

Does This Patient Have Strep Throat?

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CLINICAL SCENARIOS

In each of the following cases, the physician must decide if the patient has group A β -hemolytic streptococcal pharyngitis (strep throat). In case 1, a 7-year-old boy presents in March without a cough but with 1 day of sore throat accompanied by fever, headache, moderate cervical adenopathy, and a markedly exudative and erythematous pharynx. His brother was recently diagnosed as having strep throat. In case 2, a 16-year-old presents with severe sore throat and anterior adenopathy for 3 days but no tonsillar enlargement, exudate, fever, or cough. In case 3, a 42-year-old woman presents with 5 days of sore throat and cough but no adenopathy, tonsillar enlargement, recent exposure to strep, or exudate.

Why is the Diagnosis Important?

The 1995 National Ambulatory Medical Care Survey¹ found that sore throat is the third most common presenting complaint in office-based practice, accounting for 4.3% of visits. Sore throat is usually caused by direct infection of the pharyngeal tissue (pharyngitis). The differential diagnosis of pharyngitis is summarized in TABLE 1. Sore throat can also be caused by conditions such as gastroesophageal reflux disease, acute thyroiditis, persistent cough, and postnasal drainage due to allergic rhinitis

See also Patient Page.

Context Sore throat is a common complaint, and identifying patients with group A β -hemolytic streptococcal pharyngitis (strep throat) is an important task for clinicians. Previous reviews have not systematically reviewed and synthesized the evidence.

Objective To review the precision and accuracy of the clinical examination in diagnosing strep throat.

Data Source MEDLINE search for articles about diagnosis of strep throat using history-taking and physical examination.

Study Selection Large blinded, prospective studies (having ≥ 300 patients with sore throat) reporting history and physical examination data and using throat culture as the reference standard were included. Of 917 articles identified by the search, 9 met all inclusion criteria.

Data Extraction Pairs of authors independently reviewed each article and used consensus to resolve discrepancies.

Data Synthesis The most useful findings for evaluating the likelihood of strep throat are presence of tonsillar exudate, pharyngeal exudate, or exposure to strep throat infection in the previous 2 weeks (positive likelihood ratios, 3.4, 2.1, and 1.9, respectively) and the absence of tender anterior cervical nodes, tonsillar enlargement, or exudate (negative likelihood ratios, 0.60, 0.63, and 0.74, respectively). No individual element of history-taking or physical examination is accurate enough by itself to rule in or rule out strep throat. Three validated clinical prediction rules are described for adult and pediatric populations.

Conclusions While no single element of history-taking or physical examination is sufficiently accurate to exclude or diagnose strep throat, a well-validated clinical prediction rule can be useful and can help physicians make more informed use of rapid antigen tests and throat cultures.

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or sinusitis. However, reliable estimates for the likelihood of these conditions among patients with sore throat are not available.

Untreated group A β -hemolytic streptococcal pharyngitis typically lasts 8 to 10 days. Patients are infectious during the period of acute illness and for approximately 1 week after. Antibiotic treatment decreases the severity of symptoms, reduces their duration by approximately 1 day,² reduces the risk of transmission to others after 24 hours of treatment, and reduces the likelihood of suppurative complications and rheumatic fever.⁶ Suppurative complications include peritonsillar abscess (occurring in <1% of patients treated with

antibiotics), retropharyngeal abscess, suppurative cervical lymphadenitis, bacteremia, and, by direct extension, otitis media, sinusitis, and mastoiditis.⁷ Rarely, the infection may lead to meningitis, pneumonia, or bacteremia. Rheumatic fever is a serious sequela of strep throat. Between 1 and 5 weeks after an episode

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of strep throat, a nonsuppurative inflammatory reaction results in fever, carditis, subcutaneous nodules, chorea, and/or migratory polyarthritides. Acute rheumatic fever now occurs infrequently in the United States, with a reported annual incidence of approximately 1 case per 1 000 000 population.⁸

