WEARABLE DEVICES FOR REMOTE MONITORING OF POISONED PATIENTS

Peter Chai, MD MMS
University of Massachusetts Medical School

Wearable devices are increasingly common in our daily lives. From fitness trackers to smartwatches to smart glasses, wearable devices collect and interpret key body parameters to quantify personal well-being, health and physiology. Integration of a variety of wearables into a biosensing network (body sensor network) can allow remote interpretation and management of chronically or even critically ill patients. For poisoned patients, a suite of biosensors combined with head mounted devices can provide additional data to a remote toxicologists who can make informed, directed interventions.

A body sensor network consists of patient and provider facing devices that transmit important biometric and physical exam findings to a remote physician. Integration of vital signs, laboratory results and live exam findings enables a toxicologist to evaluate, triage, and treat a poisoned patient in remote settings. Potential devices that may be used in this context include wrist mounted biosensors, head mounted devices, and ingestible biosensors.

Wrist mounted biosensors have gained popularity as fitness trackers, and continued evolution in biometric tracking has created a new generation of sensors that can accurately track eletrodermal activity (EDA), pleythsmography, heart rate, and three-dimensional acceleration. Interpretation of EDA signatures have the potential to allow toxicologists to monitor adherence to a substance abuse program by detecting episodes of abuse. Integrated with a telemedicine suite, a wrist mounted biosensor can provide critical biometric data to a remote physician who can then integrate vital sign abnormalities, EDA aberrancies and changes in movement in combination with a visual physical exam of the poisoned patient to potentially offer antidotal therapy prior to a lengthy transfer to a tertiary care center.

Ingestible sensors can be integrated into existing medications allowing for direct measures of adherence. An ingestible biosensor system consists of a digital pill with an intern radiofrequency emitter that activates upon contact with stomach acid, sending a unique signal to a wearable device that relays ingestion data to the physician through a cloud server. Real time ingestion data allows a clinician to detect adherence or nonadherence with medication regimens. Detection of nascent periods of nonadherence can allow physicians to intervene before these behaviors of nonadherence become ingrained. A toxicologist helping monitor a drug with a narrow therapeutic index can combine serum levels with medication taking behaviors through an ingestible biosensor to help physicians determine the efficacy of therapy or appropriate dose adjustments. In the setting of an overdose, these data can be queried to accurately determine the timing and dose of a biosensor-containing pharmaceutical product.

Head mounted devices (HMD) containing digital cameras are an appealing platform for telemedical consultations in a busy emergency department. We have studied the use of Google Glass, a HMD with video and photo capturing capabilities, to complete virtual toxicology consultations. Glass is a useful telemedical platform because 1) it is highly portable, and can be brought into various rooms in an emergency department without having to install new hardware or infrastructure, 2) it allows a consulting toxicologist to see a patient from a first person perspective with the bedside provider, enabling real time validation of the toxicologic exam findings, and 3) it can function through existing hospital wireless networks or hotspots.

Bedside toxicology consult services may not be feasible in remote hospitals. A low cost, portable head mounted device can allow an off-site toxicologist to observe the physical exam and ask relevant questions in real-time. Our study established the feasibility of deploying Google Glass as a telemedical platform for toxicology consults. The evolution of devices like Glass will permit improved imaging, stronger transmission power, and improved consultation ability. In conclusion, Google Glass is a feasible platform for toxicologists to assess poisoned patients in remote locations.