Research Publication

Saliva Testing for Illicit Drug Use Among Offenders: A trial initiative in New South Wales

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Research Publication No. 46
August 2004
ISSN 0813 5800

NSW Department of Corrective Services

ACKNOWLEDGEMENTS

The current study was initiated by Community Offender Services of the New South Wales Department of Corrective Services and funded through the New South Wales Drug Summit. The following contributions are appreciated.

The trial was overseen by a working party of Departmental representatives. The working party consisted of Leon Larkin, District Manager, Probation and Parole, Lyn Cartwright, Senior Correctional Officer, Corrections Intelligence Group, Melanie Martinus, Unit Leader, Intensive Supervision, Paul Finlay, NSW Coordinator, Alcohol and Other Drugs, HIV and Health Promotion Unit, Elizabeth Fitzsimmons, Manager, Bolwara Transitional Centre, Glenda Bryce, Senior Correctional Officer and Maria Kevin, Senior Research Officer, Corporate Research, Evaluation and Statistics Unit (CRES), who also supervised the research. Jolie Hutchinson, Research Analyst (CRES) assisted with statistical analysis. Simon Eyland, Director of CRES provided critical review of the report.

The valuable contributions of the offenders and staff who participated in the study are appreciated.

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Background to the study

The current trial of a propriety saliva drug testing system was initiated by Community Offender Services (COS) and funded through the NSW Drug Summit to investigate an alternative to the existing drug detection method used by the NSW Department of Corrective Services (DCS). This need arose due to certain operational limitations associated with the use of urinalysis as the sole method of detection. The evaluation of the trial investigated the overall efficacy of a saliva drug testing system when compared with urinalysis and surveyed the perceptions of participating staff and offenders.

The operational components of the trial were managed by a departmental working party. This included negotiations with the supplier of the Cozart Rapiscan saliva testing system, the development of procedural guidelines for test administration by staff and training of staff. DCS and the supplier of the technology entered into an agreement concerning issues of confidentiality as well as the ownership, storage and use of test data. The legal agreement was prepared by DCS Legal Services Division.

Method

The trial was conducted in the first half of 2004. Five sites were involved encompassing correctional and community operations as well as metropolitan and regional sites. Staff collected saliva samples from offenders who agreed to participate after they had first been identified to provide a urine sample for drug testing according to established policy. Offender participation was voluntary and no action was taken if the saliva test indicated illicit drug use. Biological samples *(saliva and/or urine*) were collected from 122 offenders of whom 48% were inmates serving custodial sentences with 52% being community-based offenders. A total of 320 on-site saliva tests, 315 urinalysis and 124 saliva confirmatory tests were completed. A confirmatory test involves laboratory-based verification of the screening test result. Staff (n=20) and a randomly selected sub-sample of offenders (n=49) were surveyed by the researcher on their perceptions of the respective procedures. Self-reported drug use was collected on the offenders surveyed (n=49).

Results

Comparing saliva test and urinalysis results

The median collection time for a saliva sample was six minutes compared to five minutes for a urine sample. The median time to obtain an on-site saliva test result was 20 minutes. It took a median of 12 days for the return of a saliva confirmatory test result from the laboratory compared to 10 days for a urinalysis result. It should be noted that when an offender is unable to provide a urine sample an extended supervised waiting period of up to two hours may incur which would increase urinalysis collection time significantly. This contingency was not captured in the above data.

Five drug classes were examined in the saliva trial *(cannabis, heroin, cocaine, amphetamines and benzodiazepines*). Of the 320 on-site saliva tests, 17% showed a positive result for at least one of the five drugs. Of the 315 urinalysis tests, 37% showed a positive result and of the

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124 saliva confirmatory tests, 17% showed a positive result.

Drug use was detected in 36% of the community-based on-site saliva tests compared with 8% of custodial-based tests. Of community-based offenders tested, 48% returned a positive on-site saliva result on at least one occasion compared with 19% of custody-based offenders.

Urinalysis was used as the reference standard against which the on-site saliva test was compared. The statistical tests *(Kappa)* showed that the level of agreement was good for opiates and amphetamines *(κ=0.66 and 0.51 respectively)*. There were markedly lower numbers of positive on-site saliva test results for cannabis when compared with urinalysis. The level of agreement was considered poor for cannabis *(κ=0.30)* and benzodiazepines (κ=0.16). The overall low number of positive cocaine results limited comparison. That said, cocaine was the only drug for which the saliva test detected more positive results than urinalysis (four versus three occasions). Less saliva samples were sent for confirmatory testing than was anticipated and numbers of positive results were low. Insufficient volumes in saliva specimens appeared to adversely affect confirmatory analysis.

Other studies reviewed have shown higher levels of agreement between saliva testing and urinalysis. It is also important to highlight that saliva and urine have different window periods of detection. Urinalysis has a longer window period of detection (once a drug is metabolised) whilst saliva has the advantage of detecting more recent drug use.

Self-reported drug use

The trial was successful in capturing a 'drug using' sample. Cannabis was the most commonly reported drug with 71% of the sample disclosing use within the past 12 months. Heroin and amphetamine use within the last year was reported by 49% and 45% of the sample respectively. Of those who reported drug use, 34% disclosed having used more than one 'heavy-end' drug *(heroin, amphetamines or cocaine)* within the last year.

Staff attitudes towards saliva testing

Although urinalysis was the most commonly preferred testing method *(just less than half of responses)* by the entire staff sample that participated in the trial, opinion was fairly evenly spread with almost one-quarter of staff undecided. When preference was examined by jurisdiction, almost three quarters of custodial-based staff indicated a preference for saliva testing. The perceived advantages with saliva testing were:

- immediacy of results;
- non-invasive nature of sample collection.

More than half the community-based (COS) staff preferred urinalysis and just under half were undecided. It should be noted that some COS offices outsourced urinalysis, but for the trial were required to administer saliva tests on-site, which may have influenced preference. Also, some staff expressed concerns over the accuracy of saliva testing. Given the nominal size of the sample and the lack of a clear trend in preference, details on satisfaction levels with specific components of the trial proved more informative. Most participants indicated being satisfied with both saliva testing

and urinalysis in regard to operating the equipment, instructions for testing and the training received. However, when compared with urinalysis, staff were less satisfied with the saliva procedure on all of these factors. Staff were most commonly dissatisfied with the time taken to obtain a result for both procedures with urinalysis rated as the more unsatisfactory of the two procedures. Concerning collection time and the attitude of offenders, staff showed higher levels of satisfaction with the saliva testing system.

Offender attitudes towards saliva testing

Almost 70% of the offenders interviewed indicated an overall preference for saliva testing with no differences across gender or location. Across all components of the trial offenders reported to be markedly more satisfied with saliva testing when compared with urinalysis. Offenders preferred saliva testing due to the relative ease of providing a sample and the shorter time required. The less intrusive nature of the saliva testing procedure was also noted as an advantage. Disadvantages with saliva testing included concerns over the accuracy of the procedure and the potential for the sample to be used for DNA testing. Most offenders noted no advantages with urinalysis. Of those who did, speed of sample collection and the potential for offenders to adulterate samples thereby avoiding drug detection were the most commonly noted advantages with urinalysis.

Cost comparison between saliva testing and urinalysis

In comparing costs, estimates were calculated based on the number of tests conducted during the trial. The manufacturer has advised that costs for saliva test kits would reduce as volume increases and that the testing machines could be rented. Even including these reductions, it appears that urinalysis is the more cost effective method of drug detection.

Conclusions

Whilst the projected number of tests to be conducted was not reached within the time frame of the trial, in general terms the saliva testing procedure was found to be operationally feasible. Saliva testing was found to have greater utility in certain contexts. In terms of accuracy of test results, the overall level of concordance between saliva and urinalysis *(the reference standard)* was moderate at best. Yet, the low number of total positive results obtained from this study limits conclusions on the accuracy of saliva testing per se.

