Original Article

End-of-Life Health Care Utilization Between Chronic Obstructive Pulmonary Disease and Lung Cancer Patients

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Abstract

Context. At the end of life, chronic obstructive pulmonary disease (COPD) and lung cancer (LC) patients exhibit similar symptoms; however, a large-scale study comparing end-of-life health care utilization between these two groups has not been conducted in East Asia.

Objectives. To explore and compare end-of-life resource use during the last six months before death between COPD and LC patients.

Methods. Using data from the Taiwan National Health Insurance Research Database, we conducted a nationwide retrospective cohort study in COPD ($n = 8640$) and LC ($n = 3377$) patients who died between 1997 and 2013.

Results. The COPD decedents were more likely to be admitted to intensive care units (57.59% vs 29.82%), to have longer intensive care unit stays (17.59 vs 9.93 days), and to undergo intensive procedures than the LC decedents during their last six months; they were less likely to receive inpatient (3.32% vs 18.24%) or home-based palliative care (0.84% vs 8.17%) and supportive procedures than the LC decedents during their last six months. The average total medical cost during the last six months was approximately 18.42% higher for the COPD decedents than for the LC decedents.

Conclusion. Higher intensive health care resource use, including intensive procedure use, at the end of life suggests a focus on prolonging life in COPD patients; it also indicates an unmet demand for palliative care in these patients. Avoiding potentially inappropriate care and improving end-of-life care quality by providing palliative care to COPD patients are necessary.   J Pain Symptom Manage 2019;57:933−943. © 2019 American Academy of Hospice and Palliative Medicine. Published by Elsevier Inc. All rights reserved.

Key Words
End-of-life care, COPD, lung cancer

Introduction

Chronic obstructive pulmonary disease (COPD) is a major cause of morbidity and mortality worldwide; in 2016, COPD caused 2.93 million deaths.[1] Advanced COPD patients experience chronic airflow limitation, breathlessness, persistent cough, and fatigue; lung cancer (LC) patients exhibit similar symptoms at the end of life.[2] Although COPD is recognized as a life-limiting illness, COPD patients do not receive adequate information on end-of-life care.[3] Compared with LC patients, COPD patients are considerably less likely to receive palliative care at the end of life.[4−8]

Typically, cancer patients are the target population of palliative care because of the public perception that cancer is a terminal disease, whereas COPD is less known.[9] The unpredictable trajectory of COPD might be one of the causes of the difference in the receipt of palliative care between COPD and LC patients.[10]

The progress of COPD is characterized by a slow decline in lung function over a long period and frequent exacerbations.[11] Acute exacerbation of COPD (AECOPD) is an acute aggravation of a patient's respiratory symptoms beyond the usual level.[12] COPD exacerbations affect the natural progression of the disease. Patients with frequent exacerbations experience aggravation of symptoms, a more rapid reduction in lung function, and impaired quality of life and require unscheduled physician visits and hospitalization; consequently, COPD accounts for a considerable portion of direct health care costs, and it is associated with high mortality.[13] COPD exacerbations affect resource use during the end of life and influence decisions regarding end-of-life care plans; however, no population-based study has assessed resource use at the end of life of AECOPD patients; such a study would enable the identification of AECOPD patients who are likely to receive end-of-life care different from that received by patients with other diseases. This differentiated evaluation of end-of-life resource use can provide crucial insights, enabling appropriate end-of-life care to be provided to the entire population of COPD patients.

To systematically examine the end-of-life treatment intensity, Barnato et al. identified several indicators as measures of intensive procedures, namely intubation and mechanical ventilation (MV), tracheostomy, gastrostomy tube insertion, hemodialysis, enteral or parenteral nutrition, and cardiopulmonary resuscitation (CPR).[14] De Schreye et al. found several indications of potentially inappropriate end-of-life care in people who died of COPD in Belgium, especially related to diagnostic testing, hospital admission, and use of specialized palliative care.[15] Husted et al. found that patients who died of COPD and LC in Denmark had high service utilization in the last three years of life, but the trajectory for COPD was different from that of LC.[16] Faes et al. found that patients who died of COPD in Belgium had lower drug use for pain and symptom relief and received more invasive and noninvasive ventilation procedures than those who died of LC.[5] The demands placed on the public health care system by COPD patients are relatively high, and they receive many invasive interventions during the last months of their lives.[17] Cross-cultural differences between Western and Asian countries may affect the attitudes of medical professionals and caregivers toward terminally ill patients.[18] A few population-based studies have evaluated resource use in COPD patients in Western countries[5,16,17]; however, little is known about end-of-life health care utilization in COPD and LC patients in East Asia. Thus, this population-based study was conducted to gain a comprehensive understanding of end-of-life care in COPD and LC patients.

This study explored end-of-life care in COPD and LC patients during the last six months before death by (1) comparing end-of-life health care resource utilization and the use of intensive and supportive procedures during the last six months of life, (2) exploring changes in the trends of intensive procedures and palliative care between 2000 and 2012, and (3) examining predictive factors of the use of intensive procedures.

