

NPS-Euronet project: patterns of NPS use using wastewater – based epidemiology

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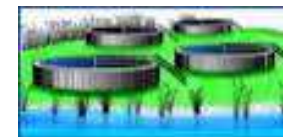
Wastewater – Based Epidemiology (WBE)

Measurement of **excretion residues (biomarker)** in urban wastewater



Evaluation of consumption or exposure to substances

- ✓ Almost all **substances** we **consume** **are excreted** unchanged or as a mixture of metabolites **in urine and/faeces**
- ✓ Excreted substances entry in **sewer network**
- ✓ Enter **sewage treatment plants**
- ✓ Sampling and **analysis raw wastewater**



Wastewater – Based Epidemiology (WBE)

Estimating Community Drug Abuse by Wastewater Analysis

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Department of Environmental Health Sciences, Istituto di Ricerche Farmacologiche Mario Negri, Milano, Italy

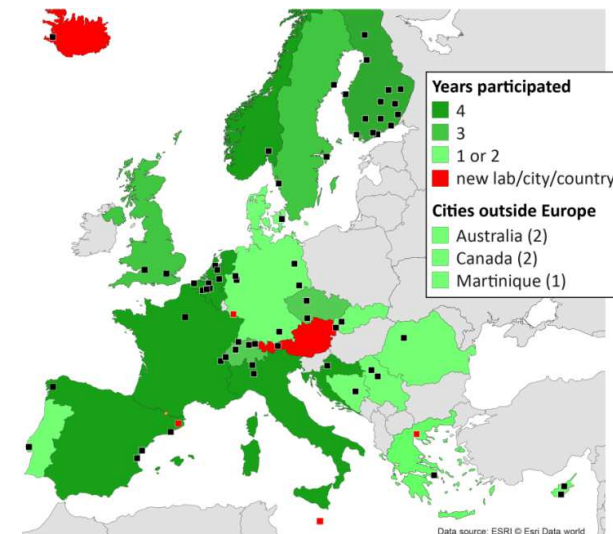
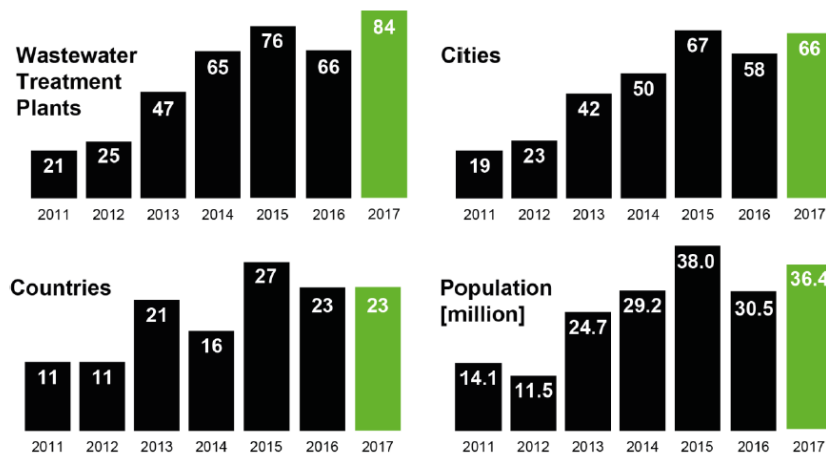
Estimation of **illicit drugs consumption** in three European cities

