Letters

RESEARCH LETTER

Pulmonary Embolism Hospitalization, Readmission, and Mortality Rates in US Older Adults, 1999-2015

Over the past 15 years, advances have occurred in the diagnosis and management of pulmonary embolism (PE).[1] Computed tomographic pulmonary angiography (CTPA) is now the routine diagnostic test. The availability of risk stratification tools and non-vitamin K antagonist oral anticoagulants that do not require routine laboratory monitoring have facilitated early discharge of patients.[2]

The risk of developing PEs and experiencing adverse outcomes increases with age, partly because of the comorbidity burden and low cardiopulmonary reserve.[3] Little is known about recent PE hospitalizations or about outcomes in older adults in the context of the improvements in diagnostics and therapeutics.

Methods | The Human Investigation Committee at Yale University exempted the study from review because all data were deidentified. We identified Medicare fee-for-service beneficiaries 65 years or older with a principal discharge diagnosis of PE (*International Classification of Diseases* [*ICD*], *Ninth Revision* codes: 415.1X, PE and infarction; 415.11, iatrogenic PE and infarction; 415.13, saddle embolus of pulmonary artery; and 415.19, other PE and infarction) from January 1999 through September 2015. These codes have high positive predictive values for PE.[4]

Table. Characteristics of Medicare Fee-for-Service Beneficiaries Hospitalized With Pulmonary Embolism[a]

	Percentage of Patients									*P* Value for Linear Trend
	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008	2009-2010	2011-2012	2013-2014	2015	
Patients with PE, No.	65 795	80 386	93 695	106 177	105 063	105 542	109 653	104 926	39 732	
Age, mean, y	77.6	77.6	77.8	78	78.2	78	78	77.7	77.6	.71
Sex										
Men	36.7	37.1	38.8	39.9	40.7	41.4	42.1	43.1	43.8	<.001
Women	63.3	62.9	61.2	60.1	59.3	58.6	57.9	56.9	56.2	<.001
Race[b]										
White	87.5	86.8	85.8	85.6	85.6	85.1	84.9	84.8	84.8	<.001
Black	10.2	10.5	11.5	11.7	11.4	12	12.2	12	11.8	.005
Other	2.4	2.7	2.7	2.8	2.9	2.9	2.9	3.1	3.4	<.001
Comorbidities										
Cancer	21.9	22.9	23.7	22.9	22.5	21.7	21.5	21.2	21.1	.03
Heart failure	16.2	15.6	16.2	15.5	14.6	13.6	13.5	12.4	12.6	<.001
Peripheral vascular disease	11.9	11.3	10.9	10.6	10.3	9.6	9.2	8.2	7.9	<.001
Atherosclerotic disease	30.4	30.6	30.5	29.9	29.5	28.3	28.1	25.5	23.6	.001
Stroke	3.8	3.4	3.4	3.1	3.2	3	2.8	2.6	2.6	<.001
Myocardial infarction	3.5	3.5	3.3	3	3	3	2.8	2.6	2.5	<.001
CVD other than stroke	5.2	5.1	4.7	4.3	4.3	4.1	4	3.6	3.3	<.001
Hypertension	54.2	58.7	62.8	63.9	67.5	68.6	70.9	68.7	66.7	<.001
Respiratory failure	4.6	4.6	4.9	5.9	7.9	8.2	8.5	8.7	9.6	<.001
COPD	27.7	28	28.9	29.6	27.8	25.8	25.4	24.2	23.6	.005
Pneumonia	17.4	18.3	19.6	20.2	21.6	21.9	21.2	20.2	20.1	<.001
Kidney failure	3.7	4.6	6.1	8.6	11.2	13	13.9	13.9	14.7	<.001
Diabetes	18.8	20.1	22.1	22.9	23.4	23.8	25	25	24.4	<.001
Other conditions										
Trauma	10.6	10.8	11.3	11.2	11.1	10.1	9.7	8.9	8.8	<.001
Malnutrition	4.4	4.3	4.9	5.4	6.6	8.2	8.5	8.8	9.0	<.001
Dementia	9.7	10.9	12.6	13.2	14.1	14.1	11.3	6.6	5.9	.23
Depression	7.2	8.8	9.8	10.2	10.4	10.1	10.8	10.4	10.1	.02

Abbreviations: COPD, chronic obstructive pulmonary disease; CVD, cerebrovascular disease.

