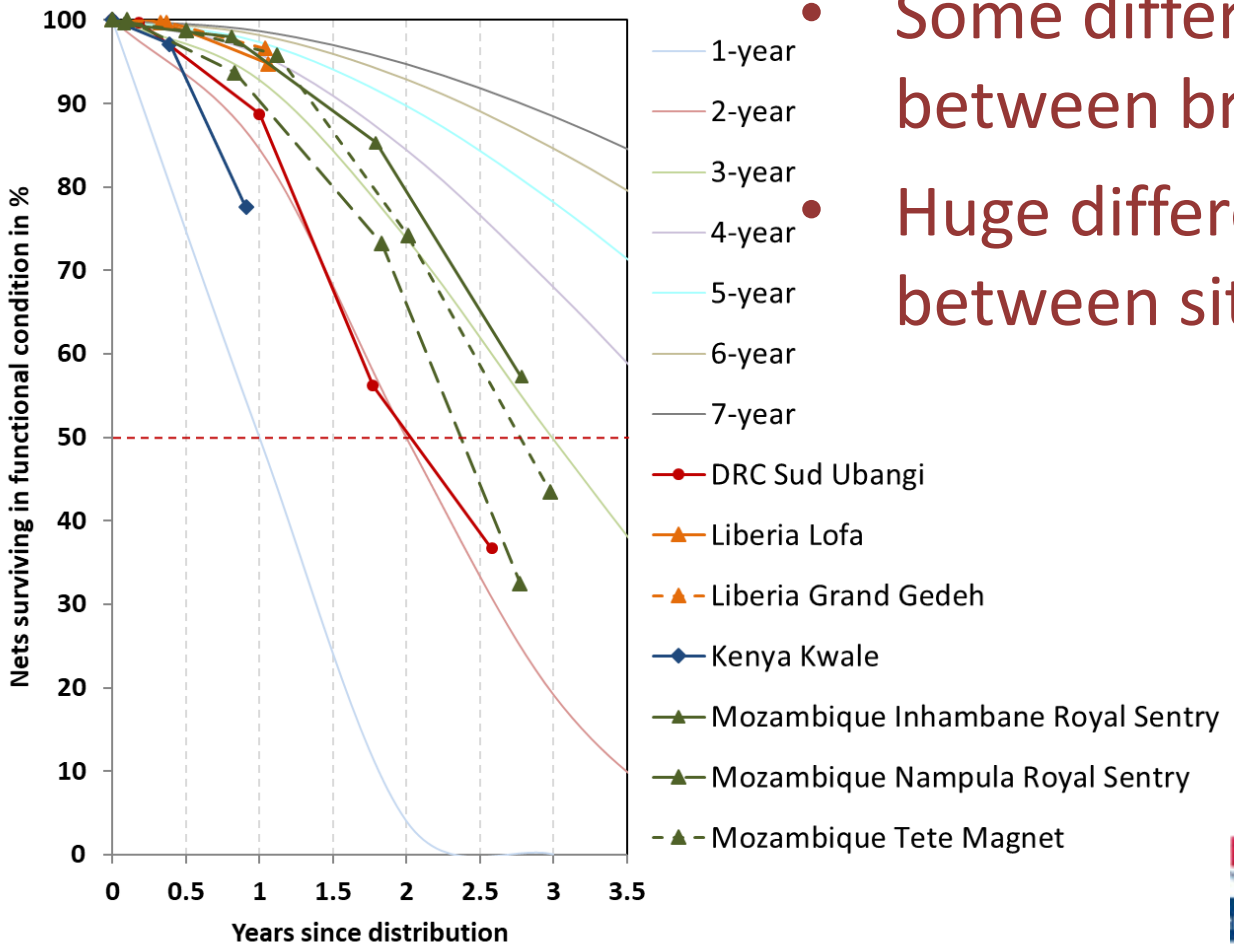


# What we found – physical durability

DawaPlus 2.0




DuraNet, Royal Sentry, MagNet

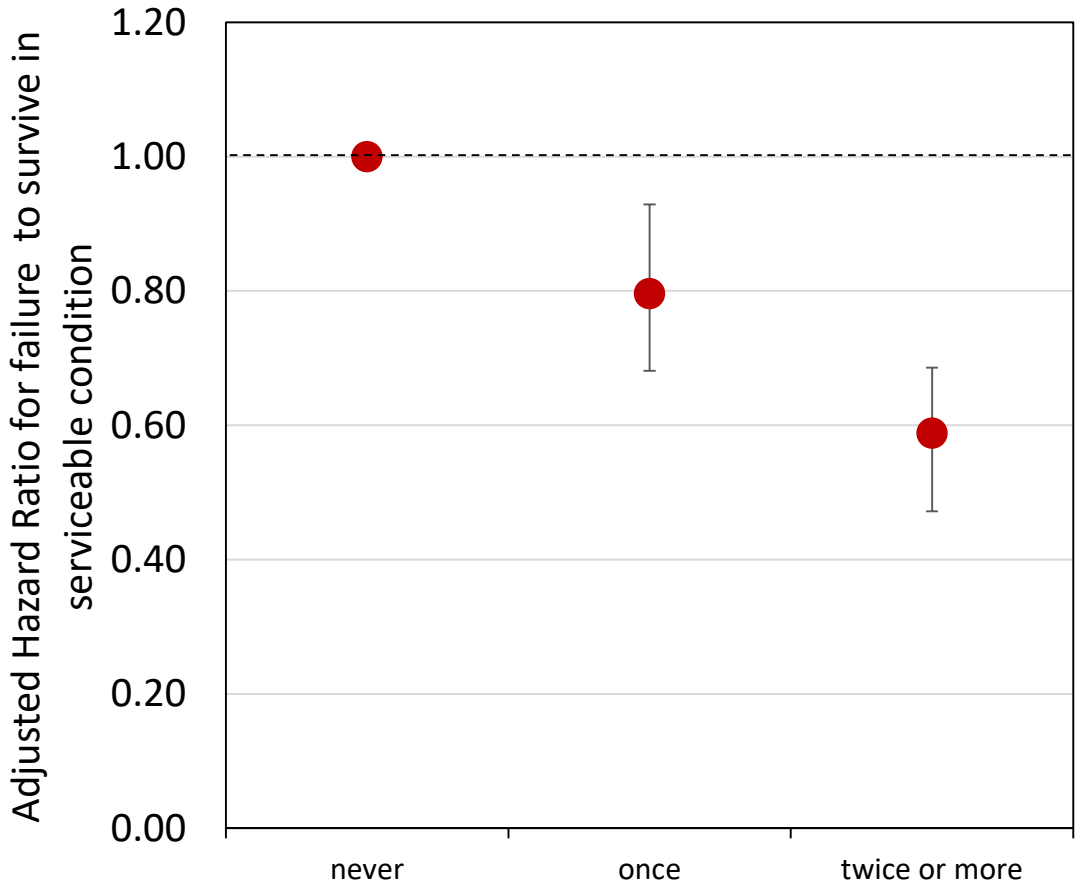



- Some differences between brands
- Huge differences between sites

# Key determinants

- Factors of **net use environment** and **net handling** were explored
- Variables were assessed across follow-up surveys
- Composite "net care attitude" score calculated
- There was some variation of the combination or intensity of determinant factors between countries
- But some clear trends across the four African countries emerged