Zuccato *et al.*, *Environ. Health Perspect.* 2008

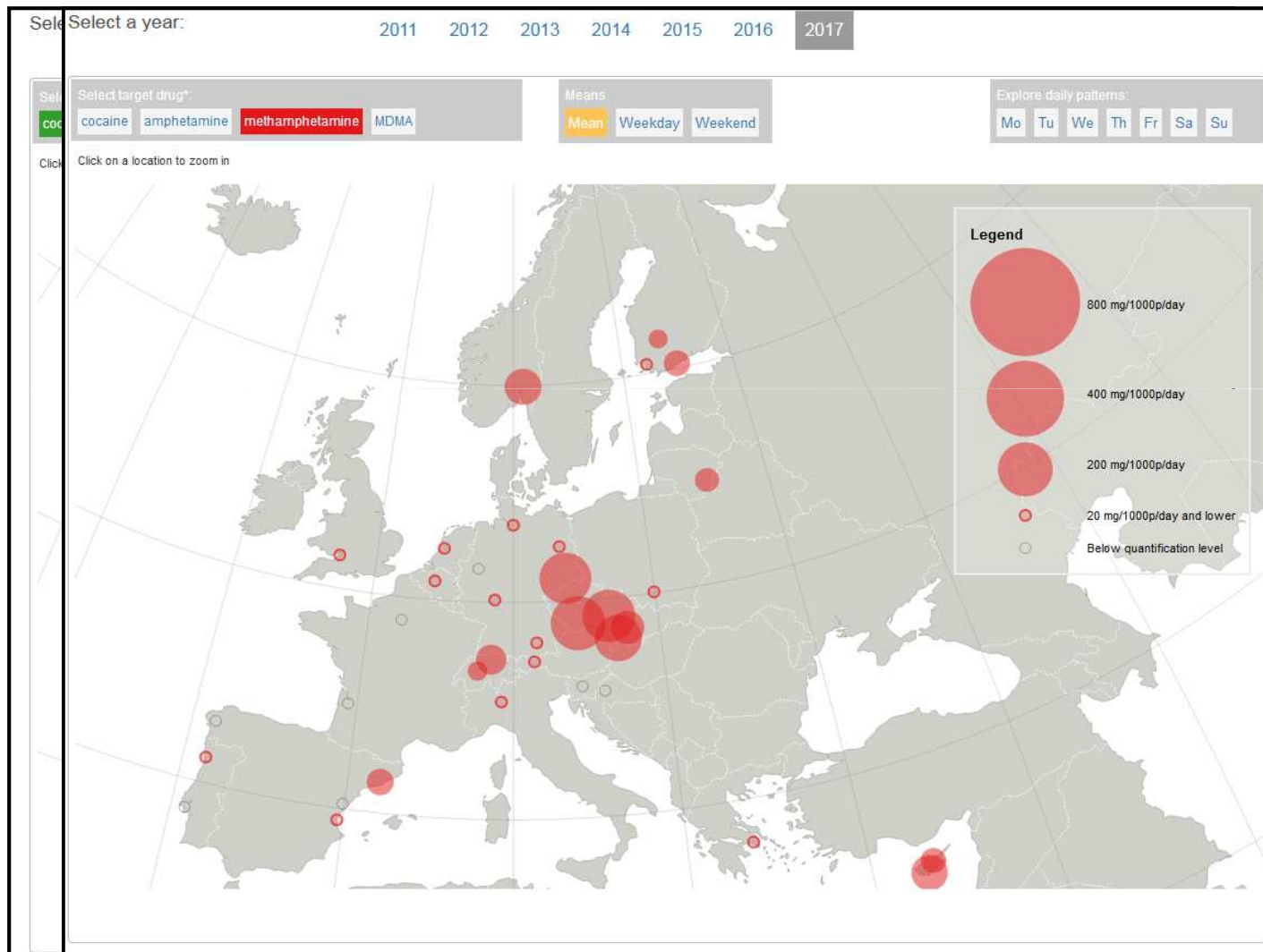
Sewage analysis CORE group (SCORE) Activities (2010)

Europe-wide monitoring (2011-2017)

Results available at: <http://www.emcdda.europa.eu/topics/pods/waste-water-analysis>



Wastewater – Based Epidemiology (WBE)



Aim of the study

Identification and Assessment of **New Psychoactive Substances in Europe**
using WBE

- ✓ **Select substances (NPS)** to be investigated
- ✓ Develop a **method to screen** the presence of NPS (qualitative analyses)
- ✓ Develop a method **to measure NPS** (quantitative analyses)
- ✓ **Monitor wastewater samples** from different countries

WBE Advantages and Challenges for NPS

Ability to provide:

- **Objective** estimates
- Near **real-time** estimates
- **Updated** information
- **Qualitative and quantitative** data



