1 2 3 4	This is the peer reviewed version of the following article: Acute care utilization and its associated determinants among patients with substance-related disorders: A worldwide systematic review and meta-analysis. Journal of Psychiatric and Mental Health Nursing 2023. Online ahead of print. which has been published in final form at https://doi.org/ 10.1111/jpm.12936. This article may be used for non-commercial purposes in accordance with Wiley Terms and Conditions for Use of Self-Archived Versions. This article may not be enhanced, enriched or otherwise transformed into a derivative work, without express permission from Wiley or by statutory rights under applicable legislation. Copyright notices must not be removed, obscured or modified. The article must be linked to Wiley's version of record on Wiley Online Library and any embedding, framing or otherwise making available the article or pages thereof by third parties from platforms, services and websites other than Wiley Online Library must be prohibited."
5	Journal of Psychiatric and Mental Health Nursing
6	
7	
8	
9	
10	
11	Acute care utilization and its associated determinants among patients with substance-
12	
13	related disorders: A worldwide systematic review and meta-analysis
14	
15	Running head: Acute care utilization among nationts with substance-related disorders
16	Running head. Acute care demization among patients with substance-related disorders
17	
12	
19	
20	
20	
21	Bahram Armoon PhD <sup>1</sup> Mark D. Griffiths PhD <sup>2</sup> Rasool Mohammadi PhD <sup>3,4</sup> Elabeh Ahounbar
22	Daniani Annoon Fiid, Mark D. Onninis Fiid, Kasoon Mohaniniau Fiid, Elanon Anounda $M_{2.56}$ Marka Lasía Elanor DiD 78
25	MSC <sup>2,0</sup> , Marie-Josee Fleury PhD <sup>7,0</sup>
24	<sup>1</sup> Social Determinants of Health Research Center, Saveh University of Medical Sciences, Saveh, Iran
25	
20	<sup>2</sup> International Gaming Research Unit, Psychology Department, Nottingham Trent University, Nottingham,
27	
20	UK
29	
30	30 mint Determinante of Hould Decemb Conten Orbert of Deblie Hould Netvitien Longeton
32	"Social Determinants of Health Research Center, School of Public Health and Nutrition, Lorestan
33	
34	University of Medical Sciences, Khorramabad, Iran
35	
36	<sup>4</sup> Department of Biostatistics and Epidemiology School of Public Health and Nutrition Lorestan University
37	of Modical Sciences, Khorremanad, Iran
38	of Medical Sciences, Knotrainabad, Iran
39	<sup>5</sup> Orygen, The National Center of Excellence in Youth Mental Health, University of Melbourne, Parkville,
40	
41	VIC, Australia
42	
43	6 Center for Verth Mentel Health Frenches of Medicine Dertistry and Health Sciences Huisensite of
44	"Center for Youth Mental Health, Faculty of Medicine, Dentistry and Health Sciences, University of
45	
46	Melbourne, Parkville, Australia
47	
48	<sup>7</sup> Douglas Hospital Research Centre, Montreal, Ouebec, Canada
49	
50	
51	<sup>8</sup> Department of Psychiatry, McGill University, Montreal, Quebec, Canada
5∠ 52	
55	
55	иг. дангаш Агшооп
56	
57	
58	1
59	±

Page 1 of 115

60

Social Determinants of Health Research Center, Saveh University of Medical Sciences, Saveh, Iran

Email: Bahramarmun@gmail.com

# Declarations

# Ethics approval and consent to participate:

The present study was an analysis of preexisting literature and did not use human participants.

# **Consent for publication**

Not applicable.

# **Competing interests**

The authors declare that there are no conflicts of interest.

# Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or non-for-profit sectors.

# Author contributions

BA. Conceived the study BA. collected all data. RM, and BA analyzed and interpreted the data. BA and EA drafted the manuscript. BA, MJF and MDG contributed to the revised paper and was responsible for all final editing. All authors commented on the drafts of the manuscript and approved the final copy of the paper for submission.

# Acknowledgments: None.

2	
3	
Δ	
- -	
2	
6	
7	
8	
a	
10	
10	
11	
12	
13	
14	
15	
10	
16	
17	
18	
19	
20	
21	
∠ ı 22	
22	
23	
24	
25	
26	
27	
20	
20	
29	
30	
31	
32	
33	
37	
54	
35	
36	
37	
38	
39	
40	
40	
41	
42	
43	
44	
45	
46	
-+0 4-7	
4/	
48	
49	
50	
51	
57	
52 E 2	
23	
54	
55	
56	
57	
58	
50	
59	
60	

# **Accessible Summary**

### What is known on the subject?

- Emergency department (ED) use and hospitalization are among the health services that impose a significant economic burden to societies.
- ED use and hospitalization can indicate limited access to healthcare services or poor outpatient care quality.
- ED use was 4.4 times higher among patients with substance-related disorders (SRDs) than general population.
- Hospitalization was 7.1 times higher among patients with SRDs than general population.

# What the paper adds to existing knowledge?

- The pooled prevalence rate of ED use among patients with SRDs was 36% (95% CI, 26%-46%).
- The pooled prevalence rate of hospitalization among patients with SRDs was 41% (95% CI, 21%-61%).
- This paper examines determinants and existing models of outpatient care that impact acute care use. ED use and hospitalization could be beneficial for designing more comprehensive healthcare plans for patients with SRDs.
- Data obtained from this present systematic review and meta-analysis showed that patients with SRDs who were the most at risk of being both ED users and hospitalized were those having medical insurance, having other drugs and alcohol use disorders, having mental health disorders, and having chronic physical illnesses. A lower level of education increased the risk of ED use only.

# What are the implications for practice?

- More comprehensive healthcare services are recommended comprising integrated SRD-• mental health disorders treatment and assertive community treatment for patients with SRDs and psychosocial disorders.
- The chronic care model could be more implemented for patients with SRDs after the • discharge of patients from acute care units or hospitals.
- Outpatient healthcare access can be facilitated by implementing outreach programs tailored • to patients with SRDs who have a lower level of education or socioeconomic status.

## Abstract

## Introduction

Identifying determinants of emergency department (ED) use and hospitalization among patients with substance-related disorders (SRDs) can improve health services to address unmet health CLIP needs.

## Aim

The present study aimed to identify the prevalence rates of ED use and hospitalization, and their associated determinants among patients with SRDs.

# Methods

Studies in English published from January 1, 1995 to December 1, 2022, were searched on PubMed, Scopus, Cochrane Library, and Web of Science to identify primary studies.

## **Results**

The pooled prevalence rates of ED use and hospitalization among patients with SRDs were 36% and 41%, respectively. Patients with SRDs who were the most at risk of being both ED users and hospitalized were those (i) having medical insurance, (ii) having other drugs and alcohol use disorders, (iii) having mental health disorders, and (iv) having chronic physical illnesses. A lower level of education increased the risk of ED use only.

## Discussion

To decrease ED use and hospitalization, more comprehensive services may be offered to these vulnerable patients with diversified needs.

## **Implications for Practice**

Chronic care integrating outreach interventions could be more provide for patients with SRDs after discharge from acute care units or hospitals.

Keywords: emergency department; hospitalization; substance-related disorders; mental health 1.04 disorders

#### **Relevance Statement**

Emergency department liaison nurses specialized in addiction may be more deployed in ED and hospitalization units to facilitate screening, brief intervention, and referral of patients with SRDs (particularly with polysubstance-related disorders and co-occurring mental health disorders) to addiction treatment centers.

## Introduction

Among patients with substance-related disorders (SRDs), mental health disorders (MHDs) and chronic physical illnesses are highly prevalent which often lead them to emergency department (ED) use and hospitalization (Rhee et al., 2019; Zhang et al., 2021). The 2017 National Survey on Drug Use and Health in the USA reported that approximately 74% of the adult SRD population reported alcohol use disorders (Substance Abuse and Mental Health Services Administration, 2018). A study conducted in the USA from 2014 to 2018 suggested that patients with SRDs accounted for 9.4% of all ED use and 11.9% of hospitalizations (acute care) (Suen et al., 2022). A systematic review and meta-analysis study concluded that adults who used illicit drugs had 4.4 and 7.1 times higher rates of ED use and hospitalization, respectively, compared to the general population (Lewer et al., 2020). Another study conducted in Switzerland (Vu et al., 2015) reported that 35% of patients using ED services had SRDs in 2009-2010.

ED use and hospitalization (Galarraga et al., 2016; Mejia de Grubb et al., 2020) are very costly, imposing a significant economic burden to societies, and are established measures of adverse outcomes if their use may be evitable (Fleury et al., 2019; Sørup et al., 2013). Moreover, ED use and hospitalization can indicate limited access to healthcare services or poor outpatient care quality (Sørup et al., 2013). Consequently, it is essential to explore sociodemographic and clinical determinants that may impact acute care use. Such knowledge could be beneficial for designing more comprehensive services to response to patient needs with SRDs.

To the best of the authors' knowledge, no previous meta-analysis has been published examining prevalence rates of ED use and hospitalization and identifying sociodemographic and clinical characteristics including types of drugs associated with acute care use among patients with SRDs. Addressing such a gap in the literature may lead to improve patient care by providing Page 7 of 115

 adequate information to fulfill this population's needs for preventing frequent ED use and hospitalization. This study thus aimed to determine the prevalence of ED use and hospitalization, sociodemographic and clinical determinants including types of drugs associated with ED use and hospitalization among patients with SRDs.

#### Methods

## Search strategy

The present systematic review and meta-analysis study was implemented following the Protocols of Systematic Reviews and Meta-Analyses (PRISMA) (Page et al., 2021). In the study selection step, two independent researchers individually reviewed the papers published between January 1, 1995 to December 1, 2022 from *PubMed, Scopus, Web of Science,* and *Cochrane Library* databases. The following search strategy keywords were validated by a librarian and adopted to each database using Boolean operators (AND/OR) and initial keywords "(acute care), (*inpatients*), (*health services administration*), (*emergency medical services*), (*emergency service*), *hospital*), (*substance use disorders*), (*substance-related disorders*), (*substance abuse, intravenous*)". The reference lists of the considered papers were reviewed manually as well to include more relevant papers (**Supplementary File 1**).

### Eligibility criteria and study selection

The papers were managed using *EndNote X9* software. The two researchers independently reviewed the titles and abstracts based on PECOS (population, exposures, comparison, outcome, and study design) criteria. With regards to 'population', only patients with SRDs were included; for 'exposures', positive and negative associations between sociodemographic and clinical determinants including type of drug and ED use and hospitalization among patients with SRDs

were assessed; the 'comparison' group was patients with SRD not reporting ED use and hospitalization; the 'outcomes' were ED use or hospitalization ('yes' or 'no' in the past 12 months) among patients with SRDs; finally, 'study design' integrated cross-sectional, cohort or case-control studies. The first author provided input as needed and resolved disagreement about included papers. Papers were analyzed fully, considering the study inclusion criteria based on PECOs. Qualitative studies, secondary studies not written in English, studies which did not include primary data, systematic reviews, and meta-analysis studies were excluded. Quantitative papers with high heterogeneity compared to other studies prior to the analysis (e.g., studies reporting very high/low odds ratio with a wide/narrow confidence interval compared to other studies) or outcome variations from the considered groups were also excluded (e.g., frequent use of acute care services which was not a binary assessment or where hospitalization was not the same as acute care services).

## Data extraction procedure

Two researchers independently reviewed and evaluated the selected papers following a standardized data collection checklist. Data extraction and management were performed utilizing *Microsoft Excel* software. The individual researchers selected the studies in a two-phase monitoring procedure. Initially, the duplicated titles/abstracts (89% agreement) meeting the Newcastle-Ottawa Scale (NOS) criteria mentioned below were removed. Next, the papers' titles/abstracts were screened for full-text review based on the inclusion criteria of the study (96% agreement). The required data were extracted from the selected papers. The following information was systematically documented: the first author's surname, the date of publication, socio-demographics (e.g., gender, ethnicity, education levels, having medical insurance) and clinical determinants (e.g., chronic physical illnesses and having MHDs) including type of drug (e.g.,

alcohol, other drug, heroin and opioid use disorder). Determinants that were not analyzed in at least two studies were not included because a minimum of two studies is needed as being sufficient to be considered in a meta-analysis (Ryan, 2016).

#### Quality assessment of the studies

The NOS (Stang, 2010) was implemented to examine the quality of the reviewed studies (**Supplementary File 2**) in terms of exposure, outcome, and comparability with a scale comprising very good, good, satisfactory, and unsatisfactory quality domains. The NOS consists of three domains of (i) selection (three items for cross-sectional studies; four items for cohort studies), (ii) comparability (one item for both cross sectional studies and cohort studies), and (iii) exposure/outcome (one item for cross-sectional studies and three items for cohort studies). The agreement levels were rated as poor (0), slight (01–0.02), fair (0.021–0.04), moderate (0.041–0.06), substantial (0.061–0.08), and almost perfect (0.081–1.00) (Landis et al., 1977). Ten studies had a high quality structure approach (Adam et al., 2020; Binswanger et al., 2008; Campbell et al., 2017; Choi et al., 2018; Hansagi et al., 2012; Larson et al., 2006; Mejia de Grubb et al., 2020; Stein et al., 2003; Turner et al., 2003; Zhang et al., 2021)

#### Data synthesis and statistical analysis

The present systematic review and meta-analysis research was performed by generating pooled odds ratios (ORs) and the 95% confidence intervals (CIs) for determining variables associated with ED use and hospitalization among patients with SRDs. The OR was computed using a 2x2 table, and an OR of <1 demonstrated a positive correlation between ED use and hospitalization and the target characteristic. An OR of >1 (i.e., the statistical threshold for examining the correlation between the outcome and expositive variables) reflects a strong

relationship between variables and vice versa. To evaluate the lack of correlation between studies, the Q test at p < 0.05 and I<sup>2</sup> statistics (with a cutoff point of  $\geq 50\%$ ) were the most optimal choices. A 95%CI was considered for  $I^2$ . However, the negative scores were considered zero. To achieve the pooled estimation, the random-effects model was used, considering different sampling methods implemented in the studies. To assess the sources of heterogeneity, subgroup analyses were run based on year of publication of studies, country, participants' sample size, type of drugs, diagnostic criteria for SRDs and main reasons for ED use and hospitalization. Data from at least two studies were needed to explain the variable under consideration within each stratum. Sensitivity analysis was conducted using Baujat plots with a random effect model. Influential effects were detected by excluding each study from the analysis to determine their effect on the overall estimates. Egger's and Begg publication bias tests was used in graphical and statistical dimensions to identify any existing publication bias (Begg et al., 1994; Egger et al., 1997). A p-value <0.05 was considered statistically significant. Subsequently, the obtained data were illustrated in forest plots. The R version 3.5.1 with the "meta" package was utilized to perform the meta-analysis of the collected data (Viechtbauer, 2010).

