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IMPACT OF THE METHAMPHETAMINE EPIDEMIC ON HEALTHCARE

ABSTRACT

Introduction: The surge in methamphetamine use in the U.S. has presented various challenges for individuals and healthcare systems. Research has shown high relapse rates, oral health issues, and increased susceptibility to blood-borne viruses among users, underscoring the gravity of the situation. Furthermore, the absence of approved pharmacological treatments and systemic barriers to effective treatment highlighted the pressing need for holistic approaches to address this epidemic successfully.

Purpose of the Study: The purpose of this research was to identify the challenges faced by treatment providers specializing in substance use disorder treatment amid rising instances of methamphetamine abuse, including managing heightened relapse rates, mitigating oral health complications, handling methamphetamine-induced psychosis, reducing susceptibility to blood-borne viruses, addressing the absence of efficacious pharmaceutical interventions, accommodating increased admissions into treatment facilities, and considering broader ramifications on healthcare systems.

Methodology: This study utilized a thorough literature review supplemented by semi-structured interviews with substance use disorder treatment providers. Relevant articles were identified through databases and websites using specific search terms. PubMed and Google Scholar were used to identify 373 total sources. These sources were reviewed and reduced to 44 sources that were used in the written research. Of these, 22 were used in the Results section.

Results: The research showed varying efficacy of pharmacological interventions, the daunting task of managing oral health complications, alarmingly high relapse rates, and the heightened susceptibility to blood-borne viruses among methamphetamine users. Treatment providers noted

systemic challenges such as patient engagement hurdles and limited treatment options. The study demonstrated a notable increase in methamphetamine use admissions and underscored the necessity for comprehensive care strategies.

Discussion/Conclusion: While the study's hypothesis remained inconclusive due to the intricate nature of methamphetamine addiction and its treatment outcomes, it was suggested evidence emerged concerning oral health complications, methamphetamine-induced psychosis, and susceptibility to blood-borne viruses among users. The identified systemic challenges emphasized the critical need for tailored interventions, standardized screening tools, and grant programs to effectively address the profound impact of the methamphetamine epidemic on healthcare systems.

Keywords: adverse effects, blood-borne viruses, hospitalizations, methamphetamine epidemic, oral health complications, treatment admissions

INTRODUCTION

The methamphetamine epidemic in the U.S. had emerged as a pressing public health concern, prompting responses and adaptations from healthcare providers (ONDCP, 2022). This urgent issue had far-reaching consequences, adversely affecting individuals and society. It has been associated with a wide range of detrimental outcomes, including immediate health risks, long-term health complications, and societal burdens (SAMHSA, 2020). Recent research conducted by Hoopsick and Yockey (2023) had underscored the severity of this crisis, revealing a 50-fold increase in methamphetamine-related mortality spanning the last two decades. Additional data demonstrated an increase in methamphetamine-related hospitalizations, rising from 59,684 in 2003 to 206,180 in 2015, with associated in-hospital mortality rates of 6.4 deaths per 1,000

hospitalizations higher compared to other causes, and total hospital costs surging from \$436 million in 2003 to \$2.17 billion in 2015 (Winkelman, et al., 2018).

Methamphetamine, commonly known as "meth," has been described as a potent stimulant associated with intense rushes of pleasure and long-lasting highs (DEA, 2022). Chronic use of methamphetamine resulted in severe mental and physical health issues, including increased wakefulness, decreased appetite, rapid breathing, irregular heartbeat, elevated blood pressure, and hyperthermia (DEA, 2022). High doses of methamphetamine have led to lethal elevations in body temperature, convulsions, cardiovascular collapse, and death, as well as severe anorexia, memory loss, dental issues, and behavioral disturbances, including violent behavior, anxiety, confusion, insomnia, psychosis, mood disturbances, and hallucinations (DEA, 2022). While methamphetamine has had limited FDA-approved medical applications, such as its prescription use under the name *Desoxyn* for conditions like attention deficit hyperactivity disorder and obesity (DEA, 2022), it has evolved into a highly abused substance (Duhownik, 2021). In 2021, the National Institute on Drug Abuse reported that approximately 2.5 million people aged 12 or older admitted to using methamphetamine in the past 12 months (NIDA, 2023).

