Nonvalue of the Initial Microbiological Studies in the Management of Nonsevere Community-Acquired Pneumonia*

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Study objective: To assess the value of the initial microbiological studies (MBS), consisting of sputum Gram’s stains, sputum cultures, and blood cultures, in the etiologic diagnosis of community-acquired pneumonia (CAP) without comorbidity.

Design: A prospective study of 74 adult patients hospitalized with nonsevere CAP empirically treated according to the American Thoracic Society guidelines (ATS-GL) and evaluated with Gram’s stains and cultures of valid sputum specimens and blood cultures.

Setting: University-affiliated community hospital.

Results: Gram’s stain of a valid sputum specimen failed to identify the etiologic agent in all patients. Sputum cultures identified pathogens in only four patients (5%). The results of all blood cultures were negative. All patients responded to the initial empiric antibiotic coverage selected according to the ATS-GL, and the results of the initial MBS had no clinical impact.

Conclusion: The initial MBS, such as sputum Gram’s stains, sputum cultures, and blood cultures, have no value in the management of nonsevere CAP without comorbid factors.

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Key words: community-acquired pneumonia; microbiology; sputum culture; sputum Gram’s stain

Abbreviations: ATS-GL = American Thoracic Society guidelines; CAP = community-acquired pneumonia; MBS = microbiological studies

The clinical efficacy of sputum Gram’s stains and sputum cultures in the management of community-acquired pneumonia (CAP) remains unclear.1–3 Traditional recommendations for management usu-

ally include Gram’s stains and cultures of the sputum in the routine evaluation of all patients with pneumonia.4,5 Some proponents feel that a properly performed sputum Gram’s stain examined according to strict criteria (ie, 25 neutrophils and less than five squamous epithelial cells per low-power field) is useful in the initial evaluation of patients with pneumonia.4–6 Others suggest that sputum Gram’s stains and sputum cultures are neither sensitive nor specific in the diagnosis of CAP.7–9 Many clinicians continue to obtain sputum Gram’s stains and sputum cultures in the evaluation of their patients with CAP despite the absence of any studies correlating data from these tests with cultures of alveolar material in a large number of patients with CAP. While an occasional study has affirmed the value of sputum Gram’s stain in predicting etiologic microorganisms in patients with bacteremic CAP,6 the usefulness of data obtained from similarly valid Gram’s stains and cultures from sputum specimens in patients with nonbacteremic CAP remains uncertain.

A closer look at the studies recommending the use of sputum Gram’s stains and sputum cultures in the evaluation of CAP shows that the studied groups consisted of heterogeneous patients of all ages with a myriad of comorbid factors, including chronic obstructive lung disease, malignancy, diabetes mellitus, neurologic disease, and immune compromise.5,6 Additionally, complicated pneumonias, including ne-
crotizing pneumonias, lung abscesses, pleural effusions, empyemas, and those with life-threatening infections and respiratory failure, also are included in these studies. Consequently, it seems inappropriate to extrapolate the results from such heterogeneous groups to those with simple (ie, uncomplicated) nonsevere CAP without associated comorbid factors.

In order to assess the value of the initial MBS (ie, sputum Gram’s stain, sputum culture, and blood culture) in the diagnosis and management of uncomplicated CAP without associated comorbid factors, we prospectively studied a group of 74 adult patients hospitalized with this diagnosis and managed according to the American Thoracic Society guidelines (ATS-GL), as regards empiric antibiotic coverage.

**Materials and Methods**

A total of 212 consecutive patients with the diagnosis of CAP admitted to St. Joseph’s Hospital and Medical Center in Paterson, NJ, were screened prospectively over a 12-month period. CAP was clinically defined as an acute febrile illness with respiratory symptoms and a new infiltrate on the chest roentgenogram in a community resident. Patients with malignancies, AIDS, nosocomial pneumonia, alcohol abuse, injection drug abuse, renal failure, chronic obstructive lung disease, insulin-dependent diabetes mellitus, and neurologic illness and those ≥65 years of age were excluded (Table 1). Patients with complicated pneumonia (ie, cavitary disease and pleural effusion), patients with prior antibiotic use within 2 weeks before admission to the hospital, and patients with severe pneumonia also were excluded (Table 1). Severe CAP was defined according to the ATS-GL. Only those patients who provided valid sputum specimens (ie, specimens with ≥20 neutrophils per low-power field) were included in the study. The screening process thus yielded 74 patients for further analysis. Applying the ATS-GL criteria of severity and the decision for hospitalization, these patients were further subdivided into a group with clinically justifiable hospitalization and another group in which hospitalization seemed unnecessary.

