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"Molecular and morphological identification of the suspected *P. vivax* malaria vectors in Sudan"

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Abstract

Plasmodium vivax malaria is endemic in Sudan but the incidence did not exceed 5%; however in the last recent years the percentage reached 30% of total malaria cases in central Sudan. It is not known whether this expansion is due emergence of new *Anopheles* vectors or due to recent genetic evolution of the parasite. This study was conducted with the aim of screening of *Anopheles* mosquito vector(s) implicated in *P. vivax* malaria transmission in two malaria endemic regions in central (Khartoum and Sennar) and eastern (New Halfa) Sudan. A total of 897 Anopheline mosquitoes were collected during cross-sectional surveys conducted during two malaria transmission seasons (2014-2016) using pyrethrum spray sheets (PSCs), active aspiration and/or by CDC light traps. A random subset (N=108) of the collected mosquitoes was dissected to detect natural sporozoites infection. The rest were subjected to molecular identification of vectors (*An. gambiae* and *An. funestus*) and *P. vivax* circumsporozoite protein (P.v.CSP) using PCR.
Our data showed the presence of *An. arabiensis* (340/897; 37.9%), *An. pharoensis* (56/897; 6.24%) and *An. funestus* (5/897; 0.55%). *P. vivax* infection rate (P.vCSP positivity) was found to be 8.23%, 1.78%, 0.0% respectively. Interestingly the study revealed high percentage of unidentified Anopheline species (388/897) with 13.4% *P. vivax* sporozoite infection rate.

The present study confirmed the ongoing transmission of *P. vivax* in the study areas. *An. arabiensis* and *An. pharoensis* besides other unidentified *Anopheles* species were shown to be infected with *P. vivax* parasite. Further studies should highlight the role of these unidentified *Anopheles* species and role of *An. funestus* in the transmission of *P.vivax* in Sudan.

"LLIN Logistics process assessments for optimal delivery for universal coverage"

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1 Global Health Supply Chain-Procurement and Supply Management Project (GHSC-PSM)

Abstract

There is evidence that the use of LLINs for malaria prevention can reduce mortality and morbidity due to malaria by over 25%. The distribution of LLINs through campaigns is one strategic approach to scale up ownership and use of LLINs. Nigeria commenced her mass campaigns in 2009 and till about 120 million LLINs have reached beneficiaries across all the states of Nigeria through the initial mass campaigns and the follow up LLIN replacement campaigns across the country. From an initial 175 coverage in 2009, the proportion of households with an ITN in Nigeria is currently 57%. Considering the huge investment in the delivery of LLINs to beneficiaries across the country there are now efforts to ensure effectiveness and efficiency in the distribution processes, first to ensure optimal use of pooled resources and then to ensure that each distribution wave ensures that LLINs reach their final destinations-households. Effective logistics process management is key to

achievement of desired campaign outcomes especially in the context of ensuring availability of LLIN at specified times and locations during the campaign process. A mismatch or alignment between logistics processes and other campaign activities usually results in fatal consequences. Reviewing improvement in logistics processes over an eight-year period, we have been able to determine key logistics challenges with campaigns as well the 12 critical logistics processes that are required to guarantee a good quality campaign. This will help implementers better appreciate the need to manage logistics processes and to ensure that future campaigns fully take these into account during campaign planning activities.

"Novel active ingredient insecticidal wall lining for malaria control in Liberia: results from a cluster randomized control trial"

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Abstract

Introduction: Insecticidal durable wall lining (DL) is a promising vector control product in malaria-endemic countries, especially where sufficient long-lasting insecticidal net (LLIN) coverage is difficult to achieve. Vector resistance to pyrethroids, reduction in indoor residual spraying (IRS) and low LLIN usage rates may all contribute to high malaria prevalence in Liberia. Here we report results of a cluster randomized trial to determine efficacy and acceptability of DL in Bomi County, Liberia.

Methods: Non-woven polyethylene fabric impregnated with a combination of avermectin and fenpyroximate (PermaNet® Lining pre-production prototype) was installed in 20 intervention clusters, each paired with one of 20 non-intervention control clusters. Community-based installation teams were selected by village leadership and trained in standardized installation methods. Plasmodium falciparum infections in children under 5 were determined using rapid diagnostic tests (n=1702 at baseline, n=1373 12 months later). Malaria prevalence was compared between study arms using a modified Cochran-Mantel-Haenszel test in SAS. WHO standard tube tests were conducted mosquitoes collected as larvae in 3 sites in the county. A smartphone-based quantitative survey was conducted 12 months after installation with data collected from 1,818 rooms. A qualitative study of community member and installer perceptions was conducted during installation and again after 18 months, with a total sample size of 251.

