A Five-Year Experience With Throat Cultures

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This study addresses the usefulness of the throat culture in a family practice residency setting and explores the following questions: (1) Do faculty physicians clinically identify streptococcal pharyngitis better than residents? (2) With time, will residents and faculty physicians improve in their diagnostic accuracy? (3) Should the throat culture be used always, selectively, or never?

A total of 3,982 throat cultures were obtained over a five-year study period with 16 percent positive for beta-hemolytic streptococci. The results were compared with the physician's clinical diagnosis of either "nonstreptococcal" (category A) or "streptococcal" (category B). Within category A, 363 of 3,023 patients had positive cultures (12 percent clinical diagnostic error rate). Within category B, 665 of 959 patients had negative cultures (69 percent clinical diagnostic error rate). Faculty were significantly better than residents in diagnosing streptococcal pharyngitis, but not in diagnosing nonstreptococcal sore throats. Neither faculty nor residents improved their diagnostic accuracy over time. Regarding age-specific recommendations, the findings support utilizing a throat culture in all children aged 2 to 15 years with sore throat, but in adults only when the physician suspects streptococcal pharyngitis.

The clinical problem of patients presenting with sore throat remains quite common. Data from the 1979 National Ambulatory Medical Care Survey (NAMCS) show that "symptoms referable to the throat" were the most common symptomatic reason for a visit to office-based physicians.[1] Robertson's study[2] of symptoms in a family practice residency revealed sore throat ranking eighth most common among acute symptoms. Yet keeping these figures in perspective, Evans et al[3] documented that only between 8 and 16 percent of adults having sore throat actually contacted a

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health professional or took prescribed drugs.

Regarding specific diagnoses, the 1979 NAMCS found acute upper respiratory infection ranking 4th most frequent, acute pharyngitis 12th, and acute tonsillitis 20th.[1] Various studies of diagnostic prevalence from the Canadian and American family practice literature rank pharyngitis as the first to tenth most common problem in the office setting.[4-8]

There continues healthy debate in the family practice, pediatric, and internal medicine literature on the proper approach to diagnosis and management of the patient with a sore throat.[9-22] Many questions that deserve current study are outlined in recent review articles by Gillette,[20] Todd,[21] and Scherger.[22] No single study can address all aspects of the streptococcal pharyngitis and throat culture problem. The present study explores the following questions: (1) Do "more experienced" physicians have better techniques for clinical identification of streptococcal pharyngitis? (2) With time, will residents and faculty physicians improve in their diagnostic accuracy? (3) Should the throat culture be used always, selectively, or never?

The overall purpose of this study was to address the usefulness of the throat culture in a family practice residency setting. The specific goals were (1) to allow resident or faculty physicians to compare their clinical diagnosis with the actual culture result, (2) to look for changes in physician accuracy and behavior over time, and (3) to look for age categories in which the clinical diagnosis is least accurate.

Methods

This study took place in the model office of the Cedar Rapids Family Practice Residency Program. This program has existed since 1971 and currently has six full-time physician faculty and 26 residents. An average of 18,000 ambulatory visits are made to the model office each year. Over a five-year study period (February 1978 through February 1983), resident and faculty physicians obtained a throat culture and made a clinical diagnosis of "nonstreptococcal" (category A) or "streptococcal" (category B) on all pharyngitis patients seen in the model office. Completeness of data collection was ensured by systematic clinical record audit. General guidelines for this clinical distinction were provided based on the work of Wannamaker[9] and Kaplan et al.[10] In category A (nonstreptococcal), the culture was done to rule out streptococcus. In these cases the physician was not oversuspicious of the presence of streptococcus. Guidelines for this category included (1) the patient may or may not complain of a sore throat, (2) the patient may or may not have fever or tender nodes, and (3) the pharyngeal examination may be unremarkable or reveal only an erythematous throat. In category B (streptococcal) the culture was done to prove or confirm the presence of streptococcus. In other words, the physician was highly suspicious of the presence of streptococcus. Guidelines for this category included (1) the patient definitely complains of a sore throat, (2) the patient usually has tender anterior nodes, and (3) the examination typically reveals large inflamed tonsils or a severe pharyngitis with or without the presence of exudate. No equivocal category was included; thus the clinician was asked to commit to a specific diagnosis.

