Drugs of abuse screening in the West Midlands: a 6 year retrospective survey of results

S George and R A Braithwaite
From the West Midlands Regional Laboratory for Toxicology, Dudley Road Hospital, Birmingham B18 7QH, UK

SUMMARY. We describe the results of urinary drugs of abuse screening performed by the West Midlands Regional Laboratory for Toxicology, Birmingham, UK, on more than 27 800 urine specimens received between January 1988 and December 1993. The number of specimens positive for amphetamine declined from 1988 to 1990, but this was followed by a doubling of specimens testing positive from 5·7% in 1990 to 12·0% in 1993. There is very little evidence of methamphetamine or Ecstasy abuse in the West Midlands. Morphine (assumed to be from heroin abuse) is the most common opiate detected, with 11·7% of all specimens received proving to be positive in 1993. The incidence of cocaine abuse is low, less than 5% when requests are based on clinical judgement, and less than 3% in the overall population monitored.

Additional key phrases: amphetamines; opiates; cannabis; cocaine

A laboratory service for screening for drugs of abuse in urine can have an important role in both the diagnosis and management of drug misuse. This service needs to be inexpensive, comprehensive, and reliable, yet able to provide a rapid turn-round of results. The West Midlands Regional Laboratory for Toxicology provides such a urinary screening service for drugs of abuse for both the West Midlands (population 5·2 million) and other areas. The sources (and the percentage of the Laboratory's workload received from these sources) for 1993 were: 38 general practitioners (3·1%), nine community addiction clinics (27·8%), 39 hospitals (68·8%) and two regular extra-regional users of the service (0·3%).

Currently, all specimens received in the Laboratory are initially screened for opiates by immunoassay (EMIT, Syva UK, Maidenhead, UK). This is an established technique that allows the rapid screening of many specimens, and the separation of negative from presumptive positive urine samples.[1,2] Screening of urine specimens for benzodiazepines, cannabinoids, and cocaine metabolite (benzoylecgonine) is only performed by specific request, for financial reasons. In addition, all specimens are screened by gas chromatography to detect the abuse of the amphetamine group of compounds, and to monitor the compliance of subjects undergoing a programme of methadone detoxification.

It is Laboratory policy periodically to analyse all specimens received for drugs of abuse screening over a period of 1 month for cocaine. This work is performed to discover the incidence of positive results in all specimens rather than simply the results of the requested workload, as a marker of the real extent of cocaine abuse in the West Midlands. In 1991 cannabinoid abuse was included in this survey. These data also reflect changes in cannabinoid and cocaine abuse with time.

Epidemiology in this area is very difficult, as the requesting patterns for drugs of abuse screening and the results obtained depend greatly on the nature of the clinic or hospital policy employed to monitor drug abuse. Regimes vary from harm reduction and containment of intravenous and 'hard' (class A) drug abuse to a requirement for total abstinence from any drug or alcohol abuse. This problem is further exacerbated by the fact that addiction clinics may be 'walk-in' treatment centres (where limited patient history is available) or drug-free hostels

Correspondence: Dr S George.

that continue rehabilitation following detoxification programmes.

In view of the variations in the drug abuse patterns of the subjects monitored, the requesting patterns within each source group (clinics, general practitioners or hospitals), and the marked differences in findings both between and within source groups, it is not beneficial to compare source group data.

Similarly, because individual drug abuse patterns can change with time, as a result of participation in detoxification programmes, multiple requests from the same individual have not been excluded. The findings presented here, therefore, provide an overview of the results obtained from the urinary drugs of abuse screening service offered by the West Midlands Regional Laboratory for Toxicology from January 1988 to December 1993, derived from the analysis of more than 27 800 specimens.