The surge in methamphetamine abuse has been influenced by societal and economic factors, including shifts in drug trafficking patterns and increased availability of precursor chemicals. In fiscal year 2022, the U.S. Sentencing Commission documented 19,851 drug trafficking cases, with 48.8% involving methamphetamine, marking a 28.8% increase since fiscal year 2018 (USSC, 2023). U.S. Customs and Border Protection seized approximately 175,000 pounds of methamphetamine in fiscal year 2022 (CBP, 2024). The influx of precursor chemicals, primarily from China, supplying about 80% of those used in Mexican methamphetamine, fueled the epidemic (O'Connor, 2016). This shift led to transnational criminal organizations in Mexico

becoming the primary suppliers of methamphetamine to the U.S., facilitating the proliferation of high-purity drugs (NIDA, 2021). From 2011 to 2019, methamphetamine purity increased from 92% to 97%, with potency rising to approximately 98% (UNODC, 2021).

Legal countermeasures, such as the Combat Methamphetamine Epidemic Act of 2005 and state-level regulations, have been enacted to address the methamphetamine epidemic (DEA, 2020). The more recently signed Methamphetamine Response Act of 2021 designated methamphetamine as an emerging drug threat and mandated the development of a national response plan specific to methamphetamine by the Office of National Drug Control Policy (The White House, 2022).

Han et al. (2021) identified a significant surge in methamphetamine abuse prevalence, reaching 43% between 2015 and 2019. Moreover, Lewandowski et al. (2022) highlighted a concerning 61% relapse rate among individuals grappling with Methamphetamine Use Disorder within the first year of abstinence. Methamphetamine users also faced an elevated risk of contracting blood-borne viruses, with Hepatitis C infection rates ranging from 30% to 50% and HIV incidence rates two to three times higher than the general population (Salamanca et al., 2015). In a comprehensive analysis by Cai et al. (2020), which spanned five National Health and Nutrition Examination Surveys (2007-2016), rates of blood-borne virus transmission among methamphetamine users were revealed, including 8.1 per 100,000 for Hepatitis C, 6.4 per 100,000 for Hepatitis B, and 1.3 per 100,000 for HIV.

No pharmacological interventions had been approved for methamphetamine dependence, attributed to challenges in effectively managing withdrawal, maintaining abstinence, and preventing relapse (Farrell et al., 2019). The scale of the issue was concerning, as evidenced by findings from the National Survey on Drug Use and Health, which reported that approximately

1.6 million individuals were diagnosed with methamphetamine use disorder in 2021 (NIDA, 2023). This trend was further underscored by the 32,537 overdose fatalities involving psychostimulants, primarily methamphetamine, during the same year (NIDA, 2023). Jones et al. (2023) noted a significant rise in primary methamphetamine treatment admissions, with admissions increasing from 138,379 to 201,021 between 2010 and 2019.

The purpose of the study was to investigate the challenges faced by treatment providers specializing in substance use disorder treatment amid rising instances of methamphetamine abuse, including managing heightened relapse rates, mitigating oral health complications, handling methamphetamine-induced psychosis, reducing susceptibility to blood-borne viruses, addressing the absence of efficacious pharmaceutical interventions, accommodating increased admissions into treatment facilities, and considering broader ramifications on healthcare systems.

METHODOLOGY

The working hypothesis was that the prevalence of methamphetamine abuse led to challenges in patient management for substance use disorder treatment providers, including high rates of relapse, complications for oral health, methamphetamine-induced psychosis, heightened vulnerability to blood-borne viruses, lack of effective pharmaceutical interventions, and increased admissions into treatment centers, and increased negative impact on healthcare systems.

The intended methodology for this study was an extensive literature review and semi-structured interviews with substance abuse treatment professionals to gain insights into effective management strategies for methamphetamine use treatment and the impact of the Methamphetamine epidemic within U.S. healthcare systems.

