Validation and Modification of Streptococcal Pharyngitis Clinical Prediction Rules

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*Objective:* To validate a simplified version of the Walsh clinical prediction rules (CPRs) for the presence of streptococcal pharyngitis in an inner-city, ethnically diverse population.

*Patients and Methods:* This prospective study conducted in New York City, NY, from January 1, 1997, to May 31, 1997, consisted of 171 consecutive adult walk-in patients who presented with symptoms of upper respiratory tract infection and/or sore throat. The patients were assessed by using 5 clinical factors: cough, exposure to known streptococcal contact, temperature, tonsillar-pharyngeal exudates, and cervical lymphadenopathy. Throat cultures for group A β-hemolytic streptococcus were obtained from all patients. Clinicians assessing the patients were unaware of throat culture results, and those processing the throat cultures were blinded to the clinical predictors.

*Results:* The prevalence of streptococcal pharyngitis was 24% (95% confidence interval, 18%-30%). The simplified version of the Walsh CPR for streptococcal pharyngitis predicted accurately the probability of a positive culture in our diverse population (area under the receiver operating characteristic curve, 0.71). The simplified CPR also showed clinically useful likelihood ratios and posterior probabilities.

*Conclusion:* A simplified version of the Walsh CPR is accurate for diagnosing streptococcal pharyngitis in an inner-city population. This finding should provide clinicians more confidence in applying the CPR in similar clinical settings.


Upper respiratory tract infections and sore throat are the most common acute illnesses in the United States and are responsible for the vast majority of absences from the workplace.1 Most patients have benign viral infections,2 and only 5%-17% have streptococcal pharyngitis.3,6 Distinguishing between patients with viral infections and those suspected of having streptococcal pharyngitis is often difficult. Several diagnostic kits or rapid streptococcus tests have been developed to help clinicians manage such patients; however, the utility of these kits has been questioned because of poor sensitivity and lack of cost-effectiveness in primary care settings.7,8

Clinical prediction rules (CPRs) can be used in this context. These practical decision-making tools include 3 or more variables obtained from the patient’s history, physical examination, or simple diagnostic tests and either provide probability of an outcome or suggest a diagnostic or therapeutic course of action9,10; however, caution must be used when a CPR is applied to a clinical setting with a different spectrum of disease from which the rule has been derived. Ideally, a CPR should be tested or validated in several different groups of patients before it can be used confidently in practice.10-12

Several CPRs have been developed over the years to help clinicians manage patients suspected of having streptococcal pharyngitis.3,4,13,14 Most of the previously derived CPRs for streptococcal pharyngitis include some variation of the following predictors: history of close contact with a person suspected of having streptococcal pharyngitis, lack of cough, temperature, tonsillar exudates, and enlarged or tender anterior cervical lymph nodes. To ob-
Table 1. Walsh Clinical Prediction Rules*

<table>
<thead>
<tr>
<th>Clinical predictor</th>
<th>Points</th>
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<tbody>
<tr>
<td>Temperature</td>
<td>3</td>
</tr>
<tr>
<td>Exposure to known streptococcal pharyngitis</td>
<td>17</td>
</tr>
<tr>
<td>Recent cough</td>
<td>-7</td>
</tr>
<tr>
<td>Pharyngeal or tonsillar exudates</td>
<td>6</td>
</tr>
<tr>
<td>Enlarged or tender nodes</td>
<td>11</td>
</tr>
</tbody>
</table>

Determine risk of streptococcal pharyngitis

<table>
<thead>
<tr>
<th>Patient's score</th>
<th>Positive likelihood ratio</th>
<th>% of patients with streptococcal pharyngitis (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-10 to 0</td>
<td>0.16</td>
<td>4.6 (0.0-12.0)</td>
</tr>
<tr>
<td>1 to 10</td>
<td>1.12</td>
<td>25.6 (13.5-41.2)</td>
</tr>
<tr>
<td>11 to 20</td>
<td>1.25</td>
<td>27.8 (14.2-45.2)</td>
</tr>
<tr>
<td>21 to 30</td>
<td>9.77</td>
<td>75.0 (47.6-92.7)</td>
</tr>
<tr>
<td>31 to 40</td>
<td>9.74</td>
<td>75.0 (19.4-99.4)</td>
</tr>
</tbody>
</table>

*CI = confidence interval.

