Original Article

Early Do-Not-Resuscitate Directives Decrease Invasive Procedures and Health Care Expenses During the Final Hospitalization of Life of COPD Patients

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Abstract

Context. Nearly 70% of do-not-resuscitate (DNR) directives for chronic obstructive pulmonary disease (COPD) patients are established during their terminal hospitalization. Whether patient use of end-of-life resources differs between early and late establishment of a DNR is unknown.

Objectives. The objective of this study was to compare end-of-life resource use between patients according to DNR directive status: no DNR, early DNR (EDNR) (established before terminal hospitalization), and late DNR (LDNR) (established during terminal hospitalization).

Methods. Electronic health records from all COPD decedents in a teaching hospital in Taiwan were analyzed retrospectively with respect to medical resource use during the last year of life and medical expenditures during the last hospitalization. Multivariate linear regression analysis was used to determine independent predictors of cost.

Results. Of the 361 COPD patients enrolled, 318 (88.1%) died with a DNR directive, 31.4% of which were EDNR. COPD decedents with EDNR were less likely to be admitted to intensive care units (12.0%, 55.5%, and 60.5% for EDNR, LDNR, and no DNR, respectively), had lower total medical expenditures, and were less likely to undergo invasive mechanical ventilator support during their terminal hospitalization. The average total medical cost during the last hospitalization was nearly twofold greater for LDNR than for EDNR decedents. Multivariate linear regression analysis revealed that nearly 60% of medical expenses incurred were significantly attributable to no EDNR, younger age, longer length of hospital stay, and more comorbidities.

Conclusion. Although 88% of COPD decedents died with a DNR directive, 70% of these directives were established late. LDNR results in lower quality of care and greater intensive care resource use in end-of-life COPD patients. J Pain Symptom Manage 2019;58:968–976.

Key Words

COPD, do-not-resuscitate (DNR), end-of-life care, medical resource use, medical expenses

Introduction

Chronic obstructive pulmonary disease (COPD) with high mortality and morbidity rates[1] was predicted to become the third leading cause of death worldwide by 2030.[2] In fact, the COPD burden is increasing faster than anticipated and already became the third leading cause of death in 2016.[3,4] Although the prognoses of COPD and lung cancer are often equally poor,

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advanced COPD patients receive intensive care more often than do lung cancer patients.[5,6] Previous research has shown that end-of-life care for COPD is inappropriate because advanced COPD patients tend to receive mechanical ventilation, are more likely to die in the intensive care unit (ICU), are less likely to receive hospice care, and are less likely to have advanced care directives, including a do-not-resuscitate (DNR) directive.[7–9]

In Taiwan, a historic change in palliative care occurred in 2000 with the enactment of the Hospice Palliative Care Act into law, giving patients suffering from a terminal illness certified by two physicians the right to sign a DNR directive.[9,10] According to the law, a DNR directive can be made in one of the two ways: 1) it could be signed by a competent terminally ill patient or 2) it could be signed by a surrogate decision maker—most commonly a close family member—when patients could not make decisions for themselves due to dementia, delirium, or other types of cognitive impairment. Before making a DNR directive decision, the physician must have a family meeting with the patient and his/her family members. Initially, this law related only to cancer patients of terminal status, allowing them to receive hospice palliative care and to choose DNR. With later amendments in 2009, insurance coverage of hospice and palliative care service was expanded to cover non−malignancy-related terminal illnesses such as COPD, dementia, heart failure, liver cirrhosis, and chronic renal failure.[9–11]

The DNR directive, one of the most commonly implemented advanced directives in palliative care, declares a refusal to accept cardiopulmonary resuscitation (CPR) in the event of cardiac or respiratory arrest.[11,12] However, the signing of a DNR directive does not guarantee that the patient will receive adequate palliative care or services. A study of patients dying of noncancer causes in a teaching center in North Taiwan reports that while 1045 patients (73.8%) had a DNR directive, only 134 (9.5%) received hospice care.[9] In a teaching hospital in Central Taiwan, Fu et al. found that 225 COPD decedents (83%) had undergone mechanical ventilation, 88 (32.5%) had died in the ICU, and 256 (94%) had been admitted via the emergency room (ER).[13] Although a high proportion of COPD decedents (234/271; 86.3%) had a DNR directive in place, 70% of these directives (165/234) were established during their terminal hospitalization.[13]

