POCT and Drugs of Abuse

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POCT and Drugs of Abuse (DOA)

- For many settings, the availability of POCT devices, designed to detect abused drugs in urine, is an attractive alternative to collection, transport, and subsequent laboratory analysis

NACB Guidelines POCT 2007 (Chapter 7)

Classification of POCT devices

- According to technology
  - agglutination reaction
  - chromogenic antibodies
  - chromogenic drug-conjugates
  - ……

- According to result evaluation
  -visual reading
  -semi-automated or automated endpoint reading

Sample

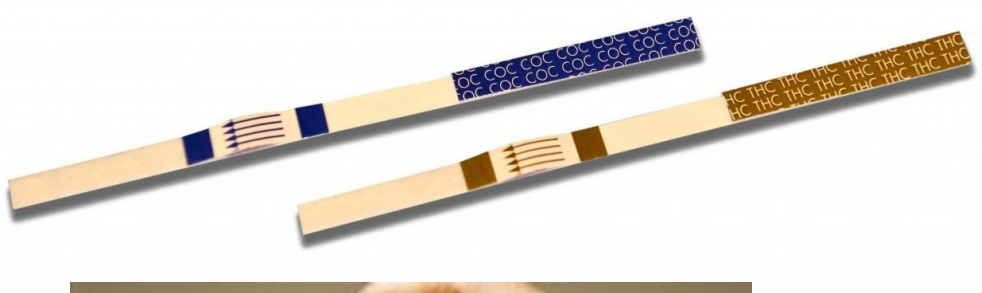
- **Urine**
- Saliva (oral fluid)
- Breath
- Sweat
- Other matrices

Technical solutions

- Strips and dip cards
- Cassette devices
- Test cups
- Automated readers

Strips and dip cards

- Similar to classic urine analitics
- Easy use
- Possible contamination
- Problems with absorbents



Cassette devices

- Pipette applied device
- Manual use of a disposable transfer pipette to apply the urine sample to the absorbent pad
- Single or multidrug devices
- Mistakes regarding the same optical appearance

Test cup

- Immunoassay POCT device is built into a collection container
- No manual intervention
- Special seal for Chain of custody
- High costs

Automatic readers

- Closed or open systems
- No subjectivity

Lateral flow immunoassay (LFI)

- The technical basis of the LFI was derived from the latex agglutination assay
- RIA Yalow and Berson (end of 50s)
- Major patents on this technology (early 80s)
- The main application driving the early development was the human pregnancy test

