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5-Year Trends in Use of Hallucinogens and Other Adjunct Drugs among UK Dance Drug Users

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Key Words
Hallucinogens · LSD · Psilocybin · Ketamine · Ecstasy

Abstract
Aims: To describe and assess trends in the use of hallucinogens and other adjunct drugs over a 5-year period. ***Design:*** Repeated-measures cross-sectional survey. ***Setting and Participants:*** Annual magazine-based survey targeting people who use drugs in dance contexts. ***Measurements:*** Lifetime use prevalence (ever used); age of first use; current use prevalence (any use within the last month), and extent of use within the last month (number of days used) for LSD, psilocybin, ketamine, GHB and nitrates. ***Findings:*** Prevalence increases for psilocybin, ketamine, GHB and nitrates use have been detected, with a sharp recent rise in current psilocybin use in 2002–2003 contrasting with more gradual and comprehensive evidence of increased ketamine use throughout the period 1999–2003. The declining prevalence of LSD use in general population surveys is replicated in this sentinel population study. ***Conclusions:*** The rise in prevalence of hallucinogen and other adjunct drugs identified among dance drug users may be mirrored by wider prevalence increases among young people with a consequent need to study these trends carefully and to develop effective interventions, where required.

Introduction

Trends in the use of stimulant drugs including MDMA (more commonly known as ecstasy), cocaine and amphetamines have been subject to extensive study and commentary since the late 1980s as their prevalence has markedly increased [1]. Alongside the use of stimulants, other drugs including cannabis, LSD and amyl nitrates have long been noted to be used by dance drug users [2, 3]. More recently, γ-hydroxybutyrate (GHB) and ketamine have also attracted substantial attention [4–7].

We have previously examined trends in the use of stimulants, sildenafil (Viagra) and cannabis among a UK population of dance drug users recruited as part of an annual magazine-based survey [8–10]. Two short papers have previously focused on individual substances in order to give specific attention to changing patterns of prevalence [9, 10]. This final paper complements the previous main stimulants paper [8] in considering trends in the use of five selected non-stimulant drugs – ketamine, GHB, amyl nitrate, magic mushrooms and LSD – which comprise all drugs other than alcohol and tobacco used to any noteworthy degree in this same population over the 5-year period 1999–2003. It has been necessary to separately communicate these data in light of the complexity of observed patterns over this time period.

Strictly speaking not all these drugs are true hallucinogens with nitrates and GHB also exhibiting dose-

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related sequential stimulant and depressant properties. However these drugs have been chosen as the focus of this paper because between them they potentially demonstrate what may become an important shift in dance drug using patterns in which stimulant drugs are less prominent and hallucinogenic and other adjunct drugs more prominent and because they serve to complete the picture of poly-drug use within this population. Furthermore, within poly-drug using youth lifestyles it is important to be vigilant to the full range of substances consumed because of the potential for unintended interactions. By way of introduction we shall provide some contextual information on each drug.

During the second half of the twentieth century, LSD emerged as the archetypal hallucinogen. After its initial adoption in the 1960s, UK prevalence is believed to have fallen during the 1970s and early 1980s, before increasing in the late 1980s, accompanying the emergence of MDMA (ecstasy) [11]. Mean dose is now believed to be lower than in earlier decades. Magic mushrooms are the street name for a variety of hallucinogenic fungi that contain the naturally occurring substituted tryptamines, psilocybin and psilocin. They produce LSD-like effects comprising changes in mood, perception, behaviour, autonomic function and somatosensory reflexes [12]. Recent increased commercialisation in the UK has led to a more consistent supply of a substance whose local availability was historically determined by the seasons (harvesting time in the UK occurs in late autumn prompted by moist conditions and heavy rainfall).

Ketamine hydrochloride is a dissociative anaesthetic with clinical uses in many areas of medicine, including paediatrics, emergency and pain management [13]. Recreational use was first reported on the West Coast of the United States in the 1970s [14]. Ketamine was considered to be a drug that provided the hallucinatory experiences of LSD but was easier to titrate, having both a shorter half life and a good dose response. Ketamine was first reported on the UK dance scene in the early 1990s, appearing as a constituent of ecstasy pills and marketed in its own right as 'K' or 'Special K' [15]. At low doses stimulant effects and elevation of mood predominate with mild sensory and perceptual distortion and euphoria. At higher doses intense psychedelic effects including out-of-body and floating experiences are encountered. The common acute adverse effects include ataxia, nausea, confusion, dizziness, slurred speech and blurred vision [14].

