

**Promoting innovation and excellence to face the rapid
diffusion of Novel Psychoactive Substances (NPS) in the EU:
the outcomes of the ReDNet project**

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Objectives: The recent emergence of new psychoactive compounds (NPS) has raised prominent challenges in the fields of drug policy, substance use research, public health and service provision. The Recreational Drugs European Network (ReDNet) project, funded by the European Commission, was implemented to improve the information stream to young people and professionals about effects/risks of NPS identifying online products and disseminating relevant information through technological tools.

Methods: Regular multilingual qualitative assessments of websites, drugs fora and other online resources were carried out using the Google search engine in 8 languages from collaborating countries. These included: the UK, Norway, Belgium, Germany, Hungary, Poland, Italy and Spain. Products were tested and prevention messages were developed and disseminated via technological tools such as interactive websites, SMS alert, social networking (Facebook, Twitter), Multimedia (You Tube), Smartphone applications (iPhone), and virtual learning environments (Second Life).

Results: The ReDNet project established itself as the first Europe-wide prevention programme designed for NPS based on the efficacy of novel ICT-based forms of intervention. More than 650 NPS products and combinations were identified; relevant information was disseminated to target population and advice was given to both EU/international agencies and national policy makers.

Conclusions: Web monitoring activities are essential for mapping the diffusion of NPS and the use of technological tools can be successfully incorporated in specific

prevention programmes. Furthermore, the involvement of multi-disciplinary international partnerships was and continues to be fundamental for responding to such a prominent challenge.

INTRODUCTION

Novel psychoactive substances (NPS) comprise an increasing number of ‘designer’, pharmaceutical and herbal drugs, often advertised and sold as ‘legal’ alternatives to illicit drugs (Corazza et al. 2011). This new phenomenon represents an unprecedented challenge in the field of drug addiction, but also a fast growing problem from social, cultural, legal and political perspectives (Schifano et al 2006; Sigismondi et al 2012). During 2012, 57 psychoactive substances were officially notified for the first time in the European Union, with the EU's early warning system reporting the appearance of more than one new psychoactive drug on the market every week (EMCDDA 2012). NPS are usually sold online through an amount of unregulated websites and are almost unknown to health professionals who may not be technically up to date/conversant, given the typical absence of up-to-date scientific literature and reliable sources of information (CASA 2008; Forman et al. 2006; Littlejohn et al. 2005).

In the last nine years, three European Commission-funded projects (the Psychonaut Web Mapping System I & II, www.psychonautproject.eu; and the ReDNet; www.rednetproject.eu) have identified over 650 NPS and combinations. These included a range of piperazines, synthetic cathinones, synthetic cannabimimetics, phenethylamines, aminoindanes, tryptamines, benzofuranes, various herbal/ethno-drugs and a number of hallucinogenic compounds (Deluca et al. 2012; Corazza et al. 2012). More specifically, the Recreational Drugs European Network (ReDNet), a multi-site project with 10 research centres across the EU, which was launched in April 2010 and ended in June 2012, aimed to: (a) develop accurate information on NPS, (b) pilot innovative and effective ICTs to disseminate this information, (c) assess the feasibility of different ICTs and the relevance of the information being

disseminated to the target groups, and (d) inform future research in e-Health, selective prevention, and harm reduction. The project was cleared for ethical approval by the School of Pharmacy Ethics Committee, University of Hatfield, UK (15 December 2010; PHAEC/10-42).

METHODS

The ReDNet methodology was articulated in three main parts:

1) Web monitoring/ content development and online survey

Regular monitoring of the web (i.e., websites, chatrooms, newgroups, fora, YouTube) was carried out. A range of generic Google search queries, with terms such as 'legal highs', 'herbal highs', 'smart drugs', and 'research chemicals', were formulated in 8 languages (e.g. English, Finnish, Norwegian, Dutch, Italian, German, Spanish, and Swedish). At the same time, a multilingual review of the available peer-reviewed literature, covering multimedia approaches for primary and secondary drug preventions, was carried out. This also included the analysis of 'non-conventional, fugitive and ephemeral publications', also known as 'grey literature' (Alberani, 1990).