Advantages were identified with the on-site saliva test with regard to collection issues. Whilst offenders highly endorsed the use of the testing system there were some reservations amongst staff, particularly those supervising offenders in the community. Further training of staff and modification of the Standard Operating Procedures may address these concerns. The trial identified some problems that would need to be resolved for future implementation. These included the collection of an insufficient volume of saliva for confirmation testing and chain of custody disruption.

Saliva testing may have utility within corrections-based drug detection programs despite the higher costs compared with urinalysis, yet further trials would need to be conducted to enable stronger conclusions. If offenders

are suspected of using illicit drugs other than cannabis, or if the detection of cannabis is not considered a priority, the application in a correctional setting should be considered, particularly where cross-gender testing is required. This technology could also be applied in situations where detection of current drug impairment is important or where the offender is unable to provide a urine sample on request.

RECOMMENDATIONS

Current findings indicate that urinalysis should be maintained for routine drug screening and that saliva testing may have application in specific contexts. The following recommendations relate to steps that should be taken in relation to the continuation of trialling this technology as part of the Department's drug detection strategy.

Future Directions of the Trial

1. The saliva testing trial be continued across limited sites and within limited contexts to allow a longitudinal evaluation that includes the testing system's application in case management.

2. Establishment of a dedicated project position to oversee the extension of the trial.

3. An investigation be undertaken of alternative saliva testing systems available within Australia. Alternative laboratories be approached to identify both technical issues and costs that apply to saliva confirmation testing to determine compliance with accepted standards.

4. Field staff called upon to administer saliva tests should receive intensive and ongoing training with the testing system. The operation manual be modified to improve clarity and a quick reference instruction document be provided for field staff.

5. Two saliva samples per offender be collected at the same point in time to overcome problems associated with an insufficient saliva sample for confirmation testing and chain of custody disruption. The packaging of the samples be observed by the offender and the chain of custody seals signed.

Overall Utility

6. Current findings indicate that saliva testing may complement urinalysis in the following specific contexts:

   - targeting suspected use of opiates, amphetamines and cocaine;

   - as a measure of current impairment as saliva testing has greater potential in the detection of very recent drug use and results can be obtained immediately. Such situations may include safety and suitability assessment concerning work duties (machine operation) and special leave;

   - where immediate results would inform case management decisions such as in drug free wings/therapeutic communities and in Probation & Parole District Offices;

   - where currently no drug testing facilities exist, particularly in rural community locations;

   - targeting the above specific drugs where staffing resources have limited drug testing (e.g., cross gender testing) and where inmates are unable to provide a urine sample.

Introduction

Correctional administrators typically employ a number of strategies to control the supply and use of illicit drugs within their jurisdiction. Across jurisdictions, one of the primary strategies used to meet this goal is the screening of urine for illicit drugs. The objectives of drug-testing usually fall within one, if not all, of the following categories:

- deter the demand for drugs and illicit drug use by offenders;
- identify offenders who should be receiving treatment and monitor their progress;
- reduce offending behaviour through the monitoring of treatment attendance and progress and responding with appropriate case management strategies;
- basis for appropriate legal decisions in offender management in the areas of placement, classification, supervision orders and review of the same.

In early 2004, the New South Wales (NSW) Department of Corrective Services (DCS) commenced a trial in the use of a saliva testing procedure, funded under the NSW Drug Summit. Some shortcomings had been identified with urinalysis, the existing drug detection method. Further, technology now allows an on-site drug screening procedure through the collection of a saliva sample. The current research project investigated the strengths and limitations of a particular saliva testing system (Cozart Rapiscan) with a correctional population.

1.1. Methods of drug detection

Detection of illicit drug use can be achieved by various means that include self-report measures and the analysis of biological specimens. Richter and Johnson (2001) noted that advantages of self-report data include the ease at which it is administered to large groups across different locations, the data is easy to quantify and analyse and it is relatively inexpensive. It has been observed that the accuracy of self-reported drug use is "a function of the social, occupational, legal and/or financial cost of admission as perceived by the individual" (Rouen, Dolan and Kimber 2001, p.1).

The reliability of self-reported drug use amongst people under the supervision of the criminal justice system is influenced by a number of variables. Research into drug use by inmates in both NSW and Scotland would suggest that self-reported drug use is a reliable measure when there are no adverse consequences to disclosure (Kevin, 2000; Kevin, 2003; Neale and Robertson; 2003). Makkai (2000) cited previous studies where self-reported drug use was considered both reliable and unreliable in measuring drug use. It would appear that when detection of drug use is being undertaken for legal supervision purposes and where sanctions may result if drug use is detected, objective measures would be the most appropriate method of drug detection.

The analysis of biological samples (urine, blood, saliva, sweat and hair) is considered to be the most objective method of drug detection with urine the

most widely used (Rouen, Dolan and Kimber, 2001). However, biological samples, particularly urine, blood, saliva and sweat, are eliminated from the body over time. Accordingly, analysis of these samples is not absolute in being able to detect drugs unless employed on a frequent basis. Such a program would be prohibitively expensive with offender populations.

Urinalysis has several advantages. It is an established procedure that is cost effective with accredited laboratories and expertise available in Australia. In addition, drugs and/or metabolites occur in high concentrations in urine (Rouen, Dolan and Kimber, 2001). That said, correctional systems have identified problems with the use of urinalysis which include:

- delays in obtaining results;
- intrusion of privacy;
- inability of some offenders to provide a urine sample under supervision ('shy bladder');
- gender matching of staff and offenders;
- potential for substitution and adulteration;
- short window of detection;
- no correlation with observed impairment.

Generally, the time that drugs can be detected after ingestion (window period) varies according to characteristics of the individual and the type and quantity of drug ingested (Makkai, 2000). Average detection times for illicit drugs in urine are presented in Table 1.

Table 1. Average detection times for drugs in urine (Makkai, 2000).

Drug Class	Average detection time
Amphetamines	2-14 days
Benzodiazepines	2-14 days
Cannabis	2-30 days
Cocaine	3-36 hours
Opiates	2-3 days

1.2. Technical issues

The testing of biological samples for drugs of abuse is a two-step process: first a screening test followed by a confirmatory test if the initial test is positive (Makkai, 2000). The technique most commonly used for screening tests is immunoassay. Immunoassay kits contain a precise quantity of a drug or metabolite which is labeled and a precise quantity of antibodies designed to detect and destroy the drug. When a biological sample is added, both the drug in the sample and the labeled drug compete to bind with the limited antibodies. Any labeled drug that has not bound to the antibodies would be detected resulting in a positive result. If no labeled drug remains the test would be negative.

Screening tests are designed to be sensitive in that they are able to detect broad classes of drugs and consequently minimise false negative results (Rouen, Dolan and Kimber, 2001). Sensitivity refers to the ability of a test to identify those individuals who have used the drug for which they are being tested (Richter and Johnson, 2001). Screening tests can however, result in false positive

results such as when the ingestion of certain cough medicines returns a positive result for amphetamines.

Specificity refers to the ability of a test to correctly return a negative result when an individual has not used the drug being tested (Richter and Johnson, 2001). Logically, confirmation tests should have high specificity and equal or greater sensitivity than the screening test. For confirmatory analysis, gas chromatography with mass spectrometry (GC-MS), has become the gold standard in forensic drug environments with immonoassays generally recognized as less sensitive (Rivier, 2000). GC-MS is a highly sensitive test, minimising false negative results. Gas chromatography is the process where components of a sample are shattered into separate parts. A mass spectrometer is then used to identify the unique fragmentation pattern of the compound which is compared to established standards to identify the drug present (Rouen, Dolan and Kimber, 2001).

Drug testing involves the determination of specific drug concentrations in a sample. With urinalysis, there are recommended minimum levels of drug concentrations for which drugs can be detected, referred to as the cut-off. The cut-off level is typically the lowest level at which a drug or metabolite can be reliably detected by a test in a biological specimen (Makkai, 2000). While the analysis of a biological sample is performed according to the actual concentration of drugs in a sample, the reporting of the result is qualitative, i.e. positive or negative. Sensitivity and cut-off levels are related as the level of detection can influence the number of false positive and false negative results. Makkai (2000) noted that in determining the cut-off level for a test, four criteria should be considered:

1. the level should enable the detection of recent, casual drug use;

2. the level should be high enough to eliminate analytical noise;

3. the level should be high enough to rule out passive exposure;

4. confirmation levels should be lower than screening levels.

