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Occupational Exposure to Cocaine Involving Crime Lab Personnel

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ABSTRACT: The possibility of exposure to cocaine as a result of analyzing it or handling material contaminated by it has been a major concern of laboratory personnel. Several different work environments and simulated situations were examined to assess the likelihood of this type of exposure occurring. Urine specimens were collected and evaluated for cocaine and benzoylecgonine using the Syva ETS System (EMIT). Each specimen was analyzed for the two substances using gas chromatography/mass spectrometry (GC/MS). Urine specimens of laboratory-management personnel not working with drug samples showed no trace of cocaine or benzoylecgonine. A urinary benzoylecgonine level of 227 ng/mL was found in the specimen from one narcotics criminalist who was working on a routine case of 2 kilos of cocaine hydrochloride in the Narcotics Laboratory. A maximal urinary benzoylecgonine concentration of 1570 ng/mL was determined in the urine specimen from one narcotics criminalist who was sampling a case containing 50 kilos of cocaine hydrochloride over a period of 3 h. Decreasing the levels of airborne cocaine dust appears to minimize the amount of cocaine absorbed by the criminalists. Gloves, face masks, and goggles prove to be effective in minimizing exposure.

KEYWORDS: toxicology exposure, narcotics, cocaine, benzoylecgonine, impinger, air pump

The Los Angeles County Sheriff's Department, Scientific Services Bureau, received approximately 27 000 narcotics cases in 1990. The exhibits include marijuana, cocaine, heroin, phencyclidine, methamphetamine, and other controlled substances. Cocaine continues to be the primary drug of abuse and constitutes approximately 60% of the cases submitted. Cocaine is routinely submitted to the laboratory in small paper bindles or plastic bags, with larger amounts coming in kilo packages. In recent years, the enormous surge in cocaine trafficking in the Southern California area has resulted in many large seizures by our department and local police agencies. Criminalists and other laboratory personnel are often called upon to analyze the confiscated narcotics.

The procedures involved in large seizures usually include inspecting the package, dusting the package for fingerprints, opening the package, transferring the contents to a balance and weighing, performing analytical testing, and resealing the package. Through all these steps, there exists the possibility that the criminalist handling the material may

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become passively exposed to cocaine either through airborne dust or physical contact. Previous investigations have documented that ingesting (*1*,*2*) or inhaling (*3*) small amounts of cocaine can cause positive results in urine cocaine and benzoylecgonine screening by immunoassay, using a detection threshold of 300 ng/mL. ElSohly et al. have shown that a urinary benzoylecgonine concentration of 1 274 ng/mL was determined 2 h after an oral dose of 2.2 mg of cocaine (*1*). An oral dose of 25 mg produced a maximal level of 7 940 ng/mL at 12 h after the ingestion (*2*). Baselt et al. have indicated that a maximal urinary concentration of 55 ng/mL benzoylecgonine was determined following dermal application of 5 mg cocaine base after 48 h (*4*). Casual handling of cocaine contaminated articles has resulted in the detection of 72 ng/mL of benzoylecgonine in urine (*5*).

To assess the likelihood of absorption of cocaine by crime lab personnel, we examined urine specimens from laboratory-management personnel, criminalists, and fingerprint-identification specialists.

The article describes the effect of passive exposures to cocaine involving crime-lab personnel during the course of their duties; and ways to limit the amount of exposure.

Materials and Methods

Reagents and Materials

Reagents and disposables for use on the Syva ETS system were purchased from the Syva Company. The calibrators, controls, and reagents were prepared according to the manufacture's recommendations (*6*). Cocaine hydrochloride, benzoylecgonine hydrate, deuterated cocaine, and deuterated benzoylecgonine were purchased from the Sigma Chemical Company. Analytical grade methanol, acetonitrile, n-butyl chloride, and dibasic potassium phosphate were obtained from the Baxter Healthcare Corporation. Bis-trimethylsilyl trifluoacetamide (BSTFA) + 1% trimethylchlorosilane (TMCS) was supplied by Supelco Inc. Detectabuse™ XAD-2 extraction columns were purchased from Biochemical Diagnostics Inc. NIOSH respirators (face masks) Model 9970 were purchased from the 3M Company.

