MEASUREMENT OF THE BACTERIAL CONTAMINATION ON SURFACES IN HOSPITALS

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THE QUANTITY of bacterial contamination on surfaces in hospitals such as floors, walls, tables, and sinks is infrequently measured. Most cleaning practices are based on appearance and tradition. Floors are mopped until they look clean. Germicides are used because cleaning has always been done that way. Responsible hospital staff members desire laboratory analysis of contamination in their areas, but the time and labor required for most of the current techniques place an excessive amount of work on the laboratory. Therefore, there is a need for improved techniques for representative sampling of bacteria on such surfaces as floors, walls, and equipment, as well as on surfaces of the human body. A simple, convenient sampling procedure would be useful in tracing routes of infection, identification of human carriers, evaluation of decontamination procedures, bacteriological surveillance of the institutional environment, and in inservice training of personnel concerned with institutional sanitation.

Most of the earlier techniques of surface sampling stem from the highly developed field of food handling sanitation. The cotton swab has been used extensively, particularly where dilution of the sample is required (*1*, *2*). In another technique, agar is applied directly to the test surface and left there during incubation of the bacteria (*3*). Although useful for the examination of food utensils or other small objects, this method could hardly be used on a floor. A similar technique uses the exposed end of an agar plug, extended from a large open end syringe. After exposure to the sampled surface, a thin disc of agar is cut off and dropped into a standard petri dish for incubation (*4*). Another technique makes use of a replicating floc to pick up the contamination from the surface and transfer it to the culture medium in a petri dish (*5*). Other variations have been adapted to the study of bacterial contamination on fabrics (*6*).

When large numbers of samples are needed, contact plates may be used to advantage. Such plates bring the solid medium momentarily into direct contact with the test surface. Improvised containers used to hold the medium include a stamped aluminum foil cup that is commercially available, milk bottle caps (reported in a personal communication from V. W. Greene and L. Herman), and standard petri dishes. All these containers are either too small in surface area or too deep. The small-diameter dishes do not sample a sufficiently large area, and they require standard petri dishes and covers to hold them during handling and incubation. The deep containers require excessive amounts of medium.

To overcome some of these disadvantages, one of the authors (Hall) has designed a disposable plastic contact plate intended specifically for the simple, rapid sampling of bacteria on surfaces in hospitals. The plate, including production modifications (figs. 1 and 2), is now commercially available. It consists of a specially designed plastic cup filled to the brim

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with solid medium. This provides a disc of medium, 2¼ inches in diameter and 3/16 inch thick, having a projected surface of approximately 4 square inches. The actual contact area can be measured and may vary somewhat from 4 square inches depending upon the height of the meniscus and the technique of application. Grid lines on the bottom of the cup facilitate the counting of colonies. A groove around the outer edge of the cup receives the base of the plastic cover. A ledge extending beyond the groove provides a convenient handling edge, and ridges around the outer edges of the base and cover facilitate stacking of the plates. The assembled plates are delivered by the manufacturer presterilized and ready for filling, sealed in plastic film, 20 to a roll.

Small quantities of plates can be filled by pipette, but this method is slow. Hand pouring from a flask is more rapid but requires a steady hand and sharp eye. Filling large numbers of plates at a time with an automatic pipetting machine is the method of choice. The volume of medium in each plate can vary from 15 to 20 ml., but about 15.7 ml. brings the edge of the meniscus level with the top of the sidewall and is recommended as a standard volume. Care must be used in replacing the covers. To eliminate airborne contamination before the agar medium has solidified, covers should be replaced as soon after pouring as practical. Disturbing the medium while it is still in the liquid state can cause it to run over the edge into the groove and spoil the plate for use. A convenient method is to lift one edge of the cover just high enough to permit proper positioning of the pipette while leaving the other edge of the cover in the groove, as shown in figure 2. After filling is accomplished, the raised edge of the cover is dropped back into the groove.

The contact plates can be stored at 4° C. and at relative humidities of 70 to 80 percent for periods up to several weeks and used as needed. Incubation for 24 hours, followed by counting with a suitable colony counter, is recommended. Incubation for longer than 24 hours may produce overgrowth. Dehydration may also occur during incubation, resulting in separation of the medium from the sidewall of the plate. However, separation alone does not adversely affect the quantitation of colony growth.

The technique of sampling is simple. The cover is removed and the plate placed flat