In addition, record was made of the physician's initial decision to treat for ten days based on his or her clinical diagnosis. The patient's name, age, and telephone number were recorded. All untreated patients developing positive cultures for beta-hemolytic streptococcus the following day were called and started on an antibiotic.

Physician study groups included the clinical faculty (4 physicians) and eight different resident groups (8 to 9 resident physicians per group). All statistical comparisons were made using chi-square analysis. An alpha value of $P < .05$ was considered significant.

Throat cultures were consistently handled according to the protocol of the American Heart Association and the Centers for Disease Control.[23,24] Second-day subculture was performed on any questionable plate.[25] During the last three years of the study, primary plate identification using the two-disk technique was instituted.[26]

One year into the study an organized quality assurance program was begun in the model office laboratory under the supervision of the medical director of the model office, a quality assurance

Table 1. Clinical Diagnostic Error Rate for Different Groups

	Number of Cultures Taken	Category A (Culture Positive) (%)	Category B (Culture Negative) (%)
Faculty	413	16	58
All residents	3,303	12	70
Fourth-year medical students	266	5	80
Total	3,982	12	69

Category A: Clinical diagnosis is nonstreptococcal
Category B: Clinical diagnosis is streptococcal
Faculty vs all residents, category A, culture positive, NS: $P > .05$
Faculty vs all residents, category B, culture negative, $\chi^2 = 6.9$, 1 *df*, $P < .01$

committee, and a hospital pathologist. This program involved two control systems. The first was an internal control system: duplicate cultures were obtained from a random patient on a periodic basis and plated independently in the two separate model office laboratories; a reliability of 96 percent was determined. The second was an external control system: on a monthly basis, an unknown throat swab originating from the hospital laboratory was evaluated in duplicate in the two model office laboratories. A 9-percent false-negative rate reflected the validity of this culture system. For the purpose of calculating predictive values and clinical diagnostic error rates, however, the office culture result was considered the "gold standard" for disease prevalence.

Results

Altogether 3,982 throat cultures were obtained of which 657 (16 percent) were positive for group A beta-hemolytic streptococcus. Of the total, 3,023 (76 percent) were judged clinically to be in category A, and 959 (24 percent) were judged clinically to be in category B.

Within category A, 2,660 (88 percent) had, in fact, negative cultures, and thus the clinical diagnosis agreed with the culture diagnosis. However, 363 (12 percent) of those in category A had positive cultures. For the purpose of this study, the clinical diagnostic error rate was thus 12 percent for category A; therefore, the negative predictive value for the clinical diagnosis of category A was 88 percent.

Within category B, 294 (31 percent) had positive cultures, and thus the clinical diagnosis agreed with the culture diagnosis. However, 665 (69 percent) of those in category B had negative cultures. Thus, the clinical diagnostic error rate was 69 percent for category B. Correspondingly, the positive predictive value for the clinical diagnosis of category B was 31 percent.

Table 1 illustrates the error rate in clinical diagnosis broken down into faculty, resident, and student groups. No further analysis was done on the student data. The faculty physicians' error rates were not significantly better, that is, lower than the combined resident groups for the clinically nonstreptococcal category (16 percent vs 12 percent). However, the faculty error rate was significantly better, that is, lower than that of the combined resident groups for the clinically streptococcal

Table 2. Clinical Diagnostic Error Rates for Seven Groups Over Five Years

	February 1978-February 1979		February 1979-February 1980		February 1980-February 1981		February 1981-February 1982		February 1982-February 1983	
	Category A, Culture Positive (%)	Category B, Culture Negative (%)	Category A, Culture Positive (%)	Category B, Culture Negative (%)	Category A, Culture Positive (%)	Category B, Culture Negative (%)	Category A, Culture Positive (%)	Category B, Culture Negative (%)	Category A, Culture Positive (%)	Category B, Culture Negative (%)
Faculty	17	45	16	72	24	57	13	44	3	62
Group 2	15	64	22	62						
Group 3	21	68	18	63	15	59				
Group 4	17	70	12	65	15	80	6	84		
Group 5			15	43	8	70	11	67	10	88
Group 6					8	80	5	78	7	75
Group 7							13	67	4	88