# Net Attitude and Net Durability




Household recorded very positive net care attitude score across surveys

# Key determinants

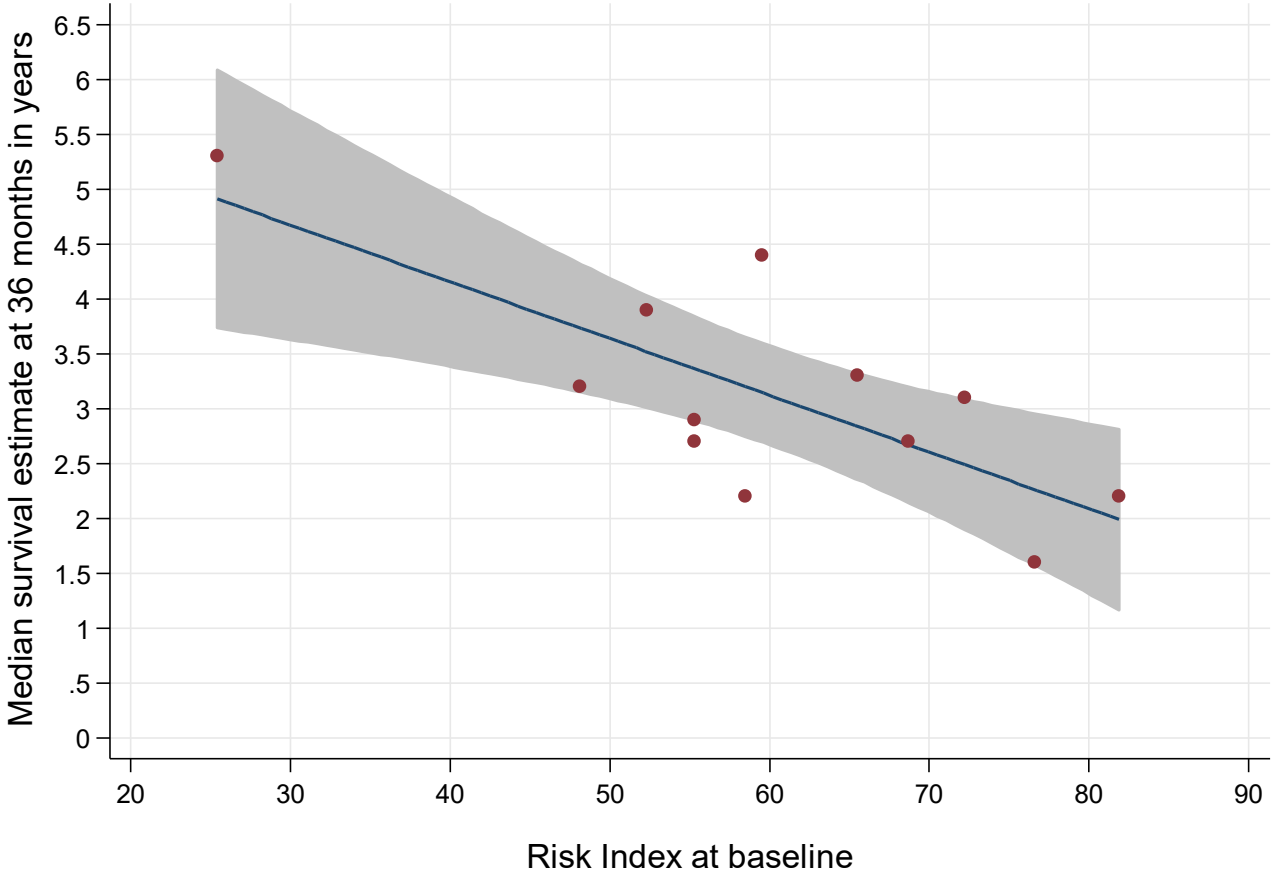
- A very positive attitude towards net care is preventive
- A net only used by adults “lives longer”
- Never folding up the net during the day is a bad idea
- Having more than two children under 10 year in your HH increases risks to the net
- Type of sleeping place may be important but can be overcome by “good care behavior”
- In some settings female headed households do a slightly better job of protecting their nets

# Risk Index

| Element and indicator | Sub-category weight | Within category weight | Category weight |
|---|---|---|---|
| **Net handling factors** | | **100** | **45** |
| Ever store food in sleeping room | | 5 | |
| Ever cook in sleeping room | | 5 | |
| Net hanging | | 10 | |
| Net NOT tied/folded when hanging | | 60 | |
| Net dried on fence/bush | | 20 | |
| **Environment factors** | | **100** | **10** |
| House walls grass/mud | | 10 | |
| Cooking fuel firewood | | 10 | |
| Rodents seen around house | | 35 | |
| Sleeping place | **100** | 45 | |
| Bedframe | 10 | | |
| Mattress | 30 | | |
| Mat or ground | 60 | | |
| **Net care and repair (risk)** | | **100-x** | **45** |
| Net care and repair | | 100 | |
| Recalls "care for your net" | | 5 | |
| Recalls "repair your net" | | 5 | |
| Net care attitude score >1.0 | | 90 | |

- Can we predict the physical durability from knowing the constellation of risk factors at baseline?

