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The Presence of Staphylococcus Aureus on Mothers Admitted to Selected Maternity Unit

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THE PRESENCE OF STAPHYLOCOCCUS AUREUS ON MOTHERS ADMITTED TO A SELECTED MATERNITY UNIT

by

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I certify that I have read this thesis and that in my opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

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CHAPTER I

INTRODUCTION TO THE STUDY

Although science has contributed much to the prevention and control of communicable disease, bacterial infections continue to be a significant health problem.

Recently, staphylococcal infections have received special attention in medical literature. A serious problem of infections with Staphylococcus aureus exists in hospitals. Wysham et al. reported an epidemic of staphylococcal infections in a hospital nursery in which 46 per cent of one hundred and seventeen newborn infants contracted clinical staphylococcal infections.[1] Fekety et al. found that 10 per cent of all deliveries occurring during a seven-month survey were complicated by staphylococcal infections either in the mother or infant, and that several fatalities had occurred from these infections.[2]

Staphylococcal infections within hospitals are not limited to the maternity unit. During a four-month period, Wysham and Kirby reported twenty-four deaths on the medical and surgical units of a selected hospital in which staphylococcal infections were a contributing factor to death.[3]

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[1]Donald N. Wysham et al., "Staphylococcal Infections in an Obstetric Unit," New England Journal of Medicine, 257:302, August 15, 1957.

[2]F. Robert Fekety et al., "Control of an Outbreak of Staphylococcal Infections Among Mothers and Infants in a Suburban Hospital," American Journal of Public Health, 48:309, March, 1958.

[3]Donald N. Wysham and William M. M. Kirby, "Micrococci (Staphylococci) Infections in a General Hospital," Journal of American Medical Association, 164:1739, August 17, 1957.

There is evidence that the problem of staphylococcal infections is universal. Shaffer et al. found that a particular strain of S. aureus, responsible for some epidemic infections in the United States, also had been isolated by investigators in forty similar epidemics in Europe, Australia, and Canada.

A factor increasing the importance of staphylococcal infections within recent years has been the presence of antibiotic-resistant organisms, particularly in the hospital environment. It has been determined that antibiotic-resistant S. aureus has increased from 50 to 80 per cent among selected patients and personnel in hospitals from 1942 until 1956.[4] Most authorities agree that the prolonged and indiscriminate use of antibiotics has contributed to this increase in resistant organisms. Negligence in maintaining aseptic techniques and certain factors within the host also appear to influence individual susceptibility to these infections.

I. THE NEED FOR THE STUDY

The identification of organisms resistant to antibiotics has initiated new and intensive research into the problem of infectious disease. The American Hospital Association, in cooperation with the United States Public Health Service, has made recommendations to hospitals that committees on the prevention and control of hospital infections be appointed.[5]

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[4]Thomas E. Shaffer et al., "Staphylococcal Infections in Newborn Infants," American Journal of Public Health, 47:990, August, 1957.

[5]Dean A. Clark et al., Prevention and Control of Staphylococcus Infections in Hospitals, Joint Commission on Accreditation of Hospitals, American Hospital Association, Bulletin 1 (Chicago: American Hospital Association, May, 1958), p. 2.

Responsible persons from the medical and nursing staff, hospital administration, and housekeeping service form such a committee at the Loma Linda Sanitarium and Hospital. In monthly meetings this group studies infections occurring in patients and hospital personnel, evaluates environmental conditions, and when necessary makes recommendations to the appropriate administrative officer.

In January, 1959, the Infections Committee of the Loma Linda Sanitarium and Hospital reported that staphylococcal infections were present in the nursery. A newborn delivered by cesarean section had cutaneous pustules present at the time of birth. These lesions were opened and found to contain resistant S. aureus. By the following month, two other newborns developed staphylococcal lesions within four days after admission to the nursery. As a result, the Committee recommended to the hospital that investigation be made to determine factors contributing to these infections in the nursery.

Since no major disregard of aseptic practices in the nursery could be determined, and previous study of the nursery personnel did not locate a human carrier of a resistant strain of S. aureus, it was suggested that possibly the mothers were a source of infection to the infants. The Committee recommended that a survey be made of mothers admitted to the maternity unit.

In addition to determining the incidence and possible source of staphylococcal infections in a selected area, such surveys have seemed to: (1) stimulate in the hospital employees an awareness of individual responsibility in maintaining a safe environment for the patient, (2) encourage physicians to be discriminate in the use of antibiotics,

(3) improve the practices of aseptic technique, and (4) aid in initiating and enforcing specific measures for the control and treatment of established infections.[6]

II. THE PROBLEM

Statement of the problem. The problem of this study was to determine if Staphylococcus aureus was present on mothers admitted to the maternity unit of the Loma Linda Sanitarium and Hospital.

Purpose of the study. The purpose of the study was to determine if S. aureus present on the mother when admitted to the maternity unit could be a factor in the development of staphylococcal infections in the infant.

Assumptions. In this study it was assumed that the drapes and instruments used during the delivery were sterile, and that the physician and others attending the delivery did not transmit S. aureus to the mother or infant.

Hypothesis. S. aureus is present on mothers at the time of admittance to the maternity unit.

Limitations of the study. Because the need of the study was related specifically to the maternity unit of the Loma Linda Sanitarium and Hospital, the study was concerned only with one hundred and forty

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[6]Raimert T. Ravenholt and Otto H. Ravenholt, "Staphylococcal Infections in the Hospital and Community Environment and Staphylococcal Disease," American Journal of Public Health, 48:204, March, 1958.

mothers and their infants admitted to the maternity unit of this hospital between September 1, 1959, and January 31, 1960.

No attempt has been made to review all the available literature related to this subject. It was felt a representation of pertinent subject matter in the field could be successfully procured by limiting the review of literature to selected materials published from 1953 until March, 1960.

Plan of the study. Before the investigation was actually begun, current literature was reviewed for orientation to the subject and for identifying effective methods and techniques found useful in previous research in this field.

The research method chosen for the study was descriptive survey. Bacteriological specimens were secured from the nares and external vulva of mothers upon admission to the maternity unit of the selected hospital, and from the nares and skin of their infants at the time of delivery. The specimens were inoculated on a selective medium in the bacteriological laboratory. The cooperation of the Department of Microbiology at the College of Medical Evangelists was secured to identify and interpret laboratory findings.

III. DEFINITION OF TERMS USED IN THIS STUDY

Mothers

Mothers surveyed in this study were one hundred and forty women admitted to the maternity unit of the Loma Linda Sanitarium and Hospital for vaginal delivery between September 1, 1959, and January 31, 1960.

