Title

Frequency of health-care utilization by adults who use illicit drugs: a systematic review and meta-analysis

Journal

Addiction, 115(6)

ISSN

0965-2140

Authors

Lewer, Dan
Freer, Joseph
King, Emma
et al.

Publication Date

2020-06-01

DOI

10.1111/add.14892

Published in final edited form as:
Addiction. 2019 November 09; 115(6): 1011–1023. doi:10.1111/add.14892.

Frequency of health-care utilization by adults who use illicit drugs: a systematic review and meta-analysis

Dan Lewer[1,2,iD], **Joseph Freer**[3], **Emma King**[1], **Sarah Larney**[4], **Louisa Degenhardt**[4,iD], **Emily J. Tweed**[5,iD], **Vivian D. Hope**[6,iD], **Magdalena Harris**[7,iD], **Tim Millar**[8], **Andrew Hayward**[1], **Dan Ciccarone**[9], **Katherine I. Morley**[2,10,iD]

[1]UCL Collaborative Centre for Inclusion Health, Institute of Epidemiology and Health Care UCL, London, UK

[2]National Addictions Centre, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, UK

[3]Centre for Primary Care and Public Health, Queen Mary University of London, London, UK

[4]National Drug and Alcohol Research Centre (NDARC), University of New South Wales, Randwick,, NSW, Australia

[5]MRC/CSO Social and Public Health Sciences Unit, University of Glasgow, Glasgow, UK

[6]Public Health Institute, Liverpool John Moores University, Liverpool, UK

[7]Department of Public Health, Environments and Society, London School of Hygiene and Tropical Medicine, , London, UK

[8]Centre for Mental Health and Safety, The University of Manchester, Manchester, UK

[9]Department of Family and Community Medicine, University of California, San Francisco, CA, USA

[10]Centre for Epidemiology and Biostatistics, Melbourne School of Global and Population Health, The University of Melbourne, Melbourne, Australia

Dan Lewer: 0000-0003-3698-7196

Louisa Degenhardt: 0000-0002-8513-2218

Emily J. Tweed: 0000-0001-6659-812X

Vivian D. Hope: 0000-0001-5712-5734

Magdalena Harris: 0000-0001-8718-8226

Katherine I. Morley: 0000-0002-2725-5535

Correspondence to: Dan Lewer, UCL Collaborative Centre for Inclusion Health, Institute of Epidemiology and Health Care UCL, 1–19 Torrington Place, London WC1E 7HB, UK. d.lewer@ucl.ac.uk.

Declaration of interests

T.M. has been a member of the organizing committee for, and chaired, conferences supported by unrestricted educational grants from Reckitt Benckiser, Lundbeck, Martindale Pharma and Britannia Pharmaceuticals Ltd (unpaid). He collaborates (unpaid) with and has received research funding from the substance misuse treatment provider Change Grow Live. He has received speaker honoraria from a commercial health-care consultancy firm (Applied Strategic). D.C. reports personal fees from Mallinckrodt Pharmaceuticals and personal fees from Nektar Therapeutics, outside the submitted work.

Europe PMC Funders Author Manuscripts

Europe PMC Funders Author Manuscripts

Abstract

Aims—To summarize evidence on the frequency and predictors of health-care utilization among people who use illicit drugs.

Design—Systematic search of MEDLINE, EMBASE and PsychINFO for observational studies reporting health-care utilization published between 1 January 2000 and 3 December 2018. We conducted narrative synthesis and meta-analysis following a registered protocol (identifier: CRD42017076525).

Setting and participants—People who use heroin, powder cocaine, crack cocaine, methamphetamine, amphetamine, ecstasy/3,4-methylenedioxymethamphetamine (MDMA), cannabis, hallucinogens or novel psychoactive substances; have a diagnosis of 'substance use disorder'; or use drug treatment services.

Measurements—Primary outcomes were the cumulative incidence (risk) and rate of care episodes in three settings: primary care, hospital admissions (in-patient) and emergency department (ED).

Findings—Ninety-two studies were included, 84% from North America and Australia. Most studies focused on people using heroin, methamphetamine or crack cocaine, or who had a diagnosis of drug dependence. We were able to conduct a meta-analysis of rates across 25 studies reporting ED episodes and 25 reporting hospital admissions, finding pooled rates of 151 [95% confidence interval (CI) = 114–201] and 41 (95% CI = 30–57) per 100 person-years, respectively; on average 4.8 and 7.1 times more often than the general population. Heterogeneity was very high and was not explained by drugs used, country of study, recruitment setting or demographic characteristics. Predictors of health-care utilization were consistent across studies and included unstable housing, drug injection and mental health problems. Opioid substitution therapy was consistently associated with reduced ED presentation and hospital admission. There was minimal research on health-care utilization by people using ecstasy/MDMA, powder cocaine, hallucinogens or novel psychoactive substances.

Conclusions—People who use illicit drugs are admitted to emergency department or hospital several times more often than the general population.

Keywords

Health services; Hospitals; Opiates; Primary Health Care; Stimulants; Substance-Related Disorders

Introduction

The use of illicit drugs is associated with health, social and economic problems. People who are dependent on illicit drugs generally have poor health outcomes, with cohort studies finding mortality rates of up to 15 times the general population, although this varies widely by population and setting [1,2]. As well as overdose, there is excess risk of cancers, cardiovascular, respiratory and liver diseases [3–5]. Excess disease may be due to both the direct effects of illicit drugs and accompanying life circumstances. For instance, people who use illicit drugs are vulnerable to homelessness, imprisonment and other forms of social

Europe PMC Funders Author Manuscripts

exclusion [6], and have high rates of tobacco smoking and harmful alcohol consumption. There are diverse subgroups of people who use drugs, and people who smoke cannabis or use illicit drugs occasionally may have better health outcomes than people who use drugs such as heroin, crack cocaine and methamphetamine [7,8].

Despite the high need for health care, qualitative research has identified multiple barriers for people who use illicit drugs. Health professionals may have negative perceptions of patients who use illicit drugs, including poor motivation, seeking prescriptions for non-medical purposes and violent behaviour, and may feel they lack training and skills to address the needs of this group [9]. Patients report that staff have stigmatizing attitudes and that there are barriers to attending appointments, such as transport costs and inflexible time-slots [10]. People who use drugs may delay treatment due to normalization of pain, fear of stigma in services and concern about inadequate opioid substitution and pain control when admitted to hospital [11]. These barriers mean that symptoms may not be addressed, leading to presentation late in the course of a disease and use of emergency care. People who use illicit drugs face distinct challenges to health-care access related to criminalization and social exclusion. We have therefore chosen to focus on this group, rather than include people who use alcohol, tobacco or other legal drugs.

Studies of patients visiting emergency departments (ED) have found that 10–20% report recent use of illicit drugs [12–14], much higher than the general population, and diagnoses of drug dependence are common among frequent ED users [15,16]. Frequent ED users are particularly likely to use drugs [17]. Such observations have led to a perception that people who use drugs are reliant upon ED services, but there is limited population-based research into the frequency and patterns of health-care utilization in this group. We aimed to (1) describe the frequencies of health-care utilization reported in observational studies of people who use illicit drugs and calculate pooled averages; (2) compare the frequency of health-care utilization to the general population; and (3) summarize evidence on the predictors and causes of health-care utilization.

Methods

Review protocol

We conducted a systematic review following the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines [18]. A protocol for this review has been registered with PROSPERO (identifier: CRD42017076525).

Search strategy

We searched Medline, PsychINFO and EMBASE from 1 January 2000 to 27 September 2017 using keywords and MeSH terms related to substance use, health-care utilization and observational study designs (full terms included in the Supporting information). We also included studies from a manual search of references. On 3 December 2018 we updated our search, using the same databases, search terms and inclusion criteria.

Europe PMC Funders Author Manuscripts

Study inclusion and exclusion criteria

We included English-language cohort and cross-sectional studies where 75% or more of participants had recently used illicit drugs. Illicit drugs were defined as heroin, powder cocaine, crack cocaine, methamphetamine, amphetamine, ecstasy/4-methylenedioxy methamphetamine (MDMA), cannabis, hallucinogens or novel psychoactive substances. We also included individuals who had had a diagnosis of 'substance use disorder' or were recruited from drug treatment services, where we were able to determine that at least 75% used illicit drugs rather than alcohol only. Primary outcomes were the rate or cumulative incidence of ED episodes, hospital admissions and primary care presentation. We excluded studies of participants recruited from acute health-care services (such as ED), who had acute disease (such as hepatitis A), who were pregnant or were aged less than 18 years. We also excluded studies with fewer than 30 participants or less than 30 days of observation per participant.

Study quality assessment

Methodological quality was assessed using a modified Newcastle-Ottowa scale [19] that included recruitment bias, non-response, ascertainment of illicit drug use, ascertainment of health-care utilization, adequacy of follow-up (for cohort studies), selection of comparison groups (for relative measures) and adjustment (for relative measures). Full details are given in Supporting information.