Materials and Methods

Data Source

The National Health Insurance (NHI) program is a compulsory social insurance program established by the Taiwanese government in 1995, and more than 99.9% of the national population is covered by the program. The NHI Research Database (NHIRD) comprises enrollment files, claims data, the drug prescription registry, and the Registry for Catastrophic Illness Patient Database (RCIPD) between 1996 and 2013. The Longitudinal Health Insurance Database (LHID; which is derived from the NHIRD) is a representative database that contains all the original claims data of 1 million enrollees randomly sampled since 2000. For researchers' convenience, the National Health Research Institutes (NHRI) of Taiwan sampled 1 million patients from the year 2000 registry of all NHI enrollees ($n = 23.75$ million) by using a systematic and random sampling method; the data of the sampled population are provided in LHID2000.[19] In LHID2000, no statistically significant differences exist in age, sex, or health care costs between the sample group and all enrollees according to NHRI reports.[19] The diagnostic accuracy of the NHIRD has been previously validated for major diseases.[20] The Joint Institutional Review Board of Taipei Medical University approved this study [N201510048] and waived the need for informed consent.

Study Design and Sample

We defined the index date as the day six months before death. In the first step, from the 1 million nationwide representative population, this study identified patients who had been diagnosed with frequent AECOPD and patients who had been diagnosed with LC during 1996−2013. In the second step, these patients who had died during 1996−2013 (i.e., they had records of death in the hospital discharge claims

data or RCIPD or did not have records of health care visits after withdrawal from the NHI program) were included in this study. We then excluded the decedents (1) who were younger than 40 years, (2) who did not have medical records during the last six months of life, and (3) with death dates before 1997 or index dates after 2013 to ensure data integrity. Finally, we enrolled 8640 decedents with COPD, 2816 decedents with LC, and 561 decedents with both LC and COPD during 1997−2013 (Fig. 1).

Patients With Frequent AECOPD. COPD patients were identified by the presence of two or more records of outpatient visits or one inpatient record of compatible COPD diagnoses and a simultaneous prescription of COPD medications during one year. Compatible COPD diagnoses were defined on the basis of primary or secondary diagnostic codes in the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM), namely ICD-9-CM codes 491.xx, 492.xx, and 496.xx. COPD medications were identified based on the Anatomical Therapeutic Chemical (ATC) code R03, and patients with asthma or COPD−asthma overlap having ATC codes R03DC,

R03BC, R03BX01, and R03DX were excluded. We defined COPD patients with frequent acute exacerbations as follows: (1) COPD patients with two or more episodes of acute exacerbations within one year (in this study, acute exacerbations were defined as exacerbations requiring emergency department visits and a prescription of systemic glucocorticosteroids) or (2) COPD patients with an episode of acute exacerbation requiring hospitalization.[12,21]

LC Patients. LC patients were identified using the compatible diagnostic codes of LC (ICD-9-CM code 162.x) in the RCIPD.[22] The Bureau of NHI rigorously validates the cancer diagnosis for each patient applying for catastrophic illness certification. Accordingly, the accuracy of cancer diagnosis in the RCIPD is expected to be high.

Measures
Health Care Resource Utilization and Use of Intensive and Supportive Procedures. Measures of health care resource utilization and indicators of intensive and supportive procedures have been described in previous studies.[14,15,17,23] In this study, measures of health
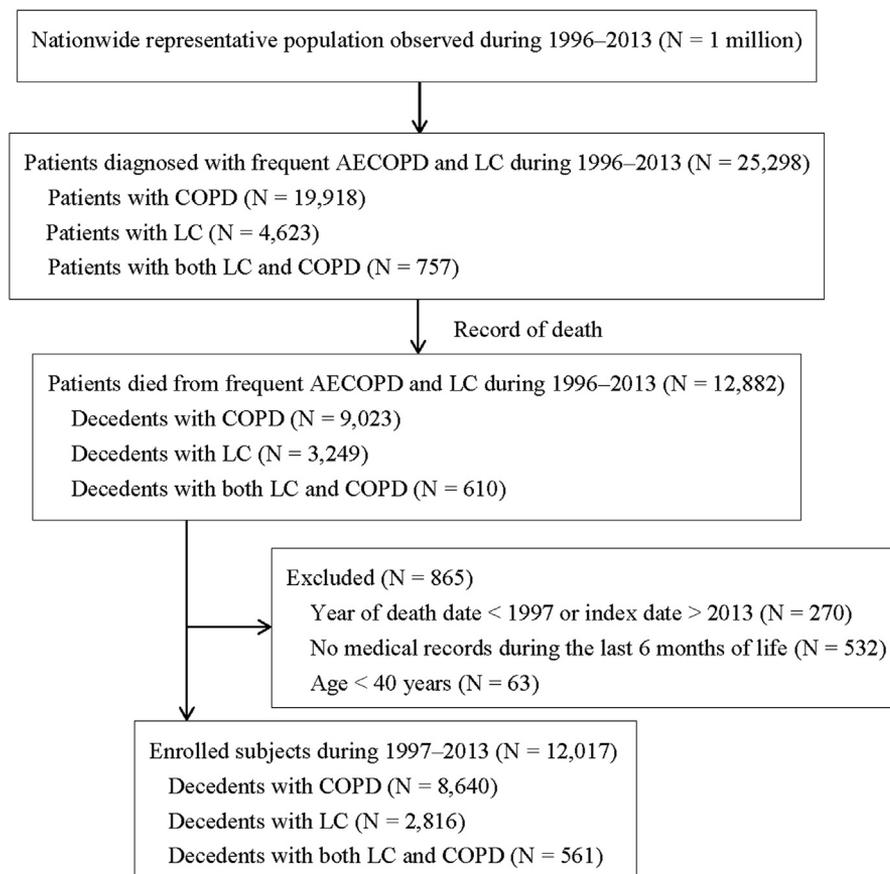