[a] For brevity, other comorbidities such as unstable angina, history of liver disease, other psychiatric disorder, and functional disability are not shown but were used in the adjustment models for outcomes. These 4 comorbidities had a prevalence of less than 5% in all study years.

[b] Race was determined through the Medicare Denominator File, which used patient-reported data from the Social Security Administration.

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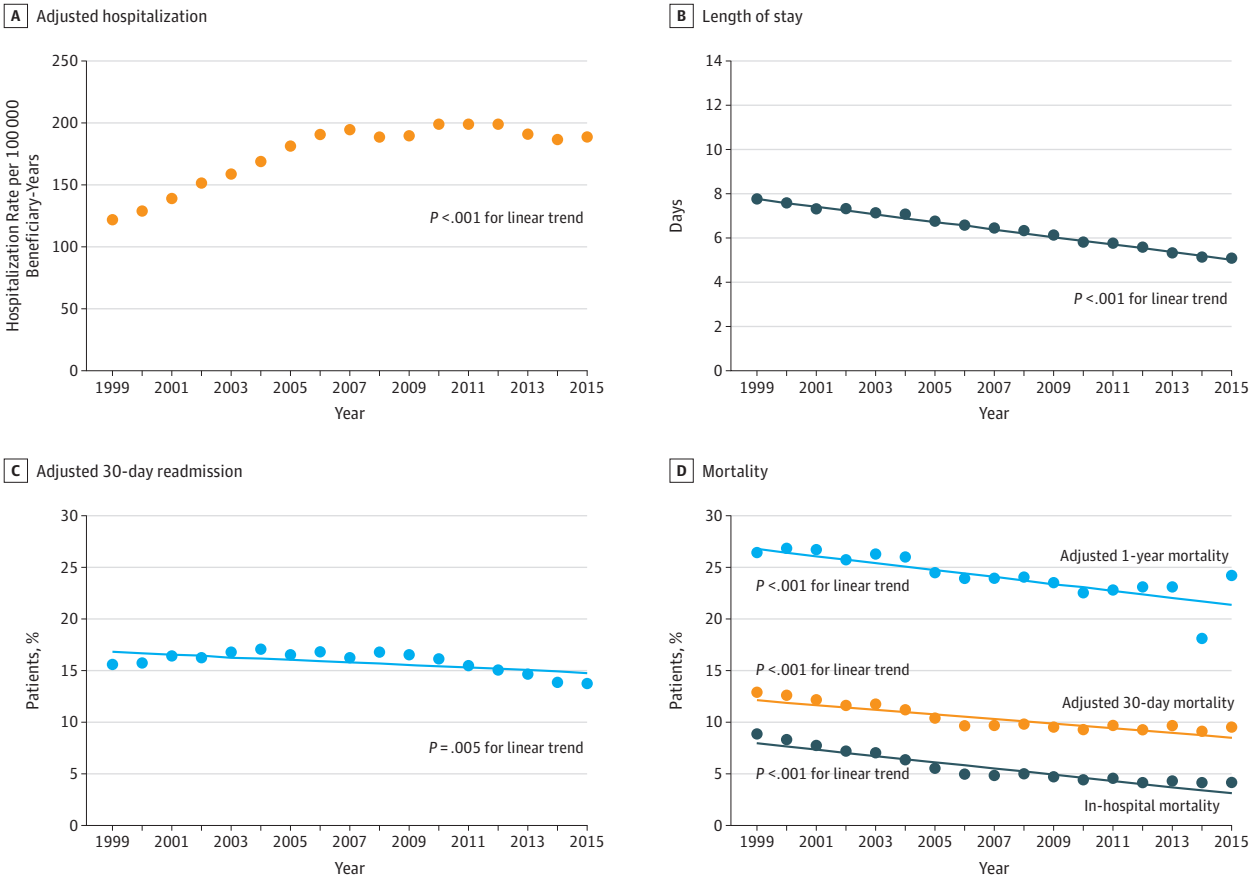
Figure. Hospitalization, Length of Stay, and Mortality Rates Among Medicare Fee-for-Service Beneficiaries With Pulmonary Embolism



Thirty-day readmission rates and 30-day mortality rates were adjusted for patient characteristics listed in the Table.

After October 2015, the codes were changed to *ICD-10*. To preserve the internal consistency for the trends, we did not include the fourth quarter of 2015.

