Health service utilisation attributable to methamphetamine use in Australia: patterns, predictors and national impact

Rebecca McKetin^{1,2}, Louisa Degenhardt², Marian Shanahan², Amanda L. Baker³, Nicole K. Lee¹, Dan I. Lubman⁴

¹National Drug Research Institute, Faculty of Health Sciences, Curtin University, Perth, Australia

²National Drug and Alcohol Research Centre, University of New South Wales, Sydney, Australia

³School of Medicine and Public Health, University of Newcastle, Newcastle, Australia

⁴Turning Point, Eastern Health and Monash University, Melbourne, Australia

Running head: Methamphetamine and health service use

Corresponding author: A/Prof. Rebecca McKetin, National Drug Research Institute, Faculty of Health Sciences, Curtin University, GPO Box U1987, Perth 6845 WA, Australia, Ph. + 61 8 9266 1600, Fax. +61 8 9266 1600, Email: rebecca.mcketin@curtin.edu.au

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: [10.1111/dar.12518](https://doi.org/10.1111/dar.12518)

Abstract

Aim and background: We estimated health service utilisation attributable to methamphetamine use, its national impact and examined other predictors of health service utilisation among dependent methamphetamine users.

Method: Past year rates of health service utilisation (number of attendances for general hospitals, psychiatric hospitals, emergency departments, general practitioners, psychiatrists, counsellors or psychologists, and dentists) were estimated for three levels of methamphetamine use (no use, < weekly, $\geq$ weekly) using panel data from a longitudinal cohort of 484 dependent methamphetamine users from Sydney and Brisbane, Australia. Marginal rates for methamphetamine use were multiplied by 2013 prevalence estimates from the National Drug Strategy Household Survey. Covariates included other substance use, demographics, mental disorders and drug treatment.

Findings: Health service use was high. More frequent methamphetamine use was associated with more frequent presentations to emergency departments (incidence rate ratios 1.3 – 2.1) and psychiatric hospitals (incidence rate ratios 5.3 – 8.3) and fewer presentations to general practitioners, dentists and counsellors. We estimate methamphetamine use accounted for between 28,400 – 80,900 additional psychiatric hospital admissions and 29,700 – 151,800 additional emergency department presentations in 2013. More frequent presentations to these services was also associated with alcohol and opioid use, comorbid mental health disorders, unemployment, unstable housing, attending drug treatment, low income and lower education.

Conclusions: Frequent methamphetamine use has a significant impact on emergency medical and psychiatric services. Better provision of non-acute health care services to address the

multiple health and social needs of dependent methamphetamine users may reduce the burden on these acute care services.

Keywords: Methamphetamine, health service use, substance use disorders, comorbidity

Author Manuscript

Introduction

Illicit methamphetamine use (often termed ‘speed’, ‘ice’ or ‘crystal meth’) is a growing public health and social concern [1]. Globally, between 13.9 and 53.4 million people are estimated to use amphetamines (0.3 – 1.0% past year use for 15-64 year olds; [2]) and an estimated 17.2 million people are dependent on these drugs [1]. Disease burden attributable to amphetamines has increased by 37% over the past two decades [1], and yet there remains substantial gaps in our understanding of how methamphetamine impacts on health services [3].

Understanding the demand for health service utilisation related to methamphetamine is crucial for planning treatment programs and responding to additional demands on the health care system for both emergency and long term health care [4]. Most research into health service use related to illicit drug use has focused on opioid use, injecting drug use and substance use generally [5-9]. This research has found high rates of health service utilisation [5, 6], particularly for people who use opioids [7-9], which can be influenced by co-occurring mental health disorders [9], polysubstance use [7] and sociodemographic factors [9, 10]. Research findings also suggest an unmet need for planned community-based health services and instead a reliance on emergency health care [5, 9].

The limited data on methamphetamine-related health service use suggests a disproportionate impact on acute services, such as emergency departments and ambulance services, which is partly related to the drug’s capacity to increase the risk of acute psychosis and agitation

among methamphetamine users [11-16]. Methamphetamine may also impact more broadly on health services as a result of other conditions, including burns related to manufacturing the drug [17], trauma from injuries [16], elevated risk of stroke [18] and cardiovascular events [19]. Elevated use of other health services has been seen amongst people who use methamphetamine [20, 21], but the extent to which this is due to methamphetamine-related conditions is not clear.

We examine patterns of health service use in a longitudinal cohort of people dependent on methamphetamine to: (i) estimate the risk of using various health services attributable to methamphetamine use; (ii) identify individual-level factors that influence health service use amongst dependent methamphetamine users; and (iii) quantify the net impact of this methamphetamine-related contact on the health sector in Australia.

