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ORIGINAL ARTICLE

# Cocaine surface contamination and the medico-legal implications of its transfer

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## KEYWORDS

Cocaine;  
Contamination;  
Drug testing;  
Hair;  
Sweat patch

**Abstract** The question posed by this research involves how frequently one can expect to contact cocaine in day-to-day living experiences where drug use may not normally be suspected. Issues concerning contamination are germane to medico-legal investigators who evaluate the significance of drug test results in (1) questioned deaths, (2) public health concerns, (3) drugs crimes, and (4) drug use toxicological tests potentially caused by external contamination, such as hair, sweat, and skin swabs. Previous surface studies focus mainly on currency drug contamination; few have addressed other common surfaces.

Public surfaces handled by a large number of people, such as building entrance door handles, bank currency dispensing machines, food store shopping carts, and service station fuel pumps within the New Haven, Connecticut metropolitan area were tested. Socio-economically, the distribution of items tested ranged from working-class to upper-middle class areas. Results were obtained using the Securetec Drugwipe II<sup>®</sup> which is an immunological, on-site test device. Precautions were taken to avoid carry-over and other potential contamination from handling including single-use latex gloves which were pre-tested as a negative control immediately before swabbing. Analysis was performed according to the manufacturer's instructions and in the laboratory to standardize conditions. Drugwipe II<sup>®</sup> limit of detection (LOD) is ~50 ng.

Test results revealed 78% positive for cocaine substances as follows: fuel pump buttons for credit card authorization, 100% positive ( $n = 10$  individual locations); ATM machines for currency withdrawal, 100% positive ( $n = 10$  individual locations); grocery store shopping carts, 70% positive; academic building entrance doors, 30% positive ( $n = 10$ ); and shopping mall entrance/exit doors, 100% positive ( $n = 5$ ).

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Forensic scientists and medico-legal investigators responsible for interpreting surface test results are cautioned to consider contamination before ascribing drug activity to a specific individual. For legal proceedings these results are indicative but not conclusive because immunological tests are considered presumptive and may react with the parent substance (cocaine), related compounds (benzoylecgonine, ecgonine methyl ester, ecgonine, nor-ecgonine, and cocaethylene) and immunologically similar materials.

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## 1. Introduction

Increasingly sensitive analytical tests for toxic chemicals and legally proscribed substances allow medico-legal investigators to use novel specimens such as skin and surface swabs, hair, nails. In questioned deaths, for example, forensic pathologists have established hair morphine concentrations using immunoassay and high performance liquid chromatography, comparing fatal/acute overdose cases with chronic heroin use where drug tolerance permits higher dosage.<sup>1</sup> Medico-legal public health concerns of heavy metal exposures have been studied in traffic control personnel;<sup>2</sup> school children living near a hazardous waste incinerator;<sup>3</sup> myocardial infarction cases;<sup>4</sup> occupationally exposed workers;<sup>5,6</sup> and a population of school children, adults, and workers at Aswan, Egypt,<sup>7</sup> all using either atomic absorption or atomic emission/inductively couple plasma spectroscopic analyses of hair or nails.

Drugs and drug metabolites in hair were initially thought to originate exclusively from within the body, i.e. from ingestion.<sup>8,9</sup> Over the past 15 years studies implicate external contamination's role in undermining the reliability of hair<sup>10,11</sup> as well as sweat patch<sup>12,13</sup> test results. Unless the origin and transfer modes are known unequivocally, few definite conclusions can be drawn from the presence of drugs and metabolites beyond "exposure." Drug residues, cocaine in particular, once thought to be limited to the environments of users and traffickers have been found on most of the circulated currency bills in the USA.<sup>14,15</sup> Since very little has been published on the topic, this research asks the question, "How widespread is the problem of surface drug contamination?"

## 2. Materials and methods

Sites chosen in the New Haven, Connecticut metropolitan area for surface cocaine testing included 10 bank currency dispensing machines (ATMs), the push buttons from 10 individual fueling establishments, 10 food store carts, 10 academic building entrance doors, and five shopping mall entrance doors. Individual locations represented a diverse socioeconomic spectrum. A new pair of disposable latex gloves was worn for each sample collection. Prior to sample collection for the study, negative controls were obtained by swabbing each pair of new gloves. Surfaces were tested with individual DrugWipe II<sup>®</sup> test devices according to the manufacturer's instructions,<sup>16</sup> capped, and stored at ambient room temperature. DrugWipe II<sup>®</sup> technology is based on immunoassay testing similar to early pregnancy (EPT) tests commercially available to the general public and has a stated limit of detection (LOD) of ~50 ng. Immunoassay development was conducted in a laboratory

under standardized, controlled conditions, following the manufacturer's instructions.