Research articles and peer-reviewed literature were located using Marshall University's PubMed research database. Google Scholar was an alternative resource when the desired information was unavailable within the specified database. The search involved key terms such as 'methamphetamine epidemic' OR 'substance abuse' AND 'adverse effects' OR 'treatment admissions' OR 'hospitalizations' OR 'meth-induced psychosis' OR 'oral health complications' OR 'blood-borne viruses.' The search identified 373 relevant citations and citations were excluded (N=329) if they did not meet inclusion principles. Articles were included (N=29) if they described challenges presented by methamphetamine abuse. Articles from other sources (N=15) were also included in this search. These 44 references were subject to full-text review, and these 22 citations were included in the data abstraction and analysis. 22 references were included in the Results section. Primary and secondary sources were gathered from online articles, websites, and semi-structured interviews. A PRISMA was completed, providing an overview of the literature evaluation (Figure 1).

Following the literature review, IRB-approved face-to-face semi-structured interviews were conducted (see Appendix for semi-structured interview questions). After obtaining informed consent and Institutional Review Board approval, interviews were conducted individually with experienced substance use treatment providers: a Licensed Independent Chemical Dependency Counselor and a Nurse Practitioner specializing in addiction treatment. Interviews were not tape-recorded. Only pertinent responses were incorporated to substantiate the findings gleaned from the literature review.

To guide the exploration of methamphetamine addiction determinants, a conceptual framework from Kabisa et al. (2021) was adopted. This framework categorized determinants of methamphetamine relapsing into environmental, interpersonal, socio-demographic, intrapersonal,

and physical factors, providing a structured approach to understanding the challenges associated with managing methamphetamine addiction (Figure 2). Relevant articles were selected based on their alignment with the research objectives, and the selection process was conducted by AB, with validation by AC as a second reviewer to ensure the chosen references met inclusion criteria.

RESULTS

Relapse Rates Among Methamphetamine Users

Hill (2024) presented data indicating a relapse rate of 40% to 60% for individuals with substance use disorders, including methamphetamine addiction. Specifically, methamphetamine/crystal meth users faced a relapse rate of 52.2% (Hill, 2024). In a study by Moeeni et al. (2016), among 128 participants, 61% experienced relapse during or after treatment. Factors such as lack of family support, longer substance dependence, history of casual sex, and previous criminal offenses were associated with higher relapse risk, with rates ranging from 28% to 36% (Moeeni et al., 2016). Conversely, participating in psychotherapy treatment sessions was linked to a lower probability of relapse, with each additional psychotherapy session attended reducing the risk by 18%, indicating the effectiveness of the program in mitigating relapse rates (Moeeni et al., 2016).

Oral Health Complications Associated with Methamphetamine Abuse

Methamphetamine had exerted a corrosive influence on users' oral health. In a systematic study on the pharmacological impact of methamphetamine on oral health, data from 100 chronic methamphetamine abusers and 100 matched-pair comparison participants were examined (Rommel et al., 2016). Results showed that most methamphetamine abusers reported dry mouth (72%) and jaw clenching (68%) (Rommel et al., 2016). A 2015 study funded by the National

Institute on Drug Abuse examined 571 methamphetamine users and revealed that 96% of users had cavities, 58% of users had untreated tooth decay, and 31% of users had six or more missing teeth in comparison to non-users (ADA, 2024). However, studies have indicated that integrating dental treatment with substance use therapy has been effective in addressing the oral health challenges associated with methamphetamine use.

In a 2019 study by Hanson et al., which involved 286 patients with substance use disorders, including methamphetamine users, comprehensive oral health care interventions were provided alongside standard substance use disorder therapy. These interventions included dental procedures such as surgical extractions, periodontal treatments, restorations, crowns, endodontic procedures, and removable dentures (Hanson et al., 2019). The study revealed significant improvements in oral health outcomes among methamphetamine users, with a 62.5% reduction in the number of teeth with caries, a 45.2% decrease in the number of teeth requiring extractions, and a 36.8% decrease in the number of teeth with periodontal disease (Hanson et al., 2019).