In addition, groups of both young people (secondary schools/college/universities) and health professionals were surveyed internationally about their a) levels of knowledge and awareness b) source and methods of distribution of reliable information about novel compounds in order to provide an initial evidence base to support key stakeholders in their efforts to enhance innovative solutions as a response to the rapid and unpredictable diffusion of NPS. Finally, the above data were used to inform fact-sheets, technical reports, scientific publications and other project-related material

2) Testing

A range of testing activities focusing on a number of NPS products purchased from the web was carried out to investigate the content of the allegedly psychoactive products. The testing was made to match the products content against their 'Label Claim'. In this respect, four questions needed to be investigated:

- Does the product contain the substance stated on the 'Label Claim'?
- If yes, what amount does it contain?
- Does it contain any other substances?
- If no, what does it contain?

Consequently, classical analytical techniques as well as modern non-destructive mobile techniques were utilized. The classical analytical techniques included: UV/Vis spectroscopy, high-performance liquid chromatography, gas chromatography-mass spectrometry and nuclear magnetic resonance. These required destruction of the product to be tested by dissolving it in a suitable solvent. However, they gave high sensitivity of analysis and thus could detect drugs present in NPS products in minute amounts. On the other hand, modern non-destructive techniques measured the sample '*as received*' and did not require any sample treatment or destruction. These included: Attenuated total reflectance Fourier transform-infrared, near-infrared and Raman spectroscopies and were available as both laboratory based and handheld instrumentation. The handheld instrumentation offered the advantage of rapid, on-spot and mobile technology; thus, saved time and money from importing the sample to the laboratory. However, the identification was limited to substances present in the instrumental library. In addition, these techniques were less sensitive than classical analytical techniques as they only identified substances present in high amounts in a product.

3) Disseminating the relevant information via ICT tools

A number of innovative ICT tools were developed to disseminate up-to-date and non-judgmental information for young people and professionals. These included: (a) Interactive websites, where health professionals could register and receive access to reports and technical folders; (b) Social networking (Facebook, Twitter), where drug threads, videos and meetings could be posted targeting at risk populations, e.g. young people; (c) SMS - Email Alerts (SMAIL), which may be seen as an innovative tool used to alert health professionals and increase awareness on NPS; (d) Multimedia tools, such as YouTube videos and virtual learning environments (e.g. Second Life events), which were implemented to facilitate fast dissemination of information relating to a range of NPS.

RESULTS

Over 650 substances were identified, including 179 phenethylamines/MDMA-like drugs, 220 synthetic cannabimimetics (e.g.: Spice drugs), 30 cathinones (e.g.: Mephedrone, MDPV), 64 tryptamine classical derivatives and 5 new derivatives (e.g.: 5-meo-DALT), 126 psychedelic phenethylamines from the Shulgin Index (Shulgin et al., 2011), 3 GHB-like drugs (e.g.: GBL, 1,4 BD), 5 PCP-like drugs (e.g.: PCE, methoxetamine), two piperazine, six herb/plants (e.g.: *Salvia divinorum*, *Mytragina speciosa* -Kratom), ten prescribing/non prescribing medicinal products (opiates/opioids, antiseptics, anticonvulsants, benzodiazepines, stimulants, antiparkinsonian) and an increasing number of PIEDs (Performance Image Enhancing Drugs).

