RESISTANCE TO DAMAGE (RD) SCORE

Analysis and utility of factors affecting ITN durability

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Agenda

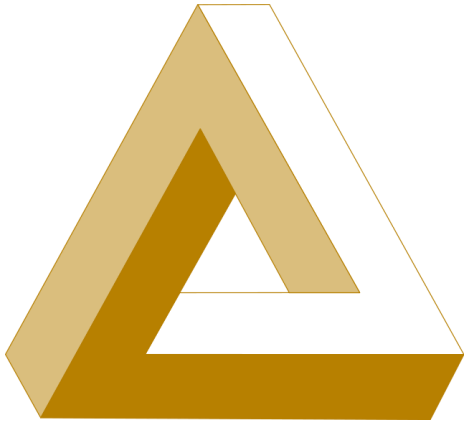
- Introduction
- History of RD score
- Refining RD score
- Avenues to innovation

Introduction

Bertozzi-Villa, A., et al.,. Nat Commun 12, 3589 (2021)

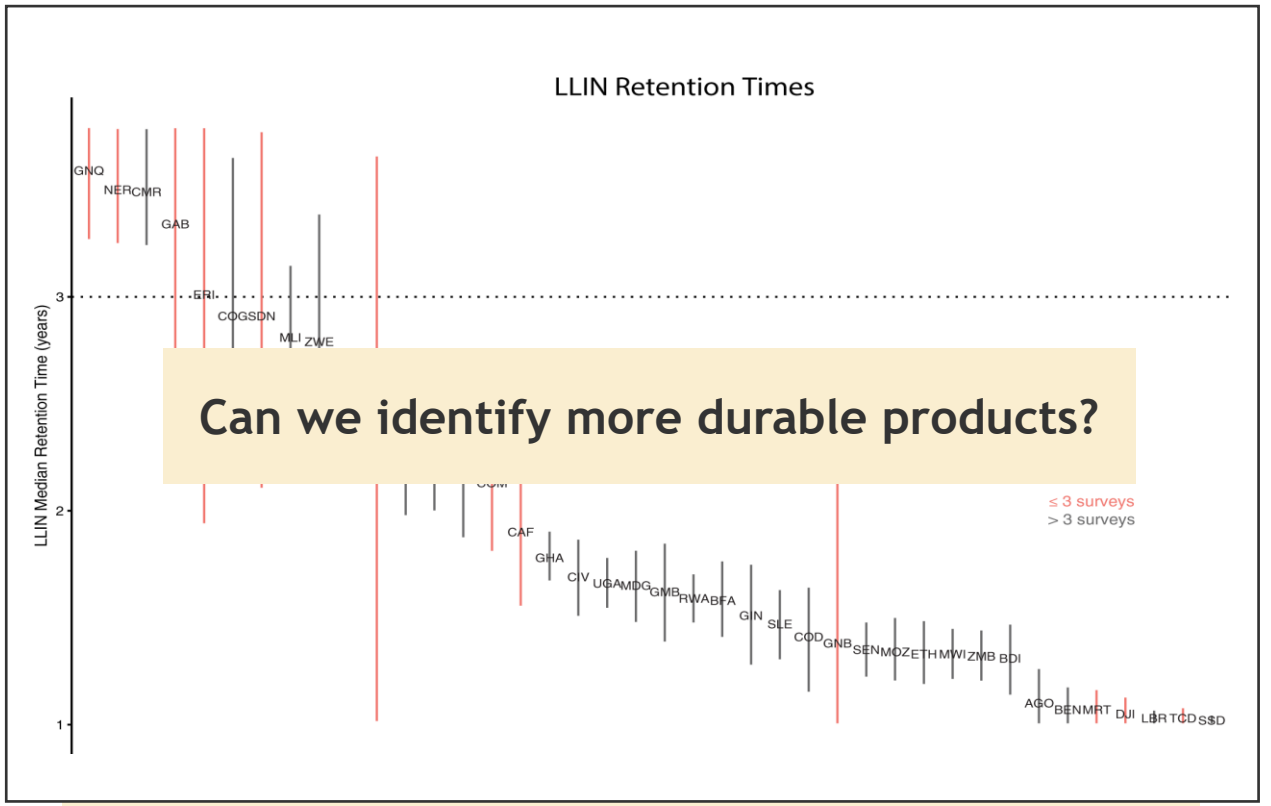
IMPOSSIBLE VC TRIANGLE

MAINTAIN COVERAGE



MORE, AND MORE EXPENSIVE, TOOLS

FLAT BUDGET

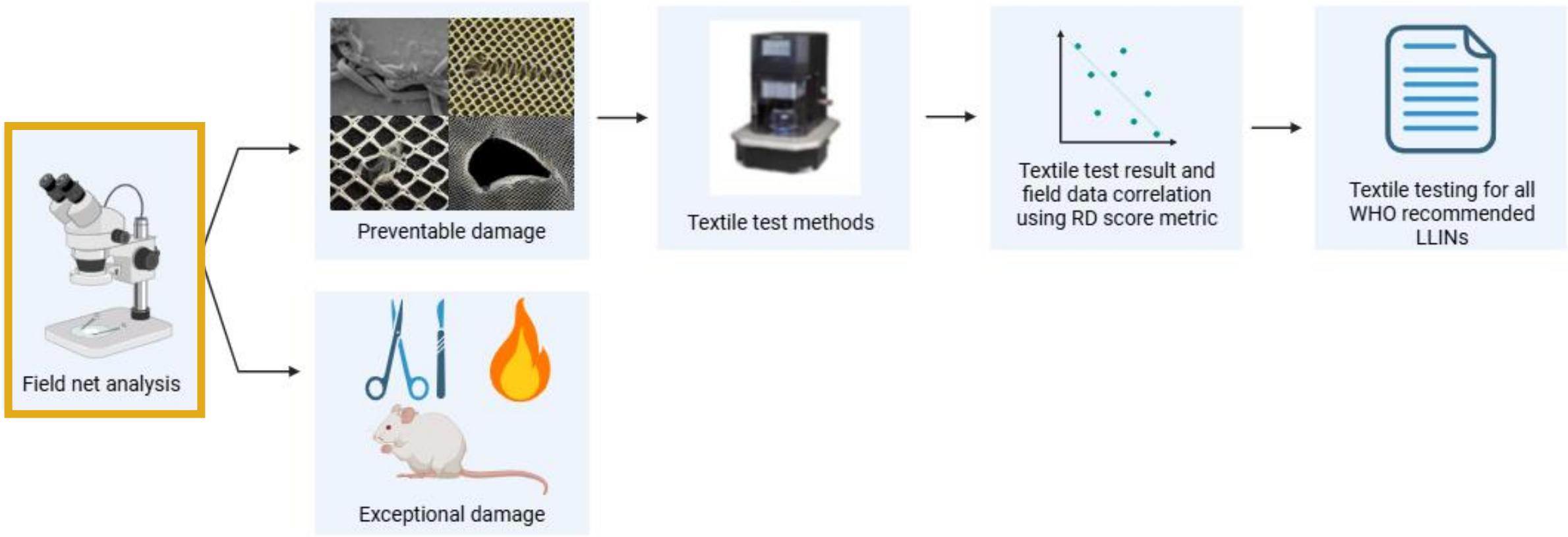


Can we identify more durable products?