However, this simplified version has never been validated. Therefore, our objectives were (1) to evaluate the diagnostic accuracy of a simplified user-friendly version of the streptococcal pharyngitis CPR by using presence of cough, fever, tonsillar or pharyngeal exudates, and cervical lymphadenopathy as well as exposure to known streptococcal contact and (2) to validate this version prospectively in an inner-city, ethnically diverse population.

PATIENTS AND METHODS

The study was conducted prospectively from January 1, 1997, to May 31, 1997, at the primary care clinic of an inner-city hospital in New York City, NY. We enrolled 171 consecutive unscheduled adult walk-in patients who presented with symptoms of upper respiratory tract infection and/or sore throat. Patients were first triaged by staff nurses and then seen by residents or attending physicians. All patients were assessed with use of the 5 predictors in the CPRs (Tables 1 and 2). The predictors were determined as follows: (1) oral temperature was recorded for each patient and entered on the chart by the triage nurse; (2) for history of close contact, patients were asked if they had had close contact with a person whom they believed to have a streptococcal infection; and (3) for cough, patients were asked if they currently had a cough. On physical examination, the patients were assessed by physicians for (4) presence or absence of pharyngeal or tonsillar exudates and (5) enlarged or tender anterior cervical lymph nodes. Neither residents nor attending physicians were given special instruction on how to assess these predictors.

The simplified version was developed by modifying the original sore throat scoring system in a manner similar to what physicians use in their day-to-day practice. Each of the 5 clinical predictors was given an equal weight of 1 point; the presence of cough was assigned a -1 weight because of its association with the absence of streptococcal infection. Fever was coded as present if the patient’s temperature was greater than 38.3°C. Throat cultures for group A β-hemolytic streptococcus (GBHS) were obtained from all patients. Clinicians who assessed the presence or absence of predictors were unaware of the throat culture results, and those who processed the cultures were blinded to the clinical information.

Sensitivity, specificity, likelihood ratios, and area under the receiver operating characteristic (ROC) curve were calculated by using SAS statistical software (version 8, Cary, NC).15,16

RESULTS

Of the 171 enrolled patients, 5 were excluded because the results of throat cultures were not available. The preva-
lence of streptococcal pharyngitis in our population was 24% (95% confidence interval [CI], 18%-30%). The mean age was 35 years (range, 18-74 years), and 23% of the patients were men (Table 3).

Both the original Walsh CPR and the simplified version predicted accurately the probability of a positive culture for GABHS. The ROC curves (Figure 1) and areas under the ROC curves of the simplified and original scoring system were similar (0.71 [95% CI, 0.67-0.74] vs 0.81 [95% CI, 0.77-0.85] for simplified and Walsh, respectively; P=.21).

The simplified CPR scores and culture results of 166 patients with complete data are shown in Table 2. A positive throat culture for GABHS was found in 3 (4.6%) of 65 patients with a clinical score of -1, 7 of 44 (15.9%) of those with a score of 0, 16 of 36 (44.4%) of those with a score of 1, 8 of 14 (57.1%) of those with a score of 2, and 5 of 6 (83.3%) of those with a score of 3. Patients with a score of -1 accounted for 39.1% of presentations, and those with a score of 2 or higher accounted for 12.5%.

Management recommendations based on the use of the simplified CPR are listed in Table 4.

**DISCUSSION**

Because of the large number of published CPRs, it appears that physicians have become aware of and have incorporated the important clinical predictors for streptococcal pharyngitis into their day-to-day management of patients. However, physicians have simplified the process, assessing probability of GABHS infection by counting the number of variables present in a patient. If no clinical predictors are present (score, -1), no treatment is offered; if several predictors are present (score, >2), treatment is offered. This method of assessment appears, at least in our study, to be accurate.

There are several practical implications of this CPR in our population. A large proportion of our patients (approximately 40%) who presented with symptoms suggestive of streptococcal pharyngitis (score, -1) could be stratified into the low probability of disease category (<5% chance of positive culture). These patients could be rapidly triaged to follow-up for worsening symptoms, without further diagnostic testing (eg, cultures or rapid streptococcal tests) or treatment. In addition, those with higher scores (>2 in the simplified model, approximately 13% of the patients) could be empirically treated with antibiotics without further diagnostic work-up. Patients in the intermediate range (score, 0 or 1) could be monitored, a culture could be obtained, the rapid streptococcal antigen test could be used with follow-up, or treatment could be administered.

