Group A Beta Hemolytic Streptococci and Rheumatic Fever in Miami, Florida:

IV. Correlation Between School Absenteeism, the Isolation of beta Hemolytic Streptococci, and Antistreptolysin O Serum Responses* **

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Streptococcal "infection" in children may be presumed to have occurred when: (1) there was clinical evidence of the typical illness syndrome, accompanied (2) by the presence of beta hemolytic streptococci in the throat and (3) by a serological response such as an elevation of 2 tubes or greater in the antistreptolysin O titer, in the case of organisms belonging to Lancefield groups A, G, human C and possibly some F strains.1,3 The absence of any one of these three criteria casts doubts on the existence of true "infection."

One important reason for determining the presence or absence of streptococcal "infections" lies in the relationship presumed to exist between group A organisms and the etiology of rheumatic fever.1 The isolation of beta hemolytic streptococci from the throats of children has been indicated to be insufficient evidence of itself of "infection," either overt or occult.3 Furthermore, the presence of antistreptolysin O (ASLO) titer elevation in association with recovery of beta hemolytic streptococci from the throat in the absence of clinical findings also is inadequate to provide positive proof of "infection," and may signify a convalescent carrier state or an "occult" infection.

The present report sets forth data on school absences of children, attending the first three grades of public schools in Miami, Florida, who participated in a throat culture study during the school year, October, 1954 - May, 1955.4-6 Absences have been related here to the illnesses diagnosed, to the isolation of beta hemolytic streptococci from the throats of these children, and to the ASLO serum titer changes observed concurrently. Tabulations of our data are presented as comparison of absentee versus non-absentee findings. The non-absentee status refers only to children's presence in school during the regularly scheduled days for sampling. Therefore, information on non-absentees includes children who were never absent at any time during the school year, as well as those who were present at all culture sessions, but who were absent one or more times between sampling periods (58.3 per cent of the 333 children were in this combined category). The results, therefore, highlight differences between absentees and non-absentees, but the degree of differences may be lessened by the effects of untabulated absenteeism among the non-absentee children.

Throat cultures were taken monthly from the throats of 333 children attending the first three grades of three public schools in Miami, Florida,

*Supported in part by funds from the Florida State Board of Health, and the Public Health Service, grant H-1738.
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<table>
<thead>
<tr>
<th>Group</th>
<th>Total</th>
<th>No</th>
<th>Yes</th>
<th>No C/P</th>
<th>Yes</th>
<th>Total</th>
</tr>
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<tr>
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<td>3</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Group B</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Group C</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>3</td>
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</tbody>
</table>

**Table 1: Relationships of All Pneumococcal Carriers of Absence and Beta Hemolytic Streptococcus Recovered From Tonsils of Children Following Absence From School. October, 1956-April, 1957, Miami, Florida.**

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for eight months from October, 1954 through May, 1955. An initial (October, 1954) and final (May, 1955) venous blood sample was obtained from each child, for ASLO titer determinations. Every time a beta hemolytic streptococcus was isolated from the throat of a child, additional throat cultures and blood samples were taken 2, 4, 8, 16, and 32 weeks later, for the duration of the study. The details of the bacteriological and serological procedures have been described previously.1-10

Whenever a child was absent from school at the time regularly scheduled for throat swabbing, either at the monthly or bimonthly period, the cause of absence was sought and every effort was exerted to obtain specimens from such a child within 72 hours of the day of absence. In the case where the child returned to school within a day or two after an absence, a throat culture and blood sample were obtained from him in school by a supplementary visit to that school by one of our technical personnel; otherwise the technician went to the child’s home to do throat swabbing and collect venous blood from the absentee. Most parents were cooperative and permitted home visits. The “ill” child was not always at home, nor was it possible to obtain accurate clinical diagnosis in every case, since, in many illnesses no physician was in attendance.

No attempt was made to get additional specimens from those children who were absent between regularly scheduled sampling periods.

Results

Of the 333 children participating in the study, 139 were absent on a regularly scheduled sampling day one or more times during the eight-month school year, October, 1954 through May, 1955. Thirty-one children were absent twice, 10 three times, and four four times. Sixty-five of the 139 absentee (46.8 per cent) had group A organisms recovered from their throats, while throat cultures from 72 of 194 children (37.1 per cent) who were never absent from school at scheduled throat-swabbing times, yielded these organisms.

