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## EVALUATION OF THE PHONE SURVEY IN AN OUTBREAK OF STAPHYLOCOCCAL INFECTIONS IN A HOSPITAL NURSERY FOR THE NEWBORN

*Walter A. Murray, Jr., M.D.; Gerald E. McDaniel, M.D., M.P.H.; and May Reed, B.S., R.N.*

**D**URING THE fall of 1956 the physicians in a moderate-size Southern city noticed an increasing incidence of severe suppurative lesions in newborn infants and recently delivered nursing

mothers. Concern was heightened when two infant deaths occurred, one the result of fulminating staphylococcal septicemia, the other of staphylococcal pneumonia. Since the infants died in different

hospitals, it was not immediately apparent that both had been delivered in a third hospital and had stayed in its crowded nursery. When this was recognized, the State Board of Health was notified and an invitation was later extended to the Communicable Disease Center to participate in the investigation. The number of cases uncovered by a full investigation in one hospital, and by brief investigations at the other two hospitals, indicated a severe community problem similar to that recently documented for Seattle.<sup>1-3</sup> While this outbreak of nursery origin is comparable to many previously described, it serves to demonstrate how an iceberg of infection may cleave through a community unrecognized. It also re-emphasizes the seriousness of *Staphylococcus pyogenes* as the etiologic agent of breast abscesses in nursing mothers and severe abscesses in infants. The investigators of this outbreak confirm the value of the telephone survey as introduced by

Ravenholt,<sup>1</sup> having found it most useful in supplementing information obtained from interviews of physicians.

Methods—Inasmuch as the two fatal cases and the majority of severe abscesses in mothers and infants were from patients in one hospital, investigative efforts were concentrated there. Review of hospital records indicated 277 mothers delivered 279 live infants from September 1 to November 30. These denominators were chosen for the analysis to encompass the recorded cases for the period September 16 to November 17 (Figure 1).

A more definite case count was obtained by interviewing physicians. Obstetricians who delivered the majority of patients reviewed a list of their deliveries; physicians who delivered less than five patients were interviewed by telephone; and all the practicing pediatricians reviewed a complete list of deliveries. Five double infections involving infant and mother were reported, but

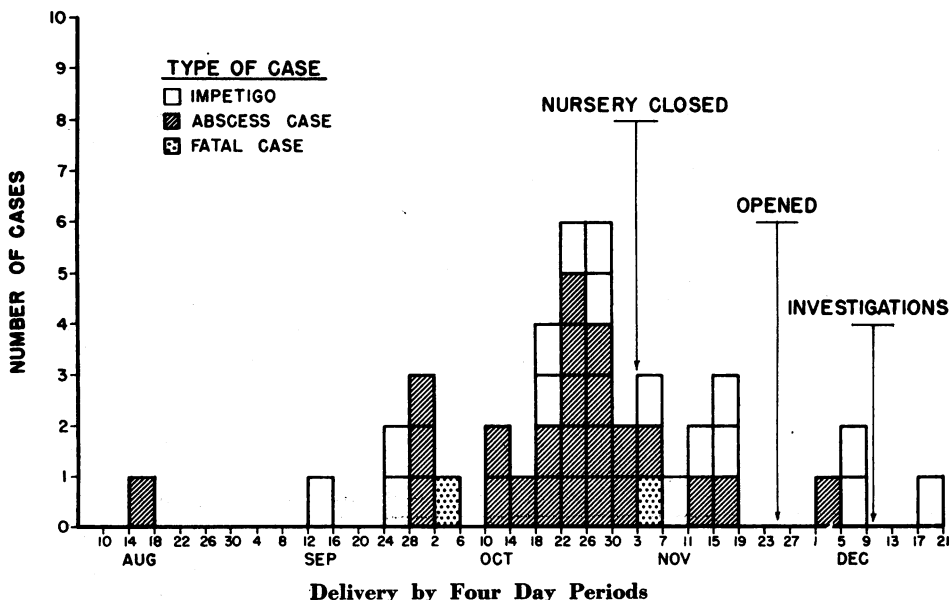


Figure 1—Staphylococcal Epidemic in a Hospital Nursery South Carolina, 1956—Reported Cases

the patients had been treated by different pediatricians and obstetricians. Permission was obtained from the obstetricians to telephone these five mothers in order to check on the occurrence of suppurative infections in the mothers and infants.

Several physicians estimated that a large number of cases had been treated at home without medical advice and in some instances only telephone consultations had been made. In order to define accurately this iceberg of infection, it was believed that a more complete telephone survey would prove valuable.

