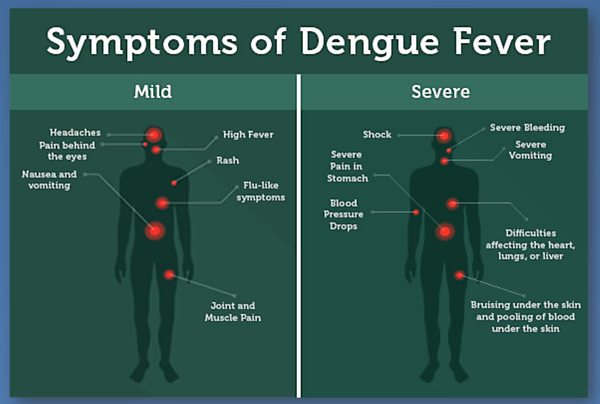
Solar Powered Propeller for the Yemen Dengue Crisis

GCH 205-004

Alyssa Anderson, Ciara Mitchell, Estella Orellana, Malin Pham, Zainab D. Kargbo

The Dengue Crisis In Yemen

Our problem was focusing on the vector-borne viral infection Dengue in Yemen. This infection, to our knowledge has no vaccine/treatment available worldwide and is continuously growing as a threat, with approximately 390 million dengue infections per year worldwide. Sometimes with either no symptoms or flu-like symptoms understanding what is taking place in your body has also been an issue as most of the people in Yemen are not educated on what exactly this infection is and what to look for. On top of this issue, there are 4 known types of Dengue that can come back a different type, which also can develop into a lethal complication known as severe dengue. Trying to solve this problem is imminent, however understanding and knowing where to start is also a complication, because not only do you have to focus on the carriers of the disease (female mosquito), but you have many other issues like standing water along with the heavy rainfall experienced (which can be hard to control), poor infrastructure and many other complications involved. This is why it is important that some kind of solution that could target either disease prevention/control or the diagnosis, testing and treatment is made.



Dengue fever. (2018, February 16). Retrieved from https://www.mayoclinic.org/diseases-conditions/dengue-fever/symptoms-causes/syc-20353078

Selecting a Problem

There are many factors that promote this disease in the country. We found that mosquitos, improper storage of water, poor storm drainage, misdiagnosis, and lack of preventative measures are we believe are the top five problems of this dengue outbreak. Through a decision matrix (seen below) we decided improper storage of personal water was the greatest contribution to the dengue outbreak because mosquitoes thrive in areas with standing water, including puddles, water tanks, containers and old tires. The amount of water from rainfall is increasing the chances of developing a breeding site for these mosquitos since most outbreak cases. "At present, the main method to control or prevent the transmission of dengue virus is to combat vector mosquitoes through: preventing mosquitoes from accessing egg-laying habitats by environmental management and modification, covering, emptying and cleaning of domestic water storage containers on a weekly basis, and applying appropriate insecticides to water storage outdoor containers." ("Dengue and sever dengue", 2018) "Community participation tends to be successful in countries having stable and strong political systems. Community based programs involving local authorities to participate in eliminating breeding places of dengue mosquitoes are the only cost effective and sustainable way of ensuring control in any dengue-affected country and countries deficient in resources." (Zahir, Ullah, Shah & Mussawar, 2016)

	Mosquitos	*Improper Storage of Water*	*Improper Drainage of Water*	*Improper Diagnosis*	*Vaccine Prevention*
Impact on Population (3)	4	4	4	4	2
Most Abundant (2)	4	4	2	3	1
Mortality Rate (4)	4	4	3.5	4	4
Longivity/ How present during the year (1)	3	4	2	4	1
Total	**39**	**40**	**32**	**38**	**25**