Table 1 presents a more detailed correlation among culture findings, ASLO titer responses, and causes of absenteeism. Of the 102 absences (in 89 children) attributed to upper respiratory infections (including colds, sore throats, tonsillitis, bronchitis, influenza, etc.) ASLO rises of 2 tubes or more were observed in four, failed to occur in 39, and were not recorded in the remaining 59 instances. Absences for which no reasons could be determined from the parents or from the school, were accompanied by titer rises in five instances and no such rises in 22. Where absences were known to be due to conditions other than respiratory illnesses (chicken pox, sunburn, or completely non-medical reasons), seven absences were associated with a rise in ASLO titer and 21 were not. Of 194 total recorded absences, beta hemolytic streptococci were recovered in 61 instances and not recovered in 133. Of the 61 streptococcus-positive absences, 13 were accompanied by ASLO responses, 42 were not, and six were not recorded; 23 (6 per cent) of recorded titer rises were elevations. In contrast, only three of 43 absences (7 per cent) where no beta hemolytic streptococci were recovered at the time of absence, showed subsequent ASLO responses. When only Group A beta hemolytic streptococci are considered, nine of 29 absences (31 per cent) were accompanied by rises.
in ASLO titers. ASLO responses occurred with Group B organisms in none of three absences; with Group C, in three of 14; with Group F, in none of three, and with Group G, in one of six absences. Careful follow-up of all absences indicated that antibiotics were administered only rarely. In every instance, throat swabs were obtained, before medication with antibiotics.

Colony counts were recorded for all beta hemolytic streptococci recovered during absences. Of the 61 recorded absences associated with beta hemolytic streptococcal recovery, 49 (80.3 per cent) yielded less than 25 colonies on original plates. In 45 of the 49, ASLO titers were recorded within six weeks of isolation of organisms. Nine (20 per cent) of these 45 were accompanied by ASLO rises of 2 tubes or more, while 36 (80 per cent) were not. Initial plate colony counts were 25 or more in 12 of the 61 absences (19.7 per cent). ASLO data were available in 10 of the 12, and four of the 10 showed ASLO titer rises of 2 tubes or more.

<table>
<thead>
<tr>
<th>Causes of Absence</th>
<th>Colony Count</th>
<th>Beta Hemolytic Streptococci Recovered</th>
<th>No.</th>
<th>per cent</th>
<th>No.</th>
<th>per cent</th>
<th>No.</th>
<th>per cent</th>
<th>No.</th>
<th>per cent</th>
<th>No.</th>
<th>per cent</th>
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<tbody>
<tr>
<td>Not Absent at Time of Sampling</td>
<td>1—4</td>
<td>209</td>
<td>41.8</td>
<td>17</td>
<td>42.5</td>
<td>76</td>
<td>39.2</td>
<td>29</td>
<td>74.4</td>
<td>57</td>
<td>45.2</td>
<td>388</td>
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<tr>
<td>Upper Respiratory Infection</td>
<td>25—99</td>
<td>50</td>
<td>10.0</td>
<td>2</td>
<td>5.0</td>
<td>24</td>
<td>12.4</td>
<td>2</td>
<td>5.1</td>
<td>9</td>
<td>6.3</td>
<td>86</td>
</tr>
<tr>
<td>Total</td>
<td>500</td>
<td>—</td>
<td>40</td>
<td>—</td>
<td>194</td>
<td>—</td>
<td>39</td>
<td>—</td>
<td>125</td>
<td>—</td>
<td>899</td>
<td>—</td>
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<td>Unknown Causes</td>
<td>1—4</td>
<td>5</td>
<td>26.3</td>
<td>2</td>
<td>100.0</td>
<td>3</td>
<td>75.0</td>
<td>1</td>
<td>50.0</td>
<td>3</td>
<td>75.0</td>
<td>14</td>
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<tr>
<td>Other Causes</td>
<td>5—24</td>
<td>10</td>
<td>52.6</td>
<td>0</td>
<td>—</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>—</td>
<td>2</td>
<td>—</td>
<td>4</td>
<td>—</td>
<td>2</td>
<td>—</td>
<td>4</td>
<td>—</td>
<td>31</td>
<td>—</td>
</tr>
<tr>
<td>Grand Totals</td>
<td>1—4</td>
<td>1</td>
<td>50.0</td>
<td>0</td>
<td>—</td>
<td>3</td>
<td>42.9</td>
<td>0</td>
<td>—</td>
<td>1</td>
<td>50.0</td>
<td>8</td>
</tr>
<tr>
<td>5—24</td>
<td>2</td>
<td>25.0</td>
<td>0</td>
<td>—</td>
<td>2</td>
<td>28.6</td>
<td>0</td>
<td>—</td>
<td>1</td>
<td>50.0</td>
<td>5</td>
<td>29.4</td>
</tr>
<tr>
<td>25—99</td>
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<td>12.5</td>
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</tr>
<tr>
<td>100+</td>
<td>1</td>
<td>12.5</td>
<td>0</td>
<td>—</td>
<td>2</td>
<td>28.6</td>
<td>0</td>
<td>—</td>
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<td>17.6</td>
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<tr>
<td>Total</td>
<td>8</td>
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<td>—</td>
<td>7</td>
<td>—</td>
<td>0</td>
<td>—</td>
<td>2</td>
<td>—</td>
<td>17</td>
<td>—</td>
</tr>
<tr>
<td>*2 non-groupable colonial recoveries not included in table. Both were in non-absentees and had less than 5 colonies each.</td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>†Wherever more than one group of organisms were recovered from 1 child at the same or different times, tabulation was carried in each of the appropriate streptococcal groups at the time of recovery.</td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
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</tr>
</tbody>
</table>