GHB is a naturally occurring fatty acid found widely distributed in the human body. GHB usually is sold as either a free acid (a colourless liquid in its pure form) or as a sodium salt (generally a white powder). GHB has a rapid onset of action when taken orally, producing dose-related initial euphoria and stimulation, and then sedation at higher doses. GHB overdose has been reported more widely than for any other dance drug, especially when combined with alcohol. In Europe, Australia and the United States the rising availability and use of GHB has been accompanied by significant increases in presentations to accident and emergency departments [16–19].

Nitrates (widely known as poppers) are rapid-onset, short-acting potent vasodilators that produce a euphoric rush characterised by warm sensations, feelings of dizziness and disinhibition that some users liken to being intoxicated with alcohol [20]. At higher doses delirium and disorientation occur. Nitrates have been a staple of the dance scene for many years and have been particularly popular among gay users [21]. Similarly, GHB and ketamine are reported to be particularly prevalent within the gay dance club scene [22–24].

With the exception of LSD which has remained a 'Class A' scheduled drug under the Misuse of Drugs Act 1971, the legal status of these other drugs has been somewhat variable in recent years in the UK. Nitrates and ketamine were not subject to regulation under the under the Misuse of Drugs Act 1971, though the latter was controlled as a Prescription Only Medicine. After having been under review for some time, the Advisory Council on the Misuse of Drugs (ACMD) recommended its classification as Class C, Schedule 4-Pt 1 in January 2005 and, at the time of writing, the government is in the process of enacting this. The Home Office has also recently made 'magic mushrooms' subject to similar control (http://www.opsi.gov.uk/acts/acts2005/50017--e.htm#21). GHB became controlled under the Misuse of Drugs Act 1971 in July 2003, after the ACMD accepted its potential for harm.

Concern about reports of wider availability and rising levels of use in the UK has not hitherto yielded actual studies of prevalence trends. For this reason, we sought to explore the extent of changes in prevalence and patterns of use of these drugs among a sentinel population of dance drug users participating in an annual cross-sectional survey over the period 1999–2003.

Method

An initial account of the year 1 data (for 1999) and methodology including a critical appraisal of the strengths and weaknesses of using a dance music magazine (Mixmag) as a vehicle for targeting dance drug users for survey purposes is contained in Win-

stock et al. [25]. A later account of the specific methods and care needed in making inferences pertaining to change over time was subsequently reported by McCambridge et al. [8]. Mixmag was originally chosen because it had the highest circulation figures of its genre and had a history of extended drug-related copy in its pages. It was considered a credible vehicle to use for opportunistic research that provided inexpensive and rapid access to large numbers of the target population. Winstock et al. [25] reported UK circulation figures of approximately 50,000 (with variations occurring annually), with an additional 10,000 readers in other countries.

The survey was printed in the September edition of the magazine and placed prominently with extensive copy support. Readers were invited to complete and return the questionnaire by freepost. In the face of falling levels of response in 2002 (see later) postal data collection was supplemented by the additional option of online access to the questionnaire in 2003 (at www.mixmag.uklinux.net). Apart from this additional data collection method, data collection procedures have been identical across the years, permitting cross-sectional comparisons over time. Between 1999–2003, 1,151, 795, 988, 491 and 1,134 UK responses have been received respectively (total n = 4,559). Of the 2003 responses 736 self-completed the questionnaire online (65%), with 398 postal responses received (35%).

Approximately 15% (n = 686) of the total have reported prior study participation and have been excluded from analyses. Although prevalence rather than incidence has been our principal focus, the inclusion of these participants would unhelpfully distort data on lifetime prevalence trends. In the final year of data collection considered here, we have included a unique identifier for each participant to facilitate cohort analyses in future years. In year 2 data on prior study participation was not collected, so the entire sample has been included (see below). This has yielded samples of 1,151, 795, 787, 335 and 805 UK responses in each of the 5 years respectively for analysis. Enquiry about location enabled the exclusion of non-UK study participants, with this report restricted to data from UK respondents only.