Architecture of LFI

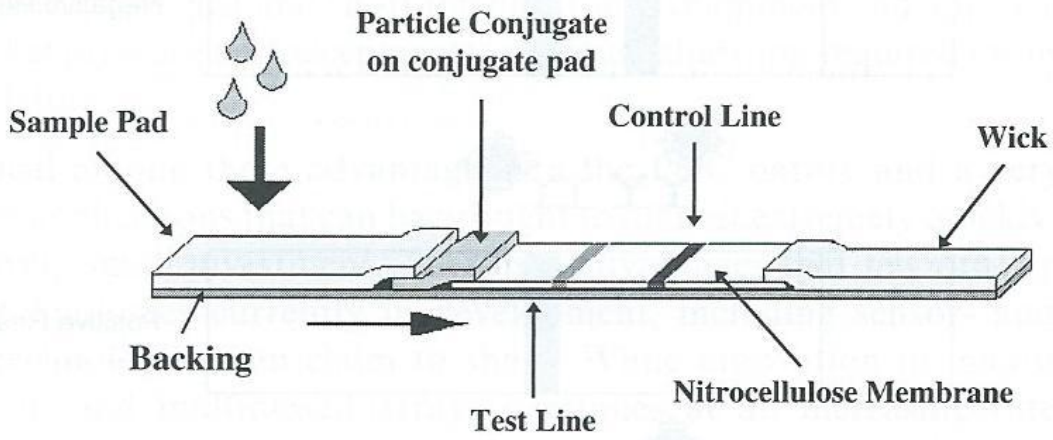


Fig. 1.1 Typical configuration of a lateral flow immunoassay test strip

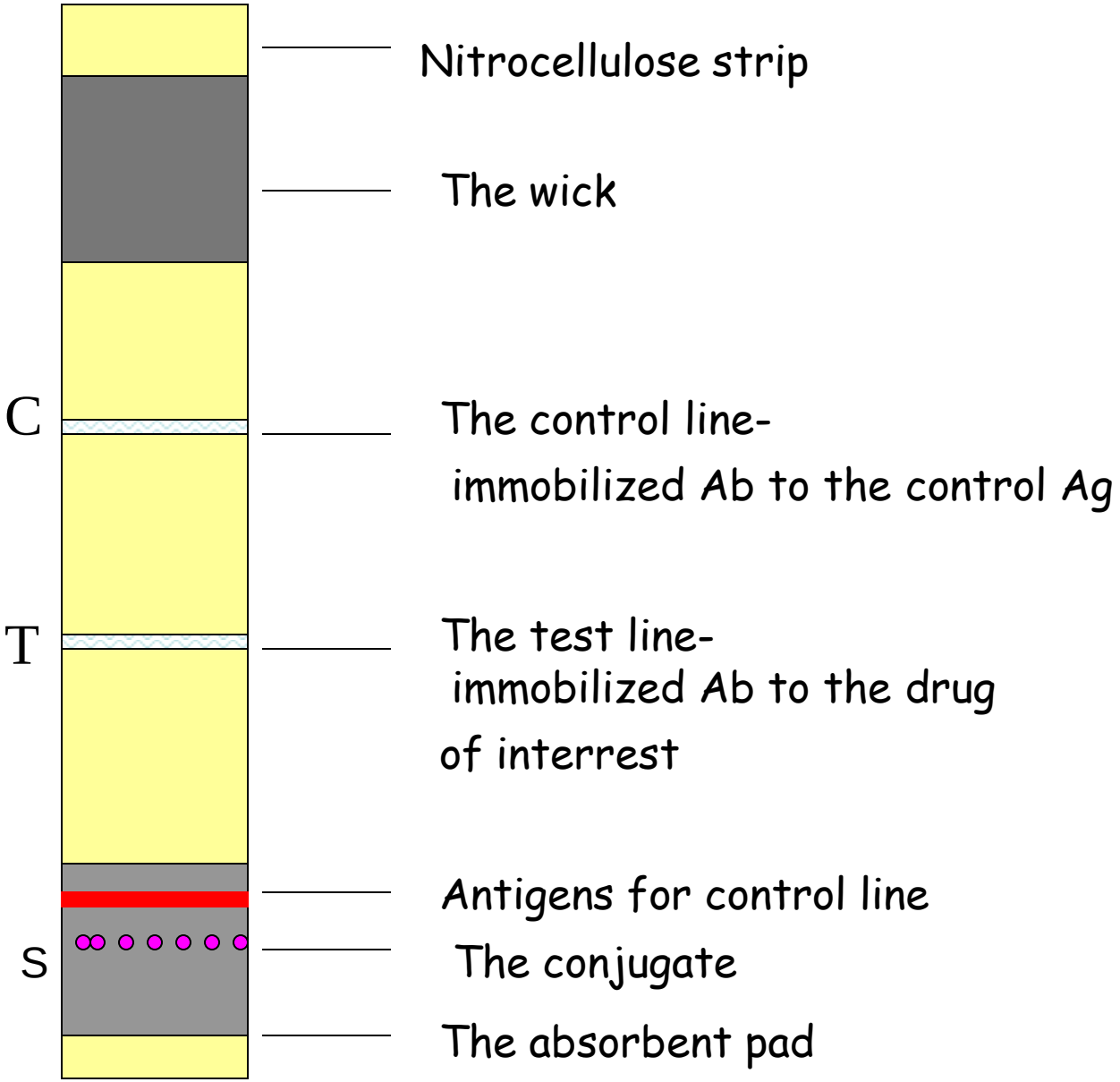
from: Lateral Flow Immunoassay. Ed.by Wong and Tse. Humana Press 2009, p3