Screening and data extraction

Two authors (D.L. and J.F.) independently screened titles and abstracts using Rayyan [20]. There was agreement of 94% (Cohen's kappa 0.58) and conflicts were resolved through discussion. We accessed full texts, and one author (D.L., J.F. or E.K.) used a piloted data extraction tool to record details including the study design, year, location of the study, recruitment setting (drug treatment services, community or health care), participant demographics, predominant drugs used and denominator and numerator for primary outcomes. Where relative frequencies (such as rate ratios) were reported, we also recorded the ratio and details of the comparison group. Where predictors of health-care use and cause-specific health-care use were reported, we marked the study for narrative synthesis. A second author checked that all data was accurate. Queries that could not be resolved were referred to K.I.M. for a final decision.

Analysis

In a narrative review, we described: (i) the range of values of the primary outcomes; (ii) predictors of health-care utilization; and (iii) causes of health-care utilization by disease.

In quantitative analysis, we displayed frequency rates of ED and in-patient utilization using forest plots. To provide informal comparisons with the general population, we used published frequencies of health-care utilization in the United States, Canada, Australia and the United Kingdom [21–23] for the general population group with the most similar age and sex profile as the study population. Details of the comparison group used for each study are given in the archived data set.

Europe PMC Funders Author Manuscripts

We conducted a random-effects meta-analysis to report the average frequency of health-care utilization across study populations, limited to results from high-income countries, and excluded studies of subgroups likely to have unusual health-care utilization (such as people living with HIV and prisoners). We anticipated that the strongest determinants of heterogeneity would be the predominant drug and the country where the study was conducted, and therefore stratified results by these variables. As an exploratory analysis of further sources of heterogeneity (not pre-specified), we included each of the following variables in the meta-analysis equation as a moderator [24]: recruitment setting (health care, drug treatment services, community or prison), country, study design, study era (1990–99, 2000–09, 2010–18), risk-of-bias score (low or high), age (average age under or over 30 years) and sex (greater or less than 60% male), using a threshold of $P < 0.05$ to identify significant moderators.

All analysis was conducted using R version 3.5.1.

Results

Search results

Our search identified 5528 studies after de-duplication, 313 of which were selected for full-text review, and 92 were included. Figure 1 shows a flow-chart of studies. Some studies included groups from distinct regions or with distinct drug use patterns, while others duplicated samples from other studies, and we identified 98 unique populations with 204 relevant data points. The full data set is available in Supporting information.

Description of study populations

Of the 98 study populations, 53 were in the United States; 16 in Australia; 13 in Canada; three in Ireland; two each in Taiwan, Italy, New Zealand, United Kingdom, Vietnam; and one each in Denmark, Finland and Norway.

Although the search strategy included people using any illicit drugs, studies focused on people who used illicit drugs associated with dependence. The largest group was people using opiate substitution (31 populations), mainly recruited from drug treatment services. The next largest comprised people who inject drugs (29 populations), mainly recruited from community settings. Eight studies focused on cannabis users, seven focused on stimulant users (where injecting was not specified) and five focused on opiate users (where injecting was not specified). Figure 2 shows the number of study populations by predominant drug used and recruitment setting. No studies recruited participants who predominantly used MDMA/ecstasy, powder cocaine, novel psychoactive substances or hallucinogens such as lysergic acid diethylamide (LSD) and psilocybin.

A mean of 68% [standard deviation (SD) = 12%] of participants were male and the mean of average ages (reported in some studies as means and in others as medians) was 36.7 (SD = 6.0).

Europe PMC Funders Author Manuscripts

Study quality

Fifty-eight of 204 data points had high risk of bias. The main risk was lack of information on non-response. The overall risk of bias was not associated with frequency of health-care utilization in meta-analysis (see below). Table 1 summarizes results from the quality assessment.

Narrative review

Range of values—Frequencies of all outcomes were high and heterogeneous. ED utilization ranged from 19 [25] to 1061 [26] per 100 person-years. The proportion of participants visiting ED in the past 12 months ranged from 10% [27] to 72% [28]. Studies including relative measures showed frequency of ED utilization of three to 10 times that of comparison groups not using illicit drugs [29–32]. Exceptions were a study in rural Taiwan, showing that people who inject heroin had a similar rate of ED presentation as the general population [33], and a study of older people who use cannabis in the United States showing similar odds of ED presentation as those who do not use cannabis [34].

The rate of in-patient episodes ranged from 8 [33] to 852 [29] per 100 person-years. The proportion of participants who were hospitalized during the past 12 months ranged from 8% [35] to 41% [36]. Studies including relative measures showed frequency of hospital admission two to eight times that of comparison groups not using illicit drugs [29–31,37–40]. Again, studies of people who inject drugs in rural Taiwan and older people who use cannabis in the United States were exceptions, showing similar frequencies of hospital admission to the general population [33,41].

There were fewer studies of primary care utilization. Ten studies reported rates, ranging from 231 [42] to 2087 [37] episodes per 100 person-years. The proportion of participants visiting primary care in the past 12 months ranged from 38% [43] to 90% [44]. Three studies found a higher frequency than the general population: a study of insurance data in Canada found people with diagnoses of ‘substance abuse’ had 4.2 times more primary care visits than those without this diagnosis [37]; a study of patients at a specialist primary care clinic in Ireland that found that those with methadone prescriptions had 4.2 times the odds of a primary care consultation during 6 months, excluding visits for drug-related problems [45]; and a study of people in drug treatment in Australia that found those primarily in treatment for opioids had a median of 12 primary care visits in the past year, compared to seven for those in treatment for alcohol [44]. Other studies found a low absolute frequency of presentation without providing formal comparisons with the general population. For example, only 58% of people who inject drugs in Baltimore saw a primary care doctor over 3 years [46]; 53% of people who use methamphetamine in Australia saw a primary care doctor over 12 months [47]; and 32% of people who inject drugs in Montreal saw a primary care provider over 6 months, which was informally compared to 90% in the general population [48].

Studies investigating the frequency of health-care utilization in more than one setting showed that primary care episodes are more frequent than ED or in-patient episodes [49–53].

Predictors of health-care utilization—ED presentation was consistently associated with regular or recent injecting [54–57], sex work, [54,58] diagnosed hepatitis C [40], diagnosed HIV [31,36,56,59,60], female sex [36,49,61–64], homelessness or unstable housing [26,55,56,61,65], crack cocaine or stimulant use [56,61,62], alcohol use [63,66,67], polydrug use [47,68] and mental health problems [36,37,63].

Hospital admission was associated with similar factors: regular or recent injecting [55–57,69,70], diagnosed hepatitis C [71,72], diagnosed HIV [35,56,69,70,73], low CD4 count among HIV-positive participants [74], female sex [38,39,49,69,70,72,74], homelessness or unstable housing [55,69], alcohol use [72], polydrug use [47] and mental health problems [31,37].

One study (the Melbourne Injecting Drug User Cohort Study) reported similar associations with primary care utilization: regular injecting, homelessness, cocaine injection and unstable income [48,75].

Opiate substitution treatment was consistently associated with a lower frequency of ED presentation and hospital admission [27,36,42,53,57,71,73,76–81] than comparison groups of untreated opiate users. Among substitution patients, consistent medication was associated with a lower rate of ED utilization [77,78,82]. Some studies looked at different types of treatment. For example, one study found that take-home methadone was associated with a lower risk of hospital admission [83]. No studies looked at the effect of treatment for dependence on drugs other than opiates.

Some studies reported non-significant associations with these factors, but none found effects in the opposite direction.

Although some studies show that mental or physical morbidity predicts health-care utilization, no studies attempted to show whether increased frequency of health-care utilization among people who use illicit drugs was explained by morbidity or other indicators of need for services.

Causes of health-care utilization—Studies with cause-specific data showed that a minority of ED and in-patient episodes relate to the direct effects of illicit drugs, such as withdrawal, overdose and intoxication (Fig. 3). Infections and particularly skin and soft-tissue infections were common causes of ED and in-patient episodes in study populations in Canada [26,31,54,56,59,69], Norway [42] and Taiwan [33]. All infections, and particularly pneumonias, were important causes of health-care utilization in HIV-positive opiate users [70,74]. Infections were less important causes of health-care utilization in Australia [84,85]. Traumas, injuries and mental health problems were important causes of ED utilization and hospital admission in all countries [33,54,56,72,84,85].

Quantitative analysis

We conducted a meta-analysis of health-care utilization rates (25 studies reporting ED episodes and 25 reporting hospital admission) and 12-month cumulative incidence (11 studies reporting ED episodes and 11 reporting hospital admission). Twelve months was the

most common period examined in the literature. While we collected data from studies of other periods, we did not analyse these data because the periods varied too widely. We were unable to determine the consistency of the definition of primary care visits among studies and therefore did not attempt quantitative analysis. We restricted the analysis to populations who primarily use heroin, crack cocaine or methamphetamine or have a diagnosis of 'substance abuse disorder' or drug dependence, as there were few studies of people who use cannabis or have other patterns of use.