On the basis of the number of cases reported by the physicians, it was found statistically appropriate to telephone every third woman delivered during the three-month period. Two of the authors conducted the survey which meant that each called every sixth mother. When no phone was listed or a long distance call was involved, the mother next on the list was called. Then, if the same difficulty prevailed with this first alternate mother, the name that preceded the original one on the list was called. In most instances the interview was completed in from three to five minutes, with an average of four minutes for those clocked; even with talkative mothers no interview required longer than seven minutes. We were able to average 8.5 calls per hour.

Information obtained from the hospital charts and physicians made it possible to gain the immediate confidence of the mother, to direct the interview, and to prevent her rambling to other subjects. It was also possible to cross-check the time of onset and duration of infection since the dates of delivery and discharge from the hospital were known and, in many instances, also the dates of visits to physicians. Knowledge of sibling ages recorded on the hospital charts helped in obtaining data on secondary cases in the family. Inquiry was then made about infections in playmates

to check on possible spread into the community.

## Results

### Findings from Hospital and Physicians

From data obtained by abstracting hospital records and from interrogation of physicians a short, sharp epidemic is depicted in Figure 1. The concentration of cases began to occur in late September, then increasing through October to a peak during the last week of that month. On November 2 the nursery was closed because of the increase in reports of suppurative illness in recently discharged mothers and infants, and because two cases of impetigo and a severe case of staphylococcal conjunctivitis were diagnosed in the nursery itself. There was a decrease in cases beginning shortly after moving to a four-bed ward temporary nursery, and, after November 17 no cases were reported for a 17-day period. The repainted and renovated nursery was again opened on November 24. Sporadic cases occurred in December and January, but no more than four were reported for either month.

Review of the hospital records and interrogation of the physicians revealed a total of 37 suppurative infections, 11 in mothers and 26 in infants. The over-all attack rate was 6.8 per cent, 3.9 per cent for mothers and 9.3 per cent for infants.

Review of the hospital charts showed that 59.8 per cent of the mothers began to breast feed their infants. Of the 11 infections among mothers, one was a vaginal abscess and the other 10 were breast abscesses—every one of the mothers involved had breast fed her infant. In addition, while only 22.8 per cent of the mothers delivered were primiparas, 60 per cent of the breast abscesses occurred in these mothers.

The 26 infant cases included two deaths, one case of conjunctivitis, five

breast abscesses, six deep subcutaneous abscesses, and 12 cases of impetigo. The first fatality occurred in a 22-day-old male infant delivered on October 6. The baby developed progressively severe abdominal distention and vomiting beginning 36 hours prior to hospitalization on October 26. On admission the chest was clear by physical examination. A surgical exploration for possible intestinal obstruction revealed only adynamic ileus. In an immediate postoperative x-ray a characteristic radiological picture of staphylococcal pneumonia was found. Despite therapy with penicillin before the operation, and increasing dosages of penicillin and streptomycin thereafter, the baby expired 22 hours after the laparotomy. Staphylococcal pneumonia with empyema and early pericarditis were confirmed at autopsy.

The second fatality occurred in a 33-day-old infant delivered November 6. Impetigo was noted by the mother 10 days prior to hospitalization on December 3. The suspected diagnosis of septicemia was confirmed by growth of *Staphylococcus pyogenes* from blood cultures. Death ensued six days after admission despite the administration of five antibiotics in high dosage and of gamma globulin. The two deaths resulted in a case fatality rate of 7.7 per cent, an implication of severity that has not been adequately stressed in articles reviewed in the recent American medical literature.

Besides the deaths, another severe manifestation among the infants was the progression of a staphylococcal conjunctivitis to a maxillary osteomyelitis requiring the extraction of four deciduous teeth.

The physicians's descriptions of impetigo were remarkably uniform, for the majority described crops of small vesicles 1 to 4 millimeters in diameter with a surrounding erythematous area of similar width. The case histories indicated the presence of clear vesicular

fluid at onset which rapidly became purulent. After rupture and later in the course of infection, larger erythematous indurated lesions were noted, but very few instances of bullous lesions were encountered. Deep abscesses developed, often spontaneously, but more often preceded by impetigo. The lesions were concentrated chiefly in warm, moist skin areas, usually in the inguinal, axillary, neck, and postauricular regions.