In addition to an initial chest roentgenogram, all patients underwent the following: blood cultures; routine blood tests, including CBC and differential leukocyte count; blood chemistry tests; and other clinically relevant tests. All patients provided a spontaneously expectorated sputum specimen, which was collected under the supervision of a resident in a sterile specimen container and was transported and processed immediately in the hospital bacteriology laboratory by a technician under the supervision of a bacteriologist. The technique of sample selection for Gram’s stains as well as cultures consisted of teasing out the purulent portion of the sputum, a section of which was then thinly spread over a glass slide. The standard technique of Gram’s staining was employed. All Gram’s stains first were screened under a microscope at low power to assess the appropriateness of the sample. Only those patients who provided sputum specimens containing ≥20 neutrophils and <10 squamous epithelial cells were included in the study. Specimens thus screened were examined further for bacteria and were cultured. The technique of sputum culture consisted of the incubation of the remaining purulent portion of the sputum specimen on chocolate agar for 48 h, on blood agar, and on MacConkey agar. Chocolate agar was incubated in 5% CO₂ for the first 24 h. Blood cultures were processed by conventional microbiological techniques. All chest roentgenograms were examined by a radiologist, and the location and extent of pneumonic infiltrates were documented. Empiric antibiotic coverage was initiated after the sputum samples were collected. Empiric antibiotic coverage on admission to the hospital consisted of a macrolide with a second-generation or third-generation cephalosporin in all patients, as recommended by the ATS-GL for the management of hospitalized patients with CAP.

### Results

Seventy-four patients (42 men, 32 women; age range, 22 to 64 years; mean age, 48 years) met the criteria for nonsevere uncomplicated CAP without comorbidity. The presenting symptoms consisted of cough with sputum production in 74 patients (100%), pleuritic chest pain in 60 patients (81%), and fever in 74 patients (100%). Sixty-eight patients (92%) showed an infiltrate involving a single lobe, while 6 patients (8%) showed an infiltrate involving two or more lobes on the chest roentgenogram. Of the 74 patients with nonsevere CAP, 53 (72%) met the following ATS-GL criteria for hospitalization: temperature > 101°F, 38 patients; WBC count of < 4 × 10⁹ cells/L, 3 patients; PaO₂ < 60 mm Hg on room air, 7 patients; and significant vomiting, 5 patients. Twenty-one patients (28%) did not meet the ATS-GL criteria and could have been treated as outpatients.

All patients experienced improvement in their symptoms within 48 h and became afebrile in 96 h, with improvement in the findings of their chest roentgenograms. No patient required a change in the empiric antibiotic coverage instituted on the day of admission.

### Table 1—Patients Excluded From the Study

<table>
<thead>
<tr>
<th>Variables</th>
<th>Patients, No.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comorbid factors</td>
<td></td>
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<tr>
<td>Malignancies</td>
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<tr>
<td>AIDS</td>
<td>22</td>
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<tr>
<td>Injection drug use</td>
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<td>Nosocomial pneumonia</td>
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<tr>
<td>Alcohol abuse</td>
<td>6</td>
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<tr>
<td>Renal failure</td>
<td>5</td>
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<tr>
<td>Chronic obstructive lung disease</td>
<td>4</td>
</tr>
<tr>
<td>Insulin-dependent diabetes mellitus</td>
<td>4</td>
</tr>
<tr>
<td>Neurologic illness</td>
<td>7</td>
</tr>
<tr>
<td>Patients ≥65 years</td>
<td>38</td>
</tr>
<tr>
<td>Complicated pneumonias</td>
<td></td>
</tr>
<tr>
<td>Cavitary pneumonia</td>
<td>5</td>
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<tr>
<td>Pleural effusion</td>
<td>9</td>
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<tr>
<td>Severe pneumonia</td>
<td>2</td>
</tr>
<tr>
<td>Prior antibiotic therapy</td>
<td>7</td>
</tr>
<tr>
<td>No sputum or invalid sputum</td>
<td>11</td>
</tr>
</tbody>
</table>

*Most patients had more than one reason for exclusion but are listed under single category.
All 74 valid sputum specimens (100%) showed mixed flora on Gram’s stains without a predominant organism or an intracellular organism. Of the 74 valid sputum samples cultured, 70 (95%) demonstrated normal respiratory flora consisting of a few colonies of \( \alpha \)-streptococci, \( \gamma \)-streptococci, Neisseria catarrhalis, and Lactobacillus. Only four sputum cultures (5%) yielded the following pathogens: Streptococcus pneumoniae, 1 patient (1%); Klebsiella pneumoniae, 2 patients (3%); and Haemophilus influenzae, 1 patient (1%). All blood cultures were devoid of microbial growth.

**Discussion**

In this prospective study of 74 patients with nonsevere CAP without comorbid factors, a Gram’s stain of a valid sputum specimen failed to identify the etiologic agent in all patients, and sputum cultures identified a pathogen in only 4 patients (5%). All blood cultures were devoid of bacterial growth. Moreover, all patients responded to the initial empiric antibiotic coverage selected according to the recommendations of the ATS-GL, and the information obtained from the initial microbiological tests had no clinical impact.