#### Results

#### Study characteristics

After a detailed assessment of over 14,348 papers, a total of 32 studies were included in the present study (Adam et al., 2020; Ayangbayi et al., 2017; Binswanger et al., 2008; Campbell et al., 2017; Cederbaum et al., 2014; Chen et al., 2015; Choi et al., 2016; Choi et al., 2018; Clark et al., 2013; Di Giovanni et al., 2020; Frank et al., 2015; Hansagi et al., 2012; Indig et al., 2010; John et al., 2017; Knowlton et al., 2005; Laine et al., 2001; Larson et al., 2006; Manuel et al., 2017; McDonald et al., 2011; Mejia de Grubb et al., 2020; Palepu et al., 1999; Parthasarathy et al., 2005; Page 11 of 115

Perron et al., 2011; Reddon et al., 2021; Rockett et al., 2005; Siegal et al., 2006; Stein et al., 2003; Turner et al., 2003; Van Doren et al., 2016; Walley et al., 2012; Wu et al., 2012; Zhang et al., 2021). The main exclusion criteria were studies that did not assess ED use or hospitalization and those that did not assess associated variables. The study selection process is illustrated in **Figure** .

## Figure 1 here

Selected studies were from three WHO regions: America (n=26, with 133,177,907 participants]. Europe (n=4, with 45.138 participants), and the Western Pacific Region (n=2, with 246,764 participants). The USA had the highest number of studies (n=24, including 133,175,588 participants). All studies were conducted within high-income countries. The lowest baseline sample size was 211 participants (Binswanger et al., 2008) and the largest was 118,000,000 (Mejia de Grubb et al., 2020) participants. The lowest response rate was 38% and the highest was 100%. Most studies (69%) were published between 2010 to 2021. Half of the studies had cohort designs and half of them had cross-sectional designs. On average, patients were more likely to be male in the studies (62.96%), varying from 44% to 87%, and were 38.8 years old. Seven studies assessed both ED use and hospitalization using administrative data (Campbell et al., 2017; Cederbaum et al., 2014; Palepu et al., 1999; Parthasarathy et al., 2005; Turner et al., 2003) or self-report survey (Rockett et al., 2005). Sixteen studies assessed ED use and nine studies assessed hospitalization only using administrative data, self-report survey or both. One-quarter of the studies reported drug use (25%) as main reason for ED use and hospitalization. Fourteen studies (44%) used the International Classification of Diseases diagnostic criteria for assessing SRDs. According to type of drug use, 22 studies polysubstance use, four cannabis use, two studies examined cocaine and heroin use, two others alcohol use, and one study cocaine use, and another one heroin use disorders.

Among the 32 studies that were included in the final meta-analysis, the following variables were reported: sociodemographic variables in 17 studies, clinical variables in 21 studies, including type of drug in 11 studies (**Table 1**).

#### Table 1 here

Pooled prevalence rate of ED use and hospitalization among patients with SRDs

The pooled prevalence rate of ED use and hospitalization among patients with SRDs were

36% (95% CI, 26%-46%) (Figure 2) and 41% (95% CI, 21%-61%) (Figure 3) respectively.

# Figures 2 and 3 here

Sociodemographic characteristics associated with ED use and hospitalization among patients with SRDs

In seven studies out of the 32 (Ayangbayi et al., 2017; Choi et al., 2018; Frank et al., 2015; Knowlton et al., 2005; Larson et al., 2006; Rockett et al., 2005; Zhang et al., 2021) and two studies out of 32 (Mejia de Grubb et al., 2020; Rockett et al., 2005), those who had medical insurance were 1.36 and 1.63 times more likely to report ED use or hospitalization compared to those with no medical insurance respectively (OR=1.36, 95%CI=1.05-1.74) (OR=1.63, 95%CI=1.61-1.65). In three studies out of 32 (Cederbaum et al., 2014; Chen et al., 2015; Wu et al., 2012), patients with SRDs who had a lower level of education were 1.23 times more likely to report ED use compared to those who had a high level of education (OR=1.23, 95%CI=1.03-1.48) (**Figures 4, 5**).

#### Figures 4 and 5 here

Type of drug associated with ED use and hospitalization among patients with SRDs

In four studies out of 32 (Cederbaum et al., 2014; Frank et al., 2015; John et al., 2017; Manuel et al., 2017) and four studies out of 32 (Cederbaum et al., 2014; Chen et al., 2015; Choi et al., 2016; John et al., 2017) patients with SRDs who had other drug use disorders (e.g., methamphetamine, cocaine ) were 1.55 and 2.33 times more likely to use ED or to be hospitalized compared to those who used heroin only respectively (OR=1.55, 95%CI=1.49-1.60) (OR=2.33, 95%CI=1.30-4.21). In two studies out of 32 (Frank et al., 2015; John et al., 2017) and three studies (Choi et al., 2016; John et al., 2017; Laine et al., 2001), patients with SRDs who had alcohol use disorders were 1.12 and 1.55 times more likely to use ED or to be hospitalized compared to those who used cannabis respectively (OR=1.12, 95%CI=1.01-1.25) (OR=1.55, 95%CI=1.18-2.05) (Figures 6, 7).

Other clinical characteristics associated with ED use and hospitalization among patients with SRDs

In eleven studies out of 32 (Adam et al., 2020; Campbell et al., 2017; Cederbaum et al., 2014; Choi et al., 2018; Clark et al., 2013; Frank et al., 2015; Indig et al., 2010; John et al., 2017; Parthasarathy et al., 2005; Perron et al., 2011; Turner et al., 2003) and eight studies out of 32 (Campbell et al., 2017; Cederbaum et al., 2014; Choi et al., 2016; Di Giovanni et al., 2020; Laine et al., 2001; Parthasarathy et al., 2005; Reddon et al., 2021; Turner et al., 2003) patients who had MHDs were 1.54 and 1.40 times more likely to report ED use and hospitalization compared to those who did not have MHDs respectively (OR = 1.54, 95%CI = 1.20-1.98) (OR = 1.40, 95%CI = 1.07-1.83). In seven studies out of 32 (Campbell et al., 2017; Cederbaum et al., 2014; Choi et al., 2018; Larson et al., 2006; Parthasarathy et al., 2005; Siegal et al., 2006; Turner et al., 2003) and nine studies out of 32 (Binswanger et al., 2008; Campbell et al., 2017; Cederbaum et al., 2014; Laine et al., 2001; Mejia de Grubb et al., 2020; Parthasarathy et al., 2005; Stein et al

2003; Turner et al., 2003; Walley et al., 2012) those who had chronic physical illnesses were 1.33 and 1.30 times more likely to have ED use or hospitalization compared to those who did not have chronic physical illnesses respectively (OR=1.33, 95%CI=1.15-1.54) (OR=1.30, 95%CI=1.15-1.47) (**Figures 6, 7**).

### Figures 6, 7 here

#### Subgroup analyses

In the present study, several subgroup analyses were performed to investigate the main source of heterogeneity on pooled prevalence rates of ED use and hospitalization. Subgroup analyses were based on year of study publication, country, participants' sample size, type of drugs, diagnostic criteria for SRDs, and main reasons for ED use and hospitalization were run. However, no heterogeneity was detected regarding any of these variables (**Supplementary Files 3–14**).

#### Sensitivity analysis

Sensitivity analysis and Baujat plots were performed to assess influential effects. Effects on the right-hand side indicate studies with more heterogeneity. The studies that had the most contributions to the heterogeneity were removed following the sensitivity analysis. Although selectivity analysis was performed for each variable which had high heterogeneity, the sensitivity analysis did not decrease the heterogeneity between studies for some of the variables (e.g., being male, alcohol use disorder, MHDs, chronic physical illnesses) (Supplementary Files 15–38).

#### **Publication bias**

To identify probable publication bias, the Egger's and Begg's tests and their graphical representation were performed. Considering the symmetry assumption, no significant publication

bias was observed in the reviewed studies selected for inclusion. As regards to the funnel plot, the paper distribution was not oriented in any specific direction, and for most of them, it was identical, confirming no publication biases in the present study (Supplementary Files 39–50).

## Discussion

The present meta-analysis identified sociodemographic, types of drug and other clinical characteristics associated with ED use and hospitalization among patients with SRDs. Patients with SRDs who were the most at risk of being both ED users and hospitalized were those (i) having insurance, (ii) having other drugs and alcohol use disorders, (iii) having MHDs, and (iv) having chronic physical illnesses. The pooled prevalence rates of ED use and hospitalization in the present study were 36% and 41%, respectively. No pooled prevalence rate for ED use and hospitalization have previously been reported in relation to patients with SRDs.

The finding that patients with SRDs who have medical insurance were more likely to use ED or be hospitalized were found in previous studies (Cronquist et al., 2001; Rockett et al., 2003). A possible explanation for this results could be the fact that having medical insurance may increase access to health care (Card et al., 2008) and may increase use of ED and hospitalization (Zhou et al., 2017). That patients with lower educational were showed to use more ED is inconsistent with previous studies (Cederbaum et al., 2014; Chen et al., 2015). The admission rate was higher among patients with SRDs who have primary education attainment, compared to their counterparts who completed high school. This may be because patients with SRDs who had lower levels of education had also low economic status and lived in deprived areas, therefore they may have more complex conditions and need to use ED.

In line with previous studies, there was an association between alcohol and other drug use disorders and an enhanced risk for ED use and hospitalization among patients with SRDs (Armoon, Grenier, et al., 2021; Fleury et al., 2022). The studies highlighted that the main abused substances among patients with SRDs included alcohol (Wu et al., 2012) and cannabis (Campbell et al., 2017). The odds of requiring acute medical care services are higher in this population (Matson et al., 2020; Phillips et al., 2022). Consistent with the findings of research on early hospital readmission (Armoon, Grenier, et al., 2021), it was found that patients with alcohol use disorders accounted for a large proportion of total cases of ED use and hospitalization, in comparison to other SRD groups. This finding could be understood in the context of the increased odds of experiencing chronic physical illnesses, such as liver diseases and cardiovascular disease (Cargiulo, 2007), a higher proneness to healthcare seeking, and episodes of alcohol withdrawal (Gupta et al., 2019) among alcohol use disorders patients, compared to patients with other SRD groups (Weisner et al., 2001).

Previous studies reported the association between ED use or hospitalization and having other drug use disorders (e.g., methamphetamine and cocaine) compared to those who used heroin only (Hendrickson et al., 2008; Marshall et al., 2012) which may be due to the serious negative effects of other drug use disorders such as methamphetamine on psychological functioning, which explains ED use (Sommers et al., 2006). ED use may be justified by the lack of availability of other outpatient services or adequate outpatient treatments for patients with SRDs who use methamphetamine (Hendrickson et al., 2008). Studies have reported a significant association of the odds of ED use or hospitalization with cocaine use (Miró et al., 2019; Sanvisens et al., 2021). A study reported a 18% readmission rate of ED user among cocaine users (Sanvisens et al., 2021), which may demonstrate the association of cocaine use and intense complications (Butler et al., 2017; Degenhardt et al., 2011). Also cocaine users may have higher risk of non-fatal and fatal

overdose comparing to none cocaine users (Armoon, Mohammadi, et al., 2021; Armoon et al., 2022). Moreover, recreational cocaine use may cause accidents or misbehaviors that augment the likelihood of ED use (Fulde et al., 2015). Although, health care systems may screen and treat chronic medical conditions, more of these services may be required for patients with alcohol/other drug use disorders (Suen et al., 2022). Due to the lack of information for clinicians and limited capacity of inpatient health providers pharmacotherapies for alcohol/other drug use disorders and referrals to specialty substance use treatment on discharge are not vastly practiced (Naeger et al., 2016; Rosenthal et al., 2016)

Our results supported previous findings indicating that the rate of using ED and hospitalization were significant among patients with SRDs who had MHDs (Armoon, Grenier, et al., 2021; Huynh et al., 2016; Vu et al., 2015). Moreover, this group tends to seek limited outpatient healthcare settings, attributable to their lack of or minimal tendency to adhere to medical care (Brorson et al., 2013; Coulson et al., 2009), explaining their high acute care use. The limitations of the availability of specialty treatment may also have led to high ED use and hospitalization (McCormack et al., 2015). The misunderstanding and negative attitudes toward patients with SRDs among some physicians may prevent them to identify SRDs as a conditions requiring outpatient treatment which justified ED use and hospitalization (Gilchrist et al., 2011; van Boekel et al., 2014). These patients searching care specially in ED have been reported rarely referred to specialists for treatment (Bogenschutz et al., 2014). In addition, individuals with SRDs and co-occurring MHDs or chronic physical disorders are more likely to have ED use since their complex conditions may not be properly managed in an outpatient health center (Huynh et al., 2016). Also, individuals with co-occurring SRDs and MHDs may search treatment for each of their condition

separately since healthcare systems usually do not provide suitable integrated care (Lavergne et al., 2022).