The generalisability of data from non-probabilistically formed samples is inherently problematic as potential participants are more likely to respond to questionnaires if they see items which interest them, so almost by definition respondents will be different from non-respondents [26]. Topp et al. [27] compared findings from nationally representative and purposively sampled studies of ecstasy users in Australia and found them to perform reasonably well. This study contained a number of noteworthy limitations including a relatively small number of directly comparable questions on use, and the absence of investigation of harms in the nationally representative surveys [26]. Purposive sampling may thus have the potential to generate samples equivalently representative to randomly formed samples, but further study is needed to demonstrate whether and how this may be achieved.

In this survey series, we make no claim that data from any one year is representative of wider population data. Repeated measurements over time, however, potentially allow inferences to be made on time trends where data collection procedures and other threats to the reliability of data can be shown to be constant or be effectively controlled. However, this is a complex endeavour with the potential for unknown biases to accumulate over time and caution is very much indicated [for an extended discussion of sampling, reliability and generalisability issues, see 8].

Four key measures of use are considered here for five drugs: lifetime use prevalence (ever used); age of first use; current use prevalence (any use within the last month). and extent of use within the last month (number of days used). These questions were asked in exactly the same format for the following drugs in all years: LSD, ketamine, GHB, and nitrates. Psilocybin ('magic mushrooms') was added to this list of drugs in years 2–5 (2000–2003).

Following presentation of the drug use prevalence data, consideration of the statistical significance of the observed time trends has been undertaken with logistic and multiple regression for prevalence and continuous data respectively (with unstandardised regression coefficients being reported). From year 3 onwards, those reporting prior study participation have been excluded from analysis. In year 2 these data were not collected, so a dummy variable was created to control for potential prior study participation among year 2 participants.

Following χ^2 tests for change in prevalence data over time, data were modelled using STATA Version 8 to control for potential confounding by data collection method (post/web), number of responses per year and potential prior study participation. Although mean age and gender did not vary substantially over the 5 years, these variables were also included in regression models as potential confounders as they are known to be highly relevant to stimulant drug use patterns. The mean age of respondents was 24 years and approximately 40% were women across the 5 years. Finally, likelihood ratio tests were employed to test whether linear models were the most appropriate models for the data. In all cases bar one (age of first ketamine use), linear models were supported.

Results

Lifetime Use Prevalence

The proportions reporting ever having used any of the drugs under consideration are presented in table 1, which indicates that in 4/5 cases there is a variation over time which is statistically significant. When these data were modelled to identify time trends and control for potential confounding, consistent change is identified for LSD, ketamine and GHB. The increases over time in the lifetime prevalence of GHB and ketamine are robust to potentially confounding and confirmed to be statistically significant (GHB OR = 1.12 [1.03–1.22], $p = 0.011$; ketamine OR = 1.23 [1.15–1.32], $p < 0.001$). Similarly, the substantial decline in the proportion of those who have ever used LSD is confirmed as highly statistically significant (LSD OR = 0.72 [0.68–0.78], $p < 0.001$).

The amyl nitrates and psilocybin trends are found to be non-significant, i.e. are inconsistent and/or attributable to the other variables under study (amyl nitrates OR = 0.9 [0.92–1.06], $p > 0.1$; psilocybin OR = 1.01 [0.9–1.03], $p > 0.1$).

Table 1. Lifetime prevalence

	1999 (n = 1,151)	2000 (n = 795)	2001 (n = 787)	2002 (n = 335)	2003 (n = 805)	4 d.f.	p
LSD, %	70.0	65.4	56.2	47.0	41.7	189.4	<0.001
Ketamine, %	25.5	33.5	37.7	39.1	39.8	57.5	<0.001
Psilocybin, %	n/a	50.3	46.9	46.3	48.0	2.48[a]	>0.1
GHB, %	12.8	15.9	14.1	12.8	17.5	10.5	0.033
Nitrates, %	73.1	84.7	73.7	71.3	68.5	61.9	<0.001

[a] 3 d.f.