Overall median value of 1.64 years LLIN retention

History of RD score - Overview

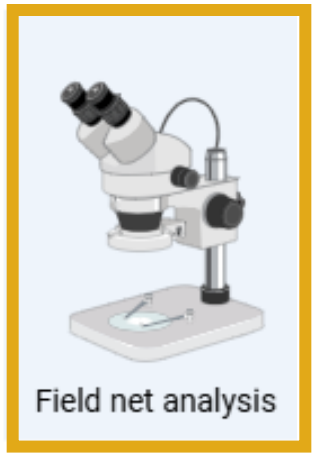
Created in BioRender.com bio

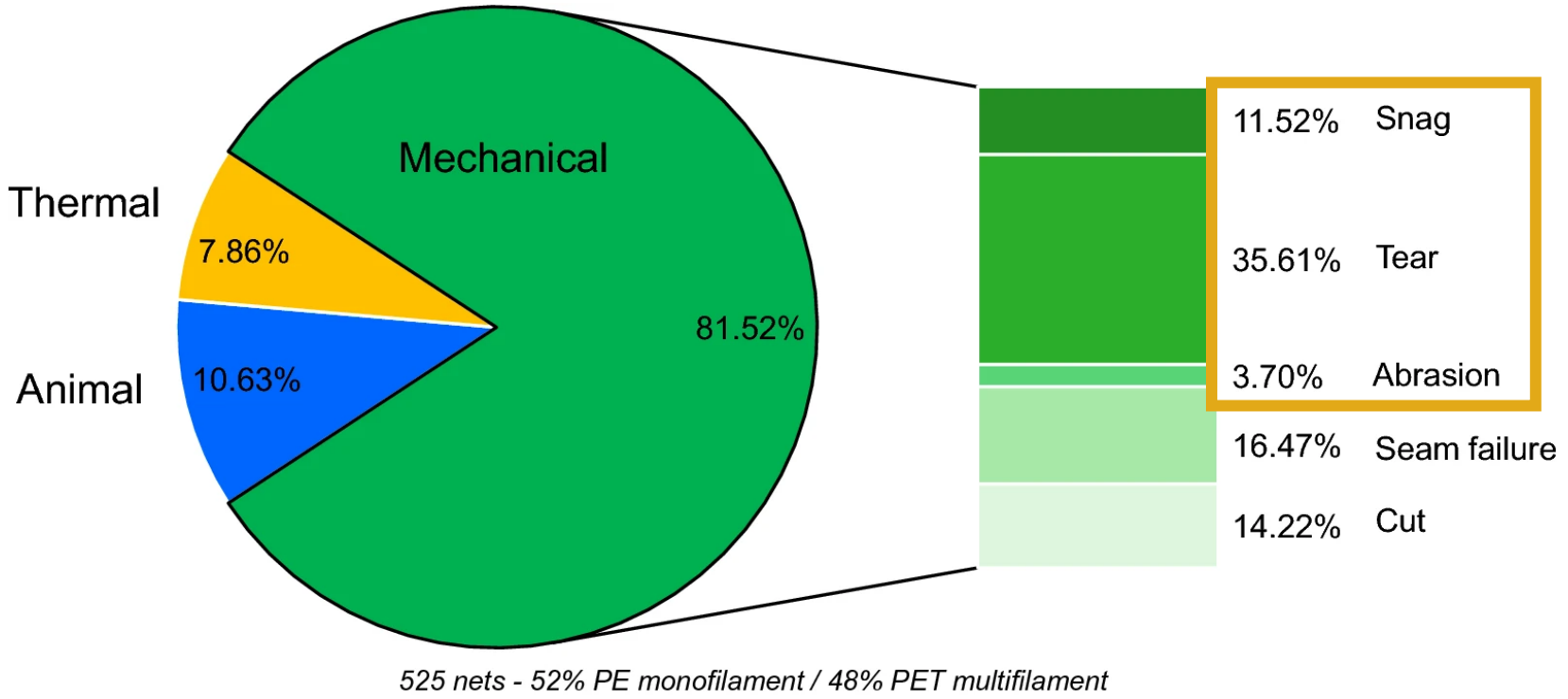


History of RD score - Field net analysis

Wheldrake A, Malar J. Jan 19;20(1):45 (2021)

Forensically classified >40,000 damaged areas in 526 ITNs collected from 5 countries



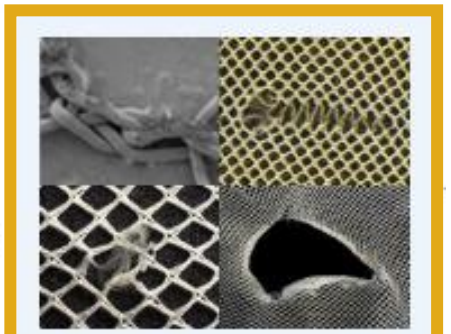


525 nets - 52% PE monofilament / 48% PET multifilament

Majority of damage is preventable

History of RD score - Division of hole types

Field net analysis



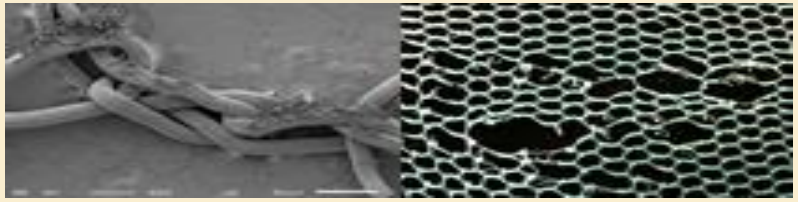
Preventable damage

Exceptional damage

Holes formed

Snag/burst

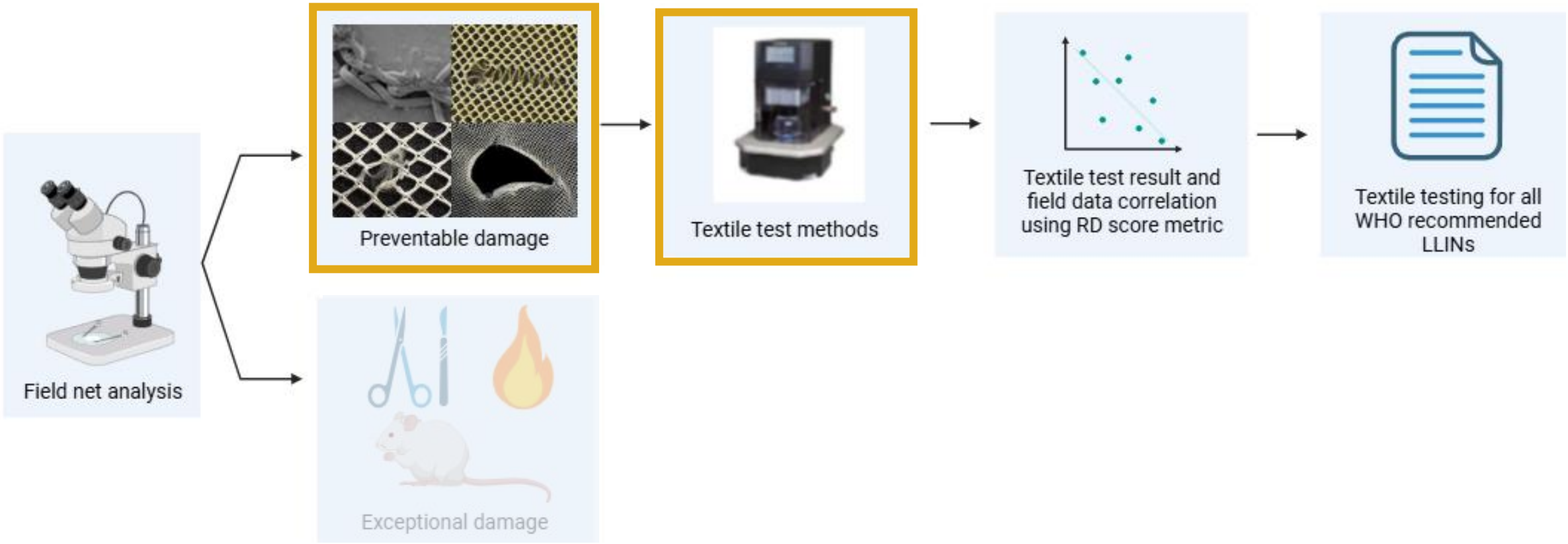
Abrasion



Holes enlarged

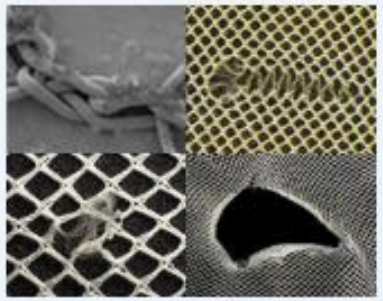
Ladder/Unravel

History of RD score - Textile test methods



History of RD score - Textile test methods

Wheldrake, A.,. *Malar J* **20**, 47 (2021)