It is informative to note that in the current review, published studies used the same cut-off levels for screen and confirmation tests on saliva specimens. As stated previously, cut-off levels can vary according to the technology being used and also according to the biological sample being analysed (see Table 3). Drug detection in urine is generally achieved by measuring the breakdown products of drugs (metabolites) while blood and saliva generally detect the parent drug. This highlights the difficulty and complexity when comparing results across different technologies and biological matrices (specimen type).

1.3. Alternatives to urinalysis: other biological specimens for drug detection

Drug use can be detected by the analysis of hair, sweat and saliva, all of which are reported to be non-invasive in terms of sample collection but which offer other advantages and disadvantages relative to each other and urinalysis (Rouen, Dolan and Kimber, 2001).

Hair analysis has the advantage of being able to detect drugs for the longest period of time compared with other techniques. Problems with hair analysis include reliability, accuracy, complexity in interpretation of results, economic cost and that limited facilities exist in Australia (Rouen, Dolan and Kimber, 2001). The authors also reviewed sweat as an alternative biological matrix in drug detection concluding that it is potentially cost effective and suitable for continuous testing over longer periods than urine and saliva. However, there are also limited facilities in Australia for this matrix and the patch used to collect sweat may be susceptible to environmental contamination and accidental or deliberate removal.

1.4. Saliva testing

A number of on-site saliva drug testing systems have been developed (Samyn, Viaene, Vandevenne and Verstraete, 1999). Police and Probation Services in the United Kingdom have initiated trials of on-site saliva testing for arrestees and convicted offenders (Matrix MHA and Nacro, 2003). Rouen, Dolan and Kimber (2001) provided a review of on-site saliva testing devices that are available. A number of advantages with testing for drugs in saliva have been identified (Kidwell, Holland and Athanaselis, 1998; Speckl, Hallbach, Guder, Meyer and Zilker, 1999; Yacoubian, Wish and Perez, 2001; Rouen, Dolan and Kimber, 2001) which include:

- ease of collection;
- resistance to adulteration;
- potential correlation with observed impairment;
- test administrators and recipients prefer saliva testing over urinalysis;
- saliva testing overcomes the 'shy bladder' where people are unable to provide a supervised urine sample on request;
- saliva can be stored at room temperature without the need for refrigeration.

Generally, when compared with urinalysis, saliva testing provides a limited amount of biological sample, drug concentrations are lower and the major compound detected is the parent drug not the metabolite (Rivier, 2000). While saliva samples are reported to be less vulnerable to adulteration compared to urinalysis, false negative results are possible by adding citric acid to the mouth or affecting saliva flow (Rivier, 2000). Further, Cone (1993) reported that the detection of cannabis in saliva is due to debris of the drug remaining in the oral cavity, so presumably rinsing the mouth could avoid detection. Other disadvantages with saliva testing are the increased expense compared to urinalysis (Kidwell, Holland and Athanaselis, 1998), the lack of application in testing for benzodiazepines (Cone, 1993) and the relatively short window of detection (Rouen, Dolan and Kimber, 2001). The average detection times for drugs in saliva are presented in Table 2.

Yacoubian, Wish and Perez (2001) conducted a study that compared saliva testing to urinalysis on an arrestee population. The method the authors used to evaluate the accuracy of saliva testing was to determine its sensitivity and

specificity compared to a reference standard presumed to be more accurate. Sensitivity was measured as the proportion of positive saliva drug tests compared to the total number of positive results as identified by urinalysis. Specificity was calculated as the proportion of negative saliva tests compared to negative urinalysis results. For cocaine, the saliva test was 100% sensitive and 99% specific. For opiates, the saliva test was 88% sensitive and 100% specific. Cannabis was reported to be only 5% sensitive.

Table 2. Average detection times for drugs in saliva.

Drug Class	Average detection time
Amphetamines	48 hours
Benzodiazepines	60 hours
Cannabis	2-10 hours
Cocaine	3-6 hours
Opiates	4-8 hours

Source: (Cone and Weddington, 1989 and Cone, 1993)

Wish and Yacoubian (2002) reported similar results to the above study when they compared test results of saliva samples with urine samples collected at the same time for an arrestee population. Saliva test sensitivity and specificity for opiates and cocaine were reported to be high, yet for cannabis sensitivity was low at 56%. Verstraete and Puddu (2000) reported that for a test to be considered good, sensitivity and specificity should be 90% or greater.

Speckl, Hallbach, Guder, Meyer and Zilker (1999) compared saliva and urine in the detection of opiates by GC-MS amongst patients participating in drug withdrawal therapy. Opiates were detected in urine from two to eight days after withdrawal, while in saliva opiates were detected from one to four days after withdrawal. Nevertheless, the investigators concluded that the concordance between urine and saliva was high and that the advantages with saliva testing as regards to collection issues were significant. It is noteworthy that the reported detection time for opiates in saliva exceeded the average time as shown in Table 2 which demonstrates the variance in the estimates reported to date.

1.5. The saliva testing system

Saliva testing during the current trial was conducted with the Cozart Rapiscan system. Samyn, Viaene, Vandevenne and Verstraete (1999) conducted an investigation into on-site drug screening equipment and provided an inventory and assessment of different systems. The Cozart Rapiscan system was reported to be non-invasive, resistant to sample adulteration and able to detect recent drug use. It was also reported that the testing system was able to provide test results within 10 minutes, the interpretation of results was objective and that storage of results was possible. However, this system was considered to be relatively expensive and that collection, preparation and testing of samples involved complicated procedures. The authors reported that cut-off levels calibrated for cannabis were high, resulting in increased numbers of false negative results. Rouen, Dolan and Kimber (2001) reported a similar assessment of the Cozart Rapiscan system.

Moore, Wicks, Spiehler and Holgate (2001) investigated the sensitivity and specificity of the Cozart on-site system for methadone and opiates versus

laboratory based immunoassay and GC-MS confirmation. They reported sensitivity as 100% (± 12%) and specificity as 92% (± 3.2%) for opiates compared to GC-MS. Jehanli, Brannan, Moore and Spiehler (2001) tested the sensitivity and specificity of the testing system for codeine and cannabis versus laboratory based immunoassay and GC-MS confirmation. Sensitivity and specificity for codeine compared to GC-MS were both reported to be over 90%. Cannabis was detected in the saliva of participants for only two hours after smoking a marijuana cigarette. Lewis (2001) reported that drinking removes cannabis from the oral cavity which could explain why saliva-testing devices generally have low sensitivity for this substance.

Previous research into the use of saliva testing in the detection of drugs has highlighted a number of advantages in the use of this biological specimen, particularly in regard to collection issues. While there are few empirical studies, it has been reported that for 'heavy-end' drugs, saliva testing is generally accurate, while results for cannabis have been less convincing. There are limited on-site saliva testing systems available for use in Australia, yet reviews of the specific system used during the current trial are consistent with the general empirical findings.

1.6. Drug detection in the New South Wales correctional system

DCS introduced a mandatory urine drug-testing program in prisons in 1988. The aim of the program was to reduce illicit drug use in prisons, reduce the negative effects of drug dealing and drug-induced behaviour, control the spread of infectious disease and to refer drug users to treatment programs. Drug use or failure/refusal to provide a urine sample generally results in a misconduct charge and the deprivation of privileges.

Community Offender Services (COS) supervises offenders in the community under terms and conditions imposed by the Court as an alternative to a custodial sentence. COS also provides courts and the New South Wales Parole Board with recommendations for sentencing and release from custody.

COS conducts urine drug testing on offenders subject to supervision. COS policy dictates that offenders granted parole should undertake urinalysis within the first two weeks of their release from prison, thereafter on two occasions during the first six months of supervision. Offenders subject to Court imposed orders with a urinalysis condition should undertake urinalysis at least once during supervision. Offenders subject to Intensive Supervision (offenders serving sentences in the community whose movements are restricted and tracked with monitoring devices) are drug tested if they have a history of illegal drug use or are suspected of such. When offenders are identified as having used illicit drugs they may be encouraged to address their drug use and/or have breach or revocation action instituted.

