

Failure to Consider Adhesive Properties of Bacteria, Swab Material and Fomites Yields Results Which Inaccurately Represent Microbial Community Structure

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ABSTRACT

Surface swabbing results in poor bacterial retrieval where a recovery rate of 2% is considered reasonable. Furthermore, bacterial attachment features such as capsules, pili and flagella, alter collection of bacteria causing comparative counts of mixed samples to be inaccurate. This issue is further compounded by the type of swab used and the surface properties of the fomites from which the sample is retrieved. To consider the impact of these parameters, a 0.5McFarland standard consisting of equal amounts of MRSA (no specializations – standard gram positive wall), *Streptococcus pneumoniae* (thick capsule) and *Escherichia coli* (various mutants with and without: pili, flagella, fimbriae, capsule) was applied to fomites of varying topography and surface energy. These were retrieved using multiple types of swabs. Swab type affected the total number of bacteria retrieved but had little effect on the proportion of bacterial species collected ($p = 0.455$, by paired t-test). Mutant strains of *E. coli* were observed to determine contribution of surface features to fomite adhesion. Pili and flagella had greatest impact on retrieval from fomites with varied topography (ANOVA $F(44,4) = 6.099$; $p = 6.0 \times 10^{-4}$), whereas surface chemistry and capsule chemistry had greatest impact on retrieval of species from fomites of different surface energies (ANOVA $F(20,3) = 52.08$, $p = 1.24 \times 10^{-9}$). Adhesive properties of additional surface structures may need to be assessed and a more quantifiable study of fomite topography needs to be explored. Because relative bacterial load as assessed by swabbing of surfaces is used to make critical decisions about safety in medical, food and athletic venues, with little consideration of bacterial attachment features, swab type, or adhesive properties of fomites, a paradigm needs to be devised to make accurate comparisons of CFUs retrieved by swabbing surfaces for microbial contaminants.

Keywords: Adhesive properties, Surface swabbing, Microbial Community Structure

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