

Drug abuse epidemiology: an overview*

Z. SLOBODA

*Institute for Health and Social Policy, University of Akron, Akron, Ohio,
United States of America*

ABSTRACT

The field of drug abuse epidemiology is a relatively new one and recognition of drug abuse as a phenomenon amenable to study within the field of epidemiology is still forthcoming. Reviews of programmes for meetings of epidemiologic research societies rarely highlight drug abuse, even in association with the transmission of, human immunodeficiency virus (HIV), hepatitis C virus (HCV) or hepatitis B virus (HBV), despite the high rates of prevalence of those infections among drug-abusing populations. The "diagnosis" of drug dependence or addiction and identification of affected populations relies heavily on data concerning problems associated with drug abuse. Both the Diagnostic and Statistical Manual and the International Classification of Diseases, for example, use behavioural criteria to define abuse and dependence. However, most surveys of general and special populations do not include measures that reflect these criteria, but limit themselves to the type of drug used and the frequency of use within a specified time period. With the progress in the development of more biological and medical tools, improved measures of abuse that combine both behavioural and physical assessments will be available to study more carefully the various forms of drug abuse and dependence. The present article has two purposes. The first is to set a framework that describes the current state of the field of drug abuse epidemiology. The second is to provide a synthesis and overview of the articles in the present issue and in vol. LV, Nos. 1 and 2 (2003), of the Bulletin, which represent work from several countries. The excitement of this emergent field is reflected in each of the articles. The study of drug abuse epidemiology is both challenging and rewarding. As more groups become aware of the global nature of this public health problem and its impact on the political, social and health situations of communities, countries and regions, we hope that drug abuse epidemiology will receive the attention it deserves by policy makers, researchers and, in particular, newly trained social scientists and epidemiologists.

Keywords: drug use patterns; discontinuation; drug trends and social influences; risk and protective factors; research methods; surveillance; monitoring surveys.

*The author of this paper is a researcher from the United States of America, and much of the introductory statements refer to work conducted in her home country, with which she is most familiar.

Introduction

Epidemiology is a field that studies the distribution of health problems in populations to determine the nature of the health problems, the characteristics of the population affected with the health problems and the environmental conditions or circumstances that are uniquely associated with the health problems and the affected populations. Epidemiologists also describe the course or stages of health problems. They have developed statistical models that simulate the progress of health problems and can use the models to determine the impact of interventions intended to stem their progress. Such models exist for many infectious diseases, including the human immunodeficiency virus (HIV), but have not been applied well to drug abuse. Drug use is seen more as an individualistic behaviour and is therefore not readily conceived of from a population perspective.

One of the most important challenges to drug abuse epidemiologists is defining and measuring the phenomenon of study. In comparison to other health disciplines, the field relies more on behavioural than on physiological or biological criteria to differentiate the range of drug-using behaviours from initiation of use through to full dependence and abuse. Currently there are at least two dimensions of drug-using behaviours that are assessed: degree of use (i.e. frequency of use) and use associated with social and health problems.

There is general recognition of several phases and degrees of drug abuse, from initiation and early-use patterns to long-term chronic use. Onset of use for each drug of abuse, including tobacco, alcohol and, often, inhalants, is used as a measure of incidence of use. Age of onset is an important measure, as many studies have found a relationship between age of onset and subsequent drug abuse or drug dependency (using either the Diagnostic and Statistical Manual or the International Classification of Diseases) [1, 2]. However, substantial portions of those who initiate drug use discontinue such use. Estimates from school surveys from the United States of America show rates of discontinuation ranging from as high as 57 per cent for inhalants, for instance, to as low as 22 per cent for marijuana [3]. Our knowledge about those who continue use, become dependent and develop problems over the course of time is very limited. Preliminary studies indicate that those who discontinue use generally initiated use for social reasons, while those who continue to chronic use, either have a family history of substance use and/or have psychological problems [4]. The paper by Glantz and Colliver [5] in the present issue of the *Bulletin on Narcotics* addresses the need to develop better definitions and measures of drug-using behaviours in order to better understand this phenomenon and improve policies and prevention and treatment approaches to stem the behaviour and its associated social and health problems.