Within COS, urine sample collection and testing methods are not standard. Some COS offices collect supervised urine samples, others refer offenders to a pathology service either directly or via a medical practitioner and others obtain results from drug treatment clinics. Some COS offices, particularly in

regional areas, have no access to urinalysis facilities.

1.7. Legislation

The current legislation regarding drug testing by DCS refers specifically to urinalysis as the method of drug detection to be employed (Crimes (Administration of Sentences) Regulation 2001). As saliva test results obtained during the current trial were not used in case management decisions, regulations to the legislation were not required to be amended. If DCS were to adopt saliva testing in the future, changes to the regulations would be required to cover either saliva testing specifically or alternative methods to urinalysis in general.

1.8. Rationale

The current trial was initiated by COS and funded through the NSW Drug Summit with a view to overcoming some of the limitations that had been identified with urinalysis. The problems identified with urinalysis are mainly in relation to collection issues, such as the difficulty in obtaining urine samples in certain instances. The evaluation of the trial investigated staff and offender perceptions towards saliva testing and the operational and clinical impact of the introduction of this new procedure. Ultimately, the degree to which a drug detection procedure is able to correctly identify offenders who have used illicit drugs will determine its utility within correctional environments. This was explored by comparing the results from saliva tests and urinalysis.

The operational components of the trial, such as negotiations with the supplier of the Cozart Rapiscan saliva testing system, the development of procedural guidelines for test administration and the training of staff were managed by a Departmental working party. DCS and the supplier of the technology entered into an agreement concerning issues of confidentiality and the ownership, storage and use of test data. The agreement was prepared by the DCS Legal Services Division.

2. Method

2.1. Aim

The current evaluation covered two broad areas:

1. investigation of the efficacy of the on-site testing system and laboratory confirmation testing in comparison to urinalysis;

2. investigation of the experiences of participating staff and offenders.

2.2. Objectives

The evaluation was divided into five phases. The specific objectives of the evaluation were to:

i. examine the accuracy of saliva drug test results when compared with urinalysis as the reference standard;

ii. compare times for testing procedures and the return of results between the saliva test and urinalysis;

iii. examine the level of endorsement for saliva testing by staff and offenders;

iv. identify any problems associated with the saliva testing technology within the DCS context;

v. identify differences in saliva testing between community and correctional contexts;

vi. undertake a cost comparison between saliva testing and urinalysis.

2.3. Sampling and procedure

Five sites were involved in the trial to obtain a cross-section of centres administered by DCS, including two prison-based pre-release drug treatment programs and three community operations. Two Intensive Supervision sites were involved where the participating offenders were serving community-based sentences by way of home detention. Metropolitan and regional centers were also represented. The two custodial sites were Bolwara Transitional Centre (female inmates) and Ngara Nura (a residential drug treatment program for male inmates at Malabar Special Purpose Centre) and the three community sites were City Intensive Supervision, Maitland Intensive Supervision and Gosford District Office. Participants in the evaluation were DCS staff who administered the saliva tests, offenders drug tested and relevant DCS management and union branches.

Saliva samples were collected from offenders who agreed to participate in the trial after they had been identified to provide a urine sample for drug testing according to established policy. Participation was voluntary and no action was taken if the saliva test indicated illicit drug use. Offenders who agreed to participate in the trial were asked to sign a consent form that explained the trial and its purpose. Refusal to participate and the reasons for doing so were recorded.

Prior to the commencement of the trial some working party members attended

each of the sites to provide training in the testing system to participating staff. Each site was provided with Standard Operating Procedures (SOP) that outlined the tasks required by testers throughout collection and testing.

2.4. Phase one: sample collection

Saliva samples were collected by staff followed by the collection of urine samples either on-site or at an approved collection center. Saliva samples were collected, prepared, tested and packaged on-site in accordance with the SOP. Urine samples were collected and samples were sent to a pathology laboratory. Saliva samples were sent to a pathology laboratory for GC-MS confirmation testing. As stated above GC-MS is highly sensitive and generally accepted as the optimal analytical method. Cut-off levels for each testing method are presented in Table 3. While cut-off levels for confirmation testing should be lower or equal to screening levels this was not the case for opiates in the current study. In the current trial, the decision on confirmation cut-off levels was reportedly determined by the laboratory used. Currently there are no national standards or general published guidelines on screening and cut-off levels for saliva testing.

The majority of saliva samples sent for confirmatory testing were the result of positive on-site tests. Within cost constraints, a proportion of saliva samples with on-site negative results were subject to confirmatory testing to examine the incidence of false negative results. In the design stage of the trial, 400 on-site tests, 400 corresponding urinalyses and 200 confirmatory tests were planned. For operational reasons sample numbers for some sites were reduced. Finally, a total of 320 on-site tests, 315 urinalyses and 124 confirmatory tests were completed (n=65 false negative tests). Target and final sample numbers are presented in Table 4.

Of note is that positive urinalysis results also included prescribed substances whilst the on-site and confirmatory tests only returned results for five drug classes: cannabis, opiates, amphetamines, cocaine and benzodiazepines.

Staff administering the tests completed a data capture sheet that included: unique identification of offenders, site location, details of previous urinalysis results, identification of staff, collection times for urinalysis and saliva samples, testing times and results for the testing systems.

2.5 Phase two: experiences of participants

2.5.1. Offenders

A sub-sample of offenders who participated in the trial were asked to complete a questionnaire via face-to-face interviews with the researcher. Questionnaires were piloted on a nominal number of offenders (n=5) prior to the formal collection of data.

Sample numbers at each site were determined proportionate to the number of offenders participating in the trial at each site. The median time for interviews to be completed was 10 minutes. Sample numbers for each site are presented in Table 5.

Table 3. Cut-off levels for each testing method (ng/ml).

	Cannabis	Opiates	Amphet-amines	Cocaine	Benzodia-zepines
Onsite Test	50	10	15	10	10
Confirmation test	20	20	15	10	10
Urinalysis	15	300	300	300	200

Table 4. Targeted and final sample numbers for biological specimens by site.

	Target	Final
BOLWARA		
On-site tests	75	72
Confirmation tests	37	45
Urinalysis	75	76
NGURA NURA		
On-site tests	125	140
Confirmation tests	62	10
Urinalysis	125	145
CITY		
On-site tests	75	56
Confirmation tests	37	36
Urinalysis	75	48
GOSFORD		
On-site tests	50	16
Confirmation tests	25	7
Urinalysis	50	13
MAITLAND		
On-site tests	75	36
Confirmation tests	37	26
Urinalysis	75	33

Note: Five refusals were recorded for the saliva procedure.

As well as unique identification, location and demographic information, the questionnaire canvassed perceptions on the testing system in relation to the following specific issues:

- overall preference of drug detection method;
- rating of specific components of both saliva testing and urinalysis;
- advantages and disadvantages of each testing method;
- self-reported drug use.

Interviews were conducted at each site excluding participants subject to Intensive Supervision in which case interviews were conducted at participants' homes. Offenders were initially asked by staff to participate in the interview process. The researcher subsequently requested participation after explaining the purpose of the interview. Offenders who agreed to participate were assured of confidentiality and all interviews were conducted in a private setting.

Table 5. Sample numbers for offenders interviewed by site.

Site	Number
Bolwara	9
Ngara Nura	15
City	9
Gosford	7
Maitland	9
Total	**49**

Note: one offender refused to participate

2.5.2. Staff

Staff involved in the trial were asked to complete a questionnaire (n=20). Questionnaires were piloted on a nominal number of staff (n=5) prior to the formal collection of data. Staff completed the questionnaire at their work location with the researcher present. The median time taken for staff to complete the questionnaire was 15 minutes. The questionnaire canvassed staff perceptions in relation to the following areas:

- overall preference of drug detection method;
- advantages and disadvantages of each testing method;
- rating of specific components of both saliva testing and urinalysis;
- suggestions for future implementation.