Results/Conclusions: Resistance to deltamethrin was found in all three collection sites. Malaria prevalence in intervention clusters after 12 months was 34.6% compared to 40.1% in control clusters (p=0.052). Wall lining was installed in 70% of rooms surveyed 12 months after installation. Those without the lining cited being absent at the time of installation (35%), and room being under construction (33%) as the most common reasons for not installing DL. Interviews revealed positive perceptions of community-based installation. Participants frequently cited aesthetic improvements to their rooms and perceived reduction in nuisance mosquitoes.

"Small solar powered 'Bɔkɔɔ' fans improve comfort inside mosquito nets in southern Ghana"

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Abstract
In rural Greater Accra, in 2014, 49% of people didn't use mosquito nets despite having access to a space under one. Discomfort due to heat is the most stated reason, but this problem is largely unaddressed. With advancing electrification and dropping price of solar power, 'Bɔkɔɔ' 0.8 W net fans equipped with a 0.1 W LED could improve comfort inside nets and be affordable to populations in malaria endemic areas. Ninety-two households (HHs) from rural communities in Greater Accra, divided into three groups, participated in a 10-month randomized cross-over trial, where fan systems (one fan per HH member in Group 1) were crossed over with water filters between Groups 1 and 2, while Group 3 served as control. Intervention HHs participated in fortnightly surveys on HH's practices related to mosquito nets, fans and water filters, while control HHs were questioned only at start, mid-point and study end. Further, key-informant interviews were held before mid-point (cross-over), and willingness to pay for fans was assessed in individual auctions at study end. Baseline net use conditional on access in the study communities was unexpectedly high at 92, 93, and 87% for Groups 1, 2 and 3, respectively, and increased to 99 and 99% at cross-over and 97 and 90% at end-point in intervention Groups 1 and 2, respectively, while it reduced to 81 and 84% in the control Group 3 at cross-over and end-point, respectively, indicating a Hawthorne / study effect. Stated fan use was 88-100% depending on the fortnight of survey. The main reason for using fans was heat, but it was also mentioned that they drove mosquitoes away. Key informants suggested they slept less exposed outside due to the fan during part of the night during the dry season. Despite the low power rating, nine out of 13 key informants stated that they placed the fan outside the bed net explaining that the air produced by the fan was enough to reach them through the net. The average bid price per fan was GH₵ 55 (~US$ 13.5), and in total 98 Bɔkɔɔ fans were sold to participating HHs. Small electric fans were accepted and desired in the study community and may be an affordable innovation to improve comfort inside mosquito nets in hot climates.

"IVCC NgenIRS project – Making 3rd generation IRS insecticides affordable"

NgenIRS Project Team ***(Marlize Coleman)***

Abstract
The IVCC Next Generation IRS (NgenIRS) project was launched in January 2016. The 4-year, $65.1 million project is funded by UNITAID and aims to make new, WHO-recommended long-lasting IRS formulations more affordable and widely used by IRS implementers for malaria prevention across Africa.

IVCC has teamed up with the US President's Malaria Initiative, Abt Associates/AIRS, PATH and The Global Fund to work with industry and national malaria control programmes and their partners to make new, long-lasting insecticides for IRS (3GIRS) more affordable and increase their use within insecticide resistance management strategies.

The project employs a three pronged strategy to reduce the price of 3GIRS to project partners. In the short term a co-payment has allowed implementing partners to procure Actellic 300CS for $15 per bottle. IVCC simultaneously underwrites an annual forecast guarantee to Syngenta in exchange for a significant discount, which will reduce the amount of co-pay required per bottle,

allowing support for larger volumes in an expanding market. Lastly, as new 3GIRS products obtain WHO-recommendation and enter the market the resulting competition will contribute downward pressure on the pricing of all products. Determining and communicating the cost effective impact of 3GIRS products is key to this initiative.

NgenIRS and its partners made great strides in 2016 allowing PMI/AIRS to procure 20-30% more 3GIRS in Ethiopia, Mali, Rwanda and Zambia than would have been possible without the UNITAID-funded co-payment. This translated into 2 million addition people protected. At the end of 2016 an additional eight countries were added to the programme, tripling the number of partner countries over 2016. The resulting effect will be 6.8 million additional people protected due to the reduced price. Further progress includes a price elasticity study and the development of a rigorous methodology for developing a reliable and consolidated Africa-wide forecast of 3GIRS products. A cluster randomized control trial of Actellic 300CS (co-funded by PMI), is underway in Mozambique to measure malaria incidence and gather evidence on the cost effectiveness of 3GIRS.

