



Preface of special issue: Advances in point-of-care technologies and biosensing for diagnostics and treatment surveillance

We are witnessing a pivotal epoch in medical innovation, where the confluence of Point-of-Care (POC) technologies and biosensing is transforming precision healthcare. By offering decentralized, dependable, and real-time diagnostics at or close to the patient interface, these quickly developing technologies are revolutionizing clinical paradigms. By integrating seamlessly into existing clinical workflows, they bridge the critical gap between centralized laboratory testing and immediate clinical decision-making, thereby empowering healthcare providers with timely, legal insights. With the growing number of medical centers establishing “home hospitals”, the roles of POCs and biosensors are poised to reach an entirely new level, enabling patient management in the comfort of their home, facilitating earlier discharges, reducing hospital burden for those in greater need, and promoting better recovery in home environment.

From early disease detection to longitudinal biomarker surveillance, POC technologies and biosensors signify far more than diagnostic instruments—they represent a paradigm shift toward personalized, adaptive, and data-driven healthcare. In an era increasingly defined by the need for rapid, accurate, and patient-centric solutions, these innovations are ushering in a new generation of diagnostic and therapeutic monitoring platforms that transcend conventional laboratory boundaries and foster precision at every level of care.

In recognition of these transformative developments, this Special Issue—*Advances in Point-of-Care Technologies and Biosensing for Diagnostics and Treatment Surveillance*—brings together a curated collection of original research articles and comprehensive reviews that collectively highlight the latest conceptual, technological, and translational advances shaping the next wave of biosensing and diagnostic innovation. The contributions span an impressive spectrum of disciplines, from material science and nanotechnology to microfluidics, optics, and computational modeling, each converging toward the common goal of achieving superior sensitivity, selectivity, and integration across diverse clinical applications.

A particular emphasis is placed on the evolution of portable and wearable diagnostic platforms, demonstrating how miniaturization, design ingenuity, and smart material engineering are enabling continuous and remote health monitoring. Simultaneously, the integration of nanostructures, metamaterials, and responsive biomaterials within sensor architectures has opened unprecedented opportunities for improving signal transduction, stability, and versatility. Technological developments in continuous monitoring and non-invasive biomarker

detection broaden the scope of patient-friendly diagnostics by making it easier to obtain clinically useful data with the least amount of discomfort and the highest level of accuracy. Similarly, lab-on-a-chip and companion diagnostic systems are redefining how therapeutic efficacy and treatment responses are evaluated, underscoring the vital role of micro- and nanoscale integration in the advancement of precision health. Complementing these technological breakthroughs, computationally driven analytical frameworks now enable real-time data interpretation, predictive modeling, and unparalleled precision in disease monitoring.

Among the notable contributions to this issue, the review article “**A Comprehensive Review of Interferometric Reflectance Imaging Sensor as a Sensitive Detection Platform and Its Application Areas**” provides an exhaustive overview of IRIS technology as a label-free, highly sensitive modality for real-time analysis of molecular bio-interactions. It highlights IRIS’ versatility across diverse applications—from DNA–protein and protein–protein interaction studies to pathogen detection—demonstrating how innovations in optical transduction and surface chemistry can advance precision diagnostics. In a complementary direction, “**Smartphone-Based Colorimetric Detection of Urinary Glucose Using a Novel Green and Red/Green Approach**” introduces a cost-effective, portable platform for urinary glucose quantification based on smartphone-assisted colorimetric analysis. This approach enhances the analytical range of conventional dipsticks and offers an accessible avenue for screening for diabetes and early treatment.

In the domain of cancer diagnostics, “**Rapid, High-Throughput Isolation of Tumor-Specific Small Extracellular Vesicles Using Radial Flow Microfluidic Chip with IEDDA Chemistry (ExoOnco Chip^{EpCAM-TCO})**” presents a radial-flow microfluidic platform that employs bioorthogonal IEDDA chemistry for selective recognition and controlled release of tumor-derived extracellular vesicles. This study represents a significant advancement in precision oncology, facilitating efficient biomarker isolation for early cancer detection. Similarly, “**Optimization of a Portable Ligand-Free Optical Spectroscopy Method for SARS-CoV-2 Protein Detection**” details a robust, probe-free optical spectroscopy approach optimized for rapid viral protein detection, underscoring the potential of portable optical systems in real-time infectious disease diagnostics.

Expanding the scope to women’s health, “**Hydrogel-Based Multiplexed High-Risk Human Papillomavirus DNA/RNA Detection for**

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Cervical Cancer Screening” introduces an innovative hydrogel-based LAMP (LAMPGel) platform capable of parallel detection of high-risk HPV DNA and RNA. Its multiplexed configuration and rapid analytical turnaround make it particularly promising for POC cervical cancer screening in resource-constrained settings. On the computational front, **“Computational Modeling of the Effects of Biofouling and Foreign Body Response on Continuous Glucose Monitors”** employs *in silico* modeling to elucidate the mechanistic impacts of biofouling and the foreign body response on long-term sensor performance, offering critical insights into sensor stability and functional longevity.

Concluding the collection, **“Decoding Point-of-Care Testing: A Strategic Tool for Influenza and SARS-CoV-2 Management in Healthcare Facilities”** provides a systematic analysis of POC diagnostic strategies for respiratory infections. It presents a comparative evaluation of diverse detection modalities, highlights emerging trends such as SERS-based diagnostics, and proposes an integrated framework for deploying POC technologies in clinical and epidemic management scenarios.

Collectively, the studies presented in this Special Issue exemplify the multidisciplinary essence of biosensing and POC innovation. They

reflect the cooperative interaction between materials engineering, analytical chemistry, computational modeling, and clinical translation—domains that collectively drive the transformation of diagnostic science from the laboratory bench to the patient bedside.

Looking ahead, the insights gathered herein underscore that the future of diagnostics will be defined by convergence—of biology with computation, of materials with intelligence, and of engineering with clinical practice. The advances highlighted in this collection are poised to catalyze continued interdisciplinary collaboration and translational progress, propelling biosensing and POC technologies toward a new era of medicine that is not only precise and preventive, but also profoundly personalized and predictive.

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