A dedicated ReDNet online database was developed using a secured server. This database enabled the project partners to collaboratively contribute to the production of the index NPS technical reports, which were made accessible via both mobile technology and standard desktop devices. Results from Europe-wide survey among young people and health professionals are still in the statistical analysis phase. The total sample size was 3.551. Preliminary data from the young people group showed that one out of five (n=168, 21%) respondents did not have access to information about NPS. Over half the sample (n=558, 69%) reported it to be either 'good' or 'very good', and further 123 (15%) participants reported it was 'average'. However, a considerable proportion of the sample (n=126, 16%) reported that their knowledge of NPS was either 'basic' or 'poor'. The following information is rated as important or very important: desired psychoactive effects (n=782, 97%), side effects (n=719, 88%) and key points/overview of NPS (n=679, 83%). Surprisingly, a significant proportion of respondents did not consider online marketing strategies (n=455, 56%), price (n=451, 55%) or appearance (n=431, 53%) to be important information. Always, according to the young people the following methods of delivery were favoured for the distribution of information: email (n=205, 68%), dedicated website (n=158, 53%) and e-newsletter (n=52, 17%). Preliminary data from the health professionals group showed that a majority (n=130, 74%) of respondents reported that their knowledge of NPS was either 'average' or 'good'. Always according to health professionals, the following information were perceived as important or very important: key points/overview of NPS (n=159, 90%), reported adverse effects (n=156, 89%) and desired psychoactive effects (n=153, 87%). Finally, the following methods of delivery were favoured for the dissemination of information by professionals: email (n=133, 76%), e-newsletter (n=70, 40%) and dedicated website (n=54, 31%). Social networking sites (n=14, 8%), sms (n=9, 5%) and conferences (n=1, 1%) were the least preferred methods of delivery.

Overall, the ReDNet has produced some 183 NPS technical reports, whose access was made restricted to the project partners only. A selection of 11 technical reports and 30 factsheets was made publicly available on the project website and distributed via SMAIL (SMS and EMAIL information Service).

Testing

In order to inspect the content of the NPS products, reference libraries of standards commonly present in NPS products were created using both the classical and non-destructive techniques.

The classical techniques identified the major substance(s) present in NPS products as well as separating them (Assi et al. 2011a, Assi et al. 2012a). Caffeine was the major impurity found in the products purchased so far and was present in more than 60% of these products.

In case of spectroscopic techniques, the libraries were created using laboratory-based instruments and transferred to handheld instruments so they could be used in the field (Assi et al. 2011b; Assi et al. 2011c; Assi et al. 2011d; Assi et al. 2012b). Following this, the Internet test products were compared against these libraries. Figure 1 shows the results' sheet of an NPS product tested using a handheld spectroscopic instrument. The spectroscopic techniques were additionally utilized to investigate the physicochemical properties of these NPS products when used with the suitable chemometric techniques. The chemometric techniques involved multivariate classification and regression (such as principal component analysis and regression) techniques in order to investigate/ identify differences among products.

Although the products were advertised as of high purity, they were often contaminated by other impurities, which could be pharmacologically active (e.g. caffeine) or not. Other impurities included anaesthetics (lidocaine), anti-emetics (domperidone) or even inactive substances (lactose).

Disseminating relevant information via ICT tools

An interactive project website was created (www.rednetproject.eu) representing the main medium by which results and news associated with the project were disseminated. The main page was translated into all languages covered by the project partners and was embedded with a number of multimedia features, including an internal database (wikiserver) for project partners, links to social networking applications, downloads, contribute function and links to the range of project activities. By June 2012, the number of visitors (per month/last month) was 1,176, with an average value of over 1,000 for the last six months of the project. Overall, the website has been visited by 16,567 people, with 998 people having registered on the mailing list.

Facebook

A project page on Facebook was launched in April 2010 and was kept updated with regular posts on various substance misuse issues as well project activity updates. By June 2012, it counted 400 'likes' from individuals from 20 different countries including the USA, Australia and Costa Rica. Typical users were females (52%) in the age range 25-34 years old.

