An Outbreak of *Streptococcus pneumoniae* Serotype 1 in a Closed Community in Southern Israel

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An outbreak of *Streptococcus pneumoniae* serotype 1 occurred in a closed community that was characterized by poverty and crowding. Vaccine was administered to individuals aged >2 years; no new cases occurred among vaccine recipients. Six weeks after vaccination, carriage of serotype 1, but not of other serotypes, decreased 8.8-fold. This suggests that the reduction in serotype 1 carriage reflects the natural course of the outbreak rather than a vaccine effect. Polysaccharide vaccine may be helpful in terminating pneumococcal outbreaks but may not affect pneumococcal carriage.

Outbreaks of pneumococcal disease have been described rarely in specific high-risk, crowded, closed populations [1–6]. Here we present a pneumococcal outbreak in a crowded and poor community with prevalent nutritional deficiency. We offered a polysaccharide vaccine to all members of the community aged >2 years, and studied colonization before and 6 weeks after vaccination.

Materials and Methods

The community includes ~1000 black Americans originally from Chicago who settled in the city of Dimona in southern Israel in the 1970s. Most members of the population are aged <20 years, and none are aged >60 years. This is a poor, crowded community in which members live as a sect with strict rules. Their diet is vegan, and there is special food for children; this diet is associated with malnutrition, anemia, and infections.

The use of regular medical services and antibiotics is restricted to severe cases. All members attend the same clinic in Dimona and are served by the Soroka University Medical Center (SUMC).

Cultures of blood, middle ear fluid, and nasopharyngeal specimens, as well as serotyping and ribotyping, were performed as described elsewhere [7–9]. Data on hospital and clinic visits were obtained from recorded logbooks.

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The intervention was approved by the ethics committee, and informed consent was signed by all participants.

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Results

**Description of the outbreak.** In March 1997, a sharp increase in the number of study population hospital visits was observed (figure 1A). Twelve individuals were hospitalized for lobar pneumonia; 3 also had bacteremia due to *Streptococcus pneumoniae* serotype 1. An additional 2-year-old child presented in April with acute otitis media; tympanocentesis yielded *S. pneumoniae* serotype 1. During March 1997, a record number of pediatric visits to the clinic was noted (52 visits [90% with respiratory symptoms], compared with the monthly average of 23). From December 1996 through February 1997, 3 other cases of bacteremia occurred among the community members (1 in an adult and 2 in children); 2 of these were also caused by serotype 1. One patient died.

During the year preceding the outbreak, 84 cases of pneumococcal bacteremia were recorded, none among the study population (figure 1B). In contrast, from December 1996 through March 1997, 53 cases of pneumococcal bacteremia occurred, 6 (12.5%) of which were among the study population (*P* < .05). Serotype 1 was isolated in 5 (83.3%) of 6 bacteremic members of the study community versus 12 (25.5%) of 47 in the general population (*P* = .017)—an incidence of 600/100,000 in the study community versus 11.8/100,000 in the general population (*P* < .001). For serotype 1, the respective incidence was 500/100,000 versus 3.0/100,000 (*P* < .001). No increase in hospital or clinic visits was observed for the general population (figure 1C).

**Intervention.** During the first week of April 1997, all individuals aged >2 years of age were offered a 23-valent polysaccharide vaccine (Pneumovax 23, Merck, Sharp, and Dohme,
Figure 1. Emergency room and clinic visits plotted with cases of pneumococcal bacteremia. A. Total emergency room visits, emergency room visits for lobar pneumonia, and clinic visits by children of members of study community from December 1996 through April 1998. B. Pneumococcal bacteremia among members of total population and study community from December 1995 through April 1998. C. Emergency room visits by general population from December 1996 through April 1998 and visits to Dimona clinic by people not belonging to study community from October 1996 through April 1998. ER, emergency room; SC, study community; arrow, vaccination on 17 April 1997.

West Point, PA). In 3 days, 641 individuals were vaccinated. Only 2 additional cases of bacteremia occurred in the community during the following year (figure 1B): 1 in an infant with protein-calorie malnutrition (serotype 9V) and 1 in an adult who refused vaccination in April (serotype 1).