NgenIRS negotiated a steep volume discount with Syngenta/Arysta for 2017, and began negotiations with Sumitomo and Bayer for collaboration on the launch of their respective 3GIRS products, pending WHO-recommendation.

"2016 LLINs Universal Coverage Campaign in Senegal: Approaches, Process and Challenges"

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1 National Malaria Control Programme
2 WHO/Senegal
3 PMI/USAID
4 IntraHealth

Abstract

Senegal, a West African country in the Sahel, has made great progress in malaria control through the scale up of malaria prevention and case management interventions and achieved a decrease in all cause child mortality of 40% from 2005 to 2010. In 2010, the Senegal National Malaria Control Programme and partners began implementation of a strategy of universal coverage of long lasting insecticide treated nets (LLINs), with a rolling campaign that covered all 14 regions over 3 years. Distribution was based on a sleeping space census conducted just before the campaign in each region, with the goal of ensuring one net per sleeping space. Pre-existing nets in good condition counted against the total to be distributed. From May 2010 through March 2013, more than 6,000,00 LLINs were distributed to more than 1,000,000 households. In early 2014, during the Global Funds New Funding Model elaboration context, decision was made to switch from sequential approach by phasing regions after regions to AN UNIQUE SIMULTANEOUS NATIONAL CAMPAIGN in 2016 campaign. This new approach is supposed to yield on (i) high availability level in the same period, (ii) increase the probability of indoor LLINs usage, (iii) avoid big differences of coverage between regions, (iv) rational use of resources and media an (v) realistic comparative analysis between region after surveys, etc. The challenges for this new approach were numerous and quite critical. Regions enrollment had to be well addressed taking into account the timing of LLINs delivery. More than 8,000,000 LLIns were supposed to be mobilized through different partners, stored at the central level first and distributed to 14 regions secondly and to 76 health districts and finally to around 1 300 health posts. Distribution should be finalized before the rainy season in order to achieve a high coverage during the high transmission period and to avoid logistical issues and the risk of limitation of activities through this particular period. Earlier in 2015, organizational disposal was set: steering committee chaired by Ministry advisor and Technical committee involving all technical partners were created, need assessment was consolidated, a road map validated and storage spaces identified at national and regional levels. From experiences and

lessons learned through the past campaigns, the different committees and actors were committed to:

- really take into account specificities of urban versus rural areas for the census and coupons redeeming
- built an adaptive and rapidly operational organization for resolving specific and spontaneous problem
- manage closely staff and health services for maintaining a correct level of curating services during campaign period
- maintain a national engagement and appropriateness?
- Ensure an effective logistic system (transportation, storage capacities, correct stock management and monitoring at each level…)

"IK Vector Control Super-Your best partner for accurate IRS spraying"

***Iñigo Garmendia*[1]**

1 Goizper Group

Abstract

This poster is about the benefits of using a new spraying equipment for IRS applications (Efficiency, Durability, Comfort, Safety And Maintenance). The first non-metallic compression sprayer that meets the WHO specification guidelines for Vector Control equipment.

"Expanding IR Mapper: mapping insecticide resistance in Anopheles species, Aedes aegypti and Aedes albopictus"

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Abstract

The emerging and rapid spread of resistance to major classes of public health insecticides threatens current malaria vector control efforts, namely long lasting insecticidal nets and indoor residual spraying, which have contributed substantially to the reduction of malaria since 2000. Prevention of dengue, chikungunya, yellow fever and Zika virus also relies heavily on insecticide based control of the primary vectors, *Aedes aegypti* and *Ae. albopictus*. Launched in 2012, IR Mapper is built on a systematic review of peer-reviewed, published literature on insecticide resistance. The user interface enables filtering by year, country, vector species, WHO or CDC assay, insecticide class and type, and resistance mechanisms. In 2016, the mapping platform was expanded to geospatially display reports of insecticide resistance in *Ae. aegypti* and *Ae. albopictus*. Additional fields added for *Aedes* included vector developmental stage and resistance ratio, where reported. As of December 2016, the *Anopheles* mapping platform consisted of over 16,000 unique field records from 60 countries and 64 *Anopheles* species or species complexes. 80% of countries reported resistance to at least one of the four classes of insecticides used for adult mosquito control. 96% of the countries that tested for pyrethroids reported confirmed resistance. Examining the top ten countries with the largest burden of malaria today, more reports of confirmed pyrethroid resistance were recorded in the period 2008-2016 compared to 2000-2007. Insecticide resistance mechanisms in *Anopheles* were reported in 80% of the localities. The *Aedes* mapping platform contained over 3,000 unique field records from 45 countries and territories. 71% of the countries and territories reported confirmed resistance to at least one of the four main insecticide classes approved for public health use. The highest proportion of confirmed resistance reports was to organochlorines (90% of tests) followed by pyrethroids (68%). Insecticide resistance was more

