Expanded malaria intervention

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Summary

Despite the progress made against malaria throughout the world, malaria prevalence has not fallen: in ten (10) Sub-Saharan African (SSA) countries, the number of malaria cases reported has an increase of more than 20% between 2016 and 2017. Long-lasting insecticide-treated nets (LLIN) are generally considered the most cost-effective of vector control strategies, and, despite several campaigns of mass distribution, the percentage of the population with access to a LLIN is estimated at only 56%. The intervention analyzed is to scale-up the coverage of LLINs; that is, to increase the percentage of the SSA population with access to a LLIN, from 56% to 75% via one (1) mass distribution (door-to-door) campaign, during the course of a calendar year. The benefit-cost ratios calculated for four regions of SSA are: Southern (0.4), Eastern (2.9), Western (11.6), and Central (27.5).

The problem

The World Malaria Report 2018 concisely depicts the progress made in the fight against malaria in sub-Saharan Africa (SSA). Incidence rates (the number of cases/1000 population) have dropped from 278 (2010) to 219 (2016 and 2017). Though, in comparison to the global malaria incidence rate (59.1) and that of South-East Asia (7.3), there is still some work to be done. There has also been a slight decrease in deaths reported between 2016 (413,000) and 2017 (403,000). The malaria mortality rate/100,000 population-at-risk in SSA is 44% and globally it is 11.7%. However, malaria prevalence has not fallen: in ten (10) SSA countries, the number of malaria cases reported has a >20% increase between 2016 and 2017. In Nigeria, Madagascar and the Democratic Republic of the Congo (DRC), the number of malaria cases exceed 500,000 in each. Eighty (80) percent of global malaria deaths in 2017 were concentrated in 17 countries in the WHO African Region and India; 7 of these countries accounted for 53% of all global malaria deaths: Nigeria (19%), DRC (11%), Burkina Faso (6%), United Republic of Tanzania (5%), Sierra Leone (4%), Niger (4%) and India (4%) (WHO 2018; 2017).

The high malaria-burden countries in SSA by Global Burden of Disease-assigned regions and their corresponding share of total malaria cases worldwide (World Malaria Report, 2018) are shown in Table 1.

TABLE 1: HIGH MALARIA-BURDEN COUNTRIES IN SUB-SAHARAN AFRICA

South	
East	Mozambique, 5%, Uganda, 4%, Tanzania, 3%, Rwanda, 3%, Malawi, 2%
West	Nigeria, 25%, Burkina Faso, 4%, Ghana, 4%, Niger, 4%, Cameroon, 3%, Mali, 3%, Guinea, 2%, Benin, 2%
Central	DRC, 11%, Angola, 2%

Children under 5 years of age are the most vulnerable group affected by malaria accounting for 61% (266 000) of all malaria deaths (435,000) worldwide in 2017 (WHO 2018; 2017).

TABLE 2: INCIDENCE OF MALARIA AND DEATHS

Regions, SSA	South	East	West	Central
Population, millions	63.2	405.5	362.8	156.5
Incidence rate, U5	1.1	29	59	69
Incidence rate, >5	0.9	8.7	16.2	17
U5 deaths of total malaria deaths, %	45.8	35.7	53.8	45.4

Sources: State of Africa's Population (2017); Global Burden of Disease

The academic literature is replete with studies demonstrating that long-lasting insecticide-treated nets (LLIN) are the most cost-effective of vector control strategies. LLINs are mosquito nets that are treated with

insecticides by the manufacturers and do not require any re-treatment. These nets are designed to preserve their efficacy against mosquito vectors for a minimum of 3 years or 20 standard washes under laboratory conditions (Sousa et al. 2019).

In 2017, 254 million LLINs were reported by manufacturers as having been delivered globally. In the same year, 220 million LLINs were distributed globally by national malaria programmes, of which 175 million (81%) in SSA; 85% of LLINs were distributed freely through mass campaigns. However impressive, this number appears insufficient, as the percentage of households in SSA owning at least one LLIN is estimated at 72%; yet, the percentage of the population with access to a LLIN was only 56% (World Malaria Report, 2018). This is known as the ownership gap, the percentage of households owning nets but not having enough for its occupants.

The effectiveness of a LLIN is also conditional upon its use. The percentage of the SSA population sleeping under a LLIN is estimated at 50%, rendering an ownership-usage ratio of 0.89.

The analysed solution

The intervention analyzed is to scale-up the coverage of LLINs; that is, to increase the percentage of the SSA population with access to a LLIN, from 56% to 75% via one (1) mass distribution (door-to-door) campaign, during the course of a calendar year.

