# Post-Acute Care Service use in Lung Cancer Patients

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# Abstract

**Purpose:** Lung cancer patients experience functional deconditioning secondary to their underlying cancer and treatment yet rehabilitation service use remains low. The goal of this study is to compare post-acute care service use in lung cancer patients admitted to a metropolitan academic medical center.

**Methods:** Adult lung cancer patients admitted from January 1, 2017 to August 31, 2018 with a diagnosis of lung cancer based on International Classification of Diseases 10, C34.0-C34.9, were included in this study. Patient characteristics including age, gender, race, marital status, functional status on admission, length of stay, and number of comorbidities were compared based on discharge setting.

**Results:** 1,139 lung cancer patients were included in our study. The majority of patients discharged home with home care (51%) followed by home without services (35%), skilled nursing facilities (SNF) (10%) and acute inpatient rehabilitation facilities (IRF) (4%). 44% (498) of patients were primarily admitted for their lung cancer diagnosis. In unadjusted analyses, patients who discharged to SNF compared to home were more likely to be older, black, unmarried, live alone and have died during the study period. Patients who discharged to IRF had longer acute care hospitalization length of stays. In adjusted analyses, age, number of concurrent comorbidities and length of stay significantly correlated with discharge location.

**Conclusion:** Lung cancer patients are unlikely to be discharged to a post-acute care facility after an acute hospitalization. Rehabilitation service use differs by sociodemographic factors, concurrent medical history and functional status. Future study is needed to better understand why these differences in discharge setting persists.


# Background

Lung cancer accounts for an estimated 2.1 million new cases and 1.8 million deaths in 2018, only second to breast cancer in number of new cases and number of new deaths worldwide[1]. Lung cancer's poor prognosis has been attributed in part to the advanced disease stage at time of diagnosis often requiring a treatment regimen combining surgical resection, chemotherapy and/or radiation [2]. These regimens have been shown to leave patients with ongoing functional deficits negatively impacting quality of life [3,4]. Exercise in patients with lung cancer has been shown to be beneficial at all stages of their disease process improving exercise capacity and pulmonary function [5,6]. In addition to objective clinical markers, rehabilitation programs have been found to improve cancer patient self-reported and clinician noted functional status; yet, referrals to acute inpatient rehabilitation (IRF) for these patients remain low [7-9]. A study by Cheville et al. of breast cancer patients found that 92% had impairments that could have benefited from a physical rehabilitation intervention with only 30% receiving treatment [10]. Previous studies have suggested that these low referral rates for cancer patients to be in part affected by the insidious loss of function, lack of knowledge by patients and providers, limited access, long wait times and interference with oncologic treatment plan [9,11,12].

At time of discharge from an acute hospitalization, there are three common post-acute service settings patients are often referred to based on their functional and medical needs: IRF, skilled nursing facility (SNF) or home services. At an IRF level of care, patients have access to medical management, physical therapy, occupational therapy and speech-language therapy. In order to qualify for discharge to this level of care, a patient must be able to tolerate 3 hours of therapy services per day five days per week. Patients recommended for this level of care have a loss of functional ability that is believed to improve with intensive therapy [13]. At SNF, patients are often at a functional level that could benefit from rehabilitation services but are unable to tolerate 3 hours of therapy per day and/or require daily nursing support [13]. In this setting, if a patient qualifies for therapy services, he or she will receive 1-2 hours of therapy per day on average. Home health care is provided to patients who are homebound and require intermittent skilled nursing and/or therapy services [14].

Little is currently known about how lung cancer patient characteristics differ by post-acute care service setting. The primary objective of this study is to characterize and compare lung cancer patients who discharge to IRF as compared to those who discharge to another level of care or home. The secondary objective of this study is to compare 90-day readmission and in-hospital mortality rate by discharge location.