Previous study reported that the rate of hospitalization was 58% among SRD patients with comorbid chronic physical illnesses (Binswanger et al., 2008). Additionally, the risk of experiencing co-occurring physical illnesses, including hypertension, diabetes, infective endocarditis, and cardiovascular disease has been found to be greater among those with SRDs, leading to increased rates of ED use and hospitalization (Binswanger et al., 2008; Rudasill et al., 2019; Stein et al., 2003).

## Limitations and strengths of the present study

This study has some limitations that should be acknowledged. First, some of the included studies utilized self-report survey to collect data. This data was thus subject to memory recall bias and social desirability bias. Second, some of the reviewed studies were based on cross-sectional research design, preventing the determination of causal and temporal correlations between the studied characteristics and acute care-seeking. Third, given the inclusion and exclusion criteria, there were no data concerning other essential features (e.g., primary care services use, non-fatal overdose, the duration of injection, the prevalence of cannabis use disorders, and employment status) that could have potentially impacted ED use and hospitalization. Fourth, there were limitations in the number of studies specifically examining a particular characteristic.

Sociodemographic characteristics associated with ED use or hospitalization were considered in 10 studies (31%), including four studies (12%) for being male, four (12%) and two studies (6%) for being of black ethnicity, seven (20%) and two (15%) studies for having health insurance, and four studies (12%) for lower educational level associated with ED use. Therefore,

among sociodemographic characteristics there was high heterogeneity and the associations may be weak. There were also only a small number of studies considering sociodemographic characteristics, therefore the results should be interpreted with caution. Regarding type of drug use associated with ED use or hospitalization, there were four studies (12%) and four studies (12%) for other drug use disorders, and two studies (6%) and three studies (9%) for alcohol use disorder respectively. Therefore, among type of drug use, high heterogeneity was observed, which also means that careful interpretation of the results is needed. Regarding clinical characteristics associated with ED use or hospitalization, there were eleven (34%) and nine studies (28%) for MHDs, and seven (22%) and nine studies (28%) for chronic physical illnesses, respectively. High heterogeneity was therefore observed among these variables, and the associations may be weak. Furthermore, due to low number of studies regarding clinical characteristics, caution must be taken when interpreting the results.

Finally, analysis indicated that the heterogeneity between studies was high in almost all variables. Several sensitivity analyses (e.g., year of study publication, country, participants' sample size, type of drugs, diagnostic criteria for SRDs) were tested but no sources of heterogeneity were found. However, the present study had a number of strengths, including the inclusion of a range of ED use and hospitalization associated variables. Additionally, major databases were searched, and the study employed a comprehensive search strategy. Moreover, the study reviewed a considerable number of papers meeting the inclusion/exclusion criteria which was a major advantage of the systematic review.

## Conclusion

The findings showed that key sociodemographic and clinical characteristics including type of drug use were associated with ED use or hospitalization, the most important having other drugs and alcohol use disorders and having a MHD. Also, the frequency of ED use and hospitalization was greater among patients with co-occurring SRDs, MHDs, and chronic medical conditions. To improve treatment compliance and minimize ED use and hospitalization, implementation of comprehensive healthcare services is recommended comprising integrated SRD-MHD treatment and assertive community treatment for patients with SRDs. Interventions including addiction consultation services in hospitals, training ED and hospital providers to consider pharmacotherapy for alcohol/other drug use disorders for patient treatments, and supporting these patients via social services and referring them to specialty care after discharge are recommended. A useful plan to reinforce chronic care in this population, especially among lower-educated patients, could provide information on the available outreach interventions after discharge from acute care units or hospitals. Essentially, outpatient healthcare access can be facilitated by implementing outreach programs tailored to patients with SRDs who have a lower level of education or low socioeconomic Perez status.

#### Abbreviations

CI: Confidence interval

ED: Emergency department

NOS: Newcastle-Ottawa Scale

OR: Odds ratio

PECOS: Population, exposures, comparison, outcome, and study design

PRISMA: Protocols of systematic reviews and meta-analyses

SRDs: Substance-related disorders

MHDs: Mental health disorders

WHO: World Health Organization

## Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

References

Adam, A., Faouzi, M., McNeely, J., Yersin, B., Daeppen, J.-B., & Bertholet, N. (2020). Further utilization of emergency department and inpatient psychiatric services among young adults admitted at the emergency department with clinical alcohol intoxication. *Journal* of Addiction Medicine, 14(1), 32-38. doi: 10.1097/ADM.00000000000529

Armoon, B., Grenier, G., Cao, Z., Huỳnh, C., & Fleury, M.-J. (2021). Frequencies of emergency department use and hospitalization comparing patients with different types of substance or polysubstance-related disorders. *Substance Abuse Treatment, Prevention, and Policy, 16*(1), 89. doi: 10.1186/s13011-021-00421-7

Armoon, B., Mohammadi, R., Fattah Moghaddam, L., & Gonabadi-Nezhad, L. (2021). Type of drug use and risky determinants associated with fatal overdose among people who use

drugs: A meta-analysis. *Journal of Substance Use*, 1-11. doi: 10.1080/14659891.2021.2019329

Armoon, B., SoleimanvandiAzar, N., Rostami, M., Higgs, P., Bayani, A., Bayat, A.-H., Mohammadi, R., Ahounbar, E., & Fattah Moghaddam, L. (2022). Drug type and risk behaviors associated with non-fatal overdose among people who use drugs: A systematic review and meta-analysis. *Journal of Addictive Diseases, 40*(1), 114-125. doi: 10.1080/10550887.2021.1950262

Ayangbayi, T., Okunade, A., Karakus, M., & Nianogo, T. (2017). Characteristics of hospital emergency room visits for mental and substance use disorders. *Psychiatric Services*, 68(4), 408-410. doi: 10.1176/appi.ps.201600125

Begg, C. B., & Mazumdar, M. (1994). Operating characteristics of a rank correlation test for publication bias. *Biometrics*, 50(4), 1088-1101. doi: 10.2307/2533446

Binswanger, I. A., Takahashi, T. A., Bradley, K., Dellit, T. H., Benton, K. L., & Merrill, J. O. (2008). Drug users seeking emergency care for soft tissue infection at high risk for subsequent hospitalization and death. *Journal of Studies on Alcohol and Drugs*, 69(6), 924-932. doi: 10.15288/jsad.2008.69.924

Bogenschutz, M. P., Donovan, D. M., Mandler, R. N., Perl, H. I., Forcehimes, A. A., Crandall,C., Lindblad, R., Oden, N. L., Sharma, G., Metsch, L., Lyons, M. S., McCormack, R.,Macias-Konstantopoulos, W., & Douaihy, A. (2014). Brief intervention for patients with

problematic drug use presenting in emergency departments: A randomized clinical trial. *JAMA Internal Medicine*, *174*(11), 1736-1745. doi: 10.1001/jamainternmed.2014.4052

Brorson, H. H., Ajo Arnevik, E., Rand-Hendriksen, K., & Duckert, F. (2013). Drop-out from addiction treatment: A systematic review of risk factors. *Clinical Psychology Review*, 33(8), 1010-1024. doi: 10.1016/j.cpr.2013.07.007

Butler, A. J., Rehm, J., & Fischer, B. (2017). Health outcomes associated with crack-cocaine use: Systematic review and meta-analyses. *Drug and Alcohol Dependence*, 180, 401-416. doi: https://doi.org/10.1016/j.drugalcdep.2017.08.036

Campbell, C. I., Bahorik, A. L., Kline-Simon, A. H., & Satre, D. D. (2017). The role of marijuana use disorder in predicting emergency department and inpatient encounters: A retrospective cohort study. *Drug and Alcohol Dependence*, *178*, 170-175. doi: 10.1016/j.drugalcdep.2017.04.017

 Card, D., Dobkin, C., & Maestas, N. (2008). The impact of nearly universal insurance coverage on health care utilization: Evidence from medicare. *American Economic Review*, 98(5), 2242-2258. doi: 10.1257/aer.98.5.2242

Cargiulo, T. (2007). Understanding the health impact of alcohol dependence. *American Journal* of *Health-System Pharmacy*, 64(5 Suppl 3), S5-11. doi: 10.2146/ajhp060647

- Cederbaum, J. A., Guerrero, E. G., Mitchell, K. R., & Kim, T. (2014). Utilization of emergency and hospital services among individuals in substance abuse treatment. *Substance Abuse Treatment, Prevention, and Policy*, 9(1), 1-5. doi: 10.1186/1747-597X-9-16
- Chen, I.-M., Huang, C. L.-C., Yeh, B.-J., & Chien, Y.-L. (2015). Health service utilization of heroin abusers: A retrospective cohort study. *Addictive Behaviors*, 45, 281-286. doi: 10.1016/j.addbeh.2015.01.042
- Choi, B. Y., DiNitto, D. M., Marti, C. N., & Choi, N. G. (2016). Impact of mental health and substance use disorders on emergency department visit outcomes for HIV patients. *Western Journal of Emergency Medicine*, *17*(2), 153-164. doi: 10.5811/westjem.2016.1.28310
- Choi, N. G., Marti, C. N., DiNitto, D. M., & Choi, B. Y. (2018). Older adults' marijuana use, injuries, and emergency department visits. *American Journal of Drug and Alcohol Abuse*, 44(2), 215-223. doi: 10.1080/00952990.2017.1318891
- Clark, B. J., Keniston, A., Douglas, I. S., Beresford, T., Macht, M., Williams, A., Jones, J., Burnham, E. L., & Moss, M. (2013). Healthcare utilization in medical intensive care unit survivors with alcohol withdrawal. *Alcoholism: Clinical and Experimental Research*, 37(9), 1536-1543. doi: 10.1111/acer.12124
- Coulson, C., Ng, F., Geertsema, M., Dodd, S., & Berk, M. (2009). Client-reported reasons for non-engagement in drug and alcohol treatment. *Drug and Alcohol Review*, 28(4), 372-378. doi: 10.1111/j.1465-3362.2009.00054.x

Cronquist, A., Edwards, V., Galea, S., Latka, M., & Vlahov, D. (2001). Health care utilization among young adult injection drug users in Harlem, New York. *Journal of Substance Abuse*, 13(1-2), 17-27. doi: 10.1016/s0899-3289(01)00073-6

Degenhardt, L., Singleton, J., Calabria, B., McLaren, J., Kerr, T., Mehta, S., Kirk, G., & Hall, W.
D. (2011). Mortality among cocaine users: A systematic review of cohort studies. *Drug* and Alcohol Dependence, 113(2), 88-95. doi: https://doi.org/10.1016/j.drugalcdep.2010.07.026

Di Giovanni, P., Di Martino, G., Zecca, I., Porfilio, I., Romano, F., & Staniscia, T. (2020). Trend in hospital admissions of drug addicts and associated factors from 2006 to 2015: An observational study on the hospitals' discharge registries from a region of central Italy. *Annali di Igiene: Medicina Preventiva e di Comunita, 32*(4), 376-384. doi: 10.7416/ai.2020.2361

Egger, M., Smith, G. D., Schneider, M., & Minder, C. (1997). Bias in meta-analysis detected by a simple, graphical test. *BMJ*, *315*(7109), 629-634. doi: 10.1136/bmj.315.7109.629

Fleury, M.-J., Cao, Z., Grenier, G., & Huỳnh, C. (2022). Predictors of frequent emergency department use and hospitalization among patients with substance-related disorders recruited in addiction treatment centers. *International Journal of Environmental Research* and Public Health, 19(11), 6607. doi:10.3390/ijerph19116607 Fleury, M.-J., Fortin, M., Rochette, L., Grenier, G., Huỳnh, C., Pelletier, É., & Vasiliadis, H.-M. (2019). Assessing quality indicators related to mental health emergency room utilization. BMC Emergency Medicine, 19(1), 8. doi: 10.1186/s12873-019-0223-8

Frank, J. W., Binswanger, I. A., Calcaterra, S. L., Brenner, L. A., & Levy, C. (2015). Nonmedical use of prescription pain medications and increased emergency department utilization: Results of a national survey. *Drug and Alcohol Dependence*, 157, 150-157. doi: 10.1016/j.drugalcdep.2015.10.027

Fulde, G. W. O., & Forster, S. L. (2015). The impact of amphetamine-type stimulants on emergency services. *Current Opinion in Psychiatry*, 28(4), 275-279. doi: 10.1097/yco.00000000000171

Galarraga, J. E., & Pines, J. M. (2016). Costs of ED episodes of care in the United States. *American Journal of Emergency Medicine*, 34(3), 357-365. doi: 10.1016/j.ajem.2015.06.001

Gilchrist, G., Moskalewicz, J., Slezakova, S., Okruhlica, L., Torrens, M., Vajd, R., & Baldacchino, A. (2011). Staff regard towards working with substance users: A European multi-centre study. *Addiction*, *106*(6), 1114-1125. doi: https://doi.org/10.1111/j.1360-0443.2011.03407.x

Gupta, N. M., Lindenauer, P. K., Yu, P.-C., Imrey, P. B., Haessler, S., Deshpande, A., Higgins, T. L., & Rothberg, M. B. (2019). Association between alcohol use disorders and

outcomes of patients hospitalized with community-acquired pneumonia. *JAMA Network Open, 2*(6), e195172-e195172. doi: 10.1001/jamanetworkopen.2019.5172

Hansagi, H., Engdahl, B., & Romelsjö, A. (2012). Predictors of repeated emergency department visits among persons treated for addiction. *European Addiction Research*, 18(2), 47-53. doi: 10.1159/000331016

Hendrickson, R. G., Cloutier, R., & John McConnell, K. (2008). Methamphetamine-related emergency department utilization and cost. *Academic Emergency Medicine*, 15(1), 23-31. doi: https://doi.org/10.1111/j.1553-2712.2007.00006.x

