# A bioassay method validation framework for laboratory and semi-field tests used to evaluate vector control tools

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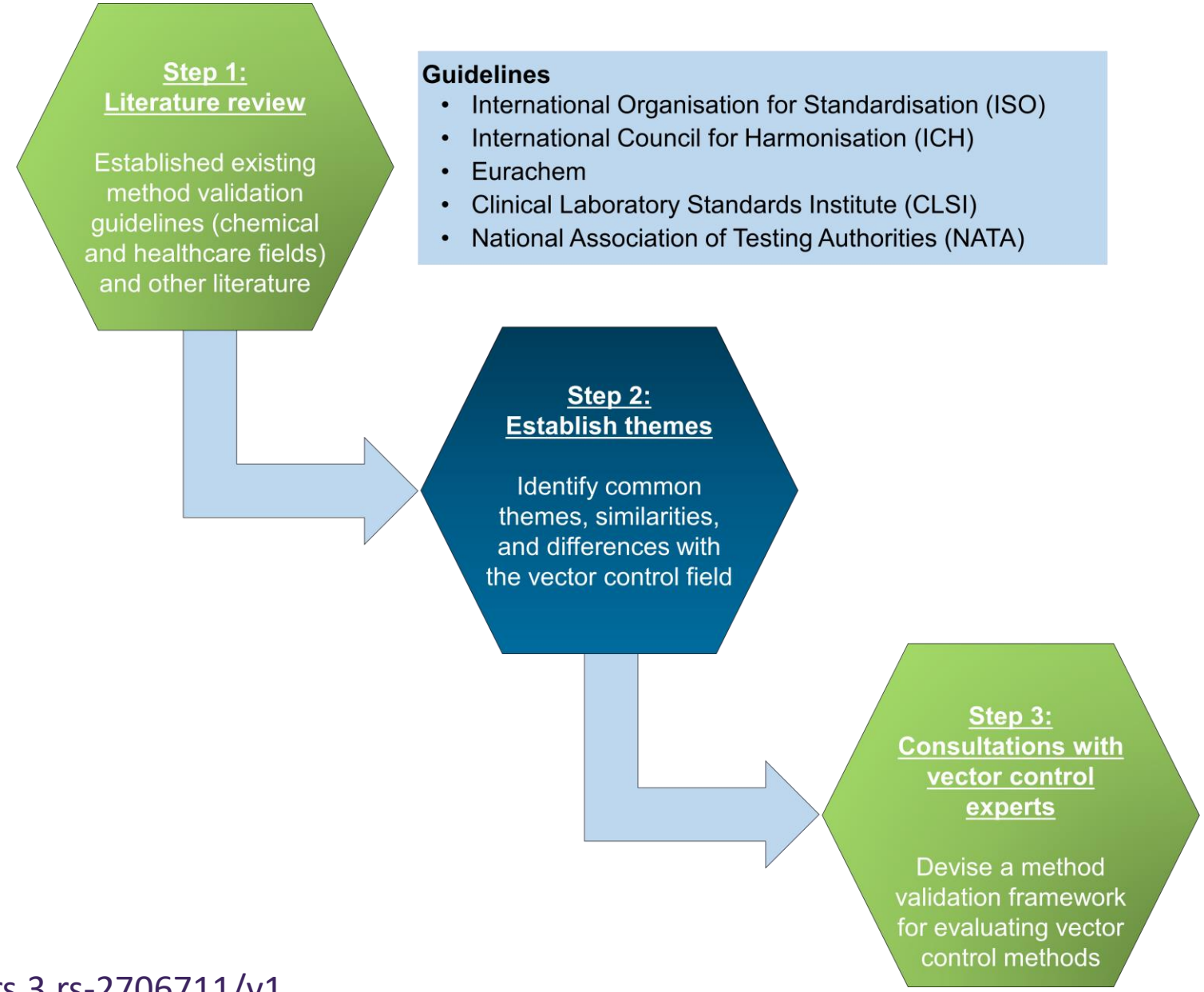
# Background

