Perspective

Drug Testing and Analysis

Received: 11 October 2010 Revised: 29 June 2011 Accepted: 30 June 2011 Published online in Wiley Online Library: 26 September 2011

(wileyonlinelibrary.com) DOI 10.1002/dta.333

Effectiveness of and challenges faced by surveillance systems

Matthew Dunn,[a]* Raimondo Bruno,[b] Lucinda Burns[a] and Amanda Roxburgh[a]

Drug information or surveillance systems have been developed in an attempt to measure illicit drug use and predict new trends. In Australia, three systems are specifically designed to monitor drug use trends and related harm. These systems have their own strengths and weaknesses. This perspective offers a discussion of these facets. A series of case studies is used to highlight how surveillance systems can be effective in detecting and monitoring trends of use while highlighting the challenges these systems face. As indicated by the case study of ecstasy, such surveillance systems are effective and can provide unique information when a drug is detected and becomes 'established' in the market but the methodology of these systems is challenged when new drug classes emerge rapidly, as is illustrated by emerging psychotropic substances such as mephedrone.
Copyright © 2011 John Wiley & Sons, Ltd.

Keywords: monitoring system; surveillance system; ecstasy; cocaine; mephedrone

Introduction

The global drug market is not static; it continually changes in response to use, demand and supply. Our understanding of this market is informed by our knowledge of the drug situation in individual countries, which in turn is informed by the varied and dynamic local markets found within. This knowledge comes from many sources, including data collected by a number of health, justice, and survey systems all of which differ in their intent, strengths, and weaknesses. Many countries rely on cross-sectional general population surveys which, whilst useful in determining population-based estimates, are limited in their capacity to provide detailed information particularly in regard to emerging concerns in the drug market or acute drug-related harms. To this end, drug information systems or surveillance systems have been developed in an attempt to measure illicit drug use and predict new drug trends.[1] The terms 'drug information system', 'surveillance system' and 'monitoring systems' appear to be used interchangeably in the literature; for consistency purposes, the current paper will refer to these systems as 'surveillance systems'.

There are a range of surveillance systems operating at various jurisdictional levels, from the international (e.g. European Monitoring Centre for Drugs and Drug Addiction; EMCDDA), the national (the Drug Abuse Warning Network [DAWN] in the United States) and the local (the Føre Var system in Bergen, Norway). The EMCDDA coordinates and gathers data from 30 national monitoring centres, which collect and submit data to the EMCDDA.[2] This data covers topics that include epidemiology (e.g. general population surveys, problem drug use), drug markets (e.g. price and purity), and new threats and developments.[2] DAWN is a public health surveillance system operating in the United States that monitors drug-related hospital emergency department (ED) visits and drug-related deaths to track the impact of drug use, misuse, and abuse.[3] The Føre Var system in Bergen aims to provide rapid and reliable identification, monitoring, and reporting of drug and alcohol trends in the city of Bergen. This involves the systematic collection of data and linking together of existing drug information sources in Bergen, developing new information sources where necessary and analysing and reporting of patterns and trends on a six-monthly basis.[4] This list is not exhaustive of the systems which exist; it does, however, highlight what is operating across various jurisdictional levels.

There is no single model for how a surveillance system should exist or what components it should comprise,[5] and these constituents vary according to its function, the resources available to implement and run the system, the intended audience, geographical location, and the data sources available.[5] Each system has its own strengths, and conversely, its own weaknesses, when it comes to detecting and monitoring trends. The aim of this paper is to discuss some of the strengths and challenges faced by surveillance systems currently operating in Australia. Its aim is not to provide an in-depth commentary on the development of these systems, as these have been discussed elsewhere;[6–8] nor is the aim to provide an in-depth discussion of surveillance systems in general, as this too has been covered elsewhere.[5] Rather, it is to present a series of case studies which highlight how surveillance systems can be effective in detecting and monitoring trends in the prevalence of use and markets for illicit drugs, and to highlight some of the challenges these systems face.

The Australian context

There are a range of surveillance systems in Australia designed to monitor trends in drug use and related harm (see Shand *et al.* [1] and Mounteney and Leirvåg [4] for further discussion of these).

* *Correspondence to: Matthew Dunn, National Drug and Alcohol Research Centre, University of New South Wales, Sydney, NSW, Australia. E-mail: m.dunn@unsw.edu.au*

a *National Drug and Alcohol Research Centre, University of New South Wales, Sydney, Australia*

b *School of Psychology, University of Tasmania, Australia*

Copyright © 2011 John Wiley & Sons, Ltd.

