A comparison of urine and oral fluid matrices for workplace drug testing

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Background

- Rail Safety National Law National Regulations 2012
- 25% of all rail safety workers must be selected to undertake drug or alcohol testing per annum
- Sydney Trains and NSW Trains drug and alcohol policy
  - Urine drug testing performed in accordance with AS4308:2008

Background

- The detection time for substances is generally longest in hair followed by urine, sweat, oral fluid and then blood
- Illicit drugs and their metabolites can be detected in urine for up to 4 days after a single dose and for weeks, or even months in exceptional cases, following chronic use of cannabis
- In oral fluid drugs of abuse are typically detected for 12 to 48 hours

Legal precedents

- Shell Refining (Australia) Pty Ltd v CFMEU [2008]
  - random testing is an intrusion on the privacy of the individual which can only be justified on health and safety grounds
  - the employer has an obligation to try and eliminate the risk that employees might come to work impaired by drugs or alcohol such that they could pose a risk to health or safety
  - the employer has no right to dictate what drugs or alcohol its employees take in their own time
- Endeavour Energy v Communications, Electrical, Electronic, Energy, Information, Postal, Plumbing and Allied Services Union of Australia and others [2012]
  - neither method tests directly for impairment
  - a method which tests for recent consumption is more likely to identify someone who is impaired
  - urine testing may be unable to identify that someone has smoked cannabis in the previous four hours - precisely the time frame which is most relevant for identifying likely impairment

Legal precedents

- Holcim (Australia) Pty Limited v. Transport Workers' Union of New South Wales [2010]
- Construction, Forestry, Mining and Energy Union v HWE Mining Pty Limited [2011]
- Construction, Forestry, Mining and Energy Union v Port Kembla Coal Terminal Limited [2015]
  - oral fluid sampling was an inferior means to detect long-term use of drugs
  - “hangover” and withdrawal effects of drugs like methylamphetamine provides compelling basis to detect long-term drug use
  - a positive oral fluid test result is more likely to be associated with impairment than a positive urine test

Legal precedents

- Owen Sharp v BCS Infrastructure Support Pty Limited [2015]
  - there is currently no direct scientific test for impairment arising from the use of cannabis
  - Oral fluid testing can more accurately detect recent cannabis use than urine testing and may be a better indicator of possible impairment, but it cannot conclusively demonstrate impairment or non-impairment
  - where an employee who shows no obvious signs of impairment undergoes a drug test at work and tests positive for cannabis use, the employer is placed in a difficult position… Apart from the employee's own explanation about the matter, which will probably not be verifiable, the employer will not be in a position properly to assess whether the employee is impaired as a result of cannabis use and therefore represents a threat to safety

Aims

- To determine the relative detection rates of urine versus oral fluid testing in a safety sensitive industry
- To determine the number of workers who tested positive and were found to have a diagnosed substance misuse disorder or possible impairment at work

Methods

- Sydney Trains Enterprise Agreement 2014 and the NSW Trains Enterprise agreement 2014 required both parties to establish and monitor a trial of oral fluid testing as part of the employer's testing regime
- Working party comprising employer, union and employee representation was established to design and oversee the trial
- 1500 paired drug tests

Methods

- Urine drug tests were performed in accordance with AS/NZS 4308:2008
- Oral fluid tests were performed in accordance with AS4760:2006
- All samples transported to an accredited laboratory
  - urine specimens screened by immunoassay and confirmed by LCMS
  - oral fluid specimens screened and confirmed by LCMS using the target values listed table 5.1 of AS 4760:2006
  - benzodiazepines and phentermine were initially tested in urine and, if detected, were tested in oral fluid at target concentrations of 10ng/ml and 25ng/ml respectively

Methods

- Positive test
  - result consistent with the use of an illicit drug
  - use of a controlled substance without a clinical indication and an appropriate prescription
- Medical assessment offered to all workers testing positive
  - confirmation of the substance(s) used
  - timing of use
  - substance use disorder (DSM-5)
  - possible impairment at work following that particular episode of substance use
    - a history of impairing symptoms at work between that instance of drug use and the time of the drug tests
    - the history of drug use provided by the worker was inconsistent with the drug test results and with subsequent repeat testing.

