COMBATTING FUTURE BIOLOGICAL THREATS – HOST-DIRECTED INTERVENTIONS TO EMERGING THREATS FOR RAPID RESPONSE

Computational Model To Assess Medical Countermeasures For Dengue Fever

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Medical countermeasure (MCM) options are limited for Dengue Fever, which has been a persistent risk to deployed U.S. military personnel in growing numbers of regions where the disease is endemic. Dengue is a viral infection that is transmitted to humans through the bites of infected mosquitoes.

Though the majority of Dengue infections are asymptomatic, symptoms can range from mild to severe, leading to shock, hemorrhage, and/or death. Paradoxically, while exposure to one Dengue Fever serotype can lead to lifelong immunity against that serotype, subsequent infection to another serotype leads to an increased risk of developing severe Dengue, due to a process known as antibody-dependent enhancement (ADE). There is some hesitation to vaccinate Dengue-naïve individuals as the vaccine itself could increase the risk of ADE upon the individual's potential subsequent exposures. Given that ADE susceptibility can last more than 20 years, U.S. military personnel with repeat deployments are particularly at risk.

To assess the potential benefit of MCMs for military personnel, MIT Lincoln Laboratory developed a model and analysis framework to estimate the impact of Dengue Fever, including reduced combat effectiveness and thus potential mission impact due to Dengue infections. The model tracks the population counts within each relevant disease state (e.g., exposed, symptomatic, etc.) and the amount of time individuals have been in that state (e.g., incubating for 1 day). Scenarios were defined to assess the potential mission impact of Dengue cases and the impact of MCMs.

This briefing provides a description of the computational model and associated assumptions, key simulation outputs and findings for the potential mission impact of Dengue Fever in the absence of MCMs, an exploration of the utility of key MCMs and potential requirements, and ideas for future extensions of the analysis.

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