Studies recommending the use of sputum Gram’s stain and sputum culture in the initial evaluation of CAP generally consist of heterogeneous groups of patients of all ages with several comorbid factors. Boerner and Zwadyk, in a study of 89 patients with CAP, concluded that sputum Gram’s stain is a sensitive and reliable indicator with which to guide therapy and to predict outcome. The patient population in their study consisted of mostly elderly subjects with a high prevalence of alcoholism, smoking, malignant neoplasia, neurologic disease, and diabetes mellitus. Some had extensive infiltrates, cavitations, or pleural effusions demonstrated on the chest roentgenograms. Clearly, these patients were quite different from those with nonsevere and uncomplicated CAP who were younger and otherwise healthy. Another prospective study recommending the use of valid sputum Gram’s stain to guide the initial antibiotic therapy in CAP consisted of 59 bacteremic patients with a mean age of 65 years. Information regarding the severity of illness, the presence of other comorbid factors, or the extent of roentgenographic involvement was not provided. Bacteremia is a marker of severe illness and conceivably indicates a larger bacterial load in the patient’s lung and in the sputum. It would, therefore, seem inappropriate to extrapolate the results from these studies to those studies of patients with nonsevere CAP without comorbidity, who are the subject of our investigation.

Conversely, there have been several other reports of which do not support the need for these MBS. Bates and coworkers, in a study of 52 patients with bacterial pneumonia of whom only 34 were able to produce sputum, found only 5 patients (9%) that yielded a pathogen. Similarly, Chalasani and coworkers, in a retrospective study of 517 patients with CAP, found that blood cultures did not have a significant impact on medical management. In another study of 184 patients with CAP without comorbid factors, even though 23% of sputum cultures and 11% of blood cultures yielded positive results among patients with nonsevere CAP, the authors did not endorse the use of MBS in the initial management of these patients.

The striking finding in this study is that among 74 patients with CAP without comorbid factors, not a single sputum Gram’s stain or blood culture and only four sputum cultures (5%) yielded a pathogen. Such low yields from MBS cannot be ascribed to poor processing of the specimens or to suboptimal laboratory techniques of smear examination and culture, since similarly handled and processed specimens from other categories of patients with infectious disease show higher yields in the same laboratory. All sputum specimens were procured under the supervision of the medical residents and were transported to the laboratory and processed immediately. All microbiological procedures were conducted by qualified technicians, under the supervision of a microbiologist who was in charge of the hospital laboratory, with strict quality controls. Prior use of antibiotics as a cause of low yield also can be ruled out since patients with previous antibiotic use for 2 weeks prior to hospitalization were excluded from this study. The inclusion of relatively younger patients in this study may have skewed the etiology toward an atypical pathogen such as Mycoplasma, Chlamydia, or even Legionella, for which a sputum Gram’s stain, a sputum culture, and a blood culture obviously would be wasted endeavors. Therefore, it is logical to conclude that bacterial pneumonias in our patients escaped detection by the conventional MBS, including sputum Gram’s stain, sputum culture, and blood culture.

Applying the ATS-GL criteria for hospitalization, we found that 28% of our hospitalized patients with CAP could have been treated as outpatients. This is a consistent finding in almost all studies including the original pneumonia-severity index study by Fine et al. Patients with nonsevere, uncomplicated CAP without comorbid factors who are appropriate for outpatient therapy similarly can safely forgo MBS. These tests merely add an incremental cost to patient care without significant benefit.

Besides providing a low diagnostic yield in other-
wise healthy patients with nonsevere CAP, these MBS do not affect the outcome when the initial antibiotic regimens are selected based on severity of illness and comorbid factors, as recommended by the ATS-GL. In the study of 184 patients hospitalized for CAP without comorbid factors by Sanyal and colleagues,\textsuperscript{12} when initial antibiotic selection was based on the ATS-GL, only 14\% of patients did not respond. There was no difference in mortality between those nonresponders whose antibiotics were changed empirically and those with microbiologically guided changes.

In summary, our results indicate that the sputum Gram's stains, sputum cultures, and blood cultures in patients with nonsevere CAP without comorbid factors do not provide diagnostically useful information, and they do not help in guiding initial therapy. Furthermore, these tests do not have any impact on the clinical outcome when the initial empiric antibiotic selection is based on a severity index, coexisting illness, and age, as recommended by the ATS-GL. These tests may be reserved for other categories of patients such as those excluded from our study. These conclusions obviously pertain only to a narrowly defined segment of patients with CAP and must not be applied to the management of patients with severe CAP or to those patients who have comorbid factors.

REFERENCES