**NOTE:** This table includes all streptococcal isolates collected at both monthly and mid-monthly periods.
Analyses of colony counts of beta hemolytic streptococci on initial plates (Table 2) are presented for children who were present at each regularly scheduled throat swabbing period, as well as those children who were absent. The findings were subdivided according to Lancefield Groups of streptococci recovered and as to numbers of colonies observed on the initial plate showing the higher count of each pair of plates. Absences due to upper respiratory infections were associated with colony counts of one to 24, in 15 of 19 instances (78.9 per cent) where Group A streptococci were isolated; colony counts of this size were found in 391 of 500 (78.2 per cent) Group A streptococcal isolates where the children were not absent from school at the time of throat culturing. In both the respiratory absentee and the non-absentee categories, colony counts of 25 to 99, and 100 and over were observed in approximately the same proportions.

An "epidemic" of type 6, Group A beta hemolytic streptococci was observed in February, 1955. The isolation of type 6 organisms for the first time from the monthly throat cultures of several children suggested the possibility of an "epidemic." These organisms were recovered from the throats of children, all of whom attended one of two first-grade classes in one school. Throat swabbing was performed on the children present in each of these two classes, on March 16, 1955. Children who were not participating in the regular studies as well as those who were, had throat cultures taken. Of 66 children attending the two classes, five refused permission, 10 were absent, and 51 had their throats swabbed (Table 3). Of the 10 children absent, two were ill with mumps, two with chicken pox, one with an upper respiratory infection and the other five were absent for unexplained reasons. Nineteen of the 51 throat cultures (37.3 per cent) were positive for type 6 streptococci, while 32 (62.7 per cent) were negative. Data on the 51 children as to absence from school were tabulated according to illness after February 1, due to respiratory in-

<table>
<thead>
<tr>
<th>TABLE 3—ABSENTEE DATA AND THROAT CULTURE FINDINGS (March 16, 1955) ON 51 CHILDREN IN TWO CLASSES AFFECTED BY &quot;EPIDEMIC&quot; OF GROUP A, TYPE 6 BETA HEMOLYTIC STREPTOCOCCI.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A type 6 beta Hemolytic Streptococci Isolated</td>
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<tr>
<td>History of Absences:</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>Classroom I</td>
</tr>
<tr>
<td>32 Individuals</td>
</tr>
<tr>
<td>Classroom II</td>
</tr>
<tr>
<td>34 Individuals</td>
</tr>
<tr>
<td>Total 2 Classes</td>
</tr>
<tr>
<td>66 Individuals</td>
</tr>
</tbody>
</table>

*2 children were ill with chicken pox, 2 with mumps, 1 with upper respiratory infection, 5 were not recorded.
†1 child in each category had non-typable Group A beta hemolytic streptococci.
#1 child had non-groupable beta hemolytic streptococci.
††1 child had Group C beta hemolytic streptococci.
fection; illness between January 1 and February 1, of respiratory origin; respiratory infections in, each of these two periods; and absences for which causes were not recorded. Of the 19 children who harbored type 6 organisms, 12 (63.1 per cent) had absences listed in one of these categories; of 32 children from whose throats Group A, type 6 streptococci were not isolated, 20 (62.5 per cent) fell into similar categories. During the period from January through March 1955, the absentee rates in the two affected classes were not higher than previously, nor were the rates higher in these classes than in the other classes of the school. The rate of absence for the school was approximately the same as during other months, and this school was among those having low rates in Dade County.

Discussion

Throat swabbing and blood sampling performed during or shortly after their absences, on children attending the first three grades of three public schools and participating in a long-term streptococcal epidemiological project, showed no consistent correlations between absenteeism and (1) rate of isolation of Group A beta hemolytic streptococci, (2) ASLO titer and serial changes in titer, and (3) colony count on original bacterial plates.