Group I. Group I consisted of sixty-six mothers (of the one hundred and forty surveyed) from whom a specimen was collected from the

nares and external vulva upon admission to the maternity unit and from the external vulva again after the vulvar preparation in the labor room.

Group II. Group II was comprised of seventy-four mothers (the remainder of the one hundred and forty surveyed) from whom a specimen was obtained from the nares and external vulva upon admission to the maternity unit and from the external vulva again after the perineal scrub.

Infants

Infants were newborns delivered from mothers participating in this study.

Vulvar Preparation

Vulvar preparation was the shaving and preliminary cleansing of the external vulva of the mother with hexachlorophene soap and water at the time of admission to the labor room.

Perineal Scrub

The cleansing of the abdomen and external vulva of the mother immediately prior to delivery with hexachlorophene soap and sterile water, followed with a spray of tincture of zephiran chloride 1-1000 to the same area.

Staphylococcus aureus (S. aureus)

Staphylococcus aureus was the gram positive coccus which grew on the 7.5 per cent sodium chloride selective medium, formed yellow pigmented colonies, produced coagulase, hemolysin, and fermented mannitol. Such growth was considered pathogenic.

Staphylococcus intermediate (S. intermediate)

Staphylococcus intermediate was an arbitrary name given gram positive coccus which formed yellow colonies, produced either hemolysin and/or fermented mannitol, but was coagulase negative. Such growth was considered as a possible, but not probable, pathogen.

Staphylococcus albus (S. albus)

Staphylococcus albus was bacterial growth which formed white colonies, did not produce coagulase or hemolysin, and did not ferment mannitol. Such growth was considered nonpathogenic.

IV. SUMMARY

There was a need at the Loma Linda Sanitarium and Hospital to determine what factors might be responsible for the incidence of staphylococcal infections in the hospital nursery. One hundred and forty mothers and their infants admitted to the maternity unit of the Loma Linda Sanitarium and Hospital between September 1, 1959, and January 31, 1960, were studied to determine if S. aureus present on the mothers at the time of admission might serve as a source of infection to the infants.

CHAPTER II

THE REVIEW OF LITERATURE

Within the past few years the medical profession has become increasingly aware of the problem of hospital-acquired staphylococcal infections. Many authors refer to the situation as possibly the most serious current communicable disease.[7] Studies have shown that the newborn represents a population which is highly susceptible to colonization by S. aureus. Cook et al., by obtaining daily nasal specimens from fifty-four newborn, found colonization by S. aureus had occurred in all newborn by the tenth day.[8] Staphylococcal infections seem to occur more frequently in the newborn and thereby constitute a major public health problem.[9]

I. SOURCE OF STAPHYLOCOCCUS AUREUS IN INFANTS

There is evidence that S. aureus may be introduced into the hospital nursery by various ways; Roundtree and Barbour consider the hospital personnel to be the primary source. In only a few cases were the

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[7]Warren E. Wheeler, "Staphylococcus Infections in the Newborn," Journal of the American Medical Association, 166:1900, April 15, 1958.

[8]Josephine Cook et al., "Acquisition of Staphylococcus Aureus by Newborn Babies in a Hospital Maternity Department," British Medical Journal, 1:76, January 11, 1958.

[9]Donald N. Wyeman and William M. M. Kirby, "Staphylococci Infections in a General Hospital," Journal of the American Medical Association, 164:1739, August, 1957.

staphylococci in the infants' nares similar to those found in the nares of the mothers.[10] Kessler and Scott also report that particular strains of S. aureus cultured from infants nares were more closely related to those of the personnel than of the mother.[11] In a seven-month study at Ohio State University Hospital, Baldwin found permanent carriers among hospital personnel to be the commonest source of colonization in infants.[12] Wysham et al. concluded, from their study of one hundred and seventeen infants in which fifty-four had clinical staphylococcal infections, that infants were sources to each other. It was believed that aerial transmission was responsible for the spread of infection, and that the infant was a source of infection to the mother.[13]

Some investigators propose that the mother should be considered an important source of S. aureus to the newborn. Fekaty et al. obtained nasal cultures from one hundred and fifty-seven mothers on admission to a selected maternity unit and found forty-one (26 per cent) were positive

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[10]Phyllis Roundtree and R. C. Barbour, "Staphylococcus Pyogenes in Newborn Babies in a Maternity Hospital," Medical Journal of Australia, 1:525, 1950.

[11]Althea Kessler and Roland Scott, "Staphylococcal Infections in Young Infants," American Medical Association Journal of Diseases of Children, 96:297, September, 1958.

[12]J. N. Baldwin et al., "Staphylococcal Infections in Newborn Infants," American Medical Association Journal of Diseases of Children, 94:115, August, 1957.

[13]Donald N. Wysham et al., "Staphylococcal Infections in an Obstetric Unit," New England Journal of Medicine, 257:302, August 15, 1957.

for antibiotic-resistant S. aureus. Identical strains were cultured from 8 per cent of their infants during the early post-partum period.[14]

Research into the possibility of maternal transmission of S. aureus during delivery is apparently limited. Only two such studies could be found. Wysham obtained vaginal cultures from ninety-nine mothers immediately after delivery, and found no growth of S. aureus.[15] Bret et al. claim, however, that vaginal transmission of S. aureus during delivery accounted for almost one-half of the infections which occurred among a selected group of newborn.[16] Kozinn et al. demonstrated that an organism (Candida albicans) could be transmitted directly from the vagina of a pregnant mouse to newborn mice, suggesting that infection of the maternal birth passage is a source of infection to the infant.[17] Although the subjects were not pregnant women, Hare and Ridley found S. aureus on the skin and perineum of individuals with no clinical evidence of infection.[18] It appears that further investigation of the presence of

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[14]Robert F. Fekety et al., "Control of an Outbreak of Staphylococcal Infections Among Mothers and Infants in a Suburban Hospital," American Journal of Public Health, 48:298, March, 1958.

[15]Donald Wysham et al., "Staphylococcal Infections in an Obstetric Unit," New England Journal of Medicine, 257:297, August 15, 1957.

[16]J. Bret et al., "Vaginities et Affections Neo-natales," La Presse Medicale, 67:216, January 31, 1959.

[17]Philip J. Kozinn et al., "Transmission of P^{32} Labeled Candida Albicans," American Medical Association Journal of Diseases of Children, 99:31, January, 1960.

[18]Robert Hare and M. Ridley, "Further Studies on the Transmission of Staphylococcus Aureus," British Medical Journal, 1:73, January 11, 1958.

S. aureus on the external vulva and/or birth canal of the mother, as a possible source of staphylococcal infections in the newborn, would be useful.