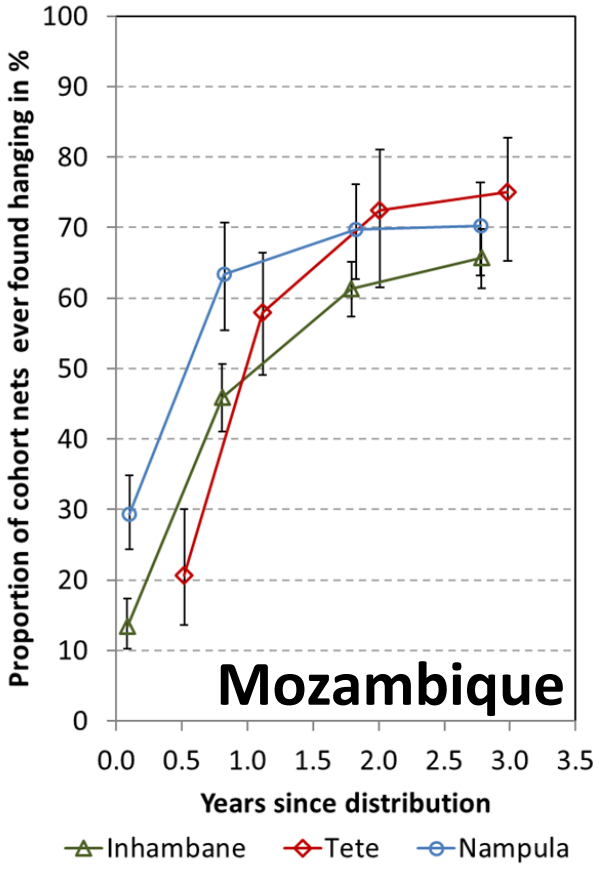
# Risk Index

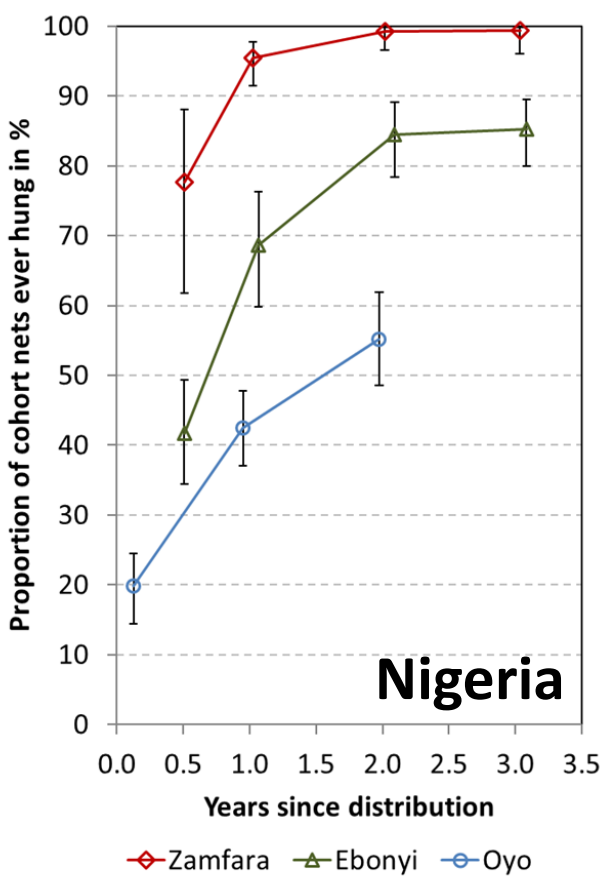


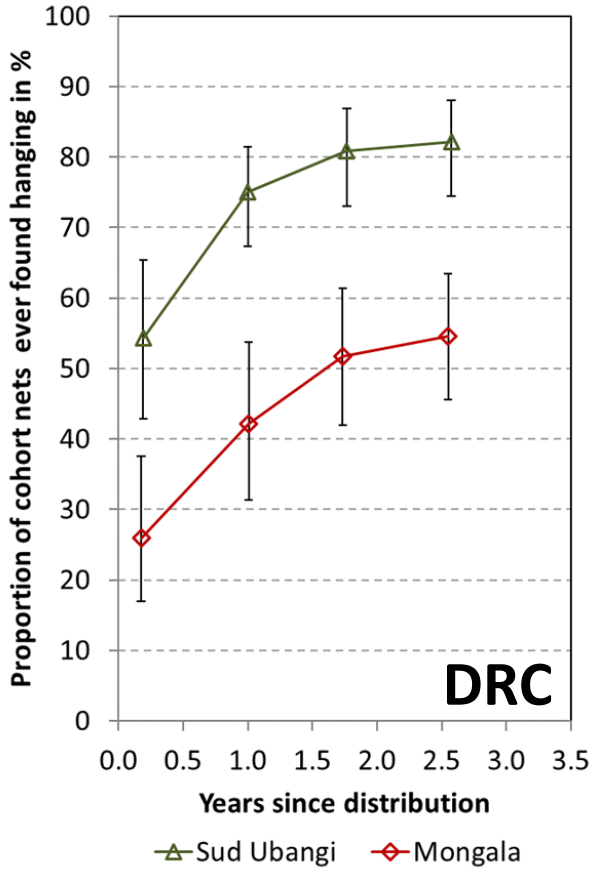

- $R^2$=0.53; p=0.004
- A reduction of the risk index by 10 points could extend medium survival by 0.5 years

