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INNOVATX Global Health Case Competition 2024 – Presented by McMaster Friends of Médecins Sans Frontières

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Abstract:
McMaster Friends of MSF (FoMSF) is a student-led club at McMaster University that supports Médecins Sans Frontières (MSF) Canada, a humanitarian relief-based organization that helps countries across the world. McMaster FoMSF organized the INNOVATX Global Health Case Competition to provide undergraduate students with the chance to problem-solve, enrich their skills, and above all, gain valuable exposure to current global health contexts. This year's competition focused on blood-borne illnesses in Sub-Saharan Africa, the region that is projected to have the highest burden of blood-borne infections among adult populations globally. In particular, participants were asked to describe one health issue related to the topic and propose a plan on how MSF can better address this issue. After a round of written submissions and another round of live presentations, the briefing notes from the four winning teams have been published in this conference book. To learn more about McMaster FoMSF or the INNOVATX Global Health Case Competition, please visit our Instagram (@mac_fomsf) page.
Disclaimer: The views expressed throughout this case competition and publication are solely those of the McMaster FoMSF team and INNOVATX participants and do not reflect those of MSF Canada, McMaster University, or any other organization.

Keywords: global health; humanitarian aid; blood borne illness, sub-Saharan Africa; health innovation

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Conference Abstracts
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First Place

Addressing the Dual Burden of Malaria and Blood Shortages in Sub-Saharan Africa: A Proposal for Volunteer-Based Mobile Clinics

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As of 2020, malaria comprises 96% of deaths in sub-Saharan Africa, making it one of the most prevalent bloodborne diseases. Although malarial parasites are principally transmitted from an infected to healthy patient through mosquito bites, transfusion-transmitted malaria imposes a serious threat to humankind in impoverished malaria-endemic countries. Because of malaria's asymptomatic presentation in individuals, ~10.2% of all blood donors donate malaria-contaminated blood which is not screened properly and ends up being used to treat various other ailments like sickle-cell anemia and hepatitis B/C. This, compounded by insufficient government support and untrained staff, perpetuates the cycle of malaria transmission, prevalence, and mortality. Therefore, educating individuals about existing preventative measures against malaria, training healthcare staff and communities about proper hemovigilance techniques, and screening for viable donors will help address the immediate demand for donated blood and mitigate malaria spread long-term. One cost-effective, direct solution that meets these demands is the use of volunteer-based mobile clinics. Given that children in refugee and rural settings have double the average child mortality, and present more frequently with advanced infection and malnutrition due to poor road networks and long distances to hospitals, these clinics could directly reach these high-risk populations to administer treatment, in line with the Médecins Sans Frontières (MSF) neutrality policy. In addition to treating individuals, mobile clinics can also administer malaria vaccines and screen for potential blood donors, which simultaneously prevents the spread of malaria and helps meet blood demand within high-risk communities. Moreover, mobile clinics should also focus on improving health literacy to mitigate malaria spread long-term. To do this, volunteers should emphasize collaboration with community and religious leaders to promote accurate understanding of the causal factors of malaria. Long-term partnership and integration with community traditional healers will also help enhance trust and facilitate community acceptance, especially given the fraught relationship between citizens and healthcare institutions post COVID-19. Furthermore, to improve feasibility, measures must be taken to strategically reduce costs where possible without impacting effectiveness or care. Based on a study where mobile clinics were used to assist hard-hit Hurricane Sandy communities, the implementation of a mobile clinic costs $2393 USD per day largely due staffing expenses. Therefore, the use of volunteer workers is important to minimize costs. Additionally, measures can be taken to lower the cost of medical resources. Currently, the R21 malaria vaccine costs around $2-4 USD per shot, shows higher effectiveness compared to other alternatives, and can be stored at feasible 2-8ºC temperatures. To fund expenses, external grants from organizations like the Bill & Melinda Gates Foundation can be used to financially support a malaria vaccine rollout. Because of their remote nature, on-site data must be collected on community vaccination rates and malaria mortality to accurately assess effectiveness. Altogether, this solution addresses the immediate need for blood to treat malaria-induced anemic patients, mitigates malaria prevalence by distributing vaccines, and increases health literacy in communities to repair the relationship between healthcare institutions and the community members.