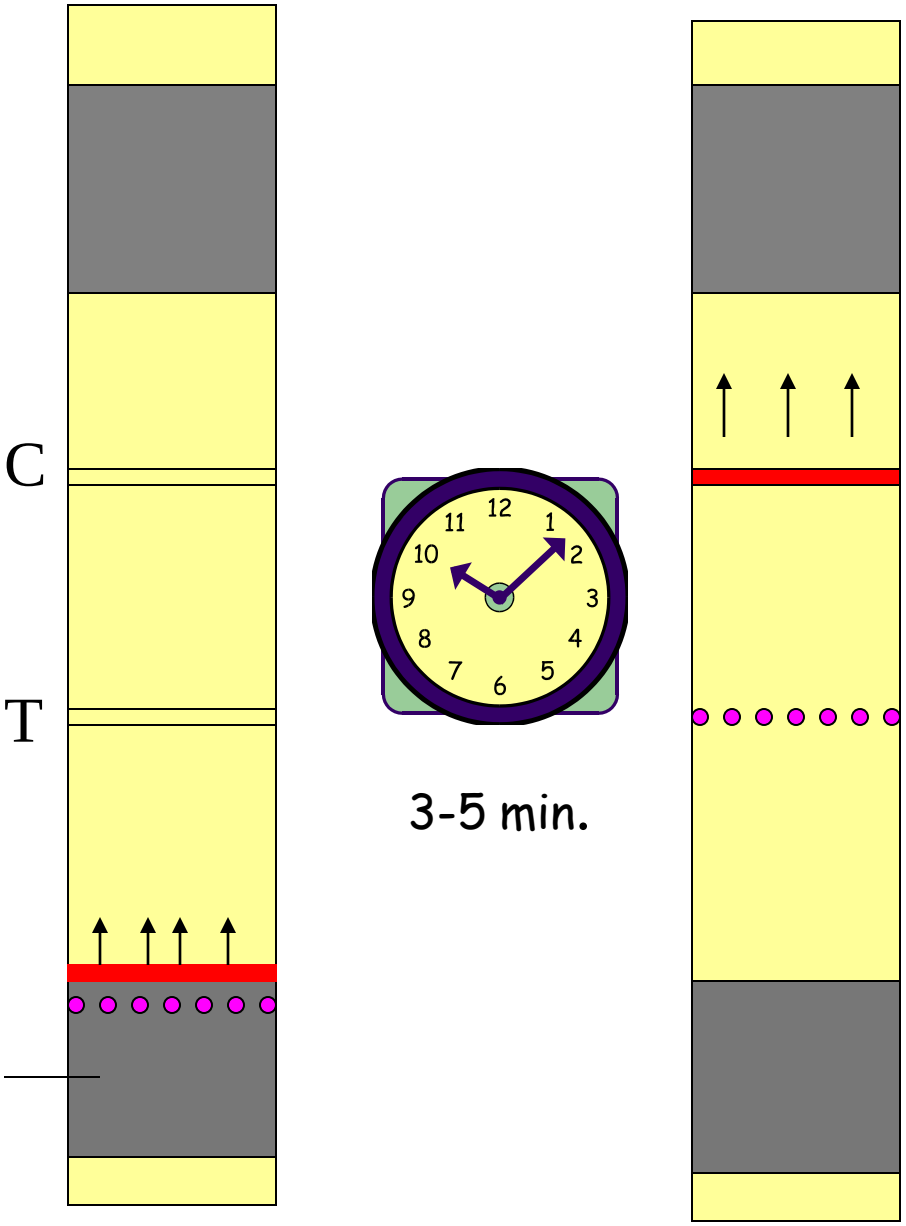
Assay components

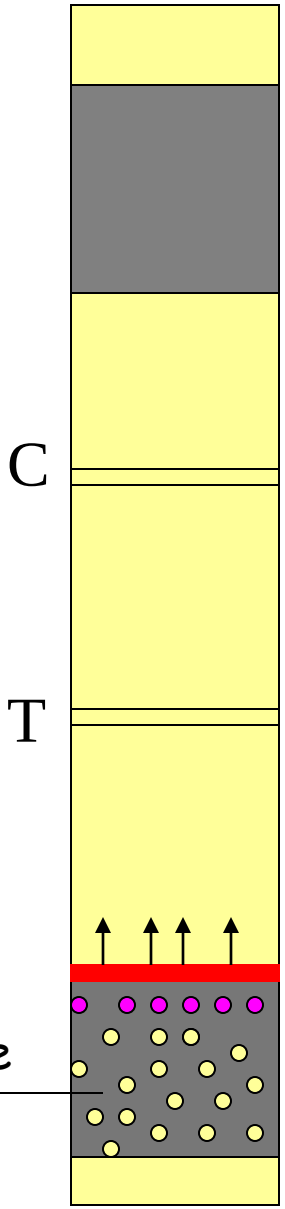
- The membrane
- The sample pad
- The backing materials
- The conjugate pad
- The wick
- Labels for detection

Immunoassay

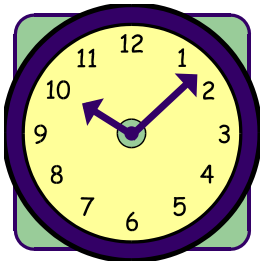
- Competitive solid-phase (inhibition) IA
- Direct-sandwich IA