Advances in medical technologies have enabled physicians to administer life-maintaining or -prolonging therapies for conditions with an unpredictable trajectory.[14] Studies have found that early palliative care intervention in the hospital setting not only increases the satisfaction of patients and their families[15] but also reduces the lengths of ICU stay[16] and decreases treatment costs[17] and the unnecessary use of medical resources.[5,18,19] Studies evaluating the use and cost of medical resources in the care of advanced COPD patients showed that COPD decedents used fewer palliative care services, received more invasive and noninvasive ventilation, and had higher medical costs during their last year of life than did lung cancer patients.[5,18–20]

No previous studies have investigated resource use and medical expenses in end-of-life COPD patients with respect to DNR status and the timing of DNR decisions. Such evaluation could provide evidence to support the hypothesis that DNR directives do not guarantee valuable palliative care and that late DNR decisions result in lower quality care for COPD. Hence, this retrospective cohort study aimed to compare end-of-life resource use between COPD patients who died without a DNR (no DNR), with a DNR chosen early (EDNR) (before the final hospitalization), and with a DNR chosen late (LDNR) (during the final hospitalization).

Materials and Methods

Data Source and Ethical Considerations

This retrospective observational cohort study was conducted at Taichung Veterans General Hospital (TCVGH) using data from their electronic health record (EHR) system. TCVGH is a tertiary teaching hospital with a total of 1576 beds, including 140 intensive care beds, and is the only public medical center located in central Taiwan. Data regarding demographics, diagnostic test results, treatment histories, medical expenditures, and all medical resource use at TCVGH were collected using the EHR system. The study protocol was reviewed and approved by the Institutional Review Board (IRB) of TCVGH Taiwan (IRB number, CE18242B; approval date, August 2, 2018). The requirement of informed consent was waived because the study design was retrospective and only deidentified patient data were obtained via the EHR system.

Study Design and Population

We enrolled TCVGH patients who died with COPD as the primary or secondary cause of death (based on International Classification of Diseases, 9th and 10th revision, Clinical Modification coding [ICD-9-CM codes 491.x, 492.x, and 496.x; ICD-10-CM code J44.9]) during 2011−2017. Subjects <40 years of age who had less than two TCVGH visits for the management of COPD-related symptoms within their last year of life were excluded.

Operational Definition of Outcome Measures

The definitions of early and late DNR used in this study were described previously.[13] Briefly, patients dying of COPD with a DNR directive signed by

themselves or their surrogates before their terminal admission to the hospital were classified as EDNR. Late DNR was defined as patients who signed a DNR directive during their last hospitalization and eventually died during that hospitalization.

Measures

The demographic data of enrolled patients included age, sex, and Charlson Comorbidity Index (CCI) score. Medical resource use in the last year of life and the medical expenditures during the last admission were analyzed. For medical resource use in the last year, we determined the number of outpatient department (OPD) visits, ER visits, and hospitalizations. We also recorded the number of CPR events in the last year. Medical resource use during the last hospitalization included the number of events involving invasive respiratory therapy, ICU admission, and the total number of ICU and length of stay (LOS). The total medical expenditures incurred during the last admission included ward fees in the ordinary ward and ICU, medication fees, and treatment fees for hemodialysis, respiratory therapy, and other unclassified fees. Other medical expenditures were classified as "other expenditures." All costs in this study are presented as United States Dollars (USD, $).

Statistical Analysis

Statistical analyses were performed using SPSS software (version 22.0; International Business Machines Corp, Armonk, NY). Categorical variables are presented as frequency and percentage and were analyzed using the chi-square test for nonparametric distribution data, the Kruskal-Wallis test was applied to compare the differences between groups, and results are presented as the median and range. The Dunn-Bonferroni test was performed for multiple comparisons of nonparametric pairwise independent groups (no DNR vs. EDNR; no DNR vs. LDNR; EDNR vs. LDNR). Simple and multivariate linear regression analyses were performed to identify the independent predictors of medical expenses. The multivariate regression model included the timing of DNR decisions in COPD decedents, in addition to important clinical factors associated with high medical expenses such as age, LOS, sex, and CCI. All differences with $P < 0.05$ were considered statistically significant.