Always doing a throat culture or rapid antigen test can lead to overtreatment of low-risk patients due to excessive false-positive results and undertreatment of high-risk patients due to excessive false-negative results. This approach also leads to increased cost.^{9,10} By using the preexamination likelihood of strep throat and the clinical examination, patients can potentially be divided into 3 groups: those with a very high probability of strep throat, who could receive empiric antibiotic therapy (case 1, above); those with an intermediate probability of disease, who may require further diagnostic testing (case 2); and those with a low probability of disease, who may require only symptomatic therapy and appropriate follow-up rather than further diagnostic testing or treatment (case 3).¹¹

Pathophysiology

Group A β -hemolytic streptococci trigger an inflammatory response in pharyngeal cells that is responsible for many of the signs and symptoms of pharyngitis. Interleukins 1 and 6, tissue necrosis factor, and prostaglandins cause the febrile response; prostaglandins and bradykinin cause pain; and prostaglandins and nitric oxide cause vasodilation and edema, manifested as erythema and swelling of the tonsillar pillars, uvula, and soft palate. Lysosomal enzymes and oxygen free radicals, while part of the body's response to infection, also cause tissue damage. This tissue damage, in addition to the pustular nature of the group A β -hemolytic streptococcal infection, results in a creamy exudate from the tonsillar pillars. The pharynx is drained primarily by the anterior cervical nodes, which may become tender and enlarged during infection.¹²

Although group A β -hemolytic streptococcus is not part of the normal flora

of the human throat, the asymptomatic carrier rate is 5.0% to 21.2% in children between the ages of 3 and 15 years. It is lower in children younger than 3 years (1.9%-7.1%) and in older adolescents and adults (2.4%-3.7%).¹³

METHODS

Search Strategy and Quality Review

For the evaluation of individual signs and symptoms, we identified studies of the diagnosis of group A β -hemolytic streptococcal pharyngitis in patients complaining of sore throat. All studies included at least 300 patients, collected data prospectively, and used throat culture as the reference standard. Examiners were unaware of the results of rapid tests or throat cultures for strep when they performed the history and physical examination. All articles therefore represent level I evidence according to previously published criteria for the evaluation of study quality.¹⁴ The results for a variable are reported only if more than 1 study reported data for that variable.

The MEDLINE search used the following Medical Subject Headings: (*sensitivity and specificity or predictive value of tests or medical history taking or physical examination*) and *pharyngitis*. This search identified 917 articles. In 2 cases, authors were contacted to provide additional information or to clarify a point in the article. Unpublished data were not sought. Seventeen studies (15 in English, 1 in German, and 1 in Spanish)

met all of the inclusion criteria described above except study size. Nine studies included at least 300 patients; they are shown in TABLE 2.¹⁵⁻²³ Each study was reviewed independently by 2 clinical investigators, and discrepancies were resolved by discussion. In addition, any articles developing or validating a clinical prediction rule were identified. The included studies reported data for 5453 patients, whereas the 8 excluded studies only reported data on 1182 patients.

Statistical Methods

The positive likelihood ratio (LR⁺) and negative likelihood ratio (LR⁻) were calculated for history and physical examination findings. The LR⁺ (LR⁺ = sensitivity/[100 - specificity]) is a measure of how well a positive result rules in disease, while the LR⁻ (LR⁻ = [100 - sensitivity]/specificity) is a measure of how well a negative result rules out disease. A likelihood ratio close to 1 does not appreciably change the likelihood of disease. A likelihood ratio greater than 1 increases the likelihood

Table 1. Differential Diagnosis of Pharyngitis^{2,4}

| Etiology | Probability, % |
|--------------------------------------|----------------|
| Viral | 50-80 |
| Streptococcal | 5-36 |
| Epstein-Barr virus | 1-10 |
| <i>Chlamydia pneumoniae</i> | 2-5 |
| <i>Mycoplasma pneumoniae</i> | 2-5 |
| <i>Neisseria gonorrhoeae</i> | 1-2 |
| <i>Haemophilus influenzae</i> type b | 1-2 |
| Candidiasis | <1 |
| Diphtheria | <1 |

