Published in final edited form as:

J Subst Use. 2014 March 1; 19(1-2): 147–151. doi:10.3109/14659891.2012.760010.

Concordance of self-reported drug use and saliva drug tests in a sample of emergency department patients

Scott Macdonald, PhD [Assistant Director],

Centre for Addictions Research of BC: PO Box 1400 STNCSC Victoria BC V8W 2Y2 Canada,
Professor, School of Health Information Science, University of Victoria, BC

Cheryl J. Cherpitel, DrPH [Scientist],

Alcohol Research Group, Emeryville, CA: 6475 Christie Avenue, Suite 400 Emeryville, CA
94608-1010, Centre for Addictions Research of BC: PO Box 1400 STNCSC Victoria BC V8W
2Y2 Canada

Tim Stockwell, PhD [Director],

Centre for Addictions Research of BC: PO Box 1400 STNCSC Victoria BC V8W 2Y2 Canada and
Department of Psychology, University of Victoria, BC

Gina Martin, MSc [Research Associate],

Centre for Addictions Research of BC, University of Victoria, BC: PO Box 1400 STNCSC Victoria
BC V8W 2Y2 Canada

Sonya Ishiguro, JD [Research Associate],

Centre for Addictions Research of BC, University of Victoria, BC: PO Box 1400 STNCSC Victoria
BC V8W 2Y2 Canada

Kate Vallance, MA [Research Associate], and

Centre for Addictions Research of BC, University of Victoria, BC: PO Box 1400 STNCSC Victoria
BC V8W 2Y2 Canada

Jeff Brubacher, MD [Scientist]

Department of Emergency Medicine, University of British Columbia: JPPN, Vancouver General
Hospital, Room 3303 910 West 10th Ave, Vancouver, V5Z1M9, BC Canada

Abstract

The purpose of this study was to assess the concordance of self-reports of cannabis, cocaine and amphetamines, and the utility of these, with a saliva point of collection drug test, the DrugWipe 5+, in an emergency department (ED) setting.

Methods—A random sample of people admitted to either of two emergency departments at hospitals in British Columbia, Canada were asked to participate in an interview on their substance use and provide a saliva test for detection of drugs.

Analyses—Concordance of self-reports and drug tests were calculated. Prior DrugWipe 5+ sensitivity and specificity estimates were compared against a gold standard of mass spectrometry and chromatography (MS/GC). This was used as a basis to assess the truthfulness of self-reports for each drug.

Results—Of the 1584 patients approached 1190 agreed to participate, a response rate of 75.1%. For cannabis, among those who acknowledged use only 21.1% had a positive test and 2.1% of those who reported no use had a positive test. For cocaine and amphetamines respectively, 50.0% and 57.1% tested positive among those reporting use, while 2.1% and 1.3%, respectively reported no use and tested positive. Self-reports of cannabis and amphetamines use appear more truthful than self-reports of cocaine use.

Keywords

Saliva testing; illicit drug use; self-reports

Introduction

Estimates of the prevalence of illicit drug use from general populations have traditionally relied on self-reports; however, this approach may create biases towards under-reporting, since drug use is illegal and some people may tend to forget these events. Drug tests offer an independent means of determining prior use of drugs within certain detection periods. The detection periods vary, depending on the type of the body the sample is taken from (i.e. hair, urine, saliva or blood) and type of drug (Macdonald, 1997; Kapur, 1994). Recently there has been interest in point of collection oral fluid (saliva) drug testing, a fairly unobtrusive test where results can be obtained within 10 minutes of collection rather than days. The aim of this study is to examine the concordance of a point of collection saliva test, the DrugWipe5+, with self-reports of drug use for cannabis, cocaine and amphetamines among emergency department (ED) attendees. This information will be used to assess the likely truthfulness of self-reports for each drug and to better understand the utility of saliva drug tests and self-reports in the ED setting.

Approximately a dozen point of collection tests are on the market today, and typically detect the active ingredients associated with use of cannabis, cocaine, amphetamines/methamphetamines/crystal meth and opiates. The accuracy of these tests varies somewhat, depending on the manufacturer, but none of the tests appear demonstrably superior. In a recent study, Blencowe et al. (2011) compared the accuracy of eight different manufactures of point of collection tests with confirmatory laboratory methods using mass spectrometry and gas or liquid chromatography (MS/GC), considered to be the nearly perfect gold standard for drug tests. They assessed *sensitivity* (the percent of people who test positive in relation to all true positives) and *specificity* (the percent of people who test negative in relation to all true negatives). The average sensitivity and specificity for amphetamines was, respectively 60% and 97%, for cannabis, 38% and 95%, and for cocaine, 36% and close to 100%. The sensitivity and specificity for the DrugWipe 5+, the saliva test used in this study, are reported in Table 1.

