

## BRIEF REPORTS

# Blood Culture Use in the Emergency Department in Patients Hospitalized With Respiratory Symptoms Due to a Nonpneumonia Illness

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**BACKGROUND:** Guidelines and performance measures recommend obtaining blood cultures in selected patients hospitalized with community-acquired pneumonia (CAP). Due to inherent diagnostic uncertainty, there may be spillover effects of these recommendations on other conditions that resemble pneumonia.

**METHODS:** Using data from the 2002 to 2010 National Hospital Ambulatory Medical Care Survey, a nationally representative sample of emergency department (ED) visits in the United States, we analyzed trends in obtaining cultures in patients hospitalized with respiratory symptoms due to a nonpneumonia illness using linear regression.

**RESULTS:** The most common primary admission diagnoses for these visits included heart failure (16%), chronic

obstructive pulmonary disease (13%), and chest pain (12%). The proportion of cultures collected in the ED during these visits increased from 10% (95% confidence interval [CI]: 7%-14%) in 2002 to 20% (95% CI: 16%-26%) in 2010 ( $P < 0.001$  for the trend). This represented a parallel increase compared to patients hospitalized with CAP ( $P = 0.12$  for the difference in trends).

**CONCLUSIONS:** The increase in collecting cultures in the ED in patients hospitalized with respiratory symptoms due to a nonpneumonia illness suggests an important potential unintended consequence of blood culture recommendations for CAP. More attention to the judicious use of blood cultures to reduce harm and costs is needed. *Journal of Hospital Medicine* 2014;9:521-524. © 2014 Society of Hospital Medicine

In 2002, based on consensus practice guidelines,<sup>1</sup> the Centers for Medicare and Medicaid Services (CMS) and the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) announced a core measure mandating the collection of routine blood cultures in the emergency department (ED) for all patients hospitalized with community-acquired pneumonia (CAP) to benchmark the quality of hospital care. However, due to the limited utility and false-positive results of routine blood cultures,<sup>2-6</sup> performance measures and practice guidelines were modified in 2005 and 2007, respectively, to recommend routine collection in only the sickest patients with CAP.<sup>2,7</sup> Despite recommendations for a more narrow set of indications, the collection of blood cultures in patients hospitalized with CAP continued to increase.<sup>8</sup>

Distinguishing CAP from other respiratory illnesses may be challenging. Among patients presenting to the ED with an acute respiratory illness, only a minority of patients (10%-30%) are diagnosed with pneumonia.<sup>9</sup> Therefore, the harms and costs of inappropriate diagnostic tests for CAP may be further magnified if

applied to a larger population of patients who present to the ED with similar clinical signs and symptoms as pneumonia. Using a national sample of ED visits, we examined whether there was a similar increase in the frequency of blood culture collection among patients who were hospitalized with respiratory symptoms due to an illness other than pneumonia.

## METHOD

### Study Design, Setting, and Participants

We performed a cross-sectional analysis using data from the 2002 to 2010 National Hospital Ambulatory Medical Care Surveys (NHAMCS), a probability sample of visits to EDs of noninstitutional general and short-stay hospitals in the United States, excluding federal, military, and Veterans Administration hospitals.<sup>10</sup> The NHAMCS data are derived through multi-stage sampling and estimation procedures that produce unbiased national estimates.<sup>11</sup> Further details regarding the sampling and estimation procedures can be found on the US Centers for Disease Control and Prevention website.<sup>10,11</sup> Years 2005 and 2006 are omitted because NHAMCS did not collect blood culture use during this period. We included all visits by patients aged 18 years or older who were subsequently hospitalized.

### Measurements

Trained hospital staff collected data with oversight from US Census Bureau field representatives.<sup>12</sup> Blood culture collection during the visit was recorded as a checkbox on the NHAMCS data collection form if at

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least 1 culture was ordered or collected in the ED. Visits for conditions that may resemble pneumonia were defined as visits with a “respiratory symptom” listed for at least 1 of the 3 “reason for visit” fields, excluding those visits admitted with a diagnosis of pneumonia (International Classification of Diseases, 9th Revision, Clinical Modification [ICD-9-CM] codes 481.xx-486.xx). The “reason for visit” field captures the patient’s complaints, symptoms, or other reasons for the visit in the patient’s own words. CAP was defined by having 1 of the 3 ED provider’s diagnosis fields coded as pneumonia (ICD-9-CM 481–486), excluding patients with suspected hospital-acquired pneumonia (nursing home or institutionalized resident, seen in the ED in the past 72 hours, or discharged from any hospital within the past 7 days) or those with a follow-up visit for the same problem.<sup>8</sup>

### Data Analysis

All analyses accounted for the complex survey design, including weights, to reflect national estimates. To examine for potential spillover effects of the blood culture recommendations for CAP on other conditions that may present similarly, we used linear regression to examine the trend in collecting blood cultures in patients admitted to the hospital with respiratory symptoms due to a nonpneumonia illness.