Cost and benefits

The costs of mass (door-to-door) distribution were taken from Winskill et al (2019), who estimated the cost/net at $2.24 and in-country delivery cost/net at $2.65, for a total of $4.89. It is assumed that the number of people who can be protected from a net is 1.8 (Winskill et al, 2017); the use life of an LLIN is three (3) years (Winskill et al. 2019), and the costs of LLINs or delivery do not increase with coverage.

TABLE 3: COSTS OF THE MASS DISTRIBUTION

	South	East	West	Central
Target population	6.7M	42.8M	38.3M	16.5M
Total costs, regional, USD, millions	$33	$209	$187	$81

The benefits of the mass LLIN distribution were identified as averted malaria treatment expenditures and averted deaths. Due to the vulnerability of children under age 5, benefits were calculated separately for those under 5 (U5) and the rest of the population at risk (>5).

The campaign would avert 4,715.54 million U5 death and disability across the continent and the total averted treatment expenditures over the three-year use life of an LLIN (discounted at 5%) at $40.79 million.

The use of LLIN for the portion of the population older than 5 years would avert 189.99 million death and disability across the continent and save 64.67 million (discounted at 5%) in treatment costs over the three years use-life of an LLIN . The benefit cost ratio (BCR) is as low as 0.4 in the southern region compared to a high BCR of 27.5 in the central region (Table 4).

TABLE4: ESTIMATED BENEFIT AND COST OF LLIN MASS DISTRIBUTION

South	East	West	Central	Total
BENEFITS USD millions				
(a) Averted malaria treatment expenditures, U5				
0.0	10.6	19.8	10.4	40.8
(b) Averted malaria treatment expenditures, >5				
0.3	19.0	31.3	14.1	64.7
(c) Averted death and disability, U5				
13.9	547.3	2,049.6	2,104.7	4,715.5
(d) Averted death and disability, >5				
0.1	20.3	72.9	96.8	190.0
(e) **Total benefit** (a+b+c+d)				
14.3	**597.2**	**2,173.5**	**2,225.9**	**5,011.0**
COSTS USD millions				
(f) LLIN distribution and delivery				
32.7	209.3	187.3	80.8	510.0
Benefit cost ratio (e/f)				
0.4	**2.9**	**11.6**	**27.5**	**9.8**

Discussion

The analysis is sensitive to incidence rates. The Southern region has the lowest BCR (0.4). This

is not a surprise because of its low malaria incidence rate for both U5 and >5 (1.1 and 0.9, respectively), as compared to those of the Central region, 69 and 17, respectively.

The regions are not homogenous where it relates to malaria transmission settings. Generally, in the Southern region, transmission rates are low. While LLINs are the most cost effective across transmission settings and at low coverage levels, Winskill et al. (2019) show that in low and medium transmission settings, the marginal impact of LLINs declines and treatment becomes a relatively cost-effective choice. This holds even before reaching universal coverage of LLINs. This is because the marginal impact of LLINs declines as the use of LLINs reduces the disease burden and consequently reduces transmissions. And in lower transmission settings, the marginal benefit of LLIN coverage, which is measured here as the reduced treatment costs and averted deaths diminishes.

References

African Union (2017). State of Africa's Population, https://au.int/sites/default/files/newsevents/workingdocuments/32187-wd-state_of_africas_population_-_sa19093_-e.pdf

Sousa, Jessica de Oliveira, Bernardino Claudio de Albuquerque, José Rodrigues Coura, and Martha Cecilia Suárez-Mutis (2019). "Use and Retention of Long-Lasting Insecticidal Nets (LLINs) in a Malaria Risk Area in the Brazilian Amazon: A 5-Year Follow-up Intervention." *Malaria Journal* 18 (1): 100. https://doi.org/10.1186/s12936-019-2735-9.

Winskill P, Walker PG, Griffin JT*, et al*Modelling the cost-effectiveness of introducing the RTS,S malaria vaccine relative to scaling up other malaria interventions in sub-Saharan Africa*BMJ Global Health* 2017;**2:**e000090. https://gh.bmj.com/content/2/1/e000090.citation-tools

Winskill, Peter, Walker, Patrick G., Cibulskis, Richard E., Ghani, Azra C. (2019). Prioritizing the scale-up of interventions for malaria control and elimination, Malaria Journal, 122, vol 18, iss 1. https://malariajournal.biomedcentral.com/articles/10.1186/s12936-019-2755-5

World Malaria Report 2018b. Geneva: World Health Organization; 2018. Licence: CC BY-NC-SA 3.0 IGO.

WHO (2017). "Prevent Malaria - Save Lives." 2017. https://www.who.int/news-room/detail/24-04-2017-prevent-malaria---save-lives-who-push-for-prevention-on-world-malaria-day-25th-april.