Information Sheet: Touch DNA, Low Copy Number DNA and High Sensitivity DNA Testing

In 1910 Edmund Locard established the first crime laboratory as a professor of forensic medicine at University of Lyons, France and is best known for his evidence transfer theory in forensic science, 'The Locard Exchange Principle'. In 1918, he also first suggested the 12 point matching system for positive fingerprint identification. Since then, both fingerprint and DNA technology have advanced significantly.

Standard forensic DNA test methods are optimized for using 1 nanogram of human DNA for identification of individuals. In recent years, forensic science has defined several specialized forms of testing that use far less than 1 nanogram of DNA in a PCR reaction. Touch DNA refers to any standard PCR reaction (typically 28-32 cycles depending on manufacturer) that follows the same test parameters as for 1 nanogram of DNA, even if the sample collected from the crime scene doesn't contain a full nanogram of DNA. Low copy number and high sensitivity testing refer to PCR reactions with additional cycles (typically 32-34 cycles) that increase the sensitivity of detection of the target DNA but also increase detection of contamination and reduce reproducibility. For this reason, three PCR reactions are tested with a sample and a composite DNA profile generated. The interpretation of these samples when consisting of complex mixtures is highly subjective regarding inclusion, exclusion or potential number of donors to the sample.

How much DNA is in a single cell and how much would you expect to recover from an item that has been touched? DNA estimates per cell are approximately 6 picograms. Standard forensic tests require approximately 5-20 cells for routine detection. Both the quantity and quality of DNA recovered affects the ability to generate a full DNA profile. Since low copy number DNA testing suffers from reproducibility issues, methods are being further developed to enhance not only recovery from the touched surface but also recovery from the swab or cutting taken from the evidentiary item.

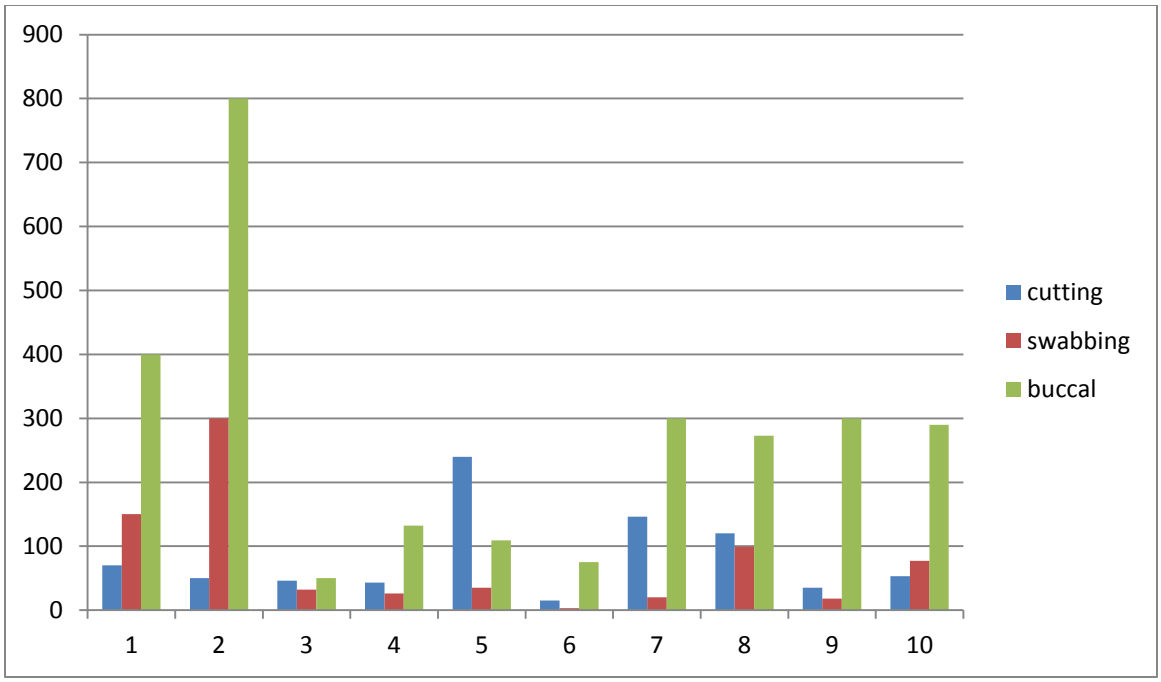

Figure 1. Methods for DNA recovery include swabbing a surface with a cotton swab or cutting a 1-3 cm^2 piece of fabric for cell recovery. While cell counts are variable from recovery with both methods, DNA quantity can be very low from touch or low copy number DNA testing. The reason for this is due to epithelial cell programmed cell death where cells are constantly being sloughed off of the skin surface and the nucleus containing the DNA is being degraded. Therefore, many of the cells recovered have no useful DNA. In contrast, almost all of the cells recovered from buccal (oral) swabs consist of nucleated cells and thus consistently yield higher DNA recovery. (x-axis, sample number; y-axis, estimated cell count).