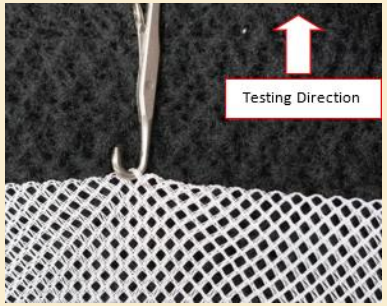
Preventable damage

Textile test methods

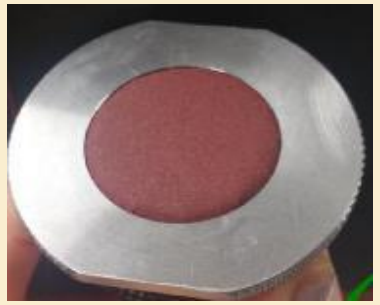
Holes formed

Bursting strength
ISO 13938-2:1999

Snag strength
ISO 13934-2:2014

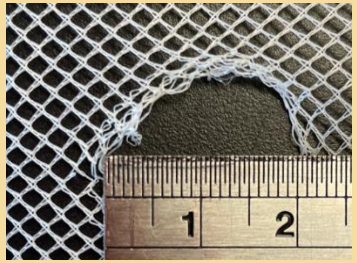


Abrasion resistance
ISO 12947:1998

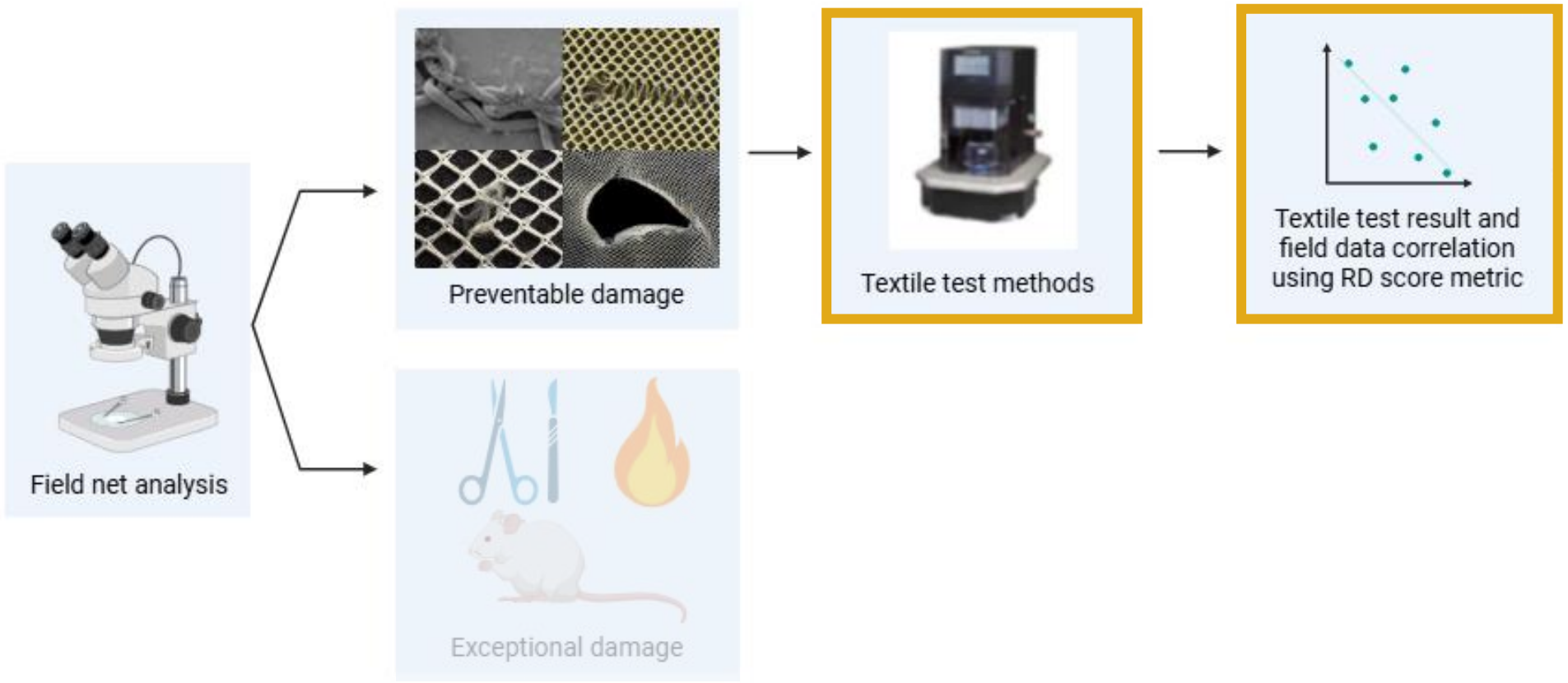


Holes enlarged

Hole enlargement resistance
ISO 13938-2:1999



History of RD score - RD score development



History of RD score - Existing results

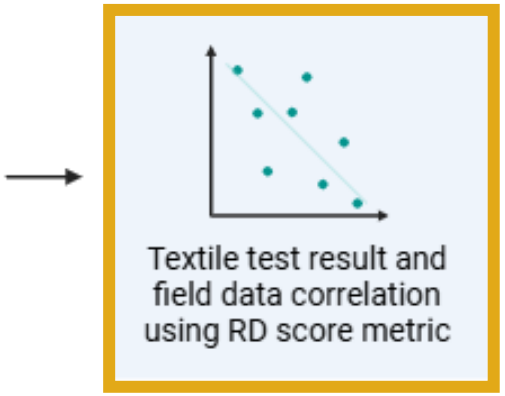
Wheldrake,. *Malar J* **20**, 46 (2021)
Kilian, A.,. *Malaria journal*, *20*(1), 29 (2021)