Table 2. Studies Included

| Source, y | Setting | Population Presenting With Complaint of Sore Throat | Patients, No. | Prevalence of Strep Throat Pharyngitis, % |
|--|----------------------|---|---------------|---|
| McIsaac et al, ²² 1998 | Office | Adults and children | 520 | 29 |
| Kljakovich, ²⁶ 1993 | Office | Adults and children | 329 | 12 |
| Reed et al, ²¹ 1990 | Urgent care | Adults and children | 806 | 25 |
| Crawford et al, ²³ 1979 | Outpatient | Adults and children | 472 | 11 |
| Komaroff et al, ¹⁶ 1986 | Office | Adults only | 693 | 10 |
| Walsh et al, ¹⁹ 1975 | Office | Adults only | 418 | 15 |
| Stenhoff et al, ¹⁵ 1997 | Office | Children only | 450 | 24 |
| Kaplan et al, ¹⁶ 1971 | Emergency department | Children only | 624 | 35 |
| Stielerman and Bernstein, ¹⁷ 1961 | Office | Children only | 1141 | 36 |

of disease, whereas a likelihood ratio less than 1 decreases the likelihood of disease. Likelihood ratios from 2 to 5, or from 0.5 to 0.2, are believed to provide weak evidence for or against the diagnosis, respectively; values from 5 to 10 or from 0.1 to 0.2 provide moderate evidence; values greater than 10 or less than 0.1 provide strong evidence. A random effects estimate was calculated for the sensitivity, specificity, LR⁺, and LR⁻ when the χ^2 statistic suggested homogeneity ($P > .05$) or when random and fixed effects models gave similar values. Otherwise, a range for each variable is shown.

The area under the receiver operating characteristic (ROC) curve is a measure of the diagnostic accuracy of a test. Specifically, a greater area corresponds to a greater ability to discriminate between patients with and without strep throat. An area of 1.0 under the ROC curve means the test is perfect, while an area of 0.5 means it is no better than chance. In this study, the area was calculated using the method of Moses et al.^{24,25} It was not possible to generate an ROC curve for some signs and symptoms if fewer than 3 studies reported their sensitivity and specificity.

PRECISION AND ACCURACY

Symptoms

Classically, the streptococcal sore throat is of abrupt onset in older children and adults. Symptoms may be less focal and more gradual in younger children.²⁶ Throat pain is typically described as severe and is associated with difficulty in swallowing. Fever is moderate (reported temperature range, 39°C to 40.5°C). Chills may be present but rigor is not typical. Strep throat is also classically associated with malaise, headache, mild neck stiffness, and gastrointestinal symptoms such as anorexia, nausea, vomiting, and abdominal pain. However, these features may be present in only 35% to 50% of patients and have not been verified by objective studies of diagnosis. Abdominal symptoms may be more common in younger patients, although more recent studies have not confirmed this as an independent predictor.²⁷

Signs

Examination of the throat may reveal erythema and edema of the pharynx and uvula and diffuse erythema and hypertrophy of the lymphoid tissue in the posterior pharynx. The posterior pharynx and tonsillar pillars may be covered with a gray-white membrane or exudate. The pharynx is often described as beefy or bright red, with the color ending abruptly at the soft palate. Petechiae may be present on the soft palate. Tonsils are commonly swollen, erythematous, and covered with a punctate or confluent gray-white exudate. The breath is characteristically foul.

The anterior cervical lymph nodes are often quite tender and enlarged, especially at the angle of the jaw. This sign occurs early in the course of infection. When present, the characteristic scarlatiniform ("scarlet fever") rash is one of fine erythematous papules beginning on the trunk and spreading to the extremities but sparing the palms and soles. The rash blanches to pressure and has a sandpapery feel. It is associated with enlarged papillae on a coated tongue that may later become denuded ("strawberry tongue"), circumoral pallor and hyperpigmentation, or accentuation of the rash in the skin creases. This is especially prominent in the antecubital fossae (Pastia sign). In very young children there may be excoriations around the nares. The rash typically subsides in 6 to 9 days and may be followed by desquamation of the palms and soles. Pharyngeal vesicles and ulcers are associated with viral upper respiratory tract infections; their presence reduces the likelihood that a sore throat is caused by group A β -hemolytic streptococci.