The data were analyzed using Stata statistical software, version 12.0 (StataCorp, College Station, TX). This study was exempt from review by the institutional review board of the University of California, San Francisco and the San Francisco Veterans Affairs Medical Center.

### RESULTS

This study included 4854 ED visits, representing approximately 17 million visits by adult patients hospitalized with respiratory symptoms due to a nonpneumonia illness. The most common primary ED provider’s diagnoses for these visits included heart failure (15.9%), chronic obstructive pulmonary disease (12.6%), chest pain (11.9%), respiratory insufficiency or failure (8.8%), and asthma (5.5%). The characteristics of these visits are shown in Table 1.

The proportion of blood cultures collected in the ED for patients hospitalized with respiratory symptoms due to a nonpneumonia illness increased from 9.9% (95% confidence interval [CI]: 7.1%-13.5%) in 2002 to 20.4% (95% CI: 16.1%-25.6%) in 2010 ( $P < 0.001$  for the trend). This observed increase paralleled the increase in the frequency of culture collection in patients hospitalized with CAP ( $P = 0.12$  for the difference in temporal trends). The estimated absolute number of visits for respiratory symptoms due a nonpneumonia illness with a blood culture collected increased from 211,000 (95% CI: 126,000–296,000) in 2002 to 526,000 (95% CI: 361,000–692,000) in 2010, which was similar in magnitude to

**TABLE 1.** Characteristics of Visits to the ED by Patients Hospitalized With Respiratory Symptoms Due to a Nonpneumonia Illness From 2002 to 2010\*

	Years 2002–2004, Weighted % (Unweighted N = 2,175) <sup>†</sup>	Years 2007–2008, Weighted % (Unweighted N = 1,346) <sup>†</sup>	Years 2009–2010, Weighted % (Unweighted N = 1,333) <sup>†</sup>
Blood culture collected	9.8	14.4	19.9
Demographics			
Age ≥65 years	56.9	55.1	50.9
Female	54.0	57.5	51.3
Race/ethnicity			
White, non-Hispanic	71.5 <sup>‡</sup>	69.5	67.2
Black, non-Hispanic	17.1 <sup>‡</sup>	20.8	22.2
Other	11.3 <sup>‡</sup>	9.7	10.6
Primary payer			
Private insurance	23.4	19.1	19.1
Medicare	55.2	58.0	54.2
Medicaid	10.0	10.5	13.8
Other/unknown	11.4	12.4	13.0
Visit characteristics			
Disposition status			
Non-ICU	86.8	85.5	83.3
ICU	13.2	14.5	16.7
Fever (≥38.0°C)	6.1	5.3	4.8
Hypoxia (<90%) <sup>§</sup>	—	11.5	10.9
Emergent status by triage	46.1	44.5	35.8
Administered antibiotics	19.6	24.6	24.8
Tests/services ordered in ED			
0–5	29.9	29.1	22.3
6–10	43.5	58.3	56.1
>10	26.6	12.6	21.6
ED characteristics			
Region			
West	16.6	18.2	15.8
Midwest	27.1	25.2	22.8
South	32.8	36.4	38.6
Northeast	23.5	20.2	22.7
Hospital owner			
Nonprofit	80.6	84.6	80.7
Government	12.1	6.4	13.0
Private	7.4	9.0	6.3

NOTE: Abbreviations: ED, emergency department; ICU, intensive care unit.

\*Years 2005 and 2006 are omitted for missing the blood culture field in the survey.

<sup>†</sup>Percentages shown are weighted to reflect complex survey design. All estimates are considered to be reliable (standard errors below the 30% threshold recommended by the National Hospital Ambulatory Medical Care Survey for reporting data and 30 or more unweighted observations per subgroup).

<sup>‡</sup>Excludes year 2002 due to incomplete ethnicity ascertainment (unweighted number for race/ethnicity ascertainment = 1,496).

<sup>§</sup>Only for years 2007 to 2010, which included oxygen saturation in the survey.

the estimated number of visits for CAP with a culture collected (Table 2).