ED frequencies are shown in Figs 4 and 5. An average of 29% [95% confidence interval (CI) = 24–35%] of participants visited ED over a 12-month period. The pooled rate was 151 visits per 100 person-years (95% CI = 114–201). There was high heterogeneity, with I^2 approaching 100% for both analyses. Thirty-two study populations were matched with published rates for groups of a similar age and sex in the general population. ED presentation ranged from 0.9 to 24.7 times the general population (mean 4.8). Stratified meta-analysis by predominant drug and country did not show significant differences to the overall pooled estimate (see Supporting information), and the exploratory meta-regression found no significant moderators.

Hospital admission rates and cumulative incidences are shown in Figs 4 and 5. An average of 22% (95% CI = 15–31%) of participants were hospitalized over a 12-month period. The pooled rate was 41 episodes per 100 person-years (95% CI = 30–57). There was high heterogeneity, with I^2 approaching 100% for both analyses. Twenty-seven study populations were matched with published rates for comparable groups in the general population. Hospital admission rates ranged from 1.9 to 35.5 times the general population (mean 7.1). As with the ED results, stratified meta-analysis by predominant drug and country did not show significant differences to the overall pooled estimate, and the exploratory meta-regression found no significant moderators.

Discussion

To our knowledge, this is the first systematic review of health-care utilization in people who use illicit drugs. The majority of available evidence relates to people who use heroin, methamphetamine and crack cocaine or have a diagnosis of drug dependence. The results show high but widely varying frequencies of ED presentation and hospital admission in this group.

The pooled frequencies of ED and hospital admissions are substantially higher than the general population. In part, this reflects morbidity and greater need for treatment. However, higher utilization does not necessarily represent good health-care access. A systematic review in 2009 [86] identified 10 studies showing that people with substance use disorders are less likely to receive definitive treatment for specific conditions, despite higher all-cause attendance. For example, a study of veterans with diagnoses of diabetes in the United States found that participants with comorbid substance use were less likely to receive foot or retina examinations [87]. Our finding of high utilization of acute services may not represent good access, but a pattern where primary and preventative health care is poor and unplanned health care is common.

The results contrast with studies of health care among people who use alcohol, which find that drinkers (including heavy drinkers) have lower rates of health-care utilization than abstainers [88]. This is likely to be explained by abstention among people who are unwell, rather than a protective effect of alcohol. In contrast, this review found that people who use illicit drugs present to health services much more frequently than the general population. This may be because studies of people who use illicit drugs tend to focus on people who are dependent on or use drugs associated with health harms, while studies of alcohol may include more moderate drinkers.

Predictors of health-care utilization were consistent across studies, including unstable housing, drug injection and mental health problems. These factors reflect previously identified risk factors for poor health in people who use drugs [89], and are likely to be associated with greater need for health care.

Effectively, all the variation across studies was due to differences between populations rather than within-study error. Despite consistent predictors of health-care utilization within studies, we were not able to explain the variation between studies by the predominant drugs used by study participants, the country of the study or any other study-level variables that we collected. Results varied widely even within countries and populations with apparently similar drug use. For example, in the United States, the rate of hospital admission of people in opiate substitution therapy ranged from 51 to 592 per 100 person-years [53,76–78,90–92]. Other research has conceptualized access to health services as a product of individual factors, social contexts and health-care systems [93,94]. The extent of the heterogeneity in our results is unlikely to be fully explained by individual-level factors that we did not capture. This suggests that social and health-care contexts can substantially affect health-care utilization. The heterogeneity also highlights the difficulty of generalizing results from single studies of health-care utilization.

The review identified three main gaps in the evidence. First, 84% of study populations were from the United States, Canada or Australia. We did not identify any studies from low-income countries. Secondly, there were few studies with primary care data, even though existing studies suggest people who use illicit drugs visit primary care more often than acute health-care settings [49–53], contrary to the stereotype of reliance on ED. Thirdly, almost all studies were of people who use heroin, crack cocaine or methamphetamine or have a diagnosis of drug dependence. There were only eight studies of people who use cannabis and none of people using MDMA/ecstasy, powder cocaine, hallucinogens, novel psychoactive substances or other drugs.

The results highlight the need for interventions that improve general health outcomes among people who use drugs. Despite a body of research into the effectiveness of opiate substitutes to reduce use of street heroin [95], community-distributed naloxone to prevent overdose deaths [96], strategies to reduce transmission of hepatitis C and improve access to hepatitis C treatment [97] and some strategies to improve treatment of soft-tissue infections among people who inject drugs [98], there is limited research into interventions that can improve treatment of health problems that are not specifically associated with drug use. Some studies have shown that Housing First can reduce all-cause ED utilization, although study outcomes

Europe PMC Funders Author Manuscripts

tend to focus on substance use rather than broader health [99]. Case management (where a single case manager is assigned to each patient) can improve drug treatment outcomes but, again, evidence of the effect on broader health outcomes is limited [100].

Limitations of the evidence

Most studies in the past have described patients in healthcare services to show the proportion that use drugs, rather than using population-based approaches. This has led in particular to a focus on ED and frequent healthcare users. To broaden this focus, we synthesized observational studies that often report health-care utilization as a secondary outcome. The strength of this approach is that it has shown the wide variation in utilization of acute hospital services, and in some settings primary care may be attended more frequently. The limitation is that many studies provide limited insight into predictors and patterns of utilization.

Half the studies in the review (43 of 92) rely on linked electronic health-care records, which may have inaccuracies in diagnostic coding. For example, there is evidence that drug-related events such as overdoses are under-recorded in ED data and may be given other diagnostic codes [101,102]. This could contribute to the small proportion of health-care episodes that are ‘drug-related’ in our results. In addition, few studies include data from the recent period when synthetic opioids such as fentanyl became more common in North American illicit drug markets. Opioid-related overdoses in the United States have increased during this period [103], and the proportion of health-care episodes that are drug-related may have increased.

The quality assessment identified non-response as the most common problem. This usually resulted from recruitment relying on volunteers or convenience samples rather than a systematic or random approach. These methods are often necessary, as it can be difficult to construct sample frames of people who use drugs. Difficulties in constructing sample frames may also account for the relative lack of studies of people using some illicit drugs, such as powder cocaine, although this may also be due to less severe health outcomes in these groups.

None of the studies included in this review looked at whether higher morbidity explained higher rates of health-care use, so we were not able to discuss the appropriateness of health service use.

Limitations of the review and meta-analysis

First, we only included English-language studies, which may partially explain the large proportion of studies from English-speaking countries—although the English-language restriction only Excluded 179 of 5528 search results. Secondly, given the heterogeneity of results, meta-analysis is only intended to provide an average across studies, rather than a meaningful estimate of health-care utilization for any specific population. Thirdly, we defined health-care utilization with simple rates or proportions. While this enabled us to perform a traditional systematic review, it meant that the results provide limited insight into the appropriateness or equity of the high rates of health-care utilization that we observed. Finally, our review focused on three mainstream health-care settings (primary care, ED and

Europe PMC Funders Author Manuscripts

in-patient hospital care), and did not consider other potential sources of health care such as community drug treatment services, which sometimes provide a wider set of interventions. Future research should consider the full range of health-care provision for people who use drugs, including opportunities for integration between drug treatment and mainstream health services.

Conclusion

People who use illicit drugs present to acute health services several times more often than comparison groups throughout primary care, ED and in-patient settings, reflecting high morbidity. Utilization rates are highest in those who inject drugs, homeless people and those with mental health problems. Research is needed into the quality of health care for people who use illicit drugs, provision of health care in non-acute settings and the development of health services that are considered safe and acceptable to this group.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements

D.L. and M.H. are funded by the National Institute for Health Research (NIHR) (DRF-2018-11-ST2–016, CDF-2016-09-014). This paper presents independent research. The views expressed are those of the authors and not necessarily those of the NHS, the NIHR or the Department of Health and Social Care. L.D. and S.L. are supported by NHMRC Research Fellowships (GNT1041742, GNT1135991, GNT1091878, GNT1140938) and NIDA R01DA1104470. The National Drug and Alcohol Research Centre at UNSW Australia is supported by funding from the Australian Government Department of Health under the Drug and Alcohol Program. E.J.T. is funded by the Medical Research Council [MC_UU_12017/13 & MC_UU_12017/15) and Chief Scientist Office (SPHSU13 and SPHSU15), and by a Chief Scientist Office Clinical Academic Fellowship (CAF/17/11). A.H. is an NIHR Senior Investigator and is funded by the Central and North West London NHS Trust. D.C. is supported by the US National Institutes of Health, National Institute of Drug Abuse Grant DA037820. K.I.M. is funded by the Wellcome Trust (109823/Z/15/Z).