Nitrocellulose strip
The wick
C
The control line-
immobilized Ab to the control Ag
T
The test line-
immobilized Ab to the drug
of interrest
Antigens for control line
S
The conjugate
The absorbent pad

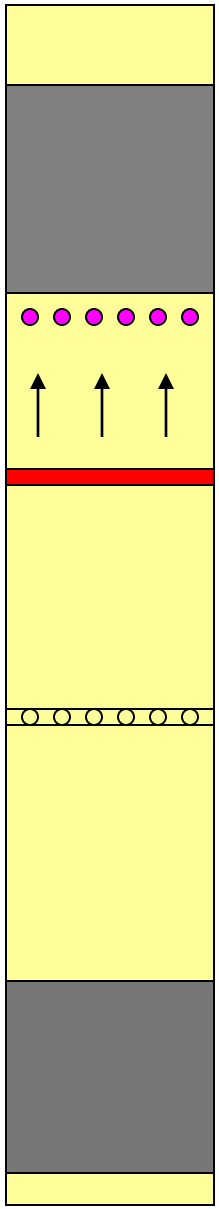

C
T
No drug in urine
3-5 min.
The control line is present= test OK
The colored line is present= the test result is NEGATIVE



Positive sample-the drug is present in urine



3-5 min.



The control line is present= test OK

No visual line on test line = the test result is POSITIVE

+

Analytes and Their Cutoffs

Effective Date: October 1, 2010

Reference: Federal Register, November 25, 2008 (73 FR 71858), Section 3.4

Initial test analyte	Initial test cutoff concentration	Confirmatory test analyte	Confirmatory test cutoff concentration
Marijuana metabolites	50 ng/mL	THCA[1]	15 ng/mL
Cocaine metabolites	150 ng/mL	Benzoylecgonine	100 ng/mL
Opiate metabolites Codeine/Morphine[2]	2000 ng/mL	Codeine Morphine	2000 ng/mL 2000ng/mL
6-Acetylmorphine	10 ng/mL	6-Acetylmorphine	10 ng/mL
Phencyclidine	25 ng/mL	Phencyclidine	25 ng/mL
Amphetamines[3] AMP/MAMP[4]	500 ng/mL	Amphetamine Methamphetamine[5]	250 ng/mL 250 ng/mL
MDMA[6]	500 ng/mL	MDMA MDA[7] MDEA[8]	250 ng/mL 250 ng/mL 250 ng/mL

[1] Delta-9-tetrahydrocannabinol-9-carboxylic acid (THCA).
[2] Morphine is the target analyte for codeine/morphine testing.
[3] Either a single initial test kit or multiple initial test kits may be used provided the single test kit detects each target analyte independently at the specified cutoff.
[4] Methamphetamine is the target analyte for amphetamine/methamphetamine testing.
[5] To be reported as positive for methamphetamine, a specimen must also contain amphetamine at a concentration equal to or greater than 100 ng/mL.
[6] Methylenedioxymethamphetamine (MDMA).
[7] Methylenedioxyamphetamine (MDA).
[8] Methylenedioxyethylamphetamine (MDEA).

http://workplace.samhsa.gov/DrugTesting/pdf/2010GuidelinesAnalytesCutoffs.pdf

Interferences and cross-reactivity

- Interferences could arise from chemicals (matrix effect) and other methods of adulteration/manipulation
- Cross-reactivity to drugs and metabolites
- *NACB guideline 85: users of POCT devices need to be aware of any known interferences from drugs or metabolites that could affect result interpretation*

POCT device evaluation and method validation

- Comparisons between POCT measurement and result obtained using instrument based immunoassay
- Sensitivity, specificity, efficiency, ease of operation
- Only discordant samples-results were evaluated
- Only trained laboratory personnel included

Use of POCT for detection of DOA

- Clinical settings (ED, visiting nurses, transport vehicles …)
- Non-clinical settings (WDT, prisons, army, police (DRUID), security, at home …