Recent brain-imaging studies are encouraging, as they present evidence of an association between drug abuse and neural/brain changes, some of which may be long-lasting [6-10], and may explain the altered and sometimes problematic behaviours observed with more chronic drug users. These changes have been observed for alcohol, tobacco, marijuana, cocaine, methylenedioxymethamphetamine (MDMA, commonly known as Ecstasy) and methamphetamines. In addition,

these studies have shown that craving for drugs, a key component of the abuse process, is the result of the stimulation of certain parts of the brain when triggers, such as seeing drug paraphernalia or persons administering drugs, are introduced, even when drug abusers have been detoxified and have not used drugs for long periods of time. These studies suggest that, in the future, drug abuse epidemiologists may be able to develop more precise diagnostic tools that are behavioural measures of changing brain functioning in response to degree of drug use.

Influences on trends and patterns of drug abuse

A number of societal factors and individual vulnerabilities influence drug abuse patterns and trends within a geographic area and during a specific period of time. Unlike infectious diseases, drug abuse, and which drugs are used by whom, is influenced more by social rather than biological factors. However, once individuals begin to abuse drugs, their brains and bodies change, and biological and physiological factors become more dominant. The paper by Rossi in the present issue of the *Bulletin* presents drug-use progression using an infectious disease model as a framework [11]. The development and workings of such models are greatly limited by the availability of information related to the nature of drug abuse. At present, this information is not sufficient to develop more accurate models representing how drug use patterns spread within and across population groups.

The societal factors found to influence both the initiation and continued use of drugs include the public's tolerance of the use of drugs, measured by perceptions of negative social and health consequences of the use of these drugs, as well as the availability of drugs. For instance, researchers for the Monitoring the Future Study found that prior to an upturn or downturn of drug use among adolescents, there are changes in adolescents' perceptions regarding the harmfulness of drugs and the social acceptance of drug use [12, 13]. Indeed, the upturn in drug use among adolescents since 1992 may be related to their changing perceptions of the harmfulness of the use of drugs [14]. Until the early 1990s, during a period of declining drug use, teens' perceptions of harm associated with drug use were comparable to those of their parents' age group. Since 1992, when drug use began to increase, teens' perceptions became more like those of 18- to 25-year-olds, the age group showing the highest rates of drug use over time.

The availability of drugs and the ways in which drugs are marketed also influence which types of drugs are used and who uses them [15]. For instance, in the United States, methamphetamines were once produced by biker gangs or individuals with laboratories and were found mostly in the western region of the country. In the mid-1990s, Mexican drug traffickers began to produce methamphetamines and transport them along the marijuana routes throughout the country, changing reported rates of use in other regions and within subpopulations [16]. The paper by Pach and Gorman [17] in the present issue of the *Bulletin* discusses a multi-city study of these changing patterns of use.

The type, quality and price of drugs also influence use. In the early 1990s, heroin from South America, Mexico and Asia was more plentiful in the United

States than heroin from other parts of the world and was available in a purer form and at lower prices [18]. The increased purity and lower price meant that one did not have to inject the drug for a “high”, but could snort it instead. This change in mode of administration made the use of heroin more attractive to populations such as suburban youth, who would not normally use heroin. However, past history of heroin use in the United States has shown that once dependent, it is more likely that one will inject [19]. Recent reports in both the United States and Europe show that even a drug that is usually smoked, such as crack-cocaine, can be dissolved in vinegar or lemon juice and injected for a more immediate effect [20, 21]. The movement from snorting to injecting puts the user at risk for a number of health problems. In the present issue of the *Bulletin*, Beyrer [22] discusses the association of changing trafficking patterns and the spread of HIV and hepatitis B and C in Asia. Even when preferred drugs become difficult to obtain because of effective interdiction or other circumstances, the changes in patterns of use can present problems for policy makers and service providers [23]. All of these patterns can have major health effects on the drug-using population that in turn will impact treatment and medical services.

Availability of drugs certainly can be seen to influence drug use patterns, but social and economic trends also appear to have an impact on who uses drugs and how they are used. Reports from countries in social and economic turmoil indicate growing rates of drug abuse among youngsters. Koshkina [24] describes the situation as it occurred in the Russian Federation.

The differential impact of these social influences results in the variation in drug use patterns observed among cities, countries and regions [25]. An understanding of the importance of the social factors that influence drug abuse trends should guide national and local policies regarding approaches to be taken to alter the devastating consequences of the problem [26, 27].

