



Mobile Mass Spectrometry Laboratory: From drug screening to confirmation on-site



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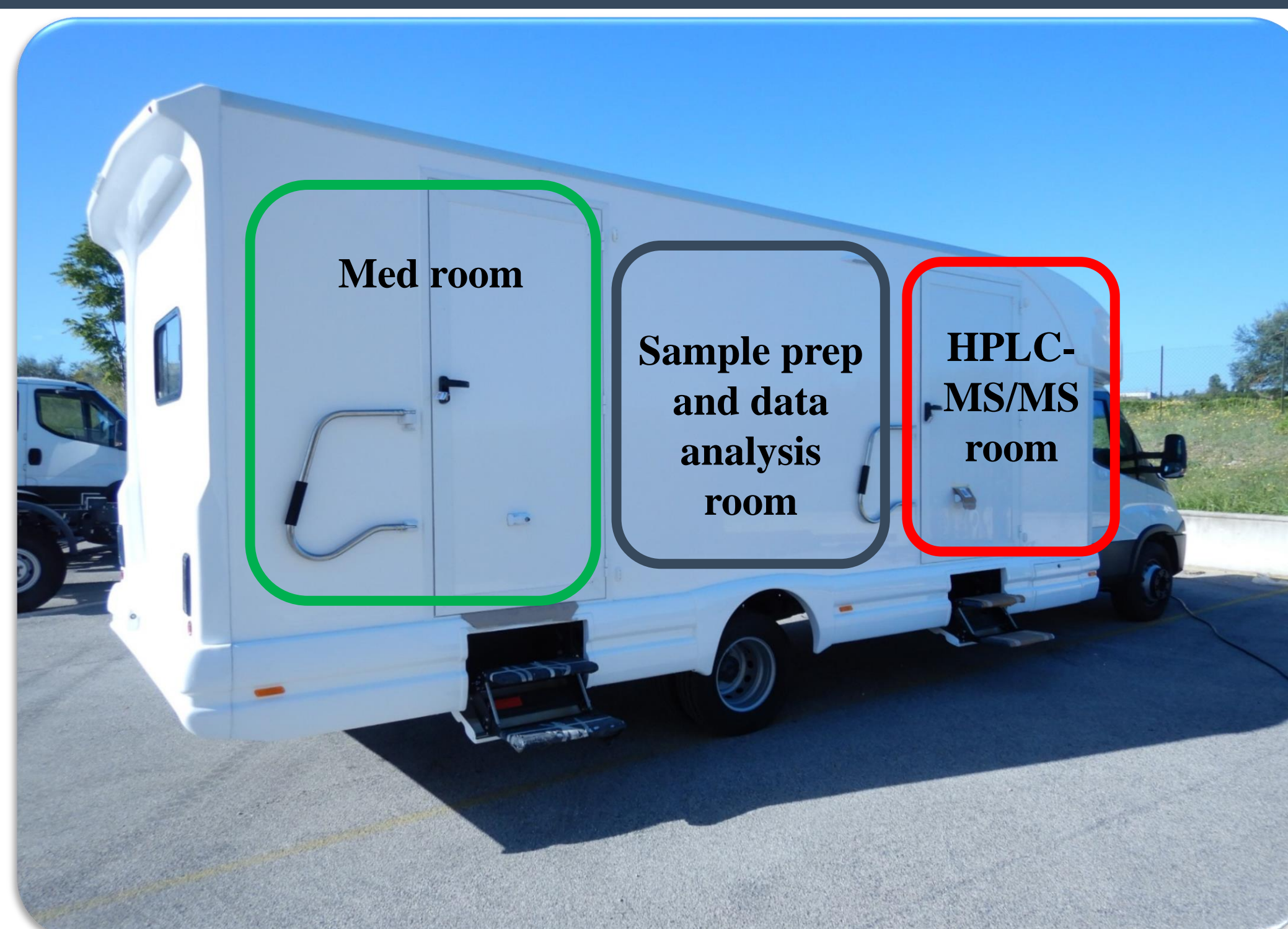


Background

Driving under the influence of drugs (DRUID) is a main issue in many countries. In Italy, Art. 187 of the c.d.s., forbids driving under the influence of drugs. In these cases, Oral Fluid (OF) or saliva is considered a premium matrix for drug-of-abuse testing [1,2]. The main advantages of OF are the simplicity and noninvasiveness of sample collection, which can be easily observed and making adulteration more difficult. The risk of contamination is lower than for blood, and similarly to blood, OF can reflect recent drug use appropriately, in fact substances can be detected in OF for short periods of time, typically up to 12–24 h after consumption. Control performed by the Police Forces involves two steps, a screening test, and eventually a confirmatory test. Saliva samples taken for confirmation (second level) are sent from all Italian cities to the central toxicology laboratory by mail and analyzed using chromatographic methods coupled with mass spectrometry. This process presents some critical issues, since the samples in custody are shipped in unpredictable times and in uncontrolled conditions (e.g.: temperature, place of custody, etc ...).

