

A systematical methodology for finding novel NPS (New Psychoactive Substances) on the Internet

Nathalie Kahrle Atterlord, Petur Weihe Dalsgaard, Niels Bjerre Holm, Irene Breum Müller, Kristian Linnet, Lotte Ask Reitzel
Section of Forensic Chemistry, Department of Forensic Medicine, Faculty of Health Sciences, University of Copenhagen.

Introduction

The market for new psychoactive substances (NPS) has evolved dramatically due to the ease of advertising and selling over the Internet, and thus today one new substance is marketed every 5-6 days. To encounter NPS, forensic chemistry and toxicology sections are often depending on seizures from police or customs, and on the availability of reference standards, meaning they are always several steps behind. Then again, as Internet has played the key role to the development of the current situation it can also give the law enforcements a chance to keep up with upcoming NPS. Nonetheless, there is no clear approach of how to use Internet when searching for newly released NPS. We here present a systematical strategy for investigating and searching for NPS over the Internet, not only NPS existing on the open market but also for NPS discussed outside those platforms.

Method

Two approaches were established: The first was to use a simple word search whereas the second was focusing on social networks related to recreational drugs. Google was chosen as the main search engine for this project.

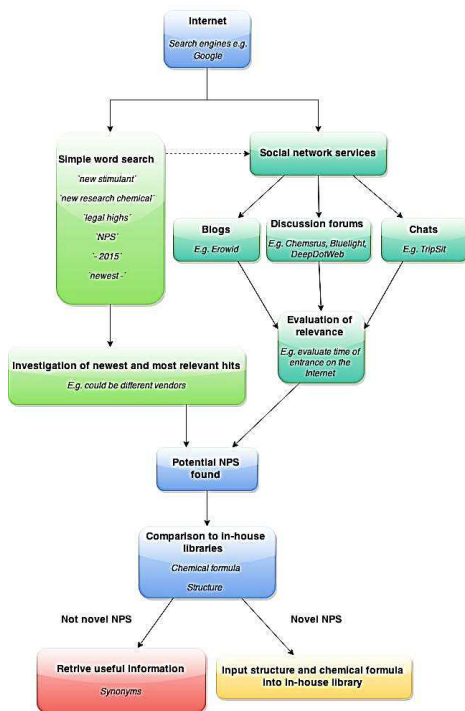
Simple word search – The simple word search was setup by using chosen keywords that enabled to retrieve the most relevant hits concerning novel NPS. 'New stimulant', 'new research chemical', 'NPS', 'newest -', and '- 2015' were some of the keywords that were more successful than others. This approach led mostly to NPS Internet-based suppliers, also known as vendors (different countries and different size of supply), but social networks can also be discovered through this approach.

Examples of vendors:

- chemicalwire.com
- theresearchchemicalshop.net
- chemicalservices.net

Social networks – The second approach used social networks associated with recreational drugs to monitor the introduction of novel NPS on the market. Different kinds of social networks were utilized such as blogs, discussion forums and chats. A post on a social network was only considered relevant if it had been entered during the last 6 months, and was then further investigated. Older than 6 months, gave a high probability that it was already in in-house libraries and were therefore more critically evaluated.

Figure 1. A flow chart over the systematical approach for finding NPS on Internet.



In-house library – Ultimately the novel NPS would be included in in-house libraries (with both structure and chemical formula), but first it would be compared to existing entries to avoid duplication. The comparison was first based on chemical formula and secondly based on structure to evaluate possible isomers.

Even though the conclusion is that it was not a novel NPS, valuable information could still be retrieved. Synonyms would be such valuable information which would make the identification process much faster and simpler in the future.

Figure 2. An example of a post that resulted in the finding of a novel NPS. The substance was included into in-house libraries with chemical formula, structure and potential synonyms.

Methamnetamine (N-methyl-PAL-287) thread
Category: Stimulants
Topic started 2 days 12 hours ago by Sandbwoy

ISEC project "RESPONSE"

The methodology is going to be used in the newly started ISEC project "RESPONSE", in which one of the goals is to enhance the NPS identification capability and efficiency of forensic laboratories.

Shared samples (Slovenian seizures): Within the frame of the RESPONSE project, Slovenian samples of fully structure-elucidated NPS were shared between partner laboratories. The compounds had not been seen in DK east, and we did not have reference standards. However, because the QTOF library was updated according to the presented methodology, we had a library match for 16 out of 17 samples. This demonstrates how the methodology works in practice.

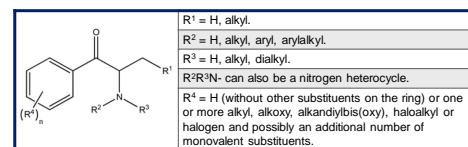
Possible use in the legislation

In Denmark generic legislation was made possible in 2012. Ten groups were introduced in July 2012.

Figure 3. Definition of a generic group in the Danish legislation.

- Base structure
 - Pr. base structure: Defined positions for possible substituents
 - Pr. position: Defined types of substituents
- Exceptions from the group

Figure 4. Example of generic group: The Cathinone group.



61 compounds covered by the ten groups were already scheduled individually before generic legislation.

Between July 2012 and March 2015 the forensic department in Copenhagen has identified 48 new NPS in cases. 10 were covered by one of the groups (5 in 2012, 2 in 2013, 3 in 2014), meaning the generic legislation served its purpose. 14 have been scheduled individually, 2 were scheduled through an update of the phenethylamine group, and 22 were still legal by 1st April 2015.