SMS - EMAIL information Service (SMAIL; www.rednetproject.eu/smail)

Over the past 10 years, the technology of mobile phones operates as digital assistants, email platforms and time schedulers. Therefore, the ReDNet project developed an integrated and free SMS-Email system, called *SMAIL (SMS and EMAIL information Service)* designed to a) send automatically an SMS with descriptive key points for unknown compounds texted both as nicknames or chemical names by health professionals b) generate instantly an email with the available and reliable information (in form of electronic fact sheets) on novel compounds requested c) receive regular invitations to NPS-related events/ meetings d) inform directly the ReDNet research team about novel trends in drug abuse. The *SMAIL* system has started in May 2012, recruiting over 100 European subscribers in only two months, providing a starting number of 20 factsheets and 217 drug search (Figure 2).

The effectiveness of the *SMAIL* service was tested by sending text messages to the subscribers for evaluation on a scale of 1 to 5; such that 1 is very effective and 5 was not effective. High response profile was obtained and it was shown that 61% of the subscribers scored 1 (Figure 3); whereas only 8% ranked it as non-effective.

Multimedia tools

Videos for You Tube/Art Communication project

The direct involvement of young people was sought for the preparation of various educational video-clips to be distributed via both You Tube and the ReDNet website. An Art Communication competition was organized among a group of 72 students (18-24 years old) at both the Film and Media Department at the University of Hertfordshire and the Marche Region Academy of Arts (Accademia di Belle Arti of Macerata, Italy), in collaboration with the 'Stammibene' project. The videos, in English and Italian languages, were uploaded to a dedicated ReDNet Art

Communication website (www.clipshow.info), which was launched in February 2012. Since then, the website has recorded 2,345 visits. Works were also disseminated via You Tube, Facebook, the website project (www.rednetproject.eu), and related websites (www.regione.marche.it).

Virtual Seminars in Second Life

A ReDNet seminar room was developed and launched in January 2011 in the virtual world of Second Life (SL) as a cost-effectiveness multimedia approach. Seven events took place throughout the duration of the project. These involved the participation of professionals internationally and various experts were invited to present issues on clinical, social and legal challenges posed by the rapid diffusion of novel psychoactive substances. This was an opportunity a) to find out more about the new products on the market b) to present a cost effective solution for international networking and partnership c) to pilot the efficacy and accessibility of virtual learning environments. Table 2 shows a list of the ReDNet seminars in Second Life.

Table 2.

CONCLUSIONS

The rapid diffusion of NPS is a cross-national challenge. This justifies the need for international networks of excellence such as ReDNet. During its 27 months of activity, the ReDNet project was able to establish itself as the first EU-wide ICT-based preventative programme designed for NPS targeted at both the young and the professionals working with them. Despite the challenge, it was able play a strategic role in providing multidisciplinary advice to both EU/international agencies and

national policy makers such as European Monitoring Centre for Drugs and Drug Addiction (EMCDDA), United Nation on Drugs and Crime (UNODC), a range of EU national Anti-drug departments, advisory boards, charities and drug organizations across the EU.

In addition, the Centre for Clinical Practice, Safe Medicine and Drug Misuse Research at the School of Pharmacy at the UH, was licenced by the UK Home Office to carry out chemical analysis and testing of a variety of new designer drugs.

Initiatives such the First International Conference on Novel Psychoactive Substances launched by ReDNet and the EMCDDA in Budapest 2012 (<https://www.rednetproject.eu/conference/>) are essential to spread scientific knowledge and reliable and multidisciplinary information as widely as possible.

The ReDNet project emphasized the importance of drug prevention through online tools appealing to young people (Facebook, Twitter, You Tube amongst others). Prevention strategies should include evidence-based public health messages to users/potential users distributed via ICT tools as most the NPS are sold online through the same mediums. In addition, an ICT-based model of prevention is a cost-effective and environmental friendly model of prevention. In addition, it explored the potential on Internet monitoring as an essential phase to identify new emerging trends and products of abuse. A possible limitation of the present study could be given by the fact that only publicly available websites, fora and similar sources were monitored. Conversely, to improve the coverage of the study not only the web pages but also more private ways of communication (including newsgroups, chatrooms, mailing lists, e-newsletters, and bulletin boards) were here considered.

