Biosensors for Infections: Revolutionizing Disease Detection and Monitoring.

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Introduction

Biosensors are devices that combine biological components with electronic systems to detect and measure specific biological or chemical substances. In recent years, biosensors have emerged as powerful tools for detecting infections, offering rapid, sensitive, and non-invasive methods for diagnosing infectious diseases. These devices are particularly valuable in clinical diagnostics, where timely and accurate identification of pathogens is critical for effective treatment and infection control. In this article, we explore the role of biosensors in detecting infections, the different types of biosensors, their applications in healthcare, and the future prospects for this rapidly advancing field [1-3].

What Are Biosensors?

A biosensor is a sensor that uses a biological recognition element (such as enzymes, antibodies, or nucleic acids) to interact with a target analyte (the substance being detected). The biological element is usually linked to a transducer, which converts the biological interaction into a measurable signal, such as an electrical, optical, or thermal response. This signal can then be analyzed to identify the presence or concentration of a specific pathogen, biomarker, or other relevant molecules associated with infections [4].

Types of Biosensors for Infection Detection

Several types of biosensors are currently being developed for the detection of infections. These sensors vary in their biological recognition elements and the methods used to convert biological interactions into measurable signals. Some of the most common types include [5]:

Electrochemical biosensors are among the most widely used for infection detection. They use electrodes to measure the changes in electrical properties (such as current, voltage, or impedance) that occur when a biological element binds to a target pathogen or biomarker. Electrochemical biosensors are favoured for their simplicity, portability, and ability to provide quick results. Detecting bacterial and viral infections, monitoring biomarkers related to infections (e.g., C-reactive protein, procalcitonin), and identifying pathogens like *E. coli*, *Salmonella*, and *Streptococcus* [6-8]. Optical biosensors use light-based methods to detect biological interactions. These sensors can measure changes in light absorption, fluorescence, or surface plasmon resonance (SPR) when a pathogen or biomarker binds to the baroreceptor. Optical biosensors are highly sensitive and can be used for real-time monitoring. Optical biosensors are used for detecting viral infections (e.g., influenza, HIV) and bacterial infections, particularly in point-of-care diagnostics. They can also be used in high-throughput screening of pathogens in clinical samples. Nucleic acid-based biosensors utilize the specific binding between complementary DNA or RNA sequences to detect infections caused by viruses or bacteria. These sensors use probes (short DNA or RNA sequences) that are complementary to the genetic material of the target pathogen. When the probe binds to the target DNA or RNA, it generates a detectable signal. Used for detecting viral infections like COVID-19, HIV, and hepatitis, as well as bacterial infections such as tuberculosis and gonorrhoea [9, 10].

Conclusion

Biosensors are revolutionizing the detection and management of infections, offering rapid, accurate, and cost-effective solutions for diagnosing infectious diseases in clinical, field, and home settings. As technology advances, biosensors will continue to play a key role in improving

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