# Methods

Patients included in this study were admitted to one of three hospitals within a metropolitan academic medical center between January 1, 2017 and August 31, 2018. International Classification of Diseases, Tenth Edition codes, C34.0-C34.9, were used to identify adult patients (> 18 years of age) with a history of lung cancer. Patients were excluded from the study if they expired during their acute hospitalization or discharged to hospice, court/law enforcement, inpatient psychiatric unit, other acute care hospital, long term acute care hospitals or transferred to a nursing facility not certified under Medicare. For purposes of analysis, a patient's discharge disposition was classified as (1) home, (2) home with home care, (3) SNF or (4) IRF. Home was representative of the lowest level of service use at discharge, followed by home with home care and then SNF. IRF was representative of the highest level of post-acute care service setting at discharge.

Demographic and hospitalization information including gender, race, marital status, smoking status, prior level of assistance, prior support, length of stay, inpatient hospital service, discharge location, readmission date and death date were collected. Readmissions and death dates were calculated for 90 days post index hospitalization. Comorbidity score was calculated using the Elixhauser Comorbidity Index [15]. Patient's primary diagnosis for admission were reviewed by two of the study authors and classified into (conditions associated with the lung cancer, conditions associated with another organ, or other. See Appendix A for full diagnosis list and classifications). Our primary study outcome was discharge location. This study was approved by the Institutional Review Board at the University of Pennsylvania.

Summary statistics are presented as frequencies and percentages for categorical variables and means with standard deviation (age) or median and interquartile range (length of stay) for continuous variables. To determine differences in discharge disposition by various demographics, chi-square tests were performed for nominal variables, analysis of variance for age and the Kruskal-Wallis test for hospital length of stay. Three multivariate logistic regression models using forced entry were developed to compare patients who were discharged to IRF versus home, SNF versus home, and home with home care versus home. All p-values were calculated based on 2-sided tests and results were deemed statistically significant at $p < 0.05$. All analyses were performed using SAS statistical software (version 9.4, SAS Institute, Cary NC).

# Results

A total of 1,268 patients were identified with a diagnosis of lung cancer during the study period. 129 patients were excluded for not meeting the study inclusion criteria leaving 1,139 patients with lung cancer as our final study cohort. Study patients were 56% (640) female, 70% (772) white, 23% (259) Black/African American, 59% (678) married/partner with an average age of 67.1 ± 10 years. Upon discharge from an acute hospitalization, 41 (4%) patients were discharged to IRF, 115 (10%) discharged to SNF, 579 (51%) discharged to home with home care and 404 (35%) were discharged home. Over the course of the study period, 177 (16%) patients died within 90-days of admission.

Patients who were discharged to SNF were more likely to be older, black, unmarried, live alone, functionally dependent and have died during the study period [Table 1]. Patients who were discharged to IRF had longer length of stay for acute inpatient hospitalizations compared to those who discharged to SNF, home with home care or home without services (IRF 12.0 days (IQR:5.6–19.2); SNF 9.2 days (IQR: 6.2, 13.2); home with home care 4 days (IQR: 3.0, 6.9); home 3 days (IQR: 2.2, 5.0); $p < 0.0001$)) [Table 1]. There was no difference in readmission or survival rate at 90 days by discharge location [Table 1].

The most common reason for acute hospitalization was from patient's primary lung cancer diagnosis (44%). Secondary cancers were the second most common reason for discharge followed by respiratory conditions [Table 2]. These three primary diagnoses accounted for 72% of hospitalizations.

In multivariate logistic regression models, patients who were discharged to an IRF, had a 29% increase odds (OR = 1.29, 95% CI: 1.20, 1.38) for every one-day increase in patient length of stay and higher odds of being older (OR = 1.06, 95% CI: 1.01, 1.11) compared to home adjusted for race, gender, marital status and concurrent comorbidities. Those who discharged to SNF as compared to home had higher odds of being older (OR = 1.10, 95% CI: 1.06, 1.14), unmarried (OR = 2.42, 95% CI: 1.30, 4.50), and have greater odds of longer length of acute care stay (OR = 1.29, 95% CI:1.20, 1.38). When comparing those who discharged to home health versus those who discharged to home, patients who discharged with home health had higher odds of being older (OR = 1.02, 95% CI: 1.00, 1.03), less comorbidities (OR = 0.90, 95% CI: 0.83, 0.98), and had greater odds of longer length of acute care stay (OR = 1.11, 95% CI: 1.01, 1.03) [Table 3].