Table 2. Mean age at first use (±SD)

	1999	2000	2001	2002	2003
LSD	17.9 ± 4.1 (n = 810)	18.1 ± 4.4 (n = 514)	18.3 ± 4.2 (n = 423)	18.3 ± 4.7 (n = 153)	18.4 ± 3.7 (n = 330)
Ketamine	21.6 ± 5.2 (n = 295)	21.1 ± 4.6 (n = 261)	22.2 ± 6.1 (n = 282)	22.2 ± 5.4 (n = 123)	21.6 ± 5.2 (n = 313)
Psilocybin	n/a	18.3 ± 4.2 (n = 395)	18.8 ± 4.1 (n = 350)	18.7 ± 4.7 (n = 152)	19.2 ± 4.3 (n = 385)
GHB	22.4 ± 5.6 (n = 149)	22.3 ± 6.1 (n = 125)	23.1 ± 6.4 (n = 103)	23.0 ± 5.3 (n = 39)	21.4 ± 4.5 (n = 140)
Nitrates	17.8 ± 4.0 (n = 883)	17.8 ± 4.7 (n = 668)	18.0 ± 4.3 (n = 551)	18.1 ± 4.4 (n = 227)	18.1 ± 4.4 (n = 536)

Age at First Use

Data on mean age at first use of the various drugs are presented in table 2. As can be seen patterns of initiation by age are largely stable over time, with some evidence of increases in the cases of LSD and psilocybin. A lack of statistically significant time trend is found when these data are modelled (LSD B = –0.07 [–0.24 to 0.09], $p > 0.1$; psilocybin B = 0.12 [–0.24 to 0.48], $p > 0.1$; GHB B = 0.10 [–0.10 to 0.31], $p > 0.1$; nitrates B = 0.01 [–0.12 to 0.14, $p > 0.1$]. The exception to this pattern is age at first use of ketamine, for which a complex pattern is apparent in the raw data. For this variable, in both models containing linear only and quadratic terms, the effect of time is statistically significant. A likelihood ratio test (LRT) indicates that the model with the quadratic term provides a better fit to the data (LRT = 8.96, p = 0.0028), indicating a statistically significant rise and fall over time.

Current Use Prevalence

The proportions reporting any use of the drugs under study within the past month are presented in table 3. The increases over time in the current use prevalence of nitrates, ketamine and psilocybin are all found to be robust to potential confounding (nitrates OR = 1.10 [1.03–1.19], p = 0.008; ketamine OR = 1.49 [1.34–1.66], $p < 0.001$; psilocybin OR = 2.01 [1.47–2.74], $p < 0.001$). The decline in current use of LSD over the 5-year period is also confirmed, notwithstanding the increase in 2003 (OR = 0.75 [0.64–0.88], $p < 0.001$). All these trends in levels of current use reach a high degree of statistical significance. There is no time trend in current use of GHB (OR = 1.01 [0.84–1.20], $p > 0.1$).

Extent of Current Use

Data on the extent of current use, measured in terms of number of days used within past month among past month users, are presented in table 4.

Table 3. Current use prevalence

	1999 (n = 1,151)	2000 (n =795)	2001 (n = 787)	2002 (n = 335)	2003 (n = 805)	4 d.f.	p
LSD, %	10.0	10.3	3.9	2.4	5.8	50.6	<0.001
Ketamine, %	3.9	8.9	10.6	12.8	16.0	86.7	<0.001
Psilocybin, %	n/a	3.1	2.7	2.4	13.7	118[a]	<0.001
GHB, %	3.4	4.0	2.7	3.9	3.1	2.7	>0.1
Nitrates, %	21.6	30.8	25.3	29.9	28.3	26.1	<0.001

[a] 3 d.f.

Table 4. Mean number of days used among past month users (± SD)

	1999	2000	2001	2002	2003
LSD	1.9 ± 1.5 (n = 115)	2.2 ± 2.4 (n = 82)	2.0 ± 2.5 (n = 31)	2.1 ± 2.1 (n = 8)	1.7 ± 1.1 (n = 47)
Ketamine	2.4 ± 2.6 (n = 45)	3.2 ± 4.0 (n = 71)	3.4 ± 4.3 (n = 83)	3.2 ± 3.6 (n = 43)	3.7 ± 4.0 (n = 129)
Psilocybin	n/a	2.6 ± 5.8 (n = 25)	2.2 ± 2.9 (n = 21)	1.5 ± 0.8 (n = 8)	2.7 ± 5.0 (n = 110)
GHB	2.7 ± 4.0 (n = 39)	3.8 ± 5.3 (n = 32)	2.8 ± 3.1 (n = 21)	5.8 ± 9.0 (n = 13)	2.4 ± 2.2 (n = 25)
Nitrates	3.8 ± 4.8 (n = 248)	3.5 ± 4.2 (n = 245)	3.7 ± 4.7 (n = 199)	3.4 ± 4.2 (n = 100)	3.3 ± 3.4 (n = 228)

The upward trend in ketamine use is confirmed, with the mean number of days used increasing by almost 1 half-day per month annually over the 5-year period (B = 0.43 [0.03–0.83], p = 0.034).