METHOD

Participants and procedure

Participants were 484 dependent methamphetamine users, recruited as part of the Methamphetamine Treatment Evaluation Study (MATES) [22]. The MATES cohort included 400 people entering community-based drug treatment services for methamphetamine use in Sydney and Brisbane, Australia (248 residential rehabilitation, 112 detoxification and 40 counselling clients) and 101 methamphetamine users from Sydney who were not in treatment (recruited through needle and syringe programs and outreach services) and who screened positive for methamphetamine dependence on the Severity of Dependence Scale [23]. Other

inclusion criteria for MATES were being at least 16 years old, comprehension of English, being willing to participate in follow-up interviews, and not having been in methamphetamine treatment, other inpatient drug treatment or prison, in the month prior to entering the study. Recruitment and follow-up interviews for MATES cohort took place from 2006 to 2010. A structured face-to-face interview was undertaken at baseline and follow-up interviews were undertaken face-to-face or by phone. For the current study, participants were excluded from this cohort if they did not meet Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV) criteria for methamphetamine dependence in the year prior to recruitment, assessed using the Composite International Diagnostic Interview (CIDI, n = 17) [24]. Participants were followed up at 3 months (91%), 1 year (76% follow-up) and 3 years (67% follow-up). For this study, data on health service utilisation in the past year were included from the baseline interview and the 1 and 3 year follow-up interviews, giving 1171 years of observation in total.

All participants were volunteers who provided informed consent, and who were reimbursed for their time and travel expenses (up to AU\$40 per interview). The research was approved by the UNSW Human Research Ethics Committee and this approval was ratified by all participating institutions.

Measures

Methamphetamine use and other substance use: Past year frequency of methamphetamine use and other drug use was assessed at the baseline, 1 year and 3 year interview (no use, less than weekly, weekly, twice weekly, 3-4 days a week or 5+ days a week). Other drug types

assessed were cannabis, heroin, other opioids, cocaine, ecstasy, hallucinogens, alcohol and tobacco. Self-reported abstinence from methamphetamine use was validated using hair toxicology in a sub-sample of 83 participants and was confirmed in 94% of cases [22]. Primary route of methamphetamine administration (injection, smoking, other) was assessed at each interview.

Health service utilisation: Utilisation of health services (general hospital admissions, psychiatric hospital admissions, emergency visits, ambulance attendances, visits to general practitioners, psychiatrists, counsellors or psychologists, and dentists) was assessed as the number of visits/admissions in the past year at each interview. Counsellors, psychologist and psychiatrist visits excluded services provided during drug treatment or hospital admissions. Use of these services was assessed by asking the participant whether they had been admitted to/received help from each of these services in the past year, and how many times they used each service (see supplementary online Appendix 1 for questionnaire).

Other covariates: Baseline measures included age, sex, country of birth, education, marital status and prison history. Unemployment, living alone, unstable accommodation (no fixed address, living in a boarding house/shelter, refuge or other temporary accommodation) and income (low income was < AU\$800 net in the past fortnight) were assessed at each time point. Comorbid mental health disorders were assessed using the CIDI [24]. Comorbidity reflected any past year diagnosis of major depression, social phobia, panic disorder (assessed at both baseline and 1 year follow-up) or a lifetime diagnosis of schizophrenia or mania

(assessed at 3 months and 1 year respectively). A DSM-IV diagnosis of childhood conduct disorder was assessed using a modified version of the Diagnostic Interview Schedule [25]. Contact with drug treatment services in the past year was assessed at each interview.

Design and statistical analysis

Data were analysed using Stata SE version 11.2 [12]. All tests were two-sided with significance set at $P < 0.05$. The mean rate of health service use and 95% confidence intervals (CI) were calculated using a Poisson distribution. A series of random effects regression models were used to assess the relationship between frequency of methamphetamine use and the use of each health service. In each of these models, the outcome variable was the time-varying number of attendances at the health service in the past year and the predictor was time-varying level of methamphetamine use in the past year (no use, $<$ weekly, $\geq$ weekly). These methamphetamine use categories were used to match published National Drug Strategy Household Survey (NDSHS) prevalence data (where the most frequent use category is $\geq$ weekly use), which we used to derive national level estimates of health service utilisation. A random intercept was used to account for clustering of variance on participant's repeated measurements over time. Negative binomial models were used to improve model fit for over-dispersed count data.

Adjusted analyses included time-varying covariates for other substance use in the past year: any tobacco use, cannabis (no use, $<$ 5 days/week; 5+ days/week), alcohol (no use, $<$ 5

days/week; 5+ days/week), and polydrug use (the number of other illicit drug classes used, including heroin, other opioids, cocaine, ecstasy, hallucinogens and inhalants). To examine the influence of other factors on health service utilisation, we added further variables to these adjusted models. These variables included both time-varying measures (income, unstable accommodation, living alone, unemployment, past year drug treatment) and time-invariant measures taken at baseline interview (age, sex, being single, prison history, being born outside of Australia, education and having a comorbid mental health disorder).

From each of these adjusted models, the marginal rates of health service use were extracted for each level of methamphetamine use (no use, < weekly, $\geq$ weekly). Confidence intervals around these were calculated using the delta method [26]. Rates of health service utilisation attributable to methamphetamine use were calculated by subtracting the rate of health service use for no methamphetamine use from the rate for each level of methamphetamine use (< weekly, $\geq$ weekly).

Rate differences derived for each level of methamphetamine use (< weekly, $\geq$ weekly) were multiplied by estimates for the number of < weekly and $\geq$ weekly methamphetamine use from the NDSHS for 2013 amongst Australians aged 14+ years. These were based on past year prevalence of methamphetamine use for Australians aged 14+ years and multiplied by the population cited for this age bracket (19,041,154) [27]. Of the 2.1% Australians aged 14+ years who used methamphetamine in the past year, 15.5% used weekly or more often (61,064) and the remainder used less than weekly (332,897).