25% **Snag resistance**

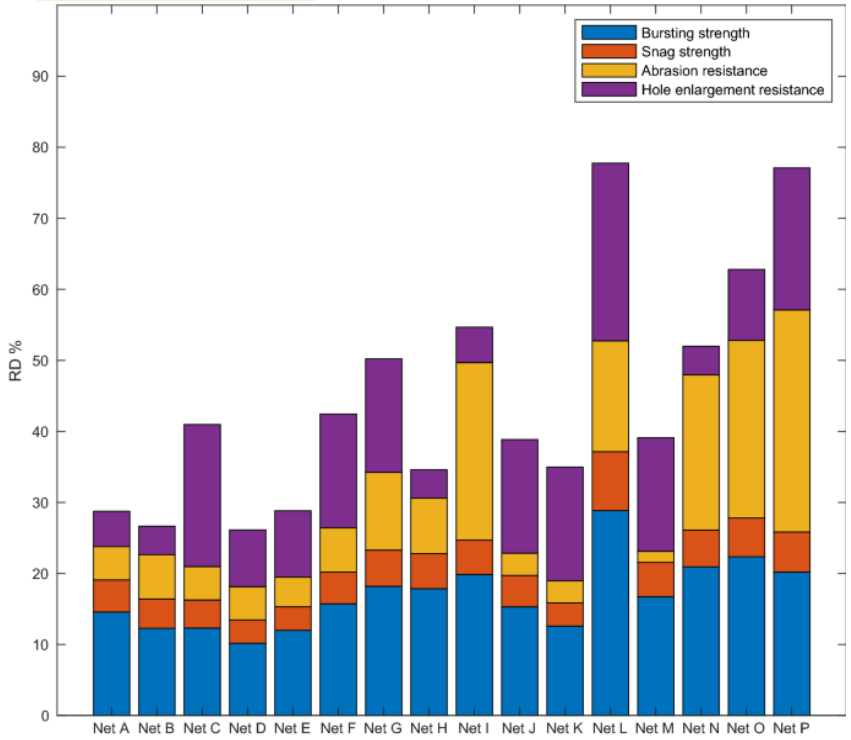
25% **Bursting strength**

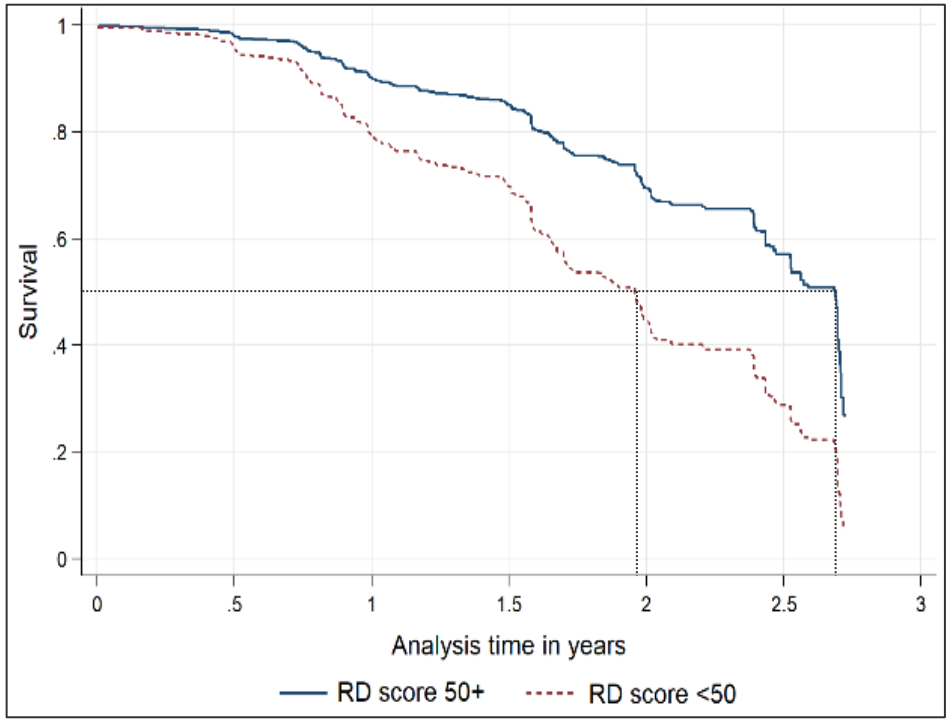
25% **Hole enlargement**

25% **Abrasion resistance**

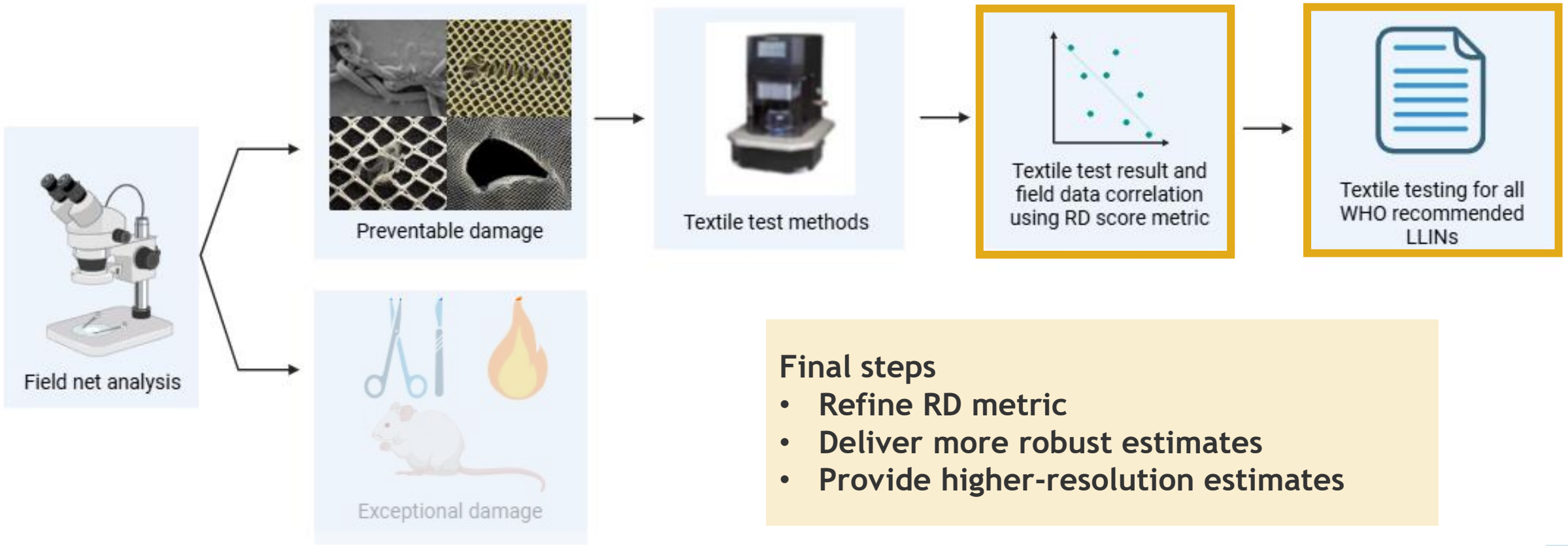


Pre-2021





History of RD score - Final steps



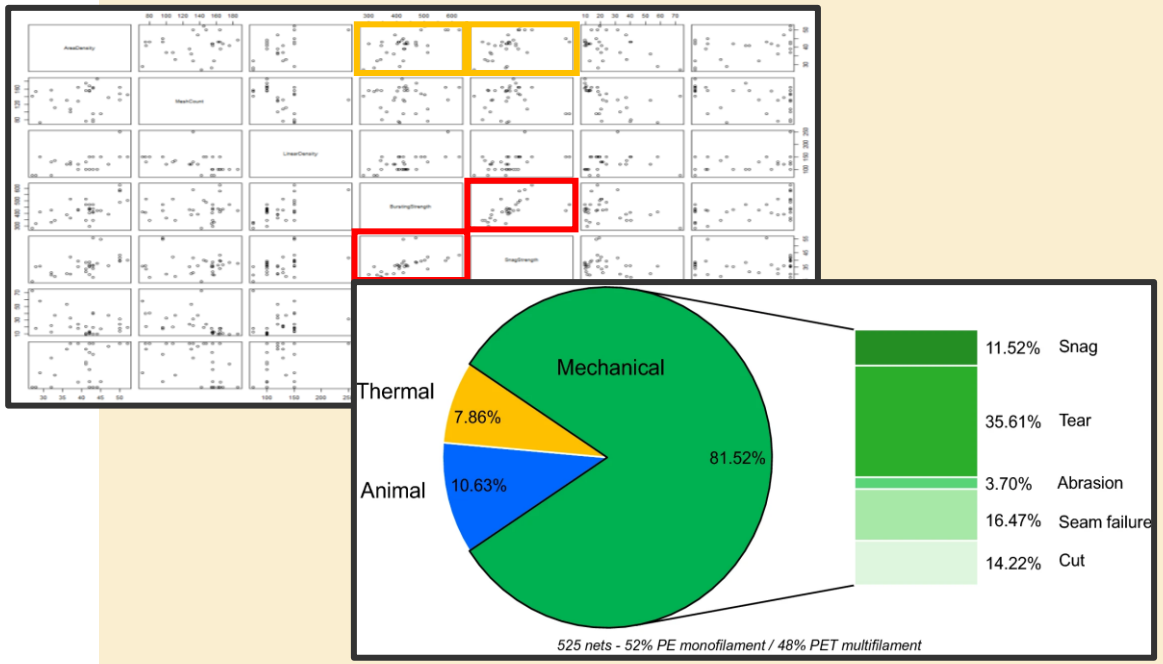
Final steps

- **Refine RD metric**
- **Deliver more robust estimates**
- **Provide higher-resolution estimates**

Refining the RD score - Combined approach

Empirical

What does a deep-dive into the data tell us?