Two complimentary systems currently monitor trends in illicit drug markets: the Illicit Drugs Reporting System (IDRS) and the Ecstasy and Related Drugs Reporting System (EDRS). The IDRS monitors trends in drug markets using regular injecting drug users (RIDU) as its sentinel population while the EDRS monitors trends in ecstasy and other drug markets (such as meth/amphetamine, cocaine, GHB, ketamine, and LSD) using regular ecstasy users (REU) as its sentinel population. Both systems operate in conjunction with a third, the National Illicit Drug Indicators Project (NIDIP), which identifies and collates epidemiological data from routine indicators (such as hospital data) on trends over time in drug-related harm.

The IDRS, and subsequently the EDRS, emerged following a review of a drug monitoring project conducted in 1990 and 1991 called the Illicit Drug Indicators project. This project, which was abandoned in 1992, largely relied on existing indicator data sources (e.g. law enforcement, and hospital or drug treatment data). The reliance on indicator data alone impaired the ability of the project to provide 'timely' information in a timely manner given that these data sources are typically reported 1–2 years after collection and are not collected in the same systematic way in each jurisdiction. The Commonwealth government commissioned a review of methods for monitoring drug trends and a new project, the IDRS, was funded based on the recommendations of this review.[8]

The IDRS and EDRS surveillance systems are based on the compilation of information from three sources. These include detailed quantitative interviews with sentinel populations of frequent drug users (RIDU and REU) in each capital city across Australia; qualitative surveys with 'key experts', defined as people who come into regular contact with the sentinel drug user population under investigation (which has the aim of accessing information about a wider population than those taking part in the sentinel component of the study); and secondary indicator data sources which may include general population data on drug use, the number and weight of drug detections at the Australian border, the purity of drugs seized by police, the number of deaths caused by drug use and so forth. Greater information on the methodologies of these projects can be found elsewhere.[6,7]

Two key aspects of these systems are worth noting for the subsequent discussion of specific challenges for these systems: first, the data collection with key experts and sentinel groups is replicated on an annual basis which means that the information collected is restricted to the year that it is collected; and secondly, secondary indicator data are typically reported between 1 and 3 years following their collection, which, while underscoring a key benefit of these surveillance systems,[5] also mean that much of the information about emergent trends provided by the IDRS and EDRS is typically derived from the consumer or key expert aspects of these systems.

Effective strategic monitoring: the case of ecstasy

The purpose for which the surveillance system is designed, and the ability with which the system can respond will, in part, dictate the components it comprises and what indicators will be included.[8] Tactical early warning applies to situations that require immediate response, while strategic early warning is any type of warning that is issued early enough to permit decision making to formulate a response.[8] Any early warning system is effective when it can monitor drugs which have already emerged and when there is sufficient demand for the substance. An example of a substance in this category is ecstasy.

Ecstasy has recently emerged as the second most widely used illicit drug in Australia, following a decline in the prevalence of methamphetamine use.[9] 'Ecstasy' is the street term commonly used for tablets containing MDMA, or 3,4-methylenedioxymethamphetamine. In reality, tablets sold and consumed as ecstasy can and do contain a range of substances that may or may not be related to MDMA. The term 'ecstasy' in this paper is used with the understanding that drugs sold and consumed as ecstasy may not contain MDMA. While past-year use has increased, from 1% of the general population aged 14 and above in 1988 to 3.5% in 2007, on a population scale, this remains a relatively low prevalence.

The development of the EDRS was a result of the observation that while the sentinel population recruited for the IDRS (i.e. RIDU) were able to provide reliable information relating to cannabis, methamphetamine, cocaine and heroin, they were less able to provide information on ecstasy and other 'party drugs', the demographics of those using these drugs, and the settings within which these drugs are used.[7] The IDRS was not specifically designed to provide information about ecstasy, [7,8] however, the increasing prevalence of ecstasy use in the general population, and the paucity of indicator data [7,10] providing information about this drug meant that a better understanding of the market and the health of those who use this drug class was an important strategic issue. Accordingly, in 2000, a two-year trial was implemented to examine the feasibility of adapting the IDRS methodology to monitor markets for ecstasy and related 'party' drugs. These markets were monitored annually in selected jurisdictions between 2000 and 2003, and have been monitored nationally since 2003.

The ability of the EDRS to capture information about those who use ecstasy is one of the clear successes of surveillance systems in Australia. Despite the relatively greater prevalence of past-year ecstasy use in the general population (3.5%) compared to drugs such as heroin (0.2%), there is extremely limited information available about use of these drugs from routine data sources. For example, in New South Wales (NSW), with a population of 6.98 million, in 2009 there were 69 treatment episodes where ecstasy was the primary drug of concern; there were two suspected drug-related deaths where ecstasy was detected; and there were 1911 arrests for ecstasy possession/use.[20] Despite this very low level of contact with services, the EDRS has been able to recruit substantial samples annually (650–750 per annum), that are highly distinct from those recruited through the IDRS and, importantly, have demographic characteristics consistent with ecstasy users recruited through representative (i.e. population surveys) rather than purposive sampling procedures.[11]