Alternative matrices

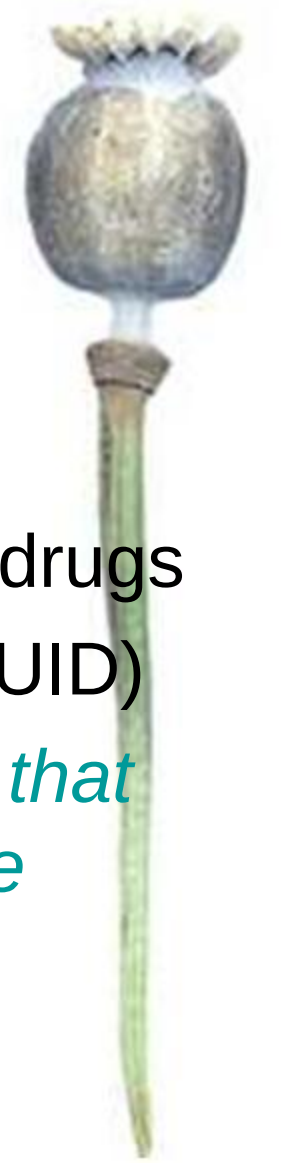
- *Urine is the best established matrix for POCT*
- *If alternative matrices are to be used, the antibodies and cutoffs must be optimized to detect the parent drug or metabolite most abundant in that matrix.*

NACB Guidelines

New technologies

- None of the POCT devices currently available are sufficiently specific to be considered a confirmatory test, with exception ob breath-alcohol analyzers.
- Other measuring principles (NIR etc.)
- Oral fluid devices
- Breath analyzers

Oral fluid devices



- Ease to use in real world applications
- Fast
- Significant interest in the field of detecting driving under the influence of drugs
- 2 big studies (ROSITA-ROSITA 2 and DRUID)
- *The results from ROSITA 2 study showed that none of the available POCT devices where suitable for DRUID detection.*

Journal of Analytical Toxicology, Vol. 34, June 2010

Amphetamines Detected in Exhaled Breath from Drug Addicts: A New Possible Method for Drugs-of-Abuse Testing

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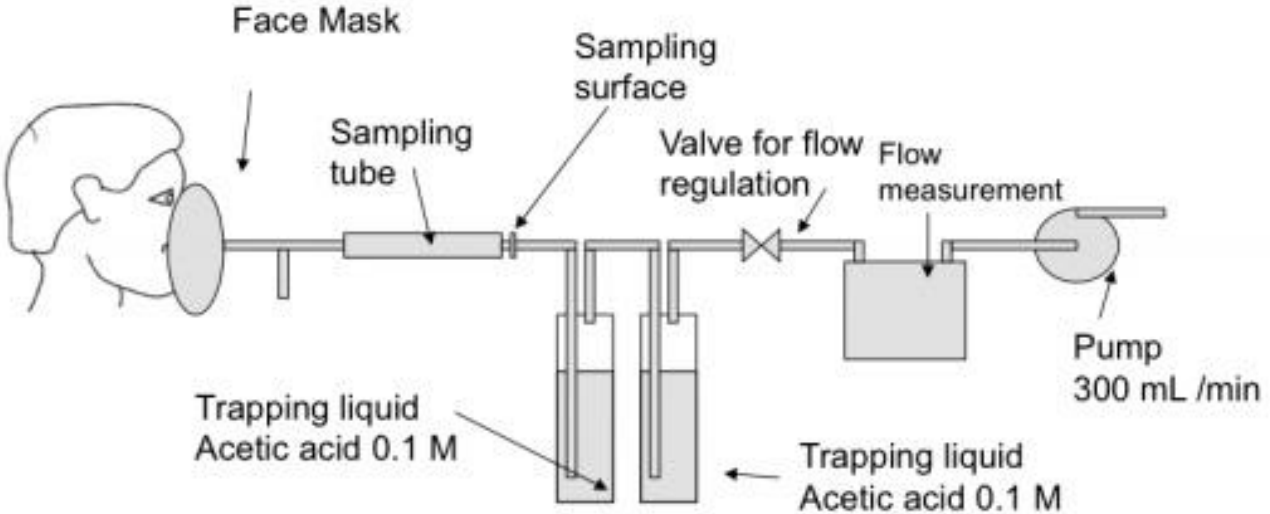

Figure 1. Outline of the sampling device used to collect exhaled breath samples on a modified silica surface (SPEC DAS cartridge). The subject was able to breath normally during the sampling time. Any expired saliva was trapped in the mask.

IOP PUBLISHING JOURNAL OF BREATH RESEARCH

J. Breath Res. 7 (2013) 026006 (11pp) doi:10.1088/1752-7155/7/2/026006

Detection of drugs of abuse in exhaled breath using a device for rapid collection: comparison with plasma, urine and self-reporting in 47 drug users

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Drugs of Abuse (DOA)

- A drug that is taken for nonmedicinal reasons (usually for mind-altering effects);
- Drug abuse can lead to physical and mental damage and (with some substances) dependence and addiction.