Because household surveys under-estimate problematic drug use [28], and under-reporting of methamphetamine use was found in the 2013 NDSHS [29], we compared estimates obtained using the NDSHS to those derived using indirect prevalence estimates of the number of regular and dependent methamphetamine users in Australia for 2013/14 (108,262 regular (but not dependent) users, 95% CI 76,733 – 152,659; 159,836 dependent users, 95% CI 109,883 – 232,497 [30]). In doing this we assumed that up to weekly use in our sample was equivalent to regular use in the national prevalence estimates (this being defined as at least monthly but not dependent use), while using methamphetamine more than weekly would be equivalent to dependent use. Within our sample, using methamphetamine $\geq$ weekly corresponded to a DSM-IV diagnosis made using the CIDI [24] (taken at each of the four follow-up points) with 83% sensitivity and 86% specificity (area under the curve 0.91, 95% CI 0.89 – 0.92) based on a non-parametric receiver operating characteristics analysis. However, the category of regular use would exclude people who used less than monthly, and hence under-estimate < weekly use.

RESULTS

Characteristics of the sample

The mean age of participants was 31.5 years (SD 8.1 years). The majority were male (73%), single (73%) and unemployed (81%). Most were Australian born (87%) and nominated English as their preferred language (96%). They had a median of 10 years of schooling (interquartile range 9 – 11), 42% had completed a technical or trade qualification and 6% had

completed a university degree. There were high rates of comorbid psychiatric disorders in the sample: 44% met criteria for major depression in the past year and 37% met criteria for either social phobia or panic disorder; 17% had a lifetime diagnosis of schizophrenia or mania and 76% had a history of conduct disorder.

All participants met DSM-IV criteria for past year methamphetamine dependence on entering the study; they had used the drug for a mean of 13.2 years (SD 7.8 years) and 85% had ever injected it. Eighty-four percent had used the crystalline form of methamphetamine in the month prior to recruitment, and 59% indicated that it was the main form of methamphetamine they had used during this time (cf. 31% “base”; 9% power, < 2% other).

Frequency of methamphetamine use across the four time points was: no use (15%), less than weekly (29%), weekly (8%), twice weekly (10%), 3-4 days per week (21%) and 5+ days per week (18%). There were high rates of tobacco use (92% of years; 95% of these involving daily smoking) and cannabis use (75% of years; 47% of these involving daily use). Sixty-eight percent of years involved alcohol consumption (19% of which involved daily drinking). Other substance use was less common (ecstasy 40%, cocaine 34%, heroin 36% of years). Greater methamphetamine use showed a significant positive correlation with cannabis, alcohol and other polydrug use ($P < 0.001$).

Contact with health services

Rates of contact with different health services are shown in Table 1. Participants had high rates of contact with most health services. Most conspicuously, they had a mean of 9 visits to their general practitioner per year (88% had at least one past year attendance) and 45% had a past year emergency department attendance. Within the past year, 27% had received help from an ambulance, 22% had been admitted to a general hospital and 10% had been admitted to a psychiatric hospital. Around one-third had seen a counsellor or psychologist (34%) and 23% had seen a psychiatrist. Less than half (41%) had been to the dentist.

Relationship between methamphetamine use and health service utilisation

More frequent methamphetamine use was related to significantly more attendances at emergency departments and psychiatric hospitals, and these effects remained after adjusting for alcohol, tobacco, cannabis and other polydrug use, and other factors correlated with the use of these health services (incidence rate ratios [IRR] 1.3 – 2.1 for emergency departments and IRRs 5.2 – 8.3 for psychiatric hospitals, Table 2). Participants who nominated crystalline methamphetamine use as their main form of methamphetamine did not have significantly higher rates of health service utilisation after adjusting for frequency of methamphetamine use (IRRs of 1.0 – 1.2, $P > 0.05$).

Additional significant predictors of emergency department presentations were greater polydrug use, being unemployed, comorbid mental health disorders and unstable living arrangements (IRRs 1.1 to 1.4). Other significant predictors of psychiatric admissions were

greater alcohol use, low income, unstable accommodation, not having a tertiary education, having been to drug treatment in the past year and having a comorbid mental disorder (IRRs 1.7 - 2.9). Details of these analyses are provided in the online Appendix 2.

Greater frequency of methamphetamine use was also associated with more ambulance attendances, but this effect was not significant after adjusting for other substance use (Table 2). The relationship between methamphetamine use and ambulance attendances was due to greater use of heroin (IRR 1.38, 95% CI 1.03 – 1.85, $P < 0.031$) and other opioids (IRR 1.59, 95% CI 1.19 – 2.12, $P < 0.002$) (see Appendix 2).

These increases in the use of acute health services contrasted with decreases in the use of several voluntary community based health services during periods of more frequent methamphetamine use (Table 2). Methamphetamine use was not significantly related to admissions to general hospitals or visits to psychiatrists.