Second Place

Malaria Mobile Initiative: Addressing the Malaria Burden Among Nigerian Children Through Education, Prevention, and Vaccines

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Malaria kills one child every minute, with 90% of malaria mortality in Nigeria being children <5 years old. Particularly, infections in Nigeria accounted for 26.8% of malaria deaths worldwide in 2022. This has placed a heavy burden on the healthcare system, where over $1.1 billion USD is spent annually to address this disease. To reduce the incidence of malaria, we propose the Malaria Mobile Initiative (MMI). MMI will involve the establishment of mobile clinics providing vaccination (R21/Matrix-M) to Nigerian children <5, long-lasting insecticide nets (LLINs) to their families, and support local community leaders in providing prevention education materials. Mobile clinics are economically effective in preventative care, with studies showing that the cost is considerably less compared to fixed clinics. In addition, current mobile clinic programs aimed at children such as the Mobile Clinic Program (MCP) in Houston demonstrates 90% cost-aversion per vaccine, indicating

potential further savings for our proposed MMI. The vaccine in this plan has demonstrated up to 80% efficacy in children. Furthermore, the use of LLINs in Sub-Saharan Africa reduced malaria incidence by 50%. Therefore, the combined approach in our proposed MMI will likely be very effective. Politically, stakeholders emphasize the need for enhanced political engagement to ensure that these malaria interventions reach all segments of Nigeria's population. This exacerbates financial barriers to implementing malaria interventions due to the lack of sustainable funding for malaria programs. Thereby, leaving the Nigerian government to rely on foreign aids, such as support from MSF, to tackle malaria. However, recent efforts by the Nigerian government in April 2023 demonstrate an advance in malaria treatment by approving the new malaria vaccine R21/Matrix-M. For sociocultural factors, studies have found that myths and misconceptions regarding malaria among Nigerian communities result in inappropriate treatment choices. Additionally, there exists resistance to the use of LLIN among Nigerians due to reasons such as mistrust in effectiveness of the nets or lack of knowledge on how to use the nets. Also, a large emphasis of our proposed project is informed consent. A study of approximately 3000 children in Nigeria identified 3 prominent reasons for malaria vaccine hesitancy, including fear of vaccine adverse effects, availability of other malaria preventive measures, and not seeing the positive effect of the vaccine. Thus, the MMI will involve engaging with volunteers from local communities in educating parents about malaria vaccines and LLINs, incorporating the Nigerian culture. This also allows families to make decisions regarding vaccine administration according to their own values and beliefs. To track the effectiveness of our mobile clinics, we will assess the prevalence of malaria in children <5 within Nigeria over a 10-year follow-up period with yearly measurements. Moreover, our plan complements the MSF past initiatives of providing malaria support in high-risk populations and aligns with MSFs guiding principles. To conclude, we believe that our proposal of the MMI is an effective strategy for addressing the malaria crisis in Nigeria.

Third Place

The Elimination of Malaria by Means of Wolbachia

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In Canada, mosquitos are a typical occurrence that do not pose significant harm. This is not the case in Sub-Saharan Africa, where one mosquito bite could lead to death. In these countries, the female *Anopheles* mosquito facilitates the transfer of an incredibly lethal blood- borne illness: malaria. An infected mosquito introduces the parasite into a person's bloodstream through malaria-containing saliva. The deadliest strain of malaria is *P. falciparum*, which causes symptoms such as fatigue, difficulty breathing, and jaundice, and predominantly affects children and pregnant women. According to the WHO, in 2022, malaria caused an estimated 608,000 deaths worldwide, 95% of which occurred in Africa. Cases are especially high in this region because of the limited healthcare and the abundance of mosquitoes. If the threat of infected mosquitoes could be eliminated, the number of malaria outbreaks would plummet, saving hundreds of thousands of lives. Thus, Wolbachia, a common bacterium that poses no harm to humans and does not impact the environment, should be used. Wolbachia is naturally found in 50% of insects. While not found in mosquitoes, Wolbachia has been injected into *Aedes aegypti* mosquitoes, which are responsible for transmitting the dengue virus. Wolbachia is responsible for decreasing mosquito lifespans and inhibiting pathogen replication within their body. This led to a 77% reduction in dengue cases in areas where Wolbachia-carrying mosquitoes were released. Studies show that Wolbachia has similar effects when introduced to *Anopheles* mosquitoes, the carriers of malaria. Through vertical transmission of Wolbachia from mother to offspring, the bacteria would spread through the population. Since this plan is similar to the dengue project, it should be within the same range ($171 million), which is within MSF's expenditure in African countries in 2022 (€736 million). Every six months (three generations of mosquitoes), random samples of mosquitoes will be collected from the population and tested for Wolbachia RNA to determine the project's success. The objective is to observe a progressive increase in Wolbachia-carrying mosquitoes after each subsequent generation. When 100% of the mosquitos contain Wolbachia, malaria will be inhibited in every mosquito, therefore eliminating the main vector of the disease. For positive community engagement, we will distribute nutrient- rich capsules containing Wolbachia mosquito eggs to households and schools. Once placed in water, the eggs will hatch and grow into Wolbachia-carrying mosquitoes. This approach supports our plan to make Wolbachia more prevalent in the population and helps alleviate fear and skepticism within the local community. While urban areas in Africa receive enough healthcare to combat malaria, rural places face challenges in accessing essential medical services. The Wolbachia solution addresses the discrepancy between urban and rural areas as it targets the root cause of the problem. All people, regardless of socioeconomic status, will equally benefit from eliminating the spread of malaria by *Anopheles* mosquitoes. Moreover, our approach is preventative instead of reactive. As

