Sudan: cluster randomised trial of LLINs alone versus LLINs plus IRS: early results

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Sudan study design

140 clusters in 4 study areas

LR

HR

Randomisation in each study area ensured balance of genotypic resistance (kdr) between study arms

LLIN arm

LLIN+IRS arm

Primary outcomes (in low transmission setting):
1. Clinical incidence by active case detection in 140 cohorts of 200 children under 10 years each
2. Prevalence of infection from cross sectional surveys (RDR and PCR)
# Sudan: Distribution of clusters by area and study arm

<table>
<thead>
<tr>
<th>Study arms</th>
<th>El Hoosh (South Gezira)</th>
<th>Hag Abdallah (South Gezira)</th>
<th>Galabat (Gadaref)</th>
<th>New Halfa (Kassala)</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Past main vector control intervention</td>
<td>IRS with Bendiocarb</td>
<td>IRS with Bendiocarb</td>
<td>LLINs</td>
<td>IRS with Pyrethroid (Deltamethrin)</td>
<td></td>
</tr>
<tr>
<td>Study arms</td>
<td>LLIN only</td>
<td>LLIN+IRS Insecticide class</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 10 cohort per cluster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of clusters</td>
<td>38</td>
<td>38</td>
<td>26</td>
<td>38</td>
<td>140</td>
</tr>
<tr>
<td>Cohort size</td>
<td>7,600</td>
<td>7,600</td>
<td>5,200</td>
<td>7,600</td>
<td>28,000</td>
</tr>
</tbody>
</table>
Results so far

• Incidence from 6 months follow-up (14,000 child years), average incidence 38 per 1000 pa
• Infection prevalence by RDT from one cross-sectional survey, awaiting PCR based infection data
• LLIN use high in both study arms: 84% in LLIN only arm, 80% in LLIN plus IRS arm
• Early indications are that there is no added protective effect of IRS in the presence of high usage of LLINs
Bioko, Equatorial Guinea: Added personal protection from nets in presence of short residual IRS and all year malaria transmission

Immo Kleinschmidt
Long season, short residual: loss of IRS effectiveness?

- IRS effectiveness depends on active ingredient of insecticide on interior walls killing mosquitoes throughout the malaria season, or until the following spray round
- The short residual lives of many insecticides presents potential problems in long or year-round transmission seasons
- Does reduction in mosquito mortality due to loss of insecticide residual lead to actual increased risk of malaria?
# Results: Effect of recent IRS

<table>
<thead>
<tr>
<th>Median time since last spray of neighbourhood (months)</th>
<th>Pf Prevalence in 2 to &lt;15 year, % (N)</th>
<th>Adjusted(^1) Odds Ratio [95% CI]</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 3</td>
<td>19.4 (1962)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>20.1 (1450)</td>
<td>1.5 [0.9 to 2.4]</td>
<td>0.032</td>
</tr>
<tr>
<td>5 or more</td>
<td>28.4 (531)</td>
<td>1.7 [1.2 to 2.5]</td>
<td></td>
</tr>
<tr>
<td>Slept under net</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>no</td>
<td>21.2 (2846)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>yes</td>
<td>15.1 (800)</td>
<td>0.7 [0.6 to 0.9]</td>
<td>0.008</td>
</tr>
</tbody>
</table>

\(^1\) Adjusted for seroconversion rate of area, socio-economic status of household and age of child
P.f. Infection in children 2-15 years and bioassay mosquito mortality on walls sprayed with Bendiocarb, both in relation to time since spraying. Bioko 2011
Excess malaria prevalence after adjusting for site level SCR

Protection by IRS AND ITN

• 1% increase in children sleeping in sprayed house and under a net corresponds to a 0.6% decrease in prevalence (95% CI 0.12- 1.06, p=0.016)
• Benefit of using nets in addition to IRS may be result of short insecticide residual
Conclusions

• Bioko
  – The effect of the loss of insecticidal efficacy may be mitigated by simultaneous usage of LLINs
  – Reduction in prevalence of infection is proportional to site specific combined use of IRS and LLINs; this may be result of the short residual life of the insecticide

• Sudan
  – Adding IRS to very high coverage and usage of nets may have no additional protective effect

• Combining LLINs and IRS is only better than one alone if one of the two is compromised, e.g. Inadequate use of nets, inadequate length of IRS residual effect