Background

The detection of each drug varies among individuals, depending on the dose, frequency of use, route of administration, duration of use, tolerance, metabolic rate and cut-off levels of the tests (Verstraete, 2004; Dyer and Wilkinson, 2008). Although saliva tests detect active metabolites for all drugs except cocaine, they cannot be used to determine impairment (Dyer and Wilkinson, 2008). The maximum detection period has been found to vary depending on the drug, for example, amphetamines (50 hours), cannabis (34 hours), and cocaine (24 hours for benzoylecgonine, the metabolite tested with the DrugWipe 5+) (Verstraete, 2004; Dyer and Wilkinson, 2008).

Overall, research is sparse on the accuracy of self-reported drug use in general populations. One study comparing self-reports of marijuana and cocaine with urine drug tests for 4,000 respondents aged 12 to 25 found minor over and under self-reporting (Harrison et al., 2007). Another study compared self-reported drug use in the prior 48 hours with results from saliva tests among patrons of music dance events (Johnson et al., 2009). Saliva was analyzed using an immunoassay screen and confirmatory MS/GC tests for positive samples. This procedure is particularly useful for minimizing the possibility of false positives, since the confirmatory approach is considered near perfect; however, false negatives are common with immunoassay screens, when not corroborated with confirmatory tests (Clarke & Wilson, 2005). Of 50 subjects who reported marijuana use, only 26 (52%) tested positive, while of 297 who reported no marijuana use, 12 (4.0%) tested positive (Johnson et al., 2009). Since false negatives are common with immunoassay testing and reporting of drug use is not socially desirable, it is likely that most of those who indicated marijuana use but tested negative were truthful. However, reports of those who deny use while testing positive likely were not truthful since false positives are extremely rare with confirmatory tests. In this same study, 15 of 16 respondents who self-reported cocaine use also tested positive – an expected finding given the much greater accuracy of immunoassays for detecting cocaine. On the other hand, 9.0% of those who reported no cocaine use tested positive, suggesting that truthfulness may be less likely for cocaine than for cannabis use. Similar results were found in another study of drug use among cruise ship patrons where more people self-reported cannabis and cocaine use than were positive on saliva tests (Gripenberg-Abdon et al., 2012).

Most ED studies aim to assess the risks related to acute drug impairment rather than past use, because impairment has more etiological relevance to the acute events treated in the ED. A quick assessment of drug use among ED admissions could be helpful for clinical purposes. The purpose of this study is to compare results of the DrugWipe 5+ with self-reported use of three types of drugs (cannabis, cocaine and amphetamines) within the past 24 hours. This study contributes to existing research on the concordance of self-reports and saliva tests by assessing utility of the saliva test in the ED setting.

Objectives

1. What is the concordance between self-reports and a point of collection saliva test (the DrugWipe5+) for cannabis, cocaine and amphetamines?

2. How does the concordance between these reports compare to expectations from previously reported sensitivities and specificities of the DrugWipe 5+?

Methods

Samples

Patients admitted to two EDs in British Columbia (one in Vancouver and one in Victoria) from September 2008 to June 2011 were approached to participate in a study to assess risk factors associated with their injuries and illness. Patients were recruited on one Friday and one Saturday evening per month between 9 p.m. and 4 a.m. Eligible patients who were between 17 and 75 years of age, could speak and understand English, and could provide informed consent were asked to participate. Each respondent was asked to complete an interview and provide a saliva test for analysis of drug use. In Vancouver, unlike Victoria, parental consent was required for those less than 19 years of age. Ethics approval was obtained from the Human Research Ethics Board at the University of Victoria and the Behavioural Research Ethics Board at the University of British Columbia.

Instruments

Respondents were interviewed using a standardized interview schedule, which consisted of questions on the reason for visit and drug use history (lifetime use, past 12 months, one month, one week, and use 6 hours prior to the injury or illness event) and demographic characteristics. Respondents provided a saliva sample that was analyzed with the DrugWipe5+. Each respondent was also requested to report any use of cannabis, amphetamines and cocaine within 24 hours prior to the saliva test.

