# Guideline-concordant timely lung cancer care and prognosis among elderly patients in the United States: A population-based study

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ABSTRACT

Objectives: Elderly carry a disproportionate burden of lung cancer in the US. Therefore, its important to ensure that these patients receive quality cancer care. Timeliness of care is an important dimension of cancer care quality but its impact on prognosis remains to be explored. This study evaluates the variations in guideline-concordant timely lung cancer care and prognosis among elderly in the US.

Materials and methods: Using the Surveillance, Epidemiology, and End Results (SEER)-Medicare database (2002–2007), we identified elderly patients with lung cancer ($n = 48,850$) and determined time to diagnosis and treatment. We categorized patients by receipt of timely care using guidelines from the British Thoracic Society and the RAND Corporation. Hierarchical generalized logistic model was constructed to identify variables associated with receipt of timely care. Kaplan–Meier analysis and Log Rank test was used for estimation and comparison of the three-year survival. Multivariable Cox proportional hazards model was constructed to estimate lung cancer mortality risk associated with receipt of delayed care.

Results: Time to diagnosis and treatment varied significantly among the elderly. However, majority of them (77.5%) received guideline-concordant timely lung cancer care. The likelihood of receiving timely care significantly decreased with NSCLC disease, early stage diagnosis, increasing age, non-white race, higher comorbidity score, and lower income. Paradoxically, survival outcomes were significantly worse among patients receiving timely care. Adjusted lung cancer mortality risk was also significantly lower among patients receiving delayed care, relative to those receiving timely care (Hazard ratio (HR) = 0.68, 95% Confidence interval (CI) = (0.66–0.71); $p \leq 0.05$).

Conclusion: This study highlights the critical need to address disparities in receipt of guideline-concordant timely lung cancer care among elderly. Although timely care was not associated with better prognosis in this study, any delays in diagnosis and treatment should be avoided, as it may increase the risk of disease progression and psychological stress in patients. Furthermore, given that lung cancer diagnostic and management services are covered under the Medicare program, observed delays in care among Medicare beneficiaries is also a cause for concern.

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## 1. Introduction

Lung cancer is the most common cause of cancer death among elderly in the United States (US) [1]. Elderly also carry a disproportionate burden of lung cancer, as approximately 81% of those living with lung cancer are 60 years of age or older [1]. This pattern is expected to persist as the estimated number of elderly in the US doubles to approximately 70 million by 2030 [2]. Therefore, its important to ensure that these patients receive quality cancer care. However, research to date has shown disparities in the receipt of appropriate lung cancer care among elderly [3].

The Institute of Medicine (IOM) recognizes timeliness of care as another important dimension of cancer care quality [4,5]. As lung cancer care requires complex coordination of services by oncology specialists, the traditional approach of referring patients for consultation with multiple specialists in a sequential fashion often results in care that is perceived slow. Therefore, standards for timely lung cancer care have been established, through clinical opinion-based guidelines, by the British Thoracic

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Society (BTS), the RAND Corporation, and by the American College of Chest Physicians (ACCP) [6–8]. However, extensive studies in European Union countries have found delays in time to diagnosis and treatment of lung cancer than recommended in guidelines [9]. In the US, while similar delays have been reported by three studies in the Veteran Affairs setting [10–12], one study from an military medical center reported no such delays in care [13]. Although guideline-concordant timely lung cancer care is important, its impact on survival remains unclear. While some studies from the European Union have reported poorer survival among patients with delayed care [14–16], others have reported better survival among patients that received less timely care [17–20]. In the US, however, one study from the VA and another from an medical center reported no such association between timeliness of care and survival [11,21]. While these studies contribute valuable information to the literature, most of them have been conducted in non-US healthcare settings [9], and of those conducted in the US have been limited to small sample sizes, included both elderly and non-elderly patients, were performed within specific health care settings, and were primarily restricted to Non-Small Cell Lung Cancer (NSCLC) patients [10–13,21]. Therefore, a population-based analysis of patterns of guideline-concordant timely lung cancer care and associated survival among elderly patients in the US is much needed. To that end, the objectives of this study were to: (1) estimate the time intervals to lung cancer diagnosis and treatment among elderly patients; (2) estimate the receipt of and determine the predictors of guideline-concordant timely lung cancer care among elderly patients; and (3) evaluate the survival outcomes associated with receipt of guideline-concordant timely lung cancer care among elderly patients in the US.

## 2. Materials and methods

### 2.1. Data source

This study used National Cancer Institute's (NCI) Surveillance, Epidemiology, and End Results (SEER)-Medicare linked data files from years 2002–2007. SEER is a consortium of 20 population-based cancer registries covering ∼28% of the US population and its data are representative of US cancer incidence and mortality [22]. Cancer registry data files provided clinical, demographic, cause of death, and initial treatment information for elderly individuals with lung cancer in selected geographic regions. The Medicare administrative data files provided the health service claims (utilization and reimbursement) information for care provided by physicians, inpatient hospital stays, hospital outpatient clinics, home health care agencies, skilled nursing facilities, and hospice programs.

