Early, Affordable and Rapid Viral Detection: Revolutionizing Home Diagnosis of Dengue and Zika through Lateral Flow Biosensing

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Capacity to control outbreaks and manage patient care for debilitating mosquito-borne flaviviral diseases hinges critically on early, rapid and accurate diagnosis. However, RT-PCR and MAC-ELISA, de facto standards in flavivirus diagnosis, lack efficiency and require expensive laboratory equipment, making them unaffordable to many health systems. In this work, lateral flow biosensors prove ideal as a point-of-care kit to diagnose flaviviral infections, viz. dengue and zika, the leading causes of illness and death in the tropical and sub-tropical regions. Gold nanoparticles (AuNPs) were conjugated with protective H-CALNN-OH peptide and antibodies specific for the sandwich-type capture of NS-1 proteins. Peak absorbance at 520 nm was maintained even in salt-mediated aggregation, proving AuNPs' sustained robustness and prolonged shelf-life in various physiological conditions. Cyclic voltammetry of surface-functionalized ferrocene was used to quantify the concentration of the sandwiched antigen-antibody complexes. Detection limit of 0.5-5 ng/mL was measured, a one order of magnitude improvement in comparison to current limits of 30-90 ng/mL. This increased sensitivity allows for diagnosis to be done two days post-infection (c.f. 10-14 days using current methods), better supporting disease management. Further, diagnosis results are obtainable within two hours, mitigating the compromise of rapidity for accuracy. The use of AuNPs on lateral flow biosensors shows potential to revolutionize patient care by enabling precise, prompt and cost-effective diagnosis of flaviviral infections. With simple variations made to the specific antibody attached, the utility of such kits can be maximized to cover the full spectra of flaviviral, and potentially other infectious disease diagnosis.