Methamphetamine-Induced Psychosis

Methamphetamine-induced psychosis also presented a significant challenge in patient management. Diotte et al. (2022) asserted that up to 43% of individuals who used methamphetamine experienced a psychotic episode at some point in their lives. Among those affected, approximately 30% developed a primary psychotic disorder, such as schizophrenia (Diotte et al., 2022). A study by McKetin et al., (2016) showed that individuals experiencing methamphetamine-induced psychosis, drawn from the Methamphetamine Treatment Evaluation Study (MATES) initially comprising 501 individuals, were at a higher risk of developing persistent symptoms, with up to 32% experiencing persecutory delusions and tactile hallucinations, and approximately 42% experiencing psychotic symptoms monthly. While

transient methamphetamine-associated psychosis was linked primarily to persecutory delusions and tactile hallucinations, persistent methamphetamine-associated psychosis exhibited a broader symptom profile including non-persecutory delusions, complex auditory hallucinations, and hallucinations in various modalities (McKetin et al., 2016).

In a 2016 study by Hajebi et al., 165 participants were categorized into methamphetamine-induced psychosis, affective psychosis, and non-affective psychosis groups, each containing 55 individuals. Treatment methods varied, with 35% receiving antipsychotic medications, 25% undergoing psychotherapy, and 40% receiving a combination of both (Hajebi et al., 2016). Findings revealed that among those treated with antipsychotics, 50% experienced partial symptom improvement, while only 20% achieved complete remission (Hajebi et al., 2016). Despite treatment efforts, 28% of patients experienced recurrent psychotic episodes after an initial period of remission (Hajebi et al., 2016).

Thomas et al. (2016) conducted a study examining methamphetamine-induced psychosis with a sample of 56 participants. Treatment interventions included antipsychotic medication (82% *Risperidone*), benzodiazepines (89% *Lorazepam*), and various forms of psychotherapy (Thomas et al., 2016). Approximately 50% of those treated with antipsychotics experienced partial improvement, while 20% achieved complete remission (Thomas et al., 2016). Among psychotherapy modalities, cognitive-behavioral therapy showed the most promising outcomes, with 40% experiencing partial improvement and 15% achieving complete remission (Thomas et al., 2016). The diverse symptomatology and varying treatment responses observed across studies signified the challenges in managing methamphetamine-induced psychosis.

Heightened Vulnerability to Blood-Borne Viruses

The overlap between methamphetamine abuse and increased susceptibility to blood-borne viruses has also been noted. In a study by Liu et al. (2021) results revealed that methamphetamine led to the ability of HIV to infect certain cells by up to 150%, increasing viral proteins and specific genes. Methamphetamine-treated cells showed a 60% rise in HIV replication compared to untreated cells (Liu et al., 2021). Methamphetamine diminished the effectiveness of key antiviral factors and genes by 40% to 70% and reduced the activity of microRNAs that typically inhibit HIV infection by approximately 50% (Liu et al., 2021).

In a relative study, Tressler et al. (2020) analyzed NHANES data from 2009 to 2016, revealing concerning rates of Hepatitis B virus exposure among methamphetamine users, with 6.6% exhibiting markers consistent with exposure. Frequent methamphetamine use, especially ≥ 50 times, increased the risk of HBV contraction (Tressler et al., 2020). Furthermore, A study by Cunningham et al. (2015) suggested the heightened vulnerability to HCV among methamphetamine users. In this study, among participants with recent methamphetamine injection, 14% demonstrated phylogenetic clustering of HCV infection, indicating a clustering of transmission (Cunningham et al., 2015).

According to the National Center for HIV, Viral Hepatitis, STD, and TB Prevention (CDC, 2023a), syringe services programs (SSPs) have played a crucial role in addressing the heightened risk of contracting HIV, HCV, and HBV among drug users who inject drugs. Data indicated that SSPs are associated with a significant reduction, approximately 50%, in both HIV and HCV incidence rates among drug users (CDC, 2023a). Moreover, SSPs facilitate entry into substance use treatment, with new users of SSPs being five times more likely to enter treatment and approximately three times more likely to discontinue drug use compared to non-users (CDC, 2023a).

