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An Approach to Make an Adaptive Immunoassay to Detect an Unknown Disease

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Abstract : Rapid diagnostics are critical infectious disease tools that are designed to detect a known biomarker using antibodies specific to that biomarker. However, a way to detect unknown viruses has not yet been achieved in a paper test format. We describe here a route to make an adaptable paper immunoassay that can detect an unknown biomarker, demonstrating it on SARS-CoV-2 variants. The immunoassay repurposes cross-reactive antibodies raised against the alpha variant. Gold nanoparticles of two different colors conjugated to two different antibodies create a colorimetric signal, and machine learning of the resulting colorimetric pattern is used to train the assay to discriminate between variants of alpha and Omicron BA.5. By using principal component analysis, the colorimetric test patterns can pick up and discriminate an unknown that it has not encountered before, Omicron BA.1. The test has an accuracy of 100% and a potential calculated discriminatory power of 900. We show that it can be used adaptively and that it can be used to pick up emerging variants without the need to raise new antibodies.

Keywords : adaptive immunoassay, detecting unknown viruses, gold nanoparticles, paper immunoassay, repurposing antibodies
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