II. PREVENTION AND CONTROL OF STAPHYLOCOCCAL INFECTION

Available research gives much consideration to the control of staphylococcal infections through the use of preventive measures. Physical techniques designed to block channels of transmission of organisms have been employed with varying degrees of success. Improved laboratory methods, particularly bacteriophage typing, have provided better identification of the organism. Hospital inservice education programs have been initiated to stimulate awareness in the hospital personnel of the potential problem of staphylococcal infections in every hospital.

The problem of staphylococcal infections is not a temporary one. There is need for more complete epidemiological surveys of hospitals and community populations, and for further study into Staphylococci-host relationship. Staphylococci exhibit complex biological properties, and numerous factors contribute to the incidence and transmission of infection. The true source of the organism and the method of transmission have not as yet been proved.[19]

SUMMARY

A review of literature on hospital-acquired staphylococcal infections in maternity patients and their newborn infants indicates

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[19]David E. Rogers, "Observations on the Nature of Staphylococcus Infections," Bulletin New York Academy of Medicine, 35:28, January, 1959.

many uncertainties concerning the pathogenesis of S. aureus. There is controversy among research authorities as to the source and method of transmission of the organism. Limited research has been done on the presence of S. aureus on the external vulva and birth canal of mothers as a potential source of staphylococcal infections in infants.

CHAPTER III

METHOD OF PROCEDURE AND SOURCE OF DATA

The purpose of this chapter is to present the research method of the study and to describe the procedure used in gathering data.

The approach selected for solving the problem of this study was descriptive survey. The survey is defined as:

> . . . . an organized attempt to analyze, interpret, and report present status of a group or area. It deals with a cross-section of the present, of duration sufficient for examination--that is, present time, not present moment. Its purpose is to get groups of classified, generalized, and interpreted data for the guidance of practice in the immediate future.[20]

Surveying the mothers for the presence of S. aureus at the Loma Linda Sanitarium and Hospital was part of a larger research project directed by the Infections Committee of the hospital. Other aspects of the project included surveying the hospital personnel and staff physicians on the maternity and surgical units for the presence of nasal S. aureus carriers. Operating room personnel were also surveyed.

The sample selected. In previous surveys the number of mothers participating has varied. Some studies conducted involved as few as fifty, while in others as many as seven hundred mothers have been surveyed. In endeavoring to obtain a truly representative sampling of the total mothers admitted to this maternity unit, it was planned that one hundred or more mothers could participate in the study. This number

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[20]Fredrick Lamson Whitney, The Elements of Research. Third edition. (New York: Prentice-Hall, Inc., 1950), p. 161.

would be in harmony with previous research, and would be possible to secure from a twenty-six-bed maternity unit.[21] The sample included only patients admitted for vaginal delivery.

Patients admitted for cesarean section were not included in the study. Since pre-operative preparation of the surgical patient is generally a function of a nurse from the surgical unit, obtaining bacteriological specimens from women admitted for cesarean section would involve the use of a second person in addition to the delivery room nurse. Error in the technique of securing bacteriological specimens may be controlled more successfully if the number of individuals employed to obtain the specimen is limited.

Only mothers admitted to the selected maternity unit between September 1, 1959, and January 31, 1960, were included in the survey. A five-month period seemed justifiable in relation to the length of previous studies, and would provide sufficient time to survey an adequate number of mothers.[22]

The source of the specimen. To determine the presence of S. aureus on mothers, bacteriological specimens were obtained from the nares and the external vulva. The nares is thought to be the main habitat of S. aureus.[23] During the first week of the survey, specimens were collected

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[21]Josephine Cook et al., "Acquisition of Staphylococcus Aureus by Newborn Babies in a Hospital Maternity Department," British Medical Journal, 1:75, January 11, 1957.

[22]Reimert T. Ravenholt et al., "Epidemiology and Prevention of Nursery Derived Staphylococcal Disease," New England Journal of Medicine, 257:789, October 24, 1957.

[23]David T. Smith and Norman F. Conant, Zinsser Bacteriology (New York: Appleton-Century-Croft, 1957), p. 244.

from the vaginal canal. This was discontinued, however, since further study of literature seemed to indicate that the vaginal canal does not harbor S. aureus during pregnancy. Wysham and Kirby state that no S. aureus was isolated from vaginal secretions taken from ninety-nine mothers at delivery.[24] Greenhill suggests there is a marked tendency for vaginal secretions to reach maximal acidity during pregnancy, especially during the later months. The pH value tends to approach 4.0 and occasionally is as low as 3.8.[25] S. aureus will tolerate a wide pH range, but prefers a slightly alkaline medium of pH 7.4 to 7.6.[26]

Since the writer hypothesized that S. aureus was possibly present on the external vulva of the mother and transmittable to the infant at delivery, specimens were taken from the skin and nares of all infants delivered from mothers participating in the study.

The collection of the specimen. The specimens were obtained from the nares and external vulva of the mothers within five to ten minutes after admission to the labor room. The specimen from the external vulva was secured previous to any cleansing procedures given the mothers on the maternity unit. A second specimen was obtained from the external vulva of sixty-six of the one hundred and forty mothers following the vulvar preparation in the labor room. In the following chapters of the

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[24]Donald Wysham et al., "Staphylococcal Infections in an Obstetric Unit," New England Journal of Medicine, 257:299, August 15, 1957.

[25]J. P. Greenhill, Obstetrics (Philadelphia: W. B. Saunders Company, 1953), p. 88.

[26]G. S. Wilson and A. A. Miles, Topley's and Wilson's Principles of Bacteriology and Immunology (Baltimore: Williams and Wilkins Company, 1955), p. 702.

study these mothers are referred to as Group I. In seventy-four mothers, comprising the rest of the total group, the second specimen was collected from the external vulva after the perineal scrub in the delivery room. These mothers are referred to in the study as Group II.

The specimens were obtained from the skin of the infant immediately after birth as it was placed on the sterile drapes covering the mother's abdomen. The head was selected as the site for the specimen, as it is generally in prolonged contact with the external vulva of the mother. Following delivery the infant was taken to the hospital nursery in the arms of the mother. Since the infant is in close proximity to the mother's face, S. aureus present in the nares of the mother could possibly be transmitted at that time to the infant. In view of this, nasal specimens were obtained from the infant twenty-four hours after delivery.

As it was not possible to employ a technician to collect the specimens, the graduate nurse regularly in charge of the delivery room at the time of admission and delivery of the mother obtained the specimens. So that the number of personnel collecting the specimens would be minimal, the writer obtained all specimens in the absence of the graduate nurse.