Aim

Due to the small amount of OF which can be sampled, it is very important to have a multitarget, rapid, effective, accurate and simple method [3]. Following the European Integrated Project DRUIDS, the aim of the present project is to gain new insights to the real degree of impairment caused by psychoactive drugs and their actual impact on road safety [2]. Here is presented a protocol for the simultaneous analysis of several psychoactive substances belonging to different classes, i.e. amphetamines, cannabinoids, stimulants, opioids, cocaine and its metabolites.



Innovation and protocol

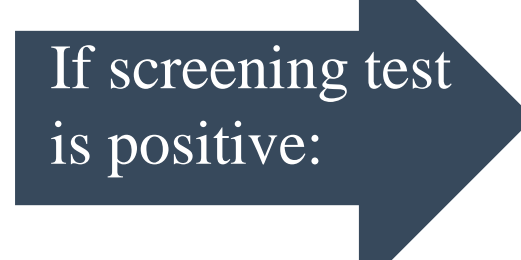
The innovation and uniqueness of the work presented here lies in the fact that all the steps of the DRUID control take place on a mobile lab, from screening to confirmation, including quantitative analysis. In the mobile lab, the simultaneous presence of multiple personnel, from technicians to doctors to chemists, allows to obtain a comprehensive and certified response in about 30 minutes

Screening test



results from the device is qualitative: "positive" or "negative" and is used as a preliminary test

Positive results must be confirmed with methods such as: LC/MS-MS or GC/MS



Confirmation test

100 µL of the solution from disposable device
100µL MeOH solution containing ISs

30 sec vortex

10 min 14.000 rpm 4°C

HPLC: ExionLC™ AD System
Mass Spectrometer: SCIEX Triple Quad 5500+ System

HPLC-MS/MS Method

HPLC parameter:

Column: C18 50x2.1 ID mm – 5 µm particles

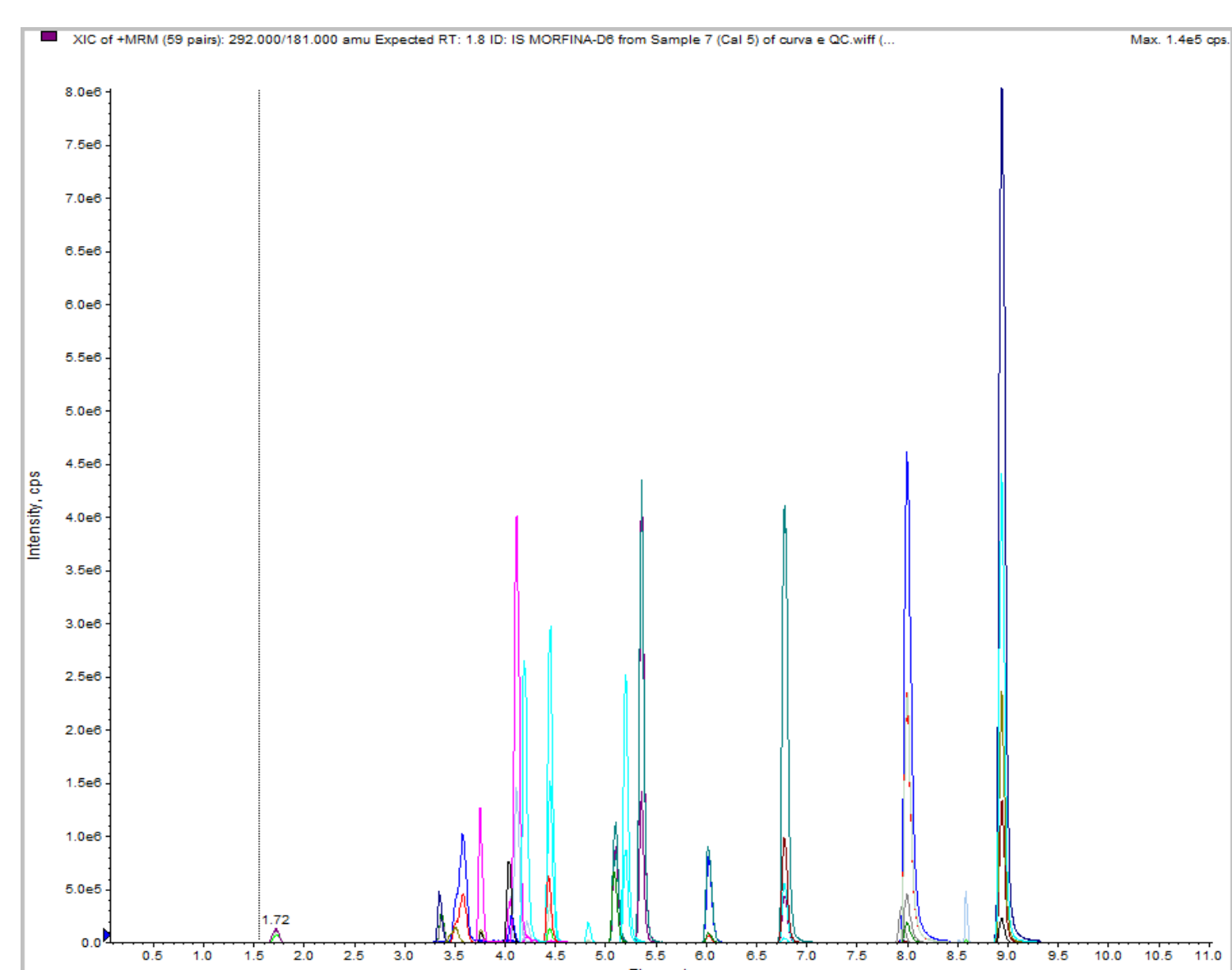
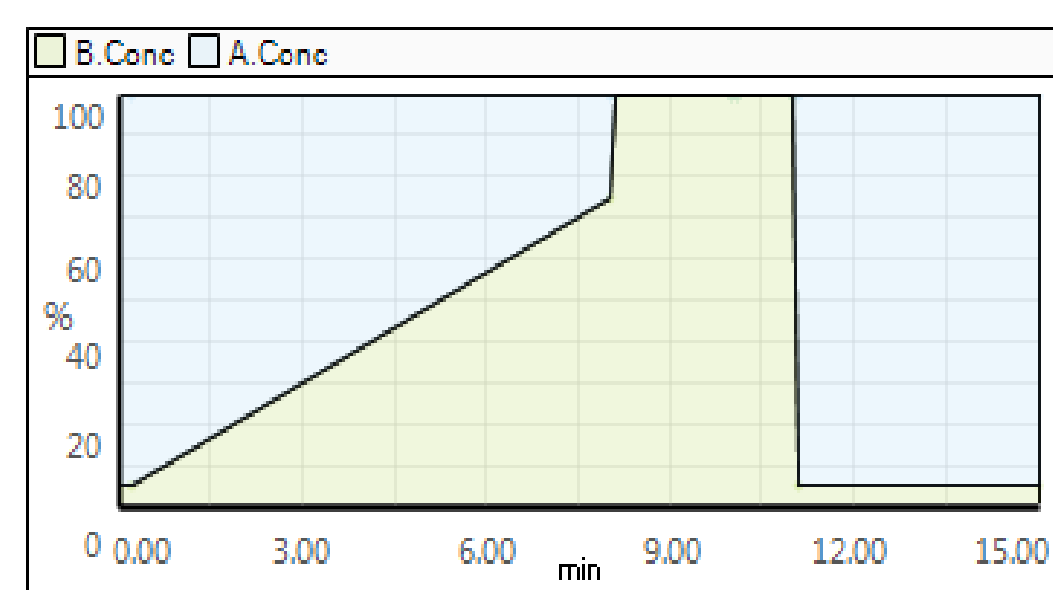
Column Temperature: 40°C