frequently investigated in *Ae. aegypti* (84% of localities) than in *Ae. albopictus* (18% of localities). The majority of data were available from Asia followed by Americas; very few data points were available from Africa. Insecticide resistance mechanisms in *Aedes* were reported in 57% of the localities. IR Mapper is a useful tool for visualizing insecticide resistance trends in both *Anopheles* and *Aedes* and can be used to assist decision making for deployment of the most appropriate tools.

"Entomological Impacts of Mass-Mosquito Trapping for Malaria Control in Western Kenya"

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3 Swiss Tropical and Public Health Institute (Switzerland)

Abstract
This poster describes the effects of odour-baited mosquito trapping on anopheline populations on Rusinga Island in Kenya. We will also discuss the directions for future work on mosquito trapping.

"ZAMEP/Abt Associates-IRS Implementation in Zanzibar: One Year Field Experiences, Lessons Learned, Challenges And Achievements"

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Abstract
Introduction: The Zanzibar Malaria Elimination Programme is working with various stakeholders in conducting IRS in the Islands. The IRS operation was re- introduced in 2006 under support of the U.S. President's Malaria Initiative. Six blanket rounds of IRS were implemented between 2006 and 2012 in all eligible structures. Lambdacyhalothrin (ICON 10WP/CS) was used from 2006 to 2012. Following insecticide resistance that was detected in 2010, lambda-cyhalothrine was replaced by Bendiocarb and letter on in 2014 Actellic® 300CS was selected to be used for IRS as a measure for insecticide resistance management.
Method: The target spraying modality was used based on malaria transmission intensity in selected areas. All areas with malaria incidence from 8/1000 and above were eligible for spraying where Malaria Early Epidemic Detection System (MEEDS) and malaria case notification data were used as main criteria for selection.

Results: The overall targeted structures were 29,528 of which 3,192 for Pemba and 26,336 for Unguja. The spray campaign covered 27,664 structures out of the 30,095 structures found, resulting in 91.9% spray coverage. Total unsprayed structures were 1,864 (517 Pemba and 1,347 Unguja). The operation managed to protect 92.5% (130,170 people) 3,253 pregnant women and 21,623 children under-five.

Few challenges were reported during this operation, such as unexpected rain during operation that was interfered the spraying schedule. As a way to overcome this next IRS round to be planned at least two weeks before expected rain season. Other operational challenges reported of outdoor mosquito biting increased due the extensive use of IRS and LLINs indoors over time. This suggesting supplementary measure such as larvae source management.

Discussion: The observed discrepancy between the IRS coverage (93.7%) and the proportion of the population protected (86.4%) was due to the fact that the target population was calculated based on the average size of house of 2012 national census whereas the proportion of the population protected was calculated based on the actual head count as a result of house to house IRS operation.

"Humoral Immune Response to Malaria Vaccine Candidates (MSP1-19-GLURP) of Children Living in Eastern Sudan"

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Abstract

Background: This study aimed to measure the antibody response of a randomly selected cohort of children for two Plasmodium falciparum MSP1 and GLURP antigens considered as vaccine candidates.

Methods: The study was conducted in two villages: Kajara and Daraweesh, in the central part of Gadaref State in Eastern Sudan. The area was characterized by seasonal unstable malaria transmission. A cohort of 510 children of both sexes was randomly selected and followed for 2 years. Clinical examination, finger prick blood smears and blood samples were collected during three surveys conducted before and after the rainy season. Standardized ELISA protocols were used to measure IgM, total IgG, and IgG subclass levels to Merozoite Surface Protein 1–19 (MSP119) and Glutamate Rich Protein (GLURP) antigens. P. falciparum parasites detected in clinical cases during the survey were characterized using PCR.