Decision matrix for selecting a problem

Creating a Solution

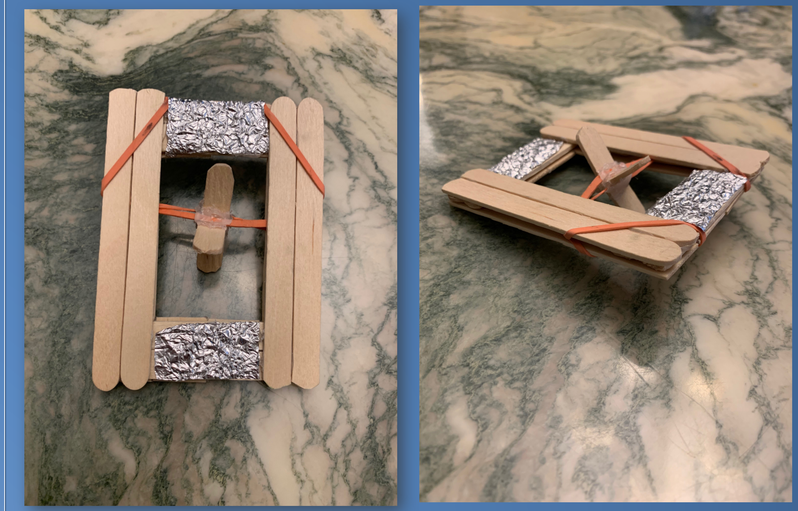
When creating solutions we had to consider the many factors facing Yemen. The country is currently in governmental turmoil with war and violence that sometimes leads to supplies being cut off. So with that we needed to keep in mind our solution needs to be easy to transport across boarders if needed. The device needs to be cheap of course and last a long time, again, it would be very difficult to keep restocking or maintaining products with the political climate and also costly. Also because the threat of Dengue is year round, we needed something that we would last a long time and would work quickly. So with creating the decision we thought of 10 criteria to compare our possible solutions to with effectiveness being the most important/ We ranked our factor and possible solutions through another decision matrix. We created 3 possible solutions to address the issue of the improper storage of water. The first solution is a solar power propeller to keep the surface of the water moving to prohibit mosquitoes from landing on the surface to lay eggs. Another solution was a filtering lid for a container that kept mosquitos out while having a filtering window where rain water can seep through to increase drinking water. And lastly was a chlorine dispenser because mosquitos are repelled by the smell of chlorine. With the results of the decision matrix we moved forward with creating the solar powered water propeller.

Criteria	Solar Propeller	Filtering Lid	Chlorine Dispenser
Cost (8)	1	3	1
Effectiveness (10)	3	2	2
Distribution (public) (3)	3	2	3
Transportation (1)	3	2	3
Lifespan (5)	3	1	2
Resources (7)	3	2	1
Feasability (2)	2	1	1
Labor (time) (4)	3	2	2
Practicallity (6)	2	2	2
Safety (9)	3	1	1
	138	102	80

Decision matrix for selecting a solution

The Solar Powered Water Propeller

We chose a solar power water propeller to be dropped into open containers where water is stored in order to prohibit breeding of mosquitos. A new generation of mosquitos can be made every 14 days. The only necessity for the mosquito's life cycle is still water. The female mosquito lays her egg is still standing water and that is the place of development for egg to adult mosquito. The solar powered propeller is placed in the bottom of water storage containers and create a light constant current in the water so the female mosquitoes are unable to lay their eggs. Thus, removing an entire breeding ground for every container with a solar power propeller. The propeller is power by the sun during the day and is constantly spinning creating a disturbance on the waters surface in any container. The solar panel is 2V 25mA Amorphous silicon which keeps the motor running and charges a 1.2V 600mAh AAA Ni-MH battery that can keep the propeller going for 6 to 8 hours after 4 to 6 hours of sunlight charging incase of cloudy days and at night when the sun is not able to power the device. Over all the cost of the device would be about $10.00 USD per device.



Prototype of Solar Propeller

Acknowledgements

We would like the thank George Mason University for the resources and services provide in order to complete this project. Also we would like to extended out appreciate to Professor Fleming, Professor Peixoto, and Hossein Ghaffari for teaching us Global Health and Engineering and providing guidance during this project.

References

Ayukekbong, J. A., Oyero, O. G., Nnukwu, S. E., Mesumbe, H. N., & Fobisong, C. N. (2017, February 12). Value of routine dengue diagnosis in endemic countries. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5303857/
Dengue and severe dengue. (n.d.). Retrieved from https://www.who.int/news-room/fact-sheets/detail/dengue-and-severe-dengue
Dengue fever. (2018, February 16). Retrieved from https://www.mayoclinic.org/diseases-conditions/dengue-fever/diagnosis-treatment/drc-20353084
Dengue/Severe dengue frequently asked questions. (2017, January 03). Retrieved from https://www.who.int/denguecontrol/faq/en/index5.html
Wenner, M. W., & Burrowes, R. (2019, March 28). Yemen. Retrieved from https://www.britannica.com/place/Yemen/Land
World Health Organization [WHO]. (2018). Dengue and sever dengue. Retrieved from https://www.who.int/news-room/fact-sheets/detail/dengue-and-severe-dengue
World Health Organization [WHO]. (2018). Dengue and sever dengue. Retrieved from https://www.who.int/news-room/fact-sheets/detail/dengue-and-severe-dengue
International Association for Medical Assistance to Travelers [IAMAT]. (n.d). Retrieved from https://www.iamat.org/country/yemen/risk/dengue#