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EDITORIAL
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Alcohol sensors and their potential for improving clinical care

Alcohol sensors are used successfully to monitor alcohol offenders in criminal justice, but their potential clinical applications with other populations are untapped. Sensors may improve provider understanding about patients' patterns of alcohol use, augment current treatment approaches and identify when alcohol may be interfering with the treatment of other conditions.

This is an exciting time in the evolution of wearable body sensors for health-care monitoring. Sensors provide information that an individual cannot report (e.g. cardiac rhythms) and/or may not report accurately (e.g. alcohol use), so can be invaluable for diagnosis and treatment. The accelerated development of different sensors, their miniaturization and their ability to provide information immediately to the wearer and/or a provider using computers and smartphones is remarkable.

Two sensors that detect the alcohol in skin perspiration have been evaluated in laboratory and field testing: the Secure Continuous Remote Alcohol Monitor (SCRAM; Alcohol Monitoring Systems, Inc., Littleton, CO, USA) ankle bracelet is commercially available and the Wrist Transdermal Alcohol Sensor (WrisTAS; Giner, Inc., Newton, MA, USA) has been used solely for research purposes [1–9].[1] These sensors are worn continuously and take readings regularly throughout the day so are less likely to miss episodes of alcohol use than other alcohol sensors (e.g. breathalyzers). Other direct alcohol biomarkers (e.g. phosphatidylethanol, ethyl glucuronide) reliably detect recent use, but may not detect some patterns of drinking [10,11], and cannot measure patterns of use over time. Thus, transdermal sensors provide greater detail about drinking episodes and are probably better at detecting any alcohol use than other biomarkers, although direct comparisons have not been made.

ALCOHOL BIOSENSORS IN CRIMINAL JUSTICE

As of August, 2014 the SCRAM was being used by agencies in 49 states and had been worn by more than 250 000 offenders [12,13]. A recent study reported that of 9100 alcohol offenders who were monitored using the SCRAM device, 75% showed no alcohol use or tampering [12]. Although no controlled studies have yet been conducted, there is evidence that alcohol monitoring is effective at reducing recidivism among repeat offenders who wore the bracelet for at least 90 days (compared to matched offenders [14]).

Electronic monitoring for alcohol use within criminal justice is showing success, but offender monitoring programs do not intersect with treatment as well as they might. McKnight *et al.* [12] reviewed six 'strong and innovative' alcohol monitoring programs in the United States and reported that, in addition to monitoring, many offenders were mandated to alcohol treatment, but typically treatment providers were not provided information from the monitoring entity. This separation between law enforcement and treatment is logical, but there are also suggestions that electronic monitoring may have greater success if its use is integrated with treatment [14,15].

POTENTIAL UTILITY OF SENSORS IN VOLUNTARY ALCOHOL TREATMENT

The accurate detection of consumption provided by an alcohol sensor can facilitate greater precision in treatment approaches, including those that involve motivational incentives. In recent investigations in which heavy drinkers received monetary rewards for no sensor-detected drinking, significant reductions were found in alcohol use [16], and significant differences were detected compared to control conditions [17]. In other treatment approaches, having an objective indicator of whether and when alcohol use occurs between treatment sessions could improve treatment effectiveness. The most straightforward application would be to share the data with the client to stimulate discussion about days when avoiding alcohol use is more challenging. Patterns of use, periods of abstinence, days of peak use and days when other substances might have exacerbated drinking could be explored with the client to attempt to understand the idiosyncratic experience of that person—an approach that has the potential to enhance the therapeutic relationship, the understanding of the individual and ultimately his/her success in treatment. This would be consistent with motivational interventions that commonly include personalized feedback based on self-report, used to increase awareness of use and consequences of use.

[1]A second ankle device, the Transdermal Alcohol Detector (BI, Inc., Boulder, CO, USA) contains the sensor from the WrisTAS and is commercially available, but to our knowledge has not been evaluated independently. Validation of alcohol sensors has been reported by multiple sources.

APPLICATIONS IN OTHER SETTINGS

Like biomarkers, sensors could be used to observe behavior among those with alcohol-related medical conditions, or any condition for which consuming alcohol complicates the progression of the disease and/or compromises the treatment. Alcohol use reduces immune function, interacts with medications and increases postoperative risks [18]. Alcohol also interferes with adherence to medication, and thus complicates the evaluation of pharmacotherapy for other diseases. More specifically, the evaluation of medication efficacy could be improved if it could be confirmed that alcohol was not interfering with the regimen. A continuous objective indicator of alcohol use has the potential to improve health outcomes, reduce costs and reduce or eliminate the interference of alcohol with medication adherence and medication efficacy.

OBVIOUS CONCERNS AND POSSIBLE SOLUTIONS

Despite their potential, it will be difficult to adopt alcohol sensors in clinical settings without major changes to the available commercial devices or the development of smaller and less expensive sensors. The appearance of the ankle bracelets and associated negative social attention is likely to be a significant deterrent to patients, who will not want to wear it, and providers who will not want to ask their patients to wear it. The WrisTAS is smaller and has a more acceptable appearance, but can be removed, so has limited utility for uses in which verifying the wearer is necessary. Despite its appearance, I have found that research participants report that after a few days they no longer noticed they were wearing the bracelet, that it interfered very minimally with work, and that they effectively chose clothing that covered the ankle bracelet. It is also possible that simply wearing the sensor will remind the patient of his/her goals, making it easier to adhere to a therapeutic plan [19]. Nevertheless, the introduction to clinical patients would need to be straightforward to address mistrust and/or defensiveness, and a collaborative approach when considering using such technology in treatment is essential.

SUMMARY

There are numerous potential populations and settings in which alcohol sensors might facilitate research and improve clinical care for those who struggle with their alcohol use. Researchers and clinicians should embrace the potential that alcohol sensors represent for improving treatment efficacy for alcohol disorders and augmenting the treatment of other conditions that are impacted by alcohol use.

Declaration of interests

None.

Keywords Alcohol biomarkers, alcohol detection, alcohol monitoring, alcohol offenders, alcohol treatment, biosensor.

NANCY P. BARNETT
Center for Alcohol and Addiction Studies, Brown University, Providence, RI, USA.
E-mail: Nancy_Barnett@brown.edu

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