Fig. 1. Flow chart of patient selection. COPD = chronic obstructive pulmonary disease; LC = lung cancer.

care resource utilization included numbers and costs of outpatient visits, hospitalizations, emergency room visits, intensive care unit (ICU) admissions, and palliative care. In Taiwan, the costs of medical services for ambulatory visits and hospitalization are separately calculated by the NHI. The categories of outpatient cost (including the costs of ambulatory visits and emergency visits) and hospitalization cost were based on the definition by the Bureau of NHI. The medical costs calculated in this study included all outpatient costs, all hospitalization costs, and the total medical cost, which combined the costs of outpatient visits and hospitalization. All costs in this study were converted to US dollars; the average exchange rate during the study period was 30 New Taiwan Dollars per 1 USD. Palliative care was care provided by the palliative care team at inpatient units or at home. The indicators of intensive procedures were CPR, invasive and noninvasive MV, extracorporeal membrane oxygenation, hemodialysis (including peritoneal dialysis), nasogastric tube, gastrostomy, enterostomy, total parenteral nutrition, blood transfusion, and vasopressor use, whereas those of supportive procedures were opioid and benzodiazepine use. Based on whether they started hemodialysis before or after the index date, the patients on hemodialysis during the last six months before death were classified into two groups with long-term hemodialysis and temporary hemodialysis. Long-term hemodialysis (i.e., hemodialysis started before the index date) was defined as hemodialysis more than twice per week, with a record of 90 consecutive days, and temporary hemodialysis (i.e., hemodialysis started after the index date) was defined as long-term hemodialysis started after the index date or temporary hemodialysis during the last six months of life. The patients with nasogastric tube dependency before the index date were defined as those with continued use of a nasogastric tube for more than three months in the year before the index date.

Patient Demographics and Disease Characteristics. The demographic data of the patients included age at the index date, sex, and insurance premium level. Based on the minimum monthly wage for 1997 in Taiwan (USD 528), the insurance premium level was classified into four groups: dependent; low, denoting income less than USD 528 per month; moderate, denoting income between USD 528 and USD 833 per month; and high, denoting an income of USD 833 or more per month. Disease characteristics such as the Charlson Comorbidity Index and common comorbidities were recorded.[24,25]

Health Care Provider Characteristics. The health care provider characteristics were the urbanization level of the hospital location, accreditation level of the hospital, and ownership of the hospital.[7,26] According to population density, urbanization of the hospital was stratified into three levels: urban (≥4000 population size), suburban (1000−3999), and rural/remote (≤999). We identified the primary (index) hospital as the hospital of the last admission during the last six months of life.

Statistical Analysis
Analysis of variance or the *t*-test for continuous variables and the chi-square test or Fisher's exact test for categorical variables were used, as appropriate, to compare the means of and differences in the proportion of patient characteristics and health care utilization between the COPD and LC patients. Associations with intensive procedures, namely CPR, invasive MV, noninvasive MV, and vasopressors, were assessed using a multiple logistic regression model through the estimation of odds ratios (ORs) and 95% confidence intervals (CIs). Each multivariate logistic regression model was adjusted for age, sex, insurance premium level, urbanization level of the hospital location, accreditation level of the hospital, ownership of the hospital, and Charlson Comorbidity Index, and these confounders have been described as determinants of these invasive procedures in previous studies.[6,27,28] The results of multivariate analysis were stratified by disease type. Stratum 1 comprised the COPD decedents, and stratum 2 comprised the LC decedents. *P* < .05 indicated statistical significance. Statistical analysis was performed using SAS software (version 9.4; SAS Institute, Cary, NC).

Results
Cohort Enrollment and Baseline Characteristics of Studied Populations
We identified 8,640, 2,816, and 561 decedents with COPD, LC, and both COPD and LC, respectively (Fig. 1). The average age of the COPD decedents (78.97 years, standard deviation [SD] = 9.87 years) was greater than that of the other two groups (Table 1). The decedents with both LC and COPD exhibited patterns of care similar to the decedents with LC alone; therefore, we combined these two groups.