Identification **of NPS**
Evaluation of **use**

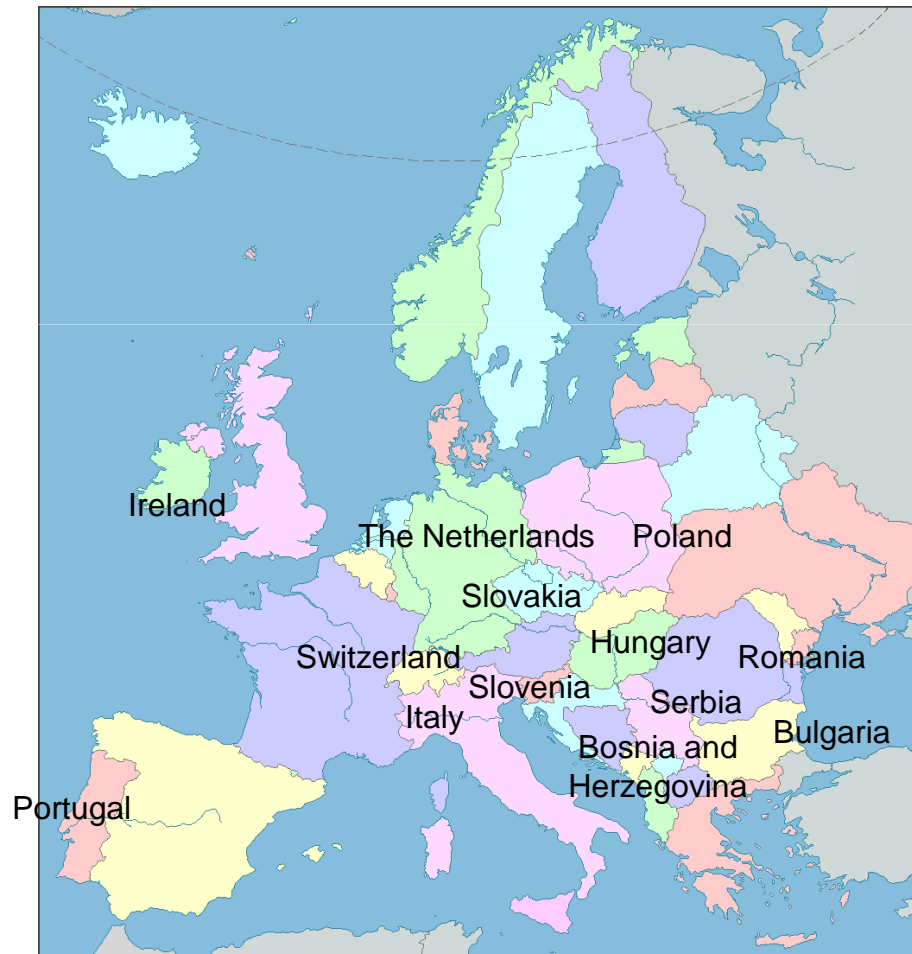
Challenges:

- Limited use
- Lots of substances
- **Low levels** in wastewater
- Human metabolism unknown
- Difficult **identify biomarkers**



WBE needs to be
tested

Samples investigated



***COST SCORE Monitoring
campaign 2016 -2017***



Raw Wastewater Samples



**14 European countries
21 cities**



***Pooled samples
Weekdays - Weekend***

Qualitative screening - NPS Selection

Sources



European Monitoring Centre
for Drugs and Drug Addiction

Alerts Reports of new substances
(December 2013-March 2016)



SISTEMA NAZIONALE DI ALLERTA PRECOCE
NATIONAL EARLY WARNING SYSTEM - N.E.W.S.