Properly viewing the pharynx can be challenging. Adequate examination of the throat requires elevation of the soft palate and uvula and depression of the posterior tongue. While a tongue blade can help, patients often gag, cough, or bite. The pharynx can sometimes be viewed without a tongue blade by having the patient pant. Small children can be asked to imitate a puppy as a way of encouraging them to pant.

Precision of Symptoms and Signs

While only limited data are available on the precision of symptoms and signs of streptococcal pharyngitis, these data suggest that observer reliability is high. Komaroff et al¹⁸ had 2 blinded observers examine the same randomly sampled patients, and found 88% agreement on 187 history and physical examination items, although the κ test was not used to evaluate agreement beyond chance. In another study, a physician and physician assistant both examined the ears, nose, throat, cervical nodes, and chest of 63 patients. Only 1 discrepancy, in examination of cervical adenopathy, was noted.¹⁹ No data were available regarding the ability of physicians to distinguish tonsillar from pharyngeal exudate, or regarding the precision of the examination in patients who have undergone tonsillectomy.

Diagnostic Accuracy of Symptoms and Signs

The sensitivity, specificity, LR⁺, and LR⁻ for variables that are reported in at least 2 studies are shown in TABLE 3. The variables with the greatest area under the ROC curve, and hence the best ability to discriminate between patients with and without strep throat, were pharyngeal or tonsillar exudate, fever by history, tonsillar enlargement, tenderness or enlargement of the anterior cervical lymph nodes, and absence of cough.

Findings that were similar across studies, had the greatest LR⁺, and were therefore best at ruling in disease were the presence of tonsillar exudate (LR⁺ = 3.4), pharyngeal exudate (LR⁺ = 2.1), and strep throat exposure in the previous 2 weeks (LR⁺ = 1.9). The absence of findings was not efficient at ruling out disease, with the lowest LR⁻ found for the absence of tender anterior cervical nodes (LR⁻ = 0.60), tonsillar enlargement (LR⁻ = 0.63), and tonsillar or pharyngeal exudate (LR⁻ = 0.74). A physician's overall estimate of the probability of strep throat was measured in 2 small studies, which found LR⁺ values of 3.0 and 1.7 and LR⁻ values of 0.36 and 0.60.^{28,29}

Estimating the Pretest Probability of Strep Throat

Clinical decision making requires an estimate of the pretest probability, in this case the probability that the patient has strep throat before examination. This estimate should be based primarily on the patient's age, the clinical setting, and the season.

In general, strep throat is more common in children than among infants and adults: group A β -hemolytic streptococcal bacteria can be isolated by throat culture in 24% to 36% of children¹⁵⁻¹⁷ and in 5% to 24% of adults with sore throat.^{4,18,19,26,30,31} Breese³² reports that the likelihood of strep throat peaks between the ages of 5 and 10 years, although it may occur somewhat earlier now because more children are in day care.

A reasonable estimate of the pretest probability of strep throat in an unselected office-based adult population is 5% to 10%, and in an unselected pediatric population is 20% to 25% (Table

2). The prevalence of strep throat is also higher among patients seen in emergency departments or urgent care centers than in office practice.^{33,34} Because strep throat is more common in autumn and winter,^{19,29,32} it may be appropriate to adjust these estimates upward during those seasons, and down in spring and summer.