Health Care Utilization and Use of Intensive and Supportive Procedures in the Last Six Months of Life
The COPD decedents were more likely to be admitted to ICUs (57.59% vs 29.82%), to have a higher number of ICU admissions (1.23 vs 0.93), and to have longer hospital stays (60.15 vs 40.28 days) and ICU stays (17.59 vs 9.93 days) than the LC decedents. The COPD decedents were less likely to use inpatient (3.32% vs 18.24%) or home-based (0.84% vs 8.17%)

Table 1
Baseline Characteristics of Decedents With COPD, LC, and LC and COPD ($N = 12,017$)

Characteristics	COPD ($n = 8640$) n (%)	LC and COPD ($n = 561$) n (%)	LC ($n = 2816$) n (%)	*P* Value
Age, years, mean ± SD	78.97 ± 9.87	73.20 ± 9.98	68.75 ± 11.32	<0.0001
40−49	120 (1.39)	16 (2.85)	195 (6.92)	<0.0001
50−59	311 (3.60)	45 (8.02)	451 (16.02)	
60−69	913 (10.57)	120 (21.39)	739 (26.24)	
70−79	2871 (33.23)	240 (42.78)	966 (34.30)	
80−89	3539 (40.96)	126 (22.46)	430 (15.27)	
≥90	886 (10.25)	14 (2.50)	35 (1.24)	
Sex, male	5996 (69.40)	454 (80.93)	1812 (64.35)	<0.0001
Insurance premium levels				<0.0001
Dependent	2978 (34.47)	170 (30.30)	884 (31.39)	
Low	2887 (33.41)	156 (27.81)	593 (21.06)	
Moderate	2559 (29.62)	207 (36.90)	1058 (37.57)	
High	216 (2.50)	28 (4.99)	281 (9.98)	
Urbanization level of the hospital location				<0.0001
Urban	3094 (35.81)	263 (46.88)	1402 (49.79)	
Suburban	2163 (25.03)	126 (22.46)	678 (24.08)	
Rural/remote	3383 (39.16)	172 (30.66)	736 (26.14)	
Accreditation level of the hospital				<0.0001
Medical centers	1979 (22.91)	243 (43.32)	1413 (50.18)	
Regional hospitals	3276 (37.92)	242 (43.14)	1087 (38.60)	
Local hospitals	3191 (36.93)	73 (13.01)	295 (10.48)	
Primary clinics	194 (2.25)	3 (0.53)	21 (0.75)	
Ownership of the hospital				<0.0001
Public	2746 (31.78)	198 (35.29)	1011 (35.90)	
Nonpublic	5894 (68.22)	363 (64.71)	1805 (64.10)	
CCI, mean ± SD	6.07 ± 3.40	8.19 ± 4.46	7.09 ± 4.63	<0.0001
≤1	525 (6.08)	32 (5.70)	509 (18.08)	<0.0001
2−3	1627 (18.83)	56 (9.98)	301 (10.69)	
4−5	2018 (23.36)	113 (20.14)	345 (12.25)	
≥6	4470 (51.74)	360 (64.17)	1661 (58.98)	
Comorbidity				
Hypertension	4480 (51.85)	226 (40.29)	1003 (35.62)	<0.0001
Diabetes mellitus	2506 (29.00)	112 (19.96)	510 (18.11)	<0.0001
Peptic ulcers	2148 (24.86)	114 (20.32)	412 (14.63)	<0.0001
Cardiac arrhythmias	1270 (14.70)	42 (7.49)	134 (4.76)	<0.0001

COPD = chronic obstructive pulmonary disease; LC = lung cancer; SD = standard deviation; CCI = Charlson Comorbidity Index.

palliative care than the LC decedents (Table 2). The COPD decedents received more intensive procedures and were less likely to receive supportive procedures than the LC decedents (Table 3).

Differences in Palliative Care Between the COPD and LC Decedents in the Last Six Months of Life Stratified by Health Care Provider Characteristics

Table 4 presents the results of bivariate analyses of palliative care received by the two groups of decedents stratified by health care provider characteristics. The COPD decedents who received care at hospitals in urban areas were more likely to receive inpatient and home-based palliative care. Significantly higher proportions of the COPD decedents at medical centers received inpatient and home-based palliative care than those at regional hospitals, local hospitals, or primary clinics. The LC decedents who received care at hospitals at urban areas were more likely to receive inpatient palliative care. The LC decedents who received care at hospitals in rural/remote areas were more likely to receive home-based palliative care.

Significantly higher proportions of the LC decedents at medical centers received inpatient palliative care than those at regional hospitals, local hospitals, or primary clinics.

Trends of Intensive and Palliative Care for COPD and LC Decedents During the Last Six Months of Life

The percentage of COPD decedents admitted to ICUs decreased from 60.7% in 2000 to 54.1% in 2012. The proportions of COPD and LC decedents receiving CPR and invasive MV decreased from 2000 to 2012. The percentage of COPD decedents who received CPR decreased from 40.2% in 2000 to 14.8% in 2012. The percentage of COPD decedents who received invasive MV decreased from 72.3% in 2000 to 48.5% in 2012. The percentage of COPD decedents who received inpatient or home-based palliative care increased from 0.9% in 2000 to 8.0% in 2012. Furthermore, the percentage of LC decedents who received palliative care increased from 16.4% in 2000 to 44.3% in 2012 (Fig. 2).