Each nurse was carefully instructed in the technique of the procedure. A dry sterile applicator was inserted approximately one inch into both nares of the mother upon admission to the maternity unit. If S. aureus was present on the external vulva, it was felt that it most likely would be at or near the clitoris. A dry sterile applicator was used to swab the clitoris, foreskin, and surrounding area.

Culturing the specimen. Within twenty-four hours, specimens from both the mother and her infant were streaked on a modified Chapman-Stone

agar medium in the microbiology laboratory.[27] The modified medium was prepared as follows:

Yeast Extract	0.25	%
Tryptone	1.0	%
Mannitol	1.0	%
Sodium Chloride	7.5	%
Agar	1.5	%
Phenol Red	.0260	%

As S. aureus is not inhibited by a high concentration of sodium chloride, a 7.5 per cent of the substance was included to inhibit growth of most other organisms that might have been present in the specimen. In addition to the nutritional substances, mannitol and phenol red were incorporated into the medium to indicate the ability of the organism to ferment mannitol as a preliminary indicator of pathogenicity. After incubating for forty-eight hours at 37.5 degrees centigrade, the plate was examined for staphylococcal-like growth. Colonies surrounded by a yellow zone indicated mannitol fermenters. Several such colonies of growth were transfered on approximately one-fourth surface of a sheep blood agar plate and observed for typical zones of clear beta hemolysis. Susceptibility of the organism to penicillin was determined at this time by placing a Difco disk containing five units of penicillin in the center of a heavily inoculated area of growth.

The slide test was used in determining coagulase production. An emulsion of the staphylococci was made by placing a sample of the growth in saline; a drop of rabbit plasma was placed on the emulsion, mixed, and the culture was observed for gross clumping of the organism.

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[27] Difco Manual (Ninth edition; Detroit: Difco Laboratories, 1953), pp. 150-154.

Staphylococcal growth was identified as either S. aureus, S. intermediate, or S. albus. S. aureus was considered to be gram positive coccus which grew on the 7.5 per cent sodium chloride selective medium, formed yellow pigmented colonies, produced coagulase, hemolysin, and fermented mannitol. Such growth was considered a potential pathogen. S. intermediate was gram positive coccus which formed yellow colonies, produced either hemolysin and/or fermented mannitol, but was coagulase negative. Such growth was considered as a possible but not probable pathogen. S. albus was gram positive coccus growth which formed white colonies, did not produce coagulase or hemolysin, and did not ferment mannitol. Such growth was considered nonpathogenic.

Bacteriophage typing of Staphylococcus aureus. The specific strain of each S. aureus was identified by bacteriophage typing. The procedure used was adapted from the work of Blair and Carr,[28] Anderson and Williams,[29] and Charles Zierdt.[30]

Streaks of staphylococci were made one-half centimeter wide on a plate containing modified Trypticase Soy agar. As shown in Figure 1, each agar plate was divided into one centimeter squares. A different

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[28]John Blair and Miriam Carr, "The Bacteriophage Typing of Staphylococci," Journal of Infectious Disease, 93:1-13, July-August, 1958.

[29]R. E. O. Williams and E. S. Anderson, "Phage Typing of Staphylococcus Aureus," Journal of Clinical Pathology, 9:115-127, May, 1956.

[30]Charles H. Zierdt, "Preservation of Staphylococcal Bacteriophage by Means of Lyophilization," American Journal of Clinical Pathology, 31:326-331, April, 1959.

bacteriophage was added by dropper to each square containing S. aureus. In this study twenty-nine commercially available bacteriophages were used.[31]

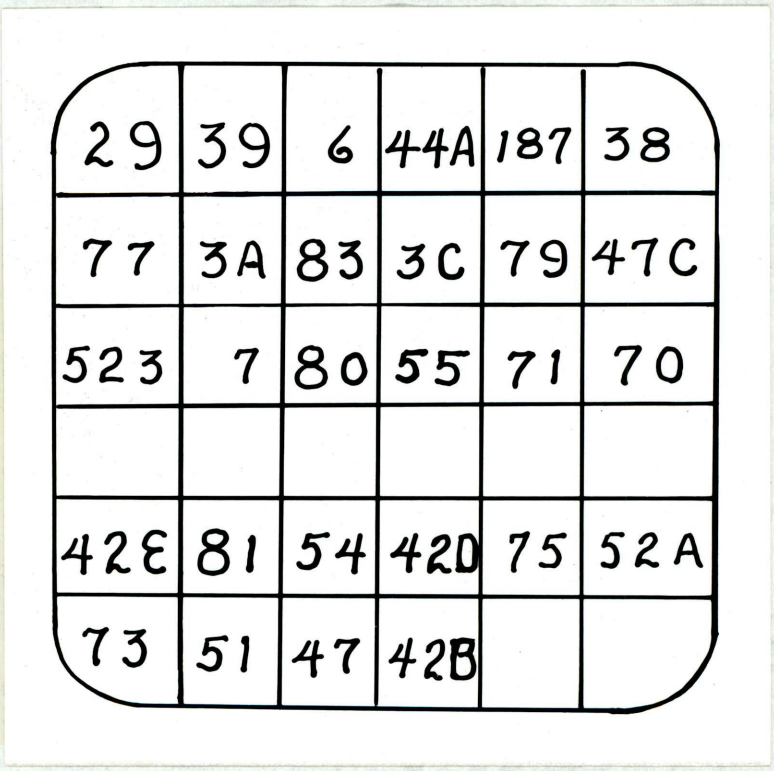

FIGURE 1

STAPHYLOCOCCUS AUREUS BACTERIOPHAGE CODE NUMBERS AND ARRANGEMENT OF PHAGE TYPING ON AGAR PLATE

Following this the plate was incubated for twelve hours at 37.5 degrees centigrade. Each square containing S. aureus was examined for

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[31]Available from Microbiological Associates, Inc., Washington 14, D. C.

absence of staphylococcal growth. As shown in Figure 2, the absence of growth indicated lytic action of the bacteriophage and enabled the strain to be identified.

Only S. aureus was tested for bacteriophage types, as almost without exception bacteriophages do not lyse coagulase negative coccus.

FIGURE 2

AN EXAMPLE OF STAPHYLOCOCCUS AUREUS
PHAGE TYPING PLATE SHOWING LYSIS BY SEVERAL PHAGES

SUMMARY

Descriptive survey was the method of research chosen for this study. To determine the presence of S. aureus on mothers admitted to the maternity unit of the Loma Linda Sanitarium and Hospital, bacteriological specimens were collected from one hundred and forty mothers and their

infants delivered between September 1, 1959, and January 31, 1960. The specimens were obtained from the nares and external vulva of the mothers and from the nares and skin of their infants.

