Analytical chemistry for infectious disease detection and prevention

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Infectious diseases refer to disorders caused by different pathogens, including bacteria, viruses, fungi, and parasites. They can rapidly transmit from person to person, and quickly spread from one location throughout the whole world. Therefore, their impacts are far-reaching; they often cause tremendous global health concerns and economic losses. Some examples of those infectious diseases include COVID-19, SARS, Ebola, HIV, tuberculosis (TB), malaria, and meningitis. In particular, the ongoing pandemic caused by COVID-19 has reminded us of the severity and impacts of infectious disease on our society. As of May 14, 2021, the statistics from John Hopkin University shows that there are about 161,482,418 COVID-19 cases, and 3,351,517 associated deaths worldwide. This has caused intensive global attention. Using "COVID-19" as the keyword to search from Web of Science on the same day, we found more than 111,000 items were published in 1.5 years, and 4294 of them (6.7%) are highly cited papers.

Analytical chemistry plays a vital role in infectious disease diagnosis and prevention. Gram stain and culture of microorganisms are commonly used methods in microbiology. However, these conventional methods often either lack high detection sensitivity and specificity or require a long time. Hence, molecular diagnostic methods such as genetic analysis-based quantitative polymerase chain reaction (qPCR) and immunoassay-based enzyme-linked immunosorbent assay (ELISA) have become popular in recent years. For instance, high-throughput qPCR becomes the gold standard in current COVID-19 diagnostics; and immunoassay-based antibody tests (e.g., IgG and IgM) are also routinely used to check immunization results from COVID-19 vaccines. Along with those well-established methods, new innovative strategies including microfluidic devices, nanotechnology, and molecular imprinting have been applied to analytical chemistry to improve various aspects of biosensing such as signal amplification for high detection sensitivity, and to address new challenges for rapid point-of-care (POC) infectious disease diagnostics in low-resource settings. Therefore, we organize this paper collection and invite worldwide experts in this field to highlight recent innovations in analytical chemistry for infectious disease detection and prevention.

This collection of articles includes reviews and original research articles. Three reviews summarize the most recent advances in particular fields of analytical chemistry for infectious disease diagnostics. Recently, a lot of research efforts focus on the development of rapid and cost-effective detection approaches. In a review article, Yang and co-workers summarized important advances in the selection and detection of bacterial- and virus-associated functional nucleic acids. To address some limitations of conventional methods, in a different review article, Lu et al. reviewed recent advances in molecular imprinting (MIP) for bacterial detection, introduced the underlying recognition mechanisms, and highlighted the applications of MIP-based biosensors in sensing foodborne pathogenic bacteria. In addition, another review article from Marco et al. summarized the most recent findings of the biological implications and the clinical significance of the main *Pseudomonas aeruginosa* alkylquinolones (AQs) that have potential to be used as biomarkers of infections.

Two original research papers from Yingfu Li and Zhaohui Li et al. reported two novel methods for rapid and sensitive

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detection of SARS-CoV-2, which are based on nanotechnology and single molecule assays, respectively. Wu and co-workers developed an ultrasensitive colorimetric sensor array (CSA) based on the interactions between aminoglycoside antibiotics and Ag nanoparticles decorated with β-cyclodextrin to discriminate microorganisms quickly and accurately. Signal amplification has been pursued to improve detection sensitivity. For instance, Lin's group presented a homogeneous electrochemical biosensor for microRNA detection based on an enzyme-driven cascaded signal amplification strategy. Cabrera's group reported a novel PCR-assisted impedimetric biosensor for colibactin-encoding *polyketide synthase* (pks) genomic island detection in *Escherichia coli* samples.

POC detection of infectious diseases is a hot research field. Interestingly, Yu's group used a WiFi scanner for quantitative detection of disease markers in blood plasma, while Tokeshi's group reported a non-competitive immunoassay for detection of H5 avian influenza virus using a portable analyzer. Chen's group reported a lateral flow gene assay using gold nanoparticles for POC detection of African swine fever virus. Furthermore, Xiujun Li's group developed a multicolorimetric ELISA biosensor on a paper/polymer hybrid microfluidic device for visual quantitative POC detection of hepatitis C without the aid of specialized instruments such as a spectrophotometer, which has great potential for many applications particularly in resource-limited settings such as rural areas and developing nations.

We would like to thank all authors for contributing their valuable work to this topical collection. We are also grateful to the Editorial Office and Editors for their timely assistance and support. Lastly, we hope this topical collection will serve as a valuable source of information on state of the art in infectious disease detection for Anal Bioanal Chem readers.

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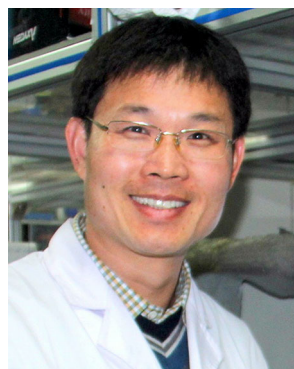
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