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Synergies in integrated malaria control

Combination of malaria vector control strategies, particularly insecticide-based approaches, needs careful consideration. Responsibility to implement a sound strategy goes beyond immediate alleviation of disease burden, to deceleration of the diminishing returns of future control efforts resulting from the spread of insecticide resistance. Vincent Corbel and coauthors[1] present a clustered randomised trial examining the combined efficacy of pyrethroid-impregnated bednets with either indoor residual spray (IRS) with carbamates, or a carbamate-impregnated plastic sheeting placed high up on household walls. The investigators noted no additional benefit, in terms of disease incidence or prevalence, of either combination over a control scenario in which only bednets were used. They suggested the short half-life of carbamate efficacy contributed to the absence of additional benefit provided by these supplements to bednets. In their Comment, Raphael N'Guessan and Mark Rowland[2] express disappointment with this explanation for absence of synergy.

More than just a lack of synergy, however, vector control strategies restricted to a subpopulation of people within a community might risk exacerbation of malaria transmission to the remaining individuals, once that the transient community-wide benefits of enhanced mosquito mortality have faded.[3] Provided that the mosquito survives its encounter with the insecticide, which is increasingly likely with depleted insecticidal potency or increased resistance, its bite is deflected onto the more accessible hosts. Because longitudinal incidence data were not collected from all individuals in the community, speculation about the transmission dynamics is difficult. However, the 32% increased odds in incidence after 18 months of combining targeted bednets with IRS (compared with bednets alone), might allude to the after-effects of potentiated transmission.

IRS, or insecticides on sheets placed in houses, combined with bednets can be distributed at the household level in different ways. For example, they can be distributed randomly, preferentially together, or preferentially apart. By simulation of these alternatives, we showed[4] that distribution of nets and IRS preferentially together at the household level, as was done in Corbel and colleagues' trial,[1] is the approach that capitalises least on any synergistic effect that these control methods might have. In the advent of the President's Malaria Initiative advocating the combined use of bednets and IRS,[5] careful and regular monitoring is particularly crucial to negate any detrimental outcomes of integrated vector management, and to capitalise on any synergisms.

We declare that we have no conflicts of interest.

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2 N'Guessan R, Rowland M. Indoor residual spraying for prevention of malaria. *Lancet Infect Dis* 2012; **12:** 581–82.
3 Yakob L, Yan G. Modeling the effects of integrating larval habitat source reduction and insecticide treated nets for malaria control. *PLoS One* 2009; **4:** e6921.
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5 USAID. The President's Malaria initiative: fourth annual report. Washington: US Agency for International Development, 2010.

Authors' reply

We agree with Laith Yakob and coauthors that promotion of complementary methods by which to reduce vectorial capacity of mosquitoes and hence to effectively tackle malaria transmission is needed. However, we consider some of their statements explaining the absence of synergism between long-lasting insecticidal mosquito nets (LLIN) and indoor residual spraying (IRS) in our clinical trial[1] to be inaccurate. In our study, malaria incidence was estimated in all children younger than 6 years in the 28 villages (ie, a cohort of 1700 children) and the vector control interventions were not restricted to a subpopulation, except in the reference group that received selective coverage of LLIN (ie, pregnant women and children <6 years), in agreement with the policy of the Malaria Control Programme (MCP) in 2007. In the three treatment groups, however, the mean LLIN ownership and coverage of IRS and carbamate-treated plastic sheeting (CTPS) in households was generally greater than 90%, hence suggesting that the risk of exacerbation of malaria transmission to untreated people of the community, as indicated by Yakob and colleagues, was low. To check this assumption, the risk of human exposure to malaria vector bites has been further analysed by the measurement of human antibodies to one anopheles salivary peptide antigen used as a bioindicator of vector control efficacy.[2] The level of child exposure to anopheles bites was not higher in the groups that received combinations of LLIN and IRS or CTPS compared with the reference group (figure). Consequently, the statistically non-significant 32% increase in clinical malaria attacks in the IRS and LLIN group (odds ratio=1·32, 95% CI 0·90–1·93, p=0·15) is unlikely to be due to a potentiated transmission