Letters

RESEARCH LETTER

Trend in Ventilator-Associated Pneumonia Rates Between 2005 and 2013

From 2006 to 2012, the incidence of ventilator-associated pneumonia (VAP) reported to the Centers for Disease Control and Prevention National Healthcare Safety Network (NHSN) decreased.[1,2] In medical and surgical intensive care units, between 2006 and 2012, the reported incidence of VAP per 1000 ventilator-days decreased from 3.1 to 0.9 (71% decline) and 5.2 to 2.0 (62% decline), respectively. Whether the decrease was attributable to better care or stricter application of subjective surveillance criteria is unclear.[3] The Medicare Patient Safety Monitoring System (MPSMS)[4] has independently measured VAP rates since 2005, using a stable definition of VAP. Trends in MPSMS VAP rates from 2005 through 2013 were analyzed.

Methods | To track the national frequency of safety events in hospitalized patients, the MPSMS abstracted a random selection of acute-care hospital records from 2002-2013, except 2008 (because of a 1-year lapse in federal funding). Between 18 000 and 34 000 records were abstracted from between 730 and 4000 randomly selected hospitals across the nation each year. Detailed MPSMS methods have been previously reported.[4] This analysis included MPSMS VAP rates during calendar years 2005 through 2013 among Medicare patients 65 years and older with principal diagnoses of acute myocardial infarction (AMI), heart failure, pneumonia (including a primary diagnosis of sepsis or

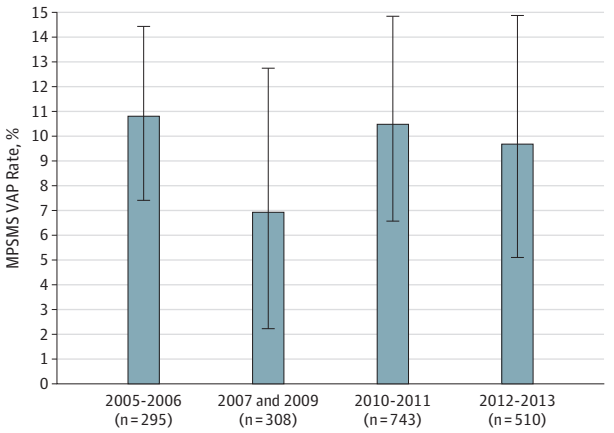
Table. Medicare Patient Safety Monitoring System Patient Characteristics and Observed VAP Rates

	No. (%)				
	2005-2006	2007, 2009	2010-2011	2012-2013	Total
Hospitals, No.	222	249	490	369	1330
MPSMS patients ≥65 y, No.	11 752	15 246	35 307	23 730	86 035
Condition					
AMI	1360 (11.6)	2223 (14.6)	7816 (22.1)	4693 (19.8)	16 092 (18.7)
Heart failure	2689 (22.9)	3268 (21.4)	9417 (26.7)	5999 (25.3)	21 373 (24.8)
Pneumonia	2889 (24.6)	4900 (32.1)	10 480 (29.7)	7353 (31.0)	25 622 (29.8)
Major surgery	4814 (41.0)	4855 (31.8)	7594 (21.5)	5685 (24.0)	22 948 (26.7)
Age, mean (SD), y	77.7 (7.8)	78.5 (8.3)	78.9 (8.4)	78.6 (8.5)	78.6 (8.4)
Sex					
Men	5293 (45.0)	6825 (44.8)	15 998 (45.3)	10 677 (45.0)	38 793 (45.1)
Women	6459 (55.0)	8421 (55.2)	19 309 (54.7)	13 053 (55.1)	47 242 (54.9)
Race[a]					
White	10 372 (88.3)	13 400 (87.9)	30 740 (87.1)	20 583 (86.7)	75 095 (87.3)
Black	785 (6.7)	1049 (6.9)	2869 (8.1)	1957 (8.3)	6660 (7.7)
Other	595 (5.1)	797 (5.2)	1698 (4.8)	1190 (5.0)	4280 (5.0)
Comorbidities					
Cancer	3072 (26.1)	3828 (25.1)	8529 (24.2)	5844 (24.6)	21 273 (24.7)
Diabetes	3856 (32.8)	5300 (34.8)	13 671 (38.7)	9186 (38.7)	32 013 (37.2)
Obesity	1416 (12.1)	2263 (14.8)	6712 (19.0)	5446 (23.0)	15 837 (18.4)
Cerebrovascular disease	2260 (19.2)	3155 (20.7)	7945 (22.5)	4956 (20.9)	18 316 (21.3)
Heart failure/pulmonary edema	5269 (44.8)	7083 (46.5)	18 921 (53.6)	12 075 (50.9)	43 348 (50.4)
Chronic obstructive pulmonary disease	4143 (35.3)	5315 (34.9)	13 003 (36.8)	8627 (36.4)	31 088 (36.1)
Smoking	1363 (11.6)	1995 (13.1)	4753 (13.5)	3652 (15.4)	11 763 (13.7)
Corticosteroids	863 (7.3)	1196 (7.8)	2879 (8.2)	1996 (8.4)	6934 (8.1)
Coronary artery disease	6159 (52.4)	8282 (54.3)	21 750 (61.6)	13 756 (58.0)	49 947 (58.1)
Renal disease	3277 (27.9)	4187 (27.5)	12 183 (34.5)	8593 (36.2)	28 240 (32.8)
Ventilated patients without a prior diagnosis of pneumonia (denominator)	295 (2.5)	308 (2.0)	743 (2.1)	510 (2.1)	1856 (2.2)
VAP cases (% of denominator)	32 (10.8)	23 (7.5)	77 (10.4)	52 (10.2)	180 (9.7)