Results

Patient Demographic Characteristics, Medical Resource Use, and Medical Expenses in COPD-Related Deaths

We identified 361 decedents with COPD fitting the enrollment criteria during 2011–2017 (Fig. 1). Patients who died of COPD in the hospital were elderly (median age, 83 years; interquartile range [IQR]: 46–102 years), were predominately male (91.4%), and had experienced frequent OPD and ER visits and hospitalizations (Table 1). Most patients (62.3%) were treated by a pulmonologist during their terminal hospitalization, 44.0% of patients experienced ICU admission, and 28.0% died in the ICU. Despite 88.1% of patients having a DNR directive, 36.8% still experienced invasive mechanical ventilation (MV) and 69.0% experienced noninvasive positive pressure ventilator support. Although 318 (88.1%) of them had expressed an interest in establishing a DNR directive by themselves or via their family surrogates, approximately 70% of the DNR directives were made during the last admission before death (LDNR). Only 31.4% (100 of 318) were classified as EDNR because a DNR directive has been signed by themselves or by their surrogates before their terminal admission to the hospital.

Medical Resource Use in the Last Year of Life and Medical Expense During the Last Hospitalization of COPD

We compared demographic data, medical resource use in the last year of life, and medical expenses during the last hospitalization between COPD decedents. Subjects were classified into three groups according to their DNR decision status: no DNR group (without DNR), EDNR, and LDNR (Table 2). EDNR patients were older (compared with LDNR; $P < 0.001$), had more frequent use of medical resource such as more frequent OPD visits (compared to those with No DNR; $P = 0.048$), more ER visits (pairwise compared with no DNR and LDNR; all $P < 0.001$), and more hospitalizations (pairwise comparison with no DNR and LDNR; all $P < 0.05$) (Table 2). However, the total medical expenses of the EDNR group during the terminal hospitalization were significantly lower than those of the no DNR and LDNR groups (pairwise comparison, all $P < 0.05$) (Table 2; Fig. 2a). In fact, the total expenses during the last hospitalization of life in the LDNR group were nearly twofold higher than those of the EDNR group ($P < 0.001$). Subgroup analysis of medical expenses also indicated that the EDNR group had significantly lower ward fees, medication fees, treatment fees, and other expenses than the other two groups (Table 2; Fig. 2b).

Intensive Care and Intensive Respiratory Therapy During the Terminal Hospitalization for COPD

Table 2 summarizes the parameters of intensive care use, showing that only 12% of EDNR patients underwent ICU admission (pairwise comparison with no DNR [60.5%] and late DNR [55.5%]; $P < 0.001$). Patients in the EDNR group had shorter hospital stay