Before vaccination, 650 nasopharyngeal specimens were obtained for culture. Pneumococcal carriage was inversely associated with age (figure 2). In contrast, no significant changes in the carriage of serotype 1 were associated with age. Six weeks after immunization, repeated cultures were obtained from 457 (70%) subjects. Carriage of type 1 decreased significantly for all age groups after vaccination (including in those aged <2 years who were not vaccinated; table 1). The nonserotype 1 isolates were divided into those commonly detected in infants and young children (6A, 6B, 9V, 14, 18C, 19A, 19F, and 23F) and in all others. No decrease in carriage after vaccination was observed in either group.
Ribotyping showed that all 30 serotype 1 isolates from the outbreak and 28 of 29 serotype 1 isolates from the general population (area- and time-matched) were identical.

**Discussion**

The present outbreak, which was caused by a single clone of *S. pneumoniae* type 1, occurred in a poor, crowded, and nutritionally deficient community, characteristics shared with populations in the developing world. We speculate that outbreaks in other underprivileged populations are more common than appreciated but go unnoticed because of the lack of availability of diagnostic methods.

As expected in populations with crowded conditions, the community members were heavily colonized with various serotypes, especially during early childhood, which is a risk factor for outbreaks. Two other risk factors are also common among such populations: respiratory viral infections (prevalent mainly in winter and spring, periods coinciding with the present outbreak) and malnutrition.

Six weeks after vaccination, the carriage of serotype 1 decreased 8.8-fold, but that of the other serotypes included in the vaccine did not decrease significantly. Although conjugate vaccines can prevent pneumococcal carriage [8, 10, 11], only 1 of 3 studies suggested reduction of colonization by a nonconjugate pneumococcal vaccine [8, 12, 13]. This and the fact that the carriage of serotype 1 among the community individuals decreased, as well in those not vaccinated (aged <2 years), suggest that the effect of the vaccine in the reduction of serotype 1 carriage was at best marginal.

It is difficult to estimate the exact role of the vaccine in the termination of the outbreak. However, given that during the follow-up period the only additional case of infection due to serotype 1 occurred in 1 of the few individuals refusing immunization and that the only low rate of hospital and clinic visits was observed during this period, it is possible that the vaccine provided protection against invasive infections. It is, therefore, suggested that the use of polysaccharide vaccine may help in terminating pneumococcal outbreaks, but may not affect carriage.

**Table 1.** Nasopharyngeal carriage of pneumococcal serotype 1, pediatric (6A, 6B, 9V, 14, 18C, 19A, 19F, and 23F), and other serotypes by age group, before and 6 weeks after immunization.

<table>
<thead>
<tr>
<th>Serotype</th>
<th>&lt;2 y  (n = 27)</th>
<th>2-5 y (n = 57)</th>
<th>6-10 y (n = 89)</th>
<th>11-15 y (n = 110)</th>
<th>&gt;16 y (n = 174)</th>
<th>All age groups (n = 457)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>1</td>
<td>2 (5)</td>
<td>0</td>
<td>7 (8)</td>
<td>1 (1)</td>
<td>7 (4)</td>
<td>24 (5.3)</td>
</tr>
<tr>
<td>&quot;Pediatric&quot;</td>
<td>5 (19)</td>
<td>4 (15)</td>
<td>11 (19)</td>
<td>10 (18)</td>
<td>2 (2)</td>
<td>24 (5.3)</td>
</tr>
<tr>
<td>Others</td>
<td>10 (37)</td>
<td>14 (52)</td>
<td>28 (49)</td>
<td>24 (42)</td>
<td>29 (33)</td>
<td>20 (22)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>27 (25)</td>
<td>23 (21)</td>
<td>15 (9)</td>
<td>109 (23.8)</td>
</tr>
</tbody>
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**P**

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<tr>
<th>&gt;0.05</th>
<th>0.05</th>
<th>0.01</th>
<th>0.001</th>
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**NOTE.** Data are no. (%) of patients unless otherwise indicated. A, 6 weeks after immunization; B, before immunization.

**References**