score was 7.0± 2.6 and range was 3 to12. Majority of cases (77%) were scored ≥ 5. *Giardia* and *H. pylori* mixed infection was observed in 18% of cases, H.pylori being most prevalent pathogen (48%), followed by Giardia (40%). Moreover, IELs were raised in 24% of cases. A negative correlation between Leptin (r-0.545; p=0.002) and IGF (r -0.293; p=0.08) were observed with increasing EED score.Further work require correlation of EED biomarkers with severity of disease, and whether EED pathology at site affects systemic or gut inflammatory biomarkers which can be captured through non-invasive EED biomarkers studies.

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DROP-THE-LOSER ADAPTIVE INTERVENTIONS: AN INNOVATIVE DESIGN FOR FINDING THE OPTIMAL INTEGRATED MALARIA VECTOR CONTROL STRATEGIES

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Vector control is the primary means of preventing mosquito-borne disease and has been implemented worldwide. Due to the large number of available and emerging interventions and the heterogeneous and dynamic nature of transmission, an innovative trial design must be developed to test interventions and find the optimal combination. One viable approach may be to build an adaptive design using a sequential multiple assignment randomized trial (SMART). We review the SMART design and highlight its advantages over alternative experimental designs in constructing and revising adaptive interventions. We used malaria vector control as an example to show how the new approach can be used to develop optimal integrated intervention strategies. We conducted the simulation study based on local vector ecology, malaria transmission characteristics, and environmental conditions. The simulated interventions included regular long-lasting insecticidal nets (LLINs), piperonyl butoxide-treated LLINs (PBO-LLINs), indoor residual spraying (IRS) with alternative insecticides, and long-lasting microbial larviciding (LLML). We used a drop-the-loser adaptive design with malaria infection prevalence (MIP) as the outcome measure. The simulation results indicate that, in an area with high pyrethroid resistance and moderate outdoor transmission, a) PBO-LLIN and alternative-insecticide IRS significantly reduced MIP compare to LLINs; b) when alternative-insecticide IRS or LLML were added to existing PBO-LLIN, both were effective in further reducing MIP; c) if only two interventions can be used, PBO-LLIN+LLML would be most effective in reducing MIP; and d) adding LLML on top of PBO-LLIN+IRS (with alternative insecticides) had a significant impact on MIP; however, if PBO-LLIN+LLML has already been implemented, adding IRS may not be recommended. Our simulation example provides a framework or new pathway for informing the optimal integrated intervention. The simulated results are in agreement with existing field trials, and the new strategy can be tested in field trials.

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EFFECTIVENESS OF COMPLEMENTARY STRATEGIES ON MALARIA BURDEN AND TRANSMISSION: A FOUR-ARMED RANDOMIZED CONTROLLED TRIAL IN KORHOGO AREA, NORTHERN CÔTE D'IVOIRE

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Communication for human behavioral changes, indoor residual spraying and larviciding belong to the vector control arsenal to fight against malaria. However, there are not conclusive evidences that their use in combination with the core vector control tool, long-lasting insecticide treated nets (LLINs) provide additional benefit. To help decision makers in policy making, we conducted a four-armed randomized controlled trial to assess whether the use of these tools in combination with LLINs provide additional protection against malaria in an area of high pyrethroid-resistance. The trial was conducted in 28 villages in Korhogo area, Northern Côte d'Ivoire from September 2017 to July 2018, after one year of baseline survey. We selected the villages based on the population size and a minimum distance between villages of 2 km. Eight villages were randomly allocated to larviciding with *Bacillus thuringiensis israeliensis*, six villages to IRS with pyrimiphos-methyl and six other villages to intensive communication for human behavioral changes. All these villages as well as the remaining 8 villages (control group) were covered with LLINs before the implementation of complementary strategies. We carried out four (4) entomological cross sectional surveys and five (5) epidemiological cross sectional surveys for the measurement of entomological and epidemiological outcomes after the implementation of strategies. The analysis of malaria incidence, prevalence and transmission in Korhogo will be presented.

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THE DISTRIBUTION AND INSECTICIDE RESISTANCE STATUS OF *ANOPHELES STEPHENSI* IN EASTERN ETHIOPIA

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Anopheles stephensi was detected in the Horn of Africa for the first time in 2012 in Djibouti and in the Somali region of Ethiopia in 2016. To understand the extent of its geographic distribution and insecticide resistance status, the PMI VectorLink project in collaboration with Jigjiga and Diredawa Universities conducted a cross-sectional survey between August and November 2018, in ten urban localities in Eastern Ethiopia: Dire Dawa, Erer, Jigjiga, KebriDehar, Degehabur, Godey, Bati, Gewane, Semera and Awash Sebat Kilo. Adult mosquitoes were sampled using Human Landing Catches (HLCs), Centers for Disease Control and Prevention Light Traps (CDC LTs) and Pyrethrum Spray Catches (PSCs). Larvae and pupae were sampled from potential mosquito breeding sites using standard dippers. Morphology-based species identification was evaluated with sequence analysis at Baylor University. Susceptibility tests against six insecticides: pirimiphos-methyl, propoxur, bendiocarb, deltamethrin, permethrin and alphacypermethrin and synergist tests using piperonyl butoxide were conducted in two of the ten sites, Diredawa and Kebridehar using WHO tube test. The study revealed the presence of *An. stephensi* in all the ten study sites. The survey produced a total of 90 adult-caught and 2,149 larval-collected *An. stephensi* Cisterns, tanks, barrels and tires were found to be important larval habitats in the study areas. The two populations of *An. stephensi* were resistant to all insecticides tested (19-80% mortalities) with the exception of pirimiphos-methyl (100% mortality). Pre-exposure to PBO fully or partially restored *An. stephensi* susceptibility to deltamethrin and permethrin indicating involvement of oxidases as a resistance mechanism. The distribution of *An. stephensi* appeared to be wider than expected, based on the initial finding in one location, and warrants a nationwide survey to understand its spatial distribution in Ethiopia. Further study is also needed to determine physiological resistance, behavioral patterns and its role in malaria transmission in Ethiopia with the goal of design of appropriate vector control interventions.

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