Individual or personal characteristics also influence drug-using behaviour patterns. A large number of factors have been found to explain why some people use drugs and others do not. They range from personality traits and other genetic and biological vulnerabilities to peer association to community problems [4]. We know that more people try drugs than actually abuse or are dependent on drugs. Although we still do not understand why some people move on to abuse and dependence, epidemiological studies that have followed young people over time do point to biological bases for significant increased drug involvement. It has been found that having parents or other relatives who have substance abuse problems or certain psychiatric illnesses increases one's risk for drug abuse or dependence [28-30]. Data from both people in treatment for drug abuse and people in treatment for mental illness indicate that many have both problems.

There is extensive literature that implicates a range of risk factors for drug use, including parent-child attachment, parental monitoring, peer association and school failure [31]. Researchers have made an effort to organize these in such a way as to generate hypotheses about the origins of drug use that could be targeted in prevention strategies [32, 33]. Research also shows that the more risk factors a person experiences in their youth, the more likely it is that drug abuse will occur [34].

Recent research into why many adolescents with such risk factors for drug use do not abuse drugs has shown that certain factors temper risks. These tempering or protective factors include family bonding and bonding to prosocial groups, behaviours and institutions [34]. There is also a growing focus on less well-articulated factors, such as resilience and positive assets [35-37]. However, all of these approaches to the issue of onset lack specificity for drug abuse.

In addition, epidemiologic studies have found a consistent sequencing of the use of substances, particularly among adolescents. Denise Kandel was the first to observe this sequencing in her research in the late 1970s [38], the results of which have been replicated in other longitudinal studies. The sequence goes from the use of alcohol and/or tobacco and marijuana to other drugs of abuse. The underlying mechanisms for this sequencing are not understood and the inevitability that everyone who smokes or drinks alcohol or even uses marijuana will move on to the next substance, is not total.

Our failure to specify risk is very much related to our failure to refine our diagnosis of drug use and abuse, [4]. More molecular epidemiologic research is needed linking neuroscience and behavioural science.

Epidemiologic methods specific to studying drug abuse

The stigmatized nature of drug abuse in most regions of the world has made it necessary for drug abuse epidemiologists to develop methods of sampling and targeting that are unique to the field. Over the past two decades, the integration of qualitative and quantitative or ethnographic approaches has provided significant information about drug-using populations that has been useful to both prevention efforts [14, 39] and treatment providers [40], as well as to policy makers [41]. The papers by Dehne and colleagues [42], Hickman and colleagues [43], Rossi [11], Degenhardt and colleagues [23], Fitch and colleagues [44] and Kemmesies [45] describe some of these approaches, including capture-recapture, multiplier methods, dynamic modelling, rapid assessment, snowball sampling, key informant interviews and focus groups.

The stigmatized nature of drug abuse suggests certain limitations in the usual epidemiologic approaches to data collection. It is generally recommended that several systems be established that collect data from both general and more at-risk populations to determine the extent and nature of drug-using behaviours in an area and to conduct special studies to address more focused research questions. The most widely used approaches to monitor drug abuse include use of existing data to determine general drug use patterns within the drug-using populations (surveillance) and surveys to estimate incidence and prevalence rates within a general population (monitoring). Both approaches are discussed below. They should be designed to be interconnected, each serving to guide the activities of the other. If they are well designed and comprehensive, surveillance systems will reflect the dynamic nature of drug-using behaviours in an area. New drugs being used, usual drugs used in new ways or new populations of users will be detected with a good surveillance system containing timely information from a number of sources. As

surveys of representative samples of general household or school populations provide rates of new and current users over time, consistency in sampling methods and data collection approaches is important to monitor trends in use. Information on new patterns of use detected through surveillance of drug use among drug-using populations must be integrated into monitoring surveys so that the spread of a new pattern can be documented and watched. Finally, key research questions that arise from either the surveillance system or monitoring surveys serve to form special population studies. The paper by Medina-Mora and her colleagues [46] discusses the importance of these systems for understanding drug abuse patterns in Mexico, while Hartnoll [47] discusses the establishment of a multi-systems approach in Europe.

Drug abuse surveillance systems

Surveillance research collects information over time from existing or archival data systems that reflect the consequences of drug abuse, such as drug abuse treatment, arrest reports for adults and adolescents, hospital emergency room visits, hospital discharge information, mortality information and infectious disease reports.