Variables	COPD (n = 8640)	LC (n = 3377)	P Value
	n (%)	n (%)	
Outpatients			
Visited	7961 (92.14)	3320 (98.31)	<0.0001
No. of visits, mean ± SD	19.76 ± 14.34	21.55 ± 12.61	<0.0001
Hospitalizations			
Admitted	8104 (93.80)	3252 (96.30)	<0.0001
No. of hospitalizations, mean ± SD	2.43 ± 1.58	2.80 ± 1.82	<0.0001
LOS of hospitalizations, mean ± SD	60.15 ± 53.90	40.28 ± 32.15	<0.0001
ICU			
Admitted	4976 (57.59)	1007 (29.82)	<0.0001
No. of ICU admissions, mean ± SD	1.23 ± 0.88	0.93 ± 0.63	<0.0001
LOS of ICU admissions, mean ± SD	17.59 ± 24.50	9.93 ± 15.50	<0.0001
Emergency room			
Visited	3898 (45.12)	1717 (50.84)	<0.0001
No. of visits, mean ± SD	2.41 ± 2.03	2.36 ± 1.84	0.320
Palliative care			
Inpatient care	287 (3.32)	616 (18.24)	<0.0001
No. of inpatient care, mean ± SD	1.47 ± 0.98	1.49 ± 0.96	0.778
LOS of inpatient care, mean ± SD	15.94 ± 16.09	15.35 ± 15.93	0.658
Home-based care	73 (0.84)	276 (8.17)	<0.0001
Medical cost, mean ± SD			
Outpatients	1257.06 ± 1834.19	3384.22 ± 3738.61	<0.0001
Hospitalizations	11,814.23 ± 12,368.01	7808.99 ± 7810.67	<0.0001
Total	13,307.46 ± 13,987.31	11,237.82 ± 8629.30	<.00001

COPD = chronic obstructive pulmonary disease; LC = lung cancer; SD = standard deviation; LOS = length of stay; ICU = intensive care unit.

Health Care Costs During the Last Six Months of Life

The mean total medical cost was approximately 18.42% higher for the COPD decedents than for the LC decedents (Table 2). The average total medical cost and hospitalization cost for the COPD decedents increased from 2000 to 2004 and then decreased from 2004 to 2012. The highest average total medical cost per COPD decedent was USD 15,586 in 2004, which steadily decreased by 19.0% in the next eight years and was USD 12,632 in 2012 (Fig. 3).

Determinants of Specific Intensive Procedure for Decedents With COPD or LC in the Last Six Months of Life

The elderly decedents with COPD (age ≥ 75 years) were less likely to receive intensive procedures including CPR (OR = 0.71, 95% CI = 0.64−0.79) and invasive MV (OR = 0.83, 95% CI = 0.75−0.92) than those aged 40−74 years. The male decedents with COPD were more likely to receive CPR (OR = 1.12, 95% CI = 1.00−1.25), invasive MV

Variables	COPD (n = 8640)	LC (n = 3377)	P Value
	n (%)	n (%)	
CPR	2369 (27.42)	430 (12.73)	<0.0001
Invasive MV	5476 (63.38)	1128 (33.40)	<0.0001
Noninvasive MV	1429 (16.54)	457 (13.53)	<0.0001
ECMO	32 (0.37)	2 (0.06)	0.002
Hemodialysis			<0.0001
Hemodialysis started before the index date	238 (2.75)	13 (0.38)	
Hemodialysis started after the index date	523 (6.05)	43 (1.27)	
Nasogastric tube			<0.0001
Nasogastric tube dependency before the index date	1343 (15.54)	39 (1.15)	
Nasogastric tube dependency after the index date	5230 (60.53)	1735 (51.38)	
Gastrostomy	20 (0.23)	9 (0.27)	0.684
Enterostomy	124 (1.44)	13 (0.38)	<0.0001
Total parenteral nutrition	338 (3.91)	104 (3.08)	0.031
Blood transfusion	5558 (64.33)	1963 (58.13)	<0.0001
Vasopressors	5243 (60.68)	1247 (36.93)	<0.0001
Opioids	3158 (36.55)	2863 (84.78)	<0.0001
Benzodiazepines	4844 (56.06)	2404 (71.19)	<0.0001

COPD = chronic obstructive pulmonary disease; LC = lung cancer; CPR = cardiopulmonary resuscitation; MV = mechanical ventilation; ECMO = extracorporeal membrane oxygenation.