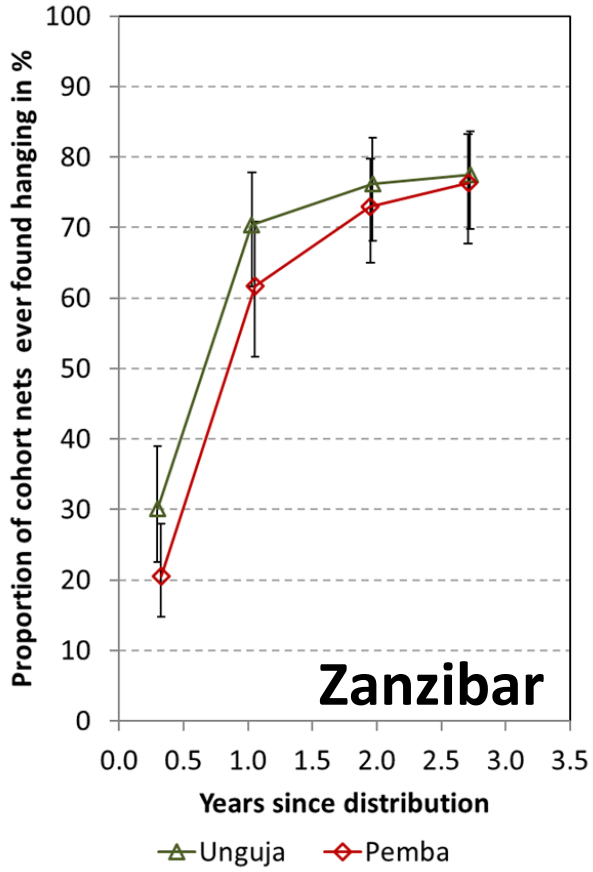
# Hanging of nets

- Initially many nets were still in the package
- Some were never hung



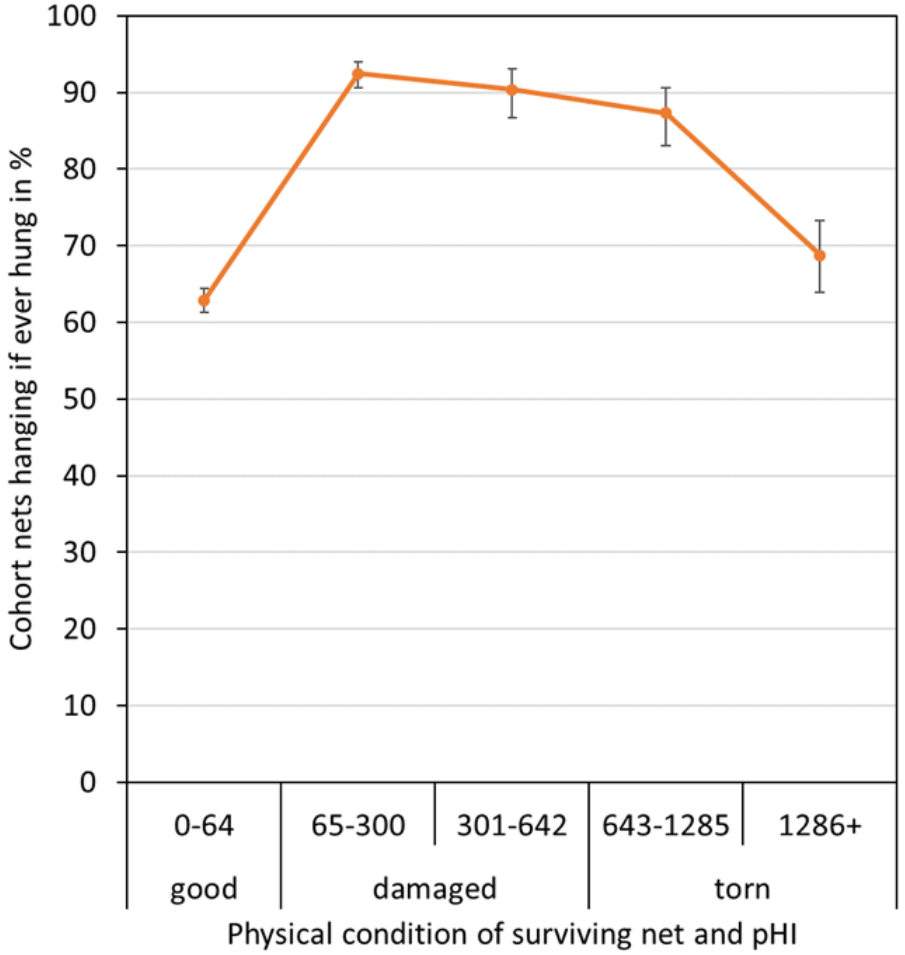



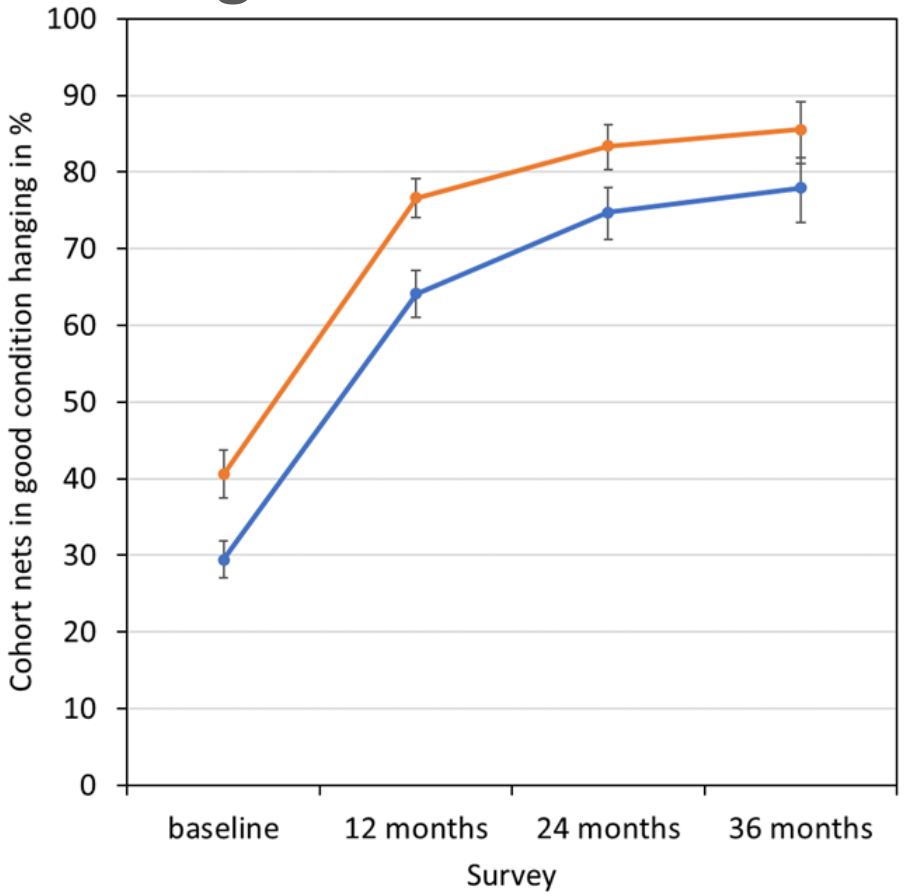
# Hanging of nets

- We found that use was closely linked to hanging
- And hanging dependent on three major factors
  - Availability of other nets in the household
  - Overall net supply situation in household
  - The physical condition of the net

# Hanging of nets

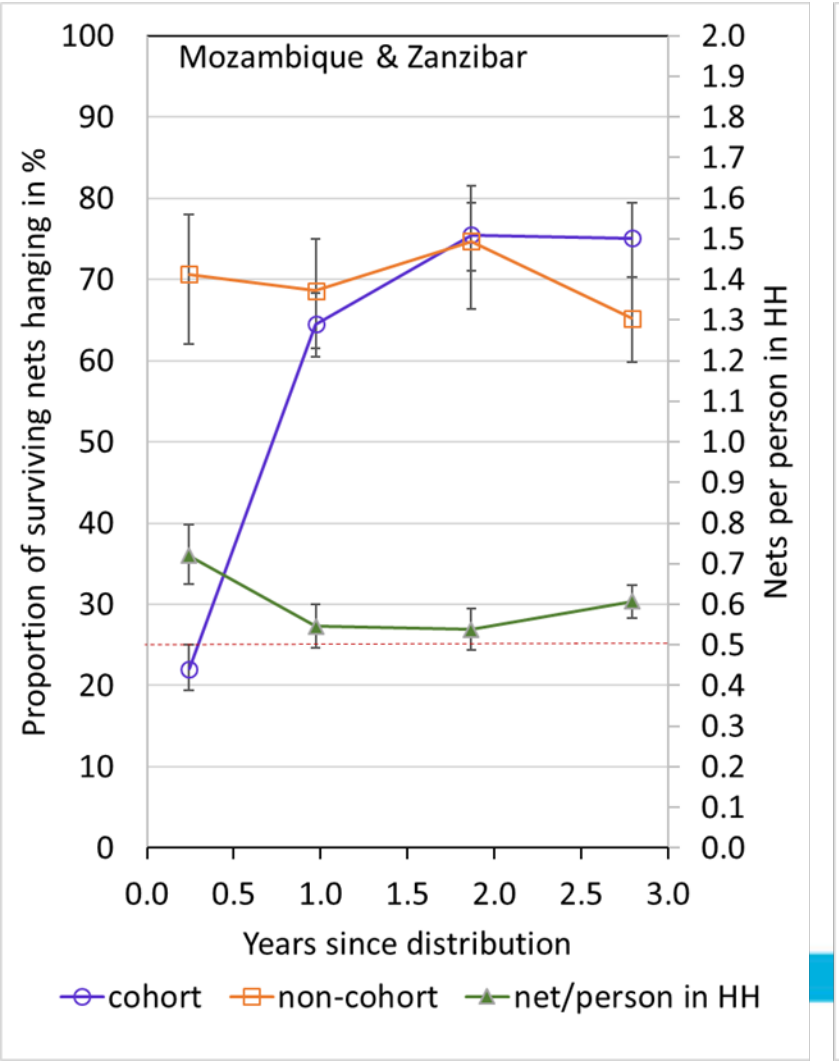
- Torn and very torn nets were still used, but increasingly less
- Good nets seemed to be hung less