Chemical Analysis

All urine specimens were analyzed for cocaine and benzoylecgonine using a SYVA ETS system, an automated analyzer for drugs of abuse in urine. All presumptive EMIT positive specimens, as well as all negative specimens, were scheduled for gas chromatography/mass spectrometry (GC/MS) confirmation.

The urine specimens and air samples were prepared for GC/MS using a solid phase extraction of cocaine and benzoylecgonine using the Zymate Laboratory Automation System (Zymark Corporation) and solid phase extraction columns. The extraction was followed by formation of the trimethylsilyl (TMS) derivatives.

GC/MS was performed using Hewlett-Packard 5890/5970A GC/mass selective detector (MSD), equipped with a 12 m (0.2 mm internal diameter, 0.3 μm 100% dimethylpoly-siloxane film thickness) HP-1 capillary column and using helium as carrier gas at 1 mL/min at 200°C oven temperature with a split ratio of 20:1. The system purge was 2 mL/min. The injector and interface temperatures were 250°C and 280°C, respectively. The temperature program was 160°C to 260°C at 20°C/min.

GC/MS identification and quantitation were performed using Thru-Put Systems' Target software on the Pascal v. 3.2 Hewlett-Packard ChemStation. Selected ion monitoring used fragments at 82, 182, and 303 atomic mass units (amu) for cocaine; 85, 185, and

306 amu for deuterated cocaine; 82, 240, and 361 amu for silylated benzoylecgonine; 85, 243, and 364 amu for silylated deuterated benzoylecgonine (*7*).

Urine Specimen Collections

All urine specimens were collected in plastic bottles containing approximately 100 mg of ascorbic acid to prevent the break down of cocaine to benzoylecgonine by maintaining an acidic pH. The specimens were then stored at 4°C until analysis.

Seven experiments involving different groups of laboratory workers were conducted.

Group I—consisted of three management personnel. Each subject was asked to donate one urine specimen in the morning before beginning work (AM specimen) and one urine specimen in the afternoon before leaving the laboratory (PM specimen). The first day of the work week (Monday) was selected to eliminate any possible exposure to cocaine prior to the collection of urine specimens.

Group II—consisted of nine criminalists assigned to the Narcotics Laboratory analyzing solid dosage forms of narcotics. Narcotics analyses were done at individual work stations. Each subject was asked to donate one urine specimen in the morning before beginning work (AM specimen) and one urine specimen in the afternoon before leaving the laboratory (PM specimen). Specimens were collected on two consecutive days (Monday and Tuesday).

Group III—consisted of two narcotics criminalists who were assigned to work on a large cocaine seizure case consisting of 50 packages of cocaine that were sampled in the field. Subject A was wearing a face mask and a pair of latex gloves. Subject B was wearing a pair of latex gloves, but no face mask. Subjects A and B spent 3 h inspecting, opening, transferring, weighing, sampling, and resealing 50 packages. Urine specimens were collected at 0, 1, 4, 8, and 24 h after the exposure. The sampling process was done in a 20′ by 20′ by 10′ room with no fume hood.

Group IV—consisted of two narcotics criminalists who were assigned to work on a 9 kilo cocaine case. Subjects A and B spent 2 h inspecting, weighing, opening, sampling, and resealing 9 packages. Unlike group III, this group only made small incisions into the packages with a stainless-steel scalpel and removed a portion of cocaine powder with a 10 by 75 mm test tube. Subject A was wearing a face mask and a pair of latex gloves, subject B was wearing a face mask, a pair of latex gloves, and a pair of goggles. Urine specimens were collected at 0, 1, and 4 h after the exposure. The sampling process was performed in a 20′ by 20′ by 10′ room with no fume hood.

Group V—consisted of two fingerprint-identification specialists who were assigned to dust 80 unopened cocaine packages for latent fingerprints. Subjects A and B were wearing latex gloves. Urine specimens were collected before and after the exposure.

Group VI—consisted of four non-narcotics criminalists. As a control subject, subject A was idle while the ambient air was being monitored for 30 min. Subjects B and C were asked to open a 1 kilo package of cocaine and transfer the contents back and forth 25 times for 30 min while the air was being monitored. Subject D was asked to transfer the contents of a 1 kilo package of cocaine 50 times while the air was being monitored. Subjects A and B wore no protective equipment, subject C wore gloves and a face mask, and subject D wore gloves, goggles, and a face mask. The intent of this experiment was to simulate field situations in which criminalists sample 25 or 50 1 kilo packages of cocaine.