Clinical Prediction Rules

Because individual signs and symptoms are not accurate enough to make a diagnosis, clinical prediction rules have been developed that use several key elements of the history and physical examination to predict the probability of strep throat. Using a clinical prediction rule gives a physician a rational basis for assigning a patient to a low-risk category (requires neither testing nor treatment), a high-risk category (empiric antibiotic therapy may be indicated), or a moderate-risk category (may require further diagnostic testing).^{9,10}

TABLE 4 summarizes previous efforts to develop and/or validate clinical prediction rules for the diagnosis of strep throat. One of the best validated is a simple 4-item clinical prediction rule developed by Centor.²⁸ The Centor's score has been validated in 3 distinct adult populations,³⁴⁻³⁶ and considers 4 signs and symptoms: tonsillar exudate, swollen tender anterior cervical nodes, absence of cough, and a history of fever. The rule is quite accurate, with an area under the ROC curve of 0.79. One point is assigned for each of the patient's signs and symptoms, and the sum is used to determine the likelihood of strep throat (FIGURE 1).²⁸ The presence of 3 or 4 findings increases the probability of strep throat. Patients with none or one of the cardinal findings have a very low risk of strep throat, and it may be appropriate to forgo testing or treatment in this group. The Centor clinical prediction rule has not been validated in younger patients. Recently, McIsaac has modi-

Table 3. Accuracy for History and Physical Examination Elements in the Diagnosis of Strep Throat*

| Symptoms and Signs | Patients, No. | Accuracy | Sensitivity (95% CI) or Range | Specificity | LR ⁺ (95% CI) or Range | LR ⁻ (95% CI) or Range |
|--|---------------|----------|-------------------------------|-------------------|-----------------------------------|-----------------------------------|
| Any exudates ^{15,16,18,19,20,21} | 3268 | 0.68 | 0.21-0.58 | 0.69-0.92 | 1.5-2.6 | 0.66-0.94 |
| Reported fever ^{15,17,20,21} | 3232 | 0.68 | 0.3-0.92 | 0.23-0.90 | 0.97-2.6 | 0.32-1.0 |
| Measured temperature >37.8°C ^{15,17,18,21} | 3091 | 0.68 | 0.11-0.84 | 0.43-0.96 | 1.1-3.0 | 0.27-0.94 |
| Anterior cervical nodes swollen/enlarged ^{15,16,18,20,23} | 3831 | 0.67 | 0.55-0.82 | 0.34-0.73 | 0.47-2.9 | 0.58-0.92 |
| Pharyngeal exudates ^{18,22,23} | 1673 | 0.65 | 0.03-0.48 | 0.76-0.99 | 2.1 (1.4-3.1)* | 0.90 (0.75-1.1)* |
| Tonsillar swelling/enlargement ^{18,19,20,22} | 2703 | 0.65 | 0.56-0.86 | 0.56-0.86 | 1.4-3.1 | 0.63 (0.56-0.72)* |
| Tonsillar or pharyngeal exudates ^{15,16,19,21} | 2246 | 0.65 | 0.28-0.61 | 0.62-0.88 | 1.8 (1.5-2.3)* | 0.74 (0.66-0.82)* |
| Anterior cervical nodes tender ^{15,16,18,22} | 2280 | 0.64 | 0.32-0.66 | 0.53-0.84 | 1.2-1.9 | 0.60 (0.49-0.71)* |
| Tonsillar exudates ^{20,22} | 840 | 0.64 | 0.36 (0.21-0.52)* | 0.71-0.98 | 3.4 (1.8-6.0)* | 0.72 (0.60-0.88)* |
| No cough ^{15,19,21,23} | 5122 | 0.63 | 0.51-0.79 | 0.36-0.68 | 1.1-1.7 | 0.53-0.89 |
| No coryza ^{15,19,22} | 3846 | 0.57 | 0.42-0.84 | 0.20-0.70 | 0.86-1.6 | 0.51-1.4 |
| Myalgias ^{18,21,22} | 2003 | 0.57 | 0.49 (0.43-0.56)* | 0.52-0.69 | 1.4 (1.1-1.7)* | 0.93 (0.86-1.0)* |
| History of sore throat ^{18,17,21,22} | 3090 | 0.57 | 0.18-0.93 | 0.09-0.86 | 1.0-1.1 | 0.55-1.2 |
| Headache ^{17,18,22} | 2350 | 0.56 | 0.48 (0.42-0.53)* | 0.50-0.80 | 0.81-2.6 | 0.55-1.1 |
| Pharynx injected ^{15,18,19,22} | 2939 | 0.54 | 0.43-0.99 | 0.03-0.62 | 0.66-1.63 | 0.18-6.42 |
| Measured temperature \geq 38.3°C ^{18,22,23} | 1096 | 0.53 | 0.22-0.58 | 0.53-0.92 | 0.68-3.9 | 0.54-1.3 |
| Nausea ^{17,21} | 1941 | 0.52 | 0.26 (0.12-0.43)* | 0.52-0.98 | 0.76-3.1 | 0.91 (0.86-0.97)* |
| Duration <3 d ^{20,22} | 824 | 0.43 | 0.26-0.93 | 0.59 (0.54-0.64)* | 0.72-3.5 | 0.15-2.2 |
| Male sex ^{21,22} | 1325 | 0.39 | 0.11-0.56 | 0.39-0.86 | 0.87 (0.72-1.05)* | 1.1 (0.93-1.2)* |
| Palatine petechiae ^{18,22} | 1202 | NA | 0.07 (0.02-0.14)* | 0.95 (0.92-0.96)* | 1.4 (0.48-3.1)* | 0.98 (0.92-1.1)* |
| Strep exposure previous 2 wk ^{18,19,22,23} | 2091 | NA | 0.19 (0.12-0.27)* | 0.87-0.94 | 1.9 (1.3-2.8)* | 0.92 (0.86-0.99)* |
| Rash ^{17,21,22} | 2356 | NA | 0.04 (0.03-0.06)* | 0.79-0.99 | 0.06-35 | 0.90-1.1 |

