Personal Protection against mosquitoes
Prof Larry Goodyer

Plan of Presentation
• Types of personal protection
• Defining efficacy and repellent kinetics
• Pharmacists advice for repellents

Modes of personal protection
• Barrier – nets and clothing
• Area – vapourised insecticides and knock down sprays
• Repellent
  • Synthetic – DEET, Icaridin, IR3535
  • Natural – lemon eucalyptus (PMO)
  • Other – Skin so Soft, other volatile oils

Barrier Methods
• Nets
  • Always treated with a pyrethroid
  • Long lasting nets for lifetime of fabric integrity
  • Excellent evidence of efficacy and disease prevention (though mosquitoes can adapt behaviour)
• Clothing
  • Little formal research
  • Compliance issues
  • Some evidence for treatment with pyrethroid or DEET
  • Use in addition to repellent on skin

Area Methods
• Reasonable evidence for vapourised insecticides
• Less evidence for knockdown sprays and candles

Repellents applied to the skin
• Synthetic – DEET, Icaridin, IR3535 — Good Evidence
• Natural – lemon Eucalyptus (PMO) — Good Evidence
• Other – Skin so Soft, other volatile oils — Good evidence for poor efficacy

BUT WHICH REPELLENT IS BEST?
**How well do Travellers Follow Advice**

<table>
<thead>
<tr>
<th>Question (%)</th>
<th>Always</th>
<th>Sometimes</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used an insect repellent on the skin while out after dusk</td>
<td>10</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>Did you wear clothing to cover arms when going out after dusk</td>
<td>10</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>Wore trousers when going out after dusk</td>
<td>10</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>Used an insecticide spray in your room</td>
<td>10</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>Used a plug-in insecticide repeller</td>
<td>10</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>Did you use a mosquito net at night</td>
<td>10</td>
<td>30</td>
<td>50</td>
</tr>
</tbody>
</table>

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**Defining efficacy**

- WHO define standards of assessment
  - But frequently not followed by manufacturers
- Preventing bites completely over an identifiable time scale:
  - Time to first bite
  - Most widely used by manufacturers when making claims of longevity
- Effective dose in mg/cm² (ED₅₀, ED₉₅) e.g., dose to repel 90%/95% of mosquitoes
- Doses for various species
- Should be below amount usually applied/acceptable
- Decay / Half life
  - Fall in percentage of mosquitoes repelled over time

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**Factors Determining Longevity in the field**

- How much user applies
  - WHO standard 1.6 mg/cm²
- Usual rate by users: 1mg/cm²
- Concentration of the ai and formulation
  - (% ai of 50% DEET = ai of 0.5mg/cm², 0.5mg/cm² 100% DEET = ai 0.5mg/cm²)
- Mosquito density/biting pressure
- Sweat off and abrasion by individual
- Moisture

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**My opinion**

**QUOTING AN ABSOLUTE TIME OF PROTECTION IS MEANINGLESS**

- Apply as much as is comfortable on exposed skin and reapply when the mosquitoes take interest
- Which ever repellent you buy, purchase the highest strength
- Consider long-acting formulations
- Use DEET as a first choice (if acceptable to user)
- We need a new system of defining longevity:
  - Perhaps proportional difference in longevity between applying DEET 50% at 1mg/cm² and the repellent (e.g., lasts 2x, 3x longer) is the best comparison of products

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**Complete Protection Time of DEET**

- Graph showing the effectiveness of DEET at different concentrations and times.
Testing against a new repellent?

Long Acting Formulation of PMD

A different approach to expressing efficay?

Should we rather consider relative protection between the product tested and a ‘gold standard’ DEET for labelling purposes e.g. proportional difference or area under the curve?

Conclusion

- Recommend all three modalities of bite avoidance
- Assume a low adherence to advice
- Ignore absolute protection times
- DEET 50% as first choice
- Safety not an issue when visiting endemic areas for mosquitoes born diseases
- PMD and icaridin at highest available concentration good second choices
- Need to apply 0.5-1 gpm per arm to get best longevity from a product
- We need better systems to compare products