Group VII—consisted of three criminalists. Each subject was asked to open a 1 kilo package of cocaine and transfer the contents back and forth 25 times for 30 min. Each subject was wearing gloves, face mask, goggles, disposable gown, and disposable cap.

Air Sample Collections

The intent of this experiment was to determine the extent of exposure caused by breathing air contaminated with cocaine dust. All air samples were collected by a personal air sampling device, which consisted of a glass impinger (Fig. 1) connected to a personal air-sampling pump model Alpha-1 (Dupont). While in operation, the glass impinger was attached to the criminalist's lab coat lapel (breathing zone) and the personal air-sampling pump was placed in the lab coat pocket. The flow rate was set at 1 L per minute. The airborne cocaine dust was collected into a glass impinger containing 15 mL deionized water with 30 mg of ascorbic acid.

Results and Discussion

This investigation was designed to provide information regarding the levels of cocaine and benzoylecgonine that could be found in urine specimens resulting from passive exposure during actual working conditions and simulated situations. All urine specimens were screened by EMIT and all specimens were confirmed by GC/MS.

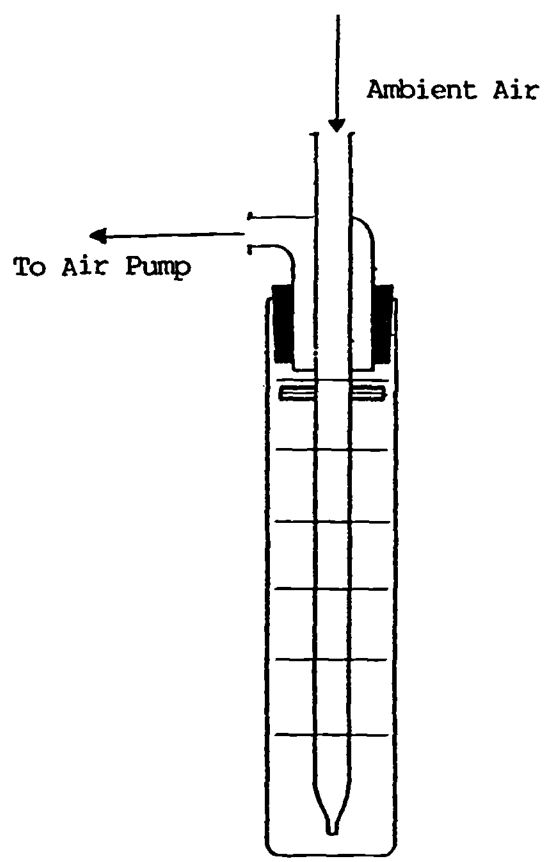

FIG. 1—*All-glass impinger.*

The results of EMIT and GS/MS analysis of the discrete urine specimens collected in the laboratory management personnel are shown in Table 1. Cocaine and benzoylecgonine were not detected in any of the specimens by EMIT and GC/MS analysis. This is not entirely unexpected since this particular group of individuals is neither involved in any analysis nor in the proximity of airborne cocaine dust.

The results of group II, involving urine specimens of 9 narcotics criminalists performing analysis on solid dosage narcotics, are shown in Table 2. All specimens gave a negative response by EMIT based on 300 ng/mL cut-off value. Urine specimens of subjects A, F, and I, however, contained detectable amounts of cocaine and benzoylecgonine by GC/MS analysis. Subject A showed benzoylecgonine levels of 60 ng/mL and 68 ng/mL in the two discrete PM specimens. Subject F showed a benzoylecgonine level of 227 ng/mL in the discrete PM urine specimen collected on the first day and subsequent benzoylecgonine levels of 108 ng/mL and 209 ng/mL in the AM and PM specimens from the following day. Subject F indicated that she was working on a 2-kilo cocaine case for 2 h and was wearing a pair of gloves, but no face mask. She also said that the procedures involved in this case included, inspecting the packages, opening the packages, transferring the contents to a balance and weighing, sampling the contents, performing analytical testing, and resealing the packages. Subject I showed a urine cocaine level of 31 ng/mL and a benzoylecgonine level of 58 ng/mL in the PM specimen of the first day and urine benzoylecgonine levels of 43 ng/mL and 68 ng/mL in the AM and PM specimens from the following day. These results indicate that low level exposure to cocaine either through air contamination or physical contact are possible. These findings are consistent with that of Houlihan (*8*), who studied the exposure of cocaine involving criminalists in the Orange County Sheriff-Coroner laboratory.