All specimens obtained were inoculated on a selective medium and observed for staphylococcal growth. Characteristics of growth were used to determine possible pathogenic strains which were typed by bacteriophage.

CHAPTER IV

PRESENTATION AND INTERPRETATION OF THE DATA

To determine the presence of S. aureus, bacteriological specimens were collected from mothers and infants admitted to a selected maternity unit. In this chapter the results of the survey are presented together with tables developed to aid in the explanation and interpretation of the data. The findings were classified into categories and analyzed.

I. PRESENTATION OF THE DATA

Mothers

Bacteriological specimens were obtained from one hundred and forty mothers from September 1, 1959, to January 31, 1960. Specimens were secured from the nares and external vulva of all mothers upon admission to the maternity unit. From sixty-six of the total group of mothers the second specimen was obtained from the external vulva after the vulvar preparation in the labor room; from the remaining seventy-four a second specimen was obtained from the external vulva after the perineal scrub in the delivery room. A total of four hundred and twenty specimens was obtained.

Mothers were classified in two categories according to the type of staphylococci cultured. Mothers from whom S. aureus was cultured were classified in the first category. Such cultures were coagulase positive and potentially pathogenic. Mothers from whom S. intermediate and S. albus were cultured were classified in the second category. S. intermediate cultures were coagulase negative but were positive in either one

or more of the colony characteristics.[32] Their pathogenicity was uncertain. S. albus were cultures negative for coagulase, negative in colony characteristics, and definitely nonpathogenic.

Since there were only eight mothers in the S. intermediate group, they were classified with mothers having nonpathogenic albus. It would be of little value to analyze the presence of such cultures on mothers in a segregated group because of the slight possibility of the cultures' being pathogenic. Such cultures could not be classified as typical S. aureus.

All mothers were further classified according to the location of the staphylococci. These categories were the nares only, external vulva only, both nares and external vulva.

Admissions with staphylococci. In this study staphylococci were present in one hundred and thirty one (94 per cent) of the one hundred and forty mothers participating in the survey.

It was found that fifty-one (36 per cent) mothers were admitted to the maternity unit as carriers of S. aureus, eighty (57 per cent) with S. albus, and nine (7 per cent) with no staphylococci present. These figures are shown on Table I.

Thirty-seven mothers were carriers of staphylococci in the nares only; twenty-seven (19 per cent) had S. aureus, and ten (17 per cent) had S. albus. Forty-one (29 per cent) mothers had staphylococci on the external vulva only. Of these, fourteen (10 per cent) had S. aureus, and twenty-seven (19 per cent) had S. albus. Fifty-three (38 per cent)

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[32]Colony characteristics referred to the hemolytic pigmented, and mannitol reaction of the cocci.

mothers had staphylococci present both in the nares and on the external vulva. In this group, S. aureus was cultured from the nares and external vulva of ten (7 per cent) and S. albus from forty-three (31 per cent). Table II describes the distribution and location of staphylococci cultured from the representative site.

TABLE I

NUMBER AND PERCENTAGE OF MOTHERS ADMITTED TO THE MATERNITY UNIT WITH STAPHYLOCOCCI

	Mothers	
	Number	Percentage
Staphylococcus aureus	51	36
Staphylococcus albus	80	57
No staphylococcal growth	9	7
Totals	140	100

TABLE II

LOCATION AND DISTRIBUTION OF STAPHYLOCOCCI ON MOTHERS ADMITTED TO THE MATERNITY UNIT

	MOTHERS							
	Nares only		External vulva only		Nares and external vulva		Totals	
	No.	%	No.	%	No.	%	No.	%
Staphylococcus aureus	27	19	14	10	10	7	51	36
Staphylococcus albus	10	7	27	19	43	31	80	57
Total mothers with staphylococci	37	26	41	29	53	38	131	93
Mothers with no staphylococci							9	7
Totals							140	100

Staphylococci after the vulvar preparation in the labor room. In sixty-six (46 per cent) mothers, indicated as Group I, a specimen was obtained from the external vulva on admission and again after the vulvar preparation in the labor room. Results from cultures taken from these mothers showed that six (9 per cent) were admitted with S. aureus, and fifty (76 per cent) with S. albus, on the external vulva. Ten (15 per cent) had no staphylococcal growth on admission. After the vulvar preparation the number and percentage of mothers with staphylococci on the external vulva were as follows: four (6 per cent) with S. aureus present; forty-seven (71 per cent) had S. albus; and fifteen (23 per cent) no staphylococcal growth was obtained. These figures are summarized on Table III.

TABLE III

NUMBER AND PERCENTAGE OF MOTHERS WITH STAPHYLOCOCCI PRESENT BEFORE AND AFTER VULVAR PREPARATION

	MOTHERS (GROUP I)			
	Before vulvar preparation		After vulvar preparation	
	Number	%	Number	%
Staphylococcus aureus	6	9	4	6
Staphylococcus albus	50	76	47	71
No staphylococcal growth	10	15	15	23
Totals	66	100	66	100

Staphylococci after the perineal scrub in the delivery room. In seventy-four (54 per cent) mothers, indicated as Group II, a specimen was obtained from the external vulva on admission and again after the perineal scrub in the delivery room. Results from this group were as follows:

eighteen (24 per cent) mothers were admitted with S. aureus; thirty-nine (53 per cent) with S. albus; and seventeen (23 per cent) with no staphylococcal growth on the external vulva. After the perineal scrub twelve (16 per cent) mothers had S. aureus on the external vulva, thirty (41 per cent) had S. albus on the external vulva, and thirty-two (43 per cent) had no staphylococci present. This is shown on Table IV.

TABLE IV

NUMBER AND PERCENTAGE OF MOTHERS WITH STAPHYLOCOCCI PRESENT BEFORE AND AFTER PERINEAL SCRUB

	MOTHERS (GROUP II)			
	Before perineal scrub		After perineal scrub	
	Number	%	Number	%
Staphylococcus aureus	18	24	12	16
Staphylococcus albus	39	53	30	41
No staphylococcal growth	17	23	32	43
Totals	74	100	74	100

Infants

The total number of infants delivered was one hundred and forty-one, as one mother delivered twins. Specimens were collected from the skin and nares of each infant.

Infants were first classified in two categories: those on which staphylococci were present and those on which staphylococci were not present. They were classified further as those with S. aureus in the nares only, on the skin only, and both in the nares and on the skin. Cultures obtained from infants were classified in the same categories as those obtained from the mothers.

Staphylococci present after delivery. Of the total number of infants surveyed on the maternity unit, seventy-six (54 per cent) had some type of staphylococci present. Staphylococci could not be obtained from sixty-six (46 per cent) infants. Of the infants with staphylococci, nineteen (14 per cent) had S. aureus, and fifty-seven (40 per cent) had S. albus. These figures are shown on Table V.