The data on absences included clinical diagnoses in most instances. When respiratory illnesses were considered, Group A streptococci were isolated from 58.5 per cent of children (38 of 65) suffering from upper respiratory infections (colds, virus infections, bronchitis, and so forth) while no beta hemolytic streptococci could be recovered from 67.4 per cent of another group of children absent because of these illnesses (29 of 43). When no respiratory illness and no absenteeism were recorded, 37.1 per cent of the children (72 of 194) were found to be carrying Group A organisms. Thus a higher percentage of absences harbored Group A streptococci than did children not absent on sampling dates. Among those children who were absent, beta hemolytic streptococci of various groups were recovered more frequently in the presence of respiratory illness (69.4 per cent) than in its absence (39.6 per cent). When an “epidemic” of Group A, type 6 beta hemolytic streptococci occurred, no increase in absences due to respiratory illness was recorded.

Respiratory illnesses, when associated with school absences were accompanied by rises in ASLO titer at the time of, or within four weeks after the isolation of Group A beta hemolytic streptococci, in only three of 15 recorded instances (Table 1). Thus when clinical and bacteriological evidence of streptococcal infection was present, only 20 per cent of the cases met the third criterion, immunological response, for such infection. Numbers of children absent from whom other groups of beta hemolytic streptococci were recovered, were too small to permit detailed analysis.

Colony counts of beta hemolytic streptococci on original throat culture swab plates were made because throat cultures predominately are considered evidence of preceding beta hemolytic streptococcal infection, evidence which constitutes a minor criterion for the diagnosis of acute rheumatic fever. Study of school absences, presumably due to respiratory illnesses, in relation to colony counts (Table 2) indicated that there were approximately the same percentages of counts over 25 colonies in this category, as there were in the group of absences due to non-respiratory and unknown causes. Percentages were approximately the same when no absences were recorded. Thus, in these investigations, no greater numbers of colonies were observed whether or not clinical respiratory illness sufficient to cause school absence was present. On the other hand, ASLO titer elevations were demonstrable in a larger percentage of absences from whose throat swabs there were colony counts of over 25, than of absences with counts of under 25, when Group A beta hemolytic streptococci were isolated. Instances in which counts were over 25 were few, however, and too much weight cannot be placed on the significance of this observation. We would like to call attention, however, to the fact that colony counts of 100 and over were observed in approximately equal percentages from both the non-absentee and upper respiratory absentee groups of children, and that these figures represented only 10 to 12 per cent of the children from whose throats Group A beta hemolytic streptococci were isolated.

Our findings in the present report give no consistent evidence of correlation between absences due to respiratory illnesses and (1) frequency of isolation of beta hemolytic streptococci; (2) beta hemolytic streptococci; (3) colony counts on original isolation plates; and (4) an “epidemic” of type 6, Group A streptococci.

We have observed: (a) elevated average ASLO titers and indices amongst those children from whose throats Group A streptococci were isolated, (b) a generally low school absentee rate due to upper respiratory infection, and (c) colony counts of
Group A streptococci of a magnitude of 25 colonies or less in approximately 75 per cent of the school absentees studied. We believe that this association of facts reflects a situation in which the host-organism relationship is such that either the host, although responding serologically to the organisms, is relatively resistant to illness caused by Group A beta hemolytic streptococci, or the organisms encountered during our study were of a low order of virulence.

SUMMARY

1. Of 333 children attending the first three grades in three public schools in Miami, Florida, October, 1954 to May, 1955, 139 were absent one or more times during regularly scheduled monthly throat swabbing periods.
2. The reason for each absence was recorded and the throats of these absentees were swabbed as soon as possible (usually within 72 hours).
3. No direct relationship between frequency of isolation of Group A beta hemolytic streptococci and absences could be determined.
4. ASLO levels and responses showed no marked correlation with absenteeism, whether or not Group A organisms were recovered.
5. Colony counts of 25 to 100, and over 100 of Group A beta hemolytic streptococci were found on throat swab culture plates with the same relative frequency in cultures taken from non-absentees as from absentees.
6. No child in our investigation developed a known acute episode of rheumatic fever or glomerulonephritis.
7. School absenteeism, in the present investigation, did not reflect upper respiratory illness in the children found to be carrying beta hemolytic streptococci in their pharynges and manifesting ASLO titer elevations. The relationship of beta hemolytic streptococci to illness has been discussed from the viewpoint of host-organism interaction.