- Evaluation of vector control products relies on bioassays and semi-field tests
- Bioassay method development requires a rigorous validation process
  - ✓ To capture appropriate entomological endpoints
- Method validation: a technique used to demonstrate that a procedure is suitable for its intended purpose and produce reliable results
- Standardised guidelines and protocols for conducting standard vector control tests are available
- No standardised guidelines for validating novel vector control methods
- Method validation framework for laboratory bioassays and semi-field tests

**When to conduct validation**

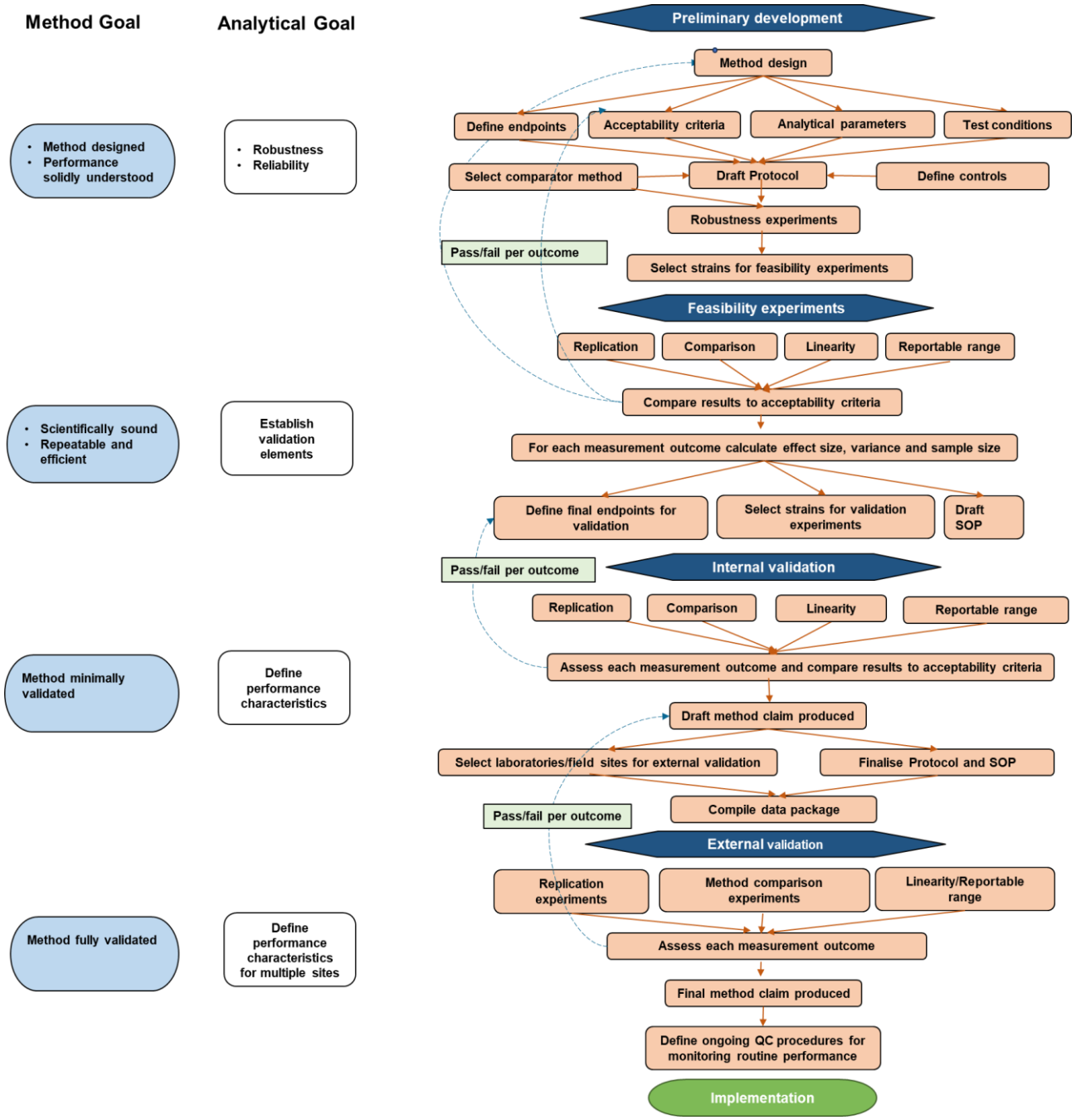
1. A new method has been designed
2. A standard method has been modified
3. A standard method is used for a new purpose
4. To demonstrate comparability between a novel method and an existing standard method