TABLE V

NUMBER AND PERCENTAGE OF INFANTS FROM WHICH CULTURES OF STAPHYLOCOCCI WERE OBTAINED WHILE ON THE MATERNITY UNIT

	INFANTS	
	Number	Percentage
Staphylococcus aureus	19	14
Staphylococcus albus	57	40
No staphylococcal growth	65	46
Totals	141	100

Staphylococcus aureus present after delivery. In eleven (58 per cent) of the nineteen infants with S. aureus, the organism was in the nares only; in five (26 per cent) it was on the skin only; and in three (16 per cent), it was both in the nares and on the skin. The location and distribution of S. aureus on the infants appears on Table VI.

Mother and Infant

The purpose of this study was to determine if S. aureus present on the mother when admitted to the maternity unit could be transmitted directly to the infant, and hence be a factor in the development of staphylococcal infections in the infant. It would be significant to the

purpose of the study if the findings indicated that the S. aureus on the infant was identical with that present on the mother.

S. aureus present on mothers and infants was considered identical if there was agreement in the following: (1) bacteriophage type, (2) coagulase production, (3) colony characteristics, and (4) penicillin sensitivity. Colony characteristics referred to the hemolysis, pigmentation, and mannitol reactions of the organism.

TABLE VI

LOCATION AND DISTRIBUTION OF STAPHYLOCOCCUS AUREUS ON INFANTS WHILE ON THE MATERNITY UNIT

Site	INFANTS	
	Number	Percentage
Nares	11	58
Skin	5	26
Nares and skin	3	16
Totals	19	100

Staphylococcus aureus on mother-infant pairs. S. aureus was cultured from fourteen (10 per cent) mother-infant pairs. In nine (6 per cent) of these pairs the bacteriophage type, penicillin sensitiveness, and colony characteristics were identical. In five (4 per cent) of the pairs, having identical S. aureus present, the organism was cultured from the external vulva of the mother after the perineal scrub and from the infant skin at delivery. Four (3 per cent) mother-infant pairs had identical S. aureus in the nares. The characteristics of the S. aureus present on these mother-infant pairs are illustrated in Table VII.

TABLE VII

LOCATION AND CHARACTERISTIC OF STAPHYLOCOCCUS AUREUS PRESENT ON NINE MOTHER-INFANT PAIRS

Characteristics	MOTHER-INFANT SITES OF CULTURES								
	Mother-Infant (vulva) (skin)					Mother-Infant (nares) (nares)			
	I	II	III	IV	V	VI	VII	VIII	IX
Bacteriophage type	73	73	187	187	7	3C/38	29/44A	187	187
Penicillin sensitivity*	S	S	S	S	S	R	R	S	S

*All cultures positive for coagulase, hemolysin, pigmentation, and mannitol fermentation. S = Sensitive R = Resistant

II. INTERPRETATION OF THE DATA

Mothers

The results of the study show that one hundred and thirty-one (93 per cent) mothers surveyed were admitted with some type of staphylococci.

It is reasonable to expect that a large percentage of mothers would be admitted with S. albus, as it can be cultured from the nares and skin of most individuals. Since S. albus is nonpathogenic, its presence on the mother is relatively unimportant. However, because it was cultured from the external vulva of mothers, discussion of its presence in relation to the vulvar preparation and perineal scrub of the mother will be found in a later section of this chapter.

In this survey fifty-one (36 per cent) of the mothers had S. aureus present in the nares and/or on the external vulva when admitted to the maternity unit. This percentage is above that reported by some investigators. Fekety found 26 per cent of the mothers admitted to a selected

maternity unit had S. aureus in the nares.[33] This increased percentage could be due to the fact that in this study, specimens were obtained from two sources on the mother, the nares and the external vulva. This would increase the chance of securing S. aureus on each mother. From Table II, however, it will be noted that the percentage of S. aureus found in the nares was 26 per cent, which is equal to that reported in Fekety's study.[34] Of the mothers admitted, 18 per cent had S. aureus which were resistant to penicillin. This is comparable to the percentage reported by Nolan, in which 12.6 to 18.5 per cent of the selected population had antibiotic-resistant staphylococci in the nares and throat.[35] The fact that in this survey 36 per cent of the mothers were admitted to the maternity unit with S. aureus, and that approximately one-half of these organisms were penicillin resistant, seems to coincide with the most recent reports in literature that antibiotic-resistant pathogens are not confined to the hospital environment, but have become increasingly distributed in the general community as a potential source of infections.[36]

Of the two carrier sites, S. aureus was found most often in the nares. This is to be expected as the nares are considered to be the main habitat of the organism. Fourteen (10 per cent) of the one hundred and

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[33]Robert Fekety et al., "Control of an Outbreak of Staphylococcal Infections Among Mothers and Infants," American Journal of Public Health, 48:309, March, 1958.

[34]Ibid.

[35]William Nolan and Homer Fleisher, "Drug Resistant and Pathogenic Staphylococci in One Community," New England Journal of Medicine, 258:491, March 6, 1958.

[36]A. J. Buhr and J. C. Scott, "Penicillin Resistant Staphylococci," Lancet, 1:1021, May 16, 1959.

forty mothers surveyed had S. aureus on the external vulva. Ten (7 per cent) mothers having S. aureus in the nares also had it on the external vulva.

Since the purpose of this study was to determine if S. aureus present on the mother could be a contributing factor in the direct transmission of S. aureus and the development of infections in the infant, it was significant that penicillin-resistant S. aureus was present in the nares and on the external vulva of the mother on admission to the maternity unit. If these organisms are present on the external vulva of the mother at delivery, it is possible that penicillin-resistant S. aureus could be transmitted to the infant at birth.

Nine (7 per cent) mothers were admitted having no staphylococcal growth in the nares or on the external vulva. Three of these mothers were admitted to the maternity unit twice, as their first admission resulted in a six- to eight-hour hospital stay in false labor. Specimens were obtained from the nares and external vulva of these mothers a second time. The second series of cultures were also negative. It is evident that some mothers, being very conscious of their personal hygiene, enter the labor room soon after thorough bathing. It is possible that in such cases growth may not be obtained from the external vulva. Of these nine mothers without staphylococcal growth, it was observed that little or no smegma was present. It is unusual that staphylococci were not obtained from the nares of these nine mothers.