References

1. Mathers BM, Degenhardt L, Bucello C, Lemon J, Wiessing L, Hickman M. Mortality among people who inject drugs: a systematic review and meta-analysis. Bull World Health Organ. 2013; 91:102–23. [PubMed: 23554523]
2. Aldridge RW, Story A, Hwang SW, Nordentoft M, Luchenski SA, Hartwell G, et al. Morbidity and mortality in homeless individuals, prisoners, sex workers, and individuals with substance use disorders in high-income countries: a systematic review and meta-analysis. Lancet. 2018; 391:241–50. [PubMed: 29137869]
3. Lewer D, Tweed EJ, Aldridge RW, Morley KI. Causes of hospital admission and mortality among 6683 people who use heroin: A cohort study comparing relative and absolute risks. Drug and Alcohol Dependence. 2019; 204doi: 10.1016/j.drugalcdep.2019.06.027
4. Degenhardt L, Larney S, Randall D, Burns L, Hall W. Causes of death in a cohort treated for opioid dependence between 1985 and 2005: mortality among opioid-dependent people. Addiction. 2014; 109:90–9. [PubMed: 23961881]
5. Degenhardt L, Bucello C, Mathers B, Briegleb C, Ali H, Hickman M, et al. Mortality among regular or dependent users of heroin and other opioids: a systematic review and meta-analysis of cohort studies: mortality among opioid users. Addiction. 2011; 106:32–51. [PubMed: 21054613]
6. Fitzpatrick S, Johnsen S, White M. Multiple exclusion homelessness in the UK: key patterns and intersections. Soc Policy Soc. 2011; 10:501–12.

7. Rogers G, Elston J, Garside R, Roome C, Taylor RS, Younger P, et al. The harmful health effects of recreational ecstasy: a systematic review of observational evidence. Health Technol Assess. 2009; 13:1–315.
8. Volkow ND, Baler RD, Compton WM, Weiss SR. Adverse health effects of marijuana use. N Engl J Med. 2014; 370:2219–27. [PubMed: 24897085]
9. van Boekel LC, Brouwers EPM, van Weeghel J, Garretsen HF. Stigma among health professionals towards patients with substance use disorders and its consequences for healthcare delivery: systematic review. Drug Alcohol Depend. 2013; 131:23–35. [PubMed: 23490450]
10. Neale J, Tompkins C, Sheard L. Barriers to accessing generic health and social care services: a qualitative study of injecting drug users: drug injectors and barriers to service use. Health Soc Care Community. 2007; 16:147–54.
11. Summers PJ, Hellman JL, MacLean MR, Rees VW, Wilkes MS. Negative experiences of pain and withdrawal create barriers to abscess care for people who inject heroin. A mixed methods analysis. Drug Alcohol Depend. 2018; 190:200–8. [PubMed: 30055424]
12. Sanjuan PM, Rice SL, Witkiewitz K, Mandler RN, Crandall C, Bogenschutz MP. Alcohol, tobacco, and drug use among emergency department patients. Drug Alcohol Depend. 2014; 138:32–8. [PubMed: 24594289]
13. Macias Konstantopoulos WL, Dreifuss JA, McDermott KA, Parry BA, Howell ML, Mandler RN, et al. Identifying patients with problematic drug use in the emergency department: results of a multisite study. Ann Emerg Med. 2014; 64:516–25. [PubMed: 24999283]
14. Binks S. Prevalence and healthcare burden of illegal drug use among emergency department patients. Emerg Med J. 2005; 22:872–3. [PubMed: 16299197]
15. Urbanoski K, Cheng J, Rehm J, Kurdyak P. Frequent use of emergency departments for mental and substance use disorders. Emerg Med J. 2018; 35:220–5. [PubMed: 29311114]
16. Byrne M, Murphy AW, Plunkett PK, McGee H, Murray A, Bury G. Frequent attenders to an emergency department: a study of primary health care use, medical profile, and psychosocial characteristics. Ann Emerg Med. 2003; 41:309–18. [PubMed: 12605196]
17. Dent A, Hunter G, Webster AP. The impact of frequent attenders on a UK emergency department. Eur J Emerg Med. 2010; 17:332–6. [PubMed: 20038842]
18. Shamseer L, Moher D, Clarke M, Ghersi D, Liberati A, Petticrew M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. BMJ. 2015; 349
19. Wells, G; Shea, B; O'Connell, D; Peterson, J; Welch, V; Losos, M; , et al. [accessed 18 January 2018] The Newcastle–Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses. Available at: https://web.archive.org/web/20190609041323/http://www.ohri.ca/programs/clinical_epidemiology/oxford.asp
20. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan—a web and mobile app for systematic reviews. Syst Rev. 2016; 5:210. [PubMed: 27919275]
21. Centers for Disease Control and Prevention. National Hospital Ambulatory Medical Care Survey: 2015 Emergency Department Summary Tables. 2015. Available at: https://web.archive.org/web/20190422173149/https://www.cdc.gov/nchs/data/nhamcs/web_tables/2015_ed_web_tables.pdf ().
22. Australian Institute of Health and Welfare. [accessed 12 December 2018] Emergency department care 2016–17: Australian hospital statistics. 2017. Available at: https://web.archive.org/web/20190329121754/https://www.aihw.gov.au/reports/hospitals/ahs-2016-17-emergency-department-care/data
23. NHS Digital. [accessed 12 December 2018] Hospital Accident and Emergency Activity, 2017–18. 2018. Available at: https://web.archive.org/web/20190426044531/https://digital.nhs.uk/data-and-information/publications/statistical/hospital-accident--emergency-activity/2017-18
24. Viechtbauer W. Conducting meta-analyses in R with the metafor package. J Stat Softw. 2010; 36doi: 10.18637/jss.v036.i03
25. Chen Y-C, Chen C-K, Lin S-K, Chiang SC, Su LW, Wang LJ. Health care service utilization and associated factors among heroin users in northern Taiwan. Addict Behav. 2013; 38:2635–8. [PubMed: 23896066]

26. Fairbairn N, Milloy M-J, Zhang R, Lai C, Grafstein E, Kerr T, et al. Emergency department utilization among a cohort of HIV-positive injecting drug users in a Canadian setting. J Emerg Med. 2012; 43:236–43. [PubMed: 21719229]
27. Clay E, Khemiri A, Zah V, Aballéa S, Ruby J, Asche CV. Persistence and healthcare utilization associated with the use of buprenorphine/naloxone film and tablet formulation therapy in adults with opioid dependence. J Med Econ. 2014; 17:626–36. [PubMed: 24841329]
28. Ngamini-Ngui A, Fleury M-J, Moizan J, Grégoire JP, Lesage A, Vanasse A. High users of emergency departments in Quebec among patients with both schizophrenia and a substance use disorder. Psychiatr Serv. 2014; 65:1389–91. [PubMed: 25124150]
29. Schmidt LM, Hesse M, Lykke J. The impact of substance use disorders on the course of schizophrenia—a 15-year follow-up study. Schizophr Res. 2011; 130:228–33. [PubMed: 21592731]
30. Campbell CI, Bahorik AL, Kline-Simon AH, Satre DD. The role of marijuana use disorder in predicting emergency department and inpatient encounters: a retrospective cohort study. Drug Alcohol Depend. 2017; 178:170–5. [PubMed: 28651153]
31. Kendall CE, Boucher LM, Mark AE, Martin A, Marshall Z, Boyd R, et al. A cohort study examining emergency department visits and hospital admissions among people who use drugs in Ottawa, Canada. Harm Reduct J. 2017; 14:16. [PubMed: 28494791]
32. Bahorik AL, Satre DD, Kline-Simon AH, Weisner CM, Young-Wolff KC, Campbell CI. Alcohol, marijuana, and opioid use disorders: 5-year patterns and characteristics of emergency department encounters. Subst Abuse. 2018; 39:59–68.
33. Chen I-M, Huang CL-C, Yeh B-J, Chien Y-L. Health service utilization of heroin abusers: a retrospective cohort study. Addict Behav. 2015; 45:281–6. [PubMed: 25747796]
34. Choi NG, Marti CN, DiNitto DM, Choi BY. Older adults' marijuana use, injuries, and emergency department visits. Am J Drug Alcohol Abuse. 2018; 44:215–23. [PubMed: 28481624]
35. Tran BX, Phan HTT, Nguyen LH, Nguyen CT, Nguyen AT, Le TN, et al. Economic vulnerability of methadone maintenance patients: implications for policies on copayment services. Int J Drug Policy. 2016; 31:131–7. [PubMed: 26922633]
36. Turner BJ, Laine C, Yang CP, Hauck WW. Effects of long-term, medically supervised, drug-free treatment and methadone maintenance treatment on drug users' emergency department use and hospitalization. Clin Infect Dis. 2003; 37:S457–S463. [PubMed: 14648464]
37. Graham K, Cheng J, Bernards S, Wells S, Rehm J, Kurdyak P. How much do mental health and substance use/addiction affect use of general medical services? Extent of use, reason for use, and associated costs. Can J Psychiatry. 2017; 62:48–56. [PubMed: 27543084]
38. Onyeka IN, Beynon CM, Ronkainen K, Tiihonen J, Föhr J, Kuikanmäki O, et al. Hospitalization in a cohort seeking treatment for illicit drug use in Finland. J Subst Abuse Treat. 2015; 53:64–70. [PubMed: 25641737]
39. Pavarin RM, Gambini D. Health status of users of the Bologna local health authority drug addiction treatment services: a study of hospital admissions in the period 2004–2013. Infez Med. 2015; 23:5–11. [PubMed: 25819044]
40. Tarricone I, Boydell J, Panigada S, Allegri F, Marcacci T, Minenna MG, et al. The impact of substance use at psychosis onset on first episode psychosis course: results from a 1 year follow-up study in Bologna. Schizophr Res. 2014; 153:60–3. [PubMed: 24525084]
41. Bhandari S, Hillard CJ, Venkatesan T. Marijuana users do not have increased healthcare utilization: a National Health and nutrition examination survey (NHANES) study. Eur J Intern Med. 2016; 34:e9–e10. [PubMed: 27499177]
42. Skeie I, Brekke M, Lindbæk M, Waal H. Somatic health among heroin addicts before and during opioid maintenance treatment: a retrospective cohort study. BMC Public Health. 2008; 8
43. Cucciare MA, Han X, Timko C, Zaller N, Kennedy KM, Booth BM. Longitudinal associations between outpatient medical care use and substance use among rural stimulant users. Am J Drug Alcohol Abuse. 2018; 44:235–43. [PubMed: 28662352]
44. Lubman DI, Garfield JBB, Manning V, Berends L, Best D, Mugavin JM, et al. Characteristics of individuals presenting to treatment for primary alcohol problems versus other drug problems in the Australian patient pathways study. BMC Psychiatry. 2016; 16

