TOXIN DIAGNOSTICS – DEVELOPMENT OF NOVEL, FIELDABLE TECHNOLOGIES TO DIAGNOSE TOXIN EXPOSURE

Continuous Biosensor Platform To Detect Indicators Of Chemical Exposure

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Background Information: Military service members and civilian first responders are at risk of accidental or adversarial exposure to toxic environments. An early warning system that can alert individuals to a potential toxic exposure could greatly reduce the potential short-term and long-term health consequences.

Purpose: PercuSense is creating a continuous sensing platform to monitor electrochemical and physical markers of toxin exposure and provide real-time feedback to alert users of impending danger. Specifically, PercuSense is developing a single-probe, minimally invasive sensor that is capable of monitoring multiple analytes, which when combined with associated algorithms can provide early detection and warning of exposure to opioids, organophosphates, and mustard agents.

Objective: The objective of this effort is to develop a field platform to be used by military service members and civilian first responders for early chemical exposure detection. The technology is still in the development stage, and the goal of this phase of the program is to test the prototype platform in first-in-human studies to assess the sensors' performance and accuracy of the target analytes before moving on to animal testing with chemical warfare agents or simulants.

Rationale of the Research: The PercuSense technology continuously monitors key metabolites including lactate and oxygen, while also monitoring neurotransmitter precursor choline (with research into acetylcholine monitoring) to assess early physiological response to toxin exposure. The metabolites and neurotransmitter precursor are known to be impacted by toxin exposure. These analytes may be combined with other physiological monitoring to improve the detection capability of the system.

Relationship to Other Areas of Study: While the main focus of the technology development is aimed at early detection of chemical exposure, it is expected that there may be other potential military and civilian applications of the monitoring system including physical exertion load managements, training/exercise optimization, early detection of viral/bacterial infection, and metabolic monitoring in the trauma/critical care environment, among other potential applications.

Methods: PercuSense is in the Technology Development phase with this effort, testing prototypes in both in vitro and pre-clinical in vivo environments to gain critical feedback on the performance of the technology and make continual advances and improvements. PercuSense has recently completed three ACURO-approved pre-clinical studies utilizing rodents to test the expected sensor response when exposed to changing in vivo analyte concentrations.

Preliminary Results: Successful in vitro and pre-clinical in vivo testing has demonstrated the viability of the PercuSense system. Pre-clinical results showed accurate tracking to lactate, oxygen, and choline changes in the rodent model. The PercuSense biowearable platform has also been miniaturized to allow for first-in-human evaluation.

Preliminary Conclusions: The early feasibility work shows the potential viability of a minimally invasive biosensor platform in its ability to track key metabolites and neurotransmitter precursors. With further sensor development, miniaturization, and algorithm development, the technology could potentially be deployed in military and civilian settings to provide early detection and warning of chemical exposure.

Impact to DTRA Mission and Warfighter: With early exposure detection, we hope to mitigate the threat and negative health outcomes to the warfighter when exposed to chemical weapons. Funding provided by DTRA and DIU.