Of the 62 NPS (Table 1) found from 2014-09-29 to 2015-04-07 with the methodology presented here, 11 are covered by one of the generic groups (the cathinone and phenethylamine groups). We tried to group the other 51 NPS according to base structures. There are of course several solutions to this puzzle, since you need to decide which part of the molecule is the base structure and which parts are substituents. We divided the 51 NPS into 19 new base structures (numbered 1 – 19 in Table 1), which led to (at least) 13 new substituents (numbered 1 – 13 in Table 1). 7 of the base structures represented groups of 2 to 11 NPS.

Conclusion

A systematical methodology for search of novel NPS through Internet is here presented. Two different approaches were established during the development of the methodology; simple word search together with investigation of social networks. The methodology has been implemented within forensic chemistry at the University of Copenhagen and has given rise to more than 60 internet-findings of novel NPS in the time frame of sep-2014 up to april-2015.

It is suggested that the same approach could be used by legislators in order to keep the legislation and lists of controlled substances updated.

The methodology should be considered a continuous process. Otherwise it will loose its value.

Table 1. The compounds found by the presented methodology and included into in-house library. Generic legislation builds on base structures and substituents. We identified 19 new base structures (no. 1 – 19) and (at least) 13 new substituents (no. 1 – 13).

Compound	In-house library	EDND	Reported in case, DK east	New base structure no.	New substituent no.
5F-ADB-PINACA	2014-09-29	apr-15		1	1
4-Fluorocathinone (4-FEC)	2014-10-02	feb-15		Cathinone	no
AL-LAD	2014-10-10	mar-15	2015-02-26	2	no
FUB-AKB-48	2014-10-15	jul-14		1	2
4-Fluoro-butylfentanyl	2014-10-16	mar-15		3	no
FUB-PB-22	2014-10-16	dec-13		4	3, 4
Mephedramine	2014-10-16	jul-13	2015-03-26	5	
MDMB-CHMINACA	2014-10-28	sep-14	2015-02-26	4	1
5F-NPB22	2014-10-30	jan-14		1	3
2-Chloro-4,5-MDMA	2014-10-30	jan-15		Phenethylamine	no
5-Meo-NBPbT	2014-10-30			Phenethylamine	4
Isopropinaline	2014-10-30			Phenethylamine	no
ALD-52	2014-10-30			2	no
Isopropylphenidate (IPH)	2014-11-05	mar-15	2015-03-26	6	no
HMPP-28	2014-11-05	mar-15		6	5
Modafinil	2014-11-05	oct-14		7	
Fluoromazepam	2014-11-05	oct-14		8	no
MDPHP	2014-11-05	nov-14		Cathinone	no
6-Pyrrolidinoheptanophenone (PV-8)	2014-11-05	jul-13	2014-12-23	Cathinone	no
bk-IVP	2014-11-05	jan-15		Cathinone	6
Clonazepam	2014-11-10	jan-15		8	7
MDMB-CHMINACA	2014-11-10			1	1
MA-CHMINACA	2014-11-10			1	1
FUB-AMB	2014-11-10	dec-14		1	1, 4
PX-2	2014-11-10	nov-14		1	8
FUB-144	2014-11-10	feb-15		4	4, 9
PRO-LAD	2014-11-13			2	no
ETH-LAD	2014-11-17			2	no
IDRA-21	2014-11-17			9	no
NSI-189	2014-11-17	jan-15		10	no
GLYX-13	2014-11-17			11	no

Compound	In-house library	EDND	Reported in case, DK east	New base structure no.	New substituent no.
NESS-0327	2014-11-17			12	
U-47700	2014-11-17	jan-15		13	
5F-PCN	2014-11-17			14	10
DB-MDBP	2014-11-17	mar-15		15	
MDMB-FUBINACA	2014-11-18			1	1, 4
2-Bromo-4,5-MDMA	2014-11-18			Phenethylamine	no
SDB-005	2014-11-18	apr-15		1	11
ALEPH-21	2014-11-20			Phenethylamine	no
ETHYL-L	2014-11-20			Phenethylamine	no
4-CAB	2014-11-21			Phenethylamine	no
4-MAB	2014-11-21			Phenethylamine	no
3-Fluorophenmetrazine (3-FPM)	2014-12-01	sep-14	2015-02-26	16	no
NRG-3	2014-12-01			Cathinone	5
5F-AMB-PICA	2014-12-01	dec-14		4	1
AZ-097	2015-01-29			17	1
4-MPH	2015-01-29			16	no
FUB-NPB22	2015-01-29			1	3, 4
4-Chloromethamphetamine (4-CMA)	2015-01-29			Phenethylamine	no
1p-LSD	2015-02-03	mar-15	2015-03-07	2	no
Phenetrazine	2015-02-03			16	no
MR-2096	2015-02-03			18	
TH-PVP	2015-02-03			Cathinone	6
LSM-775	2015-02-23			2	12
TH-PBP	2015-02-23			Cathinone	6
Propylphenidate (PPH)	2015-02-23		2015-03-26	6	no
Methamnetamine	2015-02-23			Phenethylamine	5
2-Methyl-3-phenylpropanamide	2015-03-30			19	no
3-(Benzof[1,3]dioxol-5-yl)-2-methylpropanamide	2015-03-30			19	no
3-(Benzofuran-5-yl)-2-methylpropanamide	2015-03-30			19	13
4-Chloro-alpha-PVP	2015-04-07			Cathinone	no
MO-CHMINACA	2015-04-07			1	1