Alerts (Europe and Italy) + Italy seizure list
+ Notifications in Italy (intoxications)
(October 2013-March 2016)



UNODC
United Nations Office on Drugs and Crime

UNODC control list

Criteria

Frequency of reporting
Most recently reported



DATABASE

195 substances

phenethylamines,
arilcicloexilamine -
ketamine analogues,
piperidine,
tryptamine,
synthetic cathinones,
synthetic cannabinoids,
synthetic opioids,
aminorex derivates,
natural psychoactive
substances,
benzodiazepines

Qualitative screening - NPS Identified

Classes of NPS	NPS	Country
Synthetic cathinones	3,4-DMeO-alpha-PVP	Poland, Romania, Portugal
Tryptamines	AMT (alpha-methyltryptamine)	The Netherlands, Slovenia, Slovakia, Italy, Germany, Portugal, Spain
Aminorex derivates	N-methyaminorex 4,4 DMAR	Slovenia Ukraine
Phenethylamines	NPDPA 2-methoxyamphetamine 25iP-NBoME 25E - NBoMe 25H - NBoMe	Serbia, Romania Bosnia Herzegovina, Portugal, Spain, Italy Romania Slovenia, Germany Spain

Quantitative analysis

Results 2016

Results 2017

- Synthetic Cathinones**
- Mephedrone**
 - Methcathinone**
 - N,N-Dimethylcathinone
 - Ethcathinone**
 - Methedrone
 - 4-FMC
 - 3,4-DMMC**
 - 4-MEC
 - Buphedrone
 - Pentedrone
 - Methylone**
 - Ethylone
 - Butylone**
 - Pentylone**
 - 1-Naphyrone
 - Naphyrone
 - MDPV**
 - α -PVP**
 - 4-Cl- α -PPP

- Phenethylamines**
- PMA**
 - PMMA
 - 25-B-NBoMe
 - 25-C-NBoMe
 - 25-I-NBoMe
 - Ketamine analogues**
 - Methoxethamine
 - Tryptamines**
 - 5-MeO-MIPT

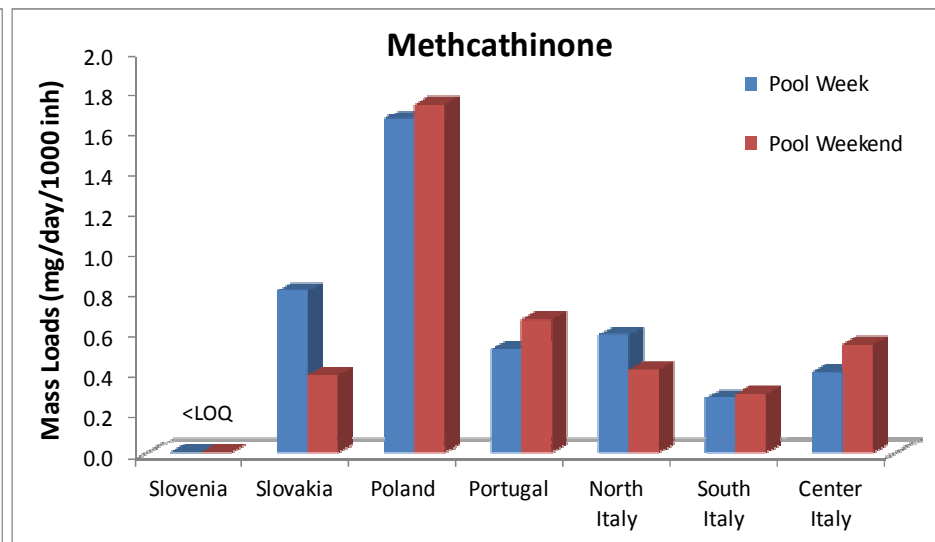
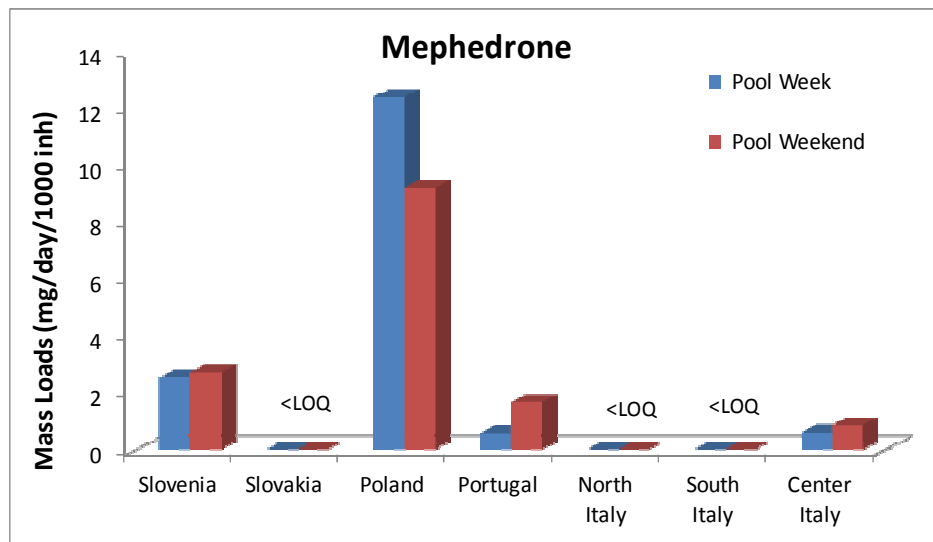
26 substances searched
10 substances found in
wastewater (21 cities)