Results: The incidence of malaria was 2.590%. High levels of IgG1 and IgG3 to MSP1-19 were detected in sera of children who didn't develop clinical symptoms of malaria during the study. The detected IgG1 and IgG3 are known cytophilic antibodies, the level of total IgG to GLURP and MSP1-19 was strongly associated with reduced malaria incidence (P=0.009 and P=0.003) respectively. IgG3 and IgG1 against MSP1-19 were associated with reduced risk of clinical malaria. There was a significant increase in the levels of IgG anti bodies to MSP1 and GLURP in the elder age groups who are known to be at lower risk for developing clinical symptoms of malaria. There was no evidence of association between antibody responses to MSP1-19 and baseline parasitemia.

Conclusion: Although children are known to be more vulnerable to clinical malaria, in areas of seasonal unstable transmission, children who produce high level of IgM, Ig2 and IgG3 antibodies to MSP1 and GLURB are protected from clinical malaria. Similar findings were reported in other studies (Ref). In conclusion P. falciparum MSP1 and GLURB antigens induce protective antibody responses in children living in areas of season unstable transmission.

"Identification of *An. Parensis* and *An. arabiensis* as potential *Plasmodium* vectors in Botswana"

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Abstract

Background: Botswana is one of the elimination eight countries in Southern Africa with an agenda of vector control. Data available indicates that *Anopheles arabiensis* is the only known vector of *Plasmodium* parasites in Botswana. This study assessed *Anopheles* species presence in seven districts of Botswana. **Results:** Overall 404 *Anopheles* mosquito females were collected. One hundred and ninety six were larvae collected from several breeding sites, and 208 were adults obtained from indoor pyrethrum spray catches (PSC). *Anopheles* species were molecularly characterized by polymerase chain reaction-restriction fragment length polymorphism (PCR-RFLP) assay. *An. arabiensis* (58.9%) accounted for the highest relative frequency in 5 out of 7 districts. The other species collected, among those identified, were barely represented: *An. longipalpis* type C (16.3%), *An. parensis* (8.9%), *An. quadriannulatus* (5.4%), and *An. leesoni* (0.2%). PCR test for human β-globin on mosquitoes collected by PSC showed that An. arabiensis and *An. parensis* have bitten human hosts. Moreover *An. arabiensis* showed a non-negligible *Plasmodium falciparum* infection rate in two sites (3.1% and 2.5% in Chobe and Kweneng West districts, respectively). **Conclusions:** Our results provide confirms the wide presence of *An. Arabiensis* in Botswana and a first report of the presence of *An. funestu* and *An. parensis* in the country. *An. parensis* and *An. arabiensis* appear to be potential *Plasmodium* vectors in the country, requiring further investigation.

"Insecticide resistance monitoring of the main malaria vectors in the malaria endemic areas of I.R.Iran"

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Abstract

Introduction: Recent trends and current situation of malaria in I.R. Iran: Since the 1950s, Iran has gone through several cycles of vigorous action to combat malaria, eradication, control and elimination. The trend in numbers of total malaria, *Plasmodium falciparum*, *P. vivax* and Autochthonous cases from 2000 to 2015 are presented in Figure 1. In southern areas of the country, *Anopheles culicifacies Giles s.l.*, *Anopheles dthali Patton*, *Anopheles fluviatilis James s.l.*, *Anopheles stephensi Liston* and *Anopheles superpictus Grassi* are the proven malaria vectors, while there is also report of sporozoite infection of *Anopheles pulcherrimus Theobald* in southeastern Iran (Fig 2) (Zaim et al. 1993, Vatandoost et al. 2006, Hanafi-Bojd et al. 2011). It was relatively easy to interrupt transmission in the North and the West; in the southeast, however, the transmission mainly caused by *Anopheles culicifacies* and *An. stephensi* has been more severe. Furthermore, the vectors have developed resistance to several insecticides. The transmission season is about 8-9 months with two peaks, one in May-July and the other in August-September.
Objective: This study aims to develop management and operational plan for monitoring resistance (WHO susceptibility tests) against nine types of insecticides (mentioned below) in four target provinces in south- southeast of Iran.
Materials and methods: The selection of sentinel sites was conducted based on different coepidemiological factors including: (i) malaria transmission indicators; (ii) availability and abundance of mosquito larval habitats; (iii) existence of agricultural schemes and type of irrigation