Table 4
Palliative Care During the Last Six Months of Life Stratified by Health Care Provider Characteristics

	Inpatient Care (*n* = 903)				Home Care (*n* = 349)			
	COPD (*n* = 287)		LC (*n* = 616)		COPD (*n* = 73)		LC (*n* = 276)	
Variables	n (%)	*P* Value	n (%)	*P* Value	n (%)	*P* Value	n (%)	*P* Value
Urbanization level of the hospital location		<0.0001		<0.0001		0.297		0.002
Urban	143 (4.62)		366 (21.98)		32 (1.03)		146 (8.77)	
Suburban	58 (2.68)		109 (13.56)		18 (0.83)		42 (5.22)	
Rural/remote	86 (2.54)		141 (15.53)		23 (0.68)		88 (9.69)	
Accreditation level of the hospital		<0.0001		<0.0001		<0.0001		0.056
Medical centers	125 (6.32)		332 (20.05)		26 (1.31)		139 (8.39)	
Regional hospitals	128 (3.91)		244 (18.36)		41 (1.25)		118 (8.88)	
Local hospitals	34 (1.07)		40 (10.87)		6 (0.19)		19 (5.16)	
Primary clinics	0 (0.00)		0 (0.00)		0 (0.00)		0 (0.00)	
Ownership of the hospital		0.273		0.020		0.077		0.395
Public	100 (3.64)		246 (20.35)		16 (0.58)		92 (7.61)	
Nonpublic	187 (3.17)		370 (17.07)		57 (0.97)		184 (8.49)	

(OR = 1.18, 95% CI = 1.07−1.30), and vasopressors (OR = 1.14, 95% CI = 1.03−1.25) than the female decedents. Furthermore, the male decedents with LC were more likely to receive CPR (OR = 1.41, 95% CI = 1.11−1.79), invasive MV (OR = 1.55, 95% CI = 1.32−1.83), noninvasive MV (OR = 1.34, 95% CI = 1.07−1.68), and vasopressors (OR = 1.38, 95% CI = 1.18−1.61) than the female decedents (Table 5).

Discussion

The present nationwide population-based study found that in Taiwan, COPD patients tend to receive more intensive procedures, incur higher costs, and receive less palliative care and supportive procedures than LC patients at the end of their lives; hence, the end-of-life care for COPD patients appears to be mainly focused on prolonging life and does not meet their specific end-of-life care needs. To the best of our knowledge, this is one of the few nationwide population-based studies to investigate the difference in end-of-life health care utilization between COPD and LC patients. Differences were observed in health care utilization between the COPD and LC decedents, providing awareness regarding end-of-life care for COPD patients. Our results provide a crucial reference for policymakers about the resources used and costs incurred at the end of life for COPD and LC decedents. COPD patients are prone to acute exacerbations, which not only cause acute deterioration of quality of life but also abruptly cause critical conditions in the patients because of vital organ failures.[29,30] Given the fluctuating nature of COPD, confidently identifying patients' end-stage phase is difficult even if the patients are hospitalized; thus, clinicians cannot accurately predict patient survival.[29,30] Advance care planning, including communication about end-of-life care, is of major importance for COPD patients and their families and should be an important part of regular care for advanced COPD patients.[31] Having advance care planning discussions with seriously ill patients will increase the likelihood that medical care aligns with patient preferences.[32] Promoting advance care planning for COPD patients is a potential strategy for improving end-of-life care for COPD patients and for developing health policies in the future.

Acute hospital visits, ICU admissions, physician visits, and invasive intervention and medication use are the key drivers of resource use and costs for terminal COPD patients.[17] Moreover, COPD decedents use fewer palliative care services in acute care hospitals or home care settings.[17] Our results revealed that 57.6% of the COPD decedents were admitted to ICUs, 93.8% were admitted to hospitals, and 92.1% made outpatient visits during the last six months of life, which were substantially higher than those reported in previous studies.[4−8] Compared with the data reported between 1997 and 2001 in the United States, 32.6%, 61.3%, and 77.5% of the COPD decedents required ICU admission, hospital admission, and primary care visits, respectively.[27] Faes et al. reported that 28.7% and 76.8% of all COPD decedents in Belgium required ICU and hospital admission, respectively, during the last six months of life.[5] In the present study, we found that 27.4% and 63.4% of the COPD decedents received CPR and invasive MV, respectively, which are substantially higher than the corresponding rates of 2.4% and 20.9% reported by Faes et al.[5] By contrast, we found that 16.5% and 36.6% of the COPD decedents received noninvasive MV and opioids, respectively, which are lower than the
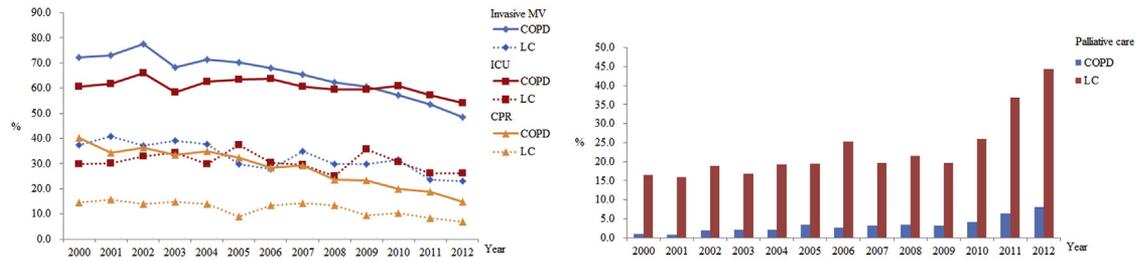
Fig. 2. Trends of the receipt of invasive MV and CPR, ICU admissions, ad palliative care for COPD and LC during the last six months of life from 2000 to 2012. The use of palliative care includes both inpatient and home-based palliative care. COPD = chronic obstructive pulmonary disease; LC = lung cancer; MV = mechanical ventilation; ICU = intensive care unit; CPR = cardiopulmonary resuscitation.