The results of group III, involving urine specimens of two narcotics criminalists working on a 50 kilo case, are shown in Table 3. Urine specimens of subject A, wearing gloves and a face mask, showed negative response by EMIT but showed a maximal urine cocaine concentration of 112 ng/mL at 1 h and maximal urine benzoylecgonine level of 278 ng/mL at 24 h. Urine specimens of subject B, wearing gloves, but no face mask, showed a positive response by EMIT at the 300 ng/mL threshold in urine specimens collected at 4, 8, and 24 h. Subject B showed a maximal urine cocaine concentration of 137 ng/mL at 1 h and a maximal benzoylecgonine concentration of 1570 ng/mL at 8 h. Both subjects A and B were working side by side in a 20′ by 20′ by 10′ room without a fume hood. Subject B experienced a slight local anesthetic effect on the lips, while subject A reported no noticeable local or systemic effects. They spent 3 h inspecting, opening, transferring, weighing, and sampling 50 1 kilo packages of cocaine. The percentage of cocaine in these packages was from 69 to 80. The presence of cocaine in their urine specimens at 24 h

TABLE 1—*Results of EMIT and GC/MS analysis of discrete urine specimens of three laboratory management personnel (Group I).*

Subject	Time	EMIT Cutoff Level (300 ng/mL)	Concentration by GC/MS (ng/mL)	
			Cocaine	BEC[a]
A	AM	ND[b]	ND	ND
	PM	ND	ND	ND
B	AM	ND	ND	ND
	PM	ND	ND	ND
C	AM	ND	ND	ND
	PM	ND	ND	ND

[a]Benzoylecgonine.
[b]Not Detected.

TABLE 2—*Results of EMIT and GC/MS analysis of discrete urine specimens of nine narcotics criminalists (Group II).*

Subject	Time	EMIT Cutoff Level (300 ng/mL)	Concentration by GC/MS (ng/mL)	
			Cocaine	BEC[a]
A (Monday)	AM	ND[b]	ND	ND
	PM	ND	ND	60
A (Tuesday)	AM	ND	ND	ND
	PM	ND	ND	68
B (Monday)	AM	ND	ND	ND
	PM	ND	ND	ND
B (Tuesday)	AM	ND	ND	ND
	PM	ND	ND	ND
C (Monday)	AM	ND	ND	ND
	PM	ND	ND	ND
C (Tuesday)	AM	ND	ND	ND
	PM	ND	ND	ND
D (Monday)	AM	ND	ND	ND
	PM	ND	ND	ND
D (Tuesday)	AM	ND	ND	ND
	PM	ND	ND	ND
E (Monday)	AM	ND	ND	ND
	PM	ND	ND	ND
E (Tuesday)	AM	ND	ND	ND
	PM	ND	ND	ND
F (Monday)	AM	ND	ND	ND
	PM	ND	ND	227
F (Tuesday)	AM	ND	ND	108
	PM	ND	ND	209
G (Monday)	AM	ND	ND	ND
	PM	ND	ND	ND
G (Tuesday)	AM	ND	ND	ND
	PM	ND	ND	ND
H (Monday)	AM	ND	ND	ND
	PM	ND	ND	ND
H (Tuesday)	AM	ND	ND	ND
	PM	ND	ND	ND
I (Monday)	AM	ND	ND	ND
	PM	ND	31	58
I (Tuesday)	AM	ND	ND	43
	PM	ND	ND	68

[a]Benzoylecgonine.
[b]Not Detected.

suggests the possibility of re-exposure to cocaine perhaps through their contaminated clothing or hair. Previous investigations indicated that if cocaine was detected in the urine specimen, then the urine specimen was collected less than 12 h after cocaine administration (*9,10*). The results also show that wearing a face mask can effectively minimize the amounts of cocaine exposure.