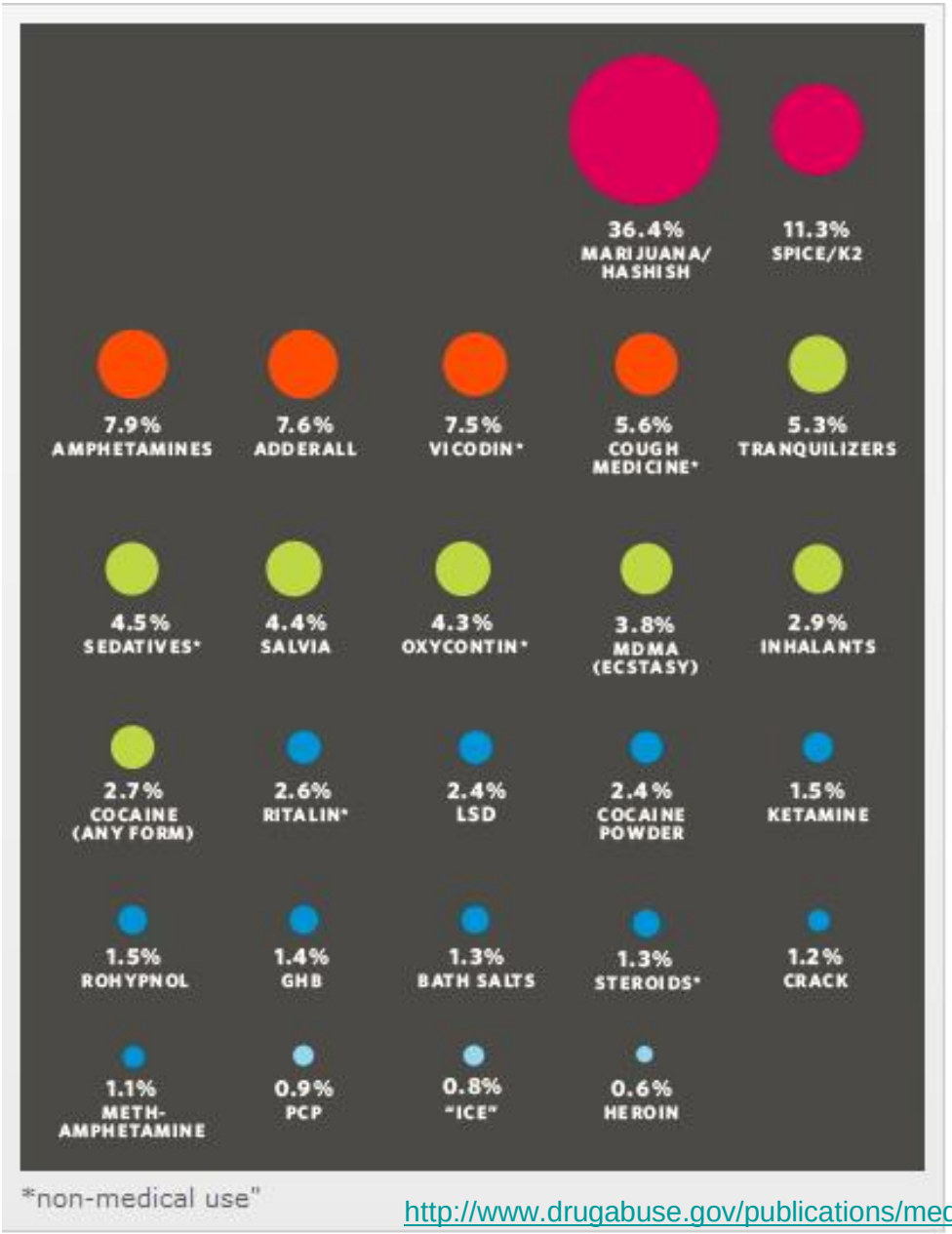
Drugs of Abuse

- *Alcohol*
- Amphetamines
- Barbiturates
- Benzodiazepines
- Cannabis
- Cocaine
- Ketamine
- LSD
- Methadone
- Opiates
- Propoxyphene