The somewhat inconsistent year-to-year changes in the use of other drugs, as seen in table 4, is also reflected in the findings of the statistical modelling. No other time trends are detected (LSD B = 0.01 [–0.27 to 0.29], $p > 0.1$; GHB B = 0.05 [–0.68 to 0.78], $p > 0.1$; nitrates B = –0.15 [–0.41 to 0.12], $p > 0.1$; psilocybin B = 0.66 [–0.80 to 2.11], $p > 0.1$).

Discussion

Substantial increases in either or both lifetime or current prevalence have been detected for ketamine, psilocybin, GHB and nitrates, alongside a pronounced reduction in lifetime and current prevalence of LSD use. Data on patterns of use indicate stability among users, with the exception of ketamine, whose use appears to have become steadily more frequent. The likely limitations of this study will be considered before giving more detailed attention to these findings, and to their implications.

Perhaps most importantly, we are limited in our study of these trends by available data. We are not in a position to make inferences about the influence of unknown and unmeasured variables upon the observed trends, nor upon their implications for their generalisability. We will thus concentrate further remarks upon available data.

Changing levels of study participation warrant attention as they suggest the possibility of response bias. Are later study participants likely to be different in population characteristics than their earlier counterparts? In our view the substantial fall-off in 2002 does indeed pose a potential difficulty. The most likely explanation for this lower response would appear to be idiosyncratic handling of the survey in the magazine in that particular year. This year aside, there is a reasonable level of consistency in UK response levels (1,151, 795, 787, 335 and 805, respectively). Data from 2002 do not, however, stand out in any way.

Related to variability in levels of study participation is the question of how to deal with past participants. Our exclusion of those reporting prior study participation in later years may have unwittingly served to inflate the prevalence and ongoing use levels in year 1 and possibly also year 2, if repeat survey participants are heavier users of drugs, and they took these earlier opportunities to report their heavier use patterns. This interpretation is quite difficult to discount, and the lifetime prevalence data are particularly vulnerable to this threat to the validity of the observed trend. However, the findings were similar regardless of whether past participants were included or excluded. It is especially notable that if this has been the case, we may have underestimated rather than overestimated the extent of change over time. There may also be information bias in respect to our treatment of prior study participation: we have relied upon self-report. Including participants who have in fact previously participated in the survey, without reporting so doing, would run counter to the previously described form of bias.

The possible effect of the introduction of online data collection was dealt with statistically via inclusion as a covariate in the models. Whilst controlled for as a potential confounder in this way, the existence of some level of residual confounding cannot be ruled out, and further study of this data collection method is indicated. The emerging literature on online data collection should be helpful in this regard, but it will also be necessary to study the specific features of data on drug use.

In the context of a rise in the prevalence of hallucinogenic drug use, the marked decline in LSD prevalence would seem very curious. However precisely these trends have been detected in the British Crime Survey, the general population drug prevalence data source. This trend is difficult to explain and warrants more detailed study. However, one possibility is that LSD's much longer duration is less compatible with leisure lifestyles that are organised around an evening out [28]. The sharp increase in recent use of psilocybin between 2002 and 2003 accords with press and other media reports of wider use following on from increased availability through market stalls and other commercial outlets in the UK as well as via online access. It will be interesting to see how the subsequently implemented controls impact upon prevalence in this series of surveys.

By contrast the rise in ketamine use has been altogether more gradual, and is now evident across multiple indicators. Current prevalence has been increasing at approximately 50% per annum over the 5-year study period, and this is the only drug for which more frequent use among users has been identified. In both cases, these trends have yet to be successfully captured in general population prevalence data. Wider use in the general population would thus appear possible in view of the sentinel nature of the current study population.