activities; (iv) type and distribution of malaria vector control interventions; (v) patterns of insecticide use in public health and in agriculture; and (vi) insecticide susceptibility status of malaria vectors. The proposed districts for selection of the sentinel sites (one site in each district) for monitoring insecticide resistance in malaria vectors in Iran in 2014 is presented in Map 1. The map shows the spatial distribution of sentinel sites for this study at the county level. Based on the distribution of malaria vectors in selected sentinel sites, the susceptibility of *An. stephensi, An. culicifacies* and *An. superpictus* to different insecticides were carried out in each site. All tests were conducted on sugar fed 2-5 days old female mosquitoes reared in laboratory from the field-collected larvae, using WHO recommended diagnostic concentrations and testing procedures.Result of the susceptibility studies carried out since September 2014 in different sentinel sites, in malaria endemic areas of Iran, is presented in Table 1. *Anopheles stephensi* was found resistant to DDT and dieldrin and tolerant to pyrethroids (permethrin and Lambda-cyhalothrin) in some sentinel sites.

This study is an on-going project, increasing the number of sentinel sites and testing susceptibility of other vectors, including *An. culicifacies* and *An. superpictus*.

Conclusions: Continuous monitoring and systematic evaluation of the implementation of the National Malaria Elimination Plan (NMEP) are also essential and would ensure that problems detected and actual results and impact reported are used to improve the implementation of the NMEP.To minimize insecticide selection pressure and to preserve vector susceptibility, rational and judicious use of insecticides and quality and effective application of vector control interventions are recommended.

"Implementation of Small-Scale Roll Out of 'Mosquito-Proofing' Housing Improvements in Namibia – Initial Lessons Learned On Operational Feasibility"

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1 Clinton Health Access Initiative
2 Namibia National Vector-Borne Disease Control Programme
3 ARCHIVE Global
4 DXA Studio

Abstract

Background: Namibia is aggressively working to reach malaria elimination by 2020. As part of the country's vector control efforts to achieve and sustain this goal, the program is currently conducting a small-scale, targeted implementation of housing improvements with technical support from the Clinton Health Access Initiative, ARCHIVE Global, and DXA Studio, and with financial support from Malaria No More UK and the Bill & Melinda Gates Foundation. Initial analysis of this housing improvement project may shed light on the operational feasibility for scaling up in Namibia and initiating housing improvement projects in other countries.

Methods: Housing improvements were are in the process of being conducted in approximately 1,540 structures in 6 communities in northern Namibia, selected based on risk of malaria transmission, analysis of community surveys and focus group discussions that assessed acceptability and need, and diversity of housing type. Types of improvements include screening windows, air vents, eaves, and doors; sealing gaps in the wall; and patching roofs. Planning for the improvements began in January 2016 and included a literature review, community surveys and focus group discussions, material selection, development of training materials, community and implementer training, and individual household assessments. Local contractors were recruited through partnership with the National Youth Services, a subsidiary of the Ministry of Sport, Youth, and National Service, and were trained with technical support from ARCHIVE Global and DXA Studio. A protocol for the project underwent a local and US ethical review. Implementation of the improvements is currently underway, with monitoring and evaluation follow-ups to occur three months and six months following completion.

Results: Community acceptance of the project has been high to date; this likely results from many touch points with the community in advance of the implementation, including focus group discussions and surveys, community training, and recruitment of National Youth Services contractors from the communities. Plans for thorough documentation of community acceptance are planned during the project's evaluation phase. Careful, advanced planning of materials that maximize effectiveness and efficiencies while minimizing cost took place. Based on the pre-construction housing assessments and materials procured, early estimates for cost per structure is $29, $22, $20 for a modern, traditional, and metal structure, respectively, covering an expected 5 improvements per structure.

Conclusion: Early results from the small-scale housing improvement project in Namibia show that community engagement is important for acceptance. Cross-ministerial engagement has built local ownership and support for the project. Namibia will consider scale-up options after analyzing the final results from the small-scale roll out.

"Data-driven approaches for effective intervention targeting, prioritization and implementation of Indoor Residual Spraying in Southern Africa"

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1 Clinton Health Access Initiative (CHAI)

Abstract

Geographical Information Systems (GIS) and remote sensing technologies provide malaria programs with methodologies to improve the understanding of spatial-temporal distributions of populations at risk and intervention coverage, which can be used to target and assess effectiveness of interventions. CHAI is working with the governments in Southern Africa and other partners to compile and analyse freely available GIS data, along with routine data collected during field operations, to improve efficiencies and effectiveness of Indoor Residual Spraying (IRS) programs in Botswana, Namibia, Swaziland and Zimbabwe. Methods were adapted to suit country needs and outcomes will be evaluated against each country's previous spray seasons.