# Methodology




http://dx.doi.org/10.21203/rs.3.rs-2706711/v1

# Method validation framework



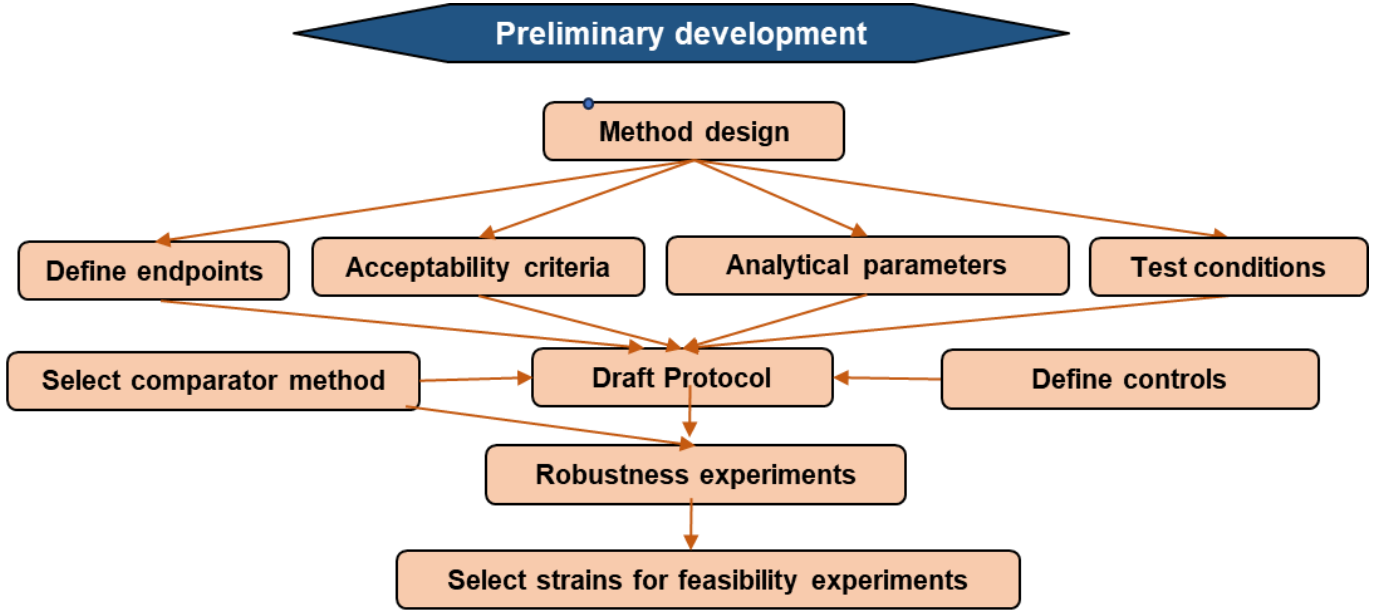
# Stage 1: Preliminary development

**Method Goal**

- Method designed
- Performance solidly understood