These systems tend to indicate new and existing drug abuse patterns within the drug abusing community and among new users, who may have some negative health effects. Surveillance epidemiologists look for reports of new types of drugs that are abused, new ways to administer drugs and changing characteristics of drug users. Any of these changes is a sign of new patterns of drug abuse that need to be studied further.

As the data used in surveillance systems reflect consequences and are not population-based, it is difficult to develop incidence or prevalence rates from them. However, one can review these data over time, draw conclusions from them about where new drug abuse patterns exist and follow how these patterns spread across geographic areas. The paper by Sloboda and Kozel [16] reports on what is probably the oldest ongoing drug abuse surveillance system, the Community Epidemiology Work Group. This group of experts representing 20 to 21 United States cities has met biennially since 1975. Over time, the CEWG has evolved common data elements across sites and a reporting format that provides descriptions of drug use patterns among varying populations within each geographic area. Both common, and unique patterns have been observed, and the movement of certain patterns across areas has been well documented. Other model surveillance systems have been or are being established in several countries and regions around the world. The papers by Stauffacher [48], Parry and colleagues [49], Douglas [50], Bless [51] and Koshkina [24] present the experiences of each group in the development of their systems. Several political and resource barriers confront these researchers [52]; however, perseverance and commitment has enabled several systems to be institutionalized [41].

Recognition of the global nature of drug abuse and the utility of surveillance systems brought a group of epidemiologists representing countries around the

world to form the International Epidemiology Work Group on Drug Abuse (IEWG). Until 1999, the Group met annually to discuss new trends in their countries or regions. The United Nations International Drug Control Programme's Global Assessment Programme on Drug Abuse (GAP) has continued the work initiated by IEWG. Both IEWG and GAP are working towards building comparable epidemiologic foundations in countries around the world. The paper by Griffiths and McKetin [53] provides an overview of this approach.

Monitoring surveys

Monitoring surveys are generally population-based, which means they collect data on people who live in a defined geographic area or who share similar characteristics. These surveys generally take "snapshots" of drug abuse in the defined population on a regular basis over long periods of time. Each time the survey is conducted the same measures are taken or questions asked in order to maintain comparability so that trends can be detected. In general, these surveys are either of persons who reside in households or other stable environments or of persons who represent specific populations, such as students, homeless groups, military or institutionalized patients.

Such surveys are expensive to conduct. Drug-using behaviours are usually rare events in a general population, and therefore large sample sizes are required in order to improve the precision of estimations of prevalence. Furthermore, drug abusers may be homeless or live in transient situations, often clustering in geographic areas, and therefore may be more likely to be missed if traditional sampling and interviewing techniques are applied. Until recently, many of these surveys required trained and skilled interviewers, as the survey methods used face-to-face interviews in combination with forms completed by the respondents. Research has shown that telephone and mailed surveys yield the lowest rates of drug use among household members. However, with current advances in computer technology, the surveys can be administered electronically [54, 55]. Some groups are more difficult to engage in surveys. For example, children and adolescents interviewed in the household when a parent/caregiver is present tend to report lower rates of drug use, even when techniques that imply privacy, such as computer-assisted interview procedures, are used.

Surveys of students conducted in the classroom using self-administered data collection instruments provide information regarding the incidence or initiation of the use of drugs and the prevalence rates for overall drug use. Age of onset, as well as the sequencing of substances used (e.g. tobacco, alcohol, inhalants and marijuana), assist prevention programmers in their design and targeting interventions.

Sampling issues, the timing of surveys and the drugs included in the surveys are challenges to both household and school surveys. Response rates vary by size of community, with metropolitan areas often having lower participation rates than suburban communities [56]. The lower population density of rural areas tends to

increase the expense, both of sampling residents of these areas and of conducting the survey with them. Surveys conducted during the day may bias who responds to the survey, with more stay-at-home mothers being available to respond and excluding those who are working. Attention must be given to these issues when conducting a survey.

School surveys conducted on one particular day may miss those who are absent from school because of their substance use for reasons such as associated illnesses or suspension or even expulsion. Furthermore, students who leave or drop out of school, and therefore do not always participate in the surveys, may be at highest risk for drug use.