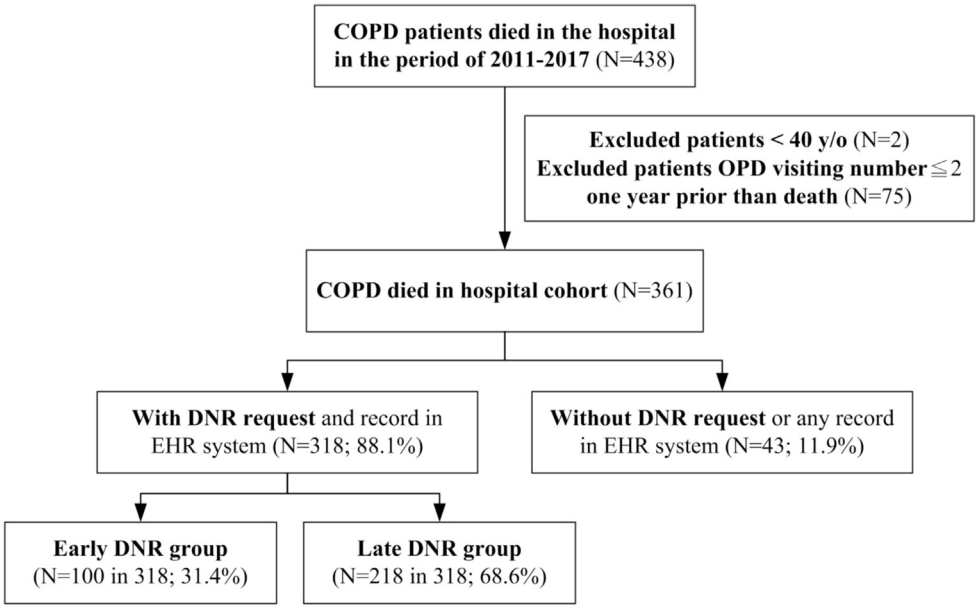

Fig. 1. Study flowchart. "Early DNR" was defined as "COPD patients or their surrogates who had a DNR directive in place before their last admission." "Late DNR" was defined as "COPD patients or their surrogates who established a DNR directive during their last hospitalization." COPD = chronic obstructive pulmonary disease; DNR = do-not-resuscitate; OPD = outpatient department.

before death ($P = 0.001$), underwent less CPR ($P = 0.001$), and fewer died in the ICU ($P < 0.001$). Comparison of the use of intensive respiratory therapy during the last hospitalization between the three groups showed that only 8% of the COPD decedents with EDRN underwent invasive mechanical ventilation (vs. no DNR, 69.8% vs. LDNR, 43.6%; $P < 0.001$). However, the use of noninvasive positive pressure ventilation did not differ between the three groups (no DNR, 55.8%; EDNR, 68.0%; LDNR, 72.0%; $P = 0.107$).

Factors Affecting the Total Medical Expenses During the Terminal Hospitalization

Factors that contributed to the total medical expenses during the terminal hospitalization for COPD are shown in Table 3. Univariate linear regression analysis revealed that EDNR and older age were significantly associated with lower cost during the last hospitalization ($P < 0.001$ and $P = 0.002$, respectively), while the length of hospital stay was correlated positively and significantly with the cost of the last hospitalization ($P < 0.001$). The multivariate models used to predict the cost per COPD death during the terminal hospitalization are presented in Table 3. According to multivariate analysis models 1 and 2, several covariates had a significant influence on cost per episode. Multivariate model 2 indicated that higher cost was associated with no EDNR status ($P < 0.001$), younger age ($P = 0.007$), longer LOS ($P < 0.001$), and higher CCI score ($P = 0.044$). These factors accounted for about 60% of the total medical expenses incurred during the terminal hospitalization of patients who died from COPD-related causes ($P < 0.001$).

Trends in DNR Status of COPD Decedents During 2011–2017

The distribution of DNR status in COPD decedents is shown in Fig. 3. The fraction of patients who died from COPD without a DNR directive decreased from 19.2% in 2011 to 9.9% in 2017. However, the majority of these DNR decisions were made during their last hospitalization, accounting for nearly 60% of COPD decedents. The trend in EDNR directives increased from 14.9% in 2011 to 32.4% in 2017 (Fig. 3). Those COPD decedents with EDNR had fewer ICU admission, fewer CPR events, and fewer deaths in the ICU than did those in the LDNR group (Table 2).

Discussion

The present study reports four major findings regarding medical resource use and expenses during the last year and the last hospitalization of COPD decedents. First, most COPD decedents (88.1%) died with a DNR directive in place; however, 70% of these DNR directives were made during the last hospitalization. Second, the number of ICU admissions was significantly higher among patients in the LDNR group (55.5%) than in the EDNR group (12%). Third, the total expenses during the last

Table 1
Demographic Characteristics, Medical Resource Use During the Last Year, and Medical Expenditures During the Last Hospitalization of COPD Patients Who Died in Hospital ($N = 361$)