Estimated national health service utilisation attributable to methamphetamine use

Table 3 shows the number of emergency and psychiatric hospitalisations attributable to methamphetamine use (per 100 person years). Marginal rates were adjusted for other substance use variables (tobacco, alcohol, cannabis and other polydrug use), past year drug treatment, and other predictors of emergency department and/or psychiatric hospital use (having a comorbid mental disorder, unstable accommodation, not having tertiary accommodation, low income and unemployment). Extrapolating the admissions attributable

to methamphetamine use to the NDSHS estimates for the number of < weekly and $\geq$ weekly methamphetamine users in Australia, we estimated that in 2013, methamphetamine use nationally resulted in between 28,400 and 80,900 additional psychiatric hospital admissions and between 29,700 and 151,800 additional emergency department admissions. Indirect prevalence estimates produced slightly lower overall estimates for emergency department and psychiatric hospital utilisation (Table 3), although they were relatively higher for $\geq$ weekly use.

DISCUSSION

This study produced novel findings regarding health service utilisation attributable to methamphetamine use. We clearly demonstrated the impact of methamphetamine use on emergency departments and psychiatric hospitals, and the need to resource these services to manage increased patient load during times of elevated methamphetamine use. The dual impact on emergency departments and psychiatric hospitals is most likely due to a proportion of methamphetamine-related presentations involving methamphetamine psychosis [14].

These types of presentations can be particularly resource intensive to manage due to patient agitation, with some patients requiring sedation and/or physical restraint [14, 31, 32].

Conversely, there was evidence that people reduced their use of various non-acute health services (general practitioners, dentists, counsellors or psychologists) during periods of more frequent methamphetamine use. This relationship persisted even after adjustment for other substance use, and in some cases became more pronounced after adjustment for other

substance use, suggesting that this phenomenon was strongly related to the use of methamphetamine per se. Reduced contact with non-acute health services during periods of more frequent methamphetamine use could be related to a service system that is ill-prepared to engage with people who use methamphetamine, or to respond to their specific needs, in an out-patient setting. It may also reflect avoidance due to the stigma associated with illicit drug use, or concerns about confidentiality (e.g. the legal repercussions of disclosing illicit drug use), which are documented barriers to seeking help for methamphetamine use [33]. The effects of frequent intoxication and withdrawal from methamphetamine, or the constraints of an illicit drug using lifestyle (e.g. cost of GP attendances, unstable housing, involvement in crime, or criminal sanctions), may also impact on people's capacity to seek help, while the stimulant effects of methamphetamine could mask symptoms of health conditions (e.g. fatigue, depression) resulting in a lower perceived need for health care [34].

This pattern of health care utilisation suggests a disengagement with non-acute health care services during periods of frequent methamphetamine use, resulting in increased reliance on expensive acute care services for more critical health care situations. Increasing engagement with less expensive non-acute health services to provide improved long-term health care may reduce the costs attributable to methamphetamine use for acute care services. For example, the current average medical benefit fee for a GP visit is AU\$42, range AU\$17-\$106, while the current average medical benefit fee for a Medicare Australia accredited psychologist consultation is AU\$68. In contrast, the average current cost of an emergency department presentation is AU\$583, while the average current cost for an acute mental health admission

is AU\$1061/day [35]. Ensuring non-acute services are well equipped to respond to the needs of people who use methamphetamine is crucial to encourage people to access these services.

It is important to note, however, that very high baseline rates of health care use were observed in this cohort relative to the general population, suggesting that reduced contact with health services during periods of frequent methamphetamine use is unlikely to reflect a low need for health care. For example, past year attendance for both hospitals and emergency departments in the Australian general population aged 15 years and older is 13% [36], compared to 22% for hospitals and 45% for emergency departments in this sample; rates of general practice use in the past year were around 9 attendances per year, compared to around 3 per year for men and 4 per year for women aged 15-44 years in Australia [37].

Presentations to emergency departments and psychiatric hospitals were also associated with greater polysubstance use, comorbid mental health disorders and various demographic factors (unstable housing, unemployment, low education) suggesting a potential benefit ensuring easier access to a range of services to address the broader health and social needs of this population (e.g. community-based mental health services, employment and training, housing). One interesting finding that warrants further investigation was that methamphetamine-related utilisation of ambulance services was accounted for by concurrent opioid use. This could reflect the incidental use of methamphetamine in people who use heroin or other opioids (a practice which is common in Australia [38]), or it could reflect overdose from combined drug toxicity [39, 40].

Limitations and considerations

The extrapolation of health service utilisation rates to estimate national health service use was done to provide an example of how these data could potentially be used, rather than provide definitive numbers to be used for costing or burden studies. This would ideally be done using an attributable fraction approach that was underpinned by evidence of a causal relationship between the drug and the condition for which the person was being treated. However, the necessary data to confirm a causal contribution to various conditions, or to derive related attributable fractions, is largely lacking for methamphetamine use [3]. Our methods provide an alternative interim way of estimating the likely impact of the drug on health services.

Estimating the national level impact of methamphetamine use on health services is contingent on having reliable prevalence estimates, particularly for problematic levels of use.

Problematic illicit drug use is notoriously difficult to measure and typically under-estimated by household surveys [28], as was the case for methamphetamine use in the 2013 Australian survey [29]. We used indirect prevalence estimates for problematic methamphetamine use in Australia [30] for the sake of comparison. As expected, these indirect estimates produced greater rates of health service utilisation for $\geq$ weekly use, but overall health service utilisation was slightly lower than the household survey-based estimates, because these indirect prevalence estimates excluded less than monthly methamphetamine use. Together these data suggest that we may have under-estimated the true extent of methamphetamine-related health service utilisation.

