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Driver Alcohol Detection System for Safety (DADSS) – Human Testing of Two Passive Methods of Detecting Alcohol in Tissue and Breath Compared to Venous Blood

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Abstract

Alcohol-related traffic crashes and deaths remain a major problem in the United States as data indicate that there are approximately 37,000 traffic fatalities yearly, with 30% (~11,000) of them alcohol related. The Automotive Coalition for Traffic Safety (ACTS) and the National Highway Traffic Safety Administration (NHTSA) entered into a Cooperative Research Agreement to explore the feasibility of using passive technologies as an in-vehicle alcohol detection system that is less intrusive than ignition interlocks, but still able to reduce the incidence of drunk driving. Two passive technologies (TruTouch™ and Senseair™) were tested against breath (Alco-Sensor-FST™) and venous blood under a number of environmental scenarios in which individuals engage every day. A total of 92 healthy male and female volunteers (age 22-38) signed an IRB-approved informed consent and participated in experiments in which they consumed 0.9 g/kg of alcohol under a variety of drinking regimens and scenarios that mimicked real-life situations. The volunteers then provided passive breath and tissue (finger touch) samples and had their blood drawn at 5 min intervals for quantification of alcohol via gas chromatography. Lag time of appearance of alcohol, peak concentration, time to peak, and elimination rate were the primary dependent variables. The overall aim of the experiments was to test whether the alcohol concentrations measured by the two prototype devices correlated with venous blood under the following scenarios: lag time, eating a snack, eating a full meal, exercising, and “last call.” Each scenario was simulated in the experimental laboratory. The lag time experiment revealed that the order of alcohol appearance after drinking was (from first to last): breath, blood, and tissue, although early breath samples were contaminated by mouth alcohol. However, with over 4,000 matched points, the concentration-time curves for both prototypes paralleled that of blood with correlation coefficients of 0.7876 and 0.819 for touch- and breath-based technologies, respectively. Similar profiles were observed in the “last call” experiment with a “surge” of alcohol being observed after an extra drink was consumed during the distribution phase. The exercise scenario revealed similar profiles, and finally, the two eating scenarios indicated that blood alcohol concentrations (BAC) were lower after consuming a meal compared to a snack; the breath and tissue samples paralleled this profile. The data not only support the proof-of-concept that two different passive technologies (breath and tissue) can detect alcohol fast enough to be useful in a motor vehicle environment, but extend the parameters by demonstrating that the measurement of alcohol in the human body is not affected by many of the common scenarios that are known to alter blood alcohol concentrations. The passive devices each tracked the time course of BAC regardless of the situation demonstrating that these two compartments provide a high degree of accuracy while at the same time minimizing the disruption to the driver. These two devices, if proven to be reliable and with reproducible results under additional environmental and biological conditions, represent a significant technological breakthrough in strategies to reduce alcohol-impaired individuals from driving a vehicle and causing injuries and/or deaths.