**Long abstract**

# Swab Touch Spray - Mass Spectrometry for Direct Analysis of Bacteria and Drugs in Oral Fluid

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Swab touch spray (STS) mass spectrometry (MS) is a spray-based ambient ionization technique in which a sample is transferred to a medical swab from which direct ionization occurs via electrospray-like mechanisms. This new adaptation of touch spray, which originally used metallic teasing probes for surgical applications, allows for direct, non-invasive and *in vivo* biofluids analysis, *e.g.* oral fluid. The use of medical swabs for both sample collection and ion generation has potential for rapid point-of-care testing in several clinical applications as well as *in situ* forensic applications. Here we present STS studies for oral fluid testing to detect common pharmaceutical and illicit drugs, and to detect *Streptococcus pyogenes*, the leading bacterial cause of strep throat. In both applications, a one-step STS-MS approach is developed as an alternative analytical protocol to standard dual-step procedures involving screening by immunoassays, followed by confirmatory tests with more time demanding and expensive laboratory techniques, *e.g.* chromatography coupled with mass spectrometry and bacteria culture(Fig. 1).

Different experimental settings were used in each application, and optimized accordingly. Drugs were analyzed and detected with acetonitrile doped with formic acid via sequential product scans (an $MS^3$ experiment) in order to achieve enough analytical specificity to confirm identity. Membrane lipids of bacterial cells, including phosphatidylserine, phosphatidylinositol, and phosphatidylglycerols, were detected in negative ion mode (full MS scan) with methanol doped with surfactant (n-octyl-beta-D-glucoside), to increase ionization efficiency. Swabs spiked with oral fluid were simply affixed in front of the MS inlet, after a short drying period. The solvent

was applied to the swab tip; high voltage was applied directly to the swab aluminum wire. Analysis time is rapid (< 1 min) and requires minute amount of oral fluid (about 40 µL).

Proof-of-concept results proved that MS detection is sensitive and specific. It allows detection of several drugs in the ng/mL range, and the detection of different *Streptococci* species, intended as an alternative method to rapid immunoassay test. However, current performance in both applications requires refinement in the analytical procedures to meet clinical/legal requirements. Moreover, testing to establish the efficacy of the developed STS-MS methodology using clinical patient samples is currently ongoing.

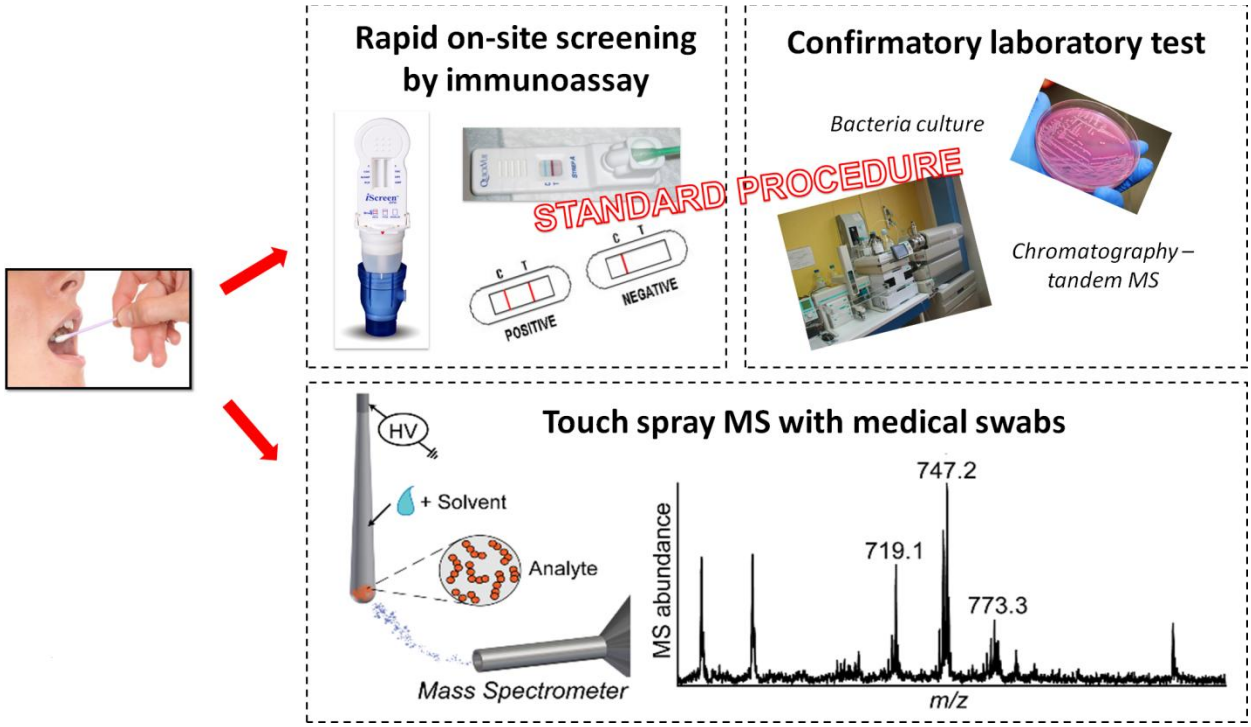


Figure 1. After sampling oral fluid with a swab, current procedures (top) include immunoassay and confirmatory analysis. The new STS-MS method (bottom) uses the sample swab for direct ambient MS.