Study outcomes included hospitalization rates per 100 000 beneficiary-years, length of stay (LOS); all-cause 30-day readmissions; and all-cause in-hospital, 30-day, and 1-year mortality. Because models for adjustment of LOS and in-hospital mortality have not been validated, unadjusted results are presented. We explored the changes in patient characteristics over time (**Table**). We used mixed-effects models with the Poisson link function and state-specific random intercepts to assess the hospitalization rates adjusted for demographics, and a logit link function and hospital-specific random intercepts to assess the 30-day and 1-year mortality and 30-day readmission rates, adjusted for patient characteristics. A 2-sided $P < .05$ was considered significant. Analyses were performed with SAS version 9.4 (SAS Institute Inc).

Results | From 1999 through 2015, there were 810 969 patients with a principal discharge diagnosis of PE. Mean age did not change significantly (77.6 years). The prevalence of some comorbidities, including myocardial infarction and stroke, decreased. The prevalence of respiratory failure and malnutrition increased ($P < .001$ for trend for all; Table).

The adjusted PE hospitalization rate per 100 000 beneficiary-years was 120.0 (95% CI, 120.0-120.0) in 1999, peaked at 198.0 (95% CI, 194.4-201.6) in 2010, and was 187.2 (95% CI, 184.0-190.4) in 2015. Length of stay declined over time (from 7.7 to 5.0 days; $P < .001$ for trend). A significant decline was observed in adjusted 30-day readmission rates from 1999 through 2015 (from 15.5% to 13.6%; $P = .005$; **Figure**). From 1999 through 2015, unadjusted in-hospital (decline from 8.7% to 4.0%) and adjusted 30-day (decline from 12.7% to 9.4%) and 1-year (decline from 26.3% to 24.1%) mortality rates had a similar pattern ($P < .001$ for trend).

Discussion | From 1999 through 2015 among older US adults, hospitalization rates for PE increased, but LOS, readmission rates, and short-term and 1-year mortality rates declined. Use of a more sensitive diagnostic modality (CTPA), which may lead to the diagnosis of anatomically small or incidental PEs with lower acuity of illness, may explain the trends.[5] Alternatively, the trends, which are consistent with findings from Registro Informatizado de Enfermedad TromboEmbólica (RIETE)[6]—a prospective registry primarily from Europe—may reflect improvements in timeliness of diagnosis and therapeutics and in processes of care for older adults with PE. The mortality rates in the final years, when CTPA was routine,

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remained relatively stable, but LOS and 30-day readmission rates continued to decline.

This study had some limitations. It focused on fee-for-service beneficiaries with principal discharge diagnosis of PE and did not examine other subgroups. Data from 2016 or 2017 were not included because the codes changed to *ICD-10*, which may have affected the trends. No control condition was studied, so it is unknown whether the trends reflect general trends in hospitalizations, readmissions, and mortality.

Additional studies are required to determine the reasons behind the observed trends and strategies that may mitigate the residual risk of death or recurrence in older adults.

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Author Contributions: Dr Wang had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
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Perceived Bullying Among Internal Medicine Residents

Bullying during medical education can have negative consequences that range from the well-being of the trainees to compromised patient care.[1,2] The rates at which medical trainees report bullying has fluctuated widely (10%-48%) in prior studies,[2-4] and differs by level of training and country.

A recent study of internal medicine residency training program directors reported that only 31% were aware of any bullying of their trainees during the previous year.[5] We characterized the proportion of residents who perceived to have been bullied during their residency training.

Methods | This study was deemed exempt by the Johns Hopkins University institutional review board. The Internal Medicine In-Training Examination (IM-ITE) is a self-assessment examination administered by the American College of Physicians every year to internal medicine residents; a brief survey is attached to the end of the examination and its completion is voluntary. The 2016 IM-ITE supplementary survey focused on bullying during residency training.

Bullying was defined as "harassment that occurs repeatedly (>once) by an individual in a position of greater power"[1,2,6] and residents were asked "During your time at your residency program, were you ever bullied?" Those perceiving to have been bullied were asked to characterize the type of harassment (verbal, physical, sexual, or other), the consequences of the bullying (from a list of 8 options plus none of the above; **Table 1**), and whether they sought help.

We used descriptive statistics to summarize trainee and program characteristics and Pearson χ^2 tests for bivariable analysis of characteristics associated with perceived bullying. Multivariable logistic regression models were used to examine the odds of perceived bullying by trainee and program characteristics. Because the probability of experiencing bullying during training could only increase with each postgraduate year, we entered postgraduate year level into the model and

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