The results of group IV, involving urine specimens of two narcotics criminalists working on a 9 kilo cocaine case, are shown in Table 4. Both subjects A and B spent 2 h inspecting, weighing, and sampling 9 cocaine packages. After completing these tasks, neither of their urine specimens showed any trace of cocaine or benzoylecgonine. It is important to note that this group made only a small incision into the packages and removed the contents with a test tube, therefore creating little or no cocaine dust. This group demonstrates that the sampling method may have a greater influence on the degree of exposure than the type and amount of protective equipment worn.

The results of group V, involving urine specimens of two fingerprint-identification

TABLE 3—*Results of EMIT and GC/MS analysis of discrete urine specimens of two narcotics criminalists on a 50 kilo cocaine case (Group III).*

Subject	Protective Equipment	Time (h)	EMIT Cutoff Level (300 ng/mL)	Concentration by GC/MS (ng/mL)	
				Cocaine	BEC[a]
A	Gloves	0	ND[b]	ND	ND
	Mask	1	ND	112	80
		4	ND	91	231
		8	ND	85	142
		24	ND	84	278
B	Gloves	0	ND	ND	ND
		1	ND	137	137
		4	DETECTED	113	1522
		8	DETECTED	40	1570
		24	DETECTED	64	733

[a]Benzoylecgonine.
[b]Not Detected.

specialists, are shown in Table 5. Cocaine and benzoylecgonine were not detected in any of the specimens by EMIT and GC/MS analysis. This was not surprising because both specialists were wearing gloves and dusted for latent fingerprints from 80 unopened cocaine packages.

The results of group VI, involving 4 non-narcotics criminalists working on simulated 25 and 50 kilo cases, are shown in Table 6. Urine specimens of subject A showed no trace of cocaine or benzoylecgonine, while the ambient air in the narcotics laboratory was determined to be at 68 nanograms of cocaine per liter of air. Urine specimens of subject B, wearing no gloves or face mask, showed a maximal benzoylecgonine level of 101 ng/mL at 12 h by GC/MS. None of the urine specimens gave a positive response by immunoassay at 300 ng/mL threshold. The air sample was monitored at 4400 nanograms of cocaine per liter of air. Urine specimens of subject C, wearing gloves and face mask, showed a maximal benzoylecgonine concentration of 39 ng/mL at 6 h by GC/MS while the air sample showed a concentration of 3800 nanograms of cocaine per liter of air. Urine specimens of subject D, wearing gloves, face mask, and goggles, showed a maximal cocaine concentration of 38 ng/mL at 12 h and a maximal benzoylecgonine concentration of 122 ng/mL at 48 h. The air sample was determined to be at 6400 nanograms of cocaine per liter of air.

TABLE 4—*Results of EMIT and GC/MS analysis of discrete urine specimens of two narcotics criminalists on a 9 kilo cocaine case (Group IV).*

Subject	Protective Equipment	Time (h)	EMIT Cutoff Level (300 ng/mL)	Concentration by GC/MS (ng/mL)	
				Cocaine	BEC[a]
A	Gloves	0	ND[b]	ND	ND
	Mask	1	ND	ND	ND
		4	ND	ND	ND
B	Gloves	0	ND	ND	ND
	Mask	1	ND	ND	ND
	Goggles	4	ND	ND	ND

[a]Benzoylecgonine.
[b]Not Detected.

TABLE 5—*Results of EMIT and GC/MS analysis of discrete urine specimens of two fingerprint identification specialists who dusted latent prints on 80 unopened cocaine packages (Group V).*

Subject	Time	EMIT Cutoff Level (300 ng/mL)	Concentration by GC/MS (ng/mL)	
			Cocaine	BEC[a]
A	Pre Exposure	ND[b]	ND	ND
	Post Exposure	ND	ND	ND
B	Pre Exposure	ND	ND	ND
	Post Exposure	ND	ND	ND

[a]Benzoylecgonine.
[b]Not Detected.

