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Tools for Rapid, Single-Molecule Sensitivity, Detection of Viral Nucleic Acids

Dengue is a mosquito-borne viral infection that is one of the leading causes of illness and death in the subtropical and tropical areas of the world. The incidence of dengue is growing rapidly, threatening more than 2.5 billion people in more than 100 countries. Symptoms of dengue virus infection can be severe with fatality rates as high as 10% in the first week if proper treatment is not administered. Because the dengue virus is a single-strand RNA, RT-PCR is the most widely used technique for identification. However, RT-PCR is expensive, time-consuming, can take 1-2 days for results and is not suitable in remote areas.

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Researchers at the Biodesign Institute of Arizona State University, and colleagues, have developed novel tools for rapid and cost-effective detection of the 4 serotypes of dengue virus. Certain serotypes have different potential to cause severe illness, thus, serotype-specific detection in the acute setting may help risk-stratify patients and target treatment. Using a DNA tetrahedron having a single-strand DNA edge for annealing complementary target RNA, dengue virus RNA sequences could be specifically detected. The fluorescence signal from the DNA tetrahedron is amplified using novel tandem toehold-mediated displacement reactions (tTMDR). Each RNA target can be recycled many times during the tTMDR process to form an amplifying loop for enhancing the fluorescence signal.

This novel tool allows for extremely sensitive detection of the RNA of all dengue virus serotypes for critical early stage diagnosis and treatment. Further, this tool could also be adapted for detection of different viruses.

Potential Applications

- Early detection of dengue virus infection
- o Can identify all 4 serotypes
- Could be adapted to detect other viral infections

Benefits and Advantages

- As few as 6 copies of RNA per sample can be detected using single molecule

technology

- Detection limit as low as 10 pM using traditional fluorescent scanner
- Enzyme-free amplification at room temperature without any additional equipment – easier than traditional amplification schemes
- The tetrahedron system can be formed with high efficiency and repeatability
- Distinguishes Dengue Virus serotypes from other viruses including Zika, Chikungunya and Yellow Fever

For more information about this opportunity, please see

Gao et al - Chem Commun (CAMB) - 2018

[Gao et al - ACS Infect Dis - 2019](#)

For more information about the inventor(s) and their research, please see

Dr. Hecht's departmental webpage

[Dr. Chen's departmental webpage](#)