worldwide temperatures increase, *Anopheles* mosquitoes are migrating further North, leading to more people being exposed to Malaria. If the threat of Malaria is eliminated, a future global pandemic could be prevented now.

Fourth Place

"One-Stop-Shop" Treatment of Hepatitis C Virus in Rural Sub-Saharan Africa

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Hepatitis C Virus (HCV) affects approximately 177.5 million individuals worldwide and among these cases, WHO estimates that 32 million residents are grappling with HCV in Sub-Saharan Africa (SSA). Currently, MSF's efforts lie in reducing the cost of direct-acting antiviral (DAA) treatment while strategically establishing HCV treatment clinics in regions such as Cambodia and Malaysia. Despite the severity, countries in SSA face a "silent epidemic" marked by the lack of dedicated HCV treatment centers, overwhelmed health services, and DAA treatments restricted for those with chronic conditions. The absence of pre-treatment screening leads to a reported 95% of those infected by HCV in SSA being unaware of their infection, consequently leading to the inability to benefit from treatment while unintentionally spreading the virus to others around them. To avert this crisis, MSF must employ proactive and effective screening measures to pre-emptively catch instances of HCV in individuals in SSA, while also ensuring individuals will willingly access screening and treatment. Our solution aims to incentivize individuals living in hotspots for HCV to get screened for the disease by administering antibody tests in return for essential goods such as health products and locally sourced nutritional goods. These antibody screening tests take 5-7 days to complete and provide accurate results at a reasonable price. By providing these essential goods, we also partially address the inaccessibility of health products and food insecurity. Addressing HCV infection through early screening and treatment reduces the financial burden of liver disease on the limited SSA healthcare environment and improves the quality of life for the affected individuals, however, those methods might be limited in impoverished and low-income regions such as SSA. A material incentive will encourage at-risk individuals in these areas to get screened and address a potential infection in its early stages. This program can be facilitated by implementing HCV treatment clinics at local hospitals in hotspot regions such as Cameroon that follows a similar system as the one MSF piloted on Cambodia. This system can be introduced in other Asian and African countries and allows for accessible and affordable treatment after a potential diagnosis through the administration of DAAs while treating more patients with the current resources available. The system also follows a decentralized model of care, which overcomes the economic barriers from travelling long distances for care that many individuals in SSA regions face. Once individuals take their screening tests, they will receive their essential goods, and will then be contacted regarding the results of their tests. Documentation of HCV rates and its severity will be collected by treatment clinics. This collected data will be assessed over a 12-month period and compared to other hotspot regions to determine the program's efficacy in long term reduction of HCV cases and intensity. Although MSF has made efforts to tackle HCV in vulnerable populations, its attempts in diminishing the virus in SSA have been insufficient. Screening in hotspot regions, combined with community incentives, proactively reduces HCV spread and risk without burdening healthcare services.

Conflicts of Interest
All authors declare that they have no conflict of interests.

Authors' Contributions
AS: founded the INNOVATX Global Health Case Competition, served as a planning committee for the conference, drafted the conference abstract booklet, and gave final approval of the version to be published.
SA: founded the INNOVATX Global Health Case Competition, served as a planning committee for the conference, and gave final approval of the version to be published.
SV: founded the INNOVATX Global Health Case Competition, served as a planning committee for the conference, and gave final approval of the version to be published.
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