2.6. Phase three: site inspections

Site inspections were carried out to assess compliance with the SOP. A checklist was developed covering the major SOP and the researcher observed collection and testing of saliva samples at each site (n=15 testing occasions). The checklist covered the following aspects of procedures that staff were required to follow:

- explanation of trial and consent documentation;
- collection and storage of saliva samples;
- recording of identification details;
- compliance with chain of custody procedure;
- checks of the testing system;
- saliva testing and recording results;
- sample packaging and delivery to pathology laboratory.

2.7. Phase four: feedback from management and union branches

Relevant DCS management and union representatives were invited to table submissions in order to canvas views on the feasibility of the saliva testing procedure.

2.8. Phase five: data analysis

Data analyses were predominantly descriptive. Descriptive statistics were derived from staff and offender perceptions and qualitative data were content analysed. Kappa statistics (κ) were obtained to test the degree of agreement between urinalysis results and saliva test results. When κ is greater than 0.75 there would be excellent agreement between tests, when κ is less than 0.75 but greater than 0.4 the agreement is considered good and when κ is less than 0.4 the agreement between tests is poor (Woodward, 1999). Sensitivity and specificity for the saliva tests were calculated as compared to urinalysis (the reference standard). SPSS (Statistical Package for the Social Sciences) and SAS (Statistical Analysis System) were used for the statistical analyses.

3. Results

3.1 Demographics

The biological data were obtained from a sample of 122 offenders, 87 males (71%) and 35 females (29%). The age of participating offenders ranged from 20 years to 50 years with an average age of 30 years. Of the sample, 48% (n=59) were inmates serving custodial sentences and 52% (n=63) community-based offenders.

Offender survey data were obtained from 49 offenders, with 49% serving custodial sentences and 51% serving sentences in the community. Of the offenders surveyed, three quarters were male. Survey data were obtained from 20 staff members of whom half were custodial and half community-based.

3.2. Staff attitudes on saliva testing

Although urinalysis was the most commonly preferred testing method *(just less than half of responses)* by the entire staff sample that participated in the trial, opinion was fairly evenly spread with almost one-quarter of staff undecided. When preference was examined by jurisdiction, almost three quarters of custodial-based staff indicated a preference for saliva testing. More than half the community-based (COS) staff preferred urinalysis and just under half were undecided. The fact that some COS offices outsourced urinalysis testing would have had a confounding effect on comparison results for community-based staff. Table 6 provides a selection of quotes from staff that highlight the themes put forward on each testing method.

3.2.1. Perceived advantages with saliva testing

The most common advantages identified by staff with saliva testing were the immediacy of results and the non-invasive nature of sample collection. Other advantages as perceived by staff included the ability for cross-gender drug testing (noted only by community-based staff), time efficiency of sample collection, the perception that saliva is less susceptible to adulteration and that a supervised urine collection procedure is avoided.

3.2.2. Perceived disadvantages with saliva testing

The major disadvantages with saliva testing noted by staff sampled were concerns over the accuracy of the testing system, the time required to collect and test the sample and that the testing equipment and procedures were complicated. Two community-based staff members trained in the use of the testing system chose not to participate in the trial. The reasons they gave were that the procedure took too long, particularly given the high workload levels perceived by these staff members. It was also noted that the SOP were unclear and too detailed and that the testing procedure was complicated.

3.2.3. Perceived advantages with urinalysis

Accuracy and reliability were the major advantages noted by staff in regard to urinalysis. Other advantages noted were that the process is considered to be less time consuming and sample collection is a simple procedure (community only).

Table 6. Quotes from staff on the advantages and disadvantages of both saliva testing and urinalysis.

ADVANTAGES WITH SALIVA TESTING

"If you believe someone to be drug affected the procedure would give you an immediate result."

"It allows for human dignity."

"Simplified testing method. Don't need to worry about client not producing urine."

"Don't need to worry about gender of client."

DISADVANTAGES WITH SALIVA TESTING

"More time consuming than urine testing – both at client's home and then analysing sample."

"Test equipment can fail and tests can be compromised."

"Not a long enough window period in which to identify drug use. As clients do not report at random (community-based supervision) it would be difficult to determine drug use."

ADVANTAGES WITH URINALYSIS

"Usually a quick operation especially if client is used to urinalysis."

"Current pathology unit provides a good, reliable service."

"Enables monitoring of cannabis reduction."

"Presents an easier option for Probation Officers as it is a simple matter of referral for testing."

DISADVANTAGES WITH URINALYSIS

"Perhaps more prone to adulteration / substitution…"

"The delay in receiving the results."

"Problems with obtaining samples if you're a female officer from a male client."

"Provision of sample can be lengthy, dependent upon persons being able to provide under supervised conditions."

3.2.4. Perceived disadvantages with urinalysis

The major disadvantage noted with urinalysis was the susceptibility of urine samples to adulteration or substitution. Other concerns included the time consuming nature of both collection and the receipt of results, problems associated with cross-gender testing and the intrusive nature of supervised urine collection.

3.2.5. Rating specific components of the trial

Given the nominal size of the sample and the lack of a clear trend in preference, details on satisfaction levels with specific components of the trial proved more informative (see Table 7). Most participants indicated being satisfied with both saliva testing and urinalysis in regard to operating the equipment, instructions for testing and the training received. Yet, when compared with urinalysis, staff were less satisfied with the saliva procedure on all of the above factors with about one third stating dissatisfaction across these factors. With respect to time to obtain a result, staff most commonly reported dissatisfaction on both procedures with urinalysis rated as the more unsatisfactory of the two procedures. When compared with urinalysis, staff showed higher levels of satisfaction with the saliva testing system in terms of collection time and the attitude of offenders. These cited advantages on the saliva testing system are consistent with the available literature.

Table 7. Staff satisfaction levels on components of the trial. [base=20]

	Saliva No.	**Urinalysis** No.
Training		
Satisfactory	10	11
Unsatisfactory	6	3
Unsure	4	2
No response	0	4
Instructions for testing		
Satisfactory	9	12
Unsatisfactory	7	2
Unsure	4	2
No response	0	4
Operating testing equipment		
Satisfactory	11	10
Unsatisfactory	7	3
Unsure	2	2
No response	0	5
Ease of testing		
Satisfactory	12	11
Unsatisfactory	5	6
Unsure	3	1
No response	0	2
Sample collection time		
Satisfactory	12	7
Unsatisfactory	7	9
Unsure	1	0
No response	0	4
Time to obtain results		
Satisfactory	7	5
Unsatisfactory	9	11
Unsure	4	3
No response	0	1
Offender attitude		
Satisfactory	17	6
Unsatisfactory	1	13
Unsure	1	0
No response	1	1

Table 8. Offender satisfaction levels for saliva testing and urinalysis on components of the trial. [base=49]

	Satisfactory		Unsatisfactory		Unsure	
	Saliva %	Urinalysis %	Saliva %	Urinalysis %	Saliva %	Urinalysis %
Instructions for Procedure	95.9	91.8	0	6.1	4.1	2.0
Level of comfort	91.8	18.4	8.2	77.6	0	4.1
Ability to provide sample	93.9	30.6	4.1	65.3	2.0	4.1
Time to provide sample	87.8	34.7	10.2	57.1	2.0	8.2
Perception of staff attitude	69.4	46.9	8.2	34.7	22.4	18.4

Note: four offenders refused to participate

Staff were asked to rate their overall job satisfaction to measure any relationship with their satisfaction of the trial. Of the staff sampled, nine out of ten rated their job as satisfactory. There were ten missing cases on this item which discounted further correlational analysis.