Variable	Median/n	Range/%
Age (yrs)	83	46–102
Sex		
Female	31	8.6%
Male	330	91.4%
CCI	3	1–10
Medical resource use during the year before the last hospitalization		
Total OPD visit numbers	13	0–212
Total ER visit numbers	2	0–23
Total admission numbers	2	1–19
Total medical expenditure ($) during the last hospitalization	4912	96–45,026
Ward fee ($)	1168	39–18,193
ICU fee ($)	0	0–17,850
Ordinary ward fee ($)	354	0–5349
Medication fee ($)	950	0–9302
Treatment fee ($)	900	7–12,160
Hemodialysis ($)	0	0–9430
Respiratory therapy ($)	355	0–5129
Other treatment ($)	425	0–4112
Other expenditure ($)	1272	0–18,941
Invasive respiratory therapy during the last hospitalization		
Experienced ventilator support	133	36.8%
Total ventilator using days	8.6	0–45.5
Experienced NIPPV support	249	69.0%
Total NIPPV using days	4.4	0–65.3
Experienced tracheostomy support	27	7.5%
Total tracheostomy using days	22.4	0.1–79.5
Experienced CPR	22	6.1%
Total hospital stay during the last hospitalization (days)	17	0–172
Experienced ICU admission	159	44.0%
Total ICU stay during the last hospitalization (days)	14	1–79
Died in the ICU	101	28.0%
Without DNR decisions (no DNR)	43	11.9%
With DNR	318	88.1%
DNR during the last hospitalization (late DNR)	218	68.6%
DNR prior than the last admission (early DNR)	100	31.4%
Service by pulmonologist	225	62.3%

COPD = chronic obstructive pulmonary disease; CCI = Charlson Comorbidity Index; OPD = outpatient department; ER = emergency room; ICU = intensive care unit; NIPPV = noninvasive positive pressure ventilator; CPR = cardiopulmonary resuscitation; DNR = do not resuscitate.

hospitalization of life in the LDNR group were nearly twofold higher than those of the EDNR group. Fourth, about 60% of the medical expenses incurred were accounted for by no EDNR status, younger age, longer LOS, and more comorbidities. To the best of our knowledge, this is the first study to investigate the difference in the use of end of life health care services with respect to DNR status and the timing of DNR directive establishment in COPD patients.

In advanced COPD patients, the discussion of end-of-life issues and referral to hospice and palliative care by physicians is often too late.[21–23] This study shows that while 88.1% of COPD patients died with a DNR directive in place, only 31.4% were EDNR. This phenomenon may be attributable to factors such as poor communication between patients and physicians and the unpredictable trajectory of COPD.[24–26] Even patients who have DNR directives in place and clearly documented in their medical records may be treated intensively, with the intent of life extension, based on the interpretation of the DNR by physicians. Cohen et al. conducted a national survey in the U.S. investigating the association between resident physician decision-making and the DNR status of patients.[27] The group found that physicians interpret a DNR order as a limitation on invasive or intensive interventions only beyond CPR and endotracheal intubation.[27] In other words, if patients make their DNR decision near their time of death, they may still experience many invasive treatments and ICU admission instead of palliative care.[8,18,28] For chronic, life-limiting illnesses such as dementia, a previous study in Taiwan revealed that patients who understand the prognosis of their disease or have had previous discussions about end-of-life decisions tend to establish a DNR directive early.[11] Late referral to hospice or palliative care might result from the lack of proper education of the majority of hospital health care professionals regarding communication and management of ethical dilemmas related to noncancer chronic life-limiting illness.[29,30]

Advanced COPD patients commonly seek medical help during the last six to 12 months of life and eventually die in the hospital because of increased symptom burden and acute exacerbation of dyspnea and respiratory distress.[31,32] Emerging evidence suggests that a delay or failure to identify patients in need of palliative care has detrimental effects on their care, including inadequate continuity of care, insufficient support, and increased health care costs.[33–35] In recent years, the ER has become a critical point of palliative care access for end-stage disease or advanced cancer patients.[36] In fact, a previous study showed that frequent ER visits are an important predictor of EDNR in COPD and that according to the GOLD grading, very severe status (forced expiratory volume [FEV1] $\leqq$ 30% of predicted) is not a predictor of EDNR.[13] Wu et al. demonstrated that early end-of-life discussions including DNR decisions and palliative care consultation in the ER are associated with a significantly shorter length of stay for patients admitted to the hospital.[37] Our findings are consistent with those of a previous study, showing that COPD patients with EDNR had more frequent ER visits (pairwise comparison vs. no DNR and LDNR; all $P < 0.001$) and more hospitalizations (pairwise comparison vs. no DNR and LDNR; all $P < 0.05$) during the last year of life. However, during the last