Although we demonstrated a temporal relationship between methamphetamine use and health service use, we cannot infer that presentations were due to methamphetamine-related morbidity because of reverse causality (e.g. self-medication) and because health service utilisation reflects various factors (e.g. avoidance, referral) in addition to drug-related morbidity. We controlled for a variety of demographic factors that were associated with high levels of methamphetamine use in this sample (e.g. unemployment, unstable housing, mental health disorders), but we were unable to control for all lifestyle factors (e.g. poor diet, exercise, social support, financial stress), which may contribute to poor health, injuries, and the subsequent use of health services. We did not control for incarceration during the follow-up period, which would have restricted access to health services; however, most participants who became incarcerated were lost to follow-up because we were unable to conduct interviews within prison.

A strength of our approach is that we examined changes in health service utilisation during periods of methamphetamine use, relative to periods of no use, within the same cohort of people. This provides more accurate control for factors associated with dependent drug use (e.g. personality, risk taking, comorbid mental health problems) and it therefore provides a more conservative estimate of health service use attributable to methamphetamine use than a general population comparison. A limitation of this approach is that it does not capture the chronic health effects of methamphetamine use, which are likely to make a significant contribution to health care use, the impact of which would continue beyond periods of acute

use. This would deflate our estimates of health service use related to methamphetamine use, which only reflect the impact of contemporaneous methamphetamine use. We also relied on self-reported drug use, but this is found to be reliable when confidentiality is assured, as it was in our research [41]. Self-reported health service utilisation is limited by the integrity of participant's recall, however, this approach provides information on contact with health services not captured by administrative data sources.

Our findings are based on health service contact amongst a cohort of dependent methamphetamine users, most of whom were engaged with drug treatment services. The findings do not reflect health service use among people who use methamphetamine occasionally (i.e. less than monthly) and they also may not reflect health service use amongst methamphetamine users who are not engaged with drug treatment services.

Methamphetamine users in Australia who do not seek treatment tend to be less severely dependent on methamphetamine, have different sociodemographic profile [42], be less likely to inject the drug, and be in better health [42, 43], although they also show relatively high rates of health service use [44]. Recent changes in the Australian methamphetamine market [45, 46] may have impacted on health service use, while findings may not generalise to other countries or even non-metropolitan regions within Australia due to variation in the availability and nature of health service provision.

Conclusion

The increase in rates of problematic methamphetamine use that have been seen in Australia and several other countries over the past decade are likely to be placing an additional burden on emergency departments and psychiatric hospitals. Patterns of health service utilisation suggest that frequent methamphetamine use is associated with a crisis approach, with consumers disengaging with non-acute health services during periods of frequent methamphetamine use, whilst increasing their presentations to emergency departments and psychiatric hospitals. Developing better pathways and more assertive models of care from emergency departments and psychiatric departments into other health and social services may reduce the impact of the drug on frontline medical and psychiatric services. Further research is needed to cost the impact of methamphetamine use on these services to ensure appropriate resourcing.

Acknowledgements: The data reported in this paper were collected through the Methamphetamine Treatment Evaluation Study (MATES), which was conducted by the National Drug and Alcohol Research Centre, University of New South Wales, and was funded by the National Health and Medical Research Council and the Australian Government Department of Health and Ageing. The authors thank Sharon Dawe, Jake Najman, Richard Mattick, Robert Ali and Joanne Ross, who were investigators on the project, researchers working on the project (Erin Kelly, Shelley Cogger, Rachel Sutherland, Grace Ho, Cathie Sammut, Kate Hetherington, Sagari Sarkar, Julia Rosenfeld and Miriam Wyzenbeek), the participating treatment agencies and health services, and the participants.

Declaration of interest: Dan Lubman has provided consultancy advice to Lundbeck, and has received travel support and speaker honoraria from Astra Zeneca, Bristol Myers Squibb, Janssen and Lundbeck. Other authors have no interests to declare. Other authors have no conflicts to declare.