**Analytical Goal**

- Robustness
- Reliability

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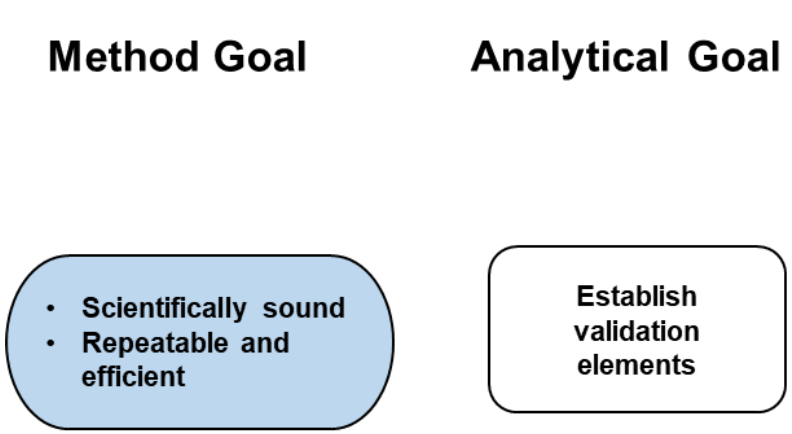
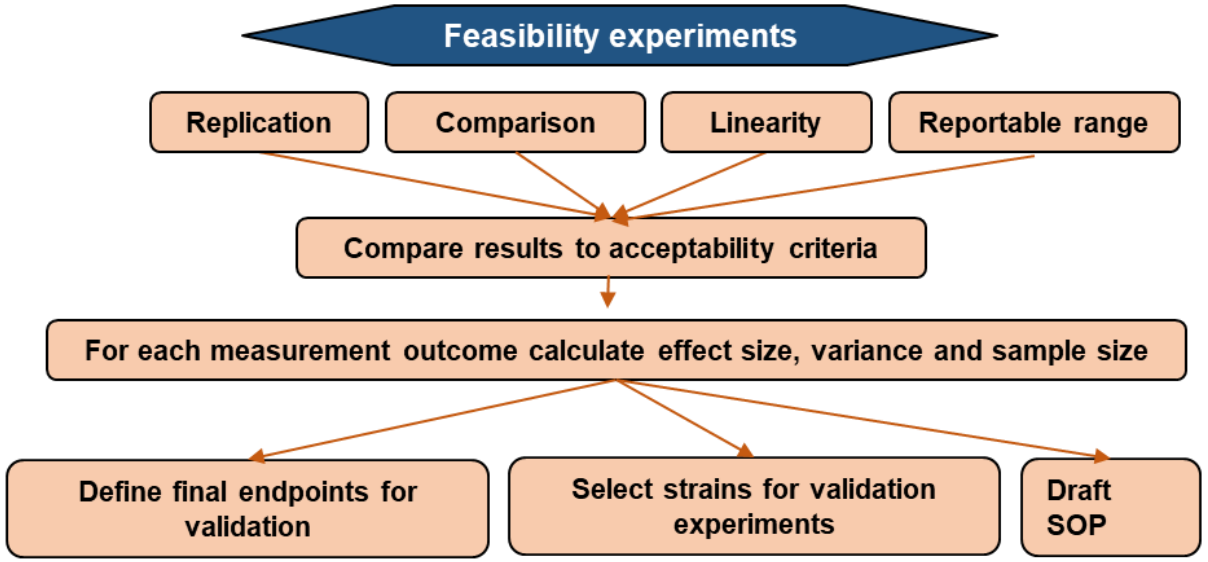
# Stage 2: Feasibility experiments