Methods

- All workers undertaking testing were asked to complete an optional anonymous questionnaire
  - The instructions provided by the authorised person were simple to understand
  - I found the oral fluid swab test procedure more or less uncomfortable than the urine test
  - I found the process of providing a swab sample to be quicker and easier than the urine test
  - I would be more comfortable providing oral fluid swab sample during routine drug and alcohol testing than providing a urine sample.

Results

- 1501 workers tested
- 1500 paired samples
- Substances detected in 56/1500 urine samples (3.7%) vs 8/1500 oral fluid (0.5%) ($p<0.0001$)
  - 17/56 urine samples contained more than one substance
  - 7/8 oral fluid detections also detected in urine
  - 1 worker (0.07%) had a substance detected on oral fluid alone vs 49 (3.3%) that had substances detected in urine alone

Results: total detections

	Urine			Oral fluid		
	N	%	95% CI	n	%	95% CI
Individuals with detections	56	3.7	2.77-4.69	8	0.5	0.16-0.90
Individuals with positive results	11	0.7	0.27-1.12	3	0.2	0-0.43
Adulterations	1	0.1	0-0.26	1	0.1	0-0.26
Mean collection time	6.2* min	NA	6.1-6.3min	5.1	NA	5.0-5.2min

*includes average 1.5 minutes form completion time

Results: total detections by substance

Substance	Urine n [mean time from dose]	Oral Fluid n [mean time from dose]	p
codeine	28 [10hr]	3 [3hr]	<0.0001
morphine	18 [19hr]		*
pholcodeine	1 [24hr]		*
amphetamine	5 [37hr]	1 [5hr]	0.0455
methylamphetamine	2 [77hr]	1 [82hr]	0.3173
pseudoephedrine	1 [1hr]		*
phentermine	3 [4hr]	1 [2hr]	0.1573
MDMA/MDA	2 [65hr]		*
cocaine metabolites/cocaine	3 [55hr]	1 [50hr]	0.1573
THCCOOH/THC	5 [86hr]	1 [1hr]	0.1025
benzodiazepines*	8 [131hr]		*
TOTAL RESULTS	76	8	

*McNemar test could not be performed due to the lack of a detection in oral fluid

Positive results

- 12 workers returned a positive result
  - 3 tested positive to more than 1 substance
  - 9 workers positive on urine alone
  - 1 positive on oral fluid alone
  - 2 positive on urine and oral fluid
- p=0.0114

Positive results listed by substance

Substance(s)	Urine n	Oral Fluid n
cocaine metabolites/cocaine	3	1*
Amphetamine/methylamphetamine	2	1*
MDMA	2	0
THCCOOH/THC	5	1
Phentermine	1	0
TOTAL POSITIVE DETECTIONS	13	3