RESUMEN

1. De 333 niños que asisten a los tres primeros años en tres escuelas públicas de Miami, Florida de Octubre de 1954 a Mayo de 1955, hubo 139 que faltaron una o más veces durante los exámenes de tomas de frotis de garganta que se hicieron mensualmente.
2. La razón de cada falta de asistencia se investigó y las gargantas de estos faltistas se sujetaron a la toma de frotis con torunda tan pronto como fue posible (generalmente dentro de 72 horas).
3. No se encontró relación directa entre el aislamiento del estreptococo beta hemolítico grupo A y las faltas.
4. Los niveles de ASLO y la respuesta no mostraron correlación con las ausencias ya que se encontraron o no gérmenes del grupo A.
5. Las colonias con cuenta de 25 a 100 o más de 100 del estreptococo beta hemolítico grupo A, se encontraron en los cultivos de garganta, con la misma frecuencia relativa en cultivos de faltistas como de puntuales.
6. Ningún niño en nuestra investigación presentó un episodio conocido de fiebre reumática o de glomerulonefritis.
7. Las faltas a la escuela según esta investigación no se debían a afecciones respiratorias superiores en los niños que se encontraron tenían estreptococo beta hemolítico en la faringe y con título de ASLO elevado. La relación del estreptococo hemolítico con la enfermedad se discute desde el punto de vista de las interacciones entre el germen y el huésped.

RÉSUMÉ

1. Sur 333 enfants fréquentant les cours des trois premiers degrés dans trois écoles publiques à Miami (Floride) d’octobre 1954 à mai 1955, 139 furent absents une ou plusieurs fois pendant les périodes mensuelles régulièrement prévues pour faire des prélèvements laryngés.
2. La raison de chaque absence fut enregistrée et la gorge de ces absents fut écouvillonnée aussi tôt que possible (habituellement moins de 72 heures après l’absence).
3. Aucune relation directe ne put être déterminée entre la fréquence d’isolement de streptocoques hémolytiques beta du groupe A et les absences.
4. Les taux et les réponses des antistreptolysines O ne montrèrent aucune corrélation nette avec l’absentéisme, que l’on ait compté ou non des germes du groupe A.
5. On trouva un nombre de colonies de 25 à 100 et d’autres de plus de 100 pour les streptocoques hémolytiques beta du groupe A, à la culture des prélèvements laryngés, avec la même relative fréquence pour les cultures faites chez les enfants qui avaient été absents que chez ceux qui ne l’avaient pas été.
6. Pendant notre investigation aucun enfant ne fit d’épisode aigu connu de rhumatisme articulaire ou de glomérulonéphrite.
7. L’absentéisme scolaire, dans la présente étude, ne reflète aucune atteinte respiratoire particulière chez les enfants porteurs de streptocoques hémolytiques beta dans leur pharynx et ayant une élévation des antistreptolysines O. La relation entre streptocoques hémolytiques beta et la maladie a été discutée du point de vue de l’interaction entre le microbe et l’individu qui l’héberge.
ZUSAMMENFASSUNG

1. Von 333 Kindern, die die ersten 3 Klassen der drei öffentlichen Schulen in Miami in Florida zwischen Oktober 1954 und Mai 1955 besuchten, fehlten 139 ein oder mehrere Male im Verlauf von regelmäßig festgesetzten Terminen für monatliche Halsabstriche.

2. Der Grund für jedes Fehlen wurde ermittelt und der Halsabstrich bei diesen Kindern sobald als möglich nachgeholt (gewöhnlich innerhalb von 72 Stunden).


4. ASLO-Werte und Reaktionen zeigten keine ausgesprochene Beziehung zu dem Fehlen, unbeschadet dessen, ob Erreger der Gruppe A gefunden wurden oder nicht.

5. Auszählung von Kolonien zwischen 25 und 100 und über 100 der beta-hämolytischen Gruppe A fanden sich auf Kulturplatten von Halsabstrichen mit derselben relativen Häufigkeit in Kulturen von Kindern, die nicht gefeht hatten, und solchen, die fehlgeblich waren.

6. Bei keinem Kind unserer Untersuchungsreihe entwickelte sich ein akutes Stadium eines rheumatischen Fiebers oder eine Glomerulonephritis.

7. Das Fehlen von Abstrichen der Schule war in der vorliegenden Untersuchung kein Spiegelbild einer Erkrankung der oberen Luftwege unter Kindern, bei denen sich herausgestellt hatte, daß sie in ihrem Hals beta-hämolytische Streptokokken besaßen.

REFERENCES