*Where one of these operating characteristics was homogeneous ($P > .05$ for the χ^2 test) the summary value and a 95% confidence interval (CI) are given. Where they are heterogeneous, only the range is given. Variables are given in the order of the area under the receiver operative characteristic curve, where one could be drawn. LR⁺ indicates positive likelihood ratio; LR⁻, negative likelihood ratio.

Table 4. Clinical Prediction Rules for the Prediction of Strep Throat in Patients With Sore Throat*

| Reference | Description | Population | Accuracy | Comment |
|-----------------------------------|---|---|--|--|
| Centor et al. ²⁶ 1981 | Simple 4 variable additive score | 236 US adult patients in the emergency department | Area under the ROC curve 0.79 (good accuracy) | Successfully validated in 3 new adult populations ^{24,25} |
| Dobbs. ²⁹ 1996 | Bayesian score with 14 variables | 206 Patients >4 years in a British general practice | 71% sensitive, 71% specific | No prospective validation, relies on one physician's examination skills |
| Breese. ³² 1977 | 9-item additive score, including white blood count (see Figure 2) | 670 US children in original study, 892 children in validation study ³⁷ | LR ⁺ = 2, LR ⁻ = 0.75 in pediatric validation study ³⁷ | The lowest risk group still has a 6% ³² to 16% ³⁷ risk of strep throat; similar results in study of adults and children ²¹ |
| Clancy et al. ³⁶ 1988 | 3-item additive score based on history alone | 1237 US adult patients in 2 emergency departments, and 189 patients at a student health service | Area under the ROC curve 0.70 to 0.74 depending on setting; 85% sensitive and 42% specific | No prospective validation |
| Hoffman. ³ 1992 | 7-item score, including age | 1783 Patients in a Danish general practice | LR ⁺ = 1.3, LR ⁻ = 0.2 | Rule has low specificity (26%) |
| Komarof et al. ¹⁹ 1986 | 6-item additive score | 693 US adult outpatients | Results presented as nomogram only | Not prospectively validated |
| Walsh et al. ¹⁹ 1975 | Algorithm based on 5 signs and symptoms (see Figure 1) | 418 US adults with sore throat at an HMO outpatient clinic | High risk = 28% strep; moderate risk = 15% strep; low risk = 4% strep | In a prospective study in adults and children by Crawford et al. ²³ 23% of high-risk patients, 12% of moderate-risk patients, and 3% of low-risk patients had a positive throat culture for strep |
| Meland et al. ³⁶ 1993 | Algorithm based on 4 signs and symptoms | 133 Norwegian adults and children with sore throat | High risk = 62% strep; moderate risk = 34% strep; low risk = 10% strep | Not prospectively validated |
| McIsaac. ³⁷ 2000 | Algorithm based on 4 signs and symptoms and patient age | 621 Canadian adults and children >3 years presenting to family physicians | Risk stratified into 5 levels, from 1%-51% | Good prospective validation in primary care practices, including both children and adults |