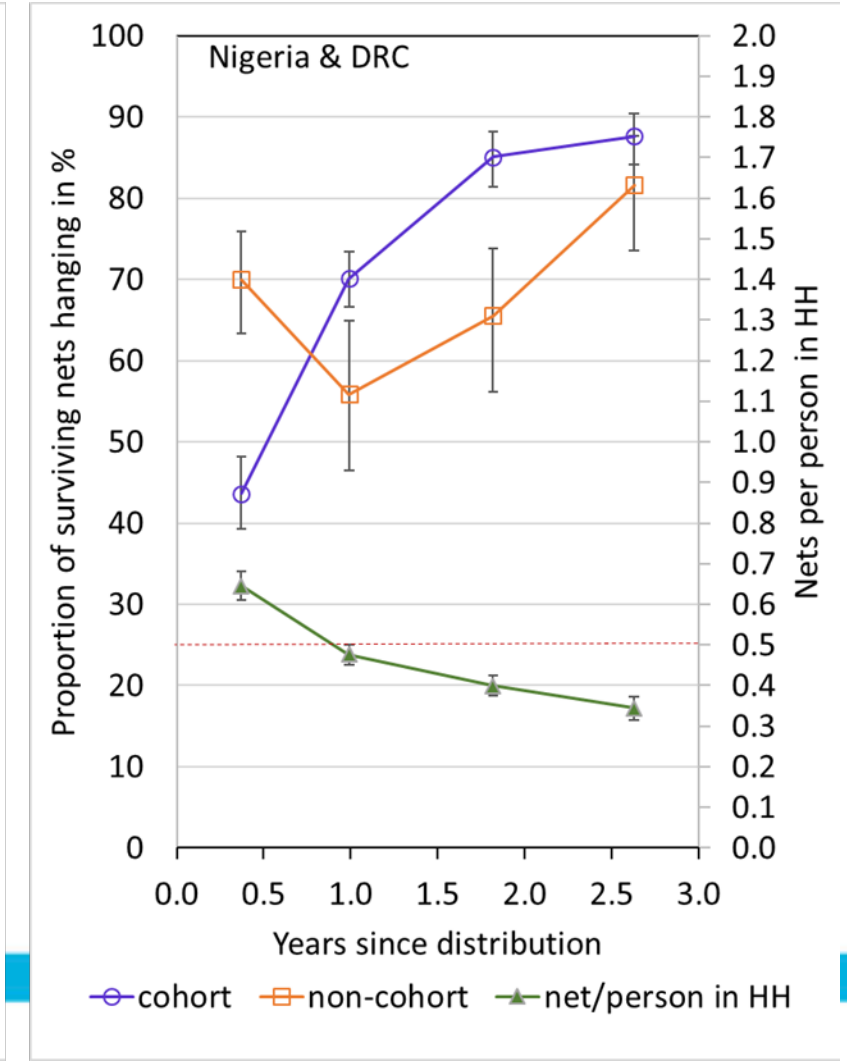



- But only at baseline

# Hanging of nets

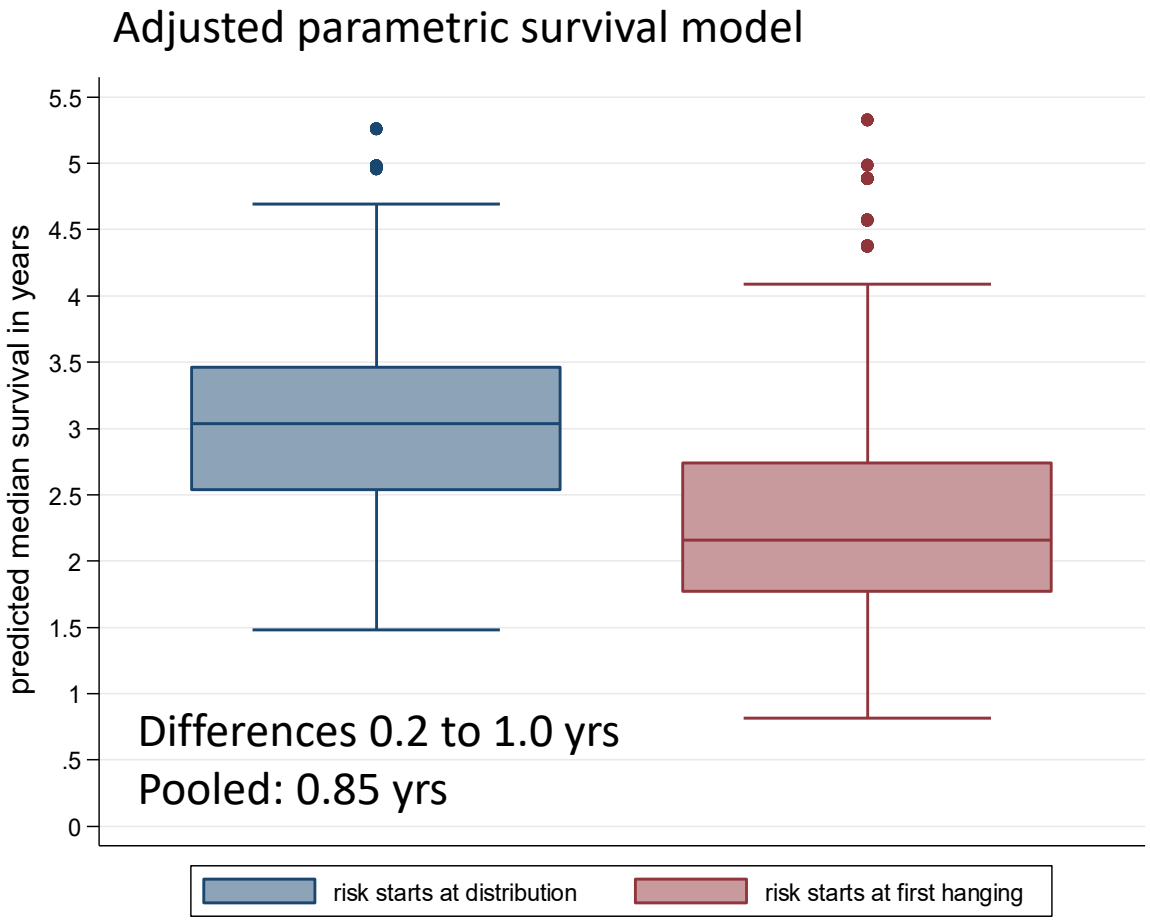



- Two pattern emerged:
- High supply level and non-cohort nets were used first
- Declining supply and cohort nets used quickly but as need arises use of non-cohort nets increased