REFERENCES

1. Degenhardt L, Baxter AJ, Lee YY, Hall W, Sara GE, Johns N, et al. The global epidemiology and burden of psychostimulant dependence: findings from the Global Burden of Disease Study 2010. *Drug Alcohol Depend.* 2014;137:36-47.
2. United Nations Office on Drugs and Crime. *World Drug Report 2015*. New York: United Nations; 2015.
3. Degenhardt L, Whiteford H, Hall W. The Global Burden of Disease projects: What have we learned about illicit drug use and dependence and their contribution to the global burden of disease? *Drug Alcohol Rev* 2013;33:4-12.
4. Twomey CD, Baldwin DS, Hopfe M, Cieza A. A systematic review of the predictors of health service utilisation by adults with mental disorders in the UK. *BMJ Open* 2015;5.
5. O'Toole TP, Pollini R, Gray P, Jones T, Bigelow G, Ford DE. Factors identifying high-frequency and low-frequency health service utilization among substance-using adults. *J Subst Abuse Treat* 2007;33:51-9.
6. Manning V, Garfield JB, Best D, et al. Substance use outcomes following treatment: Findings from the Australian Patient Pathways Study. *Aust N Z J Psychiatry* 2016 [Epub ahead of print].
7. Darke S, Ross J, Teesson M, Lynskey M. Health service utilization and benzodiazepine use among heroin users: findings from the Australian Treatment Outcome Study (ATOS). *Addiction* 2003;98:1129-35..
8. Reissner V, Kokkevi A, Schifano F, et al. Differences in drug consumption, comorbidity and health service use of opioid addicts across six European urban regions (TREAT-project). *Eur Psychiatry* 2012;27:455-62.
9. Chen IM, Huang CL, Yeh BJ, Chien YL. Health service utilization of heroin abusers: a retrospective cohort study. *Addict Behav* 2015;45:281-6.
10. Nambiar D, Stoové M, Dietze P. A cross-sectional study describing factors associated with utilisation of GP services by a cohort of people who inject drugs. *BMC Health Serv Res* 2014;14:1-7.
11. Cloutier RL, Hendrickson RG, Fu RR, Blake B. Methamphetamine-related psychiatric visits to an urban academic emergency department: an observational study. *J Emerg Med* 2013;45:136-42.
12. Marshall BD, Grafstein E, Buxton JA, Qi J, Wood E, Shoveller JA, et al. Frequent methamphetamine injection predicts emergency department utilization among street-involved youth. *Public Health.* 2012;126:47-53.
13. Pluddemann A, Dada S, Parry CD, et al. Monitoring the prevalence of methamphetamine-related presentations at psychiatric hospitals in Cape Town, South Africa. *Afr J Psychiatry (Johannesbg)* 2013;16:45-9.
14. Bunting PJ, Fulde GWO, Forster SL. Comparison of crystalline methamphetamine ("ice") users and other patients with toxicology-related problems presenting to a hospital emergency department.[see comment]. *Med J Aust* 2007;187:564-6.
15. Pasic J, Russo JE, Ries RK, Roy-Byrne PP. Methamphetamine users in the psychiatric emergency services: a case-control study. *Am J Drug Alcohol Abuse.* 2007;33:675-86.

16. Richards JR, Bretz SW, Johnson EB, Turnipseed SD, Brofeldt BT, Derlet RW. Methamphetamine abuse and emergency department utilization. *West J Med* 1999;170:198-202.
17. Davidson SB, Blostein PA, Walsh J, Maltz SB, Elian A, VandenBerg SL. Resurgence of methamphetamine related burns and injuries: a follow-up study. *Burns* 2013;39:119-25.
18. Westover AN, McBride S, Haley RW. Stroke in young adults who abuse amphetamines or cocaine: a population-based study of hospitalized patients. *Arch Gen Psychiatry*. 2007;64:495-502.
19. Kaye S, McKetin R, Duflou J, Darke S. Methamphetamine and cardiovascular pathology: A review of the evidence. *Addiction*. 2007;102:1204-11.
20. Morasco BJ, O'Neil ME, Duckart JP, Ganzini L. Comparison of health service use among veterans with methamphetamine versus alcohol use disorders. *J Addict Med* 2014;8:47-52.
21. Kelly E, McKetin R, McLaren J. Health service utilisation among regular methamphetamine users. UNSW, Sydney, Australia.: National Drug and Alcohol Research Centre; 2005.
22. McKetin R, Najman J, Baker A, et al. Evaluating the impact of community-based treatment options on methamphetamine use: findings from the Methamphetamine Treatment Evaluation Study (MATES). *Addiction* 2012;107:1998-2008
23. Topp L, Mattick RP. Choosing a cut-off on the Severity of Dependence Scale (SDS) for amphetamine users. *Addiction* 1997;92:839-45.
24. Janca A, Robins LN, Cottler LB, Early TS. Clinical observation of assessment using the Composite International Diagnostic Interview (CIDI). An analysis of the CIDI Field Trials--Wave II at the St Louis site. *Br J Psychiatry* 1992;160:815-8.
25. Robins LN, Helzer JE, Ratcliff KS, Seyfried W. Validity of the diagnostic interview schedule, version II: DSM-III diagnoses. *Psychol Med* 1982;12:855-70.
26. Xu J, Long JS. Confidence intervals for predicted outcomes in regression models for categorical outcomes. *Stata Journal* 2005;5:537-59.
27. Australian Institute of Health and Welfare. National Drug Strategy Household Survey 2013 data & references Supplementary tables Government of Australia; 2014 [updated 17 July, 2014 August 25, 2014]. Available from: <http://www.aihw.gov.au/alcohol-and-other-drugs/ndshs/2013/data-and-references/>.
28. Hickman M, Taylor C, Chatterjee A, et al. Estimating the prevalence of problematic drug use: A review of methods and their application. *Bull Narc* 2002;54:15-32.
29. Chalmers J, Lancaster K, Hughes C. The stigmatisation of 'ice' and under-reporting of meth/amphetamine use in general population surveys: A case study from Australia. *Int J Drug Policy* 2016;36:15-24.
30. Degenhardt L, Larney S, Dobbins T, Chan G, Weier M, Roxburgh A, et al. Estimating the number of regular and dependent methamphetamine users in Australia, 2002-2014. *Med J Aust* 2016;204:153.
31. McKetin R, Kelly E, McLaren J. The Sydney Methamphetamine Market: Patterns of Supply, Use, Personal Harms and Social Consequences. NDLERF Monograph Series. No. 13. Australasian Centre for Policing Research, Commonwealth of Australia, Adelaide: National Drug Law Enforcement Research Fund; 2005.