The characteristics of the regular ecstasy users sampled in the EDRS have remained relatively stable since monitoring began, with low numbers of participants completing repeat annual surveys, reflecting the relative transience of ecstasy use.[12] REU are typically male, aged in their mid-twenties, are in full-time employment or engaged in a mixture of employment and tertiary education. Across time, however, changes in the patterns of use among this group have also become noticeable. For instance, proportions of REU reporting weekly or more frequent ecstasy use has declined while the average amount of ecstasy used per occasion has increased; greater proportions are taking drugs for longer periods without sleep, which is a pattern of use associated with greater psychobiological stress and adverse health

Copyright © 2011 John Wiley & Sons, Ltd.

consequences; and the rates of co-incident heavy alcohol use in conjunction with ecstasy use has increased.[13]

Such health-related information, along with monitoring of issues such as psychological distress and access to mental health treatment, sexual health, and engagement in drug driving, is uniquely provided by the EDRS and fills an important gap in strategic monitoring for Australian drug policy responses. Both the National Drug Strategy Household Survey (NDSHS; the general population survey of drug and alcohol use in Australia) and the EDRS have provided important information about the emergence of the use of ecstasy and patterns of ecstasy-related harms in Australia. These systems have also highlighted the need for more systematic recording of the harms associated with ecstasy in existing routine data collections, as many of the national routine data collections (e.g. the National Hospital Morbidity Database and the Australian Bureau of Statistics Causes of Death data) do not code ecstasy related harms separately from harms due to amphetamine type stimulants.

Strengths of surveillance systems: The benefits of retrospective analysis

The value of a surveillance system often becomes more evident as the number of years in which they operate increases. Data collected systematically and regularly over an extended period is important in several ways, the two most important being (1) to help identify when an apparent change becomes a meaningful trend and (2) to assist in measuring the impact that policy change has on behaviour.

The benefit of collecting data across time is that it allows researchers to clarify with greater certainty, in particular instances where multiple data sources are synthesized, when a 'trend' reflects a meaningful change as opposed to an unsustained fluctuation in the drug market. After the first five years of data collection in Sydney, the IDRS was able to detect changes in the heroin and cocaine markets, chief among these being a decline in price and an increase in purity, which subsequently led to increases in the proportions of RIDU using these drugs.[14,15] Other changes which were documented after several years of data collection included the decline in methadone injecting among Sydney RIDU;[16] the increased injection of pharmaceutical morphine in jurisdictions without heroin;[17] the emergence of more potent forms of methamphetamine in the Sydney drug market;[18] and the increase in the use of gamma hydroxybutyrate (GHB) among REU in Sydney. [19] In some instances, these trends may not have been observed by other routine data sources such as calls to telephone help lines, data pertaining to accidental deaths or arrests for possession, use or supply.

A further benefit to collecting data across time is that it allows for retrospective policy analysis. Several data sources, including data from the NSW IDRS, were used to study the impact of removing temazepam gel capsule preparations from the Australian market on benzodiazepine injecting. There had been concerns in the United Kingdom in 1996 surrounding injection-related harms associated with the gel capsules. Given this situation, and research in Australia investigating benzodiazepine use and harms among injecting drug users,[20] there was concern among the medical community about injection-related harms among injecting drug users associated with the injection of these gel capsules. It was found that removing this formulation from the Australian market in 2004 resulted in increased prescribing of tablet formulations of temazepam but overall benzodiazepine prescription numbers remained stable.[21] The injection of benzodiazepines ceased as a mode of administration among RIDU in inner Sydney but frequent oral use remained high. In this case the synthesis of multiple data sources including patterns of use among RIDU, data from the Sydney Medically Supervised Injecting Centre, and national benzodiazepine prescription data allowed for a retrospective analysis of policy initiatives (i.e. the removal of the gel capsules from the Australian market) as well as allowing continued monitoring to evaluate the effectiveness of the response.

Monitoring trends outside defined sentinel populations: a case study of cocaine

The review of the Illicit Drug Indicators project recommended that the IDRS include data collected from special population surveys, such as those purposefully designed for specific groups thought to be more likely to display higher levels of drug-related harm.[8] The IDRS included the sentinel population of RIDU because it was anticipated that due to their extensive polydrug use, and their involvement in a more hazardous route of drug use they would be a group well placed to report on trends concerning a number of drug classes and issues that required early responses.[6]

For the EDRS, it was necessary to define an equivalent population, and among the drugs considered 'party drugs', ecstasy was the most widely used at the time; further, studies had shown that virtually all of those who reported ketamine and GHB use appeared to be experienced users of ecstasy but that the reverse was not the case.[7] Thus, REU became the sentinel population for this system. Selecting this sentinel population allowed for the detection of emerging trends in other drug use among those who engaged in regular ecstasy use. However, it makes understanding trends outside of these groups difficult, as can be exemplified by the case of cocaine.

