Fine-scale mapping of localities households to plan, implement, monitor and evaluate malaria control campaigns on Bioko Island, Equatorial Guinea

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The Bioko Island Malaria Control Project (BIMCP), in collaboration with the National Malaria Control Program (NMCP) of the Ministry of Health and Social Welfare (MOHSW) of Equatorial Guinea, has been implementing malaria control activities on Bioko Island for at least 14 years. Like many developing nations, the urban environment of Bioko Island is characterized by informal housing, a lack of a household address system, and the absence of formalized geospatial administrative units. In 2011, the BIMCP established a Geographic Information System (GIS) to enumerate households to track household interventions and has collaborated with the Ministry of the Interior to delineate geopolitical administrative units. The GIS mapping efforts have allowed the BIMCP and the Equatorial Guinea Malaria Vaccine Initiative (EGMVI) to plan, mobilize, monitor, evaluate interventions at the household level, and aggregate results at different spatial scales depending on their needs. The system has been possible largely due to considerable support from project donors, collaboration with the government of Equatorial Guinea, and also due to the size of the island (2,017 km2), with less than 100 km2 of which is populated. These factors have made it possible to map populated areas at very fine-scales within small geopolitical units undergoing rapid change due to the country's economic development. Fine-scale urban mapping has been a challenge on Bioko, as 95% of the inhabitants live in a densely populated urban core representing more than half of the island's total populated area. High-resolution mapping of localities and households has enabled the BIMCP to track household interventions in near-real-time, and the outputs have empowered local authorities and leaders to take action in their communities to increase intervention coverage and individual uptake.

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ABSTRACT

Background:

The Bioko Island Malaria Control Project (BIMCP), in collaboration with the National Malaria Control Program (NMCP) of the Equatoguinean Ministry of Health and Social Welfare (MOHSW), has implemented a malaria control program on Bioko Island for at least 14 years. Like many developing nations, the urban environment of Bioko Island is characterized by informal housing, a lack of a household address system, and the absence of formalized geospatial administrative units, which made planning, implementation, and monitoring difficult of BIMCP interventions at to the household level in real time. Fine-scale urban mapping has been a challenge in Bioko, as 95% of the inhabitants live in a densely populated urban core representing more than half of the island's total population. In 2011, the BIMCP established a Geographic Information System (GIS) to enumerate households in an effort to track household interventions, with assistance from the Ministry of the Interior to delineate geopolitical administrative units.

Objective:

To highlight the importance of fine scale mapping in the planning, implementation and monitoring of malaria control intervention on Bioko Island

METHODS

Between June and October 2011, a team of 25 people were trained to implement the first mapping that consisted of working in the community by neighborhood location, listing and assigning a unique code to each household generated automatically by an ArcGIS-based application, which would serve as identity for each household on the island using the satellite imager and based on a non-geopolitical subdivision of the island. PDA devices were used to map households in rural areas.

Due to the lack of clarity and quality of the images during the 2011 mapping, the mapping was updated in 2013. The update using higher quality imagery was used to determine the geopolitical division of the island, up to the community level.

Figure 1 Equatorial Guinea and study site

Figure 2 GIS/Operations mapping a household

Figure 3 Community president (Ministry of the interior) collaborating with the GIS/Operations team (BIMCP) and showing the boundaries of their community

RESULTS

The development and implementation of a GIS on Bioko island has enabled the BIMCP to conduct the following:

- To plan activities according to the geopolitical division of the island up to the community level.

- To calculate the prevalence of malaria at the community level.

- To make epidemiological stratifications for the implementation of malaria control activities such as IRS, mass distribution of mosquito nets, Malaria indicator Survey, etc.

- To calculate the coverage of the interventions up to the community level.

- To monitor and evaluate interventions at the community and household level.

- The fine-scale mapping allows for identification of hot spots and to plan for action.

Table 1 Unique codes of households rejecting intervention by community in 2017

community	Codes of houses rejecting intervention on 2017
2-1.2 Marina B	M0219S085E049P01
2-15 Fishtown II	M0279S093E017P01
2-6.2 Sumco VII	M0337S005E047P01
2-7 Campamento Marina	M0278S006E099P01
3-12.2 Dr. Loeri Combá	M0219S082E018P01
3-18.3 Porvenir III	M0396S028E001P01
5-8.1 Santa María V	M0393S018E038P01

Figure 4 Number of rejections per community in 2017

Figure 5 Map illustrating the spatial location of a household that rejects interventions

Figure 6 Communication and awareness team accompanied by the community president visiting a home that rejects interventions
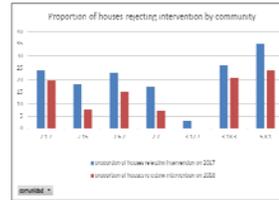
Figure 7 Comparison of rejections by community between 2017 and 2018

Table 2 Increase in acceptance of interventions by community between 2017 and 2018

community	# houses rejecting intervention on 2017	#houses rejecting intervention on 2018	Increase in the acceptance of interventions
2-1.2 Marina B	24	20	16%
2-15 Fishtown II	18	8	55,5%
2-6.2 Sumco VII	23	15	34,7%
2-7 Campamento Marina	17	7	58,8%
3-12.2 Dr. Loeri Combá	3	0	100%
3-18.3 Porvenir III	26	21	19,2%
5-8.1 Santa María V	35	24	31,4%
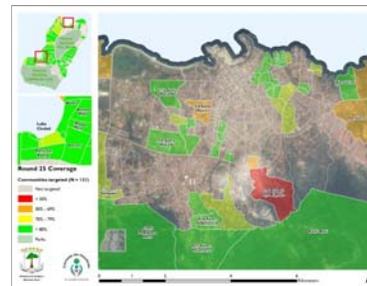
Figure 8 Spatial distribution of the coverages of the 25th round of spraying at the community level

Figure 9 Stratification of the island of Bioko to implement round 25 of spraying based on communities where the prevalence of malaria is higher

DISCUSSION

The mapping system has populated areas at very fine-scales within small geopolitical units.
This has improved the efficiency of resource deployment in space and time.

- Accurate house count to improve planning for budgeting and logistics.

- Tracking of interventions at household levels

- Enabling the project to identify hot spots and to plan for action.

The GIS mapping efforts is currently being used by Equatorial Guinea Malaria Vaccine Initiative (EGMVI) to plan, mobilize, monitor, evaluate malaria vaccine trials on the Island.

The system has been possible largely due to considerable with the ministry of interior of Equatorial Guinea.

The size of the Island (2,017km²) has also made it possible to implement the fine-scale mapping system on the Island

Conclusion:
The BIMCP fine scale mapping system is efficient and provides in real-time information on malaria control interventions. The continuous update of the system is necessary for accurate information in space and time.

REFERENCES

- BIMCP OpenhdsLocation 2017 and 2018 data base

- BIMCP IRS quarterly 2018 report

ACKNOWLEDGEMENTS