**Ke ord :** Lung cancer detection; Non-invasive diagnostics; Low-dose computed tomography (CT); Magnetic resonance imaging (MRI); Biomarkers

## In rod c ion

Lung cancer remains one of the leading causes of cancer-related mortality worldwide, primarily due to its late-stage diagnosis and limited treatment options once the disease has progressed. Early detection is critical for improving prognosis and survival rates, but conventional diagnostic methods o en involve invasive procedures, substantial radiation exposure, or limited sensitivity [1]. Consequently, there is a growing emphasis on developing non-invasive detection methods that can o er early, accurate, and patient-friendly alternatives [2]. Non-invasive lung cancer detection methods aim to identify the disease with minimal discomfort and risk to patients. Advances in imaging technologies, such as low-dose computed tomography (CT) and magnetic resonance imaging (MRI), have revolutionized lung cancer screening by improving the sensitivity of early detection [3,4]. Despite these advances, challenges persist in distinguishing between benign and malignant lesions and in managing the associated risk of false positives, which can lead to unnecessary follow-ups and anxiety. Biomarker-based detection has emerged as a promising non-invasive approach [5]. Researchers have identi ed various biomarkers, including circulating tumor cells (CTCs) and tumor-derived DNA, which can be detected through blood tests [6]. ese biomarkers o er the potential for early diagnosis and monitoring but face hurdles related to assay validation, reproducibility, and clinical integration. Liquid biopsy, another innovative method, analyzes genetic material found in bodily uids to detect cancerous changes. is technique provides a minimally invasive option for early detection and ongoing monitoring. However, its implementation is challenged by issues such as assay sensitivity, speci city, and cost-e ectiveness. is introduction sets the stage for a comprehensive examination of both the progress and the hurdles in non-invasive lung cancer detection [7]. By exploring recent breakthroughs and ongoing challenges, this review aims to provide insights into how these methods can be optimized and integrated into clinical practice to enhance early detection and improve patient outcomes in lung cancer.

## Re l

e exploration of non-invasive lung cancer detection methods has yielded notable advancements and identi ed several key challenges.

these biomarkers is constrained by issues related to assay sensitivity, speci city, and standardization across di erent populations and clinical settings. Liquid biopsy, which analyzes cell-free DNA or RNA in bodily uids, represents a groundbreaking advancement in non-invasive cancer detection. is method has demonstrated the ability to detect genetic alterations associated with lung cancer, providing insights into tumor dynamics and treatment response. Despite its potential, liquid biopsy faces challenges including assay performance, high cost, and the need for further validation in larger, diverse patient cohorts. Overall, while signi cant progress has been made in non-invasive lung cancer detection methods, challenges such as assay validation, standardization, and clinical integration remain. Continued research and technological development are essential to overcoming these