Recently published guidelines from the American College of Physicians-American Society of Internal Medicine and the Centers for Disease Control and Prevention recommend rapid streptococcal antigen testing in patients with intermediate probability of GABHS infection and antibiotic therapy for patients with a positive test result. These guidelines are based on the 4 Centor criteria: history of fever, tonsillar exudates, no cough, and tender anterior cervical lymphadenopathy. The recommendation for patients with low (none or 1 of the Centor criteria) probability of GABHS is no testing or treatment; for those with high probability of GABHS (3 or 4 of the Centor criteria), empirical antibiotics. Guidelines from the Infectious Diseases Society of America recommend rapid streptococcal antigen testing in adults with suspected GABHS infection, without confirming negative rapid antigen test results with negative culture results, because the complications of GABHS pharyngitis in adults are rare and the risk of transmission is low. None of these guidelines or the Centor criteria have been evaluated prospectively.

The prevalence of positive cultures in our population was higher than expected. There are several potential
Figure 2. Sore throat scores (simplified version) for 127 patients with negative cultures and 39 patients with positive cultures.

reasons for this finding. One explanation may be that some of the patients were carriers and did not have acute streptococcal infection. Estimates of asymptomatic carrier rates of streptococcal pharyngitis range between 2% and 5%. One shortcoming of our study was the failure to determine the carrier rate in our asymptomatic population. The chronic carrier rate could explain the 4.6% positive culture rate in patients with very low scores, ie, those who were relatively asymptomatic. If this were the case, the return visit rate due to a false-negative prediction in those with low probability would be negligible; however, the CI for the 4.6% positive culture rate in patients with low scores is 0% to 12%, and thus it is possible that screening could miss a few cases. Another reason for the high prevalence rate may be due to the fact that our population of patients is more likely to experience overcrowding at home and hence exposure to streptococci. Finally, the high prevalence rate may simply be due to the fact that these were strictly urgent care visits, which may include a higher proportion of patients with true GABHS infection.

Ideally, the proportion of patients with a sore throat receiving an antibiotic would approximate or perhaps slightly exceed the prevalence of GABHS infection in those with sore throat. Only 5% to 17% of patients presenting with sore throat have streptococcal pharyngitis; however, primary care physicians prescribe antibiotics to more than half of adults with sore throat. Moreover, nonrecommended, more expensive, and broader-spectrum antibiotics are used frequently. Our assumption is that proper application of the CPR would improve identification of GABHS infection, limit the need for throat swab in all patients with sore throat, and reduce unnecessary antibiotic use. However, the true benefit of any such guide can be assessed only by performing a randomized trial or impact analysis. An impact analysis is performed by randomizing the explicit application of the CPR to one group of patients and usual care to another group. This analysis can assess how the CPR will change clinical behavior with regard to ordering tests and offering treatment. In addition, an impact analysis can assess potential cost savings and changes in quality of care.

The development of a CPR is a multistep process involving the derivation, validation, and assessment of the impact of the guide. The accuracy of a CPR may vary from one clinical site to another, and therefore the validation process is ideally performed prospectively several times and at various sites in which prevalence and spectrum of disease may vary. Our validation of this CPR should give clinicians the added confidence to apply this guide in similar clinical settings.

Table 4. Guide for Managing Patients Suspected of Having Streptococcal Pharyngitis*

<table>
<thead>
<tr>
<th>Patient’s score of positive culture* for GABHS (%)</th>
<th>Suggested management</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1</td>
<td>4.6</td>
</tr>
<tr>
<td>0</td>
<td>15.9</td>
</tr>
<tr>
<td>1</td>
<td>44.4</td>
</tr>
<tr>
<td>2</td>
<td>57.1</td>
</tr>
<tr>
<td>3</td>
<td>83.3</td>
</tr>
</tbody>
</table>

*GABHS = group A β-hemolytic streptococcus.
†Determine the patient’s score by assigning points according to Table 2.
‡Assuming a prevalence of 24% of positive cultures, as calculated in our population.

REFERENCES