# Discussion

In this study, we conducted a retrospective analysis of discharge pattern for patients who were hospitalized with a diagnosis of lung cancer. This study is the first of its kind to describe the services lung cancer patients use after an acute hospitalization.

Despite the known benefits skilled therapy has for cancer patients, only 14% of patients in our study discharged to a post-acute care facility upon discharge. This is a lower percent then what has been previously reported for post-acute care service use from all medical diagnoses. In a recent study of Medicare patients by Werner et al., post-acute care service use was found to be increasing over the last two decades with an estimated 26.3% discharging to a facility in 2015 [16]. Although, patients in our study were enrolled in private insurance plans, the average age of our patients was 67.2 ± 10.0 years, which is greater than the 65 years of age eligibility requirement for Medicare suggesting that there are likely similarities between the groups as the majority of patients included would be eligible for Medicare. This lower admission rate may be due to a number of factors including under-referral as well as insurance denial of services[11]. A concern that is often cited in the cancer population is the ability to participate in therapy requirements at post-acute care facilities, which can range from 1–3 hours total per day of physical therapy, occupational therapy or speech therapy[17]. Despite this postulated apprehension, previous studies have found that cancer patients make significant functional gains during IRF stay, comparable to gains made for stroke, traumatic brain injury and spinal cord injury patients for which IRF is commonly recommended [18–21]. Functional gains in the IRF setting is often measured by the functional independence measure (FIM) score. In a study by Mix et al. in 2017, cancer patients of all types including lung cancer patients were found to have a mean total FIM change between admission and discharge of 23.5 ± 16.2 [22]. A FIM change of 22 has been found to be the minimal clinically important difference that reflect a change in a patient's management improving independence and decreasing caregiver burden [23]. The lower referral rate to IRF in our study may suggest a bias in the utilization of skilled rehabilitation services in lung cancer patients.

In unadjusted analyses, we found that black patients were more likely to discharge to SNF than to other post-acute care settings. This trend remained in adjusted analyses; however, it was no longer statistically significant. Racial differences in post-acute care service use have been previously studied in total knee arthroplasty (TKA) and stroke populations with mixed evidence of service use. In the 2019 study by Singh et al., black patients after TKA were more likely to discharge to IRF or SNF for care as compared to white patients. However, in Kind et al.'s 2010 study of ischemic stroke patients, black patients were less likely to discharge to SNF compared to white patients[24]. Our findings, in conjunction with what has been previously studied in other populations, suggest that social determinants of health may play a role in how post-acute care services are allocated.

Acute hospitalization length of stay was longer for those who discharged to an IRF, SNF or home with home care as compared to those who discharged to home. This is consistent with what has been previously reported in colorectal cancer patients [25,26]. The longer length of stay may be reflective of

patients with greater comorbidities and medical complexity. Additionally, a longer length of acute hospitalization suggests that patients may have had a more complex medical course and are likely more deconditioned and therefore likely to benefit from additional rehabilitative services.

Use of post-acute care settings on discharge have been found to be associated with lower readmission rate and lower mortality in non-cancer patients. In our study, we found no difference in 90-day readmission or mortality rate by discharge setting. The similar readmission and death rate seen in our study across discharge settings despite differences in comorbidities and age suggest that these individuals can benefit from the therapy and medical services available at these settings.

We found that most reasons for acute hospitalization were due to respiratory issues followed by secondary malignancies. This finding is consistent with what has been previously reported in a study of emergency room presentation of lung cancer patients that reviewed both cancer-related and cancer-unrelated conditions [27]. Cancer providers should be aware that lung cancer patients are most likely to seek acute care for respiratory symptoms and develop treatment plans to prevent unnecessary hospitalization.