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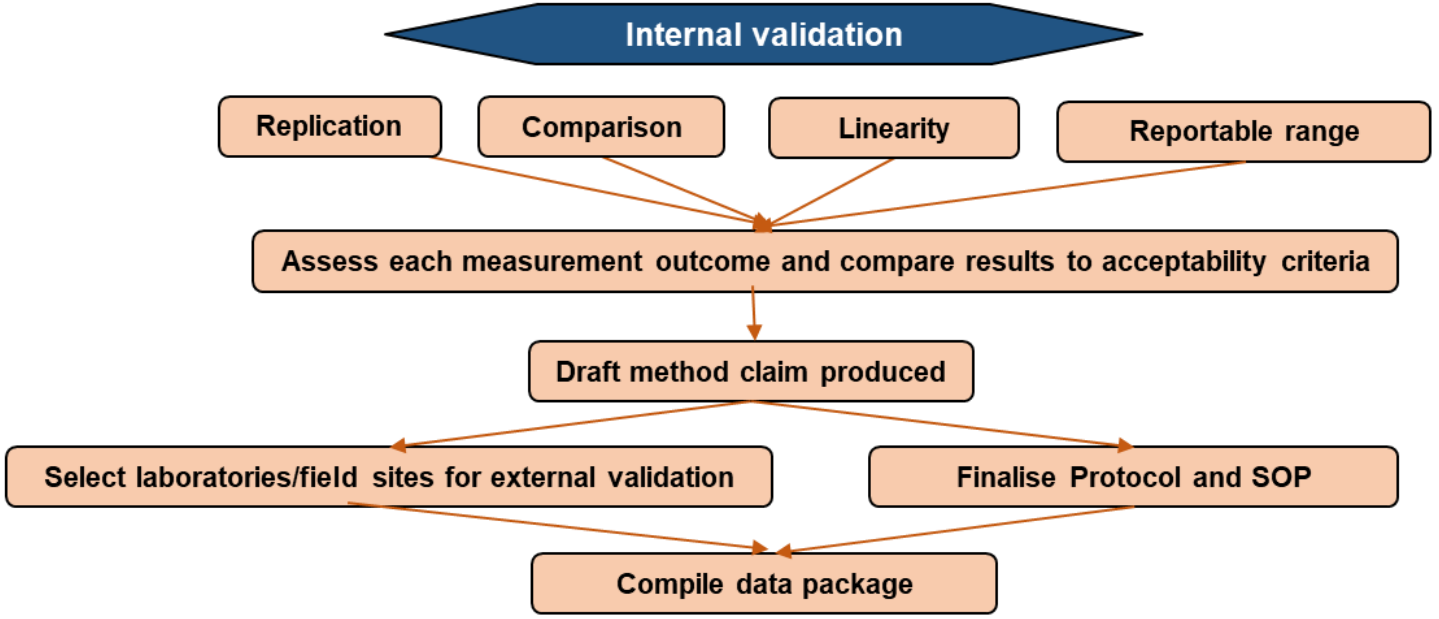
# Stage 3: Internal validation