Mobile phase A: H₂O + 0,1% FA

Mobile phase B: Methanol + 0,1% FA

Injection volume: 2µL

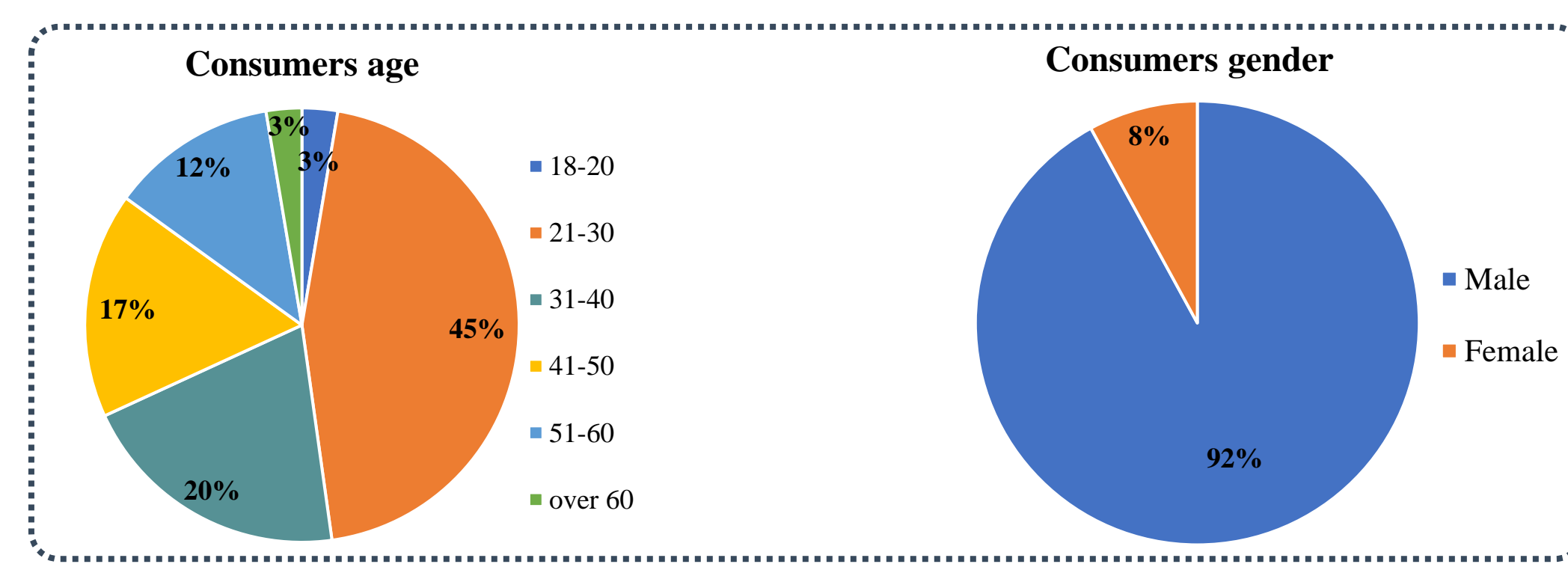
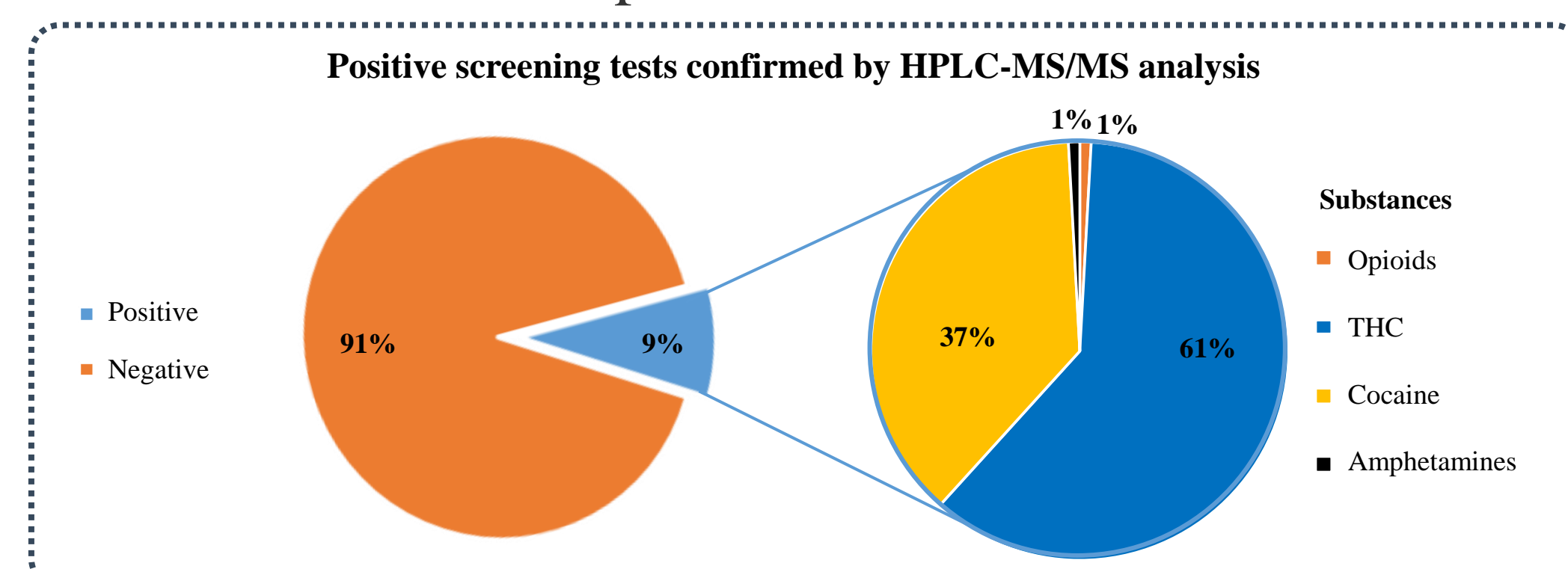
MS/MS parameter:



Analyte	Q1	rT	Q1	DP	EP	Q3	CE	CXP
Morphine	Morphine-D6	1.8	286.1	120	10	165	60	12
Codeine	Codeine-D6	3.4	300.1	120	10	181	48	12
Amphetamine	Amphetamine-D5	3.7	136.1	45	10	165.1	64	12
6-MAM	6-MAM-D6	3.9	328.0	140	10	153.1	62	12
MDA	MDA-D5	4.1	180.2	50	10	91	27	12
Methamphetamine	Methamphetamine-D5	4.2	150.1	60	10	165	53	12
BEG	BEG-D3	4.3	290.1	95	10	211.2	38	12
MDMA	MDMA-D5	4.5	194.2	65	10	133.1	25	12
MDE	MDE-D6	5.1	208.2	62	10	135.1	27	12
Ketamine	No-IS	5.3	238.0	65	10	119.1	16	12
MBDB	MBDB-D3	5.4	208.2	60	10	91	29	12
Cocaine	Cocaine-D3	6.0	304.2	120	10	168.1	25	12
Cocaethylene	Cocaethylene-D3	6.8	318.1	100	10	105	44	12
Buprenorphine	Buprenorphine-D4	7.8	468.2	90	10	163	18	12
EDDP	EDDP-D3	8.0	278.1	120	10	105	34	12
THC	THC-D3	8.6	315.2	50	10	163.1	29	12
Methadone	Methadone-D9	8.9	310.2	80	10	135.1	25	12

Results

To date, several control were performed in over than 50 Italian cities. Over 3300 screening test and over 300 confirmation test were performed.



Thanks to this project, it was possible to provide an important contribution by analyzing data regarding drug consumption in Italy and identifying which substances are more used.

Conclusions

An innovative and unique workflow is presented in which all the steps of the DRUID control take place in a mobile lab, from screening to confirmation and quantitative analysis. Thanks to this project comprehensive and certified response is possible and is provided in about 30 min. The results demonstrate the applicability, effectiveness and usefulness of the entire protocol and provide valuable information regarding the use of drugs or medication that affect the drivers' ability to drive safely. The protocol was also validated according to international guidelines and this project is still active thanks to several national collaborations.

References

- European Monitoring Center for Drugs and Drug Addiction (EMCDDA), Publications Office of the European Union (2021)
- A.M. Projektvorstellung DRUID [The "Driving under the Influence of Drugs, Alcohol and Medicines" (DRUID) project of the European Commission]. Dtsch Med Wochenschr. (2008) 133- 2: 45-46.
- N. Badawi, K. Wiese Simonsen, A. Steenoft, I.M. Bernhoft, K. Linnet, Simultaneous Screening and Quantification of 29 Drugs of Abuse in Oral Fluid by Solid-Phase Extraction and Ultrapformance LC-MS/MS, Clinical Chemistry 55-11, (2009) 2004–2018.