There are several limitations to our study. First, we were unable to identify the patient's stage of lung cancer nor where the patient was in the treatment continuum. Given that lung cancer patients have such a poor survival rate with only 19% living at 5 years after diagnosis, we felt that it would be reasonable to compare these patients at different stages [12]. Second, this study was performed at a single metropolitan institution which limits the generalizability of this study to lung cancer patients at other healthcare institutions and in other regions. Additionally, we limited our study to lung cancer patients that discharged to IRF, SNF, home health care or home, which is not inclusive of all discharge settings. We focused on these discharge locations as these are settings most commonly utilized and referenced in post-acute care service literature. By focusing on these discharge settings, our study does not address other settings such as long-term acute care facilities where patients may receive skilled therapy services. Finally, our study was a retrospective review of electronic medical records and is thereby limited to the accuracy of the documentation.

# Conclusions

This study is the first of its kind to describe the patient characteristics that may predict post-acute care service use in lung cancer patients. Findings from this study suggest that sociodemographic factors, functional status, and diagnosis may influence discharge setting in lung cancer patients. Despite these findings, readmission rate did not differ by discharge location. Further study is needed to describe lung cancer patients' post-acute care service use while accounting for social support, treatments and resource utilization in order to identify inequities in use of these resources for cancer patients.

# Declarations

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# Tables

**Table 1.** Characteristics of Lung Cancer Patients by Discharge Location

Numbers may not total to group size due to missing values

**Table 2.** Primary Acute Hospitalization Admission Diagnosis

| | Acute Rehabilitation Facility (N= 41) | Skilled Nursing Facility (N=115) | Home with Home Health Care (N= 579) | Home (N=404) | p-value |
|---|---|---|---|---|---|
| **Age, Average ± STD** | 67.4 ± 10.1 | 72.4 ± 8.4 | 67.0 ± 10.0 | 65.7 ± 9.9 | <0.0001 |
| **Gender: Female, N (%)** | 20 (49%) | 64 (56%) | 341 (59%) | 215 (53%) | 0.25 |
| **Race, N (%)** | | | | | 0.049 |
| White | 26 (70%) | 64 (59%) | 407 (72%) | 275 (70%) | |
| Black | 7 (19%) | 39 (35%) | 124 (22%) | 89 (23%) | |
| Other | 4 (11%) | 7 (6%) | 33 (6%) | 31 (8%) | |
| **Marital Status, N (%)** | | | | | <0.0001 |
| Single/Divorced/Widowed | 11 (27%) | 71 (62%) | 222 (39%) | 147 (36%) | |
| Married/ Domestic Partner | 29 (71%) | 42 (37%) | 355 (61%) | 252 (62%) | |
| Other | 1 (2%) | 2 (2%) | 2 (0%) | 5 (1%) | |
| **Comorbidities, N (%)** | | | | | 0.06 |
| 0 | 1 (3%) | 2 (2%) | 23 (4%) | 19 (5%) | |
| 1 | 3 (8%) | 8 (8%) | 84 (15%) | 54 (14%) | |
| 2 | 5 (14%) | 37 (35%) | 145 (27%) | 93 (24%) | |
| ≥3 | 28 (76%) | 59 (56%) | 292 (54%) | 219 (57%) | |
| **Prior Function: Home Mobility, N (%)** | | | | | 0.0002 |
| Independent in all aspects | 23 (85%) | 75 (82%) | 394 (94%) | 153 (97%) | |
| Areas of non-independence | 4 (15%) | 17 (18%) | 24 (6%) | 5 (3%) | |
| Complete dependence all aspects | 0 (0%) | 0 (0%) | 2 (0%) | 0 (0%) | |
| **Prior Function: Daily Living, N (%)** | | | | | <0.0001 |