Suppurative infections for the infants were found to be independent of the type of feeding that had been started. Eleven per cent of the breast-fed and 7.6 per cent of the formula-fed infants contracted infection, almost the expected ratio of 12:8 since 59.8 per cent of the mothers had begun to breast feed their infants.

Figure 2 shows that the interval from delivery to onset of suppurative illness in the infants ranged from three to 33 days, with a median of nine days. This nine-day median is similar to that reported for infant impetigo and infant breast abscess.<sup>1-3</sup> The bulk of maternal breast abscesses occurred from 12 to 18 days after delivery, with a median of 16.5 days. This is in sharp contrast to the shorter interval for infant infections.

The average duration of hospitalization for mothers and infants subsequently infected was 7.2 days, whereas the noninfected patients stayed on an average of 5.3 days, a statistically significant difference of 1.9 days. Infants of the mothers who stayed longer were boarded in the nursery. It is not surprising therefore that analysis of available data revealed that one-half, or possibly more, of these mother-infant pairs had become infected—11 infants and three mothers.

A limited number of cultures were obtained. The strains of *S. pyogenes* isolated were uniformly resistant to penicillin, the tetracycline and streptomycin antibiotics. Of cultures obtained

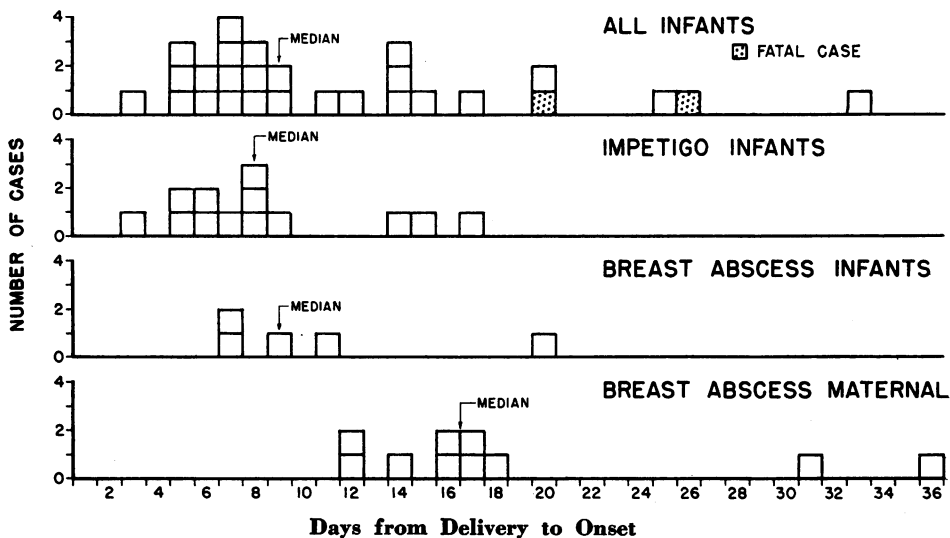


Figure 2—Staphylococcal Epidemic in a Hospital Nursery, South Carolina, 1956—Interval Delivery to Onset of Reported Cases

from lesions occurring during the epidemic, phage type 44A was recovered from one lesion and three other cultures yielded 81/52/42B. Throat cultures from physicians and nurses taken near the end of the epidemic revealed only one culture of each of the above types. Succeeding nasal and throat cultures indicated no permanent carriers of these types.

#### Findings from the Telephone Survey

The telephone survey elicited descriptions of lesions conforming to those of the doctors. The majority of the mothers who were called spontaneously described "pimples with pus" as the initial lesions seen on their infants. Any doubtful descriptions were deleted; therefore, six accounts that may have been impetigo were eliminated by other diagnoses. Adoption of a strict definition of impetigo is supported by recent reports in the literature.<sup>4, 5</sup> The presence of external suppuration allowed equally strict maternal diagnoses, and seven cases diagnosed as "mastitis" were not accepted.<sup>6</sup>

Ninety-one of the 277 mothers were interviewed during the telephone survey. Twenty-six described suppurative illness compatible with the above criteria, nine in themselves and 17 in their infants. The over-all attack rate was 14.3 per cent, 9.9 per cent for mothers and 18.7 per cent for infants. Of these 26 cases, 14—four maternal and ten infant—had not been uncovered by the previous case-finding technics. Of the four maternal infections not previously encountered, three mothers had consulted physicians who had not been reached and one mother had a Montgomery tubercle abscess which had healed spontaneously. A postauricular abscess and nine cases of impetigo constituted the ten newly discovered infant infections.