The relationship between surveillance studies and monitoring surveys has not been well recognized. Yet this relationship is important to a more thorough understanding of existing patterns of drug use within a geographic area and identification of the characteristics of use and of the users. Examination of information from both sources has shown that it may take between one to two years for an emergent pattern of drug use found in a surveillance system to move from the endemic drug-using population into the general population, where it is reported in a survey. By establishing these systems, drug abuse epidemiologists can gain a better understanding of the problem within an area and can inform prevention and treatment practitioners about new issues of which they must be aware.

Special studies

Information from surveillance systems and surveys suggest other research questions or hypotheses that can be studied in more focused research. Both the papers by Pach and Gorman [17] and Dengehardt, Topp and Day [23] are good examples of studies that grew out of information first observed in surveillance systems. When the reports from the Community Epidemiology Work Group showed that methamphetamines were becoming available in new “virgin” areas and among new populations, a multi-city study was designed to learn more about how these drugs were being used, by whom and with what impact. Similarly, the Illicit Drug Reporting System in Australia allowed reports of decreased heroin availability to be examined more closely through a detailed analysis of data from interviews with heroin users and key informants and existing data which was routinely collected through the System. Medina-Mora and colleagues [46] also mention a number of special population studies conducted in Mexico relating to issues emerging from available surveillance information. Again, such studies have important policy implications.

Ethical issues

One cannot establish such information systems or conduct epidemiologic studies focusing on drug use without being mindful of ethical considerations within the context of the laws of each jurisdiction. In their paper, Fry and Hall [57] lay out

three such ethical considerations: (a) free and informed consent; (b) confidentiality, privacy and legal hazard; and (c) safety issues for those collecting data in the field. All epidemiologists conducting studies must be cognizant of the potential ethical pitfalls. The degree of concern, however, differs somewhat when dealing with a highly stigmatized health issue, such as drug abuse. Surveys of adolescents, in most cases, will require formal consent from parents or guardians. The conduct of interviews with intoxicated or otherwise impaired respondents also poses ethical problems concerning free consent and the reliability of reported information. Protection of human subjects and the information provided by them is paramount in any study; when the information collected concerns potentially illegal activities, however, additional efforts are required to ensure privacy and confidentiality.

Many studies that collect data in the field provide safeguards for those collecting the data. This is also true for studies of drug abusers. Sending interviewers in pairs to certain areas and providing cell phones and special training are examples of ways to prevent problems. Such procedures and processes add time and costs to any drug abuse study, and this is often not understood by funding organizations.

Finally, the drug abuse epidemiologist's work also faces challenges from those who do not understand either the phenomenon of drug abuse or the many well-designed, tested and accepted methods developed in the field. The reliability and validity of self-reported information on drug-using behaviours [58-60] and the value of qualitative studies are among the most pressing issues facing drug abuse epidemiologists. A range of other issues also confronts the drug abuse epidemiologist in particular when dealing with policy makers. The need to communicate findings from the research for policy decisions, while maintaining scientific rigor requires much patience and time. Some recommendations provided by Musto and Sloboda [27] are key to this process.

Conclusions

The field of drug abuse epidemiology is challenged by the very nature of the phenomenon being studied. The present issue of the *Bulletin* and Nos. 1 and 2 of vol. LV (2003) describe these challenges, discusses how drug abuse epidemiologists are addressing them and makes suggestions for the expansion of drug abuse epidemiologic studies around the world. The importance of collaboration and communication with policy makers is stressed and recommendations are made for easing this process so that it benefits all involved—the researcher, the policy maker and others who are directly and indirectly affected. Drug abuse is a global problem impacting not only individual lives but also whole communities. An understanding of the specific aspects of the problem, including which drugs are being used and by whom, will go a long way towards containing the problem. Drug abuse epidemiology is an emergent field that is rapidly accumulating methodological and scientific knowledge and, finally, the recognition it needs to grow.