Abbreviations: AMI, acute myocardial infarction; MPSMS, Medicare Patient Safety Monitoring System; VAP, ventilator-associated pneumonia.

[a] Race obtained from chart abstraction and provided here as a routine component of demographic data.

Figure. Adjusted Ventilator-Associated Pneumonia Rates Among Medicare Patient Safety Monitoring System Patients 65 Years and Older, 2005-2013, Based on Bootstrap Analysis



Error bars indicate 95% CIs.

respiratory failure and a secondary diagnosis of pneumonia), and selected major surgical procedures.

Determination of VAP required all of the following beginning 2 or more days after initiation of mechanical ventilation: chest radiograph with a new finding suggesting pneumonia, physician diagnosis of pneumonia, and an order for antibiotics to treat pneumonia.[4] The denominator included all patients who received invasive mechanical ventilation for 2 or more consecutive days without a physician diagnosis of pneumonia prior to the onset of mechanical ventilation.

MPSMS was reviewed by Solutions IRB and determined not to be research involving human participants.

The cohort was divided into 4 periods (2005-2006, 2007 and 2009, 2010-2011, and 2012-2013). Because the proportions of patients with AMI, heart failure, pneumonia, and major surgery varied from year to year, the 2005-2006 condition-specific proportions served as a baseline. Then, a sample of patients with each condition was randomly selected (with replacement; 10% AMI, 15% heart failure, 20% pneumonia, 55% surgical) for each subsequent period to align the proportions in each period with the condition-specific proportions in 2005-2006. To reduce resampling variability, bootstrap resampling was performed, calculating VAP rates for each period 10 000 times, deriving means and 95% CIs. A mixed model with an ordinal time variable was fit, ranging from 0 to 7, corresponding to years 2005 (time = 0) to 2013 (time = 7), except 2008, to represent the annual change in VAP rates. Analyses were performed using SAS version 9.2 (SAS Institute Inc).

Results | The VAP rate was studied among 1856 patients. Numbers and characteristics of patients included in the sample during each period are reported in the **Table**. MPSMS VAP rates were stable over time (**Figure**), with an observed rate of 10.8% (95% CI, 7.4% to 14.4%) during 2005-2006, 9.7% (95% CI, 5.1% to 14.9%) during 2012-2013, and an adjusted average annual change of 0.00 (95% CI, −0.05 to 0.07).

Discussion | From 2005 through 2013, MPSMS VAP rates remained stable and substantial, affecting approximately 10% of ventilated patients. Persistently high VAP rates bolster concerns that most interventions purported to reduce VAP are supported by limited evidence.[5]

The data have limitations. The VAP rates were not measured in all hospitalized patients, just the subset included in the MPSMS (patients ≥65 years with 4 specific conditions).