32. Fulde GW, Forster SL. The impact of amphetamine-type stimulants on emergency services. *Curr Opin Psychiatry* 2015;28:275-9.
33. Wallace C, Galloway T, McKetin R, Kelly E, Leary J. Methamphetamine use, dependence and treatment access in rural and regional North Coast of New South Wales, Australia. *Drug Alcohol Rev* 2009;28:592-9.
34. Quinn B, Stooze M, Papanastasiou C, Dietze P. An exploration of self-perceived non-problematic use as a barrier to professional support for methamphetamine users. *Int J Drug Policy* 2013;24:619-23.
35. Australian Government Department of Health. MBS Online: Commonwealth of Australia; [updated 6 May 2014]. Available from: <http://www9.health.gov.au/mbs/search.cfm?q=3-51&sopt=I>.
36. Australian Bureau of Statistics. Australian Social Trends March 2011. Health services: Use and patient experiences. In: Statistics ABo, editor. Australia: Commonwealth of Australia; 2011.
37. Bayram C, Valenti L, Britt H. General practice encounters with men. *Aust Fam Physician* 2016;45:171-4.
38. Darke S, Hall W. Levels and correlates of polydrug use among heroin users and regular amphetamine users. *Drug Alcohol Depend* 1995;39:231-5.
39. Ochoa KC, Hahn JA, Seal KH, Moss AR. Overdosing among young injection drug users in San Francisco. *Addict Behav* 2001;26:453-60.
40. Coffin PO, Galea S, Ahern J, Leon AC, Vlahov D, Tardiff K. Opiates, cocaine and alcohol combinations in accidental drug overdose deaths in New York City, 1990–98. *Addiction* 2003;98:739-47.
41. Darke S. Self-report among injecting drug users: a review.[see comment]. *Drug Alcohol Depend* 1998;51:253-63; discussion 67-8.
42. Vincent N, Shoobridge J, Ask A, Allsop S, Ali R. Characteristics of amphetamine users seeking information, help and treatment in Adelaide, South Australia. *Drug Alcohol Rev* 1999;18:63-73.
43. McKetin R, Kelly E. Socio-demographic factors associated with methamphetamine treatment contact among dependent methamphetamine users in Sydney, Australia. *Drug Alcohol Rev* 2007;26:161-8.
44. Kelly E, McKetin R, McLaren J. Health service utilisation among regular methamphetamine users. NDARC Technical Report. Sydney: National Drug and Alcohol Research Centre; 2005.
45. Degenhardt L, Sara G, McKetin R, et al. Crystalline methamphetamine use and methamphetamine-related harms in Australia. *Drug Alcohol Rev* 2016 [Epub ahead of print].
46. Scott N, Caulkins JP, Ritter A, Quinn C, Dietze P. High-frequency drug purity and price series as tools for explaining drug trends and harms in Victoria, Australia. *Addiction* 2015;110:120-8.

Table 1. Rate of health service use in the past year

	n (%) PYs with any attendance (N = 1171 PYs)	Rate of use per PY ^a , Mean (95% CI)
General hospital	260 (22)	0.41 (0.38 - 0.45)
Psychiatric hospital	119 (10)	0.16 (0.14 - 0.18)
Emergency department	528 (45)	0.90 (0.84 - 0.95)
Ambulance attendance	313 (27)	0.48 (0.44 - 0.52)
General practice	1022 (88)	8.94 (8.77 - 9.11)
Psychiatrist	278 (24)	1.48 (1.41 - 1.55)
Psychologist/counsellor	401 (34)	3.83 (3.72 - 3.94)
Dentist	482 (41)	1.10 (1.04 - 1.16)

^aFor all years of observation. CI, confidence interval; PY, person year.

Table 2. Relationship between frequency of methamphetamine use and health service utilisation in the past year

	Mean (SE) attendances	Unadjusted IRR (95% CI)	<i>P</i> value	Model 1 ^a IRR (95% CI)	<i>P</i> value	Model 2 ^b IRR (95% CI)	<i>P</i> value
General hospital							
No use	0.33 (0.04)						
< weekly	0.34 (0.03)	1.00 (0.67 – 1.50)	0.982	0.92 (0.60 – 1.42)	0.718	0.96 (0.62 – 1.50)	0.858
Weekly +	0.48 (0.03)	1.20 (0.83 – 1.73)	0.338	1.03 (0.67 – 1.58)	0.904	1.05 (0.66 – 1.66)	0.834
Psychiatric hospital							
No use	0.02 (0.01)						
< weekly	0.18 (0.02)	6.83 (2.04 – 22.91)	0.002	6.06 (1.78 – 21.65)	0.004	5.16 (1.51 – 17.58)	0.009
Weekly +	0.19 (0.02)	8.28 (2.55 – 26.83)	<0.001	7.01 (2.07 – 25.75)	0.002	5.79 (1.70 – 19.72)	0.005
Emergency department							
No use	0.55 (0.06)						
< weekly	0.83 (0.05)	1.66 (1.22 – 2.27)	0.001	1.41 (1.02 – 1.95)	0.039	1.33 (0.96 – 1.85)	0.088
Weekly +	1.03 (0.04)	2.06 (1.55 – 2.73)	<0.001	1.55 (1.13 – 2.14)	0.007	1.44 (1.03 – 2.00)	0.032
Ambulance							
No use	0.26 (0.04)						
< weekly	0.41 (0.03)	1.49 (0.97 – 2.28)	0.070	1.03 (0.66 – 1.61)	0.892	1.02 (0.64 – 1.61)	0.939
Weekly +	0.57 (0.03)	2.17 (1.47 – 3.19)	<0.001	1.19 (0.77 – 1.85)	0.429	1.17 (0.74 – 1.85)	0.505
General practice							
No use	7.90 (0.21)						
< weekly	9.65 (0.17)	1.06 (0.89 – 1.25)	0.544	0.99 (0.83 – 1.18)	0.880	0.99 (0.83 – 1.19)	0.920
Weekly +	8.85 (0.12)	0.91 (0.78 – 1.06)	0.226	0.81 (0.68 – 0.97)	0.024	0.83 (0.69 – 1.00)	0.053