# Hanging of nets

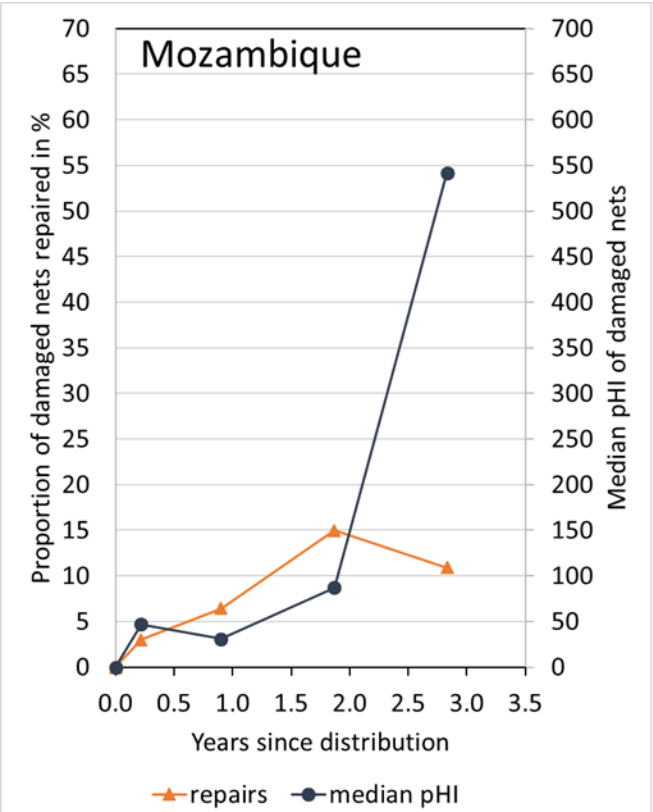
- What impact has delay of hanging on survival estimates?

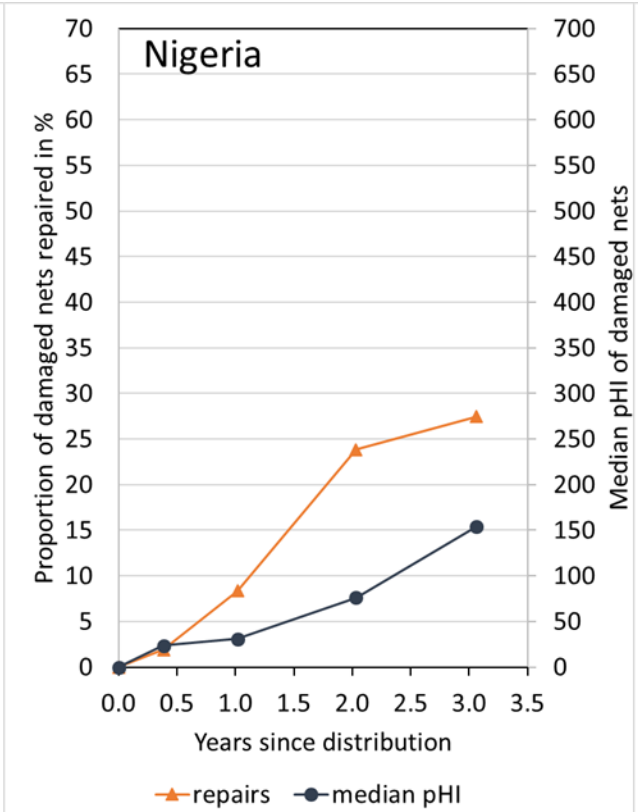


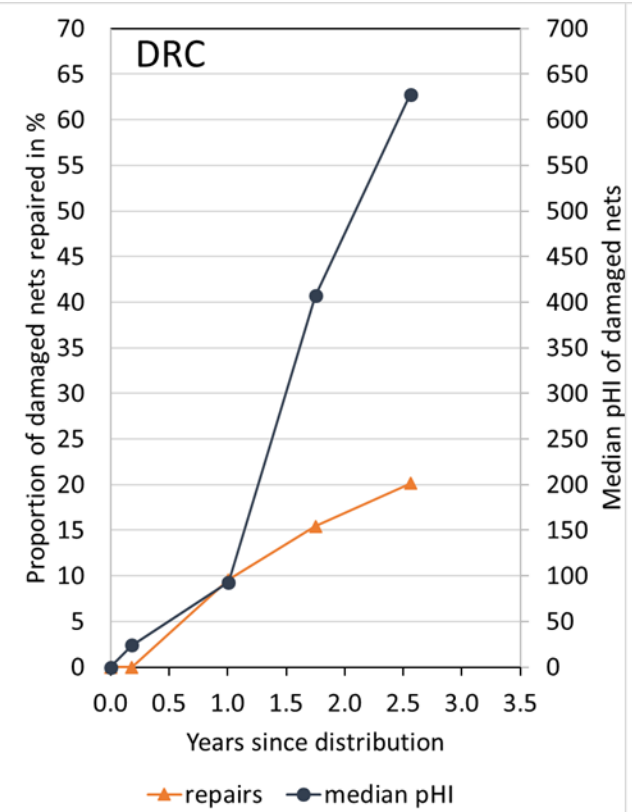
VECTOR WORKS
Scaling Up Vector Control for Malaria Prevention

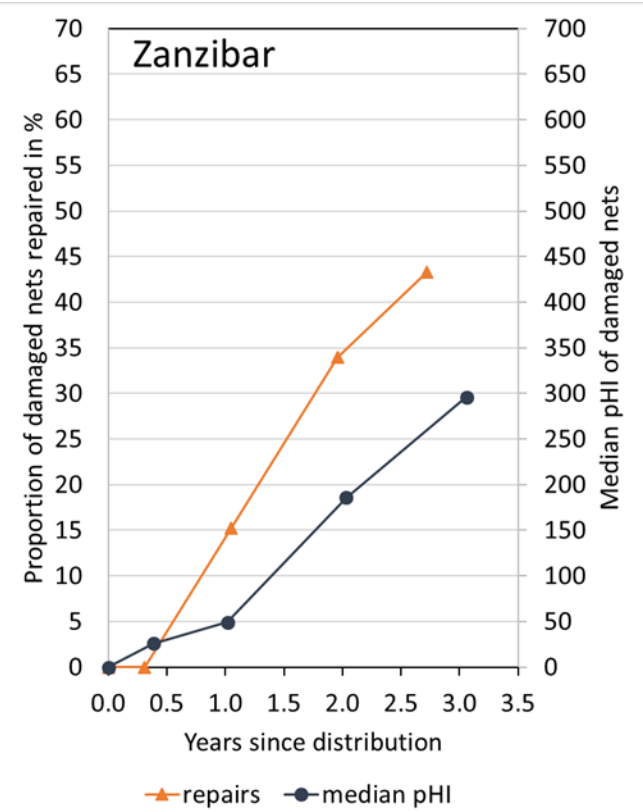
# Repairing damaged nets

- Level of repairs varied but seemed to only increase when damage was already significant