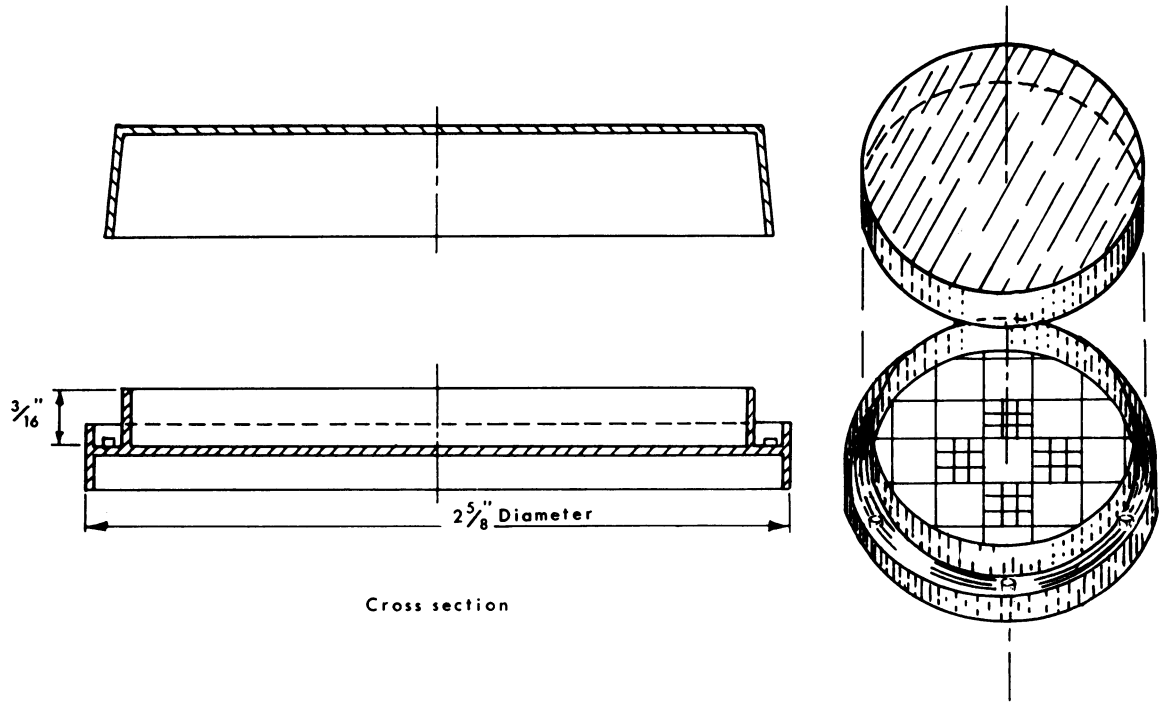

Figure 1. Disposable contact plate

Figure 2. Closeup of plate being filled by automatic pipetting machine

against the surface. The plate is pressed down until the rim makes contact. If the plate is held between the thumb and second finger as it is placed on the surface, the index finger can be used to press against the back to bring any uneven areas of the medium or sampled surface into contact. The plate and medium are sufficiently flexible to permit use on concave surfaces with radii as small as 8 inches. On convex surfaces, the plate can be rolled over the surface.

The disposable contact plate and techniques for its use are finding an increasing number of applications. The simplicity and rapidity of the method make it ideal for measurement of contamination of large areas, such as floors, where many samples are needed for statistical validity. Neutralizers can be incorporated into the medium and the plates used before and after surfaces are cleaned to measure the bacteriological efficiency of the cleaning procedure.

Contact plates also are useful for qualitative and quantitative sampling of the microflora of human skin. They may be used to determine the efficiency of surgical preparation or to detect carriers of, for example, *Staphylococcus aureus*. They can be quickly and easily applied to hospital patients upon admission and discharge in mass screening programs. The technique is readily adapted to special problems. If, for example, the surgical supervisor wants to know how long a draped table of instruments remains sterile, a number of polished stainless steel plates can be included in the pack. These steel plates, withdrawn at intervals and sampled by means of the contact plate, indicate the time at which the instruments must be resterilized.

The contact plates are particularly useful as a tool for teaching the hospital staff. Members of the staff engaged in the various hospital services can see the amount of contamination on a given surface at a glance. Samples taken and displayed after incubation reveal the relative degree of contamination; no count of the colonies is necessary.

Although the disposable contact plate may be used for many purposes, it is best suited for use on relatively clean surfaces, for its limited size restricts the number of colonies that can be resolved upon it. In many situations, however, maximum efficiency of recovery is not necessarily the primary consideration of the sampling technique. Simplicity, ready availability, ease of handling, and the economical

use of labor are also often important considerations. The disposable contact plate offers such advantages.

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Public Health Service Staff Appointments

Ruth L. Johnson has been appointed chief of the Hospital Nursing Branch, Division of Nursing.

Miss Johnson, a nurse director in the Public Health Service Commissioned Corps, joined the Service in 1944 as a nurse consultant in the U.S. Cadet Nurse Corps program. Upon reassignment to the Nursing Branch, Division of Hospitals, she served as a member of a study team to make recommendations for reorganizing the nursing service at the Public Health Service Hospital in Boston. She was appointed director of nursing at the Public Health Service Hospital in San Francisco in 1950 and in 1952 became assistant chief and then chief of the nursing department of the Clinical Center, National Institutes of Health. She joined the staff of the Division of Nursing in May 1964.

Miss Johnson received the Meritorious Service Medal of the Public Health Service in April 1964 for "superior quality work performance throughout the Public Health Service" and her outstanding achievements at the Clinical Center.

A native of Holdrege, Nebr., Miss Johnson was graduated from the Nebraska School of Nursing and earned her bachelor of science and masters' degrees from the division of biological sciences, University of Chicago. She was awarded a Rockefeller Foundation Fellowship and earned a master's degree in nursing service administration in 1949.

Mary R. Lester has been appointed chief of the Public Health Nursing Branch, Division of Nursing. She succeeds Dr. Marion Ferguson who became deputy chief of the Division on May 1964.

Mrs. Lester, who holds the rank of nurse director in the Public Health Service Commissioned Corps, joined the Service in 1950 as nurse epidemiologist in the Communicable Disease Center in Atlanta, Ga., where she served until 1953 with assignments in Alabama and Mississippi. She spent the next 2 years in Vietnam as chief nurse of the International Cooperation Administration (now Agency for International Development) mission. She returned to this country in 1955 and served as chief of the Nursing Section, Epidemiology Branch, Communicable Disease Center, until 1962.

Mrs. Lester is coauthor of "Communicable Disease Control," with Gaylord Anderson and Margaret Arnstein.

Born in Millport, Ala., Mrs. Lester was graduated from the Baptist Memorial Hospital School of Nursing in Memphis, Tenn. She received her bachelor's degree from Grenada College (now Millsaps College), Jackson, Miss., and her master of public health degree from the University of Michigan where she returned for post-master's study 1960–61.