**Method Goal**

Method minimally validated

**Analytical Goal**

Define performance characteristics



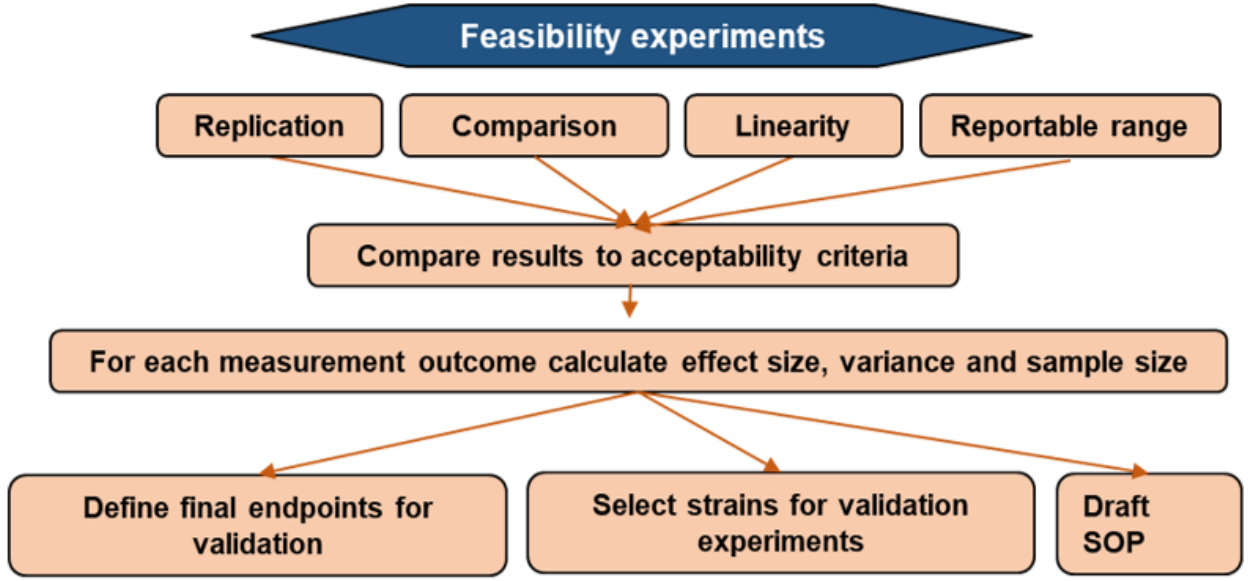
# Stage 2: Feasibility experiments

**Method Goal**

- Scientifically sound
- Repeatable and efficient

**Analytical Goal**

Establish validation elements



# Validation sub-studies

| Sub-study | Goal | Validation stage | Analytical parameter/Analysis |
|---|---|---|---|
| Robustness | • To solidly understand the method<br>• To determine the suitable testing conditions | Preliminary development | Robustness: Regression |
| Linearity and range | To determine a working range of the method's results that is accurate and precise | Feasibility, internal and external validation | Linearity: scatter plot with best line fit, linear or non-linear regression |
| Replication | A deeper understanding of variability and its sources<br>✓ Intra-assay precision, intermediate precision and reproducibility | Feasibility, internal and external validation | Precision: Simple estimates e.g., coefficient of variation, ANOVA or mixed-effects models |
| Comparison | To determine comparability of an existing method to a novel/modified method<br>✓ Experiments to be performed in parallel | Feasibility, internal and external validation | Agreement assessment: Bland-Altman plot |

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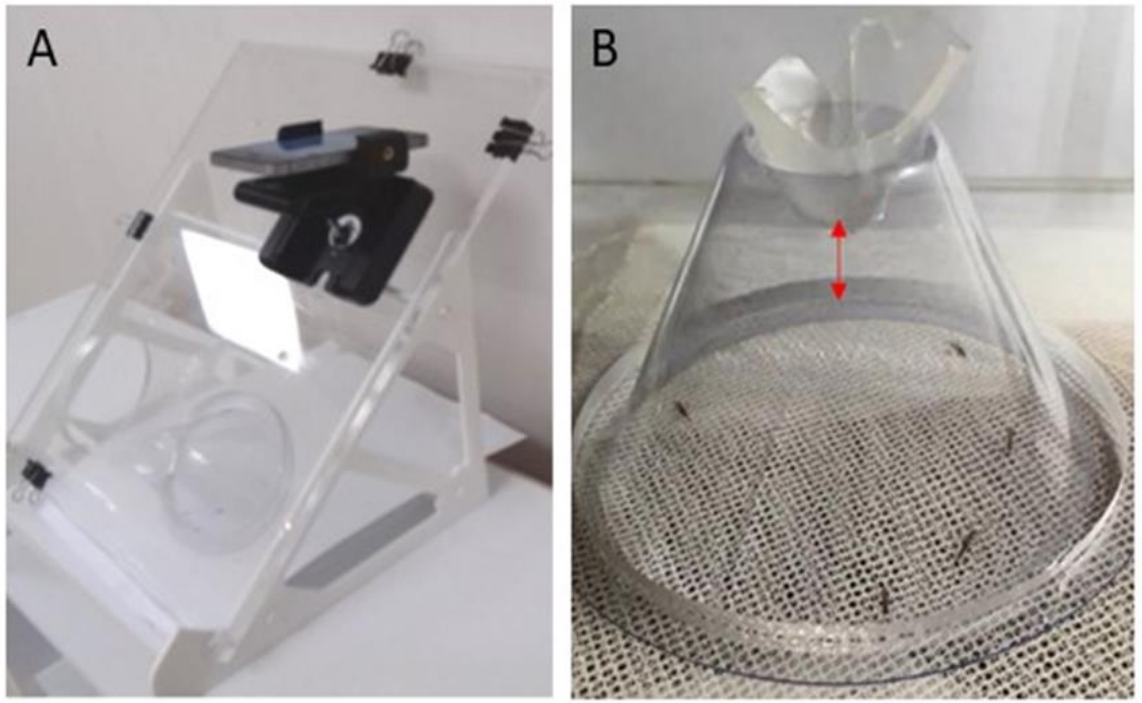
# Working Example