Overall the strength, experience and multidisciplinary resources of the network, and the internal resources of the partners by way of research attachments, will support the project sustainability and allow the ReDNet project to have a durable impact on European and international research after the end of EC co-funding (2012).

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Disclosure

No conflicts of interest are declared here which may have influenced the interpretation of present data. Please however note the following: FS is a full member of the Advisory Council on the Misuse of Drugs/ACMD in the UK; NS is a member of the German Advisory Council and both MF and MT are members of the Spanish Advisory Council; and JC is a member of the ACMD New Psychoactive Drugs working group in the UK. The views expressed here reflect only the authors' views and not necessarily those of the Home Office, the European Commission, or the ACMD.

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FIGURES

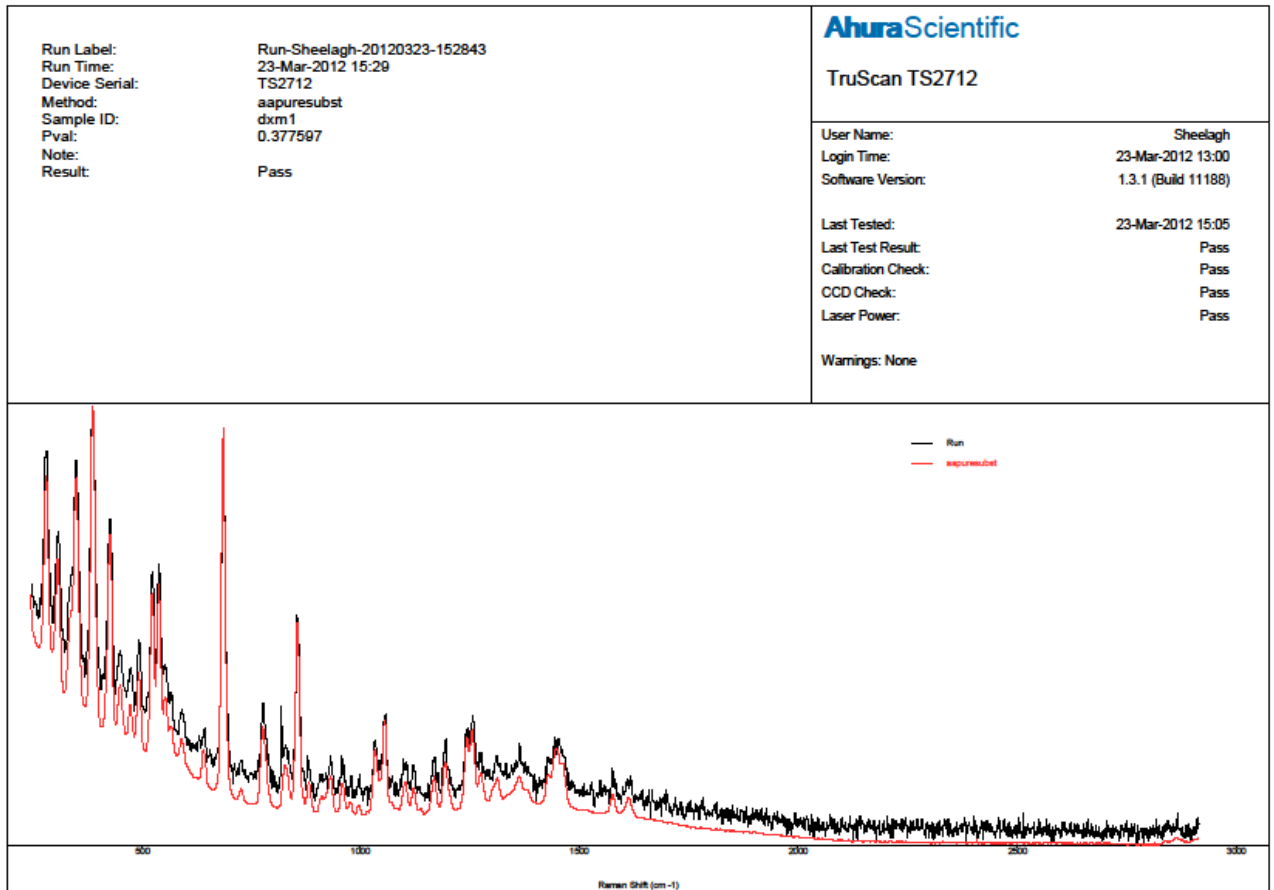


Figure 1 Results sheet showing the spectra of pure dextromethorphan hydrobromide which was matched against the reference substance in the instrument library using the Thermo Truscan handheld Raman instrument.

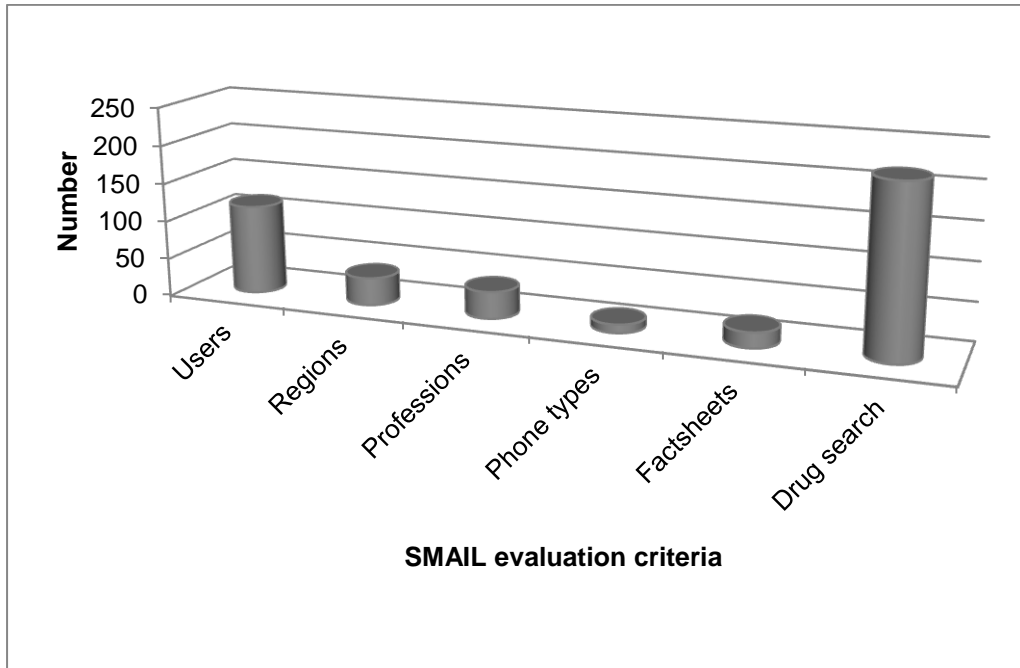


Figure 2 Number of users, regions, professions, phone types, factsheets and drug search evaluated for the SMAIL service over a period of two months.

