The Problem of Staphylococci sp. in Chlorinated Swimming Pools[1]

ANNA B. FISHER, GARRY CISKOWSKI and JERRY LEU

Northwestern State College, Alva

There has long been a feeling among sanitarians and laboratory workers that the test for the coliform group of organisms is not an adequate index of the safety of swimming pool water, since it does not take into consideration the possibility of contamination from the skin and upper respiratory tract of the bather. Due to the increase in the number of swimming pools, both privately owned and publically operated, the sanitation of swimming pools takes on new importance. The problem is further complicated by the fact that often the custodian operating the pool has little knowledge of the relationship of the residual chlorine, the temperature, and the pH.

The Sanitary Engineering Division of Oklahoma (1953) set a limit of 200 colonies per ml on the standard plate count. This standard does not consider the kinds of bacteria. Many investigators would prefer to use the enterococci as indicators of pollution rather than the coliforms in relation to drinking water. (Slantez, 1955).

Clark, et al. (1951), recommended specific methods and materials for use with the membrane filter in sanitary bacteriology. A full description of a tentative procedure for determining the coliform content of water by the millipore filter is given in "Standard Methods for Examination of Water, Sewage, and Industrial Wastes" (1955). The millipore filter method has several advantages, including speed and simplicity.

Dr. F. R. Hassler, Oklahoma Health Department (1955, personal communication), stated that in relation to bacteriological examination of swimming pools, the presence of the enterococci was not as important as the presence of hemolytic streptococci or staphylococci.

Boxell, (1952), reported a new medium for cultivating *Streptococcus salivarius*. To the sodium azide-tryptose-agar base, containing 10% sucrose, she added an extract of pig's feet. She thought that *Streptococcus salivarius* could be used as an easy index for the presence of pathogenic streptococci. She concluded therefore, that *Streptococcus salivarius* could be used as an index of the sanitary conditions of the swimming pool, much as *Escherichia coli* is used in relation to pathogenic intestinal bacteria. We were unable to confirm her results. It was possible to isolate *Streptococcus salivarius* from human throats, but not from the swimming pool samples. The variation in the results may arise from the fact that the millipore filters were used in this investigation and this procedure may favor the growth of certain organisms in some way not determined.

The procedure used in this study is that which is advocated by the "Standard Methods - - - -" (1955). Sample bottles, containing 0.1 ml of 10% sodium thiosulfate, were sterilized and used for the collection of the sample. The temperature, pH and residual chlorine readings of the water sample were recorded at the time of collection. The orthotolidine method was used for determining the residual chlorine content. It has been generally agreed that if the residual chlorine measures 0.4-0.6 parts per

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million and the pH kept at 7.2-8.0, the swimming pool water will be free from all disease producing bacteria, intestinal or otherwise.

After the 150 ml sample of water was filtered through millipore filters, the filters were placed on pads moistened with a modified Chapman-mitis salivarius medium, (omitting 10% sucrose) or BBL Vogel and Johnson Agar, to which 1% sterile potassium tellurite was added. Vogel and Johnson Agar was advertised as specific for the detection of *Staphylococcus aureus*. It was stated to have the added advantage of detecting coagulase-positive stapyhlococci.

There were 110 samples taken from various pools located in Oklahoma City, Enid, Ponca City and Alva, Oklahoma and Ashland, Kansas. Early in the work, the filters were placed on Endo's medium to detect coliform organisms, but this was not continued. The chlorine seemed adequate to kill the coliform organisms.

Staphylococci sp. were found in all the samples to which the sodium thiosulfate had been added, and in which the modified Chapman's media and/or Vogel and Johnson Agar were used. The number of colonies, per 150 ml of water filtered, varied from 3 to 300 on up to numbers that could not be counted. In several cases, it was noted that the number of colonies of staphylococci increased if swimmers were in the pool at the time the sample was taken. The colonies on Vogel and Johnson Agar were strikingly black and most of these colonies were coagulase-negative. From about 30 colonies chosen by random sampling, only two colonies proved to be coagulase-positive. These colonies also produced B-hemolysis on human blood. Frequent controls were made on the procedure to be sure that the staphylococci were not picked up from the laboratory air. A control on the coagulase procedure was made by using ATCC culture # 6538, which was known to be coagulase-positive.

The classification of *Staphylococci* and the proper nomenclature have become very confusing since the changes made in the 7th edition of Bergey's Manual. In the course of time, many different criteria have been used for the purpose of classifying the *Staphylococci*. Some insist on abiding by the rules of nomenclature. Elek, (1959) and others, feel that only those staphylococci that are coagulase-positive should be called *Staphylococcus pyogenes*. We have accepted this criterion as a basis for determining the presence of *Staphylococcus pyogenes*.

The epidemiology of *Staphylococci* has taken on a new importance. Many strains have become penicillin resistant and the percentage of carriers or means of dispersal have not been determined. Dr. Kirk T. Mosley, Oklahoma Commissioner of Health (1961), felt that some facility should be established to study staphylococci. Coagulase-positiveness may not always be a factor of virulence nor a factor of invasiveness in producing disease. We conclude merely that *Staphylococci sp.* are not killed by the chlorine of an ordinary swimming pool.

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