Holistic

What are we trying to achieve?

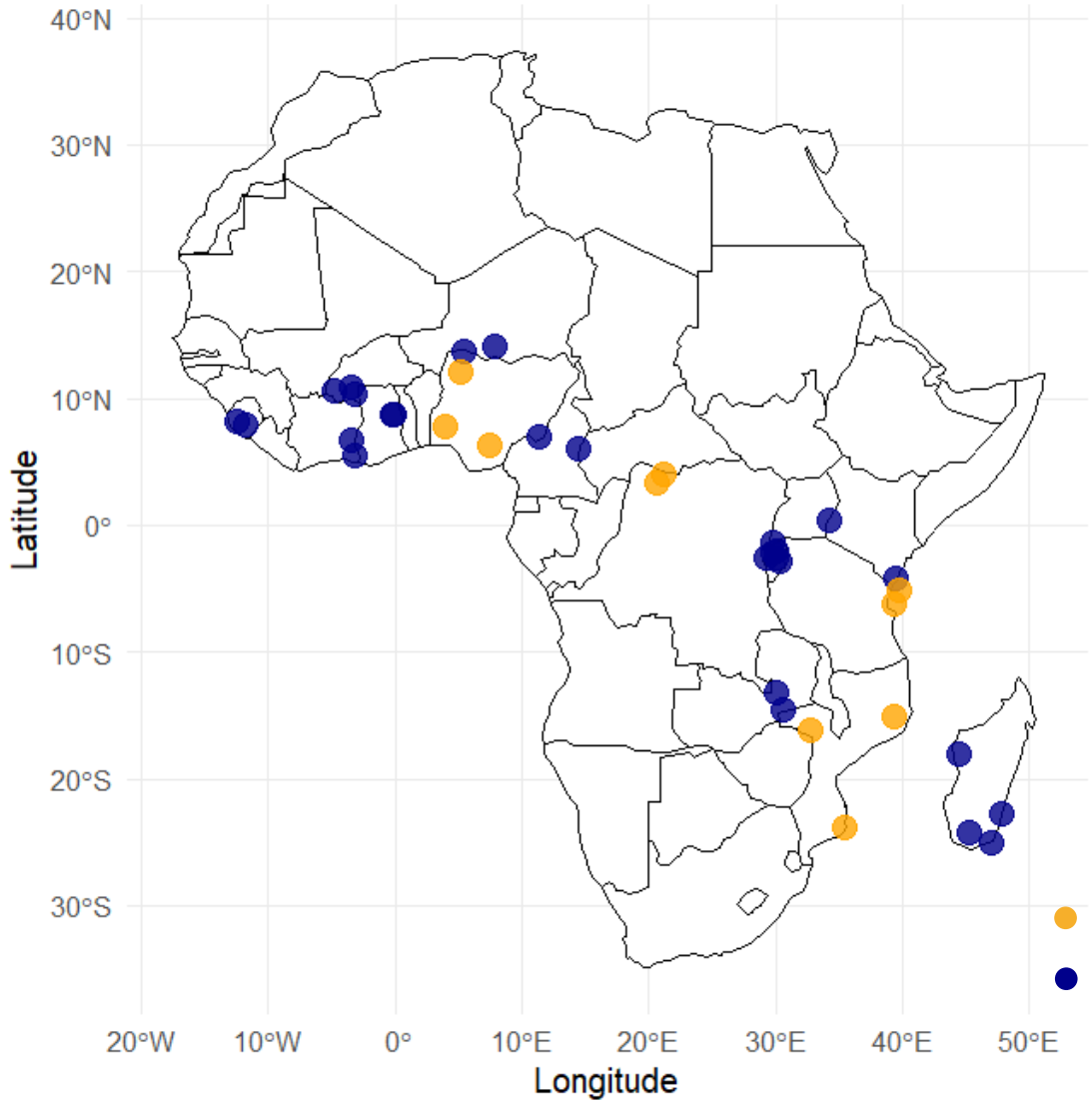
Purpose of durability is encourage retention and keep mosquitoes out

- Holes become major concern when they grow larger

Should we place greater **emphasis on ability to prevent hole enlargement**?

Refining the RD score - More durability data

Kilian, A.,. *Malaria journal*, *20*(1), 29 (2021)



	Kilian et al., 2021	2024
Countries	4	14
Durability mon. sites	10	37
LLIN brands	6	13
Campaign LLINs	4700	9500