Table 2

Comparison of Medical Resource Use and Medical Expenditures According to DNR Status of COPD Patients Who Died in Hospital

	Early DNR ($n = 100$)		Late DNR ($n = 218$)		No DNR ($n = 43$)			P[a]		
Variable	Median/n	Range/%	Median/n	Range/%	Median/n	Range/%	P	Early vs. Late	Early vs. No	Late vs. No
Age	85.5	49–102	81	46–100	81	58–99	<0.001	<0.001	0.107	1.000
CCI	3	1–10	3	1–10	2	1–8	0.071			
Gender (male)	91	91.0%	202	92.7%	37	86.0%	0.362			
Medical resource use within one year before the last hospitalization										
Total OPD visits	15.5	0–66	13	0–212	7	0–55	0.043	0.257	0.048	0.495
Total ER visit	3	1–23	2	0–22	2	0–18	<0.001	<0.001	<0.001	0.591
Total admissions	2	1–11	2	1–19	1	1–5	<0.001	0.004	<0.001	0.044
Total medical expenditures ($) during the last hospitalization	2858	96–45,026	6302	168–39,085	4914	199–36,650	<0.001	<0.001	0.015	0.622
Ward fees ($)	592	39–15,800	1707	39–18,193	1072	39–12,770	<0.001	<0.001	0.021	0.274
ICU fees ($)	0	0–154,46	1009	0–17,850	640	0–12,770	<0.001	<0.001	<0.001	1.000
Ordinary ward fees ($)	472	0–5349	319	0–4405	282	0–2569	0.034	0.121	0.056	0.829
Medication fees ($)	651	0–9185	1179	24–9302	1311	13–8866	<0.001	<0.001	0.007	1.000
Treatment fees ($)	573	7–12,160	1260	25–9284	796	53–6569	<0.001	<0.001	0.062	0.675
Hemodialysis ($)	0	0–9430	0	0–3831	0	0–1777	0.002	0.002	0.037	1.000
Respiratory therapy ($)	141	0–4051	510	0–5129	344	0–4770	<0.001	<0.001	0.182	0.257
Other treatment ($)	323	0–2683	493	25–4112	312	25–2939	0.002	0.001	0.544	0.788
Other expenditures ($)	774	0–14,791	1641	14–18,941	1232	28–14,023	<0.001	<0.001	0.014	1.000
Invasive respiratory therapy during the last hospitalization										
Ventilator support	8	8.0%	95	43.6%	30	69.8%	<0.001	<0.001	<0.001	0.002
Total ventilator days	6.15	0–14.5	10.6	0.1–45.5	4.45	0–37.6	<0.001	0.113	1.000	<0.001
NIPPV support	68	68.0%	157	72.0%	24	55.8%	0.107			
Total NIPPV days	5.5	0–56.9	4.3	0–65.3	3.55	0–26.5	0.675			
Tracheostomy support	3	3.0%	20	9.2%	4	9.3%	0.135			
Total tracheostomy days	7.6	4.8–23.6	27.15	0.1–79.5	19.7	11.6–26.6	0.314			
CPR	3	3.0%	7	3.2%	12	27.9%	<0.001	<0.001	<0.001	<0.001
Total days of the last hospitalization	12.5	0–172	19	1–87	14	0–87	0.001	0.001	1.000	0.195
ICU admission	12	12.0%	121	55.5%	26	60.5%	<0.001	<0.001	<0.001	0.616
Total ICU days during the last hospitalization	10	2–65	14	1–79	6.5	1–38	0.033	0.354	1.000	0.069
Died in ICU	7	7.0%	79	36.2%	15	34.9%	<0.001	<0.001	<0.001	<0.001
Service by pulmonologist	64	64.0%	134	61.5%	27	62.8%	0.909			

DNR = do not resuscitate; COPD = chronic obstructive pulmonary disease; CCI = Charlson Comorbidity Index; OPD = outpatient department; ER = emergency department; ICU = intensive care unit; NIPPV = noninvasive positive pressure ventilator; CPR = cardiopulmonary resuscitation.