* = substance detected in both urine and oral fluid

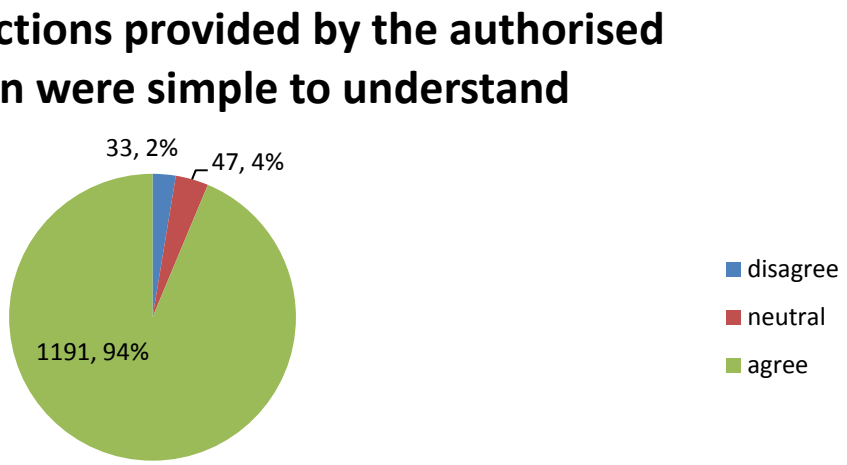
Results of medical assessment

- 11/12 workers attended the medical assessment
- 4/11 admitted to attending work after the episode of drug use whilst still impaired
- An additional 3/11 possibly impaired at work based on overall history and subsequent testing

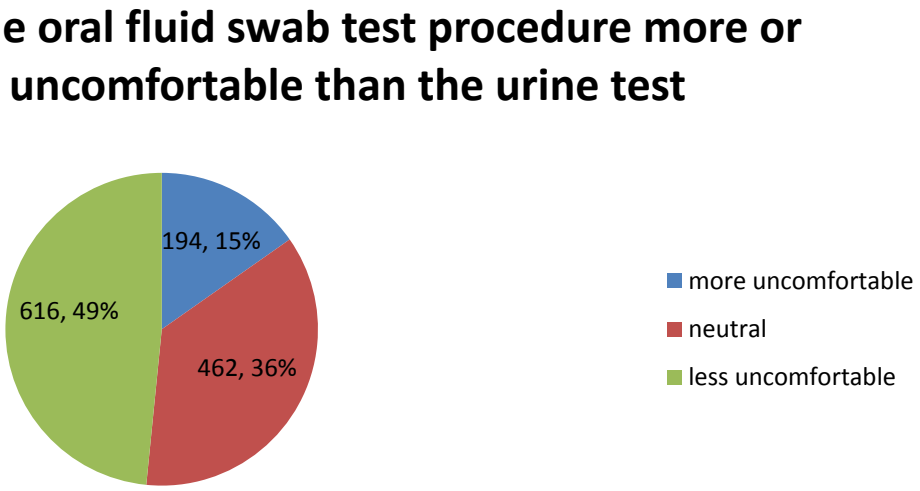
	Possible impairment				Substance use disorder	
	self-admitted	Clinically assessed	Total yes n (%)	Total no n (%)	Yes n (%)	No n (%)
Urine	4	2	6 (55%)	5 (45%)	2 (18%)	9 (82%)
Oral fluid	1	1	2 (18%)	9 (82%)	0	11 (100%)