3.3. Offender attitudes on saliva testing

Of the sample of offenders interviewed (n=49), almost 70% indicated a preference to be drug tested with the saliva procedure. There were no differences in preference between inmates and community-based participants and there were no gender differences. Table 8 shows offender satisfaction levels for various components of the trial. Concerning the ability to provide a sample, a high majority (94%) indicated that they were satisfied with the saliva testing procedure when compared with urinalysis (31%). Of the sample, 88% were satisfied with the time it took to provide a saliva sample while 35% were satisfied with the time taken to provide a urine sample. The less intrusive nature of the saliva testing procedure was also noted as an advantage. Of the sample, 92% indicated they were satisfied with the level of comfort with the saliva test. In contrast, 78% of the offender sample indicated they were dissatisfied with the level of comfort for urinalysis. These results are consistent with the literature comparing saliva testing with urinalysis. Key disadvantages with saliva testing noted by offenders regarded concerns about the accuracy of the procedure and that the sample may be used for DNA testing. While most offenders noted no advantages with urinalysis, some did

Table 9. Self-reported drug use. [base=49]

	Used in the last 12 months		Median number of days last used	Used within window detection*	
	No.	%		No.	%
Cannabis	35	71.4	60	10	28.6
Heroin	24	49.0	90	1	4.2
Amphetamines	22	44.9	165	1	4.5
Cocaine	7	14.3	180	0	0
Benzodiazepines	15	30.6	90	3	20.0

* Base=those who used the drug in the 12 mths.

note speed of sample collection and the belief that urine samples could be adulterated to avoid drug detection as advantages. The most common disadvantage was the lack of privacy and intrusiveness of sample collection.

3.4. Self-reported drug use

Offenders were asked to report how many days prior to being interviewed they had used each of the five drug classes analysed by the testing system. Only drug use within the previous year was recorded. Table 9 shows self-reported drug use both within the last 12 months and within the accepted window period for detection with urinalysis as well as the median number of days since each drug was last used.

Cannabis was the most commonly reported drug with 71% of the sample disclosing having used it within the past 12 months. Heroin and amphetamine use within the last year was reported by 49% and 45% of the sample respectively. Of self-reported drug users, 34% disclosed having used more than one 'heavy-end' drug (heroin, amphetamines or cocaine) within the last year. Only two offenders from the sample disclosed 'heavy-end' poly drug use within urinalysis window detection periods.

Table 10. Paired urinalysis and self-reported drug use within urinalysis window detection periods. [base=42]

Cannabis		
	Self report drug use	
	Disclosed	Not disclosed
Urinalysis		
Positive	7	5
Negative	4	26
Opiates		
	Self report drug use	
	Disclosed	Not disclosed
Urinalysis		
Positive	0	4
Negative	0	38
Amphetamines		
	Self report drug use	
	Disclosed	Not disclosed
Urinalysis		
Positive	0	2
Negative	0	40
Cocaine		
	Self report drug use	
	Disclosed	Not disclosed
Urinalysis		
Positive	0	0
Negative	0	42
Benzodiazepines		
	Self report drug use	
	Disclosed	Not disclosed
Urinalysis		
Positive	0	0
Negative	0	42

Comparisons were made between self-reported drug use within the detection period and urinalysis (n=42) where there were paired results (both self-report data and a urinalysis result). Table 10 presents the paired urinalysis and self reported drug use for each drug class.

In reference to cannabis, urinalysis detected the drug on 12 occasions, seven of which matched with self-reported cannabis use and five occasions where participants did not disclose cannabis use. Interestingly, on four occasions participants disclosed cannabis use when urinalysis returned a negative result. While sample numbers were low, these results suggest that self-report might be a reasonably reliable indicator of cannabis use. It also highlights that while urinalysis is the standard against which other testing methods are judged, it may be susceptible to false negative results.

When considering only paired results for opiates and amphetamines, there were no instances where participants disclosed using these substances within the window period while a small proportion of opiate urinalysis results (n=4) and amphetamine urinalysis results (n=2) indicated drug use. While the numbers are very small, these results may indicate that self-reporting of 'heavy end' drugs may be less reliable than for cannabis. There were no instances of self-reported drug use or positive urinalysis results for cocaine and benzodiazepines in this sub-sample.

While some participants disclosed cannabis, opiate and benzodiazepine use within the window period, there were no positive on-site saliva test results when paired with self-report data.

3.5. Comparing saliva testing and urinalysis

The average times for collection and testing of samples and the return of both urinalysis and saliva confirmation results from pathology laboratories are presented in Table 11.

The median collection time for a saliva sample was six minutes compared to five minutes for a urine sample. Median time taken for an on-site test result was 20 minutes. The median number of days for a confirmatory test to be completed by the laboratory from the date of testing was 12 days. The median number of days for the return of a urinalysis result from the date of testing was 10.

Table 11. Median times for collection of samples, on-site testing and return of results.

	Median time
Saliva collection	5 minutes
Urine collection	6 minutes
Saliva testing	20 minutes
Saliva confirmation result	12 days
Urinalysis results	10 days

Despite the on-site test being able to provide results in an average of 20 minutes, this advantage would appear to be negated to some extent by the fact that positive results require confirmation. The confirmation time for saliva tests was similar to that for urinalysis. It should be noted that on occasions when inmates are unable to provide a urine sample upon request, a waiting period of up to two hours may incur. Such delays would considerably increase the time required for urinalysis.

This contingency is not captured in the above data.

Of the 320 on-site saliva test results, 17% (n=55) were positive for at least one drug. Of 315 urinalysis results, 51% (n=162) were positive for at least one drug *(including prescribed medication)* and 17% (n=21) of the 124 saliva laboratory results were positive for at least one drug. It should be noted that positive urinalysis results included additional prescribed medications while the on-site saliva and confirmatory tests only returned results for the five drug classes. When prescription drugs were excluded from urinalysis results, 37% of tests showed a positive result for at least one drug. Further, the above figures reflect the overall test result and not whether a sample was positive for more than one drug. This explains why the positive results shown in Table 12 provide different numbers of positive results.

Of the total number of on-site saliva tests conducted (n=320) 33.8% were from community-based offenders and 66.3% were from custodial-based offenders. Drug use was detected in 36% of the community-based on-site saliva tests compared with 8% of custodial-based tests. Saliva laboratory confirmation tests were conducted on 69 samples from community-based offenders from which 22% returned a result indicating drug use. There were 55 confirmation tests completed from custody-based offenders and 11% of those were positive.

Comparisons were made between community and custodial-based offenders testing positive with the on-site saliva test on at least one occasion. Of community-based offenders who were saliva tested (n=58), 48% returned a positive result. Predictably, of custody-based offenders who were saliva tested (n=58), a markedly lower proportion returned a positive result (19%).

Table 12 shows the total number of positive results for each of the drug classes used in the trial *(heroin, cannabis, amphetamines, cocaine and benzodiazepines*).

The on-site test and urinalysis showed similar rates of positive results for opiates and cocaine. When compared with urinalysis (15.9%), the on-site test (6.9%) showed a lower rate of detection for cannabis. The on-site test also returned a lower proportion of positive results for both amphetamines and benzodiazepines.

Positive results for the saliva confirmatory tests were low for most of the drug classes. This finding was unexpected as usually lab confirmatory testing using the GC-MS method is more sensitive in detection than the on-site method. The poor results were possibly due to insufficient volumes in saliva samples restricting complete analyses.

3.5.1. Urinalysis versus on-site saliva test results

Urinalysis was used as the reference standard against which both the on-site and the laboratory saliva tests were compared. Direct comparisons were made between testing methods when there were paired results. Sensitivity was calculated as the proportion of positive results identified by saliva testing compared to the number of positive results as identified by urinalysis.

Table 12. Numbers and percentages of positive results for each testing method for each drug class.

	On-site saliva (total=320 tests)		Urinalysis (total=315 tests)		Saliva laboratory (total=124 tests)	
	No.	%.	No.	%.	No.	%.
Opiates	29	9.1	31	9.8	16	12.9
Cannabis	22	6.9	50	15.9	2	1.6
Amphetamines	6	1.9	14	4.4	5	4.0
Benzodiazepines	6	1.9	19	6.0	0	0.0
Cocaine	5	1.6	3	0.9	1	0.8

Note: some tests indicated poly drug use.

Specificity was calculated as the proportion of saliva tests correctly identified as negative. A perfect test would correctly identify all positive samples (100% sensitivity) and all negative results (100% specificity). Sensitivity and specificity are considered very good at 90%.