"Long Lasting IRS: New test method and Results"

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Abstract

The efficacy and residual activity in phase I of WHOPES evaluation of IRS formulations are based on application on petridishes filled with materials that imitate wall materials and are stored in the laboratory over months for measuring residual efficacy. However, applications on these materials, the surfaces and the storage and measuring environments are very different and the results from the laboratory tests have little predictive value for performance in houses. We developed test methods in huts built of local materials and tested formulations in both set-up to conclude that screening had to take place in the huts. Years were wasted in the laboratory studies, but after 3 years semi-field studies, promising candidate formulations have been found. It seems possible to make products with one year residual activity.

"Effects of cross-drafts on the behaviour of mosquitoes attacking a bed net"

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Abstract

Groups of female Anopheles gambiae were video recorded at 15 frames/sec as they attacked an occupied 1.8mX1.3mX1.5m high untreated bed net in a 3mX3mX2.5m tent in an experimental room. Near-net "appearances" (at least one mosquito in the video frame), were detected as mosquitoes flew through a red laser field 1-1.5cm from the net surface. One camera recorded a 30cmX30cm area of the net roof above the occupant's torso. Another was directed at a 30cmX30cm area halfway up the net side at torso level. Recordings were made in still air or with a low (0.1m/s) or higher speed (0.4m/s) cross-draft (from a small fan) moving through the net at its mid-level. In separate sessions, data loggers were used to record temperature and humidity at the roof and side locations under all three air movement conditions. In nine total replicates, mean appearances/min in still air were far greater on the net roof than on the side (187.7 vs. 3.5, $p<0.001$) reflecting known patterns for this species. When the cross-draft was introduced, roof activity in all five low speed replicates quickly dropped by an average of 88% and side activity increased significantly by over 500%. In the four higher speed replicates, roof activity again dropped in the cross-draft, by an average of 95%, and average activity at the side increased by over 6000% to close to levels seen on the roof in still air. Introduction of cross-drafts closely corresponded with decreases in temperature and humidity at the roof location and increases at the side location. It appears that the occupant's heat/humidity/odor plume rises in still air concentrating mosquitoes on the net roof and that the plume can be disrupted by a weak (low speed) cross-draft causing mosquitoes to re-distribute on the net. The higher speed cross-draft appears to have diverted the plume more-or-less intact resulting in mosquitoes attacking the side almost as intensely as they did the roof in still air. Significance of these results is discussed in relation to bed net design and to how initiatives to improve cross-ventilation in houses to increase bed net usage may have unintended and possibly counter-productive effects.

"Association between house quality and malaria infection in sub-Saharan Africa: a multi-country analysis"

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Abstract

Improvements to housing may contribute to malaria control and elimination by reducing house entry by malaria vectors and thus exposure to biting. We tested the hypothesis that malaria infection risk is lower in modern, improved housing compared to traditional housing in sub-Saharan Africa (SSA). All Demographic and Heath Surveys (DHS) and Malaria Indicator Surveys (MIS) that measured malaria infection by rapid diagnostic test or microscopy in SSA were analysed. Houses built using non-rudimentary wall, roof and floor materials were classified as modern and all other houses were classified as traditional. Conditional logistic regression was used to determine the

association between house quality and prevalence of malaria infection in children aged 0-5 years, adjusting for age, gender, intervention coverage, household wealth and geographic cluster. We will present the association between house quality and the odds of malaria infection in children and discuss the potential of improved housing as an intervention against malaria in a range of transmission settings across SSA. Improved housing may be an important strategy to prevent the re-introduction of malaria in areas where malaria has been eliminated.

"New developed IRS compression sprayer"

Mesto Spritzenfabrik ***(Wolfram Wagner)***

Abstract
Showing latest development of the IRS and vector control compression sprayer in 7,5 and 10 L with improved ergonomic and carrying comfort.