Staphylococci after the vulvar preparation in the labor room. As shown in Table III, Group I consisted of sixty-six mothers from whom the second specimen from the external vulva was collected after the vulvar

preparation. In analyzing the change that occurred on the vulva of individual mothers in relation to the vulvar preparation, four of the six mothers having S. aureus present on admission still had the organism present after the vulvar preparation, while the other two mothers had S. albus present after the vulvar preparation. It seems that in the majority of mothers with S. aureus on admission, the vulvar preparation did not remove the organism. In no case was the skin entirely free from bacteria.

Of the fifty mothers admitted with S. albus, forty-seven had S. albus present after the vulvar preparation. This does not mean, however, that in only three mothers the S. albus was removed. In reality it appears that, in twelve of the original fifty mothers with S. albus on admission, the vulvar preparation was effective in removing the organism, as these twelve had no growth on the external vulva after the preparation. The result is that thirty-eight of the original fifty mothers had S. albus present after the vulvar preparation. In addition two mothers admitted with S. aureus only were found to have S. albus after the preparation, and seven mothers admitted with no staphylococcal growth were found to be positive for S. albus after the vulvar preparation. Thus the total was brought to forty-seven. In these mothers the S. albus may have been received from the nurse at the time of the preparation, or possibly from the doctor at the time of the examination. Since the organism is nonpathogenic, this would not be serious.

Of the ten mothers in Group I admitted with no growth, only three of the original ten had no growth after the vulvar preparation. Therefore, these three mothers (in addition to the twelve mothers from which staphylococcus was removed) brought the total to fifteen of mothers having no growth after the vulvar preparation.

If this were the only skin preparation mothers received, it would be possible for antibiotic-resistant S. aureus, present on the external vulva upon admission and after the vulvar preparation, to be present at the time of delivery of the infant. But almost without exception, mothers admitted to the selected maternity unit for delivery received a second skin preparation: the perineal scrub in the delivery room.

Staphylococci after the perineal scrub in the delivery room. Group II was comprised of seventy-four mothers in whom the external vulvar specimen was taken upon admission and after the perineal scrub in the delivery room. Table IV on page 26 presents the results of the perineal scrub.

Of the eighteen mothers admitted with S. aureus, apparently the perineal scrub in addition to the vulvar preparation was effective in removing the organism from six mothers. As one mother admitted with S. aureus on the vulva was found to have S. albus after the perineal scrub, the total mothers with S. aureus after the perineal scrub was eleven. By adding a mother from whom a culture of S. aureus was secured after the perineal scrub who did not have the organism on admission, the total was brought to twelve.

Of the thirty-nine mothers admitted with S. albus, twenty-eight still had S. albus present after the perineal scrub. In addition, one mother having no staphylococcal growth and one mother with S. aureus only on admission were found to have S. albus after the perineal scrub. Thus the total was brought to thirty. It appears that the perineal scrub was effective in removing organisms from some mothers, but in the majority it was not.

Fifteen of the original seventeen mothers in Group II admitted with no staphylococcal growth on the external vulva were still free from growth on the external vulva after the perineal scrub.

It was not the purpose of this study to determine the effectiveness of the skin preparation given to mothers in anticipation of delivery, but the bacteriological findings on mothers in relationship to the vulvar preparation and perineal scrub seem to justify discussion of the subject. Since the object of the cleansing procedures of the external vulva of the mother is to render the area as clean and free from bacteria as possible, the presence of any type of staphylococci after any cleansing procedure is significant. The results of this study show that of the seventy-four mothers in Group II, forty-two (57 per cent) had some type of staphylococci present after the perineal scrub in the delivery room.

The fact that some mothers were admitted to the maternity unit with no growth on the external vulva and showed growth after the vulvar preparation and the perineal scrub suggests that the physician or nurse may have brought the organism to the external vulva of the mother. However, all staphylococci cultured after the vulvar preparation and perineal scrub from mothers admitted with no staphylococci on the external vulva were S. albus. In relationship to infection, the presence of S. albus is unimportant, nevertheless the fact that mothers could receive pathogenic organisms also if transmission of other organisms is possible is worth consideration. This study seems to indicate that such transmission is possible.

Two mothers with S. albus on admission had S. aureus after the vulvar preparation. In each case the organism was penicillin sensitive.

This suggests that the organism may have been present on the external vulva at the time of admission, but was not obtained, as resistant bacteria are more often acquired in the hospital.

Infants

The results of the survey show that, of the one hundred and forty-one infants on whom bacteriological specimens were obtained, S. albus was more commonly present than S. aureus.

As in the mother, these organisms are unimportant as contributing factors in staphylococcal infections. For this reason the distribution of S. albus present on the infant is not given. It also would not be possible to demonstrate that S. albus present on the infant was identical to that present on the mother. Bacteriophage types are available only for coagulase positive cocci. It is of interest that of the seventy-four mothers in Group II in which the specimen from the external vulva was obtained on admission and after the perineal scrub, 57 per cent had staphylococcal growth present after the scrub. Of the infants delivered from the mothers of this group, only 39 per cent had no staphylococci present on the skin. It seems possible that mothers may have organisms present on the external vulva during delivery and the infant not acquire them at birth.

S. aureus was cultured from nineteen (14 per cent) infants. Of the nineteen, fourteen of the mothers had S. aureus present on admission. Of the five mothers who did not have S. aureus, the organism was located in the infants' nares, and in all but one of these five infants the organism was resistant to penicillin. The penicillin-resistant characteristic suggests that the hospital environment was the source of the organism to the infant. Since specimens obtained from the infant nares were collected

twenty-four to forty-eight hours after birth, it was impossible to determine how the infant obtained the organism. Within twenty-four hours the infant had been exposed to parents, hospital personnel, and other environmental factors.

Mothers and Infants

S. aureus was found in fourteen (10 per cent) mother-infant pairs. In five (3 per cent) of the fourteen mother-infant pairs, it was determined that the S. aureus present on the external vulva of the mother on admission, and after the perineal scrub in the delivery room, was identical to that cultured from the infant's skin immediately after birth. Bacteriophage types common to the five mother-infant pairs were 7/73/187. However, these phages are not the 80/81 epidemic type which has been responsible for the staphylococcal infection in most hospital nurseries. The finding of identical S. aureus on mothers and infants suggests that possibly the infant may have acquired the organism from the mother. If the infant is not cleansed before leaving the delivery room, it is possible that the pathogenic organisms could be transported into the hospital nursery on the infant's skin.

In this particular finding, the data was analyzed statistically to determine the probability of the occurrence being due to chance. The chi-square method was used. It was determined that the probability of the occurrence being due to chance was .0009 (or one in a thousand); conversely, the probability of its being due to significant factors was .999 (or nine hundred and ninety-nine in a thousand). This, then, was a significant finding.