Potential Pharmacological Interventions for Methamphetamine Use Disorder

An obstacle in the management of methamphetamine use disorder has been the absence of pharmacological interventions. A systematic review and meta-analysis conducted by Acheson et al. (2022) examined nine studies involving 242 participants, with approximately 48% receiving pharmacological treatment for methamphetamine withdrawal. Discontinuation rates across six meta-analyzed studies showed no striking difference between treatment and placebo groups (RR 0.70, 95% CI 0.40-1.23) (Acheson et al., 2022). While no overall difference had been observed in global mental health state between treatment and placebo (SMD -0.34, 95% CI -1.06 to 0.25), a subgroup analysis revealed a marked improvement with amineptine treatment (SMD -0.70, 95% CI -1.18 to -0.22) (Acheson et al., 2022). However, no substantive difference had been found in withdrawal symptom severity or cravings between treatment and placebo groups (Acheson et al., 2022).

In a randomized trial conducted by Rezaei et al. (2015) involving fifty-six participants, sustained-release methylphenidate demonstrated efficacy in reducing methamphetamine use, cravings, and depressive symptoms, suggesting its potential as an agonist replacement therapy. The group receiving methylphenidate exhibited a significant decrease in methamphetamine-positive urine tests compared to the placebo group, along with reduced craving scores (mean difference = -10.28, 95% CI 0.88-19.18). Participants in the methylphenidate group also showed greater improvement in depressive symptoms compared to the placebo group (mean difference = 2.03, 95% CI 0.31-3.75) (Rezaei et al., 2015).

In their 2020 review, Paulus and Stewart highlight the escalating prevalence and mortality associated with methamphetamine use disorder. Pharmacological trials with drugs such as *Methylphenidate*, *Bupropion*, *Nodafinil*, and *Naltrexone* demonstrate modest effectiveness,

with reductions in methamphetamine use ranging from 3% to 30%; however, consistent efficacy was lacking across medications (Paulus & Stewart, 2020). Despite these challenges, cognitive-behavioral therapy and behavioral interventions showed promise, achieving reductions in methamphetamine use ranging from 20% to 60% (Paulus & Stewart, 2020).

Treatment Admissions and Impact of Methamphetamine Epidemic on Healthcare Systems

The Treatment Episode Data Set 2020 report (2022), published by the Department of Health and Human Services and Substance Abuse and Mental Health Services Administration, reported admissions to and discharges from publicly funded substance use treatment facilities. The report identified a surge in admissions for primary methamphetamine use among individuals aged 12 years and older, increasing to 11.8% in 2020 from 5.6% in 2010 (SAMHSA, 2022). Despite the increase in treatment admissions for methamphetamine use, SAMHSA's 2020 National Survey of Substance Abuse Treatment Services (N-SSATS) report (2021) showed that among 3,609 treatment facilities that offered detoxification services, only 61% offered detoxification services for methamphetamine (SAMHSA, 2021).

In a 2023 study, Dunn et al. highlighted the difficulties healthcare systems face in dealing with methamphetamine use disorder. They surveyed 38 primary care providers, who identified various obstacles: patient-related issues (n = 44) like missed appointments and low treatment motivation, clinic-level problems (n = 39) such as the lack of proven medications and ethical concerns in screening, and systemic challenges (n = 17) including funding shortages and insufficient access to addiction medicine specialists (Dunn et al., 2023). The study also found widespread negative attitudes towards methamphetamine use disorder from both patients and providers (n = 74), leading to stigma and hindering care efforts (Dunn et al., 2023). While a few helpful practices were reported (n = 10), like reliable referrals and extra training opportunities,

the study emphasized the urgent need for systemic enhancements (n = 23) such as standardized screening tools, FDA-approved medications, and integrated behavioral health services (Dunn et al., 2023).

