Development of a Novel, Low-Cost, and Rapid Plasmonic Lateral Flow Assay for Point-of-Care Diagnoses of N. gonorrhoeae Infections

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The CDC and WHO report around 650,000 Neisseria gonorrhoeae (Ng) infections in the U.S and more than 80 million worldwide. Current diagnostic methods for Ng, mainly nucleic acid amplification tests (NAATs), are costly (at least $60-90), limited to research settings and hospitals, and are time-consuming due to PCR usage. Therefore, there is an urgent need for a cheap and reliable diagnostic solution suitable for point-of-care settings to address the global rise of Ng infections. Plasmonic lateral flow assays (p-LFAs) present ultrabright and quantitative fluorescence-based approaches that overcome the limitations seen in standard colorimetric LFAs, such as qualitative measurements, poor sensitivity, and low accuracy. By conjugating plasmonic-fluor gold nanorods—7000 times brighter than traditional fluorophores—to detection antibodies, the Ng H8 lipoprotein antigen can be detected when it interacts with an H8 mAb. Paper-based LFA strips were created with a test line for H8 mAb and a control line with sheep IgG, all placed on a nitrocellulose membrane. An optimized 0.1% Triton X-100 buffer lyses the gonococcal membrane, releasing H8 into the solution. Urine samples from 44 Ng PCR-positive and 55 PCR-negative males were tested for clinical validation. Standard curves from solutions of 0-10^7 CFU/mL were tested, resulting in a 10-fold lower detection limit in spiked urine than existing rapid antigen tests. p-LFAs have a manufacturing cost of <1 USD and meet WHO requirements for non-molecular bioassays, demonstrating a sensitivity of 93.2% and a specificity of 96.4%. When combined with portable LFA fluorescence readers, they could effectively address the need for accurate, affordable, and user-friendly diagnostic tests for Ng infections worldwide.

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