METHODS

All specimens received for urinary drugs of abuse screening are initially screened for opiates using a Syva ETS® analyser and EMIT DAU® reagents (Syva UK, Maidenhead, UK: cut-off 0·3 mg/L). Subsequent confirmatory testing of specimens found to be positive for opiates is performed by thin layer chromatography (TLC) as follows:

Five millilitres urine is acid hydrolysed using 1 mL concentrated hydrochloric acid and boiling in a pressure cooker for 20 min. Following cooling and neutralization with sodium hydrogen carbonate, the opiates are extracted into 5mL chloroform:isopropanol (9:1) by mechanical shaking for 10 min. The organic phase is evaporated to dryness and the residue is reconstituted in 100 μL chloroform. Fifteen microlitres of extract is spotted onto a Schleicher and Schuell acid resistant silica gel TLC plate (Anderman and Co Ltd, Kingston-on-Thames, UK). A TLC standard which contains codeine, dihydrocodeine and morphine is also run to facilitate identification of opiates present in the urine specimens. Ethyl acetate:methanol: ammonia (85:10:5) is used as the solvent system, and the plates are visualized after a 10 cm run, using acidified iodoplatinate reagent and the Marquis reaction. The limit of detection of this system is 1·0 mg/L.

Cannabinoid and cocaine metabolite (benzoylecgonine) misuse are only monitored by specific request, using the Syva ETS analyser and EMIT DAU reagents. The cut-off values for these assays are 0·1 mg/L for cannabinoids and 0·3 mg/L for cocaine metabolite. Generally, no additional confirmatory testing is performed on these specimens unless the results are challenged, as we have found the cannabinoid and cocaine metabolite assays to be accurate and reliable.

From 1988 to 1991 all specimens received in the Laboratory were screened for barbiturates by the Syva ETS analyser and EMIT DAU reagents (cut-off 0·3 mg/L). All positive specimens were then confirmed by TLC to detect and identify the presence or absence of phenobarbitone and/or other barbiturates. The TLC method used is as follows:

Five millilitres urine is extracted at an acid pH into 5 mL chloroform by mechanical shaking for 10 min. The organic phase is evaporated to dryness and the residue is reconstituted in 100 μL chloroform. Twenty microlitres of extract is spotted onto the Schleicher and Schuell acid resistant silica gel TLC plate. A TLC standard containing amylobarbitone and phenobarbitone is also run to allow the identification of any barbiturates present in the urine specimens. Ethyl acetate:methanol: ammonia (85:10:5) is used as the solvent system, and the plates are visualized after a 10 cm run using mercurous nitrate reagent. The limit of detection of this system is 1·0 mg/L.

From 1992, due to the costs of maintaining this service and the continuing decline in the numbers of positive specimens detected (see Fig. 2), the screening for barbiturates was only performed by specific request, using the TLC method described above.

In addition to the above protocol, all specimens received in the Laboratory are screened for the amphetamine group of compounds such as amphetamine, methamphetamine, and methylenedioxymethamphetamine (MDMA; Ecstasy) by capillary gas chromatography (GC), using a modified method of Caldwell and Challenger.[3] The modifications are as follows:

The capillary column used is a 15 m × 0·53 mm id with a DB5 phase (film thickness 1·5 μm). The extraction is performed under alkaline conditions in a 1·9 mL polypropylene Eppendorf capped tube.

Into the Eppendorf tube are placed 0·1 mL 5 mol/L sodium hydroxide, 0·7 mL urine specimen and 0·15 mL internal standard solution (10 mg/L prazepam in butyl acetate). The tube is capped and vortex mixed for 10 s followed by centrifugation at 11 000 rpm for 5 min. The supernatant organic phase is then transferred to

TABLE 1. *Examples of the drugs detected by the standard screening protocol*

Drug class	Examples of drugs detected within class
Amphetamines and related compounds	Amphetamine Ephedrine Fenfluramine Methamphetamine Methylenedioxyamphetamine (MDA) Methylenedioxymethamphetamine (MDMA) Phentermine Phenylpropanolamine Pseudoephedrine Diethylpropion
Opiates	Codeine Dihydrocodeine Morphine
Opioids	Dipipanone Pethidine Dextropropoxyphene
Methadone	Methadone, methadone metabolite
Miscellaneous	Cyclizine, Chlormethiazole, Procyclidine, Cocaine*, Methylecgonine*

*Only detected after recent heavy ingestion of cocaine.

autosampler vials before injection onto the capillary column. The GC operating conditions are: injector 260°C; detector 300°C; initial column temperature 110°C for 1 min, then 16°C/min to 290°C and hold for 1 min; total cycle time 23 min per specimen.