TROPICAL HEALTH

INNOVATION TO IMPACT

Refining the RD score - Abrasion removed and hole enlargement increased

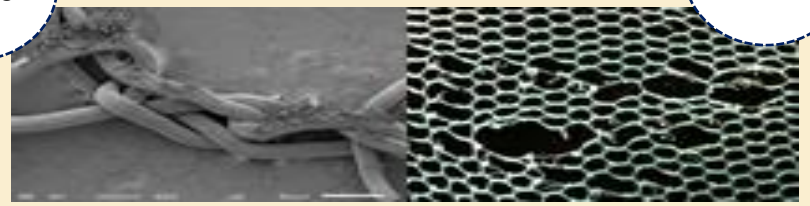
Holes formed

Snag/burst

50%

Abrasion

25%



Holes enlarged

25%

Ladder/Unravel

Refining the RD score - Abrasion removed and hole enlargement increased

Field net analysis

Preventable damage

Exceptional damage

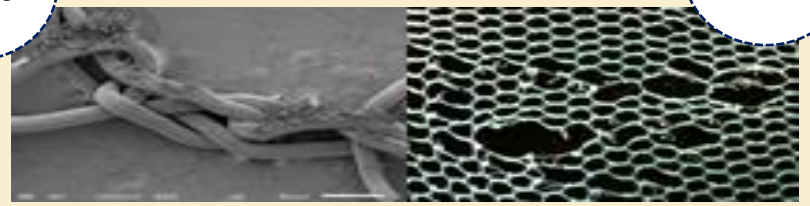
Holes formed

Snag/burst

50%

Abrasion

0%



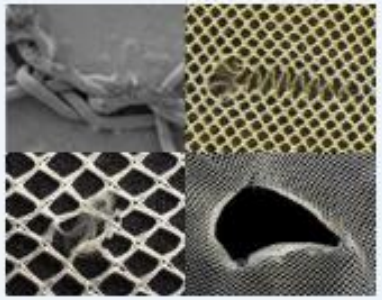
Holes enlarged

50%

Ladder/Unravel

Refining the RD score - Abrasion removed and hole enlargement increased

Field net analysis



Preventable damage

Exceptional damage

Holes formed

Snag/burst

50%

Abrasion

0%

Negligible detrimental effect when removed from RD

Holes enlarged

50%

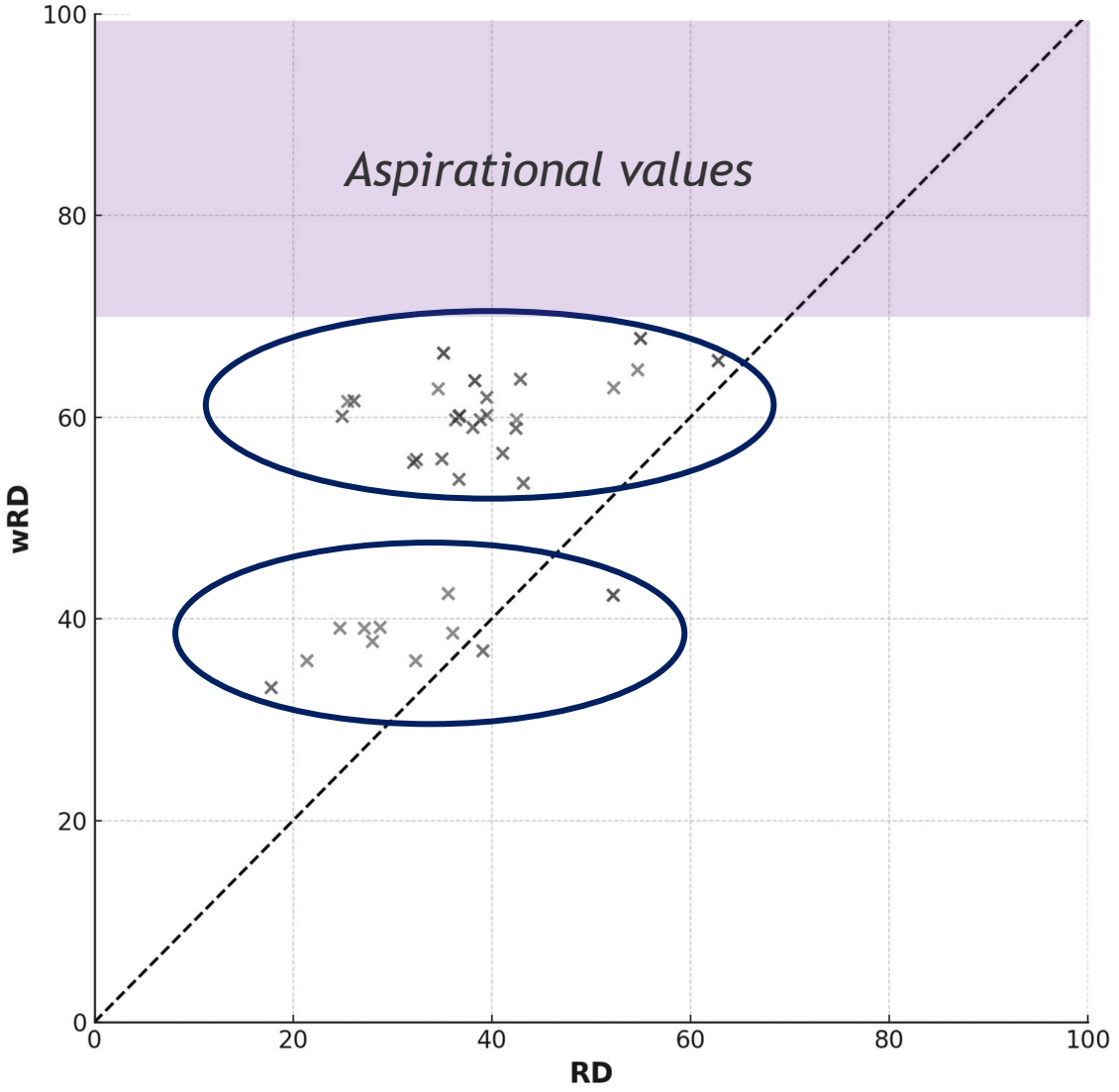
Increasing weighting of hole enlargement improves lifespan estimates

Refining the RD score - Defining the RD as the weighted RD

25% Snag resistance	25% Bursting strength	25% Hole enlargement	25% Abrasion resistance

Referred to hereafter as 'weighted RD' (wRD)

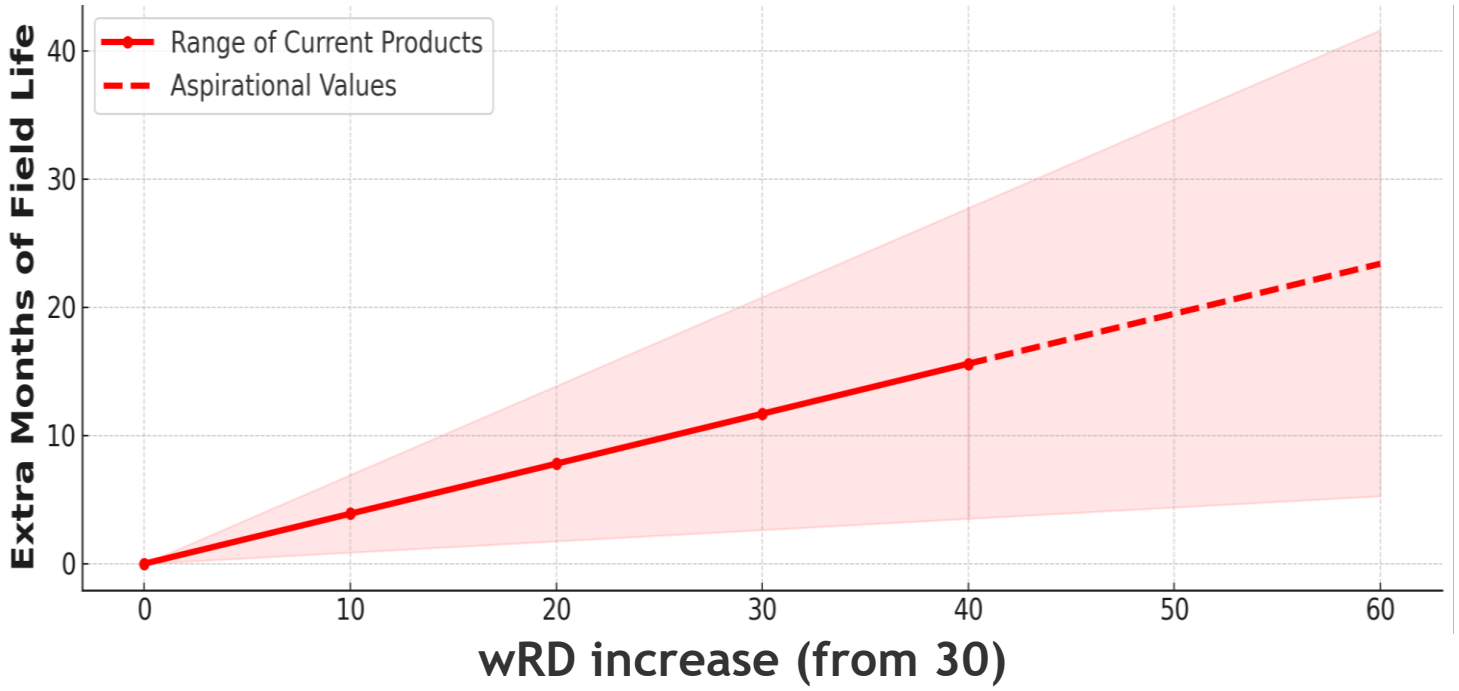
Refining the RD score - Range of wRD values



