H127 A Predictive Knowledgebase Linking Microbial Signatures to Human Lifestyle Characteristics

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After attending this presentation, attendees will understand recent advances in the microbial ecology of skin-associated trace evidence and why it may be useful for predicting human lifestyle characteristics. Attendees will be presented with results from recent experiments in which microbial communities were sampled from mock crime scenes and compared against a nascent database to determine if human characteristics of the occupants can be determined.

This presentation will impact the forensic science community by revealing the potential for Next Generation Sequencing (NGS) of microbial communities associated with the human occupants of a space to be used in trace evidence.

The composition of microbial organisms associated with skin is unique to an individual. This is because the experiences each person has since birth are unique, and these physical interactions with the world are what allow microbes to colonize and form communities ("microbiomes") on our bodies. Even identical twins, whose microbiota are significantly more similar than other siblings, each have a unique profile. Growing up together means that one will share similar microbial sources, but the key to forensic application of the microbiome is in the differences. Each person is born sterile and is normally first colonized by bacteria associated with the mother. Subsequent to that, the microbial assemblages are shaped by, for example, what people eat, whom people touch, where people live, and how much time people spend indoors versus outdoors.

While an individual's core microbiome is considered stable by the age of two to three years old, it can still undergo variation as a person changes aspects of their lifestyle that causes them to be exposed to different microbial worlds. The skin microbiome is the primary interface with the world and the interface one most readily leaves behind when he/she interacts with a space. The microbial communities on the hands, noses, buttocks, and feet are unique to each person, but are also impacted by lifestyle and physical interactions with others. This study therefore posits that the microbiome can be highly predictive of elements of one's self and one's lifestyle. Therefore, there is a huge untapped demand in the criminal justice community for "class" information to be used for investigations. This gap could be filled in part by using the microbiome of human skin.

When more laboratories have the use of NGS instrumentation at their disposal, the likelihood that microbiome data could fill this gap increases. Since forensics is an application science, human microbiome profiles may be very important in many ways to the investigator. In a recent study, individual families were matched to their homes even when they had moved to another residence. This is based on a comparison of individuals to their environment, but also and more importantly, their microbiota transferred to a new residence where they had moved. A recent true scenario that occurred in a South Florida environment is presented as an example of the possible usefulness of this analysis. A man had begun to cohabitate with an individual of the same gender, but of a significantly different age. The man was found murdered in this apartment and the younger cohabitant was known to leave the house and return later in the day on a routine basis. A conventional DNA analysis of the handle of a knife as well as many other items, which the temporary occupant may have touched, yielded no profile. The questions now arose: Who was this person? What were his traits? More importantly for the investigator in this case, where did this individual possibly live or work?

To date, the evidence to support this idea has been limited by small studies and anecdotal enquiry. A systematic analysis of a human population is being performed around Miami, FL, to determine categorically whether elements of their lives can be predicted from their microbiome, both on their bodies and that left behind on surfaces with which they interacted. In doing so, a list will be created of highly specific microbial biomarkers for particular traits (e.g., young adult female vegetarian, who lives in the suburbs, and works in a bakery or bread counter). A sophisticated artificial neural network and database will also be built to enable extrapolation of microbial signature detection to other samples, so that a person's traits can be detected from the microbial community they leave behind. This proof of principle study will form the foundation of a forensic effort in Miami, FL, to create a new suite of trace evidence options that can be leveraged by investigators to help shape their interpretation of a crime scene.

Trace Evidence, Forensic Anthropology, Microbiome

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