The proportion of the Australian general population aged 14 years and above who have ever used cocaine remained consistent across time – between 1993 and 1995, approximately 3% reported having ever used cocaine, with this figure rising to 4.3% in 1998 and remaining consistent in 2001 (4.4%) and 2004 (4.7%). In 2007 this proportion increased to 5.9% [9] and was one of only two drugs to record an increase in lifetime prevalence (the other being ecstasy). The proportion of the population who reported use in the past year has remained consistent across time, though in 2007 there was a significant increase from 1% reporting recent use in 2004 to 1.6% reporting use in 2007. Law enforcement statistics also reflect a potential expansion of the cocaine market in Australia. Cocaine-related arrests were the highest on record in 2008/09 (predominantly driven by figures in NSW) [22] and the Australian Federal Police have made several large seizures of cocaine, including a shipment of 240 kg, representing the fifth largest seizure on record in Australia.[23]

Two groups of cocaine users have traditionally been identified in Australia.[24] The first group consists of those from high socio-economic status backgrounds who are employed in professional occupations. The second consists of those from low socio-economic status backgrounds who usually inject cocaine. As drug markets have evolved, and drug users have increasingly become polydrug users, a third group of cocaine users have been identified; this group consists of those for whom cocaine is not the primary drug of choice and for whom cocaine is used in the context of polydrug use. [25]

The use of cocaine among these second and third groups has been monitored by both the IDRS and the EDRS; indeed, cocaine is one of the few drugs where use is reported by both samples.[26]

Copyright © 2011 John Wiley & Sons, Ltd.

There are similarities between the two groups on a national level: in 2010, similar proportions of both RIDU and REU reported having ever used cocaine (66% and 63%, respectively); although recent (past six month) use was more common (39% *vs* 21%) but less frequent (2 days *vs* 5 days) for REU compared with RIDU.[27,28] Among both groups, cocaine use is most apparent on the east coast of Australia, with rates highest in Sydney (NSW) in particular.

There are limitations to the data collected on these two groups, and these limitations are related to the high price of the drug and the sporadic frequency of use. The price of cocaine is between $300 and $350 per gram, [27,28] which appears to limit the frequency of use among REU, even among those who live in Sydney where access is easiest (71% of REU in Sydney reported use on a less than monthly basis [29]). While frequency of use among RIDU in Sydney is higher (a median of 20 days in the past 6 months [30]), it is difficult to generalize these cocaine consumption patterns to groups who are not primarily injecting drug users.

The first group of cocaine users (namely those from high socio-economic status backgrounds) have been difficult to reach in Australia. Whilst their existence is apparent from a number of high-profile cases publicized in the media,[31,32] the extent of this market is not well documented. In 2004/2005 researchers investigating the cocaine markets in Sydney, New South Wales and Melbourne, Victoria [33] replicated earlier work into cocaine use, identifying two distinct user groups,[33,34] however very few high socio-economic status individuals participated in the study. This group is less likely to participate in research and are highly unlikely to present to public treatment services for problems related to their cocaine use, meaning that cocaine-related harms experienced by this group go unrecorded. Our insights into the use of, markets for, and harms associated with cocaine in Australia remain largely concentrated around people who inject drugs or who are young casual users. Whilst these affluent users are not the target population of the surveillance systems, it means that there are significant gaps in our understanding of the prevalence and impacts of cocaine use in Australia.

Challenges for surveillance systems: the case of emerging psychotropic substances

As mentioned, the IDRS and EDRS are strategic and not tactical in nature. The structure of these systems in regard to their annual replication and recruitment of sentinel populations is a strength for understanding changes over time in these particular, relatively identifiable, markets. Challenges arise in monitoring new drug classes which emerge rapidly, have a very low prevalence, and are used in an unknown or highly specific subset of the population. Such is the situation currently in Australia with the drug mephedrone. Mephedrone (4-methylmethcathinone [4-MMC]) is a synthetic stimulant and its effects include increased alertness, euphoria, and feelings of stimulation with possible side-effects including nose bleeds, nausea, vomiting, anxiety, paranoia, and delusions. [35] Given its short history of use, long-term effects are unknown. The suspected drug-related deaths of several people in the UK in late 2009 and early 2010 led to its ban in that country in April 2010. [36] There is very little data in Australia in regard to the use of this drug save from a small number of police seizures, and a number of anecdotal media reports and Internet bulletin board reports of use (e.g. www.bluelight.ru) Media reports in Australia suggested that the drug was easily purchasable through the Internet where it was being sold as 'plant fertilizer'. [37] Further, there were reports that mephedrone was being sold as ecstasy. [38]