Note the bifurcation of wRD scores into two groups

Aspirational data coming from Malawi and Tanzania

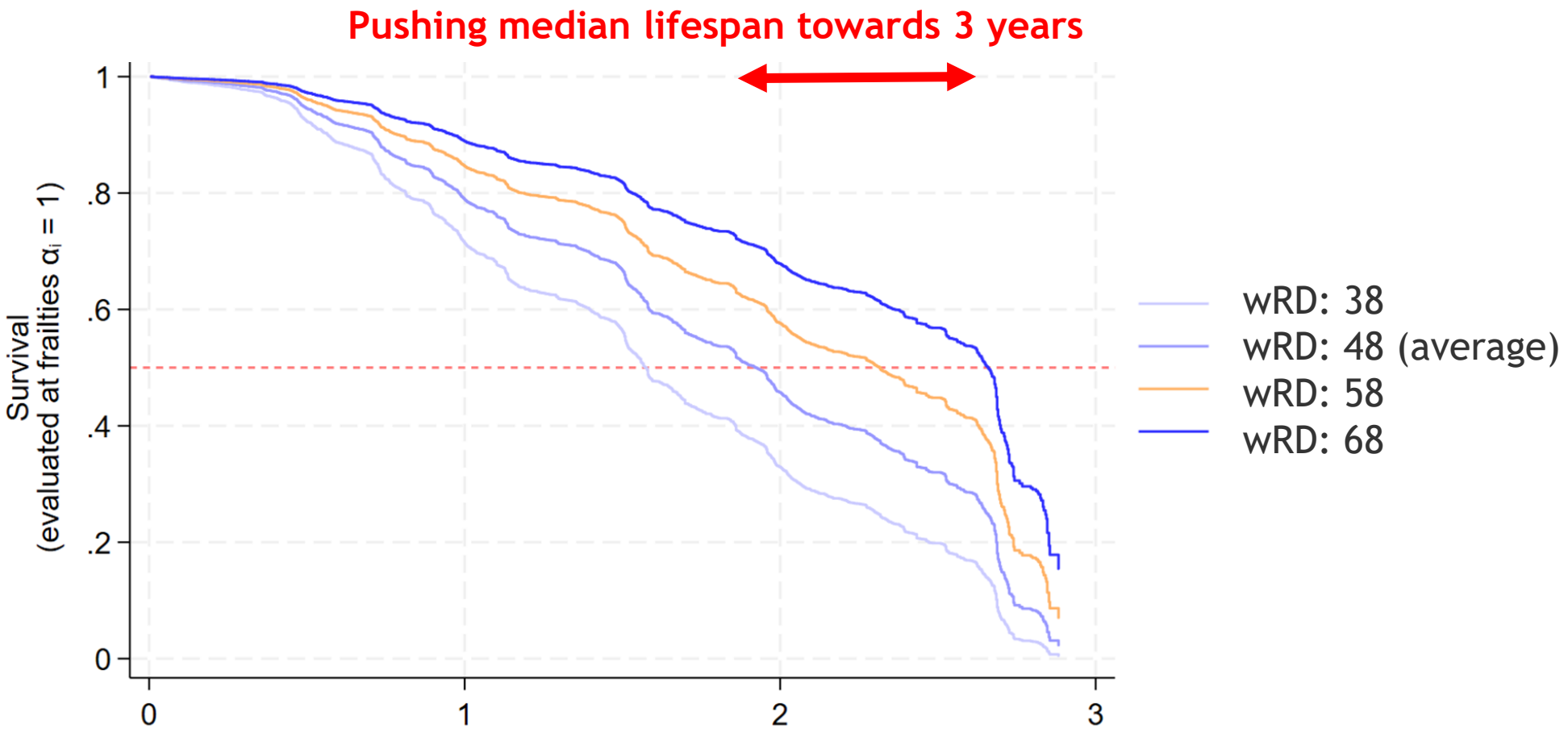
Refining the RD score - Generalising wRD (without country-specific data)



Increasing wRD from 30 to 65 increases median field life by **13.65 months**
(95% CI: 3.03-24.16)

Error bar reflects country variation:
Effect will be larger in some countries than others

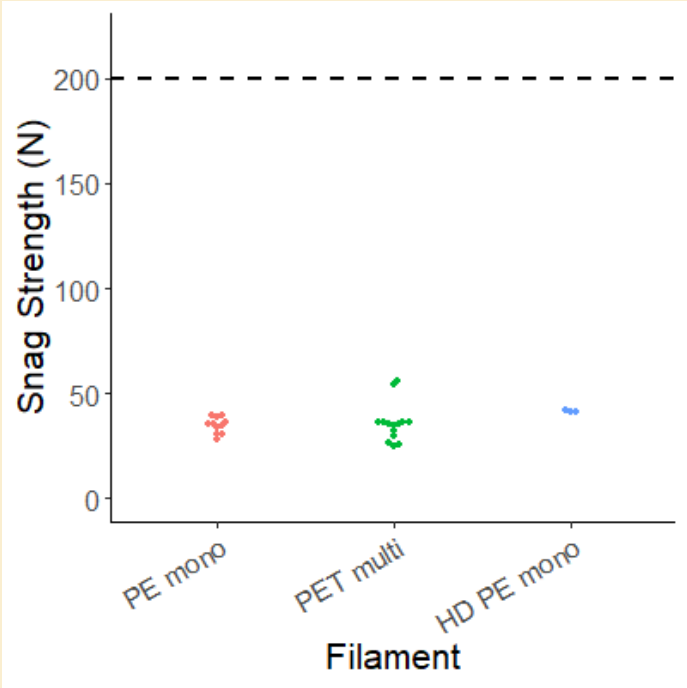
Refining the RD score - Pushing median lifespan to three years



Avenues to innovation - Physical characteristics of nets

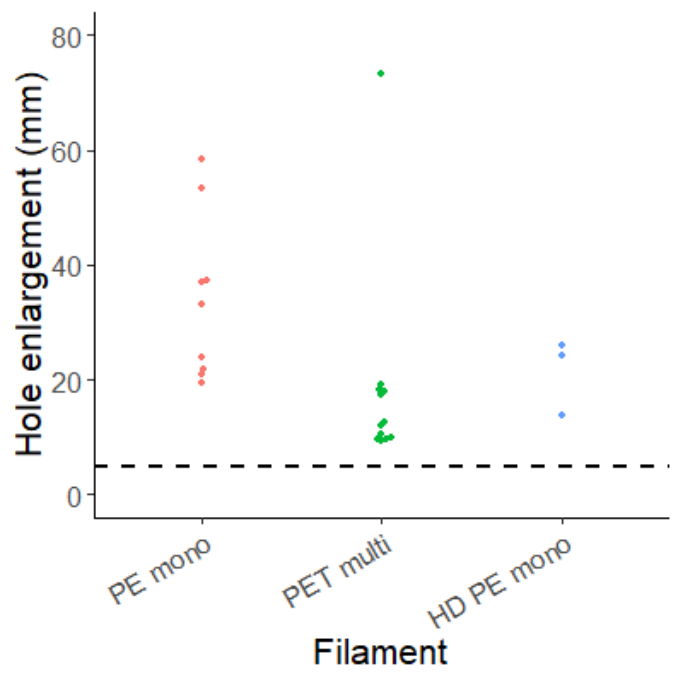
Holes formed

Increasing area density (fabric weight per unit area)?