Huynh, C., Ferland, F., Blanchette-Martin, N., Ménard, J. M., & Fleury, M. J. (2016). Factors influencing the frequency of emergency department utilization by individuals with substance use disorders. *Psychiatric Quarterly*, 87(4), 713-728. doi: 10.1007/s11126-016-9422-6

Indig, D., Copeland, J., Conigrave, K. M., & Arcuri, A. (2010). Characteristics and comorbidity of drug and alcohol-related emergency department presentations detected by nursing triage text. *Addiction*, 105(5), 897-906. doi: 10.1111/j.1360-0443.2009.02857.x

John, W. S., & Wu, L.-T. (2017). Problem alcohol use and healthcare utilization among persons with cannabis use disorder in the United States. *Drug and Alcohol Dependence*, 178, 477-484. doi: 10.1016/j.drugalcdep.2017.05.035

Knowlton, A., Hua, W., & Latkin, C. (2005). Social support networks and medical service use among HIV-positive injection drug users: Implications to intervention. *AIDS Care*, 17(4), 479-492. doi: 10.1080/0954012051233131314349

Laine, C., Hauck, W. W., Gourevitch, M. N., Rothman, J., Cohen, A., & Turner, B. J. (2001).
 Regular outpatient medical and drug abuse care and subsequent hospitalization of persons who use illicit drugs. *JAMA*, 285(18), 2355-2362. doi: 10.1001/jama.285.18.2355

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, 159-174. doi: 10.2307/2529310

Larson, M. J., Saitz, R., Horton, N. J., Lloyd-Travaglini, C., & Samet, J. H. (2006). Emergency department and hospital utilization among alcohol and drug-dependent detoxification patients without primary medical care. *American Journal of Drug and Alcohol Abuse*, 32(3), 435-452. doi: 10.1080/00952990600753958

Lavergne, M. R., Shirmaleki, M., Loyal, J. P., Jones, W., Nicholls, T. L., Schütz, C. G., Vaughan, A., Samji, H., Puyat, J. H., Kaoser, R., Kaulius, M., & Small, W. (2022).
Emergency department use for mental and substance use disorders: Descriptive analysis of population-based, linked administrative data in British Columbia, Canada. *BMJ Open*, *12*(1), e057072. doi: 10.1136/bmjopen-2021-057072

Lewer, D., Freer, J., King, E., Larney, S., Degenhardt, L., Tweed, E. J., Hope, V. D., Harris, M., Millar, T., Hayward, A., Ciccarone, D., & Morley, K. I. (2020). Frequency of health-care

utilization by adults who use illicit drugs: A systematic review and meta-analysis. *Addiction*, *115*(6), 1011-1023. doi: 10.1111/add.14892

Manuel, J. I., & Lee, J. (2017). Gender differences in discharge dispositions of emergency department visits involving drug misuse and abuse-2004-2011. Substance Abuse Treatment, Prevention, and Policy, 12(1), 1-12. doi: 10.1186/s13011-017-0114-5

Marshall, B. D. L., Grafstein, E., Buxton, J. A., Qi, J., Wood, E., Shoveller, J. A., & Kerr, T. (2012). Frequent methamphetamine injection predicts emergency department utilization among street-involved youth. *Public Health*, *126*(1), 47-53. doi: https://doi.org/10.1016/j.puhe.2011.09.011

Matson, T. E., Lapham, G. T., Bobb, J. F., Johnson, E., Richards, J. E., Lee, A. K., Bradley, K. A., & Glass, J. E. (2020). Cannabis use, other drug use, and risk of subsequent acute care in primary care patients. *Drug and Alcohol Dependence*, *216*, 108227. doi: 10.1016/j.drugalcdep.2020.108227

McCormack, R. P., Gallagher, T., Goldfrank, L. R., & Caplan, A. L. (2015). Including frequent emergency department users with severe alcohol use disorders in research: Assessing capacity. *Annals of Emergency Medicine*, 65(2), 172-177.e171. doi: 10.1016/j.annemergmed.2014.09.027

McDonald, S. A., Hutchinson, S. J., Bird, S. M., Robertson, C., Mills, P. R., Dillon, J. F., & Goldberg, D. J. (2011). Hospitalisation for an alcohol-related cause among injecting drug

users in Scotland: Increased risk following diagnosis with hepatitis C infection. *International Journal of Drug Policy*, *22*(1), 63-69. doi: 10.1016/j.drugpo.2010.04.003

Mejia de Grubb, M. C., Salemi, J. L., Gonzalez, S. J., Chima, C. C., Kowalchuk, A. A., & Zoorob, R. J. (2020). Opioid, cocaine, and amphetamine use disorders are associated with higher 30-day inpatient readmission rates in the United States. *Substance Abuse, 41*(3), 365-374. doi: 10.1080/08897077.2019.1635964

Miró, Ò., Dargan, P. I., Wood, D. M., Dines, A. M., Yates, C., Heyerdahl, F., Hovda, K. E., Giraudon, I., & Galicia, M. (2019). Epidemiology, clinical features and management of patients presenting to European emergency departments with acute cocaine toxicity: Comparison between powder cocaine and crack cocaine cases. *Clinical Toxicology*, *57*(8), 718-726. doi: 10.1080/15563650.2018.1549735

Naeger, S., Mutter, R., Ali, M. M., Mark, T., & Hughey, L. (2016). Post-discharge treatment engagement among patients with an opioid-use disorder. *Journal of Substance Abuse Treatment, 69*, 64-71. doi: 10.1016/j.jsat.2016.07.004

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., McGuinness, L. A., Stewart, L. A., Thomas, J., Tricco, A. C., Welch, V. A., Whiting, P., & Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, *372*, n71. doi: 10.1136/bmj.n71

- Palepu, A., Strathdee, S. A., Hogg, R. S., Anis, A. H., Rae, S., Cornelisse, P. G., Patrick, D. M.,
  O'Shaughnessy, M. V., & Schechter, M. T. (1999). The social determinants of emergency department and hospital use by injection drug users in Canada. *Journal of Urban Health*, *76*(4), 409-418. doi: 10.1007/BF02351499
  - Parthasarathy, S., & Weisner, C. M. (2005). Five-year trajectories of health care utilization and cost in a drug and alcohol treatment sample. *Drug and Alcohol Dependence*, 80(2), 231-240. doi: 10.1016/j.drugalcdep.2005.04.004
  - Perron, B. E., Bohnert, A. S. B., Monsell, S. E., Vaughn, M. G., Epperson, M., & Howard, M. O. (2011). Patterns and correlates of drug-related ED visits: Results from a national survey. *American Journal of Emergency Medicine*, 29(7), 704-710. doi: 10.1016/j.ajem.2010.01.044
  - Phillips, K. T., Pedula, K. L., Choi, N. G., Tawara, K.-A. K., Simiola, V., Satre, D. D., Owen-Smith, A., Lynch, F. F., & Dickerson, J. (2022). Chronic health conditions, acute health events, and healthcare utilization among adults over age 50 in Hawai'i who use cannabis: A matched cohort study. *Drug and Alcohol Dependence, 234*, 109387. doi: 10.1016/j.drugalcdep.2022.109387
- Reddon, H., Milloy, M.-J., Wood, E., Nosova, E., Kerr, T., & DeBeck, K. (2021). High-intensity cannabis use and hospitalization: A prospective cohort study of street-involved youth in Vancouver, Canada. *Harm Reduction Journal*, 18(1), 1-10. doi: 10.1186/s12954-021-00501-8

- Rhee, T. G., & Rosenheck, R. A. (2019). Association of current and past opioid use disorders with health-related quality of life and employment among US adults. *Drug and Alcohol Dependence, 199*, 122-128. doi: 10.1016/j.drugalcdep.2019.03.004
- Rockett, I. R., Putnam, S. L., Jia, H., Chang, C. F., & Smith, G. S. (2005). Unmet substance abuse treatment need, health services utilization, and cost: A population-based emergency department study. *Annals of Emergency Medicine*, 45(2), 118-127. doi: 10.1016/j.annemergmed.2004.08.003
- Rockett, I. R., Putnam, S. L., Jia, H., & Smith, G. S. (2003). Assessing substance abuse treatment need: A statewide hospital emergency department study. *Annals of Emergency Medicine*, 41(6), 802-813. doi: 10.1067/mem.2003.189
- Rosenthal, E. S., Karchmer, A. W., Theisen-Toupal, J., Castillo, R. A., & Rowley, C. F. (2016).
   Suboptimal addiction interventions for patients hospitalized with injection drug useassociated infective endocarditis. *American Journal of Medicine*, *129*(5), 481-485. doi: 10.1016/j.amjmed.2015.09.024
- Rudasill, S. E., Sanaiha, Y., Mardock, A. L., Khoury, H., Xing, H., Antonios, J. W., McKinnell, J. A., & Benharash, P. (2019). Clinical outcomes of infective endocarditis in injection drug users. *Journal of the American College of Cardiology*, *73*(5), 559-570. doi: 10.1016/j.jacc.2018.10.082

Ryan, R. (2016). Cochrane Consumers and Communication Group reviews: Meta-analysis Cochrane Handbook for Systematic Reviews of Interventions; Cochrane Consumers and Communication: Melbourne, Australia. Available at: <u>http://cccrg.cochrane.org</u>.

Sanvisens, A., Hernández-Rubio, A., Zuluaga, P., Fuster, D., Papaseit, E., Galan, S., Farré, M., & Muga, R. (2021). Long-term outcomes of patients with cocaine use disorder: A 18-years addiction cohort study. *Frontiers in Pharmacology*, *12*(111), 625610. doi: 10.3389/fphar.2021.625610

Siegal, H. A., Falck, R. S., Wang, J., Carlson, R. G., & Massimino, K. P. (2006). Emergency department utilization by crack-cocaine smokers in Dayton, Ohio. *American Journal of Drug and Alcohol Abuse*, 32(1), 55-68. doi: 10.1080/00952990500328737

Sommers, I., Baskin, D., & Baskin-Sommers, A. (2006). Methamphetamine use among young adults: Health and social consequences. *Addictive Behaviors*, 31(8), 1469-1476. doi: https://doi.org/10.1016/j.addbeh.2005.10.004

Sørup, C. M., Jacobsen, P., & Forberg, J. L. (2013). Evaluation of emergency department performance - a systematic review on recommended performance and quality-in-care measures. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine, 21*, 62. doi: 10.1186/1757-7241-21-62

Stang, A. (2010). Critical evaluation of the Newcastle-Ottawa scale for the assessment of the quality of nonrandomized studies in meta-analyses. *European Journal of Epidemiology*, 25(9), 603-605. doi: 10.1007/s10654-010-9491-z Stein, M. D., & Anderson, B. (2003). Injection frequency mediates health service use among persons with a history of drug injection. *Drug and Alcohol Dependence*, *70*(2), 159-168. doi: 10.1016/s0376-8716(02)00344-7

Substance Abuse and Mental Health Services Administration. (2018). Key substance use and mental health indicators in the United States: Results from the 2017 National Survey on Drug Use and Health. Available at https://www.samhsa.gov/data/sites/default/files/cbhsq-reports/NSDUHFFR2017/NSDUHFFR2017.pdf.

Suen, L. W., Makam, A. N., Snyder, H. R., Repplinger, D., Kushel, M. B., Martin, M., & Nguyen, O. K. (2022). National prevalence of alcohol and other substance use disorders among emergency department visits and hospitalizations: NHAMCS 2014-2018. *Journal* of General Internal Medicine, 37(10), 2420–2428. doi: 10.1007/s11606-021-07069-w

Turner, B. J., Laine, C., Yang, C. P., & Hauck, W. W. (2003). Effects of long-term, medically supervised, drug-free treatment and methadone maintenance treatment on drug users' emergency department use and hospitalization. *Clinical Infectious Diseases, 37* (Suppl 5), S457-463. doi: 10.1086/377558

van Boekel, L. C., Brouwers, E. P. M., van Weeghel, J., & Garretsen, H. F. L. (2014). Healthcare professionals' regard towards working with patients with substance use disorders:
Comparison of primary care, general psychiatry and specialist addiction services. *Drug*

*and Alcohol Dependence, 134*, 92-98. doi: https://doi.org/10.1016/j.drugalcdep.2013.09.012

Van Doren, B. A., Grimsley, K. G., Noone, J. M., & Neese, J. B. (2016). Mental health and substance misuse-related emergency department discharges in urban counties of North Carolina. North Carolina Medical Journal, 77(1), 63-68. doi: 10.18043/ncm.77.1.63

Viechtbauer, W. (2010). Conducting meta-analyses in R with the metafor package. *Journal of Statistical Software*, *36*(3), 1-48. doi: 10.18637/jss.v036.i03

Vu, F., Daeppen, J. B., Hugli, O., Iglesias, K., Stucki, S., Paroz, S., Canepa Allen, M., & Bodenmann, P. (2015). Screening of mental health and substance users in frequent users of a general Swiss emergency department. *BMC Emergency Medicine*, 15, 27. doi: 10.1186/s12873-015-0053-2

Walley, A. Y., Cheng, D. M., Pierce, C. E., Chen, C., Filippell, T., Samet, J. H., & Alford, D. P. (2012). Methadone dose, take home status and hospital admission among methadone maintenance patients. *Journal of Addiction Medicine*, 6(3), 186-190. doi: 10.1097/ADM.0b013e3182584772

Weisner, C., Mertens, J., Tam, T., & Moore, C. (2001). Factors affecting the initiation of substance abuse treatment in managed care. *Addiction*, *96*(5), 705-716. doi: 10.1046/j.1360-0443.2001.9657056.x

Wu, L.-T., Swartz, M. S., Wu, Z., Mannelli, P., Yang, C., & Blazer, D. G. (2012). Alcohol and drug use disorders among adults in emergency department settings in the United States. *Annals of Emergency Medicine*, 60(2), 172-180. e175. doi: 10.1016/j.annemergmed.2012.02.003

Zhang, X., Wang, N., Hou, F., Ali, Y., Dora-Laskey, A., Dahlem, C. H., & McCabe, S. E. (2021). Emergency department visits by patients with substance use disorder in the United States. *Western Journal of Emergency Medicine*, 22(5), 1076. doi: 10.5811/westjem.2021.3.50839

Zhou, R. A., Baicker, K., Taubman, S., & Finkelstein, A. N. (2017). The uninsured do not use the emergency department more—they use other care less. *Health Affairs*, 36(12), 2115-2122. doi: 10.1377/hlthaff.2017.0218

Perez

Tables and figure legends:

**Table 1.** Studies characteristics on emergency department (ED) use and hospitalization among

 patients with substance-related disorders

Figure 1. PRISMA flow diagram

**Figure 2.** The pooled prevalence rate of emergency department use among substance-related disorders.
Figure 3. The pooled prevalence rate of hospitalization among substance-related disorders.