45. Cullen W, O'Brien S, O'Carroll A, O'Kelly FD, Bury G. Chronic illness and multimorbidity among problem drug users: a comparative cross sectional pilot study in primary care. BMC Fam Pract. 2009; 10:25. [PubMed: 19383141]
46. Riley ED, Wu AW, Junge B, Marx M, Strathdee SA, Vlahov D. Health services utilization by injection drug users participating in a needle exchange programme. Am J Drug Alcohol Abuse. 2002; 28:497–511. [PubMed: 12211362]
47. Kelly E, McKetin R, McLaren J. Health service utilization among regular methamphetamine users. Sydney: National Drug and Alcohol Research Centre. 2005accessed 9 November 2018
48. Artenie AA, Jutras-Aswad D, Roy É, Zang G, Bamvita JM, Lévesque A, et al. Visits to primary care physicians among persons who inject drugs at high risk of hepatitis C virus infection: room for improvement. J Viral Hepatol. 2015; 22:792–9.
49. 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. [PubMed: 12873247]
50. Darke S, Marel C, Ross J, Mills KL, Slade T, Tessson M. Health service utilization among heroin users: 11-year follow-up of the Australian treatment outcome study cohort. Addict Disord Treat. 2015; 14:159–66.
51. Horyniak D, Higgs P, Jenkinson R, Degenhardt L, Stoové M, Kerr T, et al. Establishing the Melbourne injecting drug user cohort study (MIX): rationale, methods, and baseline and twelve-month follow-up results. Harm Reduct J. 2013; 10:11. [PubMed: 23786848]
52. Lintzeris N, Rivas C, Monds LA, Leung S, Withall A, Draper B. Substance use, health status and service utilization of older clients attending specialist drug and alcohol services: older drug and alcohol clients. Drug Alcohol Rev. 2016; 35:223–31. [PubMed: 26498741]
53. McCarty D, Perrin NA, Green CA, Polen MR, Leo MC, Lynch F. Methadone maintenance and the cost and utilization of health care among individuals dependent on opioids in a commercial health plan. Drug Alcohol Depend. 2010; 111:235–40. [PubMed: 20627427]
54. Marshall BDL, 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. [PubMed: 22133669]
55. Juday TR, Wu A, Celentano DD, Frick KD, Wang MC, Vlahov D. The role of Medicaid HMO enrollment in the longitudinal utilization of medical care services in a cohort of injecting drug users in Baltimore, Maryland. Subst Abuse. 2003; 24:27–41.
56. Palepu A, Tyndall MW, Leon H, Muller J, O'Shaughnessy MV, Schechter MT, et al. Hospital utilization and costs in a cohort of injection drug users. Can Med Assoc J. 2001; 165:415–20. [PubMed: 11531049]
57. Stein M. Injection frequency mediates health service use among persons with a history of drug injection. Drug Alcohol Depend. 2003; 70:159–68. [PubMed: 12732409]
58. Burnette ML, Lucas E, Ilgen M, Frayne SM, Mayo J, Weitlauf JC. Prevalence and health correlates of prostitution among patients entering treatment for substance use disorders. Arch Gen Psychiatry. 2008; 65:337. [PubMed: 18316680]
59. Kerr T, Wood E, Grafstein E, Ishida T, Shannon K, Lai C, et al. High rates of primary care and emergency department use among injection drug users in Vancouver. J Public Health. 2005; 27:62–6.
60. Reynolds GL, Fisher DG, Wood MM, Klahn JA, Johnson ME. Use of emergency room services by out-of-treatment drug users in Long Beach, California. J Addict Dis. 2003; 22:1–13.
61. Cederbaum JA, Guerrero EG, Mitchell KR, Kim T. Utilization of emergency and hospital services among individuals in substance abuse treatment. Subst Abuse Treat Prev Policy. 2014; 9:16. [PubMed: 24708866]
62. Nambiar D, Stoové M, Dietze P. Frequent emergency department presentations among people who inject drugs: a record linkage study. Int J Drug Policy. 2017; 44:115–20. [PubMed: 28511107]
63. Knowlton AR, Hoover DR, Chung S, Celentano DD, Vlahov D, Latkin CA. Access to medical care and service utilization among injection drug users with HIV/AIDS. Drug Alcohol Depend. 2001; 64:55–62. [PubMed: 11470341]

64. Siegal HA, Falck RS, Wang J, Carlson RG, Massimino KP. Emergency department utilization by crack-cocaine smokers in Dayton, Ohio. Am J Drug Alcohol Abuse. 2006; 32:55–68. [PubMed: 16450643]

65. Whittaker E, Swift W, Roxburgh A, Dietze P, Cogger S, Bruno R, et al. Multiply disadvantaged: health and service utilization factors faced by homeless injecting drug consumers in Australia: issues faced by homeless injecting drug users. Drug Alcohol Rev. 2015; 34:379–87. [PubMed: 25787785]

66. Dietze P, Jenkinson R, Aitken C, Stoové M, Jolley D, Hickman M, et al. The relationship between alcohol use and injecting drug use: impacts on health, crime and wellbeing. Drug Alcohol Depend. 2013; 128:111–5. [PubMed: 22989499]

67. Ryder N, Cullen W, Barry J, Bury G, Keenan E, Smyth BP. Prevalence of problem alcohol use among patients attending primary care for methadone treatment. BMC Fam Pract. 2009; 10

68. Nguyen LH, Nguyen LHT, Boggiano VL, Hoang CD, van Nguyen H, Le HT, et al. Quality of life and healthcare service utilization among methadone maintenance patients in a mountainous area of northern Vietnam. Health Qual Life Outcomes. 2017; 15:77. [PubMed: 28427471]

69. Lloyd-Smith E, Wood E, Zhang R, Tyndall MW, Montaner JSG, Kerr T. Risk factors for developing a cutaneous injection-related infection among injection drug users: a cohort study. BMC Public Health. 2008; 8doi: 10.1186/1471-2458-8-405

70. Shoenbaum EE, Lo Y, Floris-Moore M. Predictors of hospitalization for HIV-positive women and men drug users, 1996–2000. Public Health Rep. 2002; 117:S60–S66. [PubMed: 12435828]

71. Baum MK, Jayaweera DT, Duan R, Sales S, Lai S, Rafie C, et al. Quality of life, symptomatology and healthcare utilization in HIV/HCV co-infected drug users in Miami. J Addict Dis. 2008; 27:37–48.

72. Merrall E, Bird S, Hutchinson S. A record linkage study of hospital episodes for drug treatment clients in Scotland, 1996–2006. Addict Res Theory. 2013; 21:52–61.