Psychiatrist								
No use	1.51 (0.09)							
< weekly	1.63 (0.07)	1.49 (0.97 – 2.28)	0.067	1.30 (0.83 – 2.04)	0.254	1.29 (0.82 – 2.03)	0.273	
Weekly +	1.39 (0.05)	1.11 (0.75 – 1.66)	0.590	0.92 (0.59 – 1.45)	0.720	0.96 (0.60 – 1.53)	0.868	
Counsellor or psychologist								
No use	4.40 (0.16)							
< weekly	5.04 (0.12)	1.01 (0.74 – 1.36)	0.962	0.81 (0.58 – 1.11)	0.188	0.73 (0.53 – 1.01)	0.061	
Weekly +	3.04 (0.07)	0.84 (0.64 – 1.12)	0.233	0.57 (0.41 – 0.79)	0.001	0.51 (0.36 – 0.72)	<0.001	
Dentist								
No use	1.56 (0.09)							
< weekly	1.25 (0.06)	0.90 (0.69 – 1.17)	0.424	0.93 (0.70 – 1.22)	0.586	0.95 (0.72 – 1.27)	0.747	
Weekly+	0.89 (0.04)	0.58 (0.45 – 0.74)	<0.001	0.61 (0.46 – 0.82)	0.001	0.65 (0.48 – 0.88)	0.005	

No use (n = 185), ≤ weekly use (n = 442 PY), > weekly use (n = 579 PY).

^aModel 1 adjusted for alcohol, tobacco and polydrug use in the past month.

^bModel 2 adjusted for alcohol, cannabis, tobacco and other polydrug use in the past month, having a co-occurring mental disorder, unstable accommodation, not having tertiary education, low income, unemployment and past year drug treatment.

CI, confidence interval; IRR, incidence rate ratio; PY, person year.

Table 3. Adjusted marginal incidence rates by level of methamphetamine use and estimated total number of attendances

	Mean (95% CI) attendances per 100 person years		Estimated annual national attendances attributable to methamphetamine use (95% CI)	
	Marginal rate	Additional events attributable to methamphetamine use ^a	NDSHS prevalence estimates for 2013	Indirect prevalence estimates for 2013/14
Psychiatric hospital admissions				
No use	3 (-1 – 7)			
< weekly	17 (10 – 24)	14 (7 – 20)	44,500 (22,400 – 66,800)	14,700 (7,300 – 22,000)
Weekly+	19 (13 – 25)	16 (10 – 22)	9,500 (5,900 – 13,100)	25,000 (15,000 – 34,400)
Total			54,700 (28,400 – 80,900)	39,600 (22,800 – 56,500)
Emergency department presentations				
No use	67 (46 – 86)			
< weekly	88 (72 – 104)	21 (6 – 38)	73,200 (19,700 – 126,600)	23,800 (6,400 – 41,200)
Weekly+	95 (82 – 107)	29 (16 – 41)	17,600 (10,000 – 25,300)	46,100 (26,100 – 66,100)
Total			90,800 (29,700 – 151,800)	67,900 (32,500 – 107,300)

Prevalence estimates based on the NDSHS were 332,897 < weekly and 61,064 weekly+ users. Indirect estimates were 76,733 regular (but not dependent) + 109,883 dependent users (lower), 108,262 regular + 159,836 dependent (middle), and 152,659 regular and 232,497 dependent (upper) methamphetamine users. ^aMarginal incidence rates adjusted for tobacco, alcohol, cannabis and other polydrug use, past year drug treatment, having a comorbid mental disorder, unstable accommodation, not having tertiary accommodation, low income and unemployment.

^bFigures are rounded to the nearest 100

CI, confidence interval; NDSHS, National Drug Strategy Household Survey.

Minerva Access is the Institutional Repository of The University of Melbourne

Author/s:

McKetin, R;Degenhardt, L;Shanahan, M;Baker, AL;Lee, NK;Lubman, DI

Title:

Health service utilisation attributable to methamphetamine use in Australia: Patterns, predictors and national impact

Date:

2018-02-01

Citation:

McKetin, R., Degenhardt, L., Shanahan, M., Baker, A. L., Lee, N. K. & Lubman, D. I. (2018). Health service utilisation attributable to methamphetamine use in Australia: Patterns, predictors and national impact. DRUG AND ALCOHOL REVIEW, 37 (2), pp.196-204. <https://doi.org/10.1111/dar.12518>.

Persistent Link:

<http://hdl.handle.net/11343/292634>