In four mother-infant pairs, identical S. aureus was cultured from both mother and infant nares. As was described previously in this chapter,

the specimens from the infants' nares were obtained twenty-four hours after delivery. It was impossible to determine if the source of the organism was the mother, since during that time the infant had been exposed to other environmental factors. However, since the infant was in close proximity to the mother's nares during this time, and since the organism was of the same bacteriophage type as that present on the mother and not the hospital personnel, it seems likely that the infant did receive the organism from the mother. Of this group it was observed that in one mother-infant pair, bacteriophage type 44A penicillin-resistant was cultured. This is particularly significant, as this strain has been responsible for serious outbreaks of staphylococcal infections in some hospital nurseries. Of the fourteen mother-infant pairs in which both individuals were carriers of S. aureus, nine demonstrated identical phage types.

SUMMARY

To determine the presence of S. aureus, bacteriological specimens were obtained from one hundred and forty mothers and their infants on a selected maternity unit from September 1, 1959, to January 31, 1960. Thirty-six per cent of the mothers were admitted with S. aureus in the nares and/or on the external vulva. Fourteen per cent of the infants delivered from the mothers surveyed in this study had S. aureus present in the nares and/or on the skin. Of the one hundred and forty mother-infant pairs, 6 per cent were found to have identical strains of S. aureus present.

In Chapter V the summary and conclusions of the study are given, and recommendations are made for the prevention of staphylococcal infections in the infants.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

I. SUMMARY

In this study an attempt was made to determine if S. aureus was present on mothers admitted to a selected maternity unit. It was expected that the results of the study would indicate if mothers could be a contributing factor in the development of staphylococcal infections in their infants. In gathering data for the study, bacteriological specimens were obtained from one hundred and forty mothers and their infants at the Loma Linda Sanitarium and Hospital from September 1, 1959, to January 31, 1960. Specimens were collected from the nares and external vulva of all mothers upon admission to the maternity unit and from the nares and skin of their infants immediately after delivery.

Of the one hundred and forty mothers participating, a second specimen was obtained from the external vulva of sixty-six mothers (Group I) following the vulvar preparation in the labor room, and from seventy-four mothers (Group II) following the perineal scrub in the delivery room. Within twenty-four hours specimens from the individual mother and infant were streaked on a selective medium in the bacteriological laboratory and observed for staphylococcal growth. Bacteriophage typing was employed to identify particular strains of coagulase positive S. aureus.

The results of the study show that a significant number of mothers (36 per cent) were admitted to the maternity unit with S. aureus in the

nares and/or on the external vulva. In approximately one-half of these mothers the organisms were penicillin resistant.

Although it was not the purpose of the study to determine the effectiveness of the vulvar preparation and the perineal scrub given the mother in preparation for delivery, the findings indicate S. aureus was cultured from some mothers following the two cleansing procedures. Specimens obtained from Group I after the vulvar preparation indicated that 6 per cent of the sixty-six mothers had S. aureus present on the external vulva after the preparation. Specimens obtained from Group II after the perineal scrub showed that 16 per cent of the seventy-four mothers had S. aureus on the external vulva after the scrub.

Of the one hundred and forty-one infants delivered on the maternity unit, S. aureus was present on 14 per cent. Six per cent had the organism present on the skin, while in 10 per cent it was cultured from the nares.

In 6 per cent of the one hundred and forty mothers and infants surveyed, S. aureus cultured from the infants was identical to that present on the mothers upon admission to the maternity unit and at delivery. To determine the statistical value of this finding, the chi-square method was used. Calculations indicated a high probability that the occurrence of this finding was significant.

II. CONCLUSIONS

From the findings of this study it is concluded:

1. That mothers are admitted to the maternity unit with S. aureus present in the nares and/or on the external vulva.

2. That the vulvar preparation in the labor room and the perineal scrub in the delivery room may or may not remove S. aureus from the external vulva of the mother.

3. That it is possible that S. aureus present on the external vulva of the mother at delivery can be transmitted to the infant at birth.

4. That S. aureus present on the external vulva of the mother at delivery could be a factor in the development of staphylococcal infections in the infant.

III. RECOMMENDATIONS

Based on the findings of this study, the following recommendations are suggested for the prevention of infections in the newborn infant:

1. That the importance of skin preparation given the mother before delivery be re-emphasized to the nursing staff.

2. That study be given to ascertain if the procedure employed in the skin preparation of the mother before delivery could be improved.

3. That consideration be given to the advisability of cleansing the newborn before admission to the hospital nursery.

4. That a six-week postpartum and postnatal home follow-up survey be made of the incidence of staphylococcal infection in mothers and infants delivered between September 1, 1959, and January 31, 1960.

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COLLEGE OF MEDICAL EVANGELISTS

School of Graduate Studies

THE PRESENCE OF STAPHYLOCOCCUS AUREUS ON MOTHERS ADMITTED TO A SELECTED MATERNITY UNIT

by

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An Abstract of a Thesis

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ABSTRACT

The purpose of this study was to determine if Staphylococcus aureus present in mothers when admitted to the maternity unit of the Loma Linda Sanitarium and Hospital could be a factor in the development of staphylococcal infection in the infants. Biological specimens were collected from one hundred and forty mothers and their infants from September 1, 1959, to January 31, 1960. The specimens were obtained from the nares and external vulva of all mothers upon admission to the maternity unit, and from the nares and head of their infants after delivery. Of the one hundred and forty mothers participating, specimens were also obtained from the external vulva of sixty-six mothers (Group I) following the vulvar preparation in the labor room, and from seventy-four mothers (Group II) following the perineal scrub in the delivery room.

The results of the survey showed a larger percentage of mothers (26 per cent) were admitted to the maternity unit with Staphylococcus aureus in the nares, and that a significant percentage (17 per cent) had Staphylococcus aureus on the external vulva. Of the sixty-six mothers in Group I, six (9 per cent) had Staphylococcus aureus present upon admission. After the vulvar preparation, four (6 per cent) had the organism still present. In the seventy-four mothers in Group II, eighteen (24 per cent) had Staphylococcus aureus present before the scrub. After the perineal scrub, twelve (16 per cent) still had Staphylococcus aureus present on the external vulva. Of the one hundred and forty births, nine (6.5 per cent) of the infants had Staphylococcus aureus identical to that present in the mother. The specific strain was identified by bacteriophage typing.

It is concluded from this study that Staphylococcus aureus present in the nares and on the external vulva of the mother upon admission to the maternity unit could be a factor in the development of staphylococcal infections in the infant. Since the vulvar preparation and perineal scrub may not be effective in removing the organism from the external vulva of the mother, it is possible that Staphylococcus aureus present at the time of delivery could be transmitted to the infant's skin during birth.