**Figure 4.** Pooled odds ratio of sociodemographic characteristics associated with emergency department use among substance-related disorders.

**Figure 5.** Pooled odds ratio of sociodemographic characteristics associated with hospitalization among substance-related disorders.

**Figure 6.** Pooled odds ratio of type of drug and clinical determinants associated with emergency department use among substance-related disorders.

**Figure 7.** Pooled odds ratio of type of drug and clinical determinants associated with hospitalization among substance-related disorders.

Supplementary File 1. Search strategy

Supplementary File 2. Risk of bias assessment using the Newcastle-Ottawa Scale

**Supplementary File 3.** Subgroup analysis based on year of publication of studies for the pooled prevalence rate of emergency department use among substance-related disorders.

**Supplementary File 4.** Subgroup analysis based on year of publication of studies for the pooled prevalence rate of hospitalization among substance-related disorders.

**Supplementary File 5.** Subgroup analysis based on country for the pooled prevalence rate of emergency department use among substance-related disorders.

**Supplementary File 6.** Subgroup analysis based on country for the pooled prevalence rate of hospitalization among substance-related disorders.

**Supplementary File 7.** Subgroup analysis based on participants' sample size for the pooled prevalence rate of emergency department use among substance-related disorders.

**Supplementary File 8.** Subgroup analysis based on participants' sample size for the pooled prevalence rate of hospitalization among substance-related disorders.

**Supplementary File 9.** Subgroup analysis based on type of drugs for the pooled prevalence rate of emergency department use among substance-related disorders.

**Supplementary File 10.** Subgroup analysis based on type of drugs for the pooled prevalence rate of hospitalization among substance-related disorders.

**Supplementary File 11.** Subgroup analysis based on diagnostic criteria used for SRD for the pooled prevalence rate of emergency department use among substance-related disorders.

**Supplementary File 12.** Subgroup analysis based on diagnostic criteria used for SRD for the pooled prevalence rate of hospitalization among substance-related disorders.

**Supplementary File 13.** Subgroup analysis based on main reason for the pooled prevalence rate of emergency department use among substance-related disorders.

**Supplementary File 14.** Subgroup analysis based on main reason for the pooled prevalence rate of hospitalization among substance-related disorders.

**Supplementary File 15.** Baujat plot for being male associated with emergency department use. Effects on the right part indicated studies contribute much to the heterogeneity

**Supplementary File 16.** Pooled odds ratio of being male associated with emergency department use after removing Zhang et al (2020) and Cederbaum et al (2014) (studies that had the most contribution of heterogeneity)

**Supplementary File 17.** Baujat plot for being male associated with hospitalization. Effects on the right part indicated studies contribute much to the heterogeneity

**Supplementary File 18.** Pooled odds ratio of being male associated with hospitalization after removing McDonald et al., 2011 (study that had the most contribution of heterogeneity)

**Supplementary File 19.** Baujat plot for being Black ethnicity associated with emergency department use. Effects on the right part indicated studies contribute much to the heterogeneity

**Supplementary File 20.** Pooled odds ratio of being Black ethnicity associated with emergency department use after removing Frank et al (2015) (study that had the most contribution of heterogeneity)

**Supplementary File 21.** Baujat plot for lower educational level associated with emergency department use. Effects on the right part indicated studies contribute much to the heterogeneity

**Supplementary File 22.** Pooled odds ratio of lower educational level associated with emergency department use after removing Wu et al (2012) (study that had the most contribution of heterogeneity)

**Supplementary File 23.** Baujat plot for having insurance associated with emergency department use. Effects on the right part indicated studies contribute much to the heterogeneity

**Supplementary File 24.** Pooled odds ratio of having insurance associated with emergency department use after removing Knowlton et al (2005), Ayangbayi et al (2017) and Frank et al (2015) (studies that had the most contribution of heterogeneity)

Supplementary File 25. Baujat plot for having other drug use disorders associated with emergency department use. Effects on the right part indicated studies contribute much to the heterogeneity Supplementary File 26. Pooled odds ratio of having other drug use disorders associated with

emergency department use after removing Frank et al (2015) (study that had the most contribution of heterogeneity)

Supplementary File 27. Baujat plot for having other drug use disorders associated with hospitalization. Effects on the right part indicated studies contribute much to the heterogeneity

Supplementary File 28. Pooled odds ratio of having other drug use disorders associated with hospitalization after removing Cederbaum et al., 2014 (study that had the most contribution of heterogeneity)

Supplementary File 29. Baujat plot for having alcohol use disorders associated with hospitalization. Effects on the right part indicated studies contribute much to the heterogeneity

Supplementary File 30. Pooled odds ratio of having alcohol use disorders associated with hospitalization after removing Lain et al., 2001 (study that had the most contribution of heterogeneity)

Supplementary File 31. Baujat plot for having mental health disorders associated with emergency department use. Effects on the right part indicated studies contribute much to the heterogeneity

Supplementary File 32. Pooled odds ratio of having mental health disorders associated with emergency department use after removing Cederbaum et al (2014) (study that had the most contribution of heterogeneity)

**Supplementary File 33.** Baujat plot for having mental health disorders associated with hospitalization. Effects on the right part indicated studies contribute much to the heterogeneity

**Supplementary File 34.** Pooled odds ratio of having mental health disorders associated with hospitalization after removing Cederbaum et al., 2014 (study that had the most contribution of heterogeneity)

**Supplementary File 35.** Baujat plot for having chronic physical illnesses associated with emergency department use. Effects on the right part indicated studies contribute much to the heterogeneity

**Supplementary File 36.** Pooled odds ratio of having chronic physical illnesses associated with emergency department use after removing Choi et al (2017) (study that had the most contribution of heterogeneity)

**Supplementary File 37.** Baujat plot for having chronic physical illnesses associated with hospitalization. Effects on the right part indicated studies contribute much to the heterogeneity

**Supplementary File 38.** Pooled odds ratio of having chronic physical illnesses associated with hospitalization after removing Mejia de Grubb et al., 2020 (study that had the most contribution of heterogeneity)

Supplementary File 39. Publication bias for being male associated with emergency department use

**Supplementary File 40.** Publication bias for being Black ethnicity associated with emergency department use

**Supplementary File 41.** Publication bias for having lower educational level associated with emergency department use

**Supplementary File 42.** Publication bias for having insurance associated with emergency department use

**Supplementary File 43.** Publication bias for having other drug use disorders associated with emergency department use

Supplementary File 44. Publication bias for having mental disorders associated with emergency department use

Supplementary File 45. Publication bias for having chronic physical illnesses associated with emergency department use

Supplementary File 46. Publication bias for being male associated with hospitalization

**Supplementary File 47.** Publication bias for having other drug use disorders associated with hospitalization

**Supplementary File 48.** Publication bias for having alcohol use disorders associated with hospitalization

**Supplementary File 49.** Publication bias for having mental disorders associated with hospitalization

**Supplementary File 50.** Publication bias for having chronic physical illnesses associated with hospitalization

to per perien

# Figure 1: PRISMA flow diagram





Journal of Psychiatric and Mental Health Nursing





60

1					
2	Study	Odds Ratio	OR	95%-CI	Weight
4	-				•
5	Being Men				
6 7	Zhang et al., 2020	+	1.79	[1.66; 1.94]	10.3%
8	John & Wu, 2017	+	0.77	[0.69; 0.85]	10.2%
9	Campbell et al., 2017	+	0.95	[0.92; 0.98]	10.4%
10	Van Doren et al., 2016	+	1.20	[1.10; 1.30]	10.3%
11	Frank et al., 2015	+	1.18	[1.14; 1.23]	10.4%
12	Cederbaum et al., 2014	+	0.77	[0.73; 0.81]	4.3%
13	Wu et al., 2012	+	1.99	[1.78; 2.22]	10.3%
14	Wu et al., 2012		1.38	[1.17; 1.63]	10.1%
16	Siegal et al., 2006		0.79	[0.63; 1.00]	9.8%
17	Palepu et al.,1999		1.45	[1.11; 1.89]	9.0%
18	Random effects model	•	1.16	[0.94: 1.44]	100.0%
19	Heterogeneity: $I^2 = 98\%$ . $p < 0.01$				
20					
21	Black ethnicity	s			
23	Campbell et al., 2017		0.94	$[0.92 \cdot 0.96]$	25.5%
24	Avangbavi et al 2017		0.67	[0.57; 0.78]	24.0%
25	Frank et al. 2015		1 45	[1 39 1 51]	24.070
26	Cederbaum et al 2014		0.85	[0.79.0.91]	25.4%
2/	Random effects model		0.00	[0.75, 0.51]	100.0%
20 29	Heterogeneity: $l^2 = 90\%$ , $n < 0.01$		0.34	[0.03, 1.23]	100.070
30	Therefore the second s				
31	lower aduacation				
32	Chop of al. 2015		1 1 1	[1 06. 1 05]	16.0%
33	Codorbaum at al. 2014		1.44	[1.00, 1.93]	25 50/
34 35	Wu at al. 2012		1.01	[1.00, 1.02]	00.070/ 06.70/
36			1.24	[1.07, 1.44]	20.7 %
37	Wu et al., 2012 Bandom offecto model		1.44	[1.19, 1.74]	23.9%
38	Random effects model		1.23	[1.03; 1.40]	100.0%
39	Heterogeneity: $T = 88\%$ , $p < 0.01$				
40					
41	Having insurance	_	4 40	14 0 4 4 501	47.00/
43	Zhang et al., 2020	+	1.40	[1.24; 1.58]	17.0%
44			1.59	[1.36; 1.86]	16.6%
45	Ayangbayi et al., 2017	<b>—</b>	1.66	[1.45; 1.90]	16.9%
46	Frank et al., 2015	•	1.18	[1.10; 1.26]	17.5%
4/	Larson et al., 2009		1.80	[1.06; 3.05]	10.0%
49	Rockett et al., 2005		1.66	[1.25; 2.20]	14.5%
50	Knowlton et al., 2005		0.36	[0.18; 0.72]	7.5%
51	Random effects model	<b>•</b>	1.36	[1.05; 1.74]	100.0%
52	Heterogeneity: $I^2 = 87\%$ , $p < 0.01$				
53 54					
54 55					
56					
57		0.1 0.2 0.5 1 2 5 2	0		
58					



2 3	Study	Odds Ratio OR	95%–CI	Weight
4 5 6 7 8 9 10	<b>Opioid use disorder</b> Mejia de Grubb et al., 2020 Di Giovanni., 2020 <b>Random effects model</b> Heterogeneity: $I^2 = 34\%$ , $p = 0.22$	1.19 1.78 1.27	[1.18; 1.20] [0.94; 3.39] [0.95; 1.71]	83.2% 16.8% 100.0%
11 12 13 14 15 16 17 18 19	Other drug use disorders John & Wu, 2017 Choi et al., 2016 Cederbaum et al., 2014 Chen et al., 2013 Random effects model Heterogeneity: $l^2 = 99\%$ , $p < 0.01$	+ 1.81 + 4.15 + 1.22 3.63 - 2.33	[1.44; 2.28] [3.94; 4.37] [1.04; 1.43] [1.73; 7.63] [1.30; 4.21]	26.4% 27.5% 27.0% 19.1% 100.0%
20 21 22 23 24 25 26 27 28	Alcohol use disorders John & Wu, 2017 Choi et al., 2016 Lain et al., 2001 Random effects model Heterogeneity: $I^2 = 96\%$ , $p < 0.01$	+ 1.40 + 2.00 + 1.30 • 1.55	[1.07; 1.83] [1.87; 2.14] [1.19; 1.43] [1.18; 2.05]	27.8% 36.4% 35.8% 100.0%
29 30 31 32 33 34 35 36 37 38 39 40 41 42	Mental disorders Reddon et al., 2021 Di Giovanni., 2020 Campbell et al., 2017 Choi et al., 2016 Choi et al., 2016 Cederbaum et al., 2014 Parthasarathy et al., 2005 Turner et al., 2003 Lain et al., 2001 Random effects model	+ 1.74 1.90 + 1.22 + 1.26 + 2.21 0.62 2.98 + 1.33 + 1.31 + 1.40	[1.38; 2.20] [1.16; 3.11] [1.15; 1.29] [1.17; 1.35] [2.05; 2.38] [0.57; 0.67] [1.11; 8.01] [1.27; 1.39] [1.25; 1.37] [1.07; 1.83]	11.5% 8.8% 12.5% 12.5% 12.5% 12.4% 4.7% 12.5% 12.5% 100.0%
43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 50	Heterogeneity: $l^2 = 98\%$ , $p < 0.01$ <b>Chronic physical illnesses</b> Mejia de Grubb et al., 2020 Campbell et al., 2017 Cederbaum et al., 2014 Walley et al., 2012 Binswanger et al., 2008 Parthasarathy et al., 2008 Parthasarathy et al., 2005 Turner et al., 2003 Stein & Anderson, 2003 Lain et al., 2001 <b>Random effects model</b> Heterogeneity: $l^2 = 100\%$ , $p = 0$	1.51 1.12 1.07 1.07 2.41 1.49 2.55 1.23 1.67 1.20 1.30	[1.50; 1.52] [1.10; 1.14] [1.07; 1.08] [1.20; 4.84] [1.12; 1.99] [1.08; 6.04] [1.10; 1.37] [1.12; 2.49] [1.10; 1.31] [1.15; 1.47]	16.9% 16.8% 16.9% 2.6% 8.7% 1.8% 14.8% 6.0% 15.5% <b>100.0%</b>
60		0.1 0.2 0.5 1 2 5 20		