Chi-square test. Kruskal-Wallis test.

[a]Post hoc, Dunn-Bonferroni test.

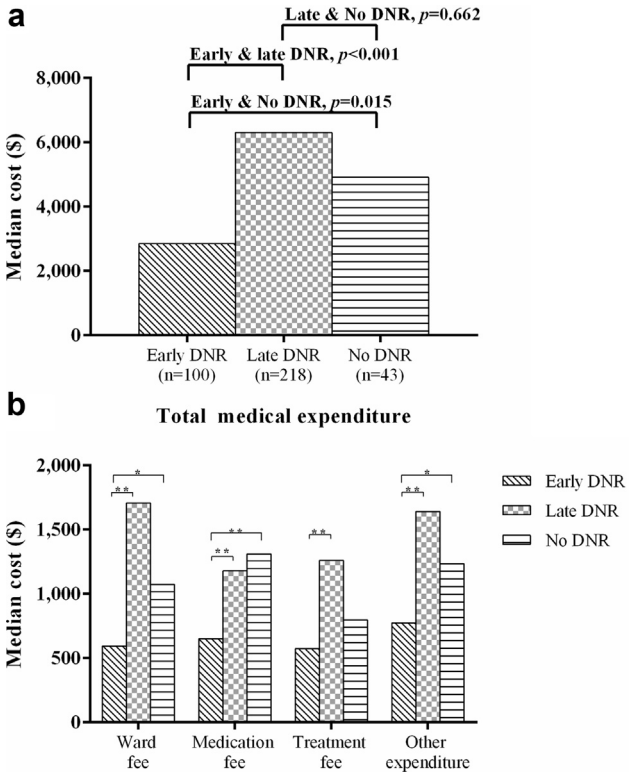

Fig. 2. Medical expenditures during the last hospitalization according to DNR status. a) Total medical expenditure. b) Fees for the ward, medication, treatment, and other expenditures. *$P < 0.05$; **$P < 0.01$. DNR = do-not-resuscitate.

hospitalization, only 12% of EDNR patients were admitted to the ICU (pairwise comparison vs. no DNR [60.5%] and late DNR [55.5%]; $P < 0.001$); EDNR patients had shorter hospital stay before death ($P = 0.001$) and had experienced fewer CPR events ($P < 0.001$), and fewer died in the ICU ($P < 0.001$). Thus, early initiation of end-of-life discussions with advanced COPD patients, even during their first ER visit or in the acute care hospital setting, may prevent a delay in DNR decisions thereby reducing futile care during the last hospitalization.

The key factors associated with higher resource use and costs for late-stage COPD patients are frequent acute hospital visits, invasive procedures and therapy, high-cost medications, and ICU admission.[18,19] In fact, previous studies showed that most COPD patients died in the hospital or ICU.[31,32,38] A study conducted in Belgium reported that 76.8% of COPD decedents were admitted to the hospital, and 28.7% of them had been admitted to the ICU during their last six months of life.[18] In our cohort, 44% of COPD decedents had been admitted to the ICU; 28% of them died in the ICU, and the median ICU stay during the last hospitalization was 14 days. A recent nationwide population-based study in Taiwan reported that 57.6% of COPD decedents were admitted to ICUs, 27.4% underwent CPR, and 63.4% underwent invasive MV.[5] These rates are higher than those reported by Faes et al. (CPR, 2.4%; MV, 20.9%).[18] We found that the average total medical expenses during the last hospitalization for LDNR decedents was nearly twofold that of EDNR decedents. Subgroup analysis of medical expenses also indicates that the EDNR group had significantly lower expenses for ward fees, medication fees, treatment fees, and other expenses. Multivariate linear regression analysis showed that 60% of the medical expenses were associated with no EDNR, age, LOS, and comorbidities. Therefore, early intervention for end-of-life decisions including DNR and palliative care service may be cost-effective and improve the value of care given to advanced COPD patients during their final hospitalization of life.

