

THERE ARE NO NORMAL VALUES IN MICROBIOLOGY!
AN IMPROPERLY COLLECTED SPECIMEN MEANS UNINTERPRETABLE RESULTS!

Normal Indigenous Flora of the Human Body

In humans, the skin and mucous membranes are colonized with a diverse and complex microbial flora (>200 species of bacteria, yeasts). In fact, the human body harbors far more microbial cells than host cells, in the order of more than a log difference. This microbial population constitutes the normal flora and this microsystem is an essential part of host defense against infection. The exact composition of the normal flora varies depending on several factors including genetics, age, sex, stress, and the nutrition and diet of the individual.

Since many bacteria and yeasts that make up the normal flora at various body sites may also become opportunistic pathogens under the right host and environmental conditions, the interpretation of culture tests in clinical microbiology is frequently a challenge. Detailed laboratory procedures dictate the standardized analysis and reporting of pathogens and normal flora for every specimen type analyzed by the clinical microbiology laboratory. However, medical consultation with a microbiologist is often required to determine the clinical significance of 'normal flora' in a culture from a non-sterile body site (i.e., wound, urine). The predominant types of organisms that make up indigenous flora of the human body are described in this newsletter to assist physicians when the laboratory reports a comment of 'normal flora'.

A brief summary of the role of the normal flora in host defense and the host conditions that allow establishment of a particular ecosystem at various body sites is outlined below.

- **Normal Flora of the Skin:** The general skin surface is dry and slightly acidic preventing the growth of many organisms, but a few have adapted to this environment and colonize this site. Prominent members of skin flora include a variety of aerobic gram-positive organisms such as staphylococcal and corynebacteria species (**Table 1**). *Propionibacterium acnes* is the main anaerobe living on the skin and colonizing pores and glands that are at lower oxygen levels. Qualitatively, the bacteria on the skin near any body orifice may be similar to those in the orifice (i.e., rectum).
- **Normal Flora of the Respiratory Tract:** The nose is always heavily colonized with coagulase negative Staphylococcus (CONS) and corynebacteria and in 20-30% of people is also the major site of carriage of *S. aureus* including methicillin-resistant strains (MRSA). A large number of bacterial species also colonize the nasopharynx and some strains may be potentially pathogenic including *N. meningitidis*, *S. pneumoniae*, *S. pyogenes* (GAS) and *H. influenzae* (**Table 1**).
- **Normal Flora of the Lower Respiratory Tract:** The trachea, bronchi and lung tissues are usually sterile because of the presence of a mucociliary epithelium that lines the tract and prevents microbes from being inoculated into the lower respiratory tract. However, if this barrier is damaged the individual becomes more susceptible to infection by bacteria living in the nasopharynx.
- **Normal Flora of the Urogenital Tract:** The predominant flora of the anterior urethra is shown in **Table 1**. Urine is a sterile fluid before it is voided through the urethra and over the peri-urethral skin where it may become contaminated with one or more of these types of bacteria or yeast. The vagina is colonized shortly after birth with corynebacteria, staphylococci, streptococci, and less frequently, a few enteric bacteria. Due to circulating estrogen after menarche, the vaginal epithelium contains glycogen and bacteria become predominant that metabolizes glycogen

(Lactobacillus, anaerobes). The lowered pH of the vagina then inhibits the growth of most bacteria and yeast such as *C. albicans*.

- **Normal Flora of the Gastrointestinal Tract:** From the mouth to the rectum, the gut is colonized with a large number of aerobic and anaerobic bacteria. Quantitative cultures of stool show that there are 10^8 aerobes per gram of feces but anaerobes are present at several higher orders of magnitude (10^{11}). Isolation of a particular bacterial species from a stool culture is equivalent to 'looking for a needle in a haystack' unless a particular enteric pathogen has substantially displaced the normal flora of the gut.

Table 1 lists the predominant organisms found at various sites in the human body.

SITE	ORGANISMS
Skin	<i>S. epidermidis</i> , other CONS, <i>S. aureus</i> Streptococcus viridans group Diphtheroids, anaerobic diphtheroids <i>Corynebacterium sp.</i> , <i>Propionibacterium acnes</i> , <i>Mallasezia furfur</i> (infants)
Mouth	Extremely complex microsystem that contains a wide variety of anaerobes and <i>S. viridans</i> group sp. (<i>S. mutans</i>) along the dental crevices and gingiva. Typical skin and nasopharyngeal flora colonizes the mucosal surfaces.
Nasopharynx (Nose, Throat)	<i>S. epidermidis</i> , CONS, <i>S. aureus</i> (MRSA), <i>S. viridans</i> group sp., <i>Corynebacterium sp.</i> , <i>Neisseria sp.</i> including <i>N. meningitidis</i> , <i>H. influenzae</i> , <i>S. pyogenes</i> (GAS), other B-hemolytic streptococci, <i>S. pneumoniae</i> , anaerobes, few yeast
Respiratory Tract (Lower)	Usually sterile but upper part of tract may recover nasopharyngeal bacterial species
Urogenital (Urethra)	<i>S. epidermidis</i> , CONS, <i>Enterococcus sp.</i> , <i>S. viridans</i> group sp., diphtheroids, corynebacteria, few enteric gram-negative bacteria (<i>E. coli</i> , Proteus, Klebsiella)
Urogenital (Vaginal)	Lactobacillus predominant after menarche, CONS, <i>S. viridans</i> group sp., diphtheroids, few gram negative rods, <i>Gardnerella vaginalis</i> , anaerobes, yeast
Gastrointestinal Tract (Upper)	Esophagus contains only bacteria swallowed with saliva and food. Stomach normally contains mainly acid-tolerant lactobacilli due to the high acidity of gastric juice.

IF YOU HAVE ANY QUESTIONS OR COMMENTS ABOUT HOW THE LABORATORY WORKS, PLEASE CALL US AT 770-3396 (Brenda Kirkham, Manager, Microbiology) or 770-3281 (Dr. Church, Division Head, Microbiology)

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