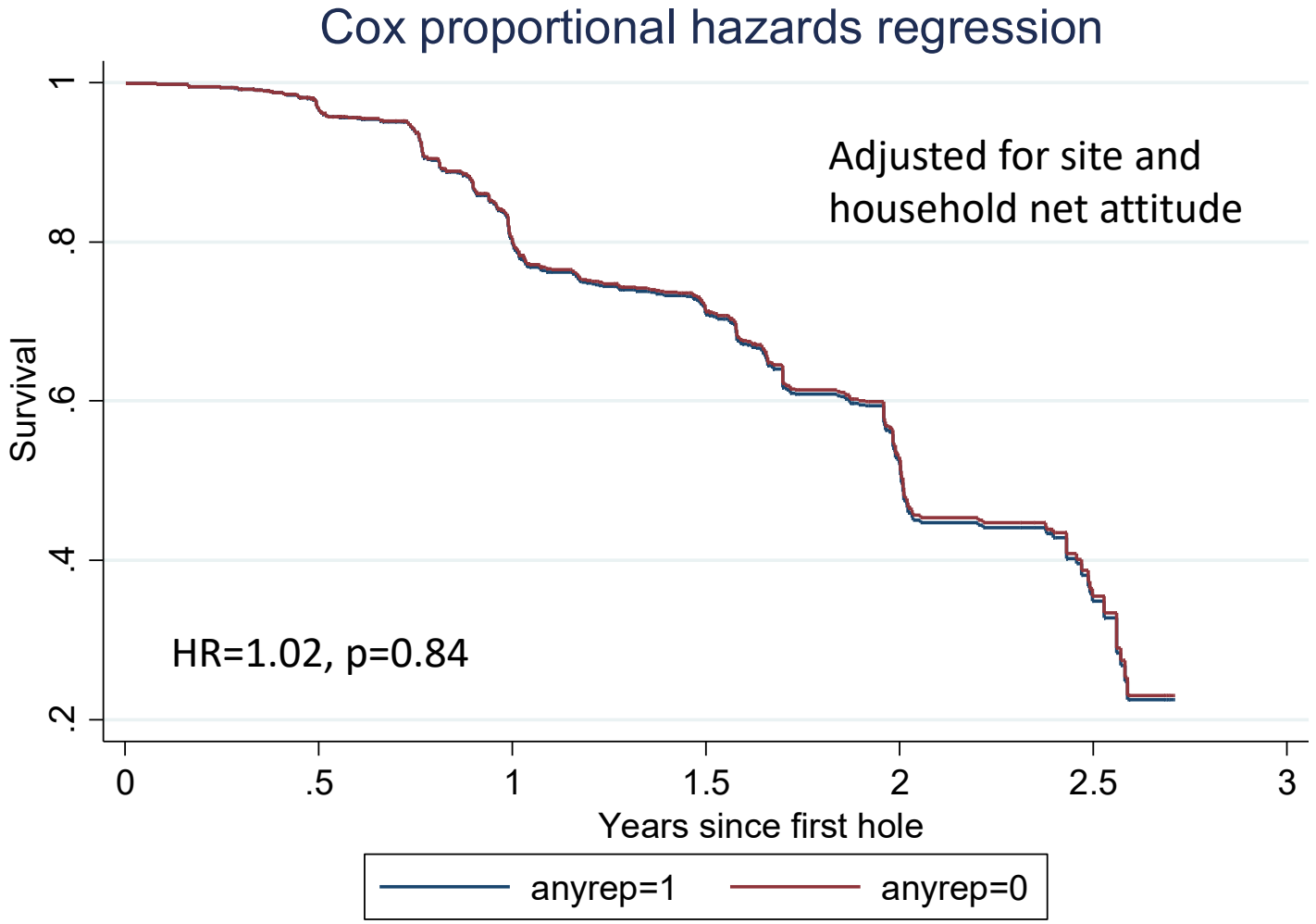


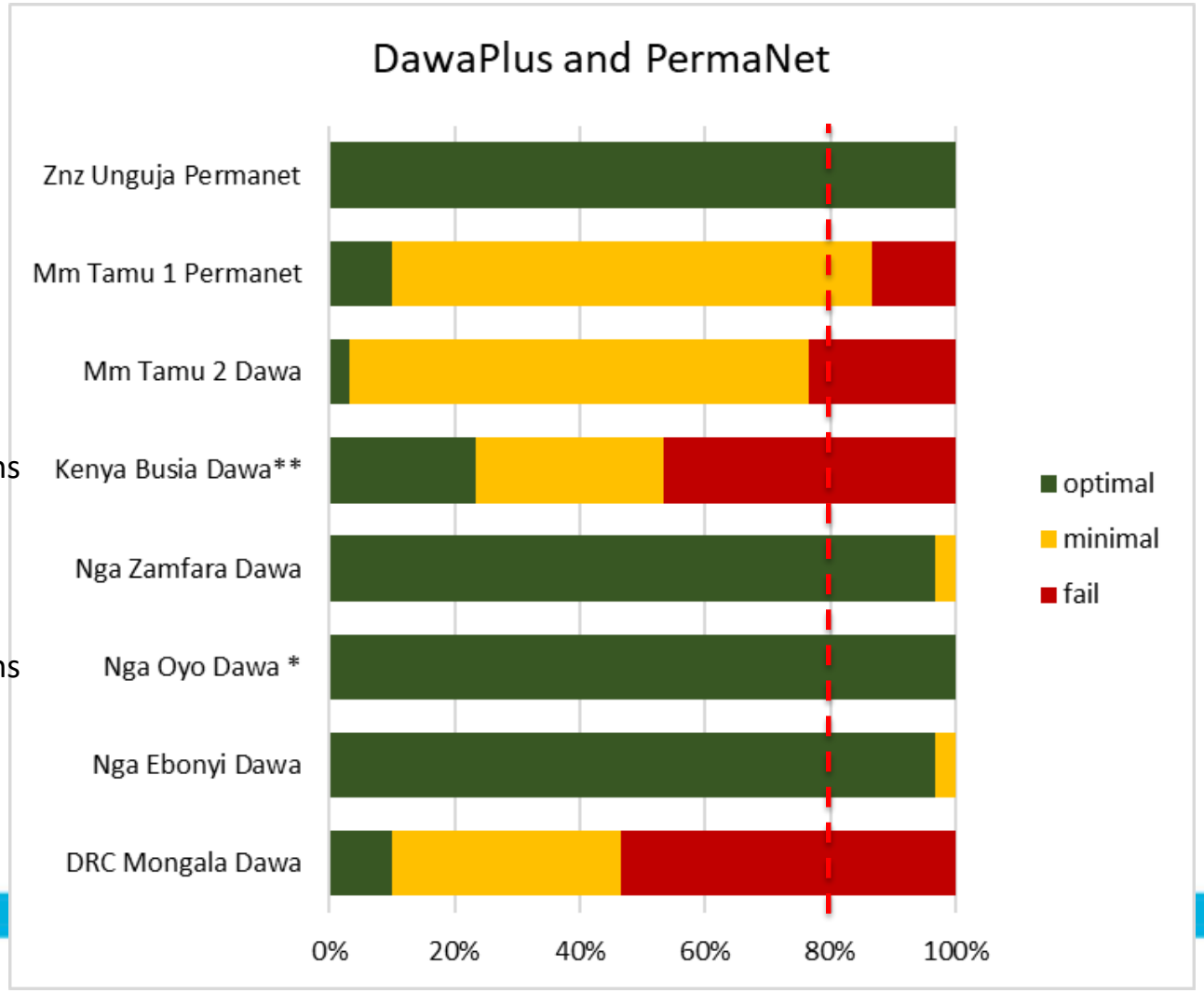



# Repairing damaged nets



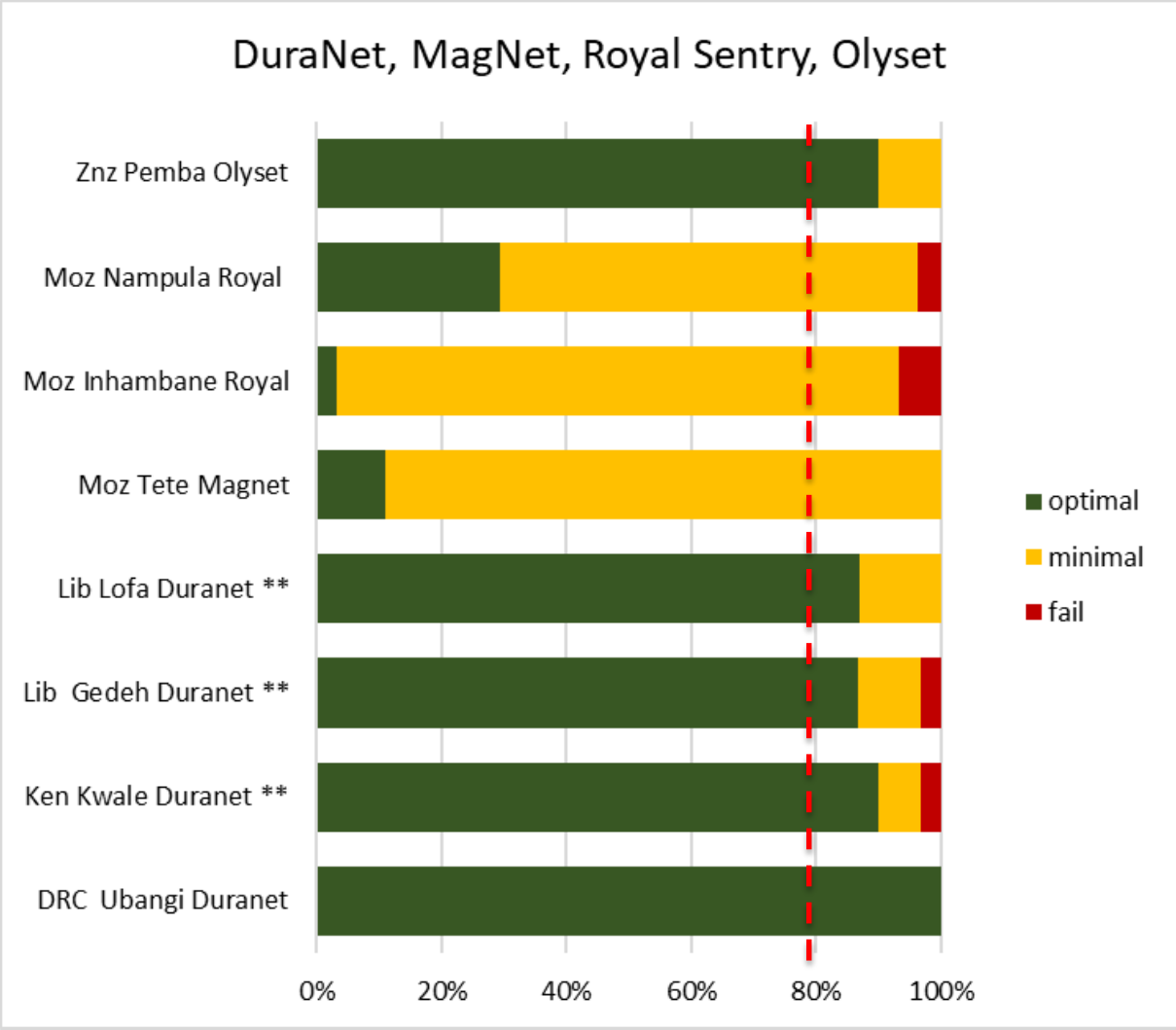

- Survival analysis starting risk of "failure" at time of first hole shows absolutely no impact of repairs on survival in serviceable condition

# Insecticidal effectiveness




- At 36 months of follow up DawaPlus had >80% optimal effectiveness in Nigeria but failed in DRC and Kenya (after only 12 months)
- Also good results for PermaNet in Unguja
- Ambiguous results in Myanmar for DawaPlus and PermaNet as low bio-assay results at all time points
  - Chemical residue at 36 months >80% with >25mg/m$^2$ deltamethrin and in total >50% of target dose

# Insecticidal effectiveness




12 months

12 months

12 months

- At 36 months follow-up DuraNet in DRC and Olyset in Pemba had >80% optimal performance.
  - Also acceptable after 12 months in Kenya and Liberia
- Royal Sentry and MagNet in Mozambique had >80% up to 24 months, then declined.
  - Still >80% minimal effectiveness
  - Chemical residue by CDC shows median alphacypermethrin of
    **Inhambane**: 4.7 g/kg (81% of target)
    **Nampula**: 1.9 g/kg (32% of target)
    **Tete**: 2.4 g/kg (41% of target)

# So what does all this mean?

# Do we need to replace nets more frequently

- In some places such as DRC probably, at least temporarily
- In others a longer interval could be considered
  - If we have sufficient evidence that the insecticidal effectiveness keeps up

# Would it help to have 'more durable nets'

- Certainly, but how do we make them more durable (what do we need to change) and still be cost-effective?
- How do we provide the evidence that a product will perform better in a "standard" use environment and incorporate that into the procurement process?
  - A problem left hanging in 2014
  - "Resistance to Damage" textile Index
  - Semi-field standardized rapid testing of promising new products

# Is there room to improve net care

- Definitely, but we also need to better understand the dynamics and interactions at play
- Definitely should focus on preventive behaviors and not repair