TABLE 6—*Results of EMIT and GC/MS analysis of four air samples and discrete urine specimens of four criminalists who worked on simulated 25 kilo and 50 kilo cocaine cases (Group VI).*

Subject	Air Sample (ng/L)	Protective Equipment	Time (h)	EMIT	Concentration (ng/mL)	
					Cocaine	BEC[a]
A	68	None	0	ND[b]	ND	ND
			1	ND	ND	ND
			6	ND	ND	ND
			12	ND	ND	ND
			24	ND	ND	ND
			48	ND	ND	ND
			72	ND	ND	ND
B	4400	None	0	ND	ND	ND
			1	ND	ND	ND
			6	ND	ND	98
			12	ND	ND	101
			24	ND	ND	36
			48	ND	ND	ND
			72	ND	ND	ND
C	3800	Gloves	0	ND	ND	ND
		Mask	1	ND	ND	ND
			6	ND	ND	39
			12	ND	ND	28
			24	ND	ND	ND
			48	ND	ND	ND
			72	ND	ND	ND
D	6400	Gloves	0	ND	ND	ND
		Mask	1	ND	ND	ND
		Goggles	6	ND	ND	42
			12	ND	38	67
			24	ND	ND	110
			48	ND	ND	122
			72	ND	ND	ND

[a]Benzoylecgonine.
[b]Not Detected.

The data on subject C show some degrees of protection from cocaine exposure through the use of gloves and a face mask as compared to the data on subject B. The levels of airborne cocaine dust generated by subjects B and C were similar in concentration. Data on subject D show exposure despite the use of gloves, face mask, and goggles. There was almost twice the amounts of airborne cocaine dust generated by subject D as compared to subjects B and C. This data shows that the chance of exposure increases with the volume of cocaine handled and the amounts of cocaine dust in the air. This data also demonstrates that some absorption occurred despite protective equipment.

The results of group VII, involving urine specimens of three non-narcotics criminalists working on a simulated 25 kilo cocaine case, are shown in Table 7. None of the urine specimens from subjects A, B, or C gave a positive response by immunoassay at the 300 ng/mL cut-off level. Trace amounts of cocaine were detected in urine specimens of subjects A and B, but not in the urine specimens from subject C. Benzoylecgonine was detected in subjects A, B, and C. Subject A showed the highest concentration of 114 ng/mL at 12 h. This data shows that small degrees of cocaine exposure can occur in spite of using gloves, face mask, goggles, disposable gown, and disposable cap.

Our study has shown that exposure to cocaine involving crime lab personnel does exist. The levels of absorption in most instances, would be so low that they would not produce positive results for benzoylecgonine by immunoassay at a 300 ng/mL cut-off value. Low levels of benzoylecgonine could, however, be detected by GC/MS. We also learned that prolonged exposure to airborne cocaine dust could produce significant urinary cocaine and benzoylecgonine concentrations, as shown in Table 3. This study emphasizes the need to use caution when dealing with cocaine evidence, especially when working on large cocaine-seizure cases. Limiting the generation of airborne cocaine dust has been proven effective in reducing the levels of exposure as demonstrated in Table 4. It is also important to point out that criminalists can significantly limit the amounts of exposure to cocaine by wearing a face mask, latex gloves, safety goggles/glasses, and a lab coat when actively analyzing cocaine evidence.

TABLE 7—*Results of EMIT and GC/MS analysis of discrete urine specimens of three criminalists who worked on a 25-kilo cocaine case with full protective equipment (Group VII).*

Subject	Protective Equipment	Time (h)	EMIT	Concentration (ng/mL) Cocaine	BEC[a]
A	Gloves, Mask	0	ND[b]	ND	ND
	Disposable Cap,	1	ND	ND	ND
	Disposable Gown,	6	ND	44	98
	Goggles	12	ND	60	114
		24	ND	ND	90
		48	ND	ND	62
		72	ND	ND	54
B	Gloves, Mask	0	ND	ND	ND
	Disposable Cap,	1	ND	ND	ND
	Disposable Gown,	6	ND	50	62
	Goggles	12	ND	ND	82
		24	ND	ND	27
		48	ND	ND	65
		72	ND	ND	41
C	Gloves, Mask	0	ND	ND	ND
	Disposable Cap,	1	ND	ND	ND
	Disposable Gown,	6	ND	ND	27
	Goggles	12	ND	ND	ND
		24	ND	ND	ND
		48	ND	ND	ND
		72	ND	ND	ND

[a]Benzoylecgonine.
[b]Not Detected.

Although this study presents important data on exposure to cocaine, more extensive studies will need to be done to establish a correlation of the effectiveness of protective equipment in preventing ingestion of cocaine from known air concentrations.

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