Table 13 shows the level to which the on-site saliva test agreed with urinalysis, on both positive and negative results. Of the 30 urinalysis tests positive for opiates, 19 were also detected by the on-site saliva test, showing a sensitivity of 63%. Agreement between the tests was calculated as good for opiates according to the Kappa level. The statistical test results (Kappa statistic and confidence intervals) measuring the level of agreement between the on-site test and urinalysis are shown in Table 14. Of the 47 urinalysis tests positive for cannabis only 12 were detected in saliva. Both sensitivity (26%) and Kappa levels from the on-site saliva test were calculated as poor for cannabis. As reported previously, cannabis is detected in saliva from debris in the oral cavity so drinking or rinsing the mouth could affect the accuracy of saliva tests for this drug. The degree to which participants in the current trial cleared their mouth with liquid is unknown, though it was reported on some occasions.

The numbers of positive results for the remaining drug classes were low, making it difficult to draw meaningful conclusions. Based on these nominal numbers, sensitivity for amphetamines was 39% and the degree of agreement between tests was calculated to be good (see Table 14). Sensitivity for cocaine was 33% and the level of agreement between tests was poor. Of the 16 urinalysis tests positive for benzodiazepines, only two were detected by the on-site saliva test, resulting in a sensitivity of 13%. The level of agreement between the two tests for this drug class was poor. Specificity (matched negatives) for all five drug classes ranged from 98% to 100%.

Across the five drug classes there were 21 occasions where the on-site saliva test indicated drug use where urinalysis

returned a negative result. In the present study these saliva test results were classified as false positives with reference to urinalysis. However, it has been reported that an advantage of saliva testing is the ability to detect intoxication at the time of testing. Further, when a drug is detected in saliva it may be due to oral contamination indicating recent drug use. Therefore, some of these results may reflect the ability of saliva testing to detect recent drug use and a failure in urinalysis to do so. Nevertheless there were markedly more numbers of positive urinalysis results that the on-site test failed to detect (false negatives). Cocaine was the only drug for which the saliva test detected more positive results than urinalysis (four versus three occasions).

3.5.2. Urinalysis versus laboratory-confirmation saliva results

Less saliva samples were sent for confirmatory testing than was anticipated and consequently the numbers of positive results were very low (Table 12). Further, 1ml of saliva was required per drug in order to test at the published cut-off levels and this amount was not always provided or multiple drugs were required to be tested. On such occasions, cut-off levels were increased which may have affected test sensitivity and subsequently the ability to make conclusions about the accuracy of the confirmatory test.

Table 15 shows the level to which the saliva confirmatory test agreed with urinalysis on both positive and negative

Table 13. Level of agreement between on-site saliva and urinalysis test results (urinalysis is the reference standard). [base=298 tests]

	Matched positives (Sensitivity)		**Matched negatives** (Specificity)	
	No.	%.	No.	%.
Opiates	19	63.3	262	97.8
Amphetamines	5	38.5	284	99.6
Cocaine	1	33.3	292	99.0
Cannabis	12	25.5	244	97.2
Benzodiaze-pines	2	12.5	4	98.6

results. The sensitivity levels of the confirmatory test for each drug class were as follows: opiates (50%); amphetamines (33%); cocaine (50%); cannabis (4%); and benzodiazepines (0%). The low number of positive results for most drug classes limits conclusions based on the sensitivity of the confirmatory test. Specificity ranged between 98% and 100%.

Table 14. Kappa statistics and confidence intervals testing agreement between the on-site test and urinalysis.

	κ	**95% CI**
Opiates	.66	[.51, .81]
Amphetamines	.51	[.23, .79]
Cannabis	.30	[.14, .45]
Cocaine	.28	[.16, .72]
Benzodiazepines	.16	[- .06, .37]

Table 15. Level of agreement between saliva confirmatory and urinalysis test results. [base=107 tests]

	Matched positives (Sensitivity)		**Matched negatives** (Specificity)	
	No.	%.	No.	%.
Opiates	12	50.0	81	97.6
Cocaine	1	50.0	105	100.0
Amphetamines	4	33.3	95	100.0
Cannabis	1	4.0	81	98.8
Benzodiaze-pines	0	0.0	93	100.0

3.6. Site inspections

Site inspections were carried out during the trial to assess compliance with the SOP. In general, participating staff complied with the required procedures. The following problems were identified during the site inspections that would need to be considered if the saliva testing trial was continued or the procedure implemented:

- incomplete recording of data on the data capture sheet;
- insufficient explanation to offenders regarding the trial and consent to participate;
- packaging of the saliva sample after collection including having offenders sign the seal;
- accurate completion of the laboratory confirmation request form.

The above problems raise some important issues that would need to be addressed in future training programs. As missing data could potentially affect results the importance of accurate and complete recording of data should be highlighted.

Chain of custody is an important consideration so as drug test results and subsequent action can withstand legal scrutiny. It was observed on two occasions that staff did not have the offender sign the sealed sample container after collection. Even when this was done *(as testing was generally conducted at a later time and in the absence of the offender)* the seal needed to be broken to test the sample on-site. If the on-site test was positive, the container was then sent to the pathology laboratory with a broken seal. This flaw in the testing procedure would need to be overcome in practice, possibly by having two samples (stored in separate containers) collected for each offender at the same point in time.

Some sites experienced problems with the reliability of the testing machines on a number of occasions. It was reported that appropriate support was available from the manufacturer and that replacement of machine parts was provided when needed.

3.7. Cost comparison between saliva testing and urinalysis

In comparing costs, estimates for each testing technique were calculated based on 320 samples *(number of on-site tests conducted*). During the trial a total of 180 saliva confirmation tests were completed on individual drugs. Some DCS centers do not collect urine samples

but refer offenders to external agencies with no cost to the DCS. Therefore, the estimates for urinalysis provided here are not conservative figures and actual costs would be lower. Based on the estimates in Table 16 it is apparent that urinalysis is a more cost efficient method of drug detection.

Table 16. Cost estimates for the on-site test and urinalysis in AUD#.

On-site test	
Screening test kits*	$43.80 per sample
Confirmation	$75.00 per drug
Total for 320 tests	$27, 516
Testing machines* †	$8950 each
Total for 5 machines**	$44, 750
Urinalysis	
Lab. Analysis	$24.00 per sample
Consumables	$2.93 per sample
Courier	$14.30 per sample
Total for 320 tests	$13, 193

* cost reduces by volume
** machine rental is also available
† machine warranty is 12 months
[#GST not included]

The manufacturer has provided estimates on cost reduction per volume for the test kits and testing machines as well as pricing for rental of the testing machines. Test kits would be reduced to AU$36 each for purchases of greater than 10,000. Machine rental is AU$250 per month for less than 10 machines or AU$150 per month for more than 10 machines. The pathology laboratory that provided confirmation testing indicated that their costing had increased since the trial to AU$85 per drug tested. Despite the price reductions, urinalysis would still hold advantages in terms of the cost.

3.8. Feedback from management and union branches

Responses to a request for feedback by both local (n=5) and central management (n=3) as to the perceived impact of saliva testing were received from only two regional COS District Office managers. One of those offices has a urinalysis policy whereby staff collect a supervised urine sample that is sent to a pathology laboratory. This urinalysis program was reported to be successful with few problems concerning collection issues. The other office reported no current access to urinalysis or drug testing facilities and that management and staff would be interested in trialling saliva testing in the future.

The opinions of trade union representatives for Custodial Officers, Probation and Parole Officers and non-custodial staff were canvassed on the initiative (n=3). A response was received from the non-custodial representative who indicated that the relevant committee had no objections to the use of saliva testing by staff.

Discussion

There is a growing interest in alternative drug testing technologies in an attempt to overcome some of the inherent problems with urinalysis. The current study compared an alternative to urinalysis in the detection of illicit drugs by investigating both the accuracy of saliva testing and the level of staff and offender endorsement for the procedure in a criminal justice setting. This would appear to be the first empirical study on saliva testing that has included convicted offenders serving sentences under varying conditions, including community supervision, intensive supervision *(home detention)* and full-time imprisonment. Furthermore, saliva testing was compared to both a reference standard and self-reported drug use.