With 26 cases discovered in the telephone survey, one might predict that about three times this number probably occurred since only one-third of the mothers were called. Statistical consideration of the variance of such a sample would indicate a possible total occurrence of  $78 \pm 8.5$  cases. These figures indicate that the scope of the

epidemic was more than twice as great as the findings from the physicians and hospital had indicated.

One would intuitively expect to encounter one-third of the previously discovered cases since every third delivery was called; and this did indeed occur, for of the 26 cases uncovered by telephone survey 12 were among the 37 cases originally discovered by interrogating physicians and reviewing hospital records. Curves based on the information obtained in the phone survey by either investigator alone are not sharp epidemic curves (Figure 3). But when the information from both investigators is combined an epidemic curve is produced which within narrow limits is comparable with that of Figure 1.

Analysis of the data gathered by telephone for the mean and median intervals from delivery to onset of illness revealed figures very similar to those obtained from physicians; and, again, all the mothers with breast abscesses

had breast fed their infants. Of the 91 mothers reached by telephone in mid-December, 50 reported that they had begun to breast feed in the hospital. Of the 50, 15 had continued breast feeding, while the other 35 had ceased doing so on an average of 24.2 days after delivery. In this respect it is interesting to note that the data from the telephone survey reveal that the mean interval from delivery to onset of breast abscess in the mothers was 19.8 days.

No evidence of spread into the family or community was apparent at the time of the telephone survey on December 20, but two instances of recurrent suppurative infection in siblings were reported later.

Discussion

The insidious nature of this epidemic allowed it to become a major problem before it was appreciated by the hospital or practicing physicians. The occur-

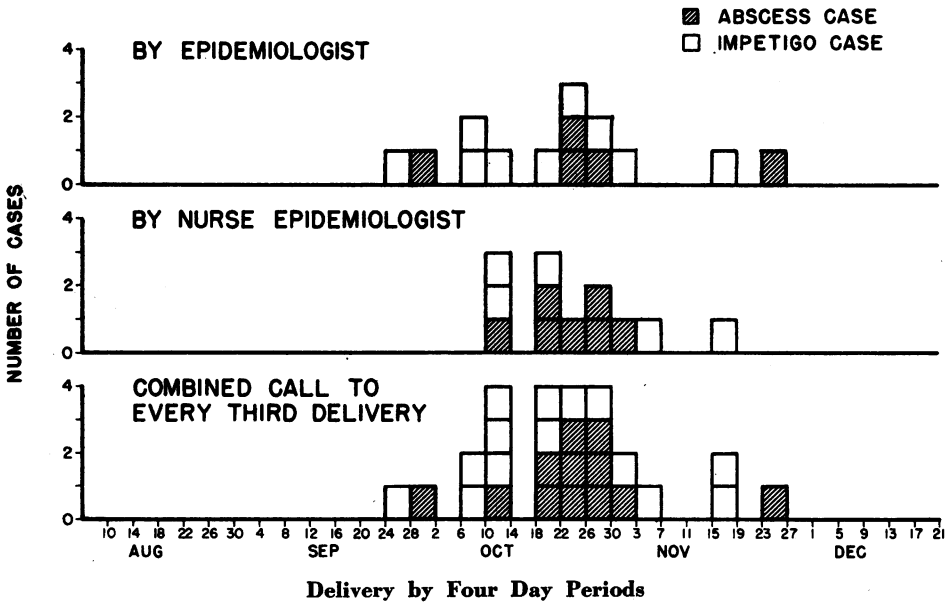


Figure 3—Staphylococcal Epidemic in a Hospital Nursery, South Carolina, 1956—Phone Survey Cases

rence of cases after discharge from the hospital produced an iceberg of infection submerged into the community. The debilitation of mothers and infants by "hospital-acquired staphylococcus" needs repeated emphasis.<sup>7-11</sup> Manifestation of this circumstance in the infant is not always a minor infection. Cases that often start innocently enough as impetigo can progress to pneumonia and empyema, septicemia, osteomyelitis, breast and other deep abscesses,<sup>2,7</sup> and in this epidemic there were two infant deaths. The data compiled here on prolonged hospitalization and prior occurrence of illness in infants supports the contention that the hospital nursery was the common source. The longer time interval (one week) between onset of suppurative infection in mothers as compared with infants provides deductive evidence for the hypothesis that staphylococci pass from infants to nursing mothers.<sup>2,3,7</sup> Had both been infected at the same time, it is unlikely that a difference in host reaction would have required a week in which to manifest itself.