Mephedrone's short history of use has posed several challenges to current surveillance systems. First, although the IDRS and EDRS are designed in a way that allows for collection of information on drugs not already explicitly monitored via structured interview schedules, the impetus is often on the interviewee to recall the use of a 'new' drug. The EDRS results show that very few participants over time have reported using other drugs such as 2 C-I [2,5-dimethoxy-4-iodophenethylamine], 2C-B [2,5-dimethoxy-4-bromophenethylamine], and mephedrone. [27]

Secondly, there is the issue of drug content. In the illicit drug market, there is no quality control for substance content. People who use these drugs purchase drugs on the presumption that they contain the active ingredient they are purported to. In the case of mephedrone if this is sold as being 'ecstasy' then users may not realize they have consumed a new drug class and hence this will not be reported in interviews for surveillance systems. The inherent variability of the content of 'ecstasy' tablet seizures, a substantial proportion of which may contain substances as varied as methamphetamine, MDA, MDEA, ketamine, BZP, methorphan, LSD, TFMPP [3-trifluoromethylphenylpiperazine], caffeine and paracetamol, [39] and the pattern of polydrug use when consuming such drugs [27] may obscure an individual's ability to identify use of new drug classes on the basis of subjective effects.

Similarly, complexities for identification arise due to the nature of marketing of these emerging psychotropic substances. For example, in 2008, use of an unknown drug known as 'neo-doves' was noted by key experts in one jurisdiction contributing to the EDRS [40] with little information available other than the drug being purchased via the Internet and sold as a legal ecstasy alternative (herbal ecstasy or ecstasy-like substance) in powder form. In the subsequent annual jurisdictional sample, a notable proportion of REU reported use of a drug known as 'Israelis'. [40] It is conceivable that these reflected use of drugs from the same source as the original producer of neo-doves. Neorganics (http://www.neorganics.net.) is based in Israel and the presentation of these pills was similar to the earlier reports. A seizure of this drug was analyzed by local police forensic services and identified as 4-methylmethcathinone, which is consistent with analyses of Neorganics products by European toxicology agencies.[41]

However, since the time of this seizure Neorganics has advertised second, third, and fourth 'generations' of these products, which likely represent variations of constituents in response to legislative changes around these drugs.[42] Given that the products are sold under the same name, but with rapidly evolving content, even if the use of neo-doves or other emerging psychotropic substances is identified in surveillance systems such as the EDRS, limited information will be available in relation to their health effects due to (1) their low prevalence in these samples, and hence low statistical power to identify patterns; (2) the obscuring of the effects of possibly multiple distinct drugs sold under the different 'generations' of drugs with the same name (and likely questionable quality control of such products) purchased within the time window of surveillance system samples; and (3) the time lag arising from police seizing drugs then passing these to forensic laboratories for analysis, during which time the drug formulation may have further 'evolved'.

Given the transient nature of the emerging psychotropic substances market, even where users believe they do know the content of the substances they are consuming, use may be fleeting.

Copyright © 2011 John Wiley & Sons, Ltd.

An example from the same jurisdiction shows that in the 2004 and 2005 EDRS surveys anecdotal reports of use of substances believed to be 2 C-I were identified.[40] In response, more systematic recording of 2 C-I was introduced into subsequent surveys, with one-quarter of the REU reporting recent use in 2006. However, in 2007 this had fallen to one-tenth of the sample and was almost absent in 2008. This highlights a challenge to the drug monitoring system; by the time the system is adjusted to probe for information regarding very specific emerging drug classes, the trend may have passed.

Finally, there is a challenge for existing monitoring systems in relation to the identification of use of emerging psychotropic substances. The ability of monitoring systems to identify such use is dependent on this low prevalence group being captured within the sentinel population used as the basis for recruitment to these systems. It is likely that the EDRS, with its emphasis on regular ecstasy users as a sentinel sample may capture at least some proportion of the population consuming emerging psychotropic substances given that these tend to be discussed on websites and Internet forums where there is also substantial discussion about ecstasy use (e.g. bluelight.ru; pillreports.com). However, if the emerging psychotropic substances market evolves into a highly specialized one, the very existence of this group may be missed by the EDRS.

Discussion

As demonstrated in the current paper, Australia's drug surveillance systems have been effective in monitoring trends in drug use and related harms, particularly among drug classes that have established markets and when there are multiple data sources available for examination over time. The fact that the IDRS and EDRS recruit sentinel groups of frequent drug users ensures that drug-related harms are effectively monitored, as it is these groups among whom we would logically expect to see harms emerging first. EDRS findings have clearly recorded changes in the consumption of ecstasy and other drugs among this group, trends that are not picked up among general population samples or routine indicators. IDRS findings have effectively demonstrated changes in patterns of cocaine, heroin and methamphetamine use among injecting drug users, as well as a decline in benzodiazepine injecting in response to policy change. The findings from the IDRS and EDRS are both effective at highlighting areas that may require more specific research.