References

1. J. C. Anthony and K. R. Petronis, "Early-onset drug use and risk of later drug problems", *Drug and Alcohol Dependence*, vol. 40, No. 1 (1995), pp. 9-15.
2. D. J. DeWit and others, "The influence of early and frequent use of marijuana on the risk of desistance and of progression to marijuana-related harm", *Preventive Medicine*, vol. 31, No. 5 (2000), pp. 455-464.
3. National Institute on Drug Abuse, *National Survey Results on Drug Use from the Monitoring the Future Study, 1975-1999, vol. I: Secondary School Students*, National Institutes of Health publication No. 98-4345, 1998.
4. M. D. Glantz and R. W. Pickens, "Vulnerability to drug abuse: introduction and overview", in *Vulnerability to Drug Abuse*, M. D. Glantz and R. W. Pickens, eds. (Washington, D.C., American Psychological Association, 1992), pp. 1-14.
5. M. Glantz and J. Collover, "Drug use, drug abuse and heterogeneity", *Bulletin on Narcotics* (United Nations publication), vol. LIV, Nos. 1 and 2 (2002), pp. 45-59.
6. N. D. Volkow and others, "Changes in brain glucose metabolism in cocaine dependence and withdrawal", *American Journal of Psychology*, vol. 48, 1991, pp. 621-626.
7. A. R. Childress and others, "Limbic activation during cue-induced cocaine craving", *Society for Neuroscience Abstracts*, vol. 21, No. 3 (1995), p. 1956.
8. J. Altman, "A biological view of drug abuse", *Molecular Medicine Today*, June 1996, pp. 237-241.
9. S. Grant and others, "Activation of memory circuits during cue-elicited cocaine craving", *Proceedings of the National Academy of Sciences*, vol. 93, 1996, pp. 12040-12045.
10. R. C. Taylor and others, "Tobacco craving: intensity-related effects of imagery scripts in drug abusers", *Experimental and Clinical Psychopharmacology*, vol. 8, No.1 (2000), pp. 75-87.
11. C. Rossi, "The role of dynamic modelling in drug abuse epidemiology", *Bulletin on Narcotics* (United Nations publication), vol. LIV, Nos. 1 and 2 (2002), pp. 33-44.
12. J. G. Bachman, L. D. Johnston and P. M. O'Malley, "Explaining the recent decline in cocaine use among young adults: further evidence that perceived risks and disapproval lead to reduced drug use", *Journal of Health and Social Behaviour*, vol. 31, No. 2 (1990), pp. 173-184.
13. J. G. Bachman, L. D. Johnston and P. M. O'Malley, "Explaining recent increases in student's marijuana use: impacts of perceived risks and disapproval, 1976 through 1996", *American Journal of Public Health*, vol. 88, No. 6 (1998), pp. 887-892.
14. Z. Sloboda, "Changing patterns of drug abuse in the United States: connecting findings from macro- and micro-epidemiologic studies", *Substance Use and Misuse*, vol. 37, Nos. 8-10 (2002) pp. 1229-1251.
15. M. L. Van Etten and J. C. Anthony, "Comparative epidemiology of initial drug opportunities and transitions to first use: marijuana, cocaine, hallucinogens and heroin", *Drug and Alcohol Dependence*, vol. 54, No. 2 (1999), pp. 117-125.
16. Z. Sloboda and N. J. Kozel, "Understanding drug trends in the United States of America: the role of the Community Epidemiology Work Group as part of a comprehensive drug information system", *Bulletin on Narcotics* (United Nations publication), vol. LV, Nos. 1 and 2 (2003).