Data Analysis

Concordance analyses were conducted between self-reported use and drug test results for cannabis, cocaine and amphetamines. Opiates were not analyzed because the self-reported question included non-opiate painkillers, which could not be distinguished from opiates. Analyses were conducted for self-reports in a 24 hour period before admission. We provide accuracy measures by comparing the concordance of saliva tests to those of self-reports. In this study we have both self-reported drug use and use based on a saliva sample from the DrugWipe5+, and each has a degree of error. Based on prior research (Blencowe et al., 2011), where the accuracy of the DrugWipe5+ was compared to the gold standard (MS/GC), the sensitivity levels of the DrugWipe5+ were low for cannabis (.43) and cocaine (.36) and high for amphetamines (.87). If self-reports are truthful, then the proportions self-reporting use but testing negative divided by all those who report use, can be compared against expected values of .13 for amphetamines (i.e. $1 - .87$), .57 for cannabis and .64 for cocaine (see Table 1, based on Blencowe et al.). The numbers can be calculated. For example, assuming b equals the number who admit cannabis use and test positive with the drug test, and d (proportion who test negative but admit cannabis use) then $d = .57 / .43 * b$. We have assumed that people who self-report drug use in the prior 24 hours are telling the truth, even if the saliva test produced a negative result, as no conceivable motive for being untruthful could be postulated.

If patients report they did not use drugs and the saliva test was positive, then two explanations are possible, either they may not have been truthful or the results could be true false positives. Table 1 shows the expected proportion of false positives (i.e. incorrect positive tests) in relation to the total number of people indicating no drug use based on prior specificities reported by Blencowe et al., (2011), from which the expected number of those who deny use but test positive can be estimated. If the actual number is below the expected number, then it would appear patients are being truthful and the test results are due to false positives; if the actual number is greater than the expected, it is suggestive that patients are not being truthful.

Results

At the two hospitals, 1584 patients were approached to participate in the study and 1189 agreed, for a response rate of 75.1%. Another 1016 patients did not meet the eligibility criteria due to being too severely injured, too intoxicated, or unable to understand English. Another 710 were excluded due to not meeting the age requirements of 17 to 75. Response rates were similar at both hospitals (78.1% and 72.8%). About 12% refused to provide a saliva sample but agreed to the interview. Data were obtained from 918 subjects who provided both self-reported drug use data and a saliva test sample. Those who refused the drug swab were not significantly different on gender or age than those who agreed.

Table 2 shows the comparisons of self-reports of drug use in the past 24 hours and saliva test results for cannabis, cocaine and amphetamines. Treating self-reports as the gold standard, the sensitivity and specificity for each drug can be calculated and compared to expected values. Of the 52 patients who reported cannabis use in the 24 hours prior to ED admission only 11 tested positive on the saliva test (sensitivity of 21.1%). A further 846 respondents reported they did not use cannabis and tested negative; however, 18 tested positive who reported they did not use cannabis. Based on calculations described in the analysis section, the number of patients who would be expected to self-report use but test negative (i.e. false negatives) was estimated at 15, which is substantially below the actual number of 41. The expected number of false positives is 43 which is much higher than the number of 18 who denied use but tested positive. These numbers are consistent with truthful self-reports for cannabis.

Similar analyses were conducted for cocaine (see Table 2), where 22 patients reported use and 11 also tested positive. The number expected to test negative but self-report use was calculated at 17, which is greater than 11. In terms of estimated false positives, the saliva tests are considered near perfect and therefore none were expected if subjects were being truthful. Overall, these estimates suggest that a sizeable proportion of subjects were not being truthful if they used cocaine.

The final analyses were conducted in relation to amphetamine use (see Table 2). It was expected that 1 person should report use but test negative which is marginally lower than the number found. For those who tested positive but denied use, 25 were expected, but only 11 were found, suggesting truthfulness of reports of amphetamine use.

Discussion

In this study, results of the saliva drug test are compared with self-reported drug use of cannabis, cocaine and amphetamines in the prior 24 hours, using Blencowe's sensitivity and specificity analyses to assess the likely truthfulness of self-reports of patients. We assumed those who admitted use were being truthful. For those who denied use but tested positive, we compared the Blencowe's specificity reports to this study.