The challenges for these systems are the ability to detect the emergence of new drugs and detecting trends among individuals outside the sentinel populations: these are partially related to the fact that these systems have been designed to be strategic rather than tactical in nature. Wardlaw, in his review of the original Illicit Drug Indicators concept, concluded that it was inadequate as an early warning system because it did not deliver timely information.[8] The issue of timeliness is still pertinent to today's surveillance systems in two ways. Firstly, there are still inherent delays in the provision of secondary indicator data, such as hospital admissions. There will thus be a lag between the time a drug enters the market and the time that harms related to the use of this drug will be captured by such systems. However, as harm related to substance use is expected to first emerge among the sentinel groups of users, it is reasonable to anticipate that these surveys may be able to act as a proxy measure for harm. Secondly, the 12 month-cycle of data release for the IDRS and EDRS is likely to be appropriate for well-established, moderate prevalence markets, but less so for low prevalence drug classes, such as the emerging psychotropic substances that may appear and disappear from the market rapidly.

In addition, these systems are not likely to detect trends among individuals whose involvement in the drug market is more tenuous. However, where the aim is to learn as much as possible about drug markets and harms experienced by substance users, the regular (and potentially problematic) users are likely to be more knowledgeable and provide greater insight. The challenge with the emergence of mephedrone in the Australian drug market is to decide whether it warrants continued monitoring and to what extent. As has been seen with drugs such as GHB,[19] routine data sources may lack the capacity to detect the use or harms associated with mephedrone; as such, these surveillance systems may provide one of the few sources of data. Alternatively, these issues may best be addressed through the use of rapid assessment of the specific market for these drugs.

As the current manuscript discusses, there are many complexities and challenges involved in the operation of surveillance systems. Some of these are related to the data collected and the level at which the system operates. For instance, the EMCDDA collates data from all European Union Member States, candidate countries and Norway. Surveillance comes from the analysis of secondary data rather than primary research. As has already been discussed, there can be a considerable lag between the time secondary data is collected and the time that this data is disseminated. Further, the drug-related issues which various countries face can differ considerably. On the other hand, the core data collected for the IDRS and EDRS is the data from the sentinel population. As discussed, these populations have been chosen because they are actively involved in the drug market through their regular drug use practices. They are able to provide more detailed information on trends in drug-related activities. Data used in the IDRS and EDRS is collected in one country. Despite this, these systems face a similar challenge as that faced by the EMCDDA. Drug markets in Australia differ across jurisdictions. The issues faced in the more populous Eastern states, such as New South Wales and Victoria differ to those faced in other states, such as Western Australia and Tasmania. For instance, the purity of ecstasy in Tasmania has consistently been reported as lower by regular ecstasy users there compared to those in New South Wales, which may be why Tasmania is seeing a higher prevalence of use of emerging psychotropic substances such as mephedrone.

Conclusion

As demonstrated, the EDRS has been able to monitor trends in the use and harm of ecstasy in part by building surveillance upon regular users of that drug. However, this poses a clear dilemma for the system when trying to capture emerging drug classes. The prevalence of ecstasy use is high enough to pose important questions with regards to appropriate health responses but low enough so that there is limited information available from routine sources of information, such as those seeking treatment. This is important when formulating strategic policy decisions. Yet, as has also been demonstrated, if the system is not flexible enough it is bound to miss the emergence of novel drug markets. Flexibility may include use of new methods and technologies to capture new markets. In the case of emerging psychotropic substances,

Copyright © 2011 John Wiley & Sons, Ltd.

measure of Internet use may prove useful. If these markets are detected, the difficulty lies in making the decision as to whether these new markets are sustained, and if they have a high enough prevalence to provide a return on the investment made in the collection of surveillance research from a strategic policy-relevant point of view.

Acknowledgements

Many thanks to the large number of regular substance users who have agreed to be interviewed for the IDRS and EDRS over the years. The IDRS has been funded by the Australian Government Department of Health and Ageing. The EDRS was funded by the Australian Government Department of Health and Ageing, the Australian Government Department of Health and Ageing and the Ministerial Council on Drug Strategy (under the cost-shared funding agreement) and the National Drug Law Enforcement Research Fund. Thanks to the agencies across Australia that have contributed to the IDRS and EDRS: the National Drug and Alcohol Research Centre (NSW), National Drug Research Institute (WA), Drug and Alcohol Services South Australia (SA), Turning Point Alcohol and Drug Centre and Macfarlane Burnet Institute for Medical Research and Public Health (Vic), Australian National University (ACT), University of Tasmania (Tas), Northern Territory Department of Health and Community Services (NT), and the Queensland Alcohol and Drug Research and Education Centre (Qld).

