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Evaluating the Cost-effectiveness of Risk Factor-based Lung Cancer Screening Programs

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Introduction

Lung cancer remains one of the leading causes of cancer-related deaths globally. Despite advancements in treatment modalities, early detection remains critical for improving survival rates. Screening programs have emerged as a vital tool in detecting lung cancer at earlier stages, potentially leading to better outcomes. Among these, risk factor-based screening programs have gained attention for their ability to target individuals at higher risk. This article delves into the concept of risk factor-based lung cancer screening programs and evaluates their cost-effectiveness [1].

Description

Understanding risk factor-based screening

Risk factor-based screening involves targeting individuals based on their risk profile for developing lung cancer. These risk factors commonly include smoking history, age, family history of lung cancer and occupational exposures to carcinogens such as asbestos or radon. By focusing screening efforts on high-risk individuals, these programs aim to maximize the detection of lung cancer cases while minimizing unnecessary screening in low-risk populations [2].

Cost-effectiveness analysis

Assessing the cost-effectiveness of any screening program is crucial for informing healthcare policy and resource allocation decisions. Cost-Effectiveness Analysis (CEA) involves comparing the costs and health outcomes of different interventions to determine their relative value. In the context of risk factor-based lung cancer screening, CEA evaluates the costs associated with screening, diagnostic procedures, treatment and the resulting health benefits in terms of lives saved, Quality-Adjusted Life-Years (QALYs) gained, or years of life gained.

Key components of cost-effectiveness analysis

Cost inputs: This includes the direct costs associated with screening, such as imaging tests diagnostic procedure treatment costs (e.g., surgery, chemotherapy, radiation therapy), as well as indirect costs like patient transportation and productivity losses.

Health outcomes: Health outcomes are measured in terms of life-years gained, QALYs, or mortality reduction. QALYs incorporate both the quantity and quality of life lived, accounting for the impact of disease and treatment on patients' well-being.

Sensitivity analysis: CEA involves conducting sensitivity analyses to assess the robustness of the findings to variations in key parameters such as screening efficacy, cost inputs and discount rates. This helps in understanding the uncertainty surrounding the cost-effectiveness estimates [3].

Incremental Cost-Effectiveness Ratio (ICER): The ICER is a key metric in CEA and represents the additional cost incurred per unit of health outcome gained compared to an alternative intervention or no intervention. In the context of lung cancer screening, the ICER quantifies the cost per QALY gained or per life-year saved.

Evidence on cost-effectiveness

Numerous studies have evaluated the cost-effectiveness of risk factor-based lung cancer screening programs, primarily using simulation models based on data from clinical trials and observational studies. The National Lung Screening Trial (NLST) in the United States provided crucial evidence supporting the efficacy of Low-dose Computed Tomography (LDCT) screening in reducing lung cancer mortality among high-risk individuals.

A landmark study by the U.S. Preventive Services Task Force (USPSTF) found that annual LDCT screening among adults aged 55 to 80 years with a 30 pack-year smoking history or more, who are current smokers or have quit within the past 15 years, was associated with a significant reduction in lung cancer mortality compared to chest radiography. While LDCT screening was found to be cost-effective in this high-risk population, its cost-effectiveness varied depending on factors such as screening frequency, age eligibility criteria and smoking history [4].

Similarly, studies in other countries have also demonstrated the cost-effectiveness of risk factor-based lung cancer screening programs, albeit with variations in screening eligibility criteria, healthcare systems and cost structures. For instance, a study conducted in the United Kingdom found that targeted LDCT screening based on age and smoking history was cost-effective within the National Health Service (NHS) framework, with an estimated ICER below the commonly accepted willingness-to-pay threshold.

Challenges and considerations

While risk factor-based lung cancer screening programs offer the potential to reduce lung cancer mortality and improve patient outcomes, several challenges and considerations need to be addressed:

Risk prediction models: Enhancing the accuracy of risk prediction models is crucial for effectively targeting high-risk individuals for screening. Incorporating additional risk factors such as genetic predisposition and biomarkers may improve risk stratification and optimize resource allocation.

Smoking cessation interventions: Integrating smoking cessation interventions within screening programs can further enhance their effectiveness by reducing smoking-related morbidity and mortality. Addressing tobacco dependence not only improves individual health outcomes but also contributes to long-term cost savings.

Equity and access: Ensuring equitable access to screening services is essential to mitigate disparities in lung cancer outcomes across socio-economic and demographic groups. Outreach efforts targeting underserved populations and addressing barriers to access can help maximize the public health impact of screening programs.

Over diagnosis and false positives: Risk factor-based screening programs may lead to overdiagnosis of indolent or non-progressive cancers

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and result in unnecessary treatments and patient anxiety. Strategies such as implementing appropriate follow-up protocols and educating patients about the potential harms of screening can mitigate these risks [5].

Conclusion

Risk factor-based lung cancer screening programs represent a promising approach for early detection and reducing lung cancer mortality, particularly among high-risk individuals. Cost-effectiveness analysis plays a critical role in informing policy decisions regarding the implementation and optimization of screening programs. By considering the costs, benefits and uncertainties associated with screening interventions, policymakers can allocate resources effectively to maximize population health outcomes. However, ongoing research, surveillance and evaluation are necessary to continuously refine screening strategies and address emerging challenges in lung cancer prevention and control.

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Conflict of Interest

None.

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