- Synthetic Cathinones**
- Mephedrone**
 - Methcathinone**
 - N,N-Dimethylcathinone
 - Ethcathinone
 - Methedrone
 - 4-FMC
 - 3,4-DMMC
 - 4-MEC
 - Buphedrone**
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 - Methylone**
 - Ethylone
 - Butylone
 - Pentylone
 - 1-Naphyrone
 - Naphyrone
 - MDPV
 - α -PVP
 - 4-Cl- α -PPP

- Phenethylamines**
- PMA
 - PMMA
 - 25-B-NBoMe
 - 25-C-NBoMe
 - 25-I-NBoMe
 - 25-iP-NBoMe**
 - NEDPA
 - Ketamine analogues**
 - Methoxethamine
 - Tryptamines**
 - 5-MeO-MIPT
 - Synthetic cannabinoids**
 - 5-Fluoropentyl-3-pyridinoylindole
 - Aminorex derivates**
 - 4-4'-DMAR (4-4'-dimethylaminorex)

30 substances searched
5 substances found in
wastewater (7 cities)

Results 2017 – Weekly Profile NPS



Mass loads mg/day/1000 inh	Slovakia		Center Italy	
	<i>Pool Week</i>	<i>Pool Weekend</i>	<i>Pool Week</i>	<i>Pool Weekend</i>
Buphedrone	0.26	0.17	<LOQ	1.77
	Slovenia		Portugal	
	<i>Pool Week</i>	<i>Pool Weekend</i>	<i>Pool Week</i>	<i>Pool Weekend</i>
Methylone	0.89	0.89	<LOQ	<LOQ
25-iP-NBoMe	<LOQ	<LOQ	0.77	0.60