The study did not demonstrate the level of methodological control adopted by the more clinically-based trials reviewed in this report. The current trial examined the application of saliva testing in an operational context. The test was administered by the staff usually responsible for drug detection. Although saliva and urinalysis sample numbers were matched in a high majority of cases, the overall number of tests completed within the time-frame fell short of projections. Further, in accordance with policy, urinalysis testing covered a broader range of drugs than the saliva testing system on trial. Hence, at times, real-world interface offset methodological control. What the current trial did find was that saliva testing had operational utility within a correctional context and test accuracy levels proved satisfactory for some drug classes.

Operational feasibility

Clear advantages have been identified with the on-site saliva test in regard to collection issues. Saliva testing overcomes the invasiveness of urine sample collection and also overcomes the problem of offenders being unable or unwilling to provide a urine sample for analysis. When custody-based offenders report being unable to provide a urine specimen, correctional staff may spend hours supervising and waiting for the supply of a sample. This is clearly not resource efficient. Furthermore, a deficit with urinalysis specific to the context of intensive supervision *(home detention)* is that staff can only collect urine samples from offenders of the same gender. Saliva testing would appear to overcome this issue.

Offenders almost unanimously endorsed the use of saliva testing as an alternative to urinalysis. As previous literature has stated, urinalysis can be a humiliating experience. Some offenders reported being unable to provide a sample under supervision, a situation that can result in serious consequences. Arguably, some offenders may feign being unable to provide a sample to avoid drug detection or for other reasons, and in most cases saliva testing would appear to be a solution in such circumstances. The endorsement of offenders is an important issue in drug testing in terms of the duty of care that correctional management has towards offenders.

Staff involved in saliva testing during the trial did not unanimously endorse the saliva testing system. However, the collection issues discussed above were noted as advantages. While it would be expected that the introduction of new

work practices would meet with some resistance and apprehension, this may not fully explain the reservations held by staff. The testing equipment and testing procedures in the current trial were noted by a number of staff as being complicated and the instructions and operating procedures were considered both unclear and lacking concision. Some staff also noted that training in the testing system could have been more comprehensive to facilitate confidence in their ability to perform the testing procedure correctly. These specific issues would explain to some extent, the general lack of endorsement by most staff for the saliva testing system, particularly the community-based staff.

Staff also appeared to lack confidence in the accuracy of the testing system, particularly in the detection of cannabis. That said, a factor that would predictably contribute to the preference by some community-based staff for urinalysis over saliva testing was the practice of some district offices to outsource urinalysis. For the trial, staff were required to personally administer the saliva tests. In brief, some staff were comparing a referral to an outside agency for urinalysis to hands on administration for saliva testing. Whilst outsourcing urinalysis would appear the simpler of the two practices, diminished quality control and delays in result determination can lead to frustration.

From the issues raised by participating staff, together with observations from the site inspections, the training and operational procedures for saliva testing could be improved. In drug detection, the chain of custody procedure is an important consideration in enabling drug test results and subsequent action to withstand legal scrutiny. It appears that the chain of custody procedures used in the current trial require refinement. A possible remedy to both this issue and the problem of insufficient samples being collected for adequate analysis is the collection of two separate saliva samples at the same point in time, both being sealed in the presence of the offender. This procedure has been implemented in a prior study (Speckl et al, 1999).

Feedback from two regional COS sites highlighted the fact there is no standard drug testing procedure across all DCS contexts. One of these sites reported a successful urinalysis program where staff collect the sample on-site and send it to a pathology laboratory for analysis. The manager reported that this system is endorsed by staff as well as being an effective case management tool, implying that an alternative drug testing method is not required at that site. The other site reported no access to drug testing facilities, a situation that may affect the ability of staff to adequately case manage all offenders in that area. It may be that the saliva testing has greater application at certain sites. This could be investigated should the trial be extended.

The working party which managed the current trial did so in addition to usual workloads. In view of the operational concerns cited by staff, future implementation would be more effectively managed through the establishment of a dedicated project position.

Drug Detection

Urinalysis was used as the reference standard by which the accuracy of the saliva testing system was gauged. In examining current findings, the ability of the saliva testing system to detect heavy-end drugs was calculated as good for opiates and satisfactory for amphetamines. The very low number of positive cocaine results precludes interpretation. Consistent with previous research into on-site saliva testing systems, the ability of the testing system to detect cannabis was poor. Results also indicated that the testing system lacked sensitivity in detecting benzodiazepines, although low sample numbers were a problem. The poor result for benzodiazepines accords with an earlier review of the literature by Cone (1993) that found low utility for saliva testing with benzodiazepines. Cone concluded that many of these drugs have weak bases and saliva concentrations may be highly dependent upon PH conditions.

Previous research has shown higher levels of concordance between saliva testing and urinalysis for the drug classes used in the current trial. One explanation for the lower levels of concordance found in the trial may be a function of the low sample numbers that were achieved. These results may also be explained by problems with the particular saliva testing technology used.

The current findings are instructive for routine drug screening in view of annual data on drugs detected by the DCS urinalysis program. In 2003, the most commonly detected drugs in the NSW correctional system were cannabis, Oxazepam *(benzodiazepine)*, morphine, methylamphetamine and Temazepam (benzodiazepine) in that order. In brief, currently *s*aliva testing shows poor detection capability in two of the most commonly used drug classes (cannabis and benzodiazepines) in NSW correctional centres. Hence, at this point in time saliva testing would not have application in routine, wide scale drug screening.

Saliva testing technology appears to have an application for the assessment of current drug impairment. Unlike urinalysis, saliva can be collected and tested on the spot and has potential in indicating drug related impairment. In brief, it would appear to have special application with offenders who are exhibiting the behavioural and/or physiological effects of drug use. Potentially, there are specific situations in which an immediate result would be appropriate, such as when an offender is unable to provide a urine sample, in the testing of offenders operating machinery or custody-based offenders returning from community-based leave who show signs of impairment.

While urinalysis is the standard against which other testing methods are usually judged, it may not be infallible in regard to false negative results. There was a number of positive saliva results recorded in the current trial where urinalysis detected no drugs (these drug positive saliva results were classified as false positives with reference to urinalysis).

To some extent, all objective testing methods are subject to inaccuracies and bias. At present, evidence on saliva testing technology shows low utility for cannabis (and possibly benzodiazepines) detection. Urinalysis and saliva testing

cannot distinguish between casual and problematic use, so for case plan and treatment assessment, there will always be a place for drug use information being obtained by self-report.

With point of collection urinalysis, confirmatory tests usually have greater sensitivity (and corresponding lower cut-off levels) as well as greater specificity in relation to the initial screening test thereby minimising false positive and false negative results. To date with saliva analysis, generally the same cut-off levels have been used for screen and confirmatory analysis.

To maintain the integrity of the DCS drug-testing program, if saliva testing were introduced, an agreement should be made with the supplier of the on-site testing system and the laboratory responsible for confirmation testing as to the cut-off levels to be used in the detection of the different drug classes and the analytical method to be used for laboratory-based confirmatory testing.

The above observations make clear the need for national standards on cut-off levels in this emerging drug testing technology.

As saliva testing technology is a rapidly evolving area of drug detection, an investigation of alternative on-site saliva testing systems that are locally available would be appropriate if correctional administrators were to utilise this method in the future. Further, advances in technology for other biological matrices should also be monitored to enable the application of the most effective detection technology, both in terms of accuracy and cost. As the body of empirical research into alternative drug detection methods grows, combined with exposure to these technologies, demand should increase and the costs reduce.

Future application

It would appear that for the routine screening of drug use, urinalysis would still be the most efficacious technology. Saliva testing may have utility within the DCS drug detection program. However, it would appear that further trials are needed to enable stronger conclusions. If offenders are suspected of using illicit drugs other than cannabis, or if the detection of cannabis is not considered a priority, saliva testing may be preferred, particularly where cross-gender testing is required. The benefits of such applications would need to offset the increased cost of this technology when compared with urinalysis.

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