H26 A Forensic Volatolomic Approach: A Step Forward in the Characterization of Wound Pathogens

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Learning Overview: After attending this presentation, attendees will better understand the Volatile Organic Compounds (VOCs) emitted by chronic wound pathogens, both *in vitro* and *in vivo*.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing an enhanced understanding of VOCs emitted by wound pathogens and how they can be analyzed to better understand the etiological causes of wound infections. Enhanced and early diagnosis of organisms colonizing a wound are critical to effective treatment and prevention of chronicity. Diagnosis by detecting and identifying VOCs could provide physicians with more rapid and sensitive knowledge of the organisms present in the wound and therefore expedite treatment to prevent complications.

With ongoing conflicts engaging military personnel, there has been a substantial increase in combat-related injury with high rates of morbidity and mortality. Chronic wounds have considerable effects on the patient, both physically and psychologically, as treatment is painful, the wound is slow to heal, and often leads to amputation to prevent sepsis and death. Treatment costs are also substantial, accumulating upward of $3 billion annually. The persistence of the chronic wound and the related costs is contributed to by microbes that colonize the wound, many of which are highly resistant to antibiotics, creating additional challenges to treatment. These microbes often form biofilms—bacteria encased in their own Extracellular Polymeric Substances (EPS), which compound the healing problem. Biofilms, especially those in the wound environment, are generally polymicrobial with relationships that vary from symbiotic to highly competitive. Diagnosis relies upon standard culture methods to identify the organisms present in the wound. However, some microbes are difficult to culture or may not be present at quantifiable levels, posing additional challenges to effective treatment.

Individual species of microbes have specific molecular makeups, including specific VOCs that are also thought to be unique to each organism. *Pseudomonas aeruginosa* and *Staphylococcus aureus* are two of the most common chronic wound pathogens and are highly multidrug resistant. Utilizing Solid-Phase Microextraction (SPME) and Gas Chromatography/Mass Spectrometry (GC/MS), this study used an *in vivo* model to compare VOCs present in the chronic wound environment to those present *in vitro*. While the number of identified volatile compounds were reduced *in vivo*, these compounds were still comparable to the *in vitro* baseline. Interestingly, in the dual species infection, the dominant compounds belonged to *P. aeruginosa* with lower levels to *S. aureus*. While relationships between organisms in a chronic wound vary from symbiotic to highly competitive, the detected volatile patterns indicate that even at low levels, pathogen VOC profiles vary between species, both qualitatively and semi-quantitatively. This method could lead to the identification of bacterial species present in acute and chronic wound infections without the time needed for standard cultures, as well as overcome limitations with regard to complex and difficult-to-culture organisms.

Volatolomics, Solid-Phase Microextraction (SPME), Pathogens