## 3. Results

Shown in Table 1, tests resulted in 78% positives for cocaine substances on the external surfaces examined in this study; of 45 surfaces tested, 35 were positive for cocaine. Fuel pump buttons (for credit card authorization) caused 100% positive results ( $n = 10$ ). Ten different service stations were tested. Similarly, ATM machines for cash withdrawal resulted in a 100% positive rate ( $n = 10$  individual locations). From shopping carts, there were seven out of 10 positives (70%). Academic building entrance doors showed the lowest positive frequency at 30% ( $n = 10$ ). Shopping mall entrance/exit doors tested positive in every instance (100%,  $n = 5$ ).

## 4. Discussion and conclusions

Three scenarios may provide insight to these results. First, primary transfer to these objects occurs when a cocaine-contaminated person touches it. But how does that person become contaminated? Next, secondary transfer occurs when an uncontaminated person touches a contaminated object or person, whether knowingly or unknowingly, and then transfers it to an object or person. Tertiary transfer is defined as contamination present on an object or person after a third transfer from the original source. Touching a sticky substance like honey can result in a transfer sequentially to objects, then people, then to objects, repeatedly. Drug contamination is insidious in that it does not feel sticky. Nor does it leave visible colors as would a similar quantity of dye. Only through proper analytical testing can one "see" if contamination is present and how much. The potential for contamination can affect the reliability of forensic analyses for drugs. In addition, the laboratory which claimed to find explosive residues implicating those convicted in Northern Ireland bombings were found to be compromised by contaminated laboratory instrumentation.<sup>17</sup>

Cocaine quantities found on United States paper currency are illustrated in Table 2.<sup>15</sup> One currency bill contained

**Table 1** Test results.

Type of location	Positive for cocaine	Total # of DrugWipe <sup>®</sup> II
Academic buildings	3	10
Gas stations	10	10
ATM's	10	10
Shopping carts	7	10
Shopping mall	5	5

**Table 2** Cocaine concentrations in United States Paper Currency (\$1 denominations) from selected cities.

City	Number positive (> 100 ng/bill)	#Pos. (> 1000 ng /bill)	Mean amount (ng /bill)	Range (ng /bill)
Baltimore, MD	9	9	75,700	0–597,000
Miami, FL	3	2	2500	0–13,100
Chicago, IL	7	4	700	0–2200
Honolulu, HI	10	5	3000	200–9900
Kansas City, KS	9	8	6300	0–24,300
Las Vegas, NV	9	5	3900	0–13,900
Los Angeles, CA	9	6	3900	0–11,400
Minneapolis, MN	8	6	63,800	0–559,800
Spanish Fort, AL	9	7	9000	0–70,300
Pittsburgh, PA	4	1	400	0–2600
Yellowstone, WY	5	2	1900	0–14,500
Whitefish, MT	7	4	900	0–3000
Portsmouth, OH	10	9	136,900	500–1,327,000

From: A.J. Jenkins, Drug contamination of US paper currency, *Forensic Science International* 121 (2001) 189–193.

1,327,000 ng of cocaine. This amount overwhelmingly exceeds the 50 ng LOD of this research and the 1–50 ng cocaine detection capability of a modern forensic laboratory, at which specimens such as hair and suspected drug paraphernalia may be reported “positive” for cocaine or other drugs. Hair tests are reported “positive” at or above 0.5 ng cocaine/mg. Affected are virtually all techniques with a “cutoff” or “reporting” concentrations sufficiently low as to compete with contamination levels.

Locard’s concept of associative evidence, that “every contact results in a transfer,”<sup>18</sup> is a foundation of modern forensic science. However, Locard’s Exchange Principle can be a double-edged sword when contamination is considered. Throughout the past century, when investigators armed with sufficiently sensitive analytical techniques “look”, they “find”. Unfortunately, without controlled, scientific testing investigators may assume that contamination is unlikely or, even worse, report that it is further proof of drug crimes. As a forensic scientist, “...the expert knows and argues that he knows the truth, but only within the limits of the risks of error inherent to the technique.”<sup>18</sup> Without information about contamination the error rate is unknown. As a precaution, forensic scientists and investigators responsible for interpreting test results may wish to exercise discretion when ascribing drug activity to a specific individual based on surface testing.

These results are indicative but not conclusive for use in legal proceedings because immunological tests are considered presumptive and may react with the parent substance (cocaine) and immunologically related compounds (benzoylecgonine, ecgonine methyl ester, ecgonine, nor-ecgonine, and cocaethyl-ene) and immunologically similar materials.

Further planned research into the causes of drug surface contamination include the frequency and effectiveness of surface cleaning, the numbers of people touching the surfaces, the effect of sweat, the degree to which liquid sweat may facilitate contamination transfer, and transfer rates under controlled conditions. Another topic of planned future research is the analysis of paper currencies worldwide as a window into drugs circulating among individual countries’ populations. Other analytes for further surface contamination research which might provide fruitful results include precursors used in clandestine drug laboratories as well as explosives residues. It is anticipated that future contamination research will be

brought to bear to achieve the highest standards of practice in cause-of-death determinations, drugs crimes, risks to public health, and drug-use status assessment of individuals, living and deceased.

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