References

[1] F. Shand, L. Topp, S. Darke, T. Makkai, P. Griffiths. The monitoring of drug trends in Australia. *Drug Alcohol Rev.* **2003**, *22*, 63.
[2] P. Griffiths, J. Mounteney, D. Lopez, F. Zobel, W. Gotz. Monitoring the European drug situation: the ongoing challenge for the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA). *Addiction*. **2011**.
[3] Drug Abuse Warning Network. Drug Abuse Warning Network, 2009: Methodology Report. Available at: http://www.oas.samhsa.gov/2k11/DAWN2009Methods/DAWN2k9_MethodologyReport.htm#1 [16 June 2011]
[4] J. Mounteney, S. Leirvåg. Providing an earlier warning of emerging drug trends: the Føre Var system. *Drugs: Edu. Prev. Pol.* **2004**, *11*, 449.
[5] P. Griffiths, L. Vingoe, N. Hunt, J. Mounteney, R. Hartnoll. Drug information systems, early warning, and new drug trends: Can drug monitoring systems become more sensitive to emerging trends in drug consumption? *Subst. Use Misuse*. **2000**, *35*, 811.
[6] J. Hando, S. Darke, S. O'Brien, L. Maher, W. Hall. The development of an early warning system to detect trends in illicit drug use in Australia: the illicit drug reporting system. *Addict. Res.* **1998**, *6*, 97.
[7] L. Topp, C. Breen, S. Kaye, S. Darke. Adapting the Illicit Drug Reporting System (IDRS) methodology to examine the feasibility of monitoring trends in party drug markets. *Drug Alcohol Depen*. **2004**, *73*, 189.
[8] G. Wardlaw, Final Report: Illicit Drug Reporting System. Consultant's report to the Commonwealth Department of Human Services and Health, NDARC Technical Report 292, University of New South Wales, Sydney, **1994**.
[9] Australian Institute of Health and Welfare, 2007 National Drug Strategy Household Survey: First results, Australian Institute of Health and Welfare, Canberra, **2008**.
[10] S. Kinner, L. Degenhardt. Reflections on the development and implementation of an early warning system for ecstasy and related drug markets in Australia. *Drug Alcohol Rev.* **2006**, *25*, 445.
[11] L. Topp, B. Barker, L. Degenhardt. The external validity of results derived from ecstasy users recruited using purposive sampling strategies. *Drug Alcohol Depend*. **2004**, *73*, 33.
[12] K. von Sydow, R. Lieb, H. Pfister, M. Hofler, H.U. Wittchen. Use, abuse and dependence of ecstasy and related drugs in adolescents and young adults-a transient phenomenon? Results from a longitudinal community study. *Drug Alcohol Depend.* **2002**, *66*, 147.
[13] L. Degenhardt, A. Roxburgh, M. Dunn, G. Campbell, R. Bruno, S.A. Kinner, J. George, B. Quinn, N. White, L. Topp. The epidemiology of ecstasy use and harms in Australia. Neuropsychobiology. **2009**, *60*, 137.
[14] S. Darke, S. Kaye, L. Topp. Cocaine use in New South Wales, Australia, 1996–2000: 5 year monitoring of trends in price, purity, availability and use from the Ilicit Drug Reporting System (IDRS). *Drug Alcohol Depend*. **2002**, *67*, 73.
[15] S. Darke, L. Topp, S. Kaye, W. Hall. Heroin use in New South Wales, Australia, 1996–2000: 5 year monitoring of trends in price, purity, availability and use from the Illicit Drug Reporting System (IDRS). *Addiction*. **2002**, *97*, 179.
[16] S. Darke, L. Topp, J. Ross. The injection of methadone and benzodiazepines among Sydney injecting drug users 1996–2000: 5-year monitoring fo trends from the Illicit drug reporting system. *Drug Alcohol Rev.* **2002**, *21*, 27.
[17] L. Degenhardt, E. Black, C. Breen, R. Bruno, S. Kinner, A. Roxburgh, C. Fry, R. Jenkinson, J. Ward, J. Fetherston, J. Weekley, J. Fischer. Trends in morphine prescriptions, illicit morphine use and associated harms among regular injecting drug users in Australia. *Drug Alcohol Rev.* **2006**. *25*, 403.
[18] L. Topp, L. Degenhardt, S. Kaye, S. Darke. The emergence of potent forms of methamphetamine in Sydney, Australia; A case study of the IDRS as a strategic early warning system. *Drug Alcohol Rev.* **2002**, *21*, 341.
[19] M. Dunn, L. Topp, L. Degenhardt. GHB in Sydney, Australia, 2000–2006: A case study of the EDRS as a strategic early warning system. *Int. J. Drug Policy*. **2009**. *20*, 413.
[20] S. Darke, J. Ross, W. Hall. Benzodiazepine use among injecting heroin users. *Med. J. Australia*. **1995**, *162*, 645.
[21] L. Degenhardt, R. Roxburgh, I. van Beek, W. Hall, M. Robinson, J. Ross, A. Mant. The effects of the market withdrawal of temazepam gel capsules on benzodiazepine injecting in Sydney. *Australia Drug Alcohol Rev*. **2008**, *27*, 145.
[22] A.C. Commission, Illicit Drug Data Report 2008/09, Australian Crime Commission, Canberra, **2010**.
[23] Australian Federal Police. $84 million of cocaine seized and four charged. Available at: http://www.afp.gov.au/media-centre/news/afp/2010/july/$84-million-of-cocaine-seized-and-four-charged.aspx [22 July 2010].
[24] J. Hando, B. Flaherty, S. Rutter. An Australian profile on the use of cocaine. *Addiction*. **1997**, *92*, 173.
[25] Australian Institute of Health and Welfare, *National Drug Strategy Household Survey: detailed findings* 2009, Australian Institute of Health and Welfare, Canberra, **2007**.
[26] G. Campbell, N. Sindicich, L. Burns, E. Black, Cocaine use in Australia, in *Drug Trends Bulletin, April 2008,* National Drug and Alcohol Research Centre, University of New South Wales, Sydney, **2008**.
[27] N. Sindicich, L. Burns. *Australian trends in ecstasy and related drug markets 2010: Findings from the ecstasy and related drugs reporting system (EDRS),* in *Australian Drug Trends Series No 46,* National Drug and Alcohol Research Centre, University of New South Wales, Sydney, **2010**.
[28] J. Stafford, L. Burns. Australian drug trends 2009: Findings from the illicit drugs reporting system (IDRS), in Australian *Drug Trends Series No. 37,* National Drug and Alcohol Research Centre, University of New South Wales, Sydney, **2010**.
[29] L. Scott, L. Burns. NSW trends in ecstasy and relatyed drug markets 2009: Findings from the ecstasy and related drugs reporting system, in *Australian Drug Trends No. 47.* National Drug and Alcohol Research Centre, University of New South Wales, Sydney, **2010**.
[30] B. Phillips, L. Burns, *NSW* Drug Trends 2009: Findings from the illicit drugs reporting system (IDRS), in Australian *Drug Trends Series No 38,* National Drug and Alcohol Research Centre, University of New South Wales, Sydney, **2010**.
[31] T. Clarke, *14 AFL players test positive to drugs in 2009,* in *The Age,* Fairfax Digital, Melbourne, **2010**.
[32] *Buttrose nephew obsessed with cocaine, court told,* in *The Age,* Fairfax Digital, Melbourne, **2009**.
[33] J. Shearer, J. Johnston, S. Kaye, P. Dillon, L. Collins, *Characteristics and dynamics of cocaine supply and demand in Sydney and Melbourne. NDLERF Monograph No. 14,* National Drug Law Enforcement Research Fund: Hobart, **2005**.
[34] J. Shearer, J. Johnston, C.L. Fry, S. Kaye, P. Dillon, P. Dietze, L. Collins. Contemporary cocaine use patterns and associated harms