17. A. Pach III and E. M. Gorman, "An ethno-epidemiological approach for the multi-site study of emerging drug abuse trends: the spread of methamphetamine in the United States of America", *Bulletin on Narcotics* (United Nations publication), vol. LIV, Nos. 1 and 2 (2002), pp. 87-102.
18. "Drug trafficking in the United States", website of the United States Drug Enforcement Administration www.usdoj.gov/dea/pubs/state_factsheets.html.
19. W. A. Johnson and L. J. Ouellet, "The injection of crack cocaine among Chicago drug users", *American Journal of Public Health*, vol. 86, No. 2 (1996), p. 266.
20. G. M. Hunter, M. C. Donoghoe and G. V. Stimson, "Crack use and injection on the increase among injecting drug users in London", *Addiction*, vol. 90, No. 10 (1995), pp. 1397-1400.
21. L. J. Ouellet, W. W. Wiebel and A. D. Jimenez, "Team research methods for studying intranasal heroin use and its HIV risks", *National Institute on Drug Abuse Research Monograph*, vol. 57 (1995), pp. 182-211.
22. C. Beyrer, "Human immunodeficiency virus (HIV) infection rates and heroin trafficking: fearful symmetries", *Bulletin on Narcotics* (United Nations publication), vol. LIV, Nos. 1 and 2 (2002), pp. 103-116.
23. L. Degenhardt, L. Topp and C. Day, "Issues surrounding the detection of a reduction in drug supply: the heroin shortage in Australia in 2001", *Bulletin on Narcotics* (United Nations publication), vol. LV, Nos. 1 and 2 (2003).
24. E. A. Koshkina, "Trends in the prevalence of psychoactive substance use in the Russian Federation", *Bulletin on Narcotics* (United Nations publication), vol. LV, Nos. 1 and 2 (2003).
25. National Institute on Drug Abuse, *Epidemiologic Trends in Drug Abuse, vol. I: Proceedings of the Community Epidemiology Work Group, Highlights and Executive Summary*, National Institutes of Health publication No. 02-5109, 2002.
26. V. Berridge, "Epidemiology and policy: the post-war context", *Bulletin on Narcotics* (United Nations publication), vol. LIV, Nos. 1 and 2 (2002), pp. 143-151.
27. D. F. Musto and Z. Sloboda, "The influence of epidemiology on drug control policy", *Bulletin on Narcotics* (United Nations publication), vol. LV, Nos. 1 and 2 (2003).
28. D. B. Kandel and others, "Psychiatric comorbidity among adolescents with substance use disorders: findings from the MECA Study", *Journal of the American Academy of Child and Adolescent Psychiatry*, vol. 38, No. 6 (1999), pp. 693-699.
29. K. S. Kendler and C. A. Prescott, "Cannabis use, abuse and dependence in a population-based sample of female twins", *American Journal of Psychiatry*, vol. 155, No. 8 (1998), pp. 1016-1022.
30. K. Yamaguchi and D. B. Kandel, "Patterns of drug use from adolescence to young adulthood: III. Predictors of progression", *American Journal of Public Health*, vol. 74, No. 7 (1984), pp. 673-681.
31. N. Z. Weinberg and others, "Adolescent substance abuse: A review of the past 10 years", *Journal of the American Academy of Child and Adolescent Psychiatry*, vol. 37, No. 3 (1998), pp. 252-261.
32. J. D. Hawkins, R. F. Catalano and J. Y. Miller, "Risk and protective factors for alcohol and other drug problems in adolescence and early adulthood: implications for substance abuse prevention", *Psychological Bulletin*, vol. 112, No. 1 (1992), pp. 64-105.

33. R. J. Pandina, "Risk and protective factor models in adolescent drug use: putting them to work for prevention", *National Conference on Drug Abuse Prevention Research: Presentations, Papers, and Recommendations*, National Institutes of Health publication No. 98-4293, 1998, pp. 17-26.
34. B. H. Bry, P. McKeon and R. J. Pandina, "Extent of drug use as a function of number of risk factors", *Journal of Abnormal Psychology*, vol. 91, No. 4 (1992), pp. 273-279.
35. J. S. Brook and others, "Young adult's drug use: a 17-year longitudinal inquiry of antecedents", *Psychological Reports*, vol. 80, No. 3, part 2 (1997), pp. 1235-1251.
36. M. D. Glantz and Z. Sloboda, "Analysis and reconceptualization of resiliency", in *Resilience and Development: Positive Life Adaptations*, M. D. Glantz and J. Johnson, eds. (New York, Kluwer Academic/Plenum Press Publishers, 1999), pp. 109-126.
37. P. L. Benson, J. Galbraith and P. Espeland, *What kids need to succeed: proven practical ways to raise good kids* (Minneapolis, Free Spirit Publishing, Inc., 1998).
38. D. B. Kandel, "Stages of adolescent involvement in drug use", *Science*, vol. 190, 1975, pp. 912-914.
39. Z. Sloboda, "Assessing substance abuse in the community", plenary presentation for the Second National Conference on Prevention, National Institute on Drug Abuse, Washington, D.C., 10 August 2001.
40. Z. Sloboda, "Building it together: qualitative and quantitative data collection methods", plenary presentation for the Treatment Needs Assessment Conference, Ohio Division for Drug Abuse and Alcohol Services, Columbus, Ohio, 22 March 2001.
41. L. Topp and R. McKetin, "Supporting evidence-based policy-making: a case study of the Illicit Drug Reporting System of Australia", *Bulletin on Narcotics* (United Nations publication), vol. LV, Nos. 1 and 2 (2003).
42. K. L. Dehne and others, "The need for a global understanding of epidemiological data to inform human immunodeficiency virus (HIV) prevention among injecting drug users", *Bulletin on Narcotics* (United Nations publication), vol. LIV, Nos. 1 and 2 (2002), pp. 117-130.
43. M. Hickman and others, "Estimating the prevalence of problematic drug use: a review of methods and their application", *Bulletin on Narcotics* (United Nations publication), vol. LIV, Nos. 1 and 2 (2002), pp. 15-32.
44. C. Fitch and others, "The role of rapid assessment methods in drug use epidemiology", *Bulletin on Narcotics* (United Nations publication), vol. LIV, Nos. 1 and 2 (2002), pp. 61-72.
45. U. Kemmesies, "How to reach the unknown: the snowball sampling technique", in *Understanding and responding to drug use: the role of qualitative research*, J. Fountain, ed., European Monitoring Centre for Drugs and Drug Addiction, Scientific Monograph Series No. 4, 2000, pp. 265-271.
46. M. E. Medina-Mora and others, "Mexico: epidemiological diagnosis systems for drug abuse", *Bulletin on Narcotics* (United Nations publication), vol. LV, Nos. 1 and 2 (2003).
47. R. Hartnoll, "Drug epidemiology in the European institutions: historical background and key indicators", *Bulletin on Narcotics* (United Nations publication), vol. LV, Nos. 1 and 2 (2003).