The discordance between these findings and the significant declines in VAP rates reported by the NHSN[1,2] could in part be due to differences in MPSMS and NHSN measure definitions, hospitals or patient groups, changes in characteristics of hospitals reporting to the NHSN over time, or preferential declines in VAP rates among hospitals reporting to the NHSN.

Nonetheless, the dichotomy between VAP rates reported to the NHSN and measured in the MPSMS supports the concern that surveillance using traditional definitions may be unreliable.[3] The ongoing risk to patient safety represented by VAP supports the NHSN's decision to explore more objective surveillance targets.[6]

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COMMENT & RESPONSE

Lack of Benefit for Liraglutide in Heart Failure

To the Editor In the Functional Impact of GLP-1 for Heart Failure Treatment (FIGHT) trial, Dr Margulies and colleagues[1] tested liraglutide in patients with advanced, recently decompensated heart failure with reduced left ventricular ejection fraction (LVEF) and found no improvement in clinical outcomes or functional capacity compared with placebo. The lack of benefit and nonsignificant increases in adverse heart failure outcomes in the subgroup of patients with diabetes are reasons for concern.

Liraglutide is clinically indicated to improve glycemic control in diabetes (at the dose used in the study) and for weight loss in patients with obesity (at higher doses). The significant reduction in glycated hemoglobin and reduction in body weight at 30 days and 90 days were therefore predicted effects. As such, the negative results of the study cannot be attributed to a wrong dose or regimen but rather suggest a more complex explanation.

In patients with diabetes and high cardiovascular risk, liraglutide vs placebo showed a significant reduction in the composite end point of cardiac death, myocardial infarction, or stroke, and nonsignificantly lower rehospitalizations for heart failure in the Liraglutide Effect and Action in Diabetes: Evaluation of Cardiovascular Outcome Results (LEADER) study.[2] In patients with clinically stable heart failure, albiglutide, another glucagon-like peptide 1 (GLP-1) agonist, improved peak oxygen consumption measured by ventilatory expired gas but not 6-minute walk test distance.[3]

Why are the results of these trials discordant? The most obvious difference is that the FIGHT study included patients with advanced heart failure (New York Heart Association [NYHA] class IV), whereas in the other studies,[2,3] patients had no or moderate heart failure (NYHA class II-III), and patients with advanced heart failure were excluded. One possibility is that the effects of GLP-1 agonists may diverge on the basis of heart failure severity. Advanced heart failure is characterized by loss of weight and lean mass, portending an unfavorable prognosis[4]; therefore, further weight loss may have influenced the FIGHT study outcomes. In the LEADER study, liraglutide had more favorable effects in the subgroups with a body mass index (BMI) greater than 30 and without heart failure.[2]

For hypothesis-generating purposes, we would like the authors to provide results stratified by BMI, weight loss, and severity of heart failure (ie, LVEF). If available, a body composition assessment would help determine whether BMI or fat or lean mass at baseline and interval changes predicted any functional improvement. In the era of precision medicine, the assessment of both heart failure severity and body weight or composition is warranted to find the most effective therapy.

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In Reply As highlighted by Mr Carbone and colleagues, comparing the FIGHT study with other recent trials of GLP-1 agonists raises interesting questions about how heart failure severity might affect GLP-1 response. Although the FIGHT study enrolled few patients with NYHA IV functional capacity (29% NYHA II, 63% NYHA III, and 5% NYHA IV), the patients enrolled clearly had more advanced heart failure (late American Heart Association/American College of Cardiology [AHA/ACC] stage C) than those in the LEADER study[1] (mostly AHA/ACC stage A and B) or the Evaluation of Lixisenatide in Acute Coronary Syndrome (ELIXA) trial,[2] which enrolled patients with a recent acute coronary event (early AHA/ACC stage C). There are many important distinctions among these and other recent trials of GLP-1 agonists for patients with type 2 diabetes.[3] Nevertheless, the overall signal that seems to emerge is a reduction in cardiovascular outcomes among patients at risk for structural heart disease, a lack of effect on heart failure outcomes among those with early cardiac remodeling, and possible detrimental effects on heart failure outcomes in patients with advanced symptomatic heart failure.