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*Review*

# Recent Advances in Early Diagnosis of Viruses Associated with Gastroenteritis by Biosensors

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**Abstract:** Gastroenteritis, as one of the main worldwide health challenges, especially in children, leads to 3–6 million deaths annually and causes nearly 20% of the total deaths of children aged < 5 years, of which ~1.5 million gastroenteritis deaths occur in developing nations. Viruses are the main causative agent (~70%) of gastroenteritis episodes and their specific and early diagnosis via laboratory assays is very helpful for having successful antiviral therapy and reduction in infection burden. Regarding this importance, the present literature is the first review of updated improvements in the employing of different types of biosensors such as electrochemical, optical, and piezoelectric for sensitive, simple, cheap, rapid, and specific diagnosis of human gastroenteritis viruses. The Introduction section is a general discussion about the importance of viral gastroenteritis, types of viruses that cause gastroenteritis, and reasons for the combination of conventional diagnostic tests with biosensors for fast detection of viruses associated with gastroenteritis. Following the current laboratory detection tests for human gastroenteritis viruses and their limitations (with subsections: Electron Microscope (EM), Cell Culture, Immunoassay, and Molecular Techniques), structural features and significant aspects of various biosensing methods are discussed in the Biosensor section. In the next sections, basic information on viruses causing gastroenteritis and recent developments for fabrication and testing of different biosensors for each virus detection are covered, and the prospect of future developments in designing different biosensing platforms for gastroenteritis virus detection is discussed in the Conclusion and Future Directions section as well.

**Keywords:** viral gastroenteritis; biosensor; virus detection



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## 1. Introduction

Gastroenteritis, an inflammation of the gastrointestinal tract, leads to abdominal pain with nausea, vomiting, and diarrhea. These clinical signs can be accompanied by systemic manifestations including fever [1,2]. Gastrointestinal disorders are divided into acute or chronic infections that can be caused by infectious pathogens including viruses, bacteria, and parasites [3,4]. Acute gastroenteritis is a common disorder in people that leads to significant deaths worldwide [5,6]. Around 3–6 million annual deaths associated with gastroenteritis are estimated worldwide, of which 1.8 million deaths belonged to children aged < 5 years, accounting for nearly 20% of total child deaths. More than 75% (1.46 million) of deaths occurred in the developing regions of Asia, Africa, and Latin America [4,7]. Meanwhile, according to the recent estimation of the Centers for Disease Control and Prevention (CDC), more than 350 million cases of acute gastroenteritis are