Results: participant questionnaire

- 85% response rate



Results: participant questionnaire

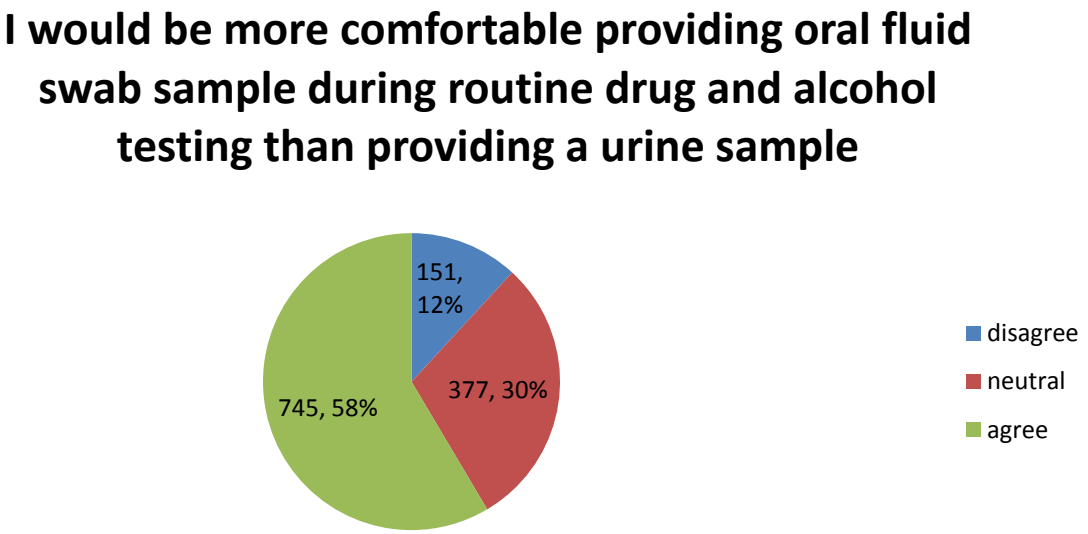


Results: participant questionnaire

I found the process of providing a swab sample to be quicker and easier than the urine test

- 1.5 min form completion
- 4.7 min urine
- 5.1 min oral fluid

Results: participant questionnaire



Discussion

- Urine drug testing performed in accordance with AS/NZS4308:2008 is significantly more likely to detect overall use of substances compared to oral fluid testing conducted in accordance with AS4760:2006
  - 3.7% versus 0.5% ($p<0.0001$)
- Urine was significantly more likely to detect workers using illicit substances, or controlled substances without a clinical indication and valid prescription, than oral fluid
  - 0.7% for urine versus 0.2% for oral fluid ($p=0.0114$)
- More workers with possible impairment at work and a substance misuse disorder were detected on urine testing than on oral fluid testing

Discussion

- Urine was significantly more likely to detect codeine and amphetamine
- Morphine, pseudoephedrine, MDMA and benzodiazepines were only detected in urine
- Δ-9 THCCOOH was detected in 5 urine specimens vs THC in one oral fluid sample
  - all 5 of the workers returning positive urine tests for Δ-9 THCCOOH were found to have possible impairment at work following that episode of drug use
- One worker positive on oral fluid alone (THC)

Conclusions

- Urine is significantly more likely to detect overall medication and substance use
- Urine is significantly more likely to detect illicit drug use
- In this study, and based on small numbers, urine was more likely to detect illicit drug use associated with impairment at work and with substance misuse disorders
- Urine can miss very recent use of cannabis by a previously abstinent person and thus the use of both urine and oral fluid provides the greatest level of assurance and could be indicated in selected circumstances eg targeted or post-incident testing

Casolin A. Comparison or urine and oral fluid for workplace drug testing. Journal of Analytical Toxicology, 2016;40:479–485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AS/NZS4308:2008

IMMUNOASSAY SCREENING TEST CUT-OFF LEVELS

Class of drug*	Cut-off level, µg/L
Amphetamine type substances	300
Benzodiazepines	200
Cannabis metabolites	50
Cocaine metabolites	300
Opiates	300

CONFIRMATORY TEST CUT-OFF CONCENTRATIONS (AS TOTAL DRUG)

Compound	Cut-off level µg/L
Codeine	300
Morphine	300
6-Acetylmorphine*	10
Amphetamine	150
Methylamphetamine	150
Methylenedioxymethylamphetamine	150
Methylenedioxyamphetamine	150
Benzylpiperazine*	500
Phentermine*	500
Ephedrine*	500
Pseudoephedrine*	500
11-nor-delta-9-tetrahydrocannabinol-9-carboxylic acid	15
Benzoylecgonine	150
Ecgonine methyl ester	150
Diazepam	200
Nordiazepam	200
Oxazepam	200
Temazepam	200
α-hydroxy-alprazolam	100
7-amino-clonazepam	100
7-amino-flunitrazepam	100
7-amino-nitrazepam	100

AS4760:2006

NON-IMMUNOASSAY INITIAL TEST AND CONFIRMATORY TARGET CONCENTRATIONS

Compound	Target concentration ng/mL
Morphine	25
Codeine	25
6-Acetyl morphine	10
Amphetamine	25
Methylamphetamine	25
Methylenedioxymethylamphetamine	25
Methylenedioxyamphetamine	25
Δ9-tetrahydrocannabinol	10
Cocaine	25
Benzoylecgonine	25
Ecgonine methyl ester	25