More Reliable On-Site Detection of Cannabis in Oral Fluid

Alain G. Verstraete1,2*

In this issue of Clinical Chemistry, Desrosiers et al. (1) describe an evaluation of an on-site test for detecting cannabinoids in oral fluid (OF).3 These investigators analyzed 66 samples from study participants who smoked a controlled dose of cannabis. The device has a cutoff of 5 μg/L for Δ9-THC (THC), and comparison of the on-site results with the results for a gas chromatography–tandem mass spectrometry method with a 2-μg/L THC cutoff yielded a diagnostic sensitivity of 91% for the on-site test. Owing to the design of the study, most of the samples contained THC, so the estimation of the specificity was less reliable. Most other published evaluations, however, have shown that the specificity of the Draeger DrugTest 5000 is quite good. In our own evaluation of the same device (5-μg/L THC cutoff) in a methadone clinic, our use of the cutoffs mandated in the Belgian legislation produced a sensitivity, specificity, and efficiency of 81%, 95%, and 92%, respectively (2).

Desrosiers et al. refer to the Driving under the Influence of Drugs, Alcohol, and Medicines (DRUID) requirements, for which the sensitivity and specificity of an on-site test should be >80%. The Draeger DrugTest 5000 meets these requirements for THC. These requirements are less demanding than the requirements in the first ROSITA (Roadside Testing Assessment) project in 2000, for which a 90% sensitivity, a 90% specificity, and a 95% efficiency were required, but these requirements were changed because no device satisfied the criteria. They are more stringent than the sensitivity of 75% required by traffic police in their operational evaluation of on-site OF tests in DRUID cases (3).

Thus, it seems that the long quest for a sensitive on-site test for detecting cannabinoids in OF is finally over. Possible applications are workplace drug testing (WDT) and detecting drivers who are under the influence. The requirements for an on-site test for drugs in OF differ according to the intended use. One needs to know if the driver is impaired for driving under the influence of drugs (DUID) and whether an individual has used drugs for WDT.

Guidelines for WDT in OF exist in Australia and in draft form in the US and Europe. Many countries (several Australian states, Belgium, France, Spain, Switzerland, and the UK) have legislation that specifically allows the use of on-site testing for drugs in OF, and these tests are used effectively in enforcing DUID legislation in some of these countries (6 Australian states, Belgium, and France). Driving under the influence of cannabis is common, with crash risk increasing when cannabis has been used. Data from a recent roadside survey in Europe has shown that 1.32% (weighted mean) of European drivers had >1 μg/L THC in their OF or blood (4). Two recent metaanalyses have shown driving under the influence of cannabis to be associated with a significantly increased risk: One study found an odds ratio of 1.92 (95% CI, 1.35–2.73) for motor vehicle collisions, compared with unimpaired driving (5). The other study found an odds ratio of 2.66 (95% CI, 2.07–3.41) (6).

Desrosiers et al. (1) also evaluated the results with different cutoffs for different analytes, including THC, 11-nor-9-carboxy-THC (THCCOOH), cannabidiol, and cannabinol, and found the highest detection rates and the longest window of detection with a 2-μg/L THC cutoff.

So what cutoffs should be used? This matter is controversial, and there currently is no definitive answer. Many states and countries have per se or “zero tolerance” legislation for DUID with analytical cutoffs. In the guidelines for research on drugged driving, a maximum cutoff of 2 μg/L THC has been proposed (7). With the results of Desrosiers et al., countries that want to have zero tolerance could use a screening cutoff of 5 μg/L, which is lower than existing cutoffs. For roadside testing, the screening cutoffs are 15 μg/L and 25 μg/L in the French and Belgian legislation, respectively, and the confirmation cutoffs are 10 μg/L and 2 μg/L in Belgium and the Australian state of Victoria, respectively (8).

For WDT, the screening cutoffs are 25, 10, and 4 μg/L in the Australian, European, and US (draft) guidelines, respectively, and the corresponding confir-
mation cutoffs are 10, 2, and 2 μg/L. Other aspects to consider are the collection method, the intended detection window, and the risk of passive contamination. Several studies have shown that the THC concentration in OF depends on the collection method.

