NEXT-GENERATION BIOAEROSOL DETECTION & IDENTIFICATION

Biothreat Detection Canines For Disease Detection And Pandemic Preparedness

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The detection and identification of chemical, biological and explosive (CBE) threats are critical capabilities needed to counter the Global War on Terror. Asymmetric warfare continues to dominate the defense landscape, bringing with it the tactics and strategies of unconventional warfare, such as the use of chemical, biological, and explosive (CBE) weapons and materials. To that end, the detection and identification of chemical, biological and explosive (CBE) threats are critical capabilities needed to counter the Global War on Terror. While SARS-CoV-2 did not originate as a biological weapons agent (BWA), COVID-19 still ravaged the global population and killed over 1M Americans. SARS-CoV-2 continues to provide a wake-up call, drawing attention to the threats posed by biological agents, with variants emerging which can escape detection by diagnostics and impede vaccination efforts. Currently fielded biological threat detection technologies and FDA-approved medical diagnostics rely on detecting a pathogen's genetic material in a host or antibodies created by the host immune response; both approaches require close contact, handling of hazmat, technical expertise, and time. However, there is one autonomous stand-off biological detector that has a rapid, seek-and-find capability thereby reducing the risk of human contact with the pathogen: Dogs. Canines represent a detection platform entirely unlike any technology in existence: semi autonomous, capable of periods of continuous operation, and truly threat-agnostic. U.S. Army DEVCOM CBC and research centers around the world have demonstrated that scent detection dogs are able to identify COVID-19 positive individuals. In 2020, the Defense Preparedness Support Initiative funded DEVCOM CBC to support a study of COVID-19 detection dogs in collaboration with the University of Pennsylvania PennVet Working Dog Center (PVWDC). The initial effort (Phase 1) resulted in a proof of concept study. Phase 1 highlighted the dogs' (n = 8) ability to identify urine from COVID-positive patients with 96% accuracy. Phase 2 involved the same 8 canines trained using clinical samples, human perspiration, from COVID positive and negative patient volunteers collected over an eight-month period. The sample matrix of perspiration/scent was passively captured onto plain t-shirts that the PCR positive- or negative-confirmed patients wore overnight. The outcomes from Phase 2 resulted in the dogs able to discriminate COVID-positive t-shirt samples from COVID-negative samples with 89% accuracy, thus moving us one step closer to a real-time human screening capability. Canine-based detection for infectious diseases on this scale demonstrates the feasibility of swiftly responding to emerging threats in a low-cost, low-burden, and widely-applicable manner. Further understanding of what odorants dogs are detecting in these clinical samples and from the volatilome of infected patients provides spiral development opportunities for the creation of VOC-based electronic sensors, novel diagnostics, and colorimetric paper-based assays.