Table 3. Clinical Diagnostic Error Rate for Different Age Groups

	Age (yr)					
	0-5 (%)	6-10 (%)	11-15 (%)	16-20 (%)	21-40 (%)	41 (%)
Category A Culture positive*	11	19	17	10	10	10
Category B Culture negative**	68	65	67	77	65	70

*Analysis performed on category A, culture positive, vs category A, culture negative, $\chi^2 = 36$, 5 *df*, $P < .001$
**Analysis performed on category B, culture positive, vs category B, culture negative, NS: $P > .05$

category (58 percent vs 70 percent, $P < .01$). The faculty, which had been graduated from medical school for an average of 17 years at the midpoint of the study, consisted of three family physicians (one residency trained) and one residency-trained primary care internist.

Table 2 illustrates the clinical diagnostic error rate for seven separate groups over the five-year period. No consistent trends toward improvement over time in the clinical diagnosis are noted, in either the faculty or the resident groups.

Table 3 illustrates the overall clinical diagnostic error rate according to patient age. Regarding category A (clinically nonstreptococcal), there is a significant difference in error rates, primarily because of the higher rates recorded in the 6- to 10-year and 11- to 15-year age groups ($P < .001$). Regarding category B (clinically streptococcal),

the error rate is not significantly different in any age group.

Discussion

The overall prevalence of positive throat cultures (16 percent) in this family practice setting is within the spectrum of other large series in the literature (10 to 40 percent).[10,12,27,28]

It was not the intent of this study to study clinical predictors of streptococcal pharyngitis or of combinations of findings that could consistently predict a true streptococcal infection. However, some comment about this topic and the streptococcal carrier state is useful.

Stillerman and Bernstein[29] suggested in 1961 there were syndromes of collected signs that were associated with positive throat cultures in more than 70 percent of cases. Their "syndromes," however, were observed in only 36 percent (150) of their 412 streptococcal cases. More recently, authors such as Breese[30] have suggested scoring systems to predict the tentative diagnosis of streptococcal pharyngitis.

Alternatively, other investigators have stressed the difficulties of making an accurate clinical diagnosis. Notably, Wannamaker,[9] based on studies at the University of Minnesota, has not supported the concept of a combination of findings consistently predicting a true streptococcal infection. He found adenitis to be the clinical manifestation most regularly associated with positive cultures. Even so, only 49 percent of patients with this sign exhibited group A streptococci. Further, only 30 percent of patients with adenitis and a positive throat culture exhibited an antibody response. Analyzing the findings of temperature 101° F or greater, adenitis, exudate, and ten or more colonies of group A streptococci on throat culture, in all possible combinations, Wannamaker's group found it impossible to detect combinations that would select 80 to 90 percent of patients developing an antibody rise while at the same time excluding the majority of patients who would not develop this antibody response.

Next, the problem of the chronic streptococcal carrier state must be reviewed. Wannamaker[9] and Kaplan[31,32] report the prevalence of asymptomatic carriers ranges up to 15 to 20 percent in school children. In a study of 624 children with pharyngitis, Kaplan et al[10] found 35 percent to have positive cultures for group A streptococcus. There was a bimodal distribution in the recovery of group A streptococci, with peaks in children aged 5 to 7 years and 12 to 13 years. In over one half (57 percent) of their children with positive cultures, there was no subsequent rise in antibody titer to streptococcal antigens. The only finding associated with a statistically significant increase in antibody response was cervical adenitis.

In the present study the overall error rates in clinical diagnosis were 12 percent for clinically nonstreptococcal illness and 69 percent for clinically streptococcal pharyngitis. Table 4 compares these data with three other reports. Hart's study[12] of four Canadian family physicians found error rates of 40 percent and 45 percent, respectively. Rowe and Stone[13] report an overall clinical accuracy of 75 percent and only 45 percent in their culture-positive cases. Forsyth[14] found error rates of 5 percent with nonstreptococcal adults, 13 percent with nonstreptococcal children, 56 percent with streptococcal adults, and 46 percent with streptococcal children. These data support the use of throat cultures rather than relying entirely on clinical judgment.

One might argue that a more experienced physician would have a lower error rate in clinical diagnosis. Such was not the case for clinically nonstreptococcal patients. In patients suspected of having streptococcal pharyngitis, however, the more experienced faculty group did have a statistically significant lower error rate than the combined residents (58 percent vs 70 percent). Although better than that of their resident colleagues, the faculty error rate of 58 percent is still dramatic.

