Inexpensive and Accurate Test Kit for Zika: Point-of-Care Diagnostics in 10 Minutes with Paper-Based Serological Flow Device

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The recent Zika outbreak in over 48 countries has severe socioeconomic impact due to its damage to fetal brain development. Currently, Zika virus (ZIKV) is diagnosed with polymerase chain reaction and enzyme-linked immunosorbent assay, which are expensive, laborious and require several hours. In this project, paper-based test kits were designed to enable rapid, accurate Zika screening with finger-prick blood. They would not require electricity to operate and has a low estimated cost of 2–3 USD per kit, facilitating application in low-resource settings. They would help to contain the spread of Zika and reduce risk of transmission by undiagnosed individuals with acute infection. Lateral flow assays with gold nanoparticles were developed to detect Zika non-structural protein 1 (NS1), an early biomarker for ZIKV infection. 64 capture-detector antibody pairs generated in-house were examined. Excellent sensitivity (5–10 ng/ml) and specificity for ZIKV against other Flaviviruses (i.e. Dengue, West Nile, yellow fever and Japanese encephalitis) were achieved. The detection limit was further improved to 1 ng/ml with novel serological flow assays using enzyme-substrate reaction for signal amplification. As Zika and Dengue infections show similar symptoms and affect common regions, multiplexing was implemented to accomplish simultaneous detection and differentiation of Zika and Dengue NS1. Besides blood sample, urine and saliva could be directly applied to the kits designed, paving the way for non-invasive sampling. Long-term stability of the kits was attained via treatment with sucrose. These inexpensive devices allow for accurate ZIKV detection with a rapid turn-around time of 10 minutes, revolutionizing Zika diagnosis.