48. M. Stauffacher, "Drug treatment data as an epidemiological indicator: methodological considerations and improved analysis", *Bulletin on Narcotics* (United Nations publication), vol. LIV, Nos. 1 and 2 (2002), pp. 73-85.
49. C. D. H. Parry, A. Pluddemann and J. Strijdom, "Developing the Southern African Development Community Epidemiology Network on Drug Use: methods and issues", *Bulletin on Narcotics* (United Nations publication), vol. LV, Nos. 1 and 2 (2003).
50. K. Douglas, "The Caribbean Epidemiological Network: the complexities of developing a regional perspective", *Bulletin on Narcotics* (United Nations publication), vol. LV, Nos. 1 and 2 (2003).
51. R. Bless, "Experiences of the Pompidou Group of the multi-city network, 1983-2002", *Bulletin on Narcotics* (United Nations publication), vol. LV, Nos. 1 and 2 (2003).
52. M. Warner-Smith, "The challenge of developing drug information systems in Africa", *Bulletin on Narcotics* (United Nations publication), vol. LV, Nos. 1 and 2 (2003).
53. P. Griffiths and R. McKetin, "Developing a global perspective on drug consumption patterns: the challenge for drug epidemiology", *Bulletin on Narcotics* (United Nations publication), vol. LV, Nos. 1 and 2 (2003).
54. M. Ramsey and A. Percy, "A national household survey of drug misuse in Britain: a decade of development", *Addiction*, vol. 92, No. 8 (1997), pp. 931-937.
55. J. Gfroerer, D. Wright and A. Kopstein, "Prevalence of youth substance use: the impact of methodological differences between two national surveys", *Drug and Alcohol Dependence*, vol. 47, No. 1 (1997), pp. 19-30.
56. J. Gfroerer, J. Lessler and T. Parsley, "Studies of non-response and measurement error in the National Household Survey on Drug Abuse", *National Institute on Drug Abuse Research Monograph*, No. 167, 1997, pp. 273-295.
57. C. L. Fry and W. Hall, "An ethical framework for drug epidemiology: identifying the issues", *Bulletin on Narcotics* (United Nations publication), vol. LIV, Nos. 1 and 2 (2002), pp. 131-142.
58. S. Darke, "Self-report among injecting drug users: a review", *Drug and Alcohol Dependence*, vol. 51, No. 3 (1998), pp. 253-263.
59. E. Finch and J. Strang, "Reliability and validity of self-report: on the importance of considering context", *Drug and Alcohol Dependence*, vol. 51, No. 3 (1998), p. 269.
60. A. M. Shillington and others, "Self-report stability for substance use over 10 years: data from the St. Louis epidemiologic catchment study", *Drug and Alcohol Dependence*, vol. 40, No. 2 (1995), pp. 103-109.