### 2.2. Study cohorts

We identified Medicare beneficiaries aged 66 years and older, with incident lung cancer diagnosis (International Classification of Diseases for Oncology (ICD-O) codes: C34.0, C34.1, C34.2, C34.3, C34.8, C34.9, and C33.9; American Joint Committee on Cancer Staging (AJCC) Tumor Node Metastasis (TNM) Stages: I–IV), during the years 2003 through 2006, in the SEER-Medicare data files (Fig. 1) [23]. Given our intent to study timeliness of care and associated prognosis, we a priori restricted our cohort to patients with complete information on stage at diagnosis (i.e., Stages I–IV diagnosis). This resulted in exclusion of patients with missing information on stage at diagnosis (14.7%), approximately 16.6% of
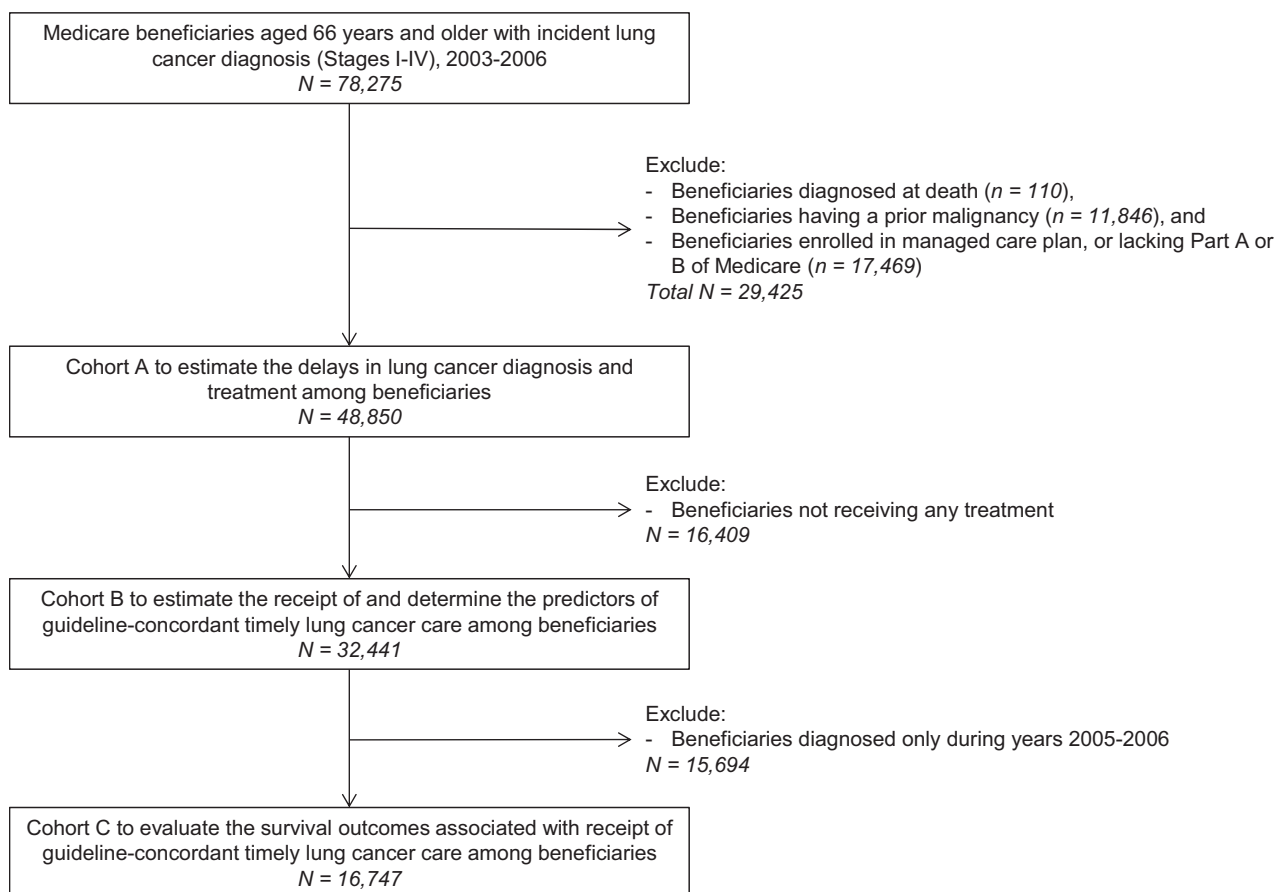


**Fig. 1.** Flowchart describing the steps involved in creating study cohorts using the inclusion and exclusion criteria.