Copyright © 2011 John Wiley & Sons, Ltd.

in Melbourne and Sydney, Australia. *Drug Alcohol Rev.* **2007**, *26*, 537.
[35] A.R. Winstock, J. Marsden, L. Mitcheson, What should be done about mephedrone? *BMJ*. **2010**, *340*, c1605.
[36] K. Morris. UK places generic ban on mephedrone drug family. *Lancet* **2010**, *375*, 1333.
[37] M. Bachl. *AFP seize 20 kg of party drug mephedrone.* Available at: http://news.ninemsn.com.au/national/981250/afp-seize-20kg-of-party-drug-mephedrone. [8 December 2009].
[38] M. Bachl. *Dealers sell meow meow in fake ecstasy pills.* Available at: http://news.ninemsn.com.au/national/1071851/dealers-sell-meow-meow-in-fake-ecstasy-capsules [17 June 2010].
[39] C. Quinn. *Drug analysis: Current issues for the drug market, in 2009 Drug Trends Conference.* Sydney, Australia, **2009**.
[40] A. Matthews, R. Bruno. *Tasmanian Trends in Ecstasy and Related Drug Markets 2009: Findings from the Ecstasy and Related Drugs Reporting System (EDRS)*. National Drug and Alcohol Research Centre, University of New South Wales, Sydney, **2010**.
[41] S. Davies, J. Ramsey, R. Archer. *Analytical profiles of methcathinone related compounds*. Available at: http://www.ltg.uk.net/admin/files/Methcathinones.pdf [6 August 2010].
[42] S.D. Brandt, H.R. Sumnall, F. Measham, J. Cole. Analyses of second-generation 'legal highs' in the UK: Initial findings. *Drug Test. Analysis* **2010**, *2*, 377.

Copyright © 2011 John Wiley & Sons, Ltd.