	Author (year of pu ED use and hospital	Years (y.) of data co (number	Sample at baseline	Final sample size ( 1	Country	Study Design	Diagnostic criteria l related disorders	Mean age (in years)	Male %	Female %	Type of drug use	Reason for ED use : hospitalization		Percentage of ED us hospitalization	Soc dete	iodem ermin	ograp ants	hic	Тур	e of d	rug		Clinic detern nts	al nina
	blication) ization studies	llections		esponse rates)	$\sim$	4	or substance-					ind		e/	Being men	Black ethnicity	Lower level of education	Having insurance	Heroin use disorders	Alcohol use disorders	Other drug use disorders	Opioid use disorders	Mental disorders	Chronic physical illnesses
ED use studies (n=16)	Zhang et al. (2020)	2016- 17 (2 y.)	27609	27609 (100%)	USA	CSª	ICD-10- CM °	46.5	44	56	Polysubstance use	Any reason	11.9	-	*			*						
	Adam et al. (2019)	2006- 07 and 2013 (3 y.)	778	630 (81%)	Swazilan d	CH	ICD-10 <sup>d</sup>	24	66	34	Alcohol use	Any reason	60	-									*	
	Manuel and Lee (2017)	2004- 11 (8 y.)	14245776	14245776 (100%)	USA	CH <sup>b</sup>	ICD-9 °	36.5	58	42	Polysubstance use	Substa nce use	NA	-							*			
	Choi et al. (2017)	2012- 13 (2 y.)	14715	14715 (100%)	USA	CSª	DSM-5 f	63	47	53	Cannabis use	Any reason	30.9	-				*					*	*
	Ayangbayi et al. (2017)	2005- 2011 (7 y.)	193526	193526 (100%)	USA	CSª	CDC/NC HS <sup>g</sup>	39.9	NR	NR	Polysubstance use	Any reason	NA	-		*		*						
	Van Doren et al. (2016)	2010 (1 y.)	24667	24667 (100%)	USA	CS <sup>a</sup>	ICD-9- CM <sup>h</sup>	38.1	51	49	Polysubstance use	Any reason	24.3	-	*									
	Frank et al. (2015)	2008- 13 (6 y.)	228556	228556 (100%)	USA	CSª	DSM-IV	34	56	44	Polysubstance use	Any reason	NA	-	*	*		*		*	*		*	
	Chen et al.(2015)	2007- 08 (2 y.)	789	789 (100%)	Taiwan	CH b	DSM-IV	34.7	87	13	Heroin use	Any reason	19.5	-			*				*			
	Clark et al. (2013)	2005- 10 (6 y.)	1802	1178 (65%)	USA	CH b	ICD-9- CM <sup>h</sup>	47	82	18	Alcohol use	Any reason	38	-									*	
	Wu et al. (2012)	2007- 09 (3 y.)	113673	113673 (100%)	USA	CH b	DSM-IV	41.5	45	55	Polysubstance use	Any reason	27.8	-	*		*							
	Perron et al. (2011)	2011 (1 y.)	43093	43093 (100%)	USA	CS <sup>a</sup>	DSM-IV i	36.5	61	39	Polysubstance use	Any reason	3.7	-									*	
	Hansagi et al. (2011)	2000- 02 (3 y.)	1287	1287 (100%)	Sweden	CH b	ICD-10 <sup>d</sup>	50	72	28	Polysubstance use	Substa nce use	21	-					*					
	Indig et al. (2009)	2004- 06 (3 y.)	263937	245975 (82%)	Australia	CSª	ICD-9 °	32.8	51	49	Polysubstance use	Any reason	NA	-									*	

Table 1: Studies characteristics concerning emergency department (ED) use and hospitalization among patients with substance-related disorders

#### Journal of Psychiatric and Mental Health Nursing

	Larson et al. (2009)	1997- 99 (3 y.)	642	470 (73%)	USA	CSª	NR	35.8	75	25	Polysubstance use	Any reason	47	-				*						*
-	Siegal et al. (2006)	1996- 97 (2 y)	333	333 (100%)	USA	CSª	ICD-9- CM <sup>h</sup>	31	59	41	Cocaine use	Any reason	67.52	-	*									*
-	Knowlton et al. (2005)	1994- 96 (3 y.)	295	295 (100%)	USA	CSª	NR	43	66	34	Polysubstance use	Injecti on drug user	14	-				*						
Hospitalizat ion studies (n=9)	Reddon et al. (2021)	2005- 15 (11 y.)	1216	1216 (100%)	Canada	СН ь	NR	21.8	69	31	Cannabis use	Canna bis use	-	NA									*	
	Di Giovanni et al. (2020)	2006- 15 (10 y)	2159	2159 (100%)	Italy	CSª	NR	38	80	20	Polysubstance use	Any reason	-	NA								*	*	
-	Mejia de Grubb et al. (2020)	2010- 14 (5 y)	118000000	11800000 0 (100%)	USA	CH b	ICD-9- CM <sup>h</sup>	49	57	43	Polysubstance use	Any reason	-	NA				*				*		*
-	Choi et al. (2016)	2012 (1 y.)	115656	115656 (100%)	USA	CS <sup>a</sup>	ICD-9- CM <sup>h</sup>	57.6	67	33	Polysubstance use	HIV infecti on	-	NA						*	*		*	
-	Walley et al. (2012)	2006- 2008 (3 y.)	365	138 (38%)	USA	CSª	NR	47.8	65	35	Polysubstance use	Metha done use	-	58										*
-	McDonald et al. (2011)	1995- 2006 (12 y.)	41062	41062 (100%)	UK	CH <sup>b</sup>	ICD-9 °	26.8	71	29	Polysubstance use	Alcoh ol use reason	-	8.1	*									
	Binswanger et al. (2008)	2004- 2008 (5 y.)	211	156 (74%)	USA	Ь	AUDIT- C and ASI <sup>j</sup>	42	63	37	Polysubstance use	Soft tissue infecti on	-	55										*
-	Stein & Anderson (2003)	2001- 2002 (2 y.)	472	472 (100%)	USA	CH b	DSM-III <sup>k</sup>	37	61	39	Heroin and cocaine	Any reason	-	13.4										*
-	Laine et al. (2001)	1996- 97 (2 y.)	58248	58248 (100%)	USA	CH b	ICD-9 °	27.5	58	42	Polysubstance use	Illicit drug	-	NA						*			*	*
ED use and hospitalizat ion (n=7)	John and Wu (2017)	2005- 13 (9 y.)	16757	16757 (100%)	USA	CSª	DSM-IV i	31	67	33	Cannabis use	Any reason	40.15	10.04	*					*	*		*	
-	Campbell et al. (2017)	2010- 14 (5 y.)	2752	2757 (100%)	USA	CH <sup>b</sup>	ICD-9 °	36.4	64	36	Cannabis use	Any reason	87	76	*	*							*	*
-	Cederbaum et al. (2014)	2006- 09 (4 y.)	73251	73251 (100%)	USA	CSª	NR	39.8	65	35	Polysubstance use	Any reason	NA	NA	*	*	*		*		*		*	*
-	Rockett et al. (2005)	1996- 97 (2 y.)	1890	1502 (79%)	USA	CSª	DSM-IV i	41.5	56	44	Polysubstance use	Any reason	NA	NA				*						
	Parthasarathy and Weisner et al. (2005)	1994- 96 (3 y.)	1204	1204 (100%)	USA	CH <sup>b</sup>	DSM-IV i	38.4	NR	NR	Polysubstance use	Drug use reason	27.89	15.84									*	*
	Turner et al. (2003)	1996- 97 (2 y.)	11556	11556 (100%)	USA	CH b	ICD-9- CM <sup>h</sup>	NR	NR	NR	Polysubstance use	HIV infecti on	47.1	93.1									*	*
-	Palepu et al.	2001 (1	1103	1103	Canada	СН	NR	35	65	35	Heroin and	Any	45	21	*									



- \*Variables that are included in the meta-analysis.
- <sup>a</sup> Cross-sectional study
- <sup>b</sup> Cohort study

- <sup>c</sup> International Classification of Diseases, Tenth Revision Clinical Modification
- <sup>d</sup> International Classification of Diseases, Tenth Revision
- <sup>e</sup> International Classification of Diseases, Ninth Revision
- <sup>f</sup> Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition
- <sup>g</sup> The Centers for Disease Control and Prevention's National Center for Health Statistics
- <sup>h</sup> International Classification of Diseases, Ninth Revision Clinical Modification
- <sup>i</sup> Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition
- <sup>j</sup> Alcohol Use Disorders Identification Test-consumption and Addiction Severity Index
- <sup>k</sup> Diagnostic and Statistical Manual of Mental Disorders, Third Edition

## Supplementary File 1: Search strategy

#27 (((( OR (H Acce Terms])) F "accessilpractition (Ho use[Ti use[Ti use[Ti inject Related (opioid (Morphin)Pubmed#26 (((( OR (H Acce Terms])) F "accessil practition	(((((Ambulatory Care[MeSH Terms]) OR (Inpatients[MeSH Terms])) Health Services Administration[MeSH Terms])) OR (Health Services essibility[MeSH Terms])) OR (Emergency Medical Services[MeSH ) OR (Emergency Service, Hospital[MeSH Terms])) OR (("access"[All Fields] OR "accessed"[All Fields] OR "accesses"[All Fields] OR bilities"[All Fields] OR "accessibility"[All Fields] OR "accessible"[All Fields] OR "accessing"[All Fields]) AND "to general oner"[Title/Abstract])) OR (General Practitioners[MeSH Terms])) OR spitalization[MeSH Terms])) AND (((((((((((((((((((((((((((((((((((
#25 drug[Ti use]' (PWID[7 cocain metham (Morphin (Injectin OR (op	<ul> <li>'ields] OR "accessed"[All Fields] OR "accesses"[All Fields] OR</li> <li>bilities"[All Fields] OR "accessibility"[All Fields] OR "accessible"[All Fields] OR "accessing"[All Fields]) AND "to general</li> <li>oner"[Title/Abstract])) OR (General Practitioners[MeSH Terms])) OR (Hospitalization[MeSH Terms])</li> <li>5 ((((((((((((((((((((((((((((((((((((</li></ul>
OR (op	vioid injection[Title/Abstract])) OR (Ativan Injection[Title/Abstract])) OR (benzodiazepine injection[Title/Abstract])
	#24 Hospitalization[MeSH Terms]
	#22 Compared Dresstition and [NA-OIL Townson]
	#23 General Practitioners[MeSH Terms]
	#23 General Practitioners[MeSH Terms]
	#23 General Practitioners[MeSH Terms]

	#21 Emergency Medical Services[MeSH Terms]
	#20 Health Services Accessibility[MeSH Terms]
	#19 Health Services Administration[MeSH Terms]
	#18 Inpatients[MeSH Terms]
	#17 Ambulatory Care[MeSH Terms]
	#16 benzodiazepine injection[Title/Abstract]
	#15 Ativan Injection[Title/Abstract]
	#14 Injecting Heroin[Title/Abstract]
	#13 opioid injection[Title/Abstract]
	#12 Morphine injection[Title/Abstract]
	#11 injecting heroin[Title/Abstract]
	#10 inject methamphetamine[Title/Abstract]
	#9 injecting cocaine[Title/Abstract]
	#8 Substance Abuse, Intravenous[MeSH Terms]
	#7 Substance-Related Disorders[MeSH Terms]
	#6 PWID[Title/Abstract]
	#5 People who inject drugs[Title/Abstract]
	#4 inject drug use[Title/Abstract]
	#3 injected drug use[Title/Abstract]
	#2 injection drug[Title/Abstract]
	#1 Injecting drug use[Title/Abstract]
	#1 TITLE-ABS-KEY ( injecting AND drug AND use )
	#2 TITLE-ABS-KEY ( injection AND drug )
	#3 TITLE-ABS-KEY ( injected AND drug AND use )
	#4 TITLE-ABS-KEY ( inject AND drug AND use )
	#5 TITLE-ABS-KEY (people AND who AND inject AND drugs)
	#6 TITLE-ABS-KEY ( pwid )
	#7 TITLE-ABS-KEY (substance-related AND disorders)
	#8 TITLE-ABS-KEY ( substance AND abuse, AND intravenous )
	#9 TITLE-ABS-KEY (injecting AND cocaine)
	#10 TITLE-ABS-KEY ( inject AND methamphetamine )
	#11 TITLE-ABS-KEY (injecting AND heroin)
G	#12 TITLE-ABS-KEY (morphine AND injection)
Scopus	#13 TITLE-ABS-KEY (opioid AND injection)
	#14 TITLE-ABS-KEY (injecting AND heroin)
	#15 TITLE-ABS-KEY ( ativan AND injection )
	#16 TITLE-ABS-KEY (benzodiazepine AND injection)
	#17 TITLE-ABS-KEY ( ambulatory AND care )
	#18 TITLE-ABS-KEY (inpatients)
	#19 TITLE-ABS-KEY (health AND services AND administration)
	#20 TITLE FABS-KEY ( health AND services AND accessibility )
	#20 TITLE ABS KEY ( neuronal AND services AND decessionity ) #21 TITLE ABS-KEY ( emergency AND medical AND services )
	#21 TITLE-ABS-KEV (emergency AND service AND hospital)
	#22 TITLE-ADS-KET ( chickgency AND service, AND hospital) #23 TITLE ABS KEV ( general AND practitioners )
	#23 TITLE-ADS-KET (general AND practitioners)
	$\pm 24$ [[] $\pm ARS_K \pm V$ (hogenitalization)

