Is Indoor Residual Spraying broken and what should be fixed?
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Indoor residual spraying (IRS) has been and is still a very successful method to control malaria. We are concerned that not enough research attention is given to improving IRS and that most funding goes towards modern but seemingly still ineffectual methods. We believe that there is ample scope for improving IRS, while reducing insecticide exposure.

Keywords: Indoor residual spray, IRS, Botha de Meillon, policy

1. Introduction
The effectiveness of DDT and other insecticides when properly used as indoor residual spray (IRS) to prevent the transmission of malaria is not in question [1] (Fig 1). We can safely assume that millions of lives have been saved in the more than 80 years since it was first used [1]. The high body burden of DDT of those protected by IRS, as well as the human health consequences of those protected by all IRS insecticides are of great concern [1,2]. However, many promises of ‘silver bullets’ (using anything but IRS) to beat malaria over the last couple of decades have come and gone on a road littered with good intentions, vast investments, and less impressive results when confronted with realities, especially in Africa.

Yet the one proven method, IRS, hardly gets recognition. IRS interrupts transmission where most infections occur - the home. It is also at home where those most likely to be infected by malaria – babies, children and pregnant mothers – are found. The negative part of the IRS approach though, remains the inevitable co-exposure of the very same susceptible groups and mosquitoes to IRS insecticides. Protection by IRS comes at a cost, creating a paradox – protection against malaria that kills hundreds of thousands of people per year with something that may be or is harmful [1,3].

2. Where did IRS start and why is it so effective?

IRS as a method has remained almost unchanged since Botha de Meillon pioneered it in South Africa and published in 1936 [4] (Figs 2 & 3). Initial IRS chemicals were pyrethrum, BHC, and DDT, often used with kerosene. DDT is now applied as a water wettable powder. Currently, pyrethroids, organophosphates, and a carbamate are recommended by the WHO for IRS. IRS initially was not very successful everywhere, but in most areas of the world it reduced infections, although the mode of action (lethality, irritancy, repellency, or combinations thereof) was not always clear.

Indiscriminate use and use in agriculture may have led to resistance in many areas. Combining basic biological knowledge about reproductive behaviour of the female vector mosquito with residual toxic chemicals within and close to residential areas where most infections occur, is effective at preventing transmission, but bad at preventing chemical exposure and uptake of the chemicals by residents - posing a paradox.

3. Who little attention on improving IRS?

Policy formulation, negotiating fora, and the development of research priorities via consensus (many or all burdened with other agendas) seem not to be good platforms to deal with such seemingly intractable paradoxes. IRS using chemicals seems out of vogue and often relegated in favour of the promises of 'high-tech' or new methods. Many of these methods are promoted from a developed country perspective, but with little or no attention to improve on a method (IRS) that has worked so well. DDT, one of the most effective and dependable IRS chemicals, is facing many pressures for premature elimination, creating 'official' resistance in countries that recognise IRS as the best practical way of protecting its populations.

4. Why maintain and improve IRS?

Maintaining a proven top-down IRS strategy supported by an effective hospital and clinic system requires a minor inconvenience but no other behavioural changes by the inhabitants [5], ecological engineering, biological interventions, environmental modifications, or vaccines. The mostly non-intrusive IRS allows inhabitants and communities the freedom for social interactions and economic betterment unhindered by the inconvenience required by some currently promoted forms malaria prevention that requires active community participation. For the foreseeable future, IRS will remain a mainstay of malaria prevention, will most likely have a role in malaria elimination in any endemic area, and/or will remain the fall-back
method in case of failure of alternatives.

5. Recommendations

We believe that a vast scope of options to improve IRS remain to be explored that will significantly reduce human exposure to chemicals while maintaining effective prevention of transmission.

Options for further exploration include:
- Study the behaviour of humans, IRS chemicals and mosquitoes following the Total Homestead Environment Approach (THEA) (Fig 4).
- Investigating how to apply insecticides more selectively, depending on (and further looking at) mosquito behaviour
- Exploring the seemingly many opportunities available regarding mosquito irritability and repellency while preventing resistance
- Investing in better formulations for IRS, including removal of compounds from formulations that are not required for control, but that may harm human health [1]
- Investigating and developing new chemicals
- Based on Thea (fig 4), develop an Integrated Host and Environmental Protection Approach

6. References