The risk of breast feeding during these epidemics has been emphasized in the recent literature.<sup>1,3</sup> This risk was further documented here—all the infected mothers had begun to breast feed their infants while in the hospital. During such epidemics, therefore, the known advantages of breast feeding must be balanced against the evident hazards. The mother should be advised of the danger and breast feeding discouraged; if she insists, early discharge from the hospital should be strongly urged.<sup>1-3</sup>

In this epidemic the greater prevalence of breast abscesses among primiparas, as well as the fact that most of the mothers discontinued breast feeding at a time coincident with the peak of breast abscesses, are two observations that may have some bearing on the pathogenesis of maternal breast abscesses. These factors plus others affecting the

etiology of breast abscess have been previously stressed.<sup>6</sup>

A review of recent literature indicates that the primary reservoir of infection is usually in the infant.<sup>2,3,8,12,13</sup> This was reflected here by the rapid decline of the epidemic after the opening of a temporary nursery, without transferring to it any of the infants from the permanent nursery. Since the same personnel worked in both nurseries, it is believed that nurses had a lesser role in the propagation of the epidemic. It is probable that during the epidemic period multiple factors were at work in perpetuating the transmission of infection in the nursery. Chief among these was the crowding into the nursery up to twice as many infants than is recommended.<sup>14</sup> This would allow easy passage of the staphylococcus from infant to infant. In addition, the high nursery census encouraged poor aseptic technics where inherent weaknesses already existed. Yet these poor technics were continued for 22 days after the move to the temporary nursery—with the exception of increased diligence in hand washing—and still the epidemic subsided. The essential change in the situation that resulted in dramatic curtailment of this epidemic was the presence of new infants in a less crowded environment. Other factors that may have been operative before and during the epidemic have been reviewed elsewhere.<sup>11,15,16</sup>

After the epidemic had subsided, no *ex post facto* evidence of the existence of permanent nasal carriers was obtained. Identification of an "epidemic strain" was not made.

The telephone survey proved to be a valuable epidemiologic tool for several reasons. It avoids the nonreporting of the questionnaire-type systems and the failure of physicians to report cases whether due to lapse of memory or omission. Concern of the mother for

the health of her infant and the pride of newly acquired motherhood motivate her to cooperate. No refusal or lack of cooperation on the part of a mother was encountered in 91 telephone calls, and the organized structure of the questions extracted the desired information with little extraneous material. Information previously obtained from the physicians and hospital charts was used as a cross-check and indicated that the telephone survey was achieving the desired result. This cross-check also demonstrated that lapse of memory was a minor problem and that the strict criterion of accepting only suppurative processes minimized the error of over-estimation. Yet the interview was so structured as not to miss staphylococcal infection, and in only one instance (nasal abscess in a mother) was information volunteered after the scheduled questions. Two mothers did surmise that the interview related to an "impetigo outbreak," but they were the only ones of the 91 called.

For the development of an intra-hospital, interhospital, intracommunity surveillance of the staphylococcus problem, a telephone survey would be most valuable. Such a technic helps to increase the awareness that these epidemics originate from a common source frequently contaminated with highly antibiotic-resistant staphylococci.

### Summary

1. Incidence of a staphylococcal epidemic in a nursery for newborn, as determined from data obtained by interrogation of physicians, indicated an over-all attack rate of 6.7 per cent of 277 mothers and 279 infants delivered during a three-month period. For infants the attack rate was 9.3 per cent, for mothers, 3.9 per cent.

2. Incidence as determined by a telephone survey of one-third of the moth-

ers delivered during the above period more than doubled these rates.

3. The interrogation of physicians uncovered 37 cases—11 mothers and 26 infants and telephoning the mothers uncovered 14 additional cases—four mothers and ten infants.

a. Of the 15 maternal cases 13 were severe breast abscesses. All 13 mothers had begun breast feeding while in the hospital.

b. The severity of the outbreak is further reflected by two infant deaths as well as by 13 severe breast and other deep abscesses in infants.

c. Only four of the 51 maternal and infant infections were detected in the hospital nursery. This iceberg of infection occurring after discharge from the hospital is a serious aspect of the staphylococcal problem.

d. Also significant is the fact that mothers and infants who were subsequently infected had remained in the hospital longer than those who escaped infection.

4. The telephone survey proved to be an accurate, nonprovocative epidemiologic tool for retrospective case finding, requiring less time and providing easier cross-checking than interrogation of physicians.

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