	#25 #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 #26 #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 #27 #25 AND #26S
Web of Knowledge	<ul> <li>TS=( Injecting drug use OR injection drug OR injected drug use OR inject drug use OR people who inject drugs OR PWID OR Substance-Related Disorders OR Substance Abuse, Intravenous OR injecting cocaine OR inject</li> <li>methamphetamine OR injecting heroin OR Morphine injection OR opioid injection OR Ativan Injection OR benzodiazepine injection) AND TS=(</li> <li>Ambulatory Care OR Inpatients OR Health Services Administration OR Health Services Accessibility OR Emergency Medical Services OR Emergency Service, Hospital OR General Practitioners OR Hospitalization)</li> </ul>
	#1 ("injecting drug use"):ti,ab,kw
	#2 (injection drug):ti,ab,kw
	#3 (injected drug use):ti,ab,kw
	#4 (People who inject drugs):ti,ab,kw
	#5 (PWID):ti,ab,kw
	#6 MeSH descriptor: [Substance-Related Disorders] explode all trees
	#7 MeSH descriptor: [Substance Abuse, Intravenous] explode all trees
	#8 (injecting cocaine):ti,ab,kw
Cochrana	#9 (inject methamphetamine):ti,ab,kw
Coemane	#10 (injecting heroin):ti,ab,kw
	#11 (Morphine injection):ti,ab,kw
	#12 (opioid injection):ti,ab,kw
	#13 (Injecting Heroin):ti,ab,kw
	#14 (Ativan Injection):ti,ab,kw
	#15 (benzodiazepine injection):ti,ab,kw
	#16 MeSH descriptor: [Ambulatory Care] explode all trees
	#17 MeSH descriptor: [Inpatients] explode all trees
	#18 MeSH descriptor: [Outpatients] explode all trees

#19 MeSH descriptor: [Health Services Administration] explode all trees
#20 MeSH descriptor: [Health Services Accessibility] explode all trees
#21 MeSH descriptor: [Emergency Medical Services] explode all trees
#22 MeSH descriptor: [Emergency Service, Hospital] explode all trees
#23 MeSH descriptor: [General Practitioners] explode all trees
#24 MeSH descriptor: [Hospitalization] in all MeSH products
#25 #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15
#26 #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 #27 #25 AND #26

6 7 8

9 10

11

12

13 14

15

16

17 18

19

20

21 22

23

24

25 26

27

28 29

30 31

32

33

34

35 36

37

38 39

40

41

42 43

44

45

46 47

48 49

50

51

52 53

54

60

#### Study Selection Comparability Exposure/outcome Method of Quality (\*\*\*•) (\*) (\*●●) Assessment assessment \* \*• Good Reddon et al. \*\*• Newcastle-(2021)Ottawa scale adapted for cohort studies Di Giovanni \* \* \* Newcastle-Satisfactory et al. (2020) Ottawa scale adapted for crosssectional studies \*\*\*• \* Very Good Mejia de \*• Newcastle-Grubb et al. Ottawa (2020)scale adapted for cohort studies \*\*\* Very Good Zhang et al. \* \* Newcastle-(2020)Ottawa scale adapted for crosssectional studies Very Good \* \*● Adam et al. \*\*\* Newcastle-(2019)Ottawa scale adapted for cohort studies

### Supplementary File 2: Risk of bias assessment using Newcastle-Ottawa scale

Choi et al.	***	*	*	Newcastle-	Very Good
(2017)				Ottawa	
				scale	
				adapted for	
				cross-	
				sectional	
				studies	
Ayangbayi et	***		*	Newcastle-	Satisfactory
al. (2017)				Ottawa	
				scale	
				adapted for	
				cross-	
				sectional	
				studies	
John and Wu	**•	*	*•	Newcastle-	Good
(2017)				Ottawa	
				scale	
				adapted for	
				cohort	
				studies	
Campbell et	***•	*	*•	Newcastle-	Very Good
al. (2017)				Ottawa	
			· L ·	scale	
				adapted for	
				cohort	
			4	studies	
Manuel and	***•	*	*	Newcastle-	Good
Lee (2017)				Ottawa	
				scale	
				adapted for	
				cohort	
				studies	
Choi et al.	**	*	*	Newcastle-	Good
(2016)				Ottawa	
				scale	
				adapted for	
				cross-	

				sectional studies	
Van Doren et al.(2016)	*	*	*	Newcastle- Ottawa scale adapted for cross- sectional studies	Satisfactor
Frank et al. (2015)	**	<0, 2000 2000	*	Newcastle- Ottawa scale adapted for cross- sectional studies	Good
Chen et al. (2015)	**•	*	*•	Newcastle- Ottawa scale adapted for cohort studies	Good
Cederbaum et al. (2014)	**•	*	*•	Newcastle- Ottawa scale adapted for cohort studies	Good
Clark et al. (2013)	**•	*	*•	Newcastle- Ottawa scale adapted for cohort studies	Good
Walley et al. (2012)	*	*	*	Newcastle- Ottawa	Satisfactor

				scale adapted for cross- sectional studies	
Wu et al. (2012)	**•	*	*•	Newcastle- Ottawa scale adapted for cohort studies	Good
Hansagi et al. (2011)	***•	*	*•	Newcastle- Ottawa scale adapted for cohort studies	Very Good
Perron et al. (2011)	**	*	*	Newcastle- Ottawa scale adapted for cross- sectional studies	Good
McDonald et al. (2011)	**	*	**	Newcastle- Ottawa scale adapted for cohort studies	Satisfactory
Indig et al. (2009)	**	*	*	Newcastle- Ottawa scale adapted for cross- sectional studies	Good

Larson et al	***	*	*	Newcastle	Very Good
(2000)				Ottowastic-	Very Good
(2009)				Ollawa	
				scale	
				adapted for	
				cross-	
				sectional	
<u></u>				studies	
Binswanger	***•	*	*•	Newcastle-	Very Good
et al. (2008)				Ottawa	
				scale	
				adapted for	
				cohort	
				studies	
Siegal et al.	**	*	*	Newcastle-	Good
(2006)				Ottawa	
				scale	
				adapted for	
				cross-	
				sectional	
				studies	
Knowlton et	**	*	*	Newcastle-	Good
al. (2005)				Ottawa	
× ,				scale	
			<i>L</i> .	adapted for	
				cross-	
				sectional	
			4	studies	
				studies	
Doolvott of ol					Good
Rockell et al.	**•	*	*•	Newcastle-	Good
(2005)	**•	*	*•	Newcastie- Ottawa	0000
(2005)	**•	*	*	Newcastie- Ottawa scale	Good
(2005)	**•	*	*	Ottawa scale adapted for	Good
(2005)	**•	*	*	Newcastie- Ottawa scale adapted for cohort	Guod
(2005)	**	*	*	Newcastie- Ottawa scale adapted for cohort studies	Guod
Parthasarathy	**•	*	*•	Newcastle- Ottawa scale adapted for cohort studies Newcastle-	Satisfactory
Parthasarathy and Weisner	**•	*	*•	Newcastle- Ottawa scale adapted for cohort studies Newcastle- Ottawa	Satisfactory
Parthasarathy and Weisner et al. (2005)	**•	*	*•	Newcastle- Ottawa scale adapted for cohort studies Newcastle- Ottawa scale	Satisfactory

				cohort studies	
Stein &	***•	*	*•	Newcastle-	Very Goo
Anderson				Ottawa	
(2003)				scale	
				adapted for	
				cohort	
				studies	
Turner et al.	***•	*	*•	Newcastle-	Very Goo
(2003)				Ottawa	
				scale	
				adapted for	
				cohort	
				studies	
Laine et al.	**•	*	*•	Newcastle-	Good
(2001)				Ottawa	
				scale	
				adapted for	
				cohort	
				studies	
Palepu et al.	**•	*	*•	Newcastle-	Good
(1999)				Ottawa	
				scale	
				adapted for	
				cohort	
				studies	
For cross-sect	ion studies				
For cohort stu	dies				
i or conort stu	41 <b>0</b> 0				

to peer peries



Journal of Psychiatric and Mental Health Nursing





Journal of Psychiatric and Mental Health Nursing





Journal of Psychiatric and Mental Health Nursing







Study	Events	Total		P	roportion	95%-CI	Weig
DSM-IV							
Parthasarathy et al., 2005	336	1204	+		0.28	[0.25; 0.31]	5.9
Perron et al., 2011	1594	43093	•		0.04	[0.04; 0.04]	5.9
Wu et al., 2012	31601	113672	٠		0.28	[0.28; 0.28]	5.9
Chen et al., 2015	154	789			0.20	[0.17; 0.22]	5.
Choi et al., 2017	4547	14715	•		0.31	[0.30; 0.32]	5.
John & Wu, 2017	6728	16757			0.40	[0.39; 0.41]	5.
Random effects model		190230			0.25	[0.15; 0.35]	35.
Heterogeneity: $I^2 = 100\%$ , p	= 0						
ICD-9							
Turner et al., 2003	5443	11556		+	0.47	[0.46; 0.48]	5.
Siegal et al., 2006	225	333		-+-	0.68	[0.62; 0.73]	5.
Hansagi et al., 2011	270	1287	+		0.21	[0.19; 0.23]	5.
Clark et al., 2013	448	1178			0.38	[0.35; 0.41]	5.
Van Doren et al., 2016	5994	24667	•		0.24	[0.24; 0.25]	5.
Campbell et al., 2017	2394	2752			0.87	[0.86; 0.88]	5.
Adam et al., 2019	378	630		+	0.60	[0.56; 0.64]	5.
Zhang et al., 2020	3285	27609	•		0.12	[0.12; 0.12]	5.
Random effects model		70012			0.45	[0.27; 0.62]	47.
Heterogeneity: $I^2 = 100\%$ , p	= 0			4			
Others							
Palepu et al., 1999	496	1103		+	0.45	[0.42; 0.48]	5.
Knowlton et al., 2005	41	295			0.14	[0.10; 0.18]	5.
Larson et al., 2009	221	470			0.47	[0.42; 0.52]	5.
Random effects model		1868			0.35	[0.14; 0.56]	17.
Heterogeneity: $I^2 = 99\%$ , $p <$	< 0.01						
Random effects model		262110			0.36	[0.26; 0.46]	100.
Heterogeneity: $I^2 = 100\%$ . p	= 0	· · ·				-,	
Test for subgroup differences	S:	C	0.2	0.4 0.6 0.8 1			
$n^2 = 3.76$ df = 2 (n = 0.15)							


2											_	
5 4	Study	Events	Total						Prop	ortion	95%-CI	Weight
5												
6	Substance use disorders	s reason										
7	Turner et al., 2003	5443	11556			•				0.47	[0.46; 0.48]	5.9%
8	Parthasarathy et al., 2005	336	1204		-	⊢				0.28	[0.25; 0.31]	5.9%
9	Knowlton et al., 2005	41	295	. –						0.14	[0.10; 0.18]	5.9%
10	Hansagi et al., 2011	270	1287		+					0.21	[0.19: 0.23]	5.9%
11	Random effects model		14342							0.28	[0.14: 0.42]	23.5%
12	Heterogeneity: $l^2 = 100\%$ p	< 0.01				-				••	[•••••, •••• <b>-</b> ]	
14		< 0.01										
15	Any reason											
16	Polonu et al 1000	406	1102							0.45	10 12 0 191	5 Q0/
17	Siggal et al., 1999	490	222							0.45	[0.42, 0.40]	5.970 E 00/
18		220	333					_		0.00	[0.02, 0.73]	5.0%
19 20	Larson et al., 2009	221	470				_			0.47	[0.42; 0.52]	5.8%
20	Perron et al., 2011	1594	43093							0.04	[0.04; 0.04]	5.9%
21	Wu et al., 2012	31601	113672		H	' : 🔿				0.28	[0.28; 0.28]	5.9%
23	Clark et al., 2013	448	1178			- <del>**</del> /				0.38	[0.35; 0.41]	5.9%
24	Chen et al., 2015	154	789		+-					0.20	[0.17; 0.22]	5.9%
25	Van Doren et al., 2016	5994	24667		٠					0.24	[0.24; 0.25]	5.9%
26	Choi et al., 2017	4547	14715			•				0.31	[0.30; 0.32]	5.9%
27	John & Wu, 2017	6728	16757			+				0.40	[0.39; 0.41]	5.9%
28	Campbell et al., 2017	2394	2752					+		0.87	[0.86: 0.88]	5.9%
29	Adam et al., 2019	378	630							0.60	[0.56: 0.64]	5.9%
31	Zhang et al., 2020	3285	27609		1					0.12	[0.12, 0.12]	5.9%
32	Random effects model	0200	247768		-		-			0.39	[0.26: 0.51]	76.5%
33	Heterogeneity: $l^2 - 100\%$ p	- 0	241100							0.00	[0.20, 0.01]	1010/0
34	Therefogeneity. $T = 100\%$ , p	- 0										
35	Pandom offects model		262110		_					0.26	10 26. 0 461	100 00/
36	Kandoni enects model	0	202110							0.30	[0.20, 0.40]	100.0 /0
3/ 20	Heterogeneity: $I = 100\%$ , $p$	= 0			0.0	0 4	0,0	0,0				
20 20		3:		U	0.2	0.4	0.6	0.8	1			
40	$\chi_1^2$ = 1.33, df = 1 ( <i>p</i> = 0.25)											
41												

