73. Laine C. Regular outpatient medical and drug abuse care and subsequent hospitalization of persons who use illicit drugs. JAMA. 2001; 285:2355. [PubMed: 11343483]

74. Floris-Moore M, Lo Y, Klein RS, Budner N, Gourevitch MN, Moskaleva G, et al. Gender and hospitalization patterns among HIV-infected drug users before and after the availability of highly active antiretroviral therapy. J Acquir Immune Defic Syndr. 2003; 34:331–7. [PubMed: 14600580]

75. Nambiar D, Stoové M, Dietze P. A cross-sectional study describing factors associated with utilization of GP services by a cohort of people who inject drugs. BMC Health Serv Res. 2014; 14

76. Baser O, Chalk M, Fiellin DA. Cost and utilization outcomes of opioid-dependence treatments. Am J Manag Care. 2011; 17:S235–S248. [PubMed: 21761950]

77. Lo-Ciganic W-H, Gellad WF, Gordon AJ, Cochran G, Zemaitis MA, Cathers T, et al. Association between trajectories of buprenorphine treatment and emergency department and in-patient utilization: buprenorphine trajectories and outcomes. Addiction. 2016; 111:892–902. [PubMed: 26662858]

78. Schwarz R, Zelenev A, Bruce RD, Altice FL. Retention on buprenorphine treatment reduces emergency department utilization, but not hospitalization, among treatment-seeking patients with opioid dependence. J Subst Abuse Treat. 2012; 43:451–7. [PubMed: 22534003]

79. Lynch FL, McCarty D, Mertens J, Perrin NA, Green CA, Parthasarathy S, et al. Costs of care for persons with opioid dependence in commercial integrated health systems. Addict Sci Clin Pract. 2014; 9:16. [PubMed: 25123823]

80. Mohlman MK, Tanzman B, Finison K, Pinette M, Jones C. Impact of medication-assisted treatment for opioid addiction on Medicaid expenditures and health services utilization rates in Vermont. J Subst Abuse Treat. 2016; 67:9–14. [PubMed: 27296656]

81. Robertson AG, Easter MM, Lin H-J, Frisman LK, Swanson JW, Swartz MS. Associations between pharmacotherapy for opioid dependence and clinical and criminal justice outcomes among adults with cooccurring serious mental illness. J Subst Abuse Treat. 2018; 86:17–25. [PubMed: 29415846]

82. Shcherbakova N, Tereso G, Spain J, Roose RJ. Treatment persistence among insured patients newly starting buprenorphine/naloxone for opioid use disorder. Ann Pharmacother. 2018; 52:405–14. [PubMed: 29302989]

83. Walley AY, Cheng DM, Pierce CE, Chen C, Filippell T, Samet JH, et al. Methadone dose, take home status, and hospital admission among methadone maintenance patients. J Addict Med. 2012; 6:186–90. [PubMed: 22694929]
84. Nambiar D, Stoové M, Hickman M, Dietze P. A prospective cohort study of hospital separations among people who inject drugs in Australia: 2008–2013. BMJ Open. 2017; 7:e014854.
85. Aitken C, Kerr T, Hickman M, Stoové M, Higgs P, Dietze P. A cross-sectional study of emergency department visits by people who inject drugs. Emerg Med J. 2013; 30:421–2. [PubMed: 22802454]
86. Mitchell AJ, Malone D, Doebbeling CC. Quality of medical care for people with and without comorbid mental illness and substance misuse: systematic review of comparative studies. Br J Psychiatry. 2009; 194:491–9. [PubMed: 19478286]
87. Desai MM, Rosenheck RA, Druss BG, Perlin JB. Mental disorders and quality of diabetes care in the Veterans Health Administration. Am J Psychiatry. 2002; 159:1584–90. [PubMed: 12202281]
88. Zarkin GA, Bray JW, Babor TF, Higgins-Biddle JC. Alcohol drinking patterns and health care utilization in a managed care organization. Health Serv Res. 2004; 39:553–70. [PubMed: 15149478]
89. Hope VD, Marongiu A, Parry JV, Ncube F. The extent of injection site infection in injecting drug users: findings from a national surveillance study. Epidemiol Infect. 2010; 138:1510–8. [PubMed: 20163753]
90. Shah A, Duncan M, Atreja N, Tai KS, Gore M. Healthcare utilization and costs associated with treatment for opioid dependence. J Med Econ. 2018; 21:406–15. [PubMed: 29320915]
91. Gourevitch MN, Chatterji P, Deb N, Schoenbaum EE, Turner BJ. On-site medical care in methadone maintenance: associations with health care use and expenditures. J Subst Abuse Treat. 2007; 32:143–51. [PubMed: 17306723]
92. Manhapra A, Agbese E, Leslie DL, Rosenheck RA. Three-year retention in buprenorphine treatment for opioid use disorder among privately insured adults. Psychiatr Serv. 2018; 69:768–76. [PubMed: 29656707]
93. Dixon-Woods M, Cavers D, Agarwal S, Annandale E, Arthur A, Harvey J, et al. Conducting a critical interpretive synthesis of the literature on access to healthcare by vulnerable groups. BMC Med Res Methodol. 2006; 6
94. Harris M, Rhodes T. Hepatitis C treatment access and up-take for people who inject drugs: a review mapping the role of social factors. Harm Reduct J. 2013; 10:7. [PubMed: 23651646]
95. Sordo L, Barrio G, Bravo MJ, Indave BI, Degenhardt L, Wiessing L, et al. Mortality risk during and after opioid substitution treatment: systematic review and meta-analysis of cohort studies. BMJ. 2017; 357
96. Clark AK, Wilder CM, Winstanley EL. A systematic review of community opioid overdose prevention and naloxone distribution programs. J Addict Med. 2014; 8:153–63. [PubMed: 24874759]
97. Hagan H, Pouget ER, Des Jarlais DC. A systematic review and meta-analysis of interventions to prevent hepatitis C virus infection in people who inject drugs. J Infect Dis. 2011; 204:74–83. [PubMed: 21628661]
98. Harris HW, Young DM. Care of injection drug users with soft tissue infections in San Francisco. California Arch Surg. 2002; 137:1217. [PubMed: 12413304]
99. Woodhall-Melnik JR, Dunn JR. A systematic review of outcomes associated with participation in housing first programs. Housing Studies. 2016; 31:287–304.
100. Hesse M, Rapp R, Broekaert E, Fridell M. Case management for persons with substance use disorders. Cochrane Database Syst Rev. 2007; 4
101. Wood DM, Conran P, Dargan PI. ICD-10 coding: poor identification of recreational drug presentations to a large emergency department. Emerg Med J. 2011; 28:387–9. [PubMed: 20660895]
102. Di Rico R, Nambiar D, Stoové M, Dietze P. Drug overdose in the ED: a record linkage study examining emergency department ICD-10 coding practices in a cohort of people who inject drugs. BMC Health Serv Res. 2018; 18:945. [PubMed: 30518362]

103. Slavova S, Costich JF, Bunn TL, Luu H, Singleton M, Hargrove SL, et al. Heroin and fentanyl overdoses in Kentucky: epidemiology and surveillance. Int J Drug Policy. 2017; 46:120–9. [PubMed: 28735777]