Further, in spite of regular feedback on the results of their throat cultures compared with their clinical diagnosis, no major trends toward improvement in clinical diagnosis were seen in faculty or residents over the five-year study period. This lack of improvement suggests the faculty's superior clinical diagnostic skill with streptococcal pharyngitis required more than five years to develop. If short-term clinical experience by residents and regular feedback on clinical vs culture results do not lead to decreased diagnostic error

Table 4. Comparative Error Rates in Clinical Diagnosis

	Cedar Rapids* (1984) (%)	Hart[12] (1976) (%)	Rowe and Stone[13] (1977) (%)	Forsyth[14]** (1975) (%)
Clinically nonstreptococcal	12	40	16	
Children	15			13
Adults	10			5
Clinically streptococcal	69	45	55	
Children	66			46
Adults	69			56

*Children aged 0 to 15 years, adults aged 16 years and over
**Children aged 0 to 14 years, adults aged 15 years and over

rates, the value of the standardized throat culture in the residency setting seems evident.

The practical question to be answered continues to be, "Should we use a throat culture in every child and adult who has pharyngitis?" Several authors address this question. Caplan[15] argues against using a throat culture because of the rate of false negatives and false positives and defends a purely clinical approach. Other authors suggest a selective use of cultures following various clinical algorithms. Forsyth[14] recommends culturing only "questionable" patients (adults or children) and clinically nonstreptococcal children. In a pediatric series of children aged 5 to 16 years, Honikman and Massell[16] recommend relying heavily on accurate temperature recordings and doing cultures in (1) all illnesses with predominantly sore throat and any degree of fever, and (2) any other illness with an oral temperature of 101° F or higher (with or without sore throat). The unreliability of home temperature recording, however, makes Honikman and Massell's scheme impractical. In an adult study, Walsh et al[17] recommend avoiding the throat culture only if a patient lacks all of the following: tender nodes, exudate, recent exposure, and an oral temperature equal to or greater than 101° F. Komaroff[18] agrees with this protocol and further recommends cultures in all patients aged 5 to 25 years. Gillette's very practical review[20] also recommends a culture in all children, but in adults with clinically suspicious pharyngitis only. And finally, Tompkins and colleagues[19] have offered an interesting cost-effectiveness study of throat culture usage. They recommend using throat cultures and treating those with positive cultures when the overall positivity rate is 5 to 20 percent, but treating all sore throat patients if the prevalence is greater than 20 percent.

Conclusions

From this and past studies it can be concluded that the throat culture is still a vital tool in helping decide which sore throat patients need antibiotic treatment. Particularly in the patient clinically suspected to be streptococcal, a 69 percent overall error rate emphasizes the need for this added tool. Because the error rate is much lower (12 percent) in the clinically nonstreptococcal patient, and the chronic carrier state exists, the throat culture is generally less indicated in this group. However, results of this study broken down by age category allow more specific suggestions to be offered. If one suspects streptococcal disease, the throat

culture is recommended regardless of patient age. Alternatively, if one suspects nonstreptotoccal pharyngitis, these data would suggest a throat culture only in the pediatric age group (6 to 15 years). Unfortunately, the 0- to 5-year age category was not subdivided. Thus, because of the intolerable possibility of missing streptococcal pharyngitis in a child aged 2 to 5 years, a culture is recommended in all children aged 2 to 15 years ragardless of clinical diagnosis. A throat culture is not recommended in very young children (up to the age of 2 years) and adults (aged 16 years and older) when nonstreptococcal disease is suspected. Avoiding throat cultures in this latter group would have saved $8,010 over the five-year study period (assuming $5 per throat culture).

The more experienced physicians in this study demonstrated clinical judgment of streptococcal pharyngitis better than that of their younger colleagues; however, both groups had error rates over 50 percent. Residents did not improve their clinical diagnostic abilities in spite of regular feedback on their clinical and culture comparisons. It remains important for residents in family medicine to become familiar with the office throat culture. A selective approach to the use of this test seems indicated. Finally, long-term research on the clinical diagnostic abilities of family practice residency graduates will be needed to identify trends toward improvement beyond their residency experience.

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