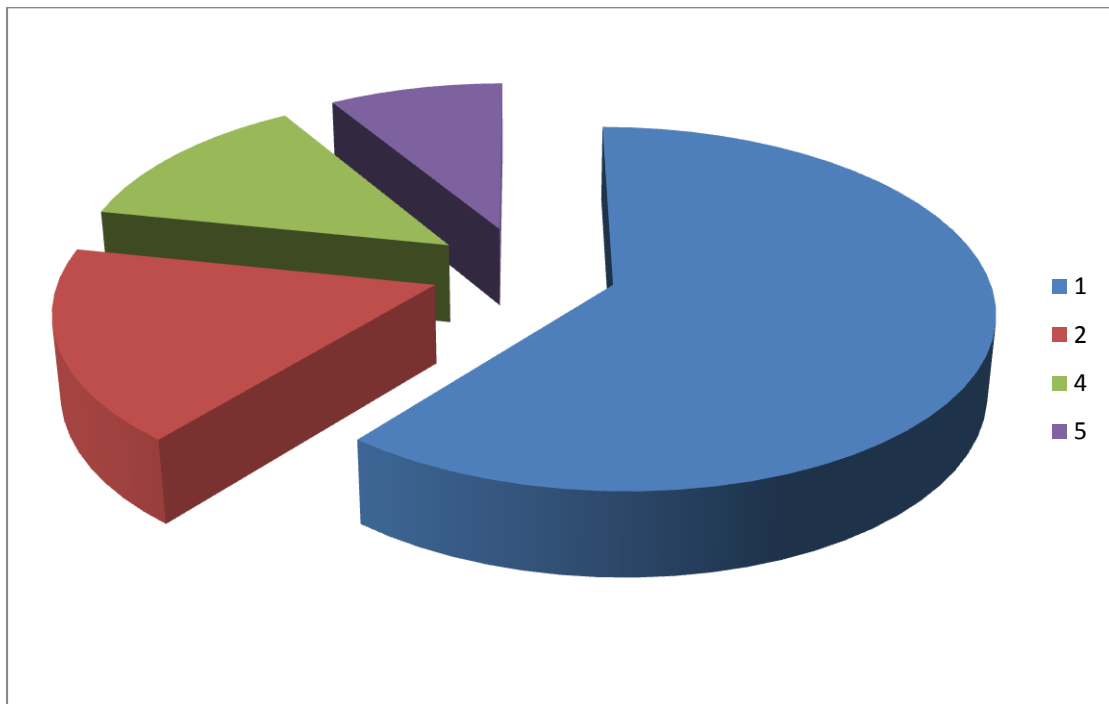


Figure 3 Effectiveness ranking of the subscribers for the SMAIL service. A score of 1 shows high effectiveness and 5 no effectiveness.

Table 1 List of speakers and seminars available in second life

Date	Discipline	Number of attendees	Number of countries	Speaker	Speaker profile	Topic
26/01/2011	Drugs and Legislation	27	6	Pasquale Policastro	Professor of Constitutional Law and European Integration, Faculty of Law and Administration, University of Szczecin, Poland	Promoting Active Life and Positive Attitude: Tasks, Methods and Proposal for New Drug Legislation
29/03/2011	Neurobiological and clinical issue	33	9	Fabrizio Schifano	Professor, MD, MRCPsych, Dip Clin Pharmacology University of Hertfordshire, UK	Novel psychoactive substances: Neurobiological and clinical issues
28/04/2011	Chemical testing	31	7	Sulaf Assi	Doctor, Centre for Excellence for Practice, Medicine Safety and Drug Misuse, School of Pharmacy, University of Hertfordshire, UK	Chemical Testing of Designer Drugs: New Techniques and Challenges
28/06/2011	Neuro-scientific and socio-cultural issues	20	5	Gilberto Gerra	Doctor, Chief of Drug Prevention and Health Branch, Division for Operations, United Nations Office on Drugs and Crime (UNODC), Vienna, Austria	Prevention of Abuse: lessons learned from neuroscience and socio-cultural research
26/10/2011	Drug use prevention	25	11	Claudia Rimondo	Project manager - Verona Addiction Department (Italy)	Drug use prevention among young people: novel methods and materials

30/11/2011	Web monitoring	27	10	Liv Holmefjord	Consultant - Bergen Clinics Foundation Competence Centre, Norway	Monitoring the new compounds on the web: an integrated component on the Bergen Earlier Warning System
08/02/2012	Trends	22	7	Ulrik Solberg	Msc, EMDDA, Lisbon, Portugal	Drugs on the Internet: emerging trends in Europe