Designer drugs – new kids in town

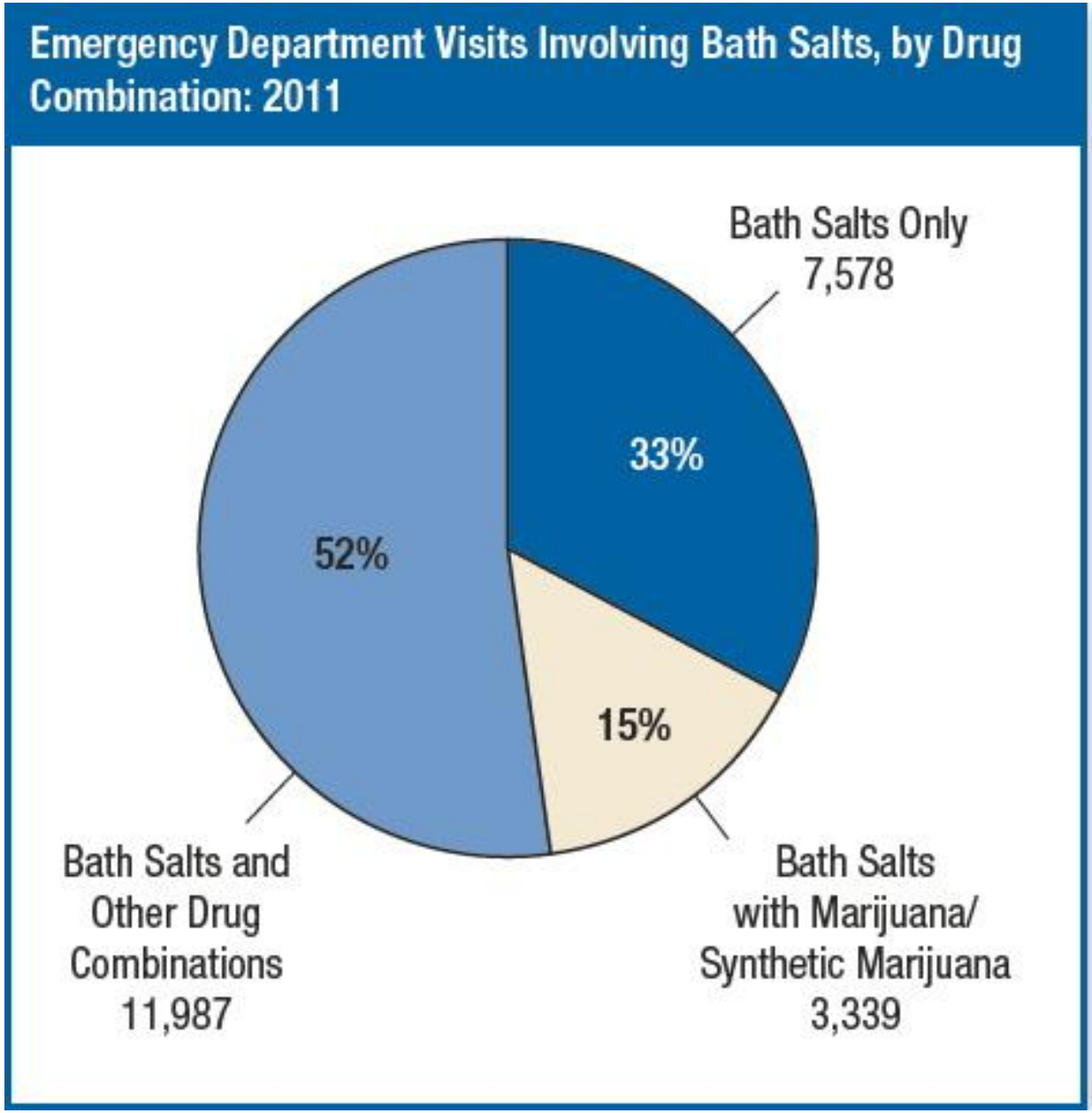
- Cannabinoids
- Cathinones
- GHB
- Piperazines
- Bath Salts, K2-Spice…
- “Natural products”

Commonly abused drugs



http://www.drugabuse.gov/publications/media-guide/commonly-abused-drugs

USA - Nearly 23000 ED visits in 2011



European Monitoring Centre for Drugs and Drug Addiction

EUROPOL

New drugs in Europe, 2012

EMCDDA–Europol 2012 Annual Report on the implementation of Council Decision 2005/387/JHA

