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THE SWEAT MATRIX: A NEW CHANCE FOR WORKPLACE DRUG TESTING?

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URINE

Biological matrix usually employed in WDT Validated both in Europe and internationally WINDOW OF DETECTION : several days





 99% water with most concentrated solute being sodium chloride

- produced by ECCRINE AND APOCRINE glands

-secretory canals flow into the skin surface and hair follicles

-sebaceous glands distributed through the body disproportionately



Sweat is eliminated through the skin: OUTER EPIDERMIS INNER DERMIS - Adipose layer under the dermis **Blood** vessels pass into and through this layer



- SWEAT SECRETION important homeostatic mechanism for maintaining a constant core body temperature to a narrow physiological range

- AMOUNT OF SWEAT highly variable and dependent upon daily activity, emotional state and environmental temperature....







 ENDOGENOUS and EXOGENOUS chemicals are secreted in sweat

• Year 1911: researchers established that drugs are excreted by the body in sweat, but many analytical and practical problems mainly due to the difficulty in collecting skin excretions

 Year 1990 a non occlusive sweat collection device (patch) was developed

MECHANISM OF INCORPORATION:

- under normal condition in sweat with a mean pH of 6.3 (more acidic than blood) basic drugs tend to accumulate
- excretion into sweat depends upon a drug's physicalchemical properties such as molecular mass, pKa, protein binding and lipophility
- **PARENT DRUG** accumulate in sweat in greater concentrations

DIFFERENT TIME INTERVAL between drug consumption and detection on the skin surface

COLLECTION DEVICES

> to detect recent use of drugs (< 24 hours) and involves only collection of sweat at a point in time (to identify individuals who are under the influence of drugs) DRUGWIPE > to monitoring the illicit drug use for time window wider - SWEAT PATCHES can be worn for up to one week or even fourteen days-



Device is a pen size, immunochemical based test strip used for the detection of drugs of abuse on surface. The wiping part enables the user to sample drug particles from any kind of surface (skin)

- Easy to use, results after two minutes.



SWEAT PATCHES

absorbent cotton pads

sandwiched between a

waterproof, polyurethane,

outer layer and a porous

inner layer that is placed

against the skin











"PharmCheck" sweat patch was marketed as a non occlusive sweat collection:

- a medical-grade cellulose blotted paper collection pad covered by a thin layer of polyurethane and acrylate adhesives
- absorption pad consists of inert cellulose that retains the non volatile components of sweat collected from the surface of the skin



ADVANTAGE

- high subject acceptability
- low incidence of allergic reactions
- monitor drug intake for a period of several
- weeks with a single patch
- Chain of custody guaranteed

















ADVANTAGES OF THE PATCH

- NO skin irritation
- NO environmental contamination during wear
- NO removed and successfully reapplied to the skin surface
- Chain of custody (unique nine-digit-number printed under the polyurethane layer)

DISADVANTAGES OF THE PATCH

- high inter-subject variability,
- possibility of environmental contamination of the patch before the application or after removal
- risk of accidental removal during a monitoring period
- quantitative analysis is not useful
- NO measurement of the volume of sweat
- Insufficient literature data about degradation of drugs

TIME WEARING

 It was not established the optimal time of wearing sweat patches and DEPENDS ON DRUG USE PATTERN AND DIFFERENT ILLICIT DRUGS

- Analyte concentrations increase significantly with increasing lengths of wear

TIME WINDOW

Time window depends in part on drug use pattern - patch identify only some of occasional drug use episodes and all of the frequent chronic userson the contrary daily urinalysis identify chronic, occasional and no-use

SCREENING TESTS

Immunoassays mainly commercialized for urine samples were also applied to sweat to detect some drugs :

- RIA and microplate enzyme immunoassay
- newer non isotopic commercial immunoassays
- Enzyme-Linked Immunosorbent Assay (ELISA)adapted for detection of analytes in sweat patches
- a modified manual Microgenics CEDIA, Cozart , OraSure ELISA

CONFIRMATORY ANALYTICAL Techniques

- GC/MS Gas chromatography -mass spectrometry
- LC/MS Liquid chromatography-mass spectrometry

INTERPRETATION > duration of patch wear > variability in sweat production > stability of drugs on the patch > unknown amount collected-NO quantitative analysis > low volume of sweat (difficulty for an independent retest) > possibility of environmental contamination of patch

INTERPRETATION

- after chronic exposure lipophilic drugs may be stored in adipose tissue - false positive results
- false positive interpretations may arise from prior presence of drugs on the exterior of the skin
- parent drug is often detected as the major analyte in the sweat patch
- stability (drugs may be degraded by enzymes in sweat, bacteria inside the patch or humid environment)

FORENSIC APPLICATIONS

- roadside drug testing -ROSITA project-
- workplace drug testing
- crime under influence
- psychiatric disorders
- doping context
- drug related deaths
- drug use in pregnancy

SWEAT AND WORKPLACE DRUG TESTING

- urine matrix
- national laws provide the step of drug-testing programs (only a few countries use of alternate biological matrices)
- 2001 Cone EJ. reviewed national and local laws of many countries providing the employ of drug testing programs (Cone, E.J. Legal, workplace, and treatment drug testing with alternate biological matrices on a global scale. For. Sci. Int. 2001, 121)
- 2001 Caplan Y.H., et al.: oral fluid, hair and sweat appear to sufficiently meet the requirements to be employed
- 2004 S.A.M.H.S.A. published a notice in the Federal Register proposing to establish also scientific and technical GUIDELINES for the testing of alternative matrices (like sweat) in addition to urine specimens

CONCLUSION

- qualitatively monitor illicit drug use
- continuous drug testing over a longer period (up to 7-14 days) than urine or saliva
- non-invasive means of obtaining information about drug exposure
- sweat patches are readily accepted by subjects limiting the number of required monitoring visits
- easy to collect and difficult to adulterate compared to traditional specimens
- no violations of privacy
- facilities for transporting noxious body fluids



- MANY PROBLEMS TO BE RESOLVED : sweat matrix is limited for routinary employ
- LACK OF EUROPEAN MANDATORY GUIDELINES
- U.S.A, SAMHSA issued mandatory guidelines for the federal workplace drug testing programs for sweat testing
- Currently in ITALY sweat testing is routinary employed in CLINICAL DIAGNOSIS of cystic fibrosis (NO for DIAGNOSIS of ADDICTION)



Continuing improvements in sweat collection and testing methods may be desirable in the near future.