This method is able to differentiate common 'over the counter' preparations such as ephedrine and pseudoephedrine from controlled sympathomimetic amines, and it also permits the identification of a range of other abused substances such as cyclizine, dextropropoxyphene and methadone (and its primary metabolite).

Examples of the range of abused substances detected by the standard screening protocol (excluding the specifically requested drugs) are shown in Table 1.

RESULTS

Since 1973, when the service was first introduced, the annual workload for drugs of abuse screening has shown a steady increase (Fig. 1). Between 1988 and 1993 there was an 80% increase in the number of urine specimen screening requests received in the Laboratory, from 3366 to 6073 per year.

The findings of this survey of analytical results are expressed as the percentage of specimens received per year that tested positive. The data for amphetamine and phenobarbitone are illustrated in Fig. 2. Similarly, the data for codeine, dihydrocodeine and morphine (not from codeine use) are shown in Fig. 3.

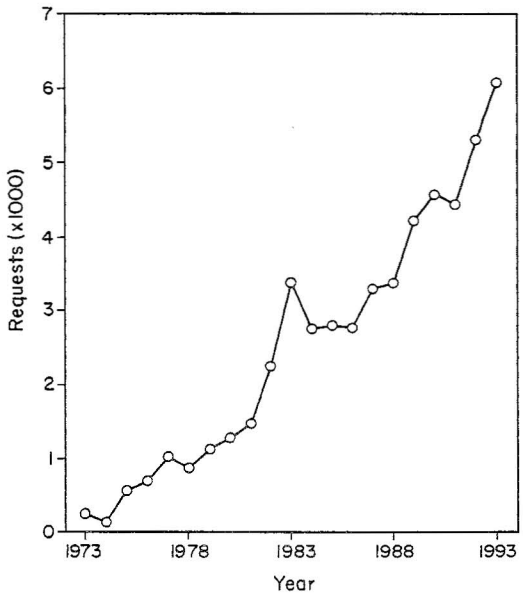

FIGURE 1. *The annual drugs of abuse screening workload for the West Midlands Regional Laboratory for Toxicology from 1973 to 1993.*

TABLE 2. *The requested workload and population incidence of cannabinoid and cocaine abuse in the West Midlands*

Survey period	Requested workload* incidence		Population incidence†	
	No. of requests	No. of positives (%)	Study total	No. of positives (%)
Cannabinoid				
June 1991	203	22 (10·8)	357	89 (24·9)
June 1992	70	18 (25·7)	426	126 (34·0)
Cocaine				
November 1989	65	3 (4·6)	400	8 (2·0)
June 1991	141	2 (1·4)	377	4 (1·1)
June 1992	23	1 (4·4)	426	12 (2.8)

*'Requested workload' refers to the number of specimens received during the survey period requesting screening for cannabinoid and/or cocaine abuse.
†'Population incidence' refers to the total number of specimens received during the survey period that were screened for cannabinoid and cocaine abuse.