corresponding rates of 50.9% and 47.3% reported by Faes et al.[5] The difference between our results and Western countries' data may be explained by a combination of cultural, religious, and administrative financial incentives.[33,34] Lee et al. found that because they are influenced by Buddhism, Taoism, and Confucianism, Chinese people traditionally believe that discussing death or related topics with elderly people is taboo.[35] A previous study found that older people in Taiwan tend not to make their own end-of-life care decisions, which renders advance end-of-life care planning difficult.[34] Most medical professionals and patients rely more on family preferences and physician authority than on patient autonomy.[34,35] By contrast, Tschirhart et al. investigated the factors influencing the use of intensive procedures among older adults in the last six months of life in the United States; they found that individual characteristics and regional practice patterns are important determinants.[36] The fee-for-service payment mechanisms in NHI schemes in Taiwan might make hospitalization and ICU care easily available to and affordable for almost everyone.[37]

The use of palliative care in the COPD decedents in our study was lower than that described in previous studies. We found that 3.3% and 0.8% of the decedents received inpatient and home-based palliative care, respectively. Goodridge et al. reported that 5.1% and 2.8% of COPD decedents in Canada received palliative care at hospitals and at home, respectively.[6] Faes et al. reported that 2.1% and 6.2% of COPD decedents in Belgium received palliative care from palliative care units and at home, respectively.[5] The unpredictable course of COPD and the difficulty of predicting survival are barriers to timely referral and receipt of palliative care for people with COPD.[38] Maddocks et al. indicated that the early integration of palliative care with respiratory care, primary care, and rehabilitation services can improve COPD patient and caregiver outcomes, with referral made on the basis of the complexity of symptoms and concerns rather than prognosis.[38]
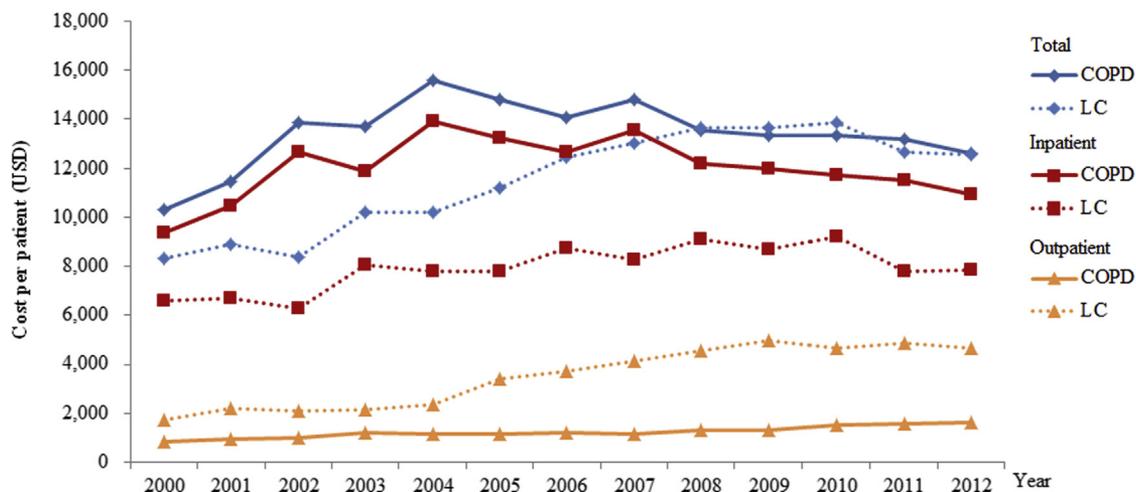

Fig. 3. Trends of change in OPD cost, hospitalization cost, and total medical cost during the last six months of life during 2000-2012. COPD = chronic obstructive pulmonary disease; LC = lung cancer.

Table 5
Multivariate Logistic Regression for Specific Intensive Procedure Indicators at the Last Six Months of Life

Variables	CPR Adjusted OR (95% CI)	Invasive MV Adjusted OR (95% CI)	Noninvasive MV Adjusted OR (95% CI)	Vasopressors Adjusted OR (95% CI)
Age (Ref: 40−74 years)				
≥75 years				
Stratum 1: COPD	0.71 (0.64−0.79)[a]	0.83 (0.75−0.92)[a]	1.38 (1.21−1.58)[a]	0.93 (0.85−1.03)
Stratum 2: LC	0.84 (0.67−1.05)	0.89 (0.76−1.04)	1.01 (0.81−1.26)	0.94 (0.81−1.10)
Sex (Ref: Female)				
Male				
Stratum 1: COPD	1.12 (1.00−1.25)[b]	1.18 (1.07−1.30)[b]	0.90 (0.79−1.02)	1.14 (1.03−1.25)[b]
Stratum 2: LC	1.41 (1.11−1.79)[b]	1.55 (1.32−1.83)[a]	1.34 (1.07−1.68)[b]	1.38 (1.18−1.61)[a]

COPD = chronic obstructive pulmonary disease; LC = lung cancer; CPR = cardiopulmonary resuscitation; MV = mechanical ventilation; OR = odds ratio; CI = 95% confidence intervals.
[a]$P < 0.001$.
[b]$P < 0.05$.