The data on GHB prevalence identifies an increase over time in ever having used this drug, but not in current use. It would seem possible that this drug is used experimentally and then subsequently discontinued by most users. The UK data contrasts, however, with data from Australia in particular. In that country increases in lifetime prevalence have been matched by similar increases in recent use prevalence [5]. Whatever the reasons for this disparity, given the potential for overdose and other harms, careful monitoring of the prevalence of the use of this drug is needed. Although GHB's effects are dose-related, it has a steep dose-response curve and people vary widely in their individual response to and metabolism of GHB. A small increase above a critical but variable threshold may induce coma and respiratory depression [29]. Such variability, combined with the risk inherent in illicit manufacturing makes the potential risk associated with the recreational use of GHB particularly significant.

The upward trends in use of hallucinogens and other adjunct drugs reported here have been identified in a period for which there has been stability or actual reductions in the prevalence of stimulant drugs [8]. Consideration of the reasons underlying the changing UK prevalence levels reported here is necessarily speculative at this stage. However, one is struck that these occur contemporaneously with the recently identified trends in high-volume ecstasy use [8, 30], and also at a time when there are increased concerns about trends in binge drinking among young people, and also about the increasing use of high-potency cannabis. Perhaps there is a new premium being placed upon intoxication among young drug users, and the rising prevalence of hallucinogenic and other disorientating drug use simply reflects and reinforces a wider cultural phenomenon. Further evidence will be needed, however, of increasing prevalence of more intoxicating commodities, and in patterns of heavy consumption more generally, and the growth of ketamine use identified in this population perhaps points in the direction of more discriminating drug-specific choices.

'Normalisation' [31, 32] may be being extended beyond the simple fact of involvement with illicit drug use among young people, so that a wider range of drugs and varieties and potencies of intoxication are increasingly to be found [28]. Getting 'hammered' or 'completely off

your face' or a countless variety of other similar terms which appear to be increasingly prominent in youth culture are perhaps indicative of a normalisation of different forms of intoxications. Different drugs may be being used as means to common non-drug-specific ends.

However, it is possible to over-state the extent of these trends, and it would certainly be premature to describe hallucinogens as in any way *replacing* stimulants among dance drug users. If we take account of the current LSD use prevalence in 1999, whilst there has been a clear increase in the overall proportions using other hallucinogens, some of these hallucinogen users would quite probably in earlier years been recruited to LSD rather than ketamine or psilocybin, i.e., as well as an increase in the overall hallucinogen-using population, there has been some switching between hallucinogenic drugs. Drug fashions come and go, and in the case of LSD it might not be too surprising if the increase in current use in 2003 signals the beginning of a resurgence in use in a more hallucinogenic-inclined drug use climate. Similarly, there is anecdotal evidence that the omission of fly agaric from the Drugs Act (2005) may be resulting in greater interest in its use as a legal, yet potent, hallucinogen.

As more and more of these drugs are brought under similar legal controls, it will be instructive to study the prominence of these sanctions in the decision-making processes of users themselves, as well as those for non-users for any evidence of deterrence. Legal sanctions do not have any straightforward relationship with availability, price and cultural acceptability, and these variables are understood to be the key influences on drug consumption [33]. The capacity of legal sanctions, whether in respect of currently legal or illegal drugs, to meaningfully constrain these forces remains to be established.

The original authors of the normalisation thesis have speculated that UK prevalence levels may have reached a plateau beyond which they will not rise [32]. If this is so, the development of new products in the context of a saturated market, is an imperative likely to exist in any commodity system. Although other drugs such as 2Ci, 2C-T-7 (Blue Mystic) and 2CB have not yet made much impact in this sentinel population, we might expect that they, or as yet unknown others, will become more widely used. We can only hope that they are not too harmful. It is not clear, however, that such a plateau has been reached, making necessary very careful attention to trends in more familiar drugs, as well as in new drugs that may emerge.

This study provides early warning of possible future trends via straightforward cross-sectional data on changing use prevalence over time in a sentinel population. Many of the harms associated with the use of these drugs are likely to be dose-related. The need for additional data on dose and other aspects of pattern of use is clear. A crucial and final point to make is that this survey series has not yet involved consistent study of changing patterns of harms that may be consequent upon these changing patterns of use. Such data are viewed by us as an essential precursor to effective harm reduction.

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