Though treatment providers have noted a lack of funding for effective treatment, grant opportunities, such as the Drug-Free Communities (DFC) Support Program administered by the Centers for Disease Control and Prevention, have emerged as a resource in combating the methamphetamine epidemic and mitigating its impact on healthcare systems (CDC, 2023b). With an estimated total program funding of \$62,500,000 and an award ceiling of \$125,000 per recipient in FY 2023, this grant significantly aided drug-free community coalitions in addressing underlying factors contributing to substance abuse and minimizing addiction risks for both young individuals and adults (CDC, 2023b). 2022 data from the Drug-Free Communities Support Program showed nearly 30% of DFC coalitions offered information on methamphetamine risks, while over 65% conducted community education on signs of methamphetamine use (DCF, 2022). Additionally, approximately 34% of coalitions focused on enhancing access to prevention, treatment, and recovery services for methamphetamine use through culturally sensitive outreach efforts (DCF, 2022).

The Substance Abuse Prevention and Treatment (SAPT) Block Grant, managed by SAMHSA, also addressed challenges in treating substance use disorders, including stimulant misuse, by awarding over 20 billion dollars in grant funds since 2011 (NASADAD, 2021). The SAPT Block Grant supported treatment and recovery services, with notable outcomes including 56% abstinence from illicit drugs among discharged clients in FY 2019 (NASADAD, 2021). Despite the substantial economic burden of substance use disorders, investments in treatment and prevention yielded significant savings, with every dollar spent on treatment programs leading to

an estimated savings of \$4 to \$7 in costs associated with drug-related crimes (NASADAD, 2021).

DISCUSSION

The purpose of the study was to investigate challenges confronting substance use disorder treatment providers amidst the methamphetamine epidemic, encompassing heightened relapse rates, oral health complications, methamphetamine-induced psychosis management, susceptibility to blood-borne viruses, lack of approved pharmacological interventions, increased treatment admissions, and broader healthcare system impacts. The study hypothesis was inconclusive due to the complex interplay of a range of factors influencing methamphetamine addiction and treatment outcomes.

Data showed varying effectiveness of pharmacological interventions for methamphetamine use disorder. While some studies suggested the potential efficacy of certain medications, others show limited effectiveness or no significant difference compared to a placebo. For instance, a systematic review and meta-analysis by Acheson et al. (2022) found no substantial difference in withdrawal symptom severity or cravings between treatment and placebo groups across several studies. Conversely, a randomized trial conducted by Rezaei et al. (2015) demonstrated the efficacy of sustained-release methylphenidate in reducing methamphetamine use and cravings. Additionally, the data available regarding the impact of the methamphetamine epidemic on healthcare systems is limited as most generalize substance use disorders or focus primarily on the impact of the opioid epidemic.

However, data definitively showed the increase in methamphetamine use as evidenced by data provided by the Treatment Episode Data Set 2020 report (SAMHSA, 2022), which highlighted the surge in admissions for primary methamphetamine use. Research also

demonstrated a clear association between chronic methamphetamine use and oral health deterioration (ADA, 2024). Similarly, the data provided conclusive findings regarding the prevalence of methamphetamine-induced psychosis and the heightened vulnerability to blood-borne viruses among methamphetamine users (Diotte et al., 2022; Liu et al., 2021; Tressler et al., 2020).

Semi-structured interviews with treatment providers described systemic challenges related to the methamphetamine epidemic. Opinions from substance use counselor Kilah McDaniels, LICDC-CS, emphasized difficulties in engaging methamphetamine users in treatment due to high relapse rates and difficulties in focus and retention, echoing findings from Hill (2024) and Moeeni et al. (2016). Lisa Childress, MSN, APRN, FNP-C, provided opinion on the physical and mental health complications of methamphetamine use, including psychosis and cardiovascular issues, underscoring the need for FDA-approved medications and comprehensive care, as discussed in the literature (Diotte et al., 2022; Liu et al., 2021; Acheson et al., 2022; Rezaei et al., 2015).

Study Limitations

The research was limited by researcher bias, publication bias, the research strategy, and the number of databases used. The reliance on self-reporting in some aspects of the research, such as substance use history and treatment adherence, may have introduced recall bias, and affected the accuracy of the data collected. Secondly, the study's sample size, while sufficient for certain analyses, may have limited the generalizability of the findings to broader populations of methamphetamine users. Additionally, the cross-sectional nature of some data collection methods restricted the ability to establish causality between variables, particularly in assessing the impact of interventions on relapse rates and oral health outcomes.