*ROC indicates receiver operating characteristic curve; LR⁺, positive likelihood ratio; LR⁻, negative likelihood ratio; and HMO, health maintenance organization.

Figure 1. Centor Clinical Prediction Rule for the Diagnosis of Strep Throat in Adults

- Assign 1 point for each of the following clinical characteristics: (1) history of fever, (2) anterior cervical adenopathy, (3) tonsillar exudate, and (4) absence of cough.
- Find the column that most closely matches the pretest probability of strep in the patient and look down the column to the row that matches the patient's number of points to determine the probability of strep.

| Points, No. | Likelihood Ratio | Pretest Probability of Strep Throat (%) | | | | | | | |
|-------------|------------------|---|----|----|----|----|----|----|--|
| | | 5 | 10 | 15 | 20 | 25 | 40 | 50 | |
| 0 | 0.16 | 1 | 2 | 2 | 3 | 5 | 10 | 14 | |
| 1 | 0.3 | 2 | 3 | 5 | 7 | 9 | 17 | 23 | |
| 2 | 0.75 | 4 | 8 | 12 | 16 | 20 | 33 | 43 | |
| 3 | 2.1 | 10 | 19 | 27 | 34 | 41 | 58 | 68 | |
| 4 | 6.3 | 25 | 41 | 53 | 61 | 68 | 81 | 86 | |

fied Centor's score and validated it prospectively in a mixed group of adults and children (FIGURE 2).³⁷ Another rule, developed by Walsh et al.,¹⁹ has been validated prospectively in a mixed population of adults and children (FIGURE 3).

Figure 2. McIsaac Modification of the Centor Strep Score

- Add Up Points for Patient

| Symptom or Sign | Points |
|---|--------|
| History of Fever or Measured Temperature >38° C | 1 |
| Absence of Cough | 1 |
| Tender Anterior Cervical Adenopathy | 1 |
| Tonsillar Swelling or Exudates | 1 |
| Age <15 y | 1 |
| Age ≥45 y | -1 |

- Find Risk of Strep

| Points | Likelihood Ratio | % With Strep (Patients With Strep/Total) |
|---------|------------------|--|
| -1 or 0 | 0.05 | 1 (2/179) |
| 1 | 0.52 | 10 (13/134) |
| 2 | 0.95 | 17 (18/109) |
| 3 | 2.5 | 35 (28/81) |
| 4 or 5 | 4.9 | 51 (39/77) |

Data from a group of 167 children aged ≥3 years and 453 adults in Ontario, Canada. Baseline risk of strep 17% in this population. Reprinted with permission.³⁷

The Breese Score has been prospectively validated in a large pediatric population.^{32,38,39} However, a low Breese score does not rule out strep: 14% of children with a score of 20 or less had a positive throat culture. In addition,

it requires the results of a white blood cell count, which is no longer routinely available in most outpatient practices.

RETURN TO THE CLINICAL SCENARIOS

Case 1 describes a child with a high likelihood (51%) of streptococcal pharyngitis based on the McIsaac clinical rule (Figure 2). In fact, the likelihood of strep throat is probably even higher, due to his recent exposure. The physician might wish to treat without further diagnostic confirmation. Children with a low or intermediate probability of strep and a negative rapid antigen test result should still have a backup throat culture.