Weekly Profile Classical Drugs

Italy - Milan

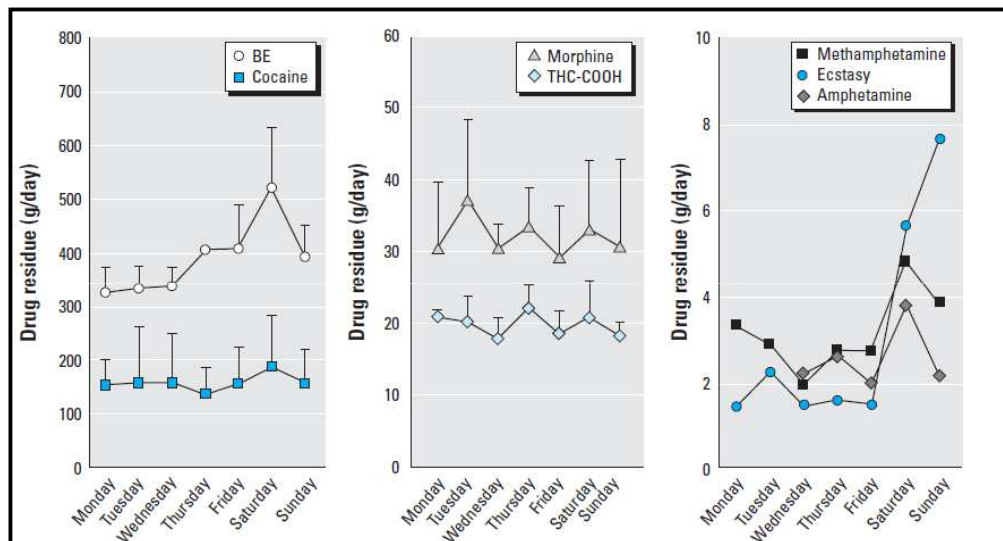


Figure 1. Average daily amounts (mean ± SD, g/day, $n = 3$) of illicit drug residues conveyed by wastewater to Milan's STP (1.25 million people served). Levels of amphetamines were near or below the LOD based on available data (2-week period). To allow a rough comparison with the profiles of the other, more abundant drugs, undetectable levels were considered 50% of the limit of quantification (LOQ; typically around 1 ng/L in wastewater).

Zuccato et al., (2008), *Environmental Health Perspectives* 116, 1027-1032

EU - 19 cities

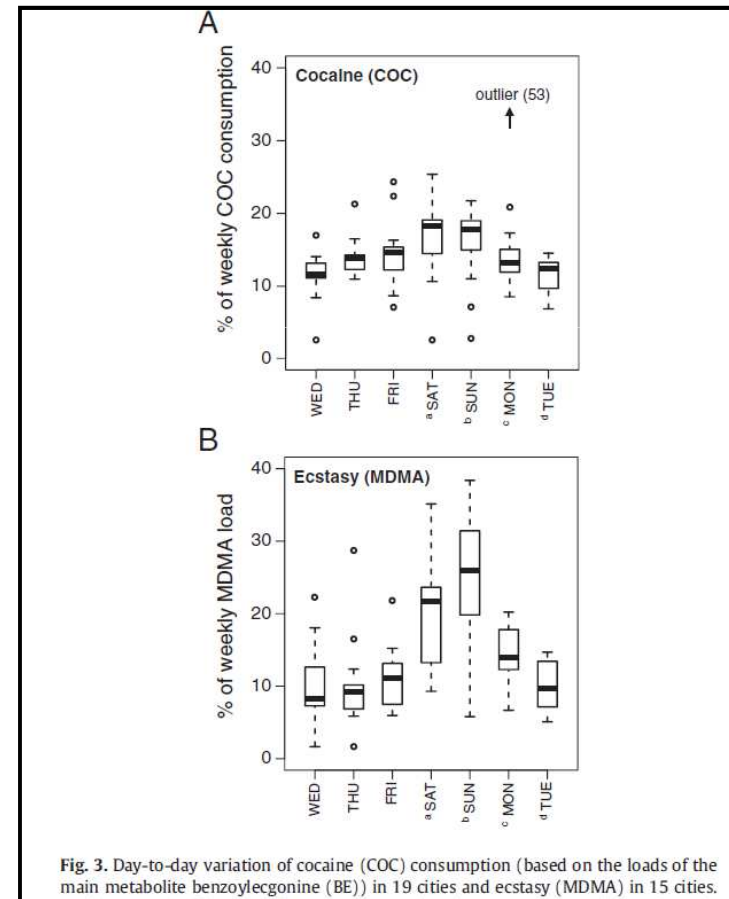


Fig. 3. Day-to-day variation of cocaine (COC) consumption (based on the loads of the main metabolite benzoylecgonine (BE)) in 19 cities and ecstasy (MDMA) in 15 cities.

Thomas et al., (2012), *STOTEN*, 432:432-9

Comparison NPS - Classical Drugs

NPS Mass Loads (mg/day/ 1000 inhabitants) 0.2-21

Classical Drugs Mass Loads (mg/day/ 1000 inhabitants)	
Amphetamine	3.8-120
Methamphetamine	0.3-177
MDMA	2.9-60
Cocaine	47-476

NPS levels in wastewater are at least 5 times lower than classical drugs



This reflects a **lower use of NPS**

Conclusions

- ✓ **WBE** was **applied successfully** to monitor the use of **NPS**
- ✓ A **quantitative analysis** was done for > 30 substances
- ✓ The **levels of NPS were lower** than those of the “classical” drugs – lower use ?
- ✓ Different **spatial and temporal patterns** of use were found among countries
- ✓ WBE is a **good complementary tool** to evaluate the **use of NPS**



Acknowledgements

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Thanks for your attention!