54 55 56



Wu et al (2012) 💿

Т

 Journal of Psychiatric and Mental Health Nursing









Page 87 of 115





 Journal of Psychiatric and Mental Health Nursing





 Journal of Psychiatric and Mental Health Nursing





24 25 26









Journal of Psychiatric and Mental Health Nursing Contribution to overall heterogeneity







Page 97 of 115

 Journal of Psychiatric and Mental Health Nursing





21 22 23



```
Linear regression test of funnel plot asymmetry
Test result: t = 0.91, df = 8, p-value = 0.3915
Sample estimates:
   bias se.bias intercept se.intercept
 4.2225 4.6618 -0.0607
                          0.1474
Details:
- multiplicative residual heterogeneity variance (tau^2 = 66.3400)
- predictor: standard error
- weight: inverse variance
- reference: Egger et al. (1997), BMJ
> metabias(m10, method.bias = "Begg")
Rank correlation test of funnel plot asymmetry
Test result: z = 0.27, p-value = 0.7884
Sample estimates:
    ks se.ks
 3.0000 11.1803
- reference: Begg & Mazumdar (1993), Biometrics
```

Supplementary File 39. Publication bias for being male associated with emergency department

, perez

use

```
Linear regression test of funnel plot asymmetry
Test result: t = 0.03, df = 2, p-value = 0.9759
Sample estimates:
   bias se.bias intercept se.intercept
 0.4268 12.5272
                 0.0037
                             0.2321
Details:
- multiplicative residual heterogeneity variance (tau^2 = 192.8781)
- predictor: standard error
- weight:
             inverse variance
- reference: Egger et al. (1997), BMJ
> metabias(m100, method.bias = "Begg",k.min = 4)
Rank correlation test of funnel plot asymmetry
Test result: z = 0.00, p-value = 1.0000
Sample estimates:
 ks se.ks
0.0000 2.9439
- reference: Begg & Mazumdar (1993), Biometrics
```

Supplementary File 40. Publication bias for being Black ethnicity associated with emergency

e perez

department use

```
Linear regression test of funnel plot asymmetry
Test result: t = 6.93, df = 2, p-value = 0.0602
Sample estimates:
   bias se.bias intercept se.intercept
 2.9776 0.4298 0.0002 0.0028
Details:
- multiplicative residual heterogeneity variance (tau^2 = 0.5170)
- predictor: standard error
- weight: inverse variance
- reference: Egger et al. (1997), BMJ
> metabias(m1000, method.bias = "Begg",k.min = 4)
Rank correlation test of funnel plot asymmetry
Test result: z = 0.68, p-value = 0.4969
Sample estimates:
    ks se.ks
 2.0000 2.9439
- reference: Begg & Mazumdar (1993), Biometrics
```

Supplementary File 41. Publication bias for having lower educational level associated with

ie perez

emergency department use

```
2
3
           Linear regression test of funnel plot asymmetry
4
           Test result: t = 0.50, df = 5, p-value = 0.6393
5
6
           Sample estimates:
7
              bias se.bias intercept se.intercept
8
            0.9836 1.9731 0.2270 0.1330
9
          Details:
10
          - multiplicative residual heterogeneity variance (tau^2 = 8.6423)
11
           - predictor: standard error
12
          - weight: inverse variance
13
          - reference: Egger et al. (1997), BMJ
14
          > metabias(m10000, method.bias = "Begg",k.min = 7)
15
           Rank correlation test of funnel plot asymmetry
16
17
           Test result: z = -0.15, p-value = 0.8806
18
           Sample estimates:
19
                ks se.ks
20
            -1.0000 6.6583
21
22
           - reference: Begg & Mazumdar (1993), Biometrics
23
24
25
           Supplementary File 42. Publication bias for having insurance associated with emergency
```

department use

ie perez

```
Linear regression test of funnel plot asymmetry
Test result: t = -0.02, df = 2, p-value = 0.9861
Sample estimates:
    bias se.bias intercept se.intercept
 -0.0186 0.9480 0.4357
                             0.0358
Details:
- multiplicative residual heterogeneity variance (tau^2 = 1.0354)
- predictor: standard error
- weight:
           inverse variance
- reference: Egger et al. (1997), BMJ
> metabias(m200, method.bias = "Begg",k.min = 4)
Rank correlation test of funnel plot asymmetry
Test result: z = -0.68, p-value = 0.4969
Sample estimates:
      ks se.ks
 -2.0000 2.9439
- reference: Begg & Mazumdar (1993), Biometrics
```

Supplementary File 43. Publication bias for having other drug use disorders associated with

ee peries

emergency department use

```
Linear regression test of funnel plot asymmetry
Test result: t = 0.76, df = 9, p-value = 0.4645
Sample estimates:
   bias se.bias intercept se.intercept
 3.1956 4.1830
                 0.0785
                            0.1652
Details:
- multiplicative residual heterogeneity variance (tau^2 = 76.5875)
- predictor: standard error
- weight:
           inverse variance
- reference: Egger et al. (1997), BMJ
> metabias(m20000, method.bias = "Begg",k.min = 2)
Rank correlation test of funnel plot asymmetry
Test result: z = -0.08, p-value = 0.9379
Sample estimates:
      ks se.ks
 -1.0000 12.8452
- reference: Begg & Mazumdar (1993), Biometrics
```

Supplementary File 44. Publication bias for having mental disorders associated with emergency

PRUCZ

department use

```
Linear regression test of funnel plot asymmetry
Test result: t = 2.29, df = 5, p-value = 0.0709
Sample estimates:
   bias se.bias intercept se.intercept
 5.1517 2.2526
                 0.0601
                            0.0057
Details:
- multiplicative residual heterogeneity variance (tau^2 = 28.5523)
- predictor: standard error
- weight:
             inverse variance
- reference: Egger et al. (1997), BMJ
> metabias(m200000, method.bias = "Begg",k.min = 2)
Rank correlation test of funnel plot asymmetry
Test result: z = 0.45, p-value = 0.6523
Sample estimates:
     ks se.ks
 3.0000 6.6583
- reference: Begg & Mazumdar (1993), Biometrics
```

Supplementary File 45. Publication bias for having chronic physical illnesses associated with

Ce perez

emergency department use

```
Journal of Psychiatric and Mental Health Nursing
```

```
Linear regression test of funnel plot asymmetry
Test result: t = 0.47, df = 2, p-value = 0.6870
Sample estimates:
   bias se.bias intercept se.intercept
 2.3903 5.1289 -0.2022
                            0.2102
Details:
- multiplicative residual heterogeneity variance (tau^2 = 23.6998)
- predictor: standard error
- weight:
           inverse variance
- reference: Egger et al. (1997), BMJ
> metabias(m30, method.bias = "Begg",k.min = 2)
Rank correlation test of funnel plot asymmetry
Test result: z = 0.00, p-value = 1.0000
Sample estimates:
     ks se.ks
 0.0000 2.9439
- reference: Begg & Mazumdar (1993), Biometrics
```

Supplementary File 46. Publication bias for being male associated with hospitalization

CC PC . CC PC . C

```
Linear regression test of funnel plot asymmetry
Test result: t = -1.23, df = 2, p-value = 0.3450
Sample estimates:
    bias se.bias intercept se.intercept
 -7.7058 6.2855 1.5588
                             0.3082
Details:
- multiplicative residual heterogeneity variance (tau^2 = 68.7158)
- predictor: standard error
- weight:
           inverse variance
- reference: Egger et al. (1997), BMJ
> metabias(m400, method.bias = "Begg",k.min = 2)
Rank correlation test of funnel plot asymmetry
Test result: z = 0.00, p-value = 1.0000
Sample estimates:
     ks se.ks
 0.0000 2.9439
- reference: Begg & Mazumdar (1993), Biometrics
```

Supplementary File 47. Publication bias for having other drug use disorders associated with

Perez

hospitalization
```
Linear regression test of funnel plot asymmetry
Test result: t = -0.54, df = 1, p-value = 0.6845
Sample estimates:
    bias se.bias intercept se.intercept
 -4.9131 9.0882 0.7436
                                0.4277
Details:
- multiplicative residual heterogeneity variance (tau^2 = 44.1968)
- predictor: standard error
- weight:
            inverse variance
- reference: Egger et al. (1997), BMJ
> metabias(m4000, method.bias = "Begg",k.min = 2)
Rank correlation test of funnel plot asymmetry
Test result: z = -0.52, p-value = 0.6015
Sample estimates:
       ks se.ks
 -1.0000 1.9149
- reference: Begg & Mazumdar (1993), Biometrics
```

Supplementary File 48. Publication bias for having alcohol use disorders associated with

Ce perez

hospitalization

```
Linear regression test of funnel plot asymmetry
Test result: t = 0.17, df = 7, p-value = 0.8735
Sample estimates:
   bias se.bias intercept se.intercept
 0.9014 5.4570 0.2237
                           0.1953
Details:
- multiplicative residual heterogeneity variance (tau^2 = 75.8757)
- predictor: standard error
- weight:
           inverse variance
- reference: Egger et al. (1997), BMJ
> metabias(m40000, method.bias = "Begg",k.min = 2)
Rank correlation test of funnel plot asymmetry
Test result: z = 0.21, p-value = 0.8348
Sample estimates:
     ks se.ks
 2.0000 9.5917
- reference: Begg & Mazumdar (1993), Biometrics
```

Supplementary File 49. Publication bias for having mental disorders associated with

ce perez

hospitalization

```
Journal of Psychiatric and Mental Health Nursing
```

```
Linear regression test of funnel plot asymmetry
Test result: t = 0.67, df = 7, p-value = 0.5247
Sample estimates:
   bias se.bias intercept se.intercept
 8.8058 13.1554
                 0.1055
                            0.0513
Details:
- multiplicative residual heterogeneity variance (tau^2 = 1161.7556)
- predictor: standard error
- weight:
           inverse variance
- reference: Egger et al. (1997), BMJ
> metabias(m400000, method.bias = "Begg",k.min = 2)
Rank correlation test of funnel plot asymmetry
Test result: z = 1.67, p-value = 0.0953
Sample estimates:
      ks se.ks
 16.0000 9.5917
- reference: Begg & Mazumdar (1993), Biometrics
```

Supplementary File 50. Publication bias for having chronic physical illnesses associated with

ce perez

hospitalization



ltem #	Checklist item	Location where item is reported
1	Identify the report as a systematic review.	Page 1
2	See the PRISMA 2020 for Abstracts checklist.	Page 2
Ν		
3	Describe the rationale for the review in the context of existing knowledge.	Page 3, the first and second paragraph
4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Page 4, the third paragraph
a 5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Page 5, Eligibility criteria and PECO terms section
6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Page 5, Search strategy and selection of studies section
7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Supplementary file 1 and search strategy section on page 4
ss 8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Pages 5 and 6, Eligibility criteria and study selection and Data extraction procedure
9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process. Journal of Psychiatric and Mental Health Nursing	Pages 5 and 6, Eligibility criteria and study selection and Data
	Item #         1         2         N         3         4         4         6         /         6         /         7         ess         9	Image:



3 4 5	Section and Topic	ltem #	Checklist item	Location where item is reported
6 7	Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each	Page 5,
8 9 10 11 12 13 14	) 2 1		study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	outcome measures, definition criteria for SRD patients and ED use and hospitalization
10 17 18 19 20 21 22 23	2 2	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Page 5, outcome measures, definition criteria for SRD patients and ED use and hospitalization
24 25 26	Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Page 6, Quality assessment section
28 29 30 31	Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Page 7, Data synthesis and statistical analysis section
32 33	Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Table 1
34 35 36 37 38		13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Page 7, Data synthesis and statistical analysis section
39 40 41 42 42	) ) <u>2</u>	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Page 7, Data synthesis and statistical analysis section
44 45		13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, land software package(s) used.	Page 7, Data synthesis and
46 47	, ,			



3 4 5	Section and Topic	ltem #	Checklist item	Location where item is reported
6 7 8				statistical analysis section
9 10 11 12 13		13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Page 7, Data synthesis and statistical analysis section
14		13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Not applicable
15 16 17 18	Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	Page 6, Quality assessment section
19 20 21 22 23	Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Pages 9 and 10, Data synthesis and statistical analysis section
24	RESULTS			
23 26 27	Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Pages 7 and 8, Study characteristics
28 29 30		16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Pages 7 and 8, Study characteristics
31 32 33	Study characteristics	17	Cite each included study and present its characteristics.	Pages 7 and 8, Study characteristics
34 35	Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Supplementary file 2
36 37 38 39	Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Pages 9, 10 and 11 in Meta-analysis section
40 41 42 43	Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Pages 9, 10 and 11 in Meta-analysis section
44 45		20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Pages 9, 10 and 11 in
46 47				



3 = 4   5	Section and Topic	ltem #	Checklist item	Location where item is reported	
5 7				Meta-analysis section	
8		20c	Present results of all investigations of possible causes of heterogeneity among study results.	Figures 2-5	
9 1 ሲ		20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Not applicable	
11 12	Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Page 11, Publication bias section	
14 15	Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Figures 2-5	
16	DISCUSSION				
17	Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Pages 11-13	
18 19 20 21		23b	Discuss any limitations of the evidence included in the review.	Page 13, Strengths and limitations section	
22 23 24 25		23c	Discuss any limitations of the review processes used.	Page 13, Strengths and limitations section	
26 27 28		23d	Discuss implications of the results for practice, policy, and future research.	Page 14, Conclusions section	
29 OTHER INFORMATION					
3ф	Registration and	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Not applicable	
31	protocol	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Not applicable	
24 33	_	24c	Describe and explain any amendments to information provided at registration or in the protocol.	Not applicable	
34	Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Page 15, funding section	
36 37 38	Competing interests	26	Declare any competing interests of review authors.	Page 15, competing interests section	
39 40 41 42	Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Page 15, Availability of data	

43 *From:* Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71 45

For more natorfastor, asi not Mental Health New Providence of

- 46
- 47