A previous study reported that significantly higher proportions of urban residents of Saskatchewan, Canada, with COPD or LC received palliative home care than small urban or rural/remote residents in the last 12 months of life.[7] Our study revealed similar results; we found that inpatient and home-based palliative care use was higher at medical centers and hospitals located in the most urbanized areas. Integration of palliative care with oncological care has been proposed for reducing high-intensity end-of-life care and associated discomfort.[9] Palliative care is associated with a decrease in hospital admission and intensive intervention use.[39] A study in Canada found community-based specialist palliative care teams to be effective for reducing acute care use and hospital deaths at the end of life.[40] Together with the aforementioned results on intensive intervention and health care service use at the end of life, our findings indicate that palliative care has been underutilized by COPD patients. Increasing palliative care utilization by COPD patients to improve quality of life near the end of life is an urgent issue that needs to be addressed.

In the present study, we found that the use of CPR and invasive MV among the COPD and LC decedents decreased from 2000 to 2012. In both groups, the use of palliative care increased from 2000 to 2012. These results might be explained by the development of a palliative care policy in Taiwan, which includes the Hospice Palliative Care Act and reimbursement policy. In 2000, the Hospice Palliative Care Act was passed in Taiwan. The NHI program started providing coverage for hospice home care in 1996, hospice inpatient care in 2000, and hospice shared care in 2004.[41] In 2006, hospice home care and hospice inpatient care were officially included in the health insurance program; however, initially, only hospice care provided to terminal cancer patients was covered. In 2009, the NHI program formally covered palliative care for noncancer patients, including eight categories of noncancerous diseases such as end-stage neurological diseases, dementia, heart diseases, lung diseases (COPD), liver diseases, and renal diseases. Notably, the proportions of the COPD and LC decedents receiving palliative care increased over time, but the proportion of the COPD decedents receiving palliative care remained low. Moreover, the proportion of the COPD decedents receiving invasive MV and CPR and ICU admission was consistently higher than that of the LC decedents over time. More appropriate end-of-life care, including palliative care, should be provided to COPD patients to reduce the disparity with LC patients.

In the present study, we found that inpatient hospitalization was the major cost driver in both groups. Tsai et al. found that the average number of hospital and ICU admissions mainly affected the average total medical cost at the end of life in COPD patients.[42] In particular, a hospital admission for a COPD exacerbation episode that requires intensive care represents a significant milestone that may merit advanced care planning and may be an opportunity to initiate communication on end-of-life care. The care model should consider the specific cost trend of COPD and integrate palliative care during the lifelong disease trajectory.

Strengths and Limitations

The strengths of our study include its national population-based approach and the use of routinely collected databases to study the quality of end-of-life care, thereby eliminating sample bias.[43] Furthermore, the routinely collected databases provide high-quality data that can be accessed by researchers at any time; thus, avoiding burdensome interviews with health care provider and caregivers for data collection.[43] One limitation of this study is the use of NHIRD data. As the NHIRD is not linked to any mortality data set, we were unable to obtain information on the cause of patients' death. Without this information, our findings should be applied with caution to different clinical situations, especially in COPD

patients. At earlier stages, cardiovascular diseases are the main causes of death in COPD patients[44] and may explain more intensive procedures at the end of life in this specific group of patients. Second, although the data of LC patients identified from the RCIPD in the NHIRD are valid and highly reliable, owing to the stringent review system, information on the cell type and clinical stage of LC is not available in this database. In addition, data on the precise stage of COPD are not available in this database. Only patients with advanced stages of COPD are admitted to palliative care units. As the grade of severity of COPD was unknown, a high percentage of patients with early stages of COPD may explain differences in palliative care resource use between both groups. Finally, because we used an administrative database in this retrospective study, we were unable to examine the association between specific patient preferences, reported outcomes, and medical decisions. Both patient preferences and the nature of medical decisions can influence the patterns of medical service use. Nevertheless, the retrospective study design and population-level measures of the quality of end-of-life care, which included specific claims-based quality indicators, allowed us to measure the real-life effectiveness of end-of-life care among COPD patients[45] and provide detailed insights into the quality of end-of-life care provided by health care providers or the related policies implemented by policy makers.[43] Additional studies should be conducted to gain a comprehensive understanding of the mechanisms underlying the use of intensive and supportive procedures and palliative care in patients with different stages of COPD, and these studies should evaluate the effectiveness of palliative care for improving the quality of end-of-life care.

Conclusion

In this study, the COPD decedents used more intensive procedures during the last six months of life and were less likely to receive inpatient or home-based palliative care than the LC decedents. Compared with the COPD decedents, the LC decedents were more likely to receive supportive procedures at the end of life, which provide symptomatic benefits. Therefore, improving end-of-life care for COPD patients, both from quality and cost perspectives, is necessary.

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