Holes enlarged

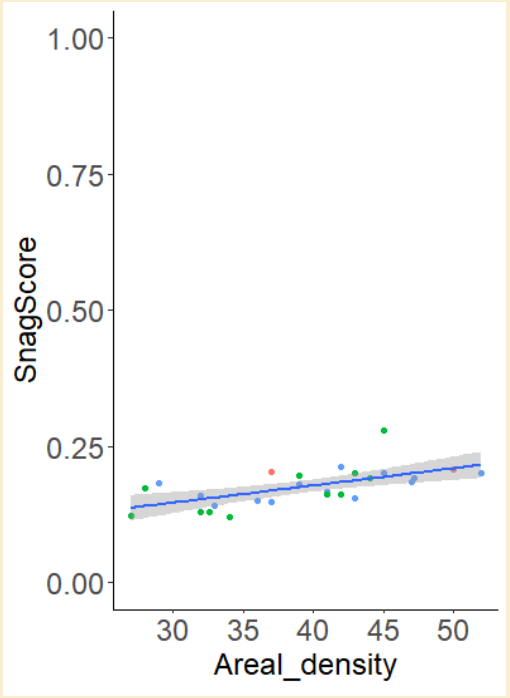
Increasing mesh count or changing knitting type?



Avenues to innovation - Physical characteristics of nets

Holes formed

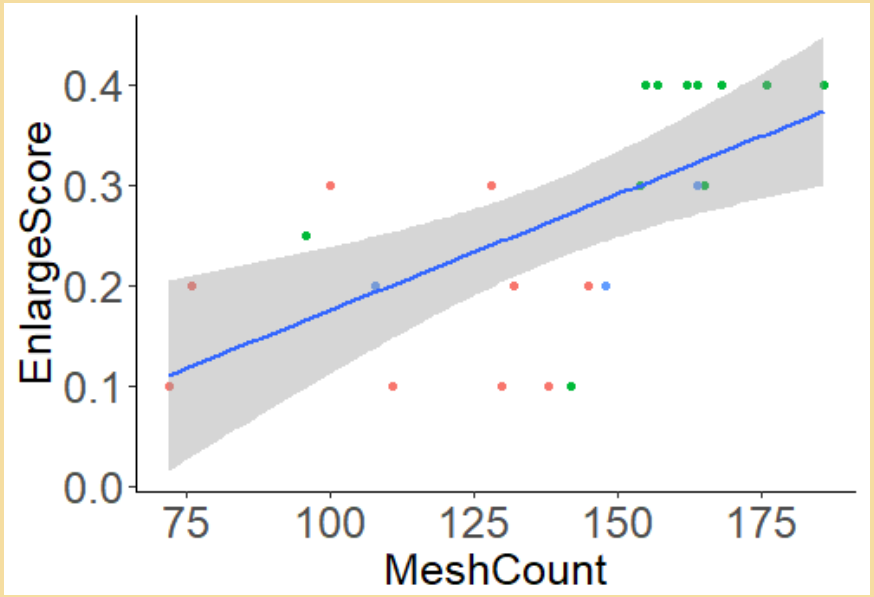
Increasing area density (fabric weight per unit area)?



Increasing fabric weight has negligible effect on snag strength

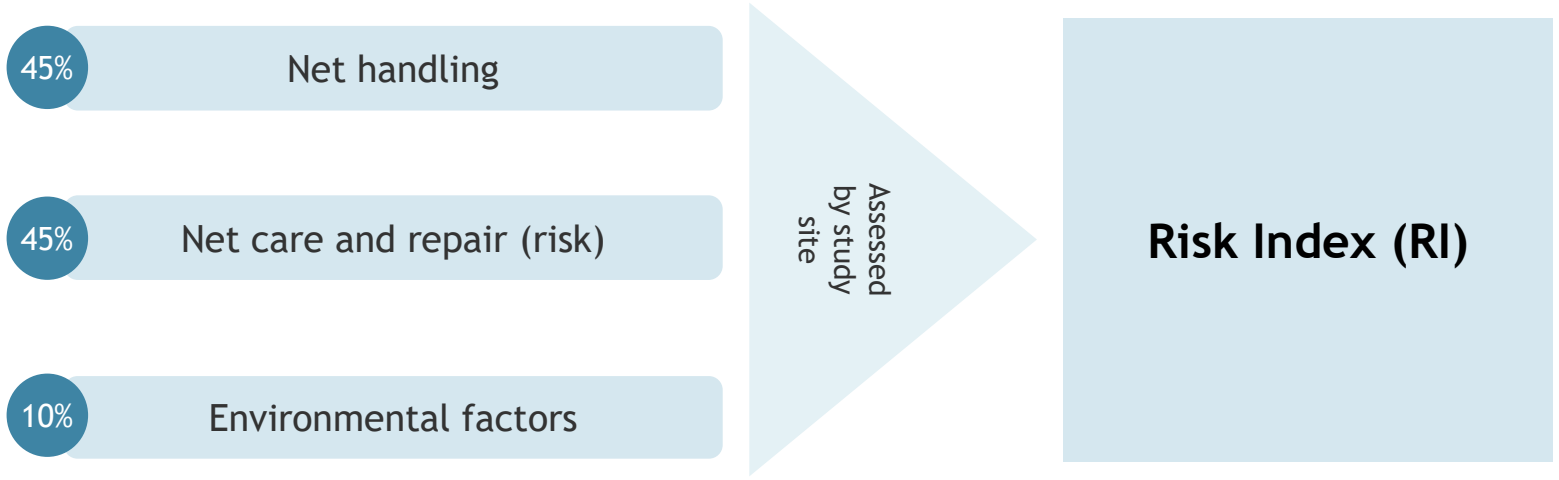
Holes enlarged

Increasing mesh count or changing knitting type?



Avenues to innovation - Refining risk index

Error bar reflects country variation:
Effect will be larger in some countries than others



wRd score + **Risk Index (RI)**

Explain a very large proportion of ITN lifespan, R^2 = 0.76

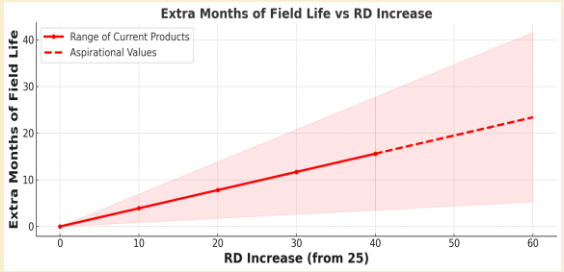
Avenues to innovation - Refining risk index

Error bar reflects country variation:
Effect will be larger in some countries than others

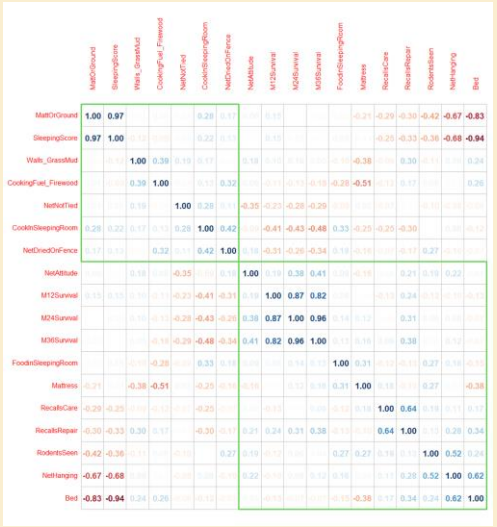
- 45% Net handling
- 45% Net care and repair (risk)
- 10% Environmental factors

Assessed by study site

Risk Index (RI)



+



Explain a very large proportion of ITN lifespan, R^2 = 0.76

Key take home message

Increasing wRD from **30 to 65** increases median field life by **13.65 months**

*(10 point increase in wRD =**3.9 months**)*

Big thank you to Steve Poyer, Matt Worges, Eleanore Sternberg, Anna Trett, Tara Seethaler, Steve Russell and Angus Spiers

QUESTIONS?

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