Europe PMC Funders Author Manuscripts

Europe PMC Funders Author Manuscripts

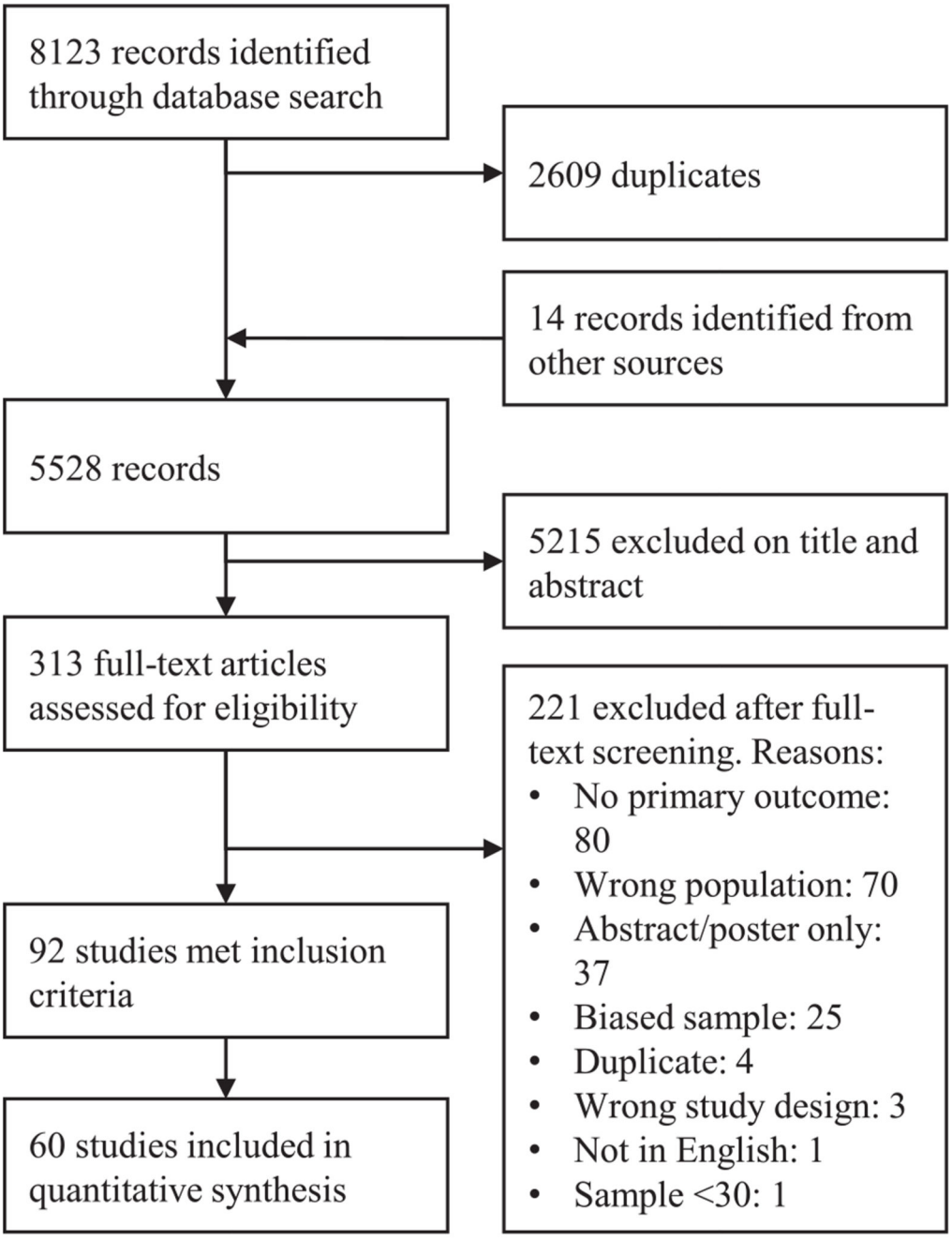

Figure 1.
Flow-chart of included studies

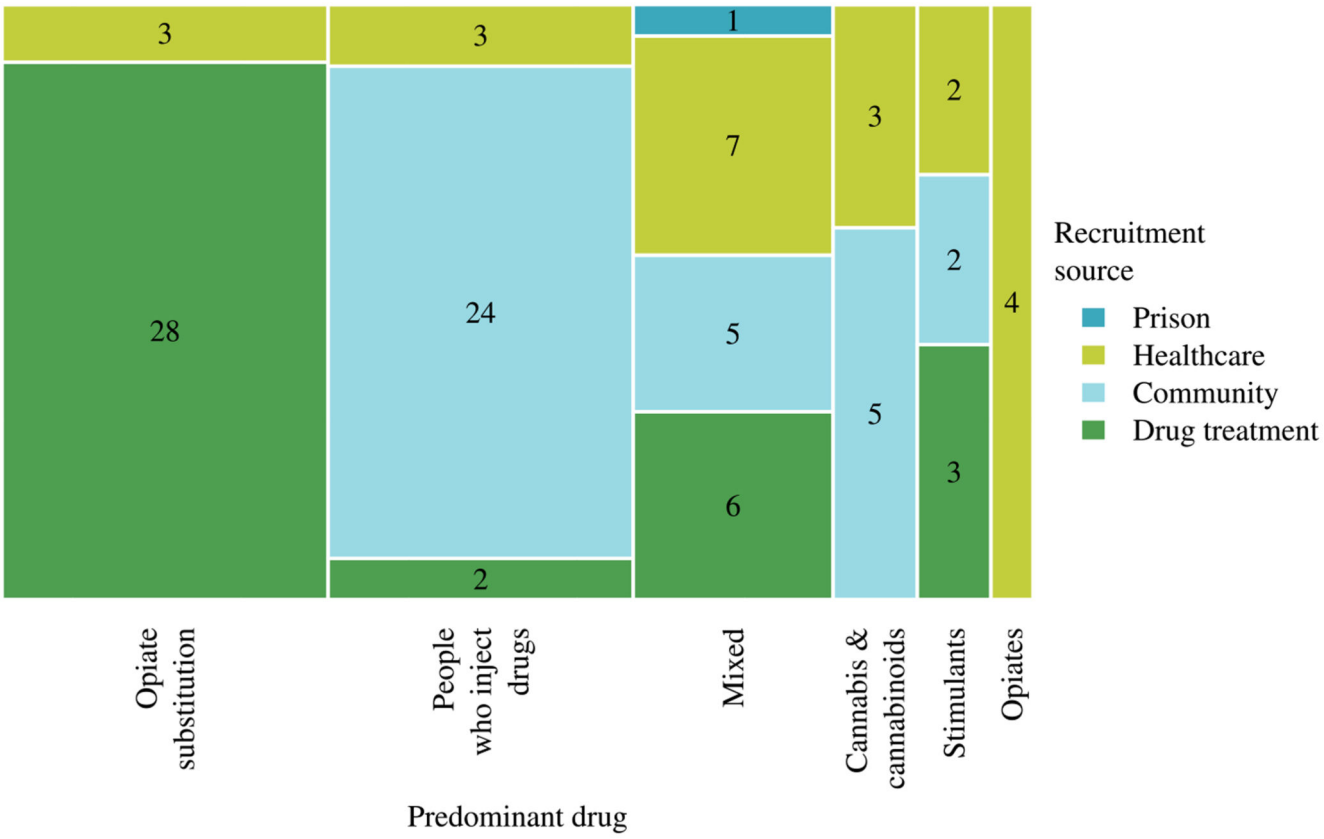

Figure 2.
Unique study populations by predominant drug and recruitment source [Colour figure can be viewed at wileyonlinelibrary.com]

Europe PMC Funders Author Manuscripts

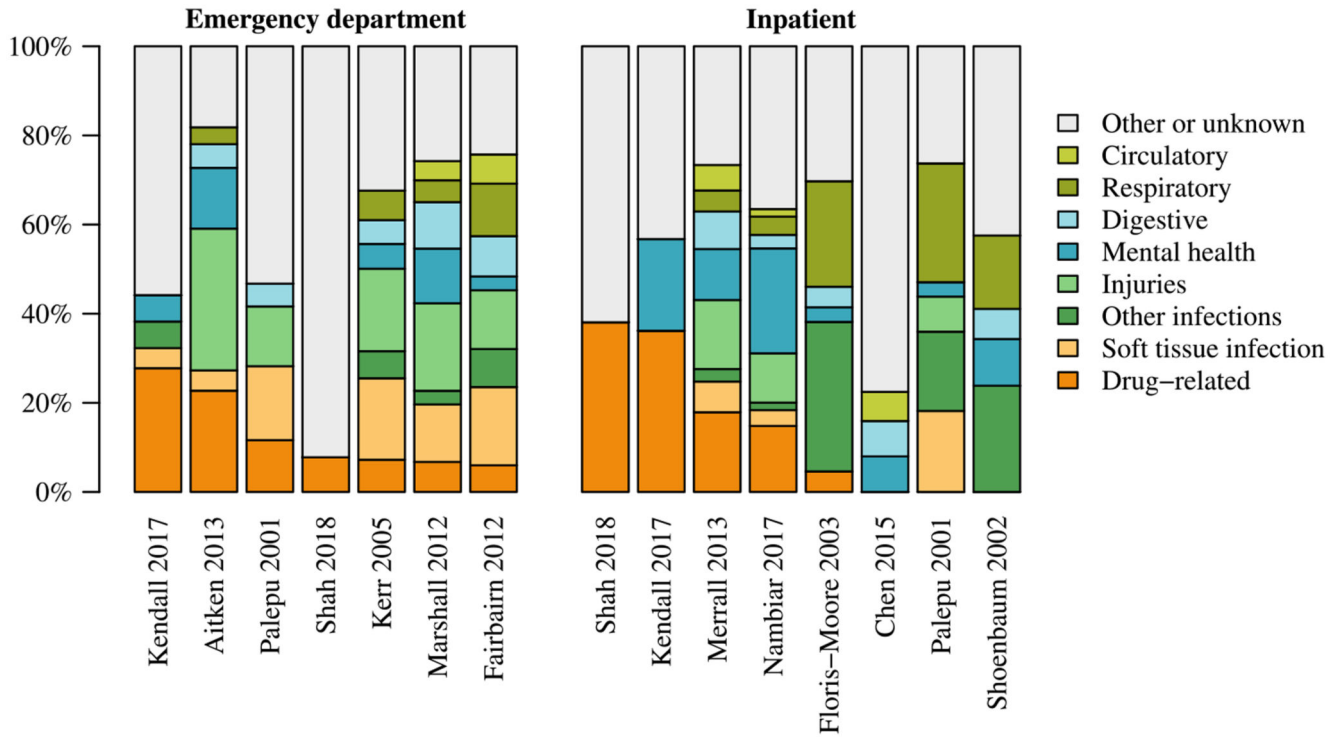

Figure 3.
Main reason for health-care utilization [Colour figure can be viewed at wileyonlinelibrary.com]