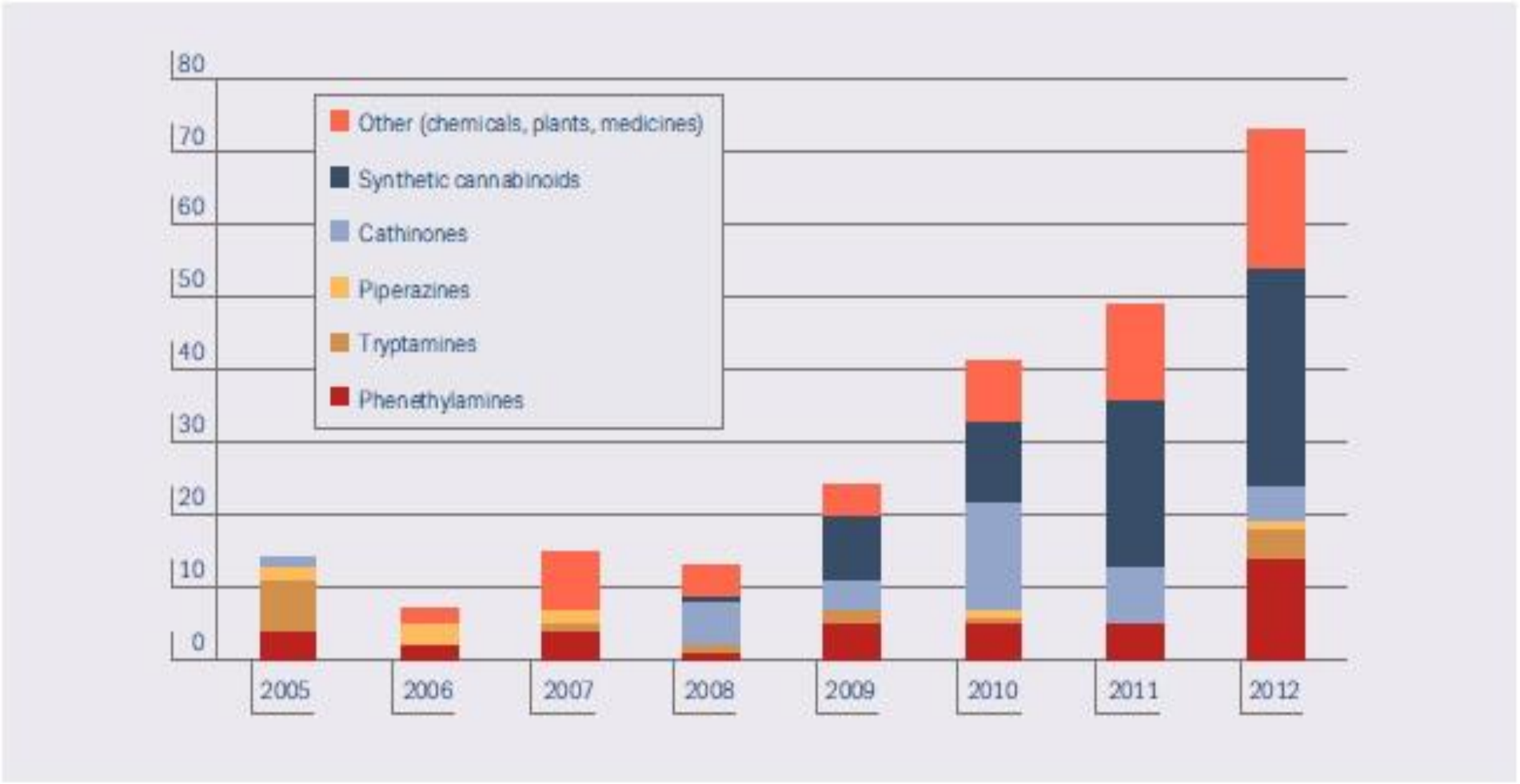
Headline activities in 2012

- 73 new psychoactive substances were officially notified for the first time through the EU Early warning system (EWS) in 2012, up from 49 in 2011, 41 in 2010 and 24 in 2009.

http://www.emcdda.europa.eu/publications/implementation-reports/2012

EMCDDA-Europol 2012 Annual Report

Figure 1: Number of new psychoactive substances notified for the first time to the EWS since May 2005 ([22])



Quality assurance

- Quality control varies between manufacturers and suppliers;
- For some (most) POCT devices there is no formal QC, making their analytical precision at best uncertain;
- Lack of formal accrediting organization;
- The accuracy of the devices claimed by the manufacturer will have no external verification or validation against external standards;

Conclusions

- POCT drug testing has grown exponentially in last years
- POCT should be used within a clearly defined framework
- The objective of testing should be clear and benefits and risks recognized
- Important role of laboratory professionals
- Quality issues, maintenance, recordkeeping, and cost/benefit also required consideration

NACB Guidelines POCT 2007 (Chapter 7)

Thank you for your attention!