"Automated 'sample to answer' diagnostic platforms for improving the impact of vector control interventions"

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Abstract
Prevention of the diseases is best achieved by vector control which relies on the use of insecticides. Monitoring mosquito vector populations is an integral component of control programs and a prerequisite for effective interventions. Several diagnostic methods have been used for this task but all have important limitations including protocol complexity, technical training requirements and high per-assay and platform cost. To address these limitations, multiplex diagnostics (MalVec-LabDisk / ArboVec-LabDisk) for monitoring species ID, insecticide resistance traits (including metabolic resistance) and infection status (pathogens) of mosquito populations have been developed. These are fully automated (sample-to-answer) and multiplex platforms, usable under tropical conditions with limited laboratory facilities and skills, using small equipment - expandable for human diagnostics and other purposes (food pathogens etc). Operational vector control programs and advisory groups are the target end users, but other stakeholders, such as academics and health authorities may use it as well.

"Quality of fever case management in the private sector in Kinshasa: results from baseline exit interview and mystery client studies"

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Abstract

Background: The private sector is the most common fever treatment source in Kinshasa. 70% of childhood fevers are treated in this sector and 97% of antimalarials are distributed through private outlets, including 89% through unregulated drug shops where diagnostic testing is not available. There is no published data on the quality of fever case management in private outlets, and a pressing need to fill this gap. **Method (Mystery Client and Exit Interview):** As part of a project to increase RDT availability and correct use in this sector we conducted exit interview and mystery client surveys to benchmark standard quality of care indicators in late 2015. **Mystery Clients:** 123 mystery client visits by confirmed RDT-negative volunteers were conducted at 65 facilities with blood testing available. The main objective of the study is to evaluate to what extent providers follow correct treatment protocol for fever cases and how they treat patients with known negative malaria status. The study has created a baseline to study the results of the study's efforts. **Exit Interviews:** 1,655 eligible client interviews were conducted at 83 health facilities, 44 pharmacies and 60 drug stores. Eligible clients were adults seeking treatment for fever for themselves or on behalf of someone else. Patients leaving facilities (both clinics and pharmacies) were surveyed during this study in order to evaluate the level of care they were receiving. The study was especially interested in identifying the percentage of clients whose fevers were confirmed (with a microscope or RDT) and received an ACT. **Results:** These studies revealed a great deal of information about the quality of treatment and diagnostics that are found in the private sector in Kinshasa, DRC. The data below demonstrates trends of: low access to testing, incorrect treatment and diagnostics, low accessibility to quality treatment and poor quality of facilities themselves.

Low access to testing:

- 79.3% of facility clients received a malaria test, with 26.7% tested by RDT and 11.4% tested by both RDT and microscopy.
- Testing was uncommon in pharmacies and drug shops (<8%) and 4 out of 10 untested clients received any antimalarial (40.6%).

Incorrect treatment and diagnosis:

- Only 35.8 % of known negatives cases received the correct diagnosis (MC)
- Only 9.8% of known negative cases did not receive an antimalarial (MC)
- 72.7% of mystery clients that tested negative for malaria that received an antimalarial
- In 63% of visits the provider reported the client was positive for malaria following testing, and only 10% of clients received the correct diagnosis (negative) and did not receive any antimalarial.

Low Accessibility to Quality Treatment

- The most common non-ACT treatments were quinine and artemisinin-based injections. 19/46 (41.3%) test-negative clients received any antimalarial.
- 82.8% of test-positive facility clients received any antimalarial. However, fewer than half received an ACT (43.9%) and a similar proportion received both an antimalarial and an antibiotic (43.7%).

Low level of quality in facilities

- 58% - performed test in a clean area
- 23% - wore gloves while performing the test
- 64.8 immediately disposed of the lancet in a sharps box
- 15.9% waited 15-20 min before reading the result

These results confirm there is much scope for improving private sector fever case management in Kinshasa, including both the provision of testing and availability of quality-assured ACT treatment.

The program is working to implement the following activities in order to address the low quality of care available at these outlets and the low availability of quality treatment and diagnosis.

- Contracts have been signed with 6 WHO pre-qualified ACT manufacturers. A factory level subsidy has been applied to the ACTs in order to reduce the price and make them more accessible to the population of DRC. The program is implementing a market-based approach with these manufacturers to develop a viable market for ACTs, allowing for long-term access of these quality products for the population.
- In order to create demand for quality testing and treatment within the population of DRC a mass media campaign has been launched which includes radio and TV spots, billboards and door-to-door visits.

- Policy change has been achieved and use of RDTs is now authorized for use in pharmacies with pharmacists.
- Rapid Diagnostic Tests are currently being distributed to private clinics and pharmacies with pharmacists. So far 407,150 RDTs have been distributed. All providers using RDTs have also been trained.
- The program is working with partners in the government to reduce the taxes and tariffs on ACTs, establishing a long-term solution to keep the price of the products lower.