Europe PMC Funders Author Manuscripts

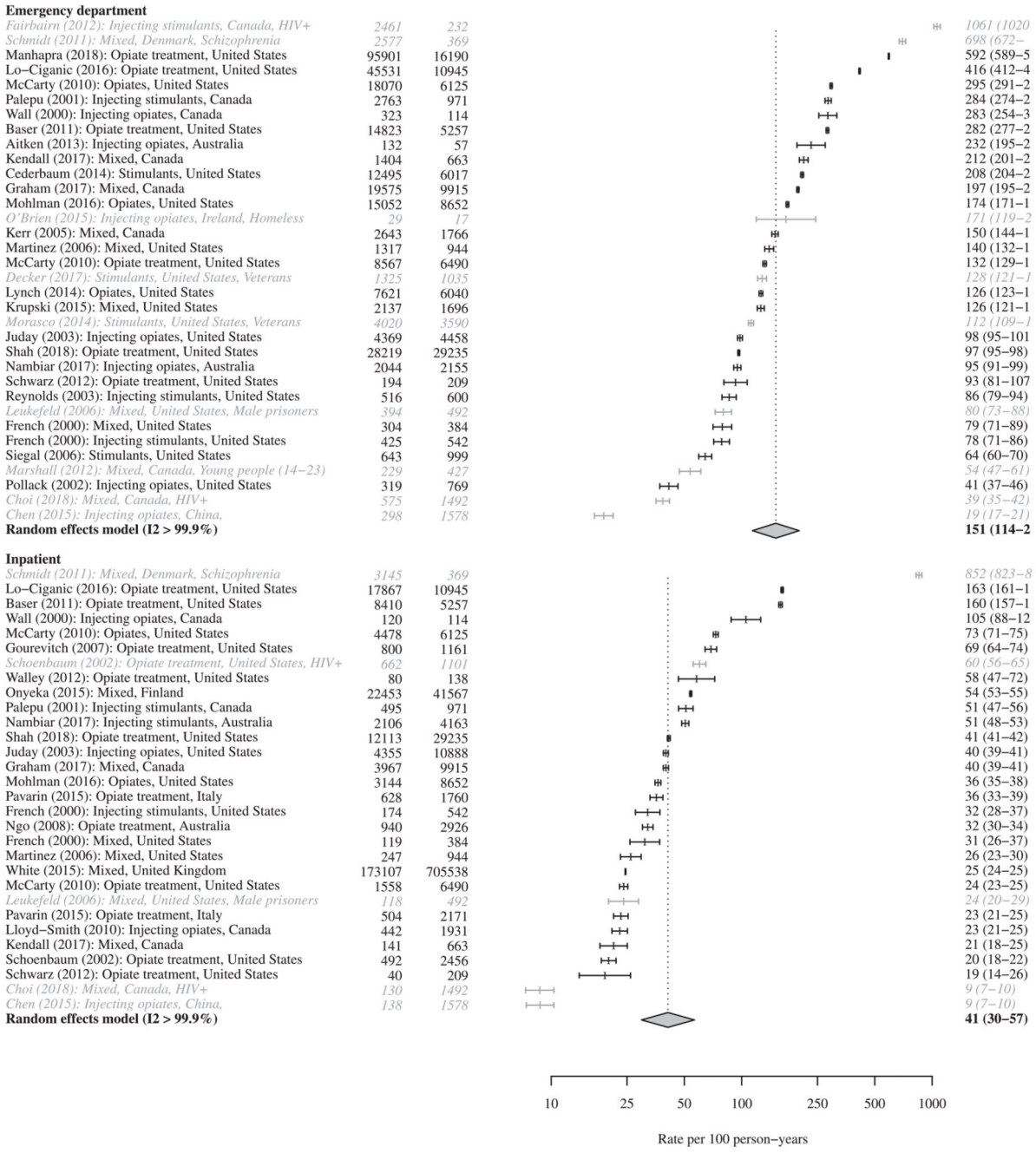

Figure 4.

Forest plot of rates of health-care utilization. Studies in grey and italics are not included in the pooled estimate

Europe PMC Funders Author Manuscripts

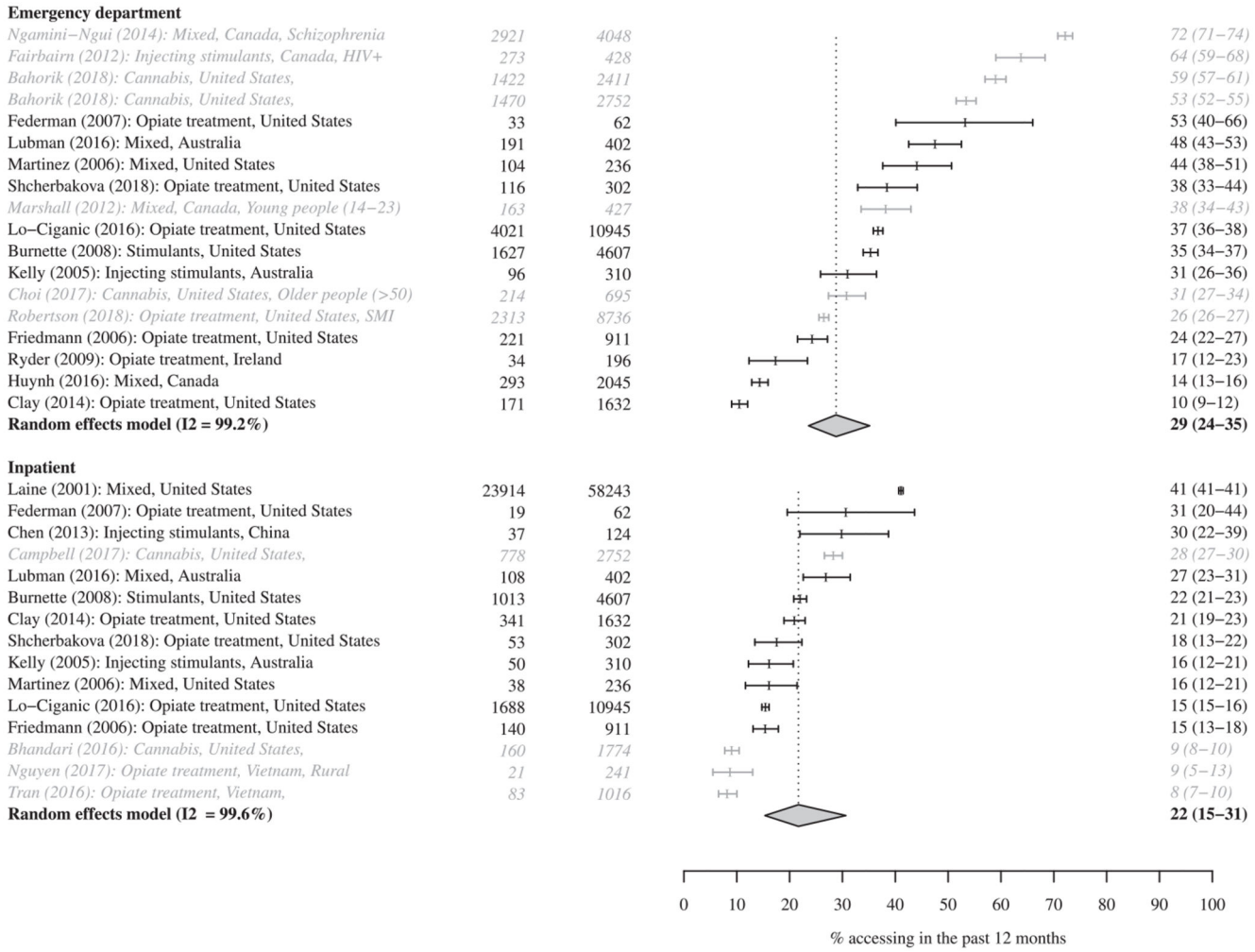

Figure 5.

Forest plot of 12-month cumulative incidence of health-care utilization. Studies in grey and italics are not included in the pooled estimate

Europe PMC Funders Author Manuscripts

Europe PMC Funders Author Manuscripts

Table 1

Results of quality assessment.

	Data points	High risk	Proportion high risk
Recruitment bias	204	28	14%
Non-response	204	121	59%
Ascertainment of illicit drug use	204	43	21%
Ascertainment of health-care utilization	204	44	22%
Adequacy of follow-up	82	21	26%
Selection of comparison group	47	4	9%
Adjustment for confounders	47	4	9%
Global assessment	204	58	28%