This study has several limitations. First, patients may have been missed because of the retrospective study design involving the collection of data from hospital records. Inappropriate coding, underreporting, and/or incorrect electronic medical record diagnoses are factors associated with the leakage of data. Second, continuity of care is required to provide complete data regarding medical resource use for these COPD patients. To minimize related errors, we excluded COPD decedents with fewer than two physician visits

Table 3
Factors Associated With Total Medical Expenditures According to Multivariate Linear Regression Analysis ($N = 361$)

	Univariate			Multivariate Model 1			Multivariate Model 2		
Variable	B	SE	*P*	B	SE	*P*	B	SE	*P*
Constant		543.43		6829		0.003	8231		0.001
DNR									
No vs. Late	−1020	1338.84	0.447	63	0.00	0.943	26	0.00	0.976
Early vs. late	−4819	969.07	<0.001	−2907	−0.16	<0.001	−3007	−0.16	<0.001
Age	−133	42.16	0.002	−62	−0.08	0.025	−76	−0.09	0.007
The last hospital stay	314	14.57	<0.001	305	0.73	<0.001	305	0.73	<0.001
Gender (male vs. female)	−66	1556.57	0.966				−1450	−0.05	0.144
CCI	104	238.37	0.662				313	0.07	0.044
Adjusted R^2				59.50%			60.01%		
P				<0.001			<0.001		

DNR = do not resuscitate; CCI = Charlson Comorbidity Index.

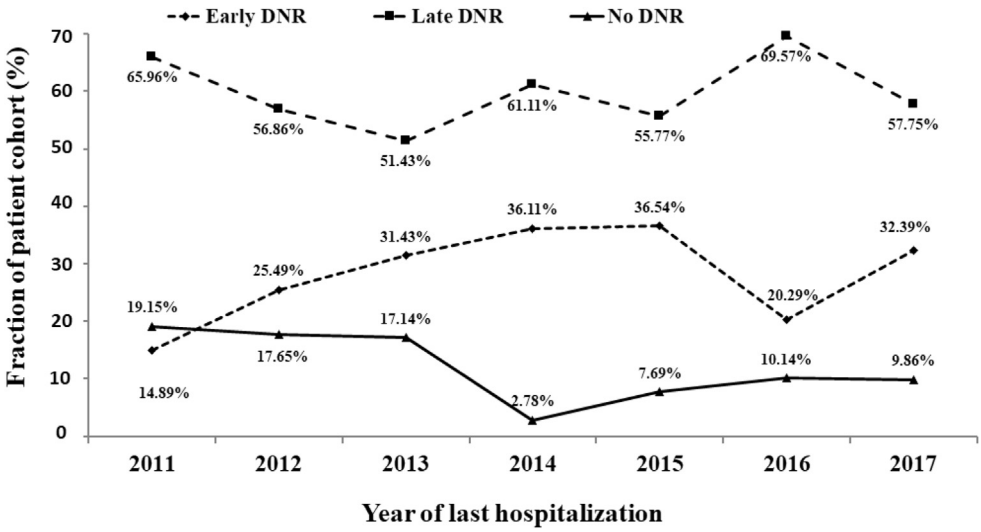

Fig. 3. Timing of DNR directive establishment in advanced COPD patients according to year (2011–2017). COPD = chronic obstructive pulmonary disease; DNR = do-not-resuscitate.

for symptoms control during their last year of life. In addition, as the referral center in the central Taiwan, TCVGH receives most of the critical COPD patients. This factor minimizes the impact of these two limitations. Third, we could not obtain the input of physicians and patients due to the limitation of the data source used. Fourth, the results are based on a single medical center in Taiwan, so they may not be applicable to patients in other countries.

Conclusion

This study shows that while 88% of COPD decedents in our cohort died with a DNR directive, 70% of these directives were put in place during the last hospitalization. The average total medical expenses during the last hospitalization for LDNR decedents were nearly double those of EDNR decedents. COPD decedents with EDNR were less likely to be admitted to ICUs (12.0% vs. 55.5% vs. 60.5%), had lower total medical expenditures, and were less likely to undergo invasive mechanical ventilator support than were those with LDNR or no DNR. Therefore, a late DNR decision could be considered as low value care for COPD owing to intensive health care resource utilization but poor health outcomes. This study brings to light this unmet need and the importance of early discussions of DNR plans with advanced COPD patients.

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The authors report no conflicts of interest in this work.

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