

# Non-invasive approaches for lung cancer diagnosis

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**Abstract** Lung cancer is the leading cause of cancer-related deaths worldwide. The case-fatality rate of lung cancer remains exceptionally high at 95% despite numerous medical advancements in therapeutic strategies in the last decades. However, patients diagnosed at Stage I are commonly curable and have a 5-year survival rate of 50–80%. Unfortunately, delayed diagnosis of lung cancer has been unavoidable and is an important factor in the overall outcome of treatment. Accordingly, screening of high-risk individuals is likely to have hugely beneficial outcomes for patient survival. Current screening approaches include low-dose computed tomography and chest X-ray. Recently, alternative approaches for lung cancer screening have been developed including analysis of biomarkers, including DNA, RNA, proteins, and antibodies in blood, sputum, bronchoalveolar lavage (BAL), and breath. Biomarker analysis would also provide critical information regarding tumor growth pattern, cells of origin of

tumor, subtype of lung cancer, and/or drug metabolism as well as monitor patient prognosis. Novel non-invasive lung cancer diagnostic strategies could improve and complement the success of CT-scan and chest X-ray.

**Keywords** Lung cancer · Diagnosis · Non-invasive

## Introduction

Lung cancer is a highly prevalent disease and is the foremost cause of cancer-related deaths worldwide, i.e., 25% of cancer-related deaths [1]. In 2012, it accounted for approximately 1.6 million deaths, which means more deaths than three well-known cancer types put together such as, breast, prostate, and colorectal cancers. The mortality rate of lung cancer closely parallels the incidence pattern resulting in an extremely high-case fatality rate of 95%. The persistently low patient survival is reflected in a 5-year survival rate of 15–17% [1, 2]. Epidemiological observations performed across varied demographic cohorts in India point towards a similar pattern of incidence and mortality, underlining the significant burden of lung cancer towards mortality and morbidity in India [3, 4].

The GLOBOCAN 2012 report estimated lung cancer incidence in India to be 70,275 (6.9%) across all ages and both sexes, and the estimation was 63,759 (9.3%), making it the third most common cause of cancer-related mortality in India after breast and cervical cancers (Fig. 1) [5]. However, it is speculated that the illustrated incidence and mortality patterns represent an underestimation of the overall lung cancer burden due to the quality of data acquired from regional hospital-based registries. According to the report of the National Cancer Registry Programme, there is significant (rise in) lung cancer incidence in Delhi, Chennai, and Bengaluru in both sexes. The incidence and pattern of lung cancer differ as per

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