| | | | | | |
|---|---|---|---|---|---|
| Independent in all aspects | 28 (93%) | 68 (78%) | 383 (93%) | | |
| Areas of non-independence | 2 (7%) | 19 (22%) | 29 (7%) | | |
| **Prior Support** | | | | | <0.0001 |
| Alone | 7 (17%) | 40 (35%) | 110 (19%) | 77 (19%) | |
| Spouse/Significant Other | 31 (76%) | 41 (36%) | 366 (64%) | 256 (64%) | |
| Children/Siblings/Parent/Friend | 3 (7%) | 28 (25%) | 82 (14%) | 43 (11%) | |
| Other/Dependent Children | 0 (0%) | 4 (4%) | 18 (3%) | 21 (5%) | |
| **Smoking Status** | | | | | 0.49 |
| Current Smoker | 8 (23%) | 21 (19%) | 100 (18%) | 56 (14%) | |
| Former Smoker | 25 (71%) | 80 (72%) | 396 (71%) | 291 (73%) | |
| Never Smoker | 2 (6%) | 10 (9%) | 65 (12%) | 50 (13%) | |
| **Length of Stay, Median, (IQR)** | 12 (7.6, 19.2) | 9.2 (6.2, 13.2) | 4.2 (3.0, 6.9) | 3.2 (2.2, 5.0) | <0.0001 |
| **Readmission, N (%)** | | | | | 0.33 |
| 3-7 days | 2 (5%) | 6 (5%) | 21 (4%) | 23 (6%) | |
| 8-30 days | 6 (15%) | 15 (13%) | 69 (12%) | 36 (9%) | |
| 31-90 days | 6 (15%) | 14 (12%) | 49 (8%) | 46 (11%) | |
| >90 days | 3 (7%) | 11 (10%) | 58 (10%) | 54 (13%) | |
| No Readmit | 24 (59%) | 69 (60%) | 382 (66%) | 245 (61%) | |
| **Survival 90-days post discharge, N (%)** | 34 (83%) | 338 (84%) | 494 (85%) | 96 (83%) | 0.88 |

| Admission Diagnosis | N (%) |
|---|---|
| **Lung Cancer** | 498 (44%) |
| **Secondary Cancers (not lung)** | 170 (15%) |
| **Respiratory Conditions** | 146 (13%) |
| **Sepsis/Infection** | 71 (6%) |
| **Cardiovascular** | 65 (6%) |
| **Neurologic** | 41 (4%) |
| **Gastrointestinal** | 39 (3%) |
| **Renal** | 21 (2%) |
| **Cancer Related Conditions** | 23 (2%) |
| **Musculoskeletal Issues** | 14 (1%) |
| **Chemotherapy/Medications** | 12 (1%) |
| **Other Diagnosis** | 39 (3%) |

**Table 3. Multivariate logistic regression results: Factors associated with discharge setting**

| | Acute Inpatient Rehabilitation | Skilled Nursing Facility | Home with Home Care |
|---|---|---|---|
| | OR (95% CI) | OR (95% CI) | OR (95% CI) |
| **Age (in years)** | 1.06* (1.01, 1.11) | 1.10* (1.06, 1.14) | 1.02* (1.00, 1.03) |
| **Gender: Female** | 1.03 (0.42, 2.54) | 1.04 (0.57, 1.92) | 1.27 (0.96, 1.68) |
| **Marital Status** | | | |
| Married | ref | ref | ref |
| Single/Widowed/Divorced | 0.37 (0.12, 1.14) | 2.42* (1.30, 4.50) | 1.09 (0.80, 1.47) |
| **Race** | | | |
| Non-Black | ref | ref | ref |
| Black | 0.52 (0.14, 1.90) | 1.52 (0.81, 2.87) | 0.92 (0.65, 1.30) |
| **Elixhauser Comorbidity Index** | 1.13 (0.86, 1.49) | 0.94 (0.80, 1.10) | 0.90* (0.83, 0.98) |
| **Length of stay (in days)** | 1.29* (1.20, 1.38) | 1.31* (1.23, 1.41) | 1.11* (1.01, 1.03) |

Note: An asterisk (*) denotes coefficients that are statistically significant at the $p \leq 0.05$ level

# Supplementary Files

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