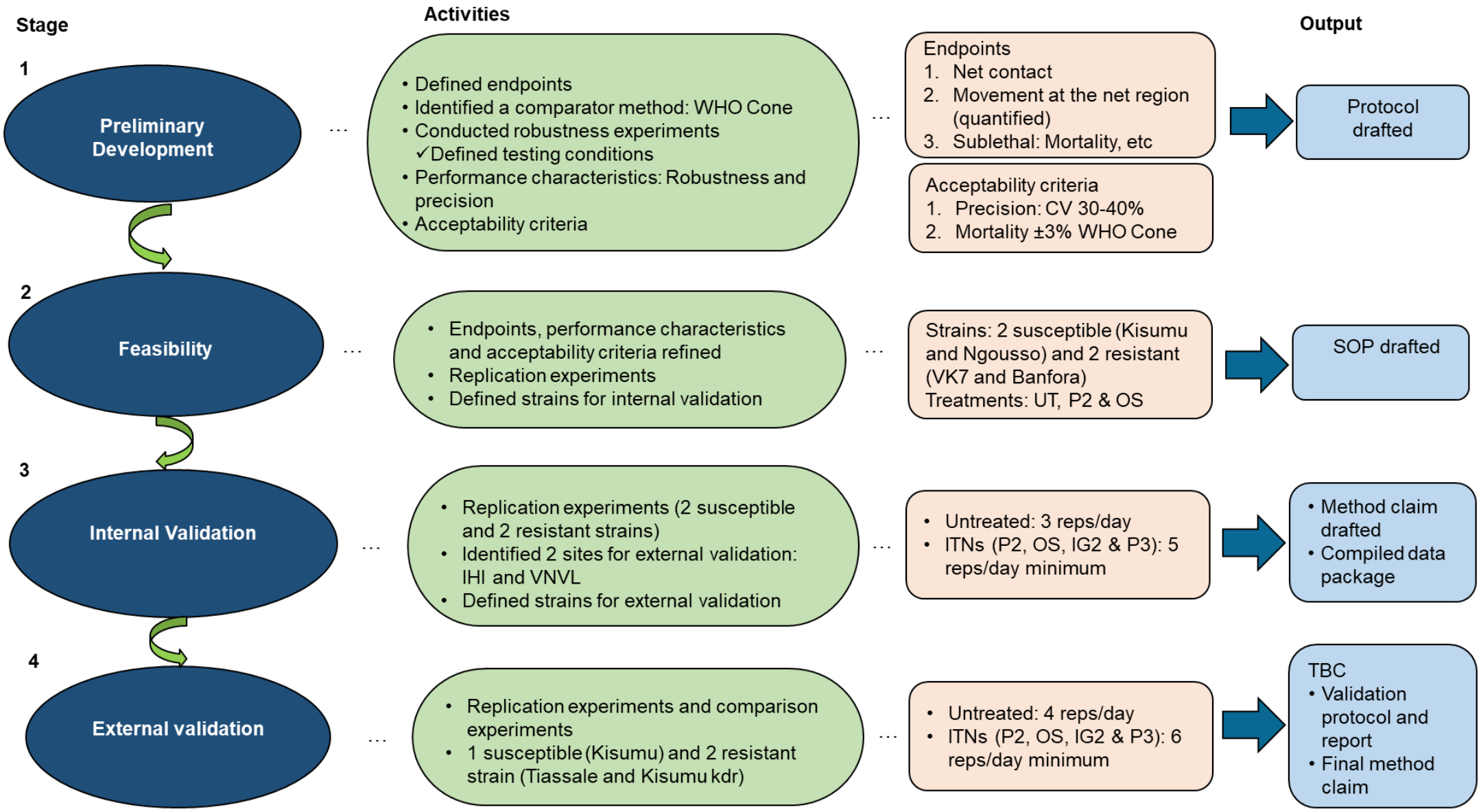
# Video Cone Test (VCT) *PLUS* Bioassay

- Bioassay developed by the Mosquito Behaviour Group (LSTM)
- Standard WHO cone test with modification
  - ✓ Smartphone used to record the mosquitoes' activity




VCT *PLUS* Apparatus (Hughes et al, 2022)

# VCT *PLUS* Validation Process



# Conclusion

- 4 stages of validation defined
  - ✓ 1) Preliminary development; 2) Feasibility experiments; 3) Internal validation, and 4) External validation
  - ✓ Modular and adaptable
- Appropriate experimental designs and data analyses that account for various sources of variability
  - ✓ To generate reliable estimates for product performance characteristics
- At-risk communities have timely access to safe and reliable vector control products

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# Thank you