

Durability of insecticide-treated nets

What the resistance-to-damage score and risk index mean for malaria programmes

Summary

Durability shapes the performance of insecticide-treated nets (ITNs) for malaria control. A resistance-to-damage (RD) score indicates inherent textile strength, while a risk index (RI) shows how local conditions and behaviours affect wear. Together, these measures offer a practical, evidence-based way for malaria programmes to understand and compare ITN longevity across settings.

Multiple factors shape ITN durability

World Health Organization (WHO) guidelines state that insecticide-treated nets (ITNs) should last 3 years, and mass distribution campaigns therefore typically take place every 3 years. However, it is widely accepted that multiple factors can impact the usable life of a net.

Durability monitoring studies show that median ITN lifespans can range from [1.6 years to more than 5 years](#).¹ This variability can even be seen for the same ITN brand, because durability depends on [three factors](#):²

- **Textile design and quality**
how resistant the fabric is to physical damage
- **User behaviour**
how nets are handled, washed, stored, and repaired
- **Use environment**
housing structures, sleeping arrangements, and surroundings.

Objective measures of ITN durability

Two metrics have been under development to measure ITN durability objectively across brands: **resistance-to-damage (RD) score**, which combines [textile parameters](#) on snagging, abrasion, tearing, and hole enlargement,³ and **risk index (RI)**, which captures aspects of [user behaviour and the influence of use environment](#) on how quickly nets deteriorate.⁴

The concept of a weighted RD (wRD) score, [developed by i2i and IVCC](#) and first presented at meetings in 2024,⁵ has been met with growing interest in recognition that [not all forms of damage contribute equally](#) to ITN failure.⁶

Refinement of the RD score

The original RD score is calculated using [textile tests](#) adapted from BS EN and ISO standards to reflect [damage patterns under typical use conditions](#), attributing equal weight to each of the four textile parameters.^{7,8} Since 2023, WHO prequalification (PQ) [requires ITN manufacturers](#) to submit test result data for these attributes.⁹

The formula to calculate the [RD score](#) was developed by NIRI using 16 commercially available new and unused ITNs to ensure it represented performance ranges across products.³ Follow-on work by i2i, NIRI, TropHealth and IVCC resulted in further analysis of the respective contribution of each textile parameter on ITN failure. This led to the refinement of the RD score to the [wRD score](#), which removes abrasion resistance and increases the weighting of hole enlargement resistance.⁶ The method for calculating the hole enlargement component was also amended from the original published method.

Textile parameter	Test method	RD score	wRD score
Bursting strength	ISO 13938-2:1999	25%	25%
Snag strength	BS EN 15598:2008 <i>(adapted)</i>	25%	25%
Abrasion resistance	ISO 12947-1:1998 <i>(adapted)</i>	25%	0%
Hole enlargement resistance	BS 3423-38:1998 <i>(adapted)</i>	25%	50%

RD scores range between 0 and 100, with a score of 100 indicating that all components reach aspirational levels of damage resistance. To date, no commercially available ITN achieves that [aspirational score](#).⁷ A study by i2i, NIRI, TropHealth and IVCC showed that wRD scores are typically higher and more varied (ranging from ~30 to ~70) than original RD scores (~18 to ~64) across PQ-listed ITNs (as at 2020).⁶

Risk index

Developed by TropHealth, the RI is based on 18 questions from standard [durability monitoring surveys](#), reflecting [risk of exposure to damage](#), rather than fabric strength.^{1,4} It covers ITN handling practices (weighted 45%), ITN care and repair attitudes (45%), and ITN use environment (10%) that influence physical durability. Values typically range [from ~30 to ~85](#),⁶ with higher values indicating conditions associated with slower ITN deterioration. Refinement of the RI is currently being undertaken by TropHealth and IVCC to further simplify and strengthen the metric.

Implications for malaria programmes

Together, RD scores and RI help inform why ITN durability differs between settings. Further, analyses led by IVCC and TropHealth

across multiple countries show that both of these measures are associated with ITN survivorship, providing national malaria programmes and other stakeholders with an objective metric to understand how ITNs will perform in real-life settings.^{2,6}

Results from this work suggest that increasing RD score from ~30 to ~70 is associated with an [increase in ITN survival](#) of 14 months,⁶ while each 10-point RI increase is associated with longer ITN lifespan of [~2 months](#).²

While RD scores and RI do not predict exact ITN lifespans, they do support clear, evidence-based ways to interpret ITN durability, ensuring malaria programmes can:

- Interpret durability monitoring results consistently
- Contribute to understanding why ITN performance varies across contexts
- Identify settings where more durable ITNs would have greatest benefit
- Strengthen messages on net care and handling
- Inform the planning for ITN replacement cycles.

Vestergaard quality commitment: RD scores for PermaNet® Dual

RD scores have been generated for Vestergaard's pyrethroid-chlorfenapyr ITN (PermaNet Dual) at Vestergaard's ISO/IEC 17025-accredited quality control laboratory in Vietnam, following WHO PQ sampling and testing procedures. Independent assessment has also been conducted by NIRI, in association with IVCC.

Laboratory	RD score	wRD score
Vestergaard quality lab (Vietnam)	36.2–41.7 (mean 38.5)	59.3–62.3 (mean 60.8)
NIRI/IVCC	Abrasion resistance testing not conducted	61.6

wRD score calculation app



An independent, open-access wRD score calculator has been developed by i2i and IVCC.



Please contact IVCC for more information.

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