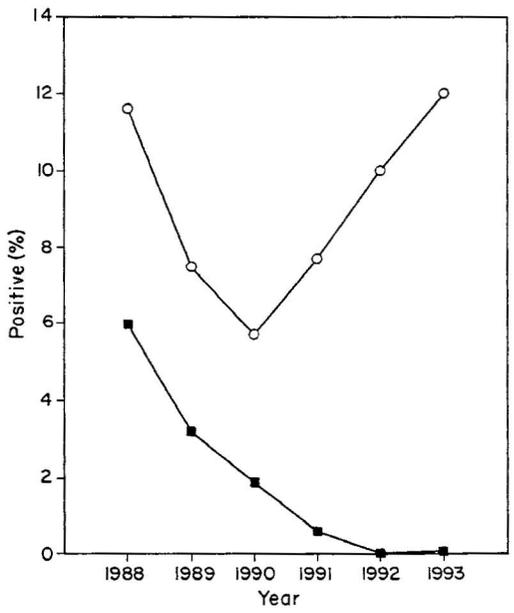

FIGURE 2. *The percentage of specimens received found to be positive for amphetamine and phenobarbitone from 1988 to 1993.* ○ = *Amphetamine;* ■ = *phenobarbitone.*

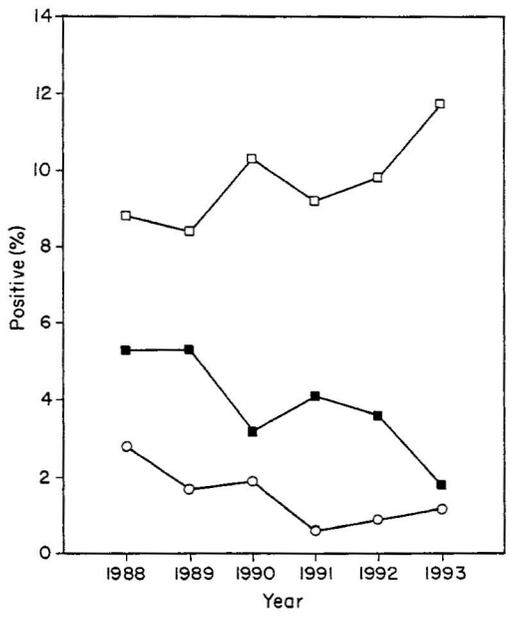

FIGURE 3. *The percentage of specimens received found to be positive for codeine, dihydrocodeine and morphine from 1988 to 1993.* ○ = *Codeine;* ■ = *dihydrocodeine;* □ = *morphine.*

The numbers of specimens received that were found to be positive for amphetamine show a marked decline from 1988 to 1990, followed by a sharp increase, rising around 30% per year from 5·7% in 1990 to 12·0% in 1993. There is surprisingly little detection of the abuse of other amphetamines, such as methamphetamine (less than 1% per year) or MDMA (Ecstasy) and related substances in the West Midlands. The numbers of specimens found to be positive for phenobarbitone show a continuing decline over the survey period even when the requests were based on clinical judgement in 1992 and 1993.

The survey findings also show that morphine (assumed to be from heroin use) remains the most commonly detected opiate, with between 8% and 12% of all specimens received per year proving to be positive. Over the period studied both codeine and dihydrocodeine show

a downward trend in the numbers of specimens testing positive. In 1993, the findings were: codeine 1·2%; dihydrocodeine 1·8%; and morphine 11·7%.

The results of the periodic review of the sample population and requested monitoring of the incidence of cannabinoid and cocaine abuse are shown in Table 2. There was an increase in the population incidence of both cannabinoid and cocaine abuse from 1991 to 1992. The findings for the incidence of cocaine abuse being higher in the requested monitoring group than the population data may be explained in part by the selective requesting of this assay by the clinicians responsible. This contrasts with the cannabinoid survey results, which demonstrate that the real extent of cannabinoid abuse in the population may be underestimated by only performing requested monitoring.

DISCUSSION

This review of analytical results was derived from the urinary drugs of abuse screening of over 27 800 specimens received in the Laboratory from January 1988 to December 1993. The results offer an overview of drug abuse patterns in the West Midlands, and act as an indicator of the service provision required to perform this work.