### DISCUSSION

In this national study of ED visits, we found that the collection of blood cultures in patients hospitalized with respiratory symptoms due to an illness other than pneumonia continued to increase from 2002 to 2010 in a parallel fashion to the trend observed for patients hospitalized with CAP. Our findings suggest that the heightened attention of collecting blood

**TABLE 2.** Emergency Department Visits With a Blood Culture Collected in Patients Subsequently Hospitalized, Stratified by Select Conditions\*

Condition	National Weighted Estimates (95% CI)							PValue <sup>†</sup>
	2002	2003	2004	2007	2008	2009	2010	
Respiratory symptom <sup>‡</sup>								
%	9.9 (7.1–13.5)	9.2 (6.9–12.2)	10.6 (7.9–14.1)	13.5 (10.1–17.8)	15.2 (12.1–18.8)	19.4 (15.9–23.5)	20.4 (16.1–25.6)	<0.001
No., thousands	211 (126–296)	229 (140–319)	212 (140–285)	287 (191–382)	418 (288–548)	486 (344–627)	526 (361–692)	
CAP								
%	29.4 (21.9–38.3)	34.2 (25.9–43.6)	38.4 (31.0–45.4)	45.7 (35.4–56.4)	44.1 (34.1–54.6)	46.7 (37.4–56.1)	51.1 (41.8–60.3)	0.027
No., thousands	155 (100–210)	287 (177–397)	276 (192–361)	277 (173–381)	361 (255–467)	350 (237–464)	428 (283–574)	

NOTE: Abbreviations: CAP, community-acquired pneumonia; CI, confidence interval; ICD-9, International Classification of Diseases, 9th Revision.

\*Years 2005 and 2006 are omitted for missing the blood culture field in the survey.

<sup>†</sup>Linear trend analysis.

<sup>‡</sup>Respiratory symptoms were defined by the patient's reason for visit. Excludes visits with an emergency department provider's diagnosis of pneumonia (ICD-9 481–486).

cultures for suspected pneumonia had unintended consequences, which led to an increase in the collection of blood cultures in patients hospitalized with conditions that mimic pneumonia in the ED.

There can be a great deal of diagnostic uncertainty when treating patients in the ED who present with acute respiratory symptoms. Unfortunately, the initial history and physical exam are often insufficient to effectively rule in CAP.<sup>13</sup> Furthermore, the challenge of diagnosing pneumonia is amplified in the subset of patients who present with evolving, atypical, or occult disease. Faced with this diagnostic uncertainty, ED providers may feel pressured to comply with performance measures for CAP, promoting the overuse of inappropriate diagnostic tests and treatments. For instance, efforts to comply with early antibiotic administration in patients with CAP have led to an increase in unnecessary antibiotic use among patients with a diagnosis other than CAP.<sup>14</sup> Due to concerns for these unintended consequences, the core measure for early antibiotic administration was effectively retired in 2012.

Although a smaller percentage of ED visits for respiratory symptoms had a blood culture collected compared to CAP visits, there was a similar absolute number of visits with a blood culture collected during the study period. While a fraction of these patients may present with an infectious etiology aside from pneumonia, the majority of these cases likely represent situations where blood cultures add little diagnostic value at the expense of potentially longer hospital stays and broad spectrum antimicrobial use due to false-positive results,<sup>5,15</sup> as well as higher costs incurred by the test itself.<sup>15,16</sup>

Although recommendations for routine culture collection for all patients hospitalized with CAP have been revised, the JCAHO/CMS core measure (PN-3b) announced in 2002 mandates that if a culture is collected in the ED, it should be collected prior to antibiotic administration. Due to inherent uncertainty and challenges in making a timely diagnosis of pneumonia, this measure may encourage providers to reflexively

order cultures in all patients presenting with respiratory symptoms in whom antibiotic administration is anticipated. The observed increasing trend in culture collection in patients hospitalized with respiratory symptoms due to a nonpneumonia illness should prompt JCAHO and CMS to reevaluate the risks and benefits of this core measure, with consideration of eliminating it altogether to discourage overuse in this population.

Our study had certain limitations. First, the omission of 2005 and 2006 data prohibited an evaluation of whether culture rates slowed down among patients hospitalized with respiratory symptoms due to a nonpneumonia illness after revisions in recommendations for obtaining cultures in patients with CAP. Second, there may have been misclassification of culture collection due to errors in chart abstraction. However, abstraction errors in the NHAMCS typically result in undercoding.<sup>17</sup> Therefore, our findings likely underestimate the magnitude and frequency of culture collection in this population.

In conclusion, collecting blood cultures in the ED for patients hospitalized with respiratory symptoms due to a nonpneumonia illness has increased in a parallel fashion compared to the trend in culture collection in patients hospitalized with CAP from 2002 to 2010. This suggests an important potential unintended consequence of blood culture recommendations for CAP on patients who present with conditions that resemble pneumonia. More attention to the judicious use of blood cultures in these patients to reduce harm and costs is needed.

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