In case 2, an adolescent has a pretest probability (estimate, 15%) falling between that of adults and children. In this age group, infectious mononucleosis is also a relatively common cause of sore throat. Assuming a pretest probability of 15%, and 2 points on the Centor score, he has a 12%

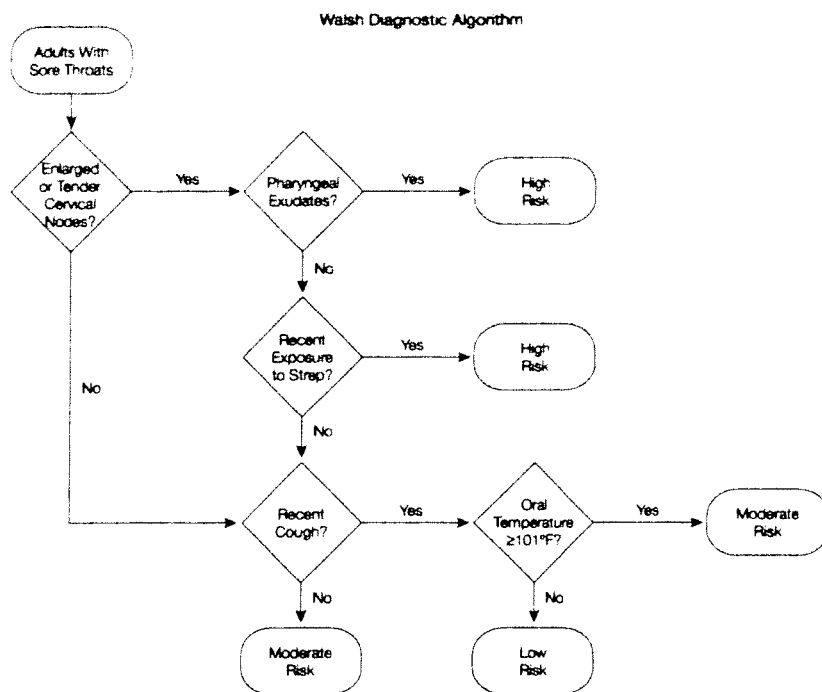
probability of strep throat (Figure 1). The physician should decide whether to recommend a rapid antigen test to clarify the need for treatment. Newer rapid tests have a sensitivity (85%) and specificity (93%) close to that of throat culture.⁴⁰ If a patient with a 12% probability of strep throat has a negative rapid test result, the likelihood of strep decreases to only 2%, whereas if the results are positive, it increases to 62%.

Finally, the woman in Case 3 has none of the cardinal characteristics of strep throat in the Centor score and the Walsh algorithm, and therefore has a very low (2%-3%) probability of strep throat. It may be appropriate to reassure this patient that strep throat is very unlikely and to consider nonbacterial causes of sore throat. Some would argue that a throat culture is always necessary and that treatment should be delayed until culture results become available.⁴¹ However, this approach ignores the accuracy of newer rapid antigen tests, particularly when used in tandem with an accurate assessment of the pretest probability using a clinical score. A recent study of 30 000 episodes of sore throat found that changing from a policy encouraging throat culture to one encouraging the use of a rapid antigen test only, with a corresponding decrease of 65% to 13% in the percentage of patients with sore throat receiving a culture, did not change the number of suppurative complications.⁴²

THE BOTTOM LINE

This study further confirms that no single element of the history or physical examination is powerful enough to confirm the probability of streptococcal pharyngitis. Instead, physicians should consider a combination of findings including tonsillar exudate, tender or enlarged anterior cervical nodes, the absence of cough, and a history of fever (or measured temperature $>38^{\circ}\text{C}$). A rational approach to therapy integrates these findings with the patient's age and the clinical setting, the information from Figures

Figure 3. Walsh Algorithm for Evaluating Cases of Adults With Sore Throats



Validation Results

| Risk Group | % Strep by Culture | |
|------------|------------------------|--------------------------|
| | Original ¹⁹ | Validation ²³ |
| High | 28 | 23 |
| Moderate | 15 | 12 |
| Low | 4 | 3 |

1 and 2, the results of rapid antigen testing or throat culture, and the clinician's own judgment.

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