Using the Draeger DrugTest 5000, Desrosiers et al. (1) found that after study participants smoked 54 mg of THC, the last positive result was obtained after 4 h in 4 individuals, 6 h in 3 individuals, and 22 h in 3 individuals. Further work is needed, because the last sampling points were 6 h after smoking in 4 individuals and 22 h in 6 individuals, with no samples having been collected between 6 h and 22 h. Surprisingly, few data exist on the detection times for THC in OF at different cutoff concentrations. A similar study from the same group (9), in which OF was collected by expectoration, found that all study participants had THC concentrations >10 μg/L for 2 h. After 4 h, 90% of these participants had concentrations >2 μg/L, and 80% had concentrations >5 μg/L. After 6 h, 70% had concentrations >2 μg/L, and 50% had concentrations >5 μg/L.

For WDT, in which one wants to detect whether a person has used cannabis, a longer detection time, preferably comparable to the detection time in urine, might be needed.

For DUID, the problem is more complex, because one wants to detect drivers who are under the influence or at risk of being involved in a crash. Impairment is generally accepted to last a few hours after smoking marijuana, but more-sensitive tests have detected impairment for 24 h or longer. So, the detection time with the Draeger DrugTest 5000 is quite similar to the duration of impairment.

Currently there are no data on the concentration-crash risk relationship for THC in OF. Some recent studies have shown an increase in crash risk of 1–2 μg/L THC in whole blood (10). Reisfield et al. have stated that determining impairing drug concentrations is ultimately unattainable and that withholding drugged-driving legislation pending the acquisition of such data is tantamount to a plan for inaction with regard to an important and growing public health and safety problem (11). They proposed that “in the interest of public safety, a rational way forward involves the widespread adoption of existing—and continually evolving—technologies for testing drugs in all drivers suspected of impairment.”

The issue of passive contamination has been raised mainly in the case of WDT, but it is relevant for detection of drivers under the influence as well. Desrosiers et al. cite the article of Moore et al. (12), who studied passive exposure under realistic conditions—3 h in a Dutch coffee shop. For the 60 measured time points for 10 study participants, 27, 18, 7, and 2 data points indicated concentrations that were >1 μg/L, >2 μg/L, >5 μg/L, and >10 μg/L of THC, respectively, in their OF samples. This result indicates that only 2 of the participants passively exposed to THC would have tested positive under the Belgian DUID legislation. In establishing a cutoff for DUID, one must find a balance between the analytical capabilities (if analytical cutoffs are used in per se legislation) and the risk of including someone whose OF contained THC due to passive contamination. If the per se legislation is based on blood concentrations, as is the case in most countries, then the risk of being positive owing to passive contamination is much lower. THCCOOH seems to behave differently from THC. It is not detectable after passive smoking, but the concentrations are so low that only a few laboratories can detect it. Moore et al. have proposed allowing laboratories to test for THCCOOH in questionable cases (13).

In the laboratory setting, the Draeger DrugTest 5000 performed very well operationally for Desrosiers et al. (1), with only 1 invalid result and only 1 sample having an insufficient sample volume (but analysis was still possible).

What can be improved? The results of the Draeger DrugTest 5000 are available after 8.5 min, which is within the requirements of police, as described by the European Traffic Police Network in DRUID (3). But 8.5 min is a long time, and a lower analysis time would be welcomed. Another operational problem is that the instrument can analyze only 1 sample at the time, so it has a throughput of approximately 6 tests/h.

In conclusion, the work of Desrosiers et al. shows that reliable on-site detection of cannabinoids is now available for WDT and detection of DUID. Although many issues—such as the elimination kinetics of THC from OF, the relationship between THC concentrations in OF and impairment or crash risk, the repeatability of sampling, and passive contamination—still need further research, governments now have a tool to detect drugged driving at the roadside reliably and quickly. Because of the test’s good sensitivity, fewer drivers who are under the influence of cannabis and fewer workers who have used cannabis will escape detection.

Author Contributions: All authors confirmed they have contributed to the intellectual content of this paper and have met the following 3 requirements: (a) significant contributions to the conception and design, acquisition of data, or analysis and interpretation of data; (b) drafting or revising the article for intellectual content; and (c) final approval of the published article.

Authors’ Disclosures or Potential Conflicts of Interest: Upon manuscript submission, all authors completed the author disclosure form. Disclosures and/or potential conflicts of interest:

Employment or Leadership: None declared.
Consultant or Advisory Role: None declared.
Stock Ownership: None declared.
Honoraria: None declared.
Research Funding: The DRUID project, funded by the European Commission (2006–2011), and the ROSITA-2 project, funded by the European Commission for the European part.
Expert Testimony: None declared.
Patents: None declared.

References