As stated above, it is not helpful to compare analytical results from within or between sources. This may be illustrated by the results obtained from the analysis of specimens received from two addiction clinic sources. In 1993, 'Clinic 1' demonstrated a 19·4% incidence of amphetamine and a 29·4% incidence of morphine positive specimens. In contrast 'Clinic 2' demonstrated a 1·7% incidence of amphetamine and a 0·5% incidence of morphine positive specimens, i.e. radically different drug abuse patterns from within the same source group. Sources can, however, be a good indicator of the workload that will be needed to process specimens received especially in terms of the numbers of confirmatory tests that may be required.

The large recent increase in amphetamine detection (more than doubling between 1990 and 1993—Fig. 2) could be related to the current 'rave' scene and the use of amphetamine as a cheap alternative for Ecstasy, or to its prescription to monitored abusers. As stated previously, there is little abuse of methamphetamine, MDMA (Ecstasy), or other related drugs, detected in this population of known drug abusers, but the results in the general population may be very different.

The continuing decline in the number of specimens found to be positive for phenobarbitone led to the withdrawal of the routine screening service in 1991. The data for 1992 and 1993 (Fig. 2) illustrate the findings of requested screening for phenobarbitone based on clinical judgement. These data probably reflect the national trend of the decreasing use of phenobarbitone as a cutting agent for heroin.

The presence in blood and urine of the heroin metabolite 6-monoacetyl-morphine (6-MAM) confirms that heroin has been used,[4] but the short half-life of 6-MAM (0·6 h), leads to a detection time in urine of less than 8 h.[5] In addition, 6-MAM readily hydrolyses in alkaline solutions, and so may be lost artefactually during extraction procedures. This means that 6-MAM is rarely detected in urine samples recieved for screening, and the presence of morphine in urine samples is widely used as an indirect marker of heroin abuse.

The survey findings presented here show that morphine (assumed to be from heroin use) remains the most commonly detected opiate in the West Midlands, with between 8% and 12% of all specimens received proving positive. It can also be seen (Fig. 3) that the abuse of both codeine and dihydrocodeine appears to be declining.

The data for cannabinoid abuse (Table 2) show that the population incidence is much greater than the apparent incidence of abuse derived from requested screening. The importance of this data depends upon the institution requesting the analysis. Certain establishments aim towards a 'reduction in harm' policy where cannabinoid abuse is relatively unimportant, whereas agencies and clinics operating a totally drug free policy need to know the incidence of all drug abuse that may occur.

The cocaine survey data show that the number of positive specimens detected from monitoring for cocaine abuse is much higher than the population incidence. One possible explanation for these results is that the original requests had some factual basis rather than simple random selection, or the routine monitoring of all subjects in any source institution.

We believe that the provision of a screening service for drugs of abuse is best organized on a regional basis to monitor the pattern of drug abuse, assist with the understanding of the

epidemiology of drug abuse, and help in the resource management facilities for treatment. We hope that the data we present will encourage other laboratories performing urinary drugs of abuse screening to publish their results, as there is a shortage of such data in the literature.

Acknowledgement

The authors would like to acknowledge the assistance of Mr I Howell in collecting some of the data.

REFERENCES

1 Sunshine I. Preliminary tests for drugs of abuse. *Clin Chem* 1988; **34**: 331–4

2 Critical issues in urinalysis of abused substances: Report of the substance-abuse testing committee. *Clin Chem* 1988; **34**: 605–32

3 Caldwell R, Challenger H. A capillary column gas-chromatographic method for the identification of drugs of abuse in urine samples. *Ann Clin Biochem* 1989; **26**: 430–43

4 Bowie LJ, Kirkpatrick PB. Simultaneous determination of monoacetylmorphine, morphine, codeine and other opiates by GC/MS. *J Anal Toxicol* 1989; **13**: 326–9

5 Cone EJ, Welch P, Mitchell JM, Paul BD. Forensic drug testing for opiates: 1. Detection of 6-Acetylmorphine in urine as an indicator of recent heroin exposure; drug and assay considerations and detection times. *J Anal Toxicol* 1991; **15**: 1–7

Accepted for publication 5 March 1994