The results showed that for every drug, among those who admitted use, large proportions tested negative (ranging from 78.9% for cannabis to 42.9% for amphetamines). This finding was not particularly surprising in light of empirical studies reported by Blencowe et al., (2011) that found saliva tests to have low sensitivities. The proportion of positive drug tests among those acknowledging use was particularly low for cannabis; 3.7 people acknowledged use for every person who tested positive which, suggesting that sensitivity of the point of collection tests for cannabis use in real life situations may be even poorer than previously reported by Blencowe et al., (2011). The sensitivity for detecting cocaine and amphetamine use in this study appear to be in the same range as those previously reported (Blencowe et al., 2011). The likelihood that respondents would be untruthful for behavior that is not deemed socially desirable seems remote.

Among those who denied drug use small percentages tested positive: 1.3% for amphetamines, 2.1% for cannabis and 2.1% for cocaine. Compared with prior specificity research (Blencowe et al., 2011) reporting 5% for amphetamines, 4% cannabis and 0% for cocaine, these proportions are low for cannabis and amphetamines, but high for cocaine. Therefore, for cannabis and amphetamines, patient self-reports appear truthful. Since, specificity for cocaine based on saliva tests has been reported to be close to perfect, findings here suggest that cocaine users may be less likely to be truthful about their use.

Another potential source of bias is due to those who refused to participate in the study. A strong case can be made that those who used drugs will be more likely to refuse to participate, given informed consent regarding the purpose of the research. Nonetheless this is a limitation for all research with informed consent, regardless of whether subjects are being requested to self-report or to provide a saliva sample for drug analysis.

One limitation of this study is that self-reports of specific drugs covered only 24 hours prior to the test; however, the detection times of the DrugWipe5+ vary. For example, the detection period for cannabis is longer than for cocaine. Unfortunately, the detection periods for the tests depend on a number of factors, such as amount and frequency of use, and metabolic factors among individuals. The maximum detection periods for the drug tests in this study for each of the three drugs investigated are at least 24 hours. Since the detection periods for the tests have such variability, error would still be found with any period chosen. Another limitation is that mass spectrometry and gas chromatography, the gold standard, was not used in this study.

One conclusion that can be drawn from this research is that the point of collection saliva tests did not appear to offer substantial benefits in terms of improving accuracy of self-reported drug use. However, the drug tests may have had an influence toward more truthful

self-reports because respondents were being monitored by external measures, a phenomena known as the bogus pipeline. For cannabis and amphetamines, results from self-reports were within the ranges of sensitivity and specificity found in other empirical studies. However, much larger proportions indicated drug use than tested positive for each of the three drugs investigated, which brings into question the utility of saliva tests. The saliva tests may have more utility for detecting cocaine than the other drugs, and if drug tests are to be used in similar research studies, it is recommended that definitive gold standard tests of MS/GC be used for all subjects, not just those who test positive with a point of collection test. It is important to note that these data were collected in the context of a healthcare environment after providing both written and verbal assurances of confidentiality. In other contexts such as testing potentially impaired drivers by law enforcement officers it is likely that saliva tests have advantages over self-report as a means of detecting prior substance use; however, again accurate assessment require the gold standard laboratory measures that take much longer for the results.

References

- Blencowe T, Pehrsson A, Lillsunde P, Vimpari K, Houwing S, Smink B, Mathijssen R, Van der Linden T, Legrand S, Pil K, Verstraete A. An analytical evaluation of eight on-site oral fluid drug screening devices using laboratory confirmation results from oral fluid. *Forensic Science International*. 2011; 208:173–179. [PubMed: 21183299]
- Clarke J, Wilson JF. Proficiency testing (external quality assessment) of drug detection in oral fluid. *Forensic Science International*. 2005; 150:161–164. [PubMed: 15944056]
- Doecke, SD.; Grigo, JAL. Annual performance indicators of enforced driver behaviours in South Australia, 2009. Centre for Automotive Safety Research, University of Adelaide; 2011.
- Dyer KR, Wilkinson C. The detection of illicit drugs in oral fluid: another potential strategy to reduce illicit drug-related harm. *Drug and Alcohol Review*. 2008; 27:99–107. [PubMed: 18034388]
- Gripenberg-Abdon J, Elgán T, Wallin E, Shaafati M, Beck O, Andréasson S. Measuring substance use in the club setting: Substance Abuse Treatment, Prevention, and Policy. *Substance Abuse Treatment, Prevention, and Policy*. 2012; 7(7):1–10.
- Grotenherman F, Leson G, Berghaus G, Drummer O, Krüger H, Longo M, et al. Developing limits for driving under cannabis. *Addiction*. 2007; 102:1910–17. [PubMed: 17916224]
- Harrison, L.; Martin, S.; Enev, T.; Harrington, D. DHHS publication No SMA 07-4249, Methodology Series M-7. Rockville, MD: Substance Abuse and Mental Health Services Administration, Office of Applied Studies; 2007. Comparing drug testing and self-report of drug use among youths and young adults in the general population.
- Johnson MB, Voas RA, Miller BA, Holder HD. Predicting drug use at electronic music dance events: Self-reports and biological measurement. *Evaluation Review*. 2009; 33:211–25. [PubMed: 19351889]
- Kapur, B. Drug testing methods and interpretations of drug testing results. In: Macdonald, S.; Roman, P., editors. *Research Advances in Alcohol and Drug Problems*. New York: Plenum Press; 1994.
- Macdonald S. Work-place alcohol and other drug testing: A review of the scientific evidence. *Drug and Alcohol Review*. 1997; 16:251–259. [PubMed: 16203434]
- Pehrsson A, Blencowe T, Vimpari K, Impinen A, Gunnar T, Lillsunde P. Performance evaluation of the DrugWipe® 5/5+ on-site oral fluid screening device. *International Journal of Legal Medicine*. 2011a; 125:675–683. [PubMed: 20652713]
- Pehrsson A, Blencowe T, Vimpari K, Langel K, Engblom C, Lillsunde P. An Evaluation of On-Site Oral Fluid Drug Screening Devices DrugWipe® 5+ and Rapid STAT® Using Oral Fluid for Confirmation Analysis. *Journal of Analytical Toxicology*. 2011b; 35:211–218. [PubMed: 21513614]

Verstraete AG. Detection times of drugs of abuse in blood, urine, and oral fluid. *Therapeutic Drug Monitoring*. 2004; 26:200–206. [PubMed: 15228165]

Table 1

Sensitivity and specificity of DrugWipe 5+ and expected additional number and proportions for discordant pairs based research reported by Blencowe (2011)

Drug	Average Sensitivity	d - Expected number reporting use and testing negative	Average Specificity	Expected proportion false positives in relation to all subjects reporting no use
Amphetamines	.87	d = 0.15 ^{*b}	.95	.05
Cannabis	.43	d = 1.33 ^{*b}	.96	.04
Cocaine	.36 [*]	d = 1.5 ^{* b}	1.0	0

^b self-report use and test positive, d – self-report use and test negative

^{*} Insufficient numbers were available for the DrugWipe 5+, therefore the average sensitivity of all other point of collection tests were used

Table 2

Comparisons of self-reported drug use with saliva test results

Cannabis				
		Self-reported cannabis in the past 24 hours		Total
		no	yes	
DrugWipe 5+: Cannabis	Positive	18	11	29
	Negative	846	41	887
	Total	864	52	916

Assuming self-reports as the gold standard, sensitivity = 21.1%, specificity = 97.9%

Expected number reporting use and testing negative = $11 \times 1.33 = 15$

Expected number reporting no use and testing positive = $.05 \times 864 = 43$

Table 3

Cocaine				
		Self-reported cocaine in the past 24 hours		Total
		no	yes	
DrugWipe 5+: Cocaine	Positive	19	11	30
	Negative	877	11	888
	Total	896	22	918

Assuming self-reports as the gold standard, sensitivity = 50%, specificity = 97.9%

Expected number reporting use and testing negative = $11 \times 1.5 = 17$

Expected number reporting no use and testing positive = 0

Table 4

Amphetamines				
		Self-reported either XTC, amp, or CMA in the past 24 hours		Total
		no	yes	
DrugWipe 5+: Amphetamine	Positive	11	4	15
	Negative	834	3	837
	Total	845	7	852

Assuming self-reports as the gold standard, sensitivity = 57.1%, specificity = 98.7%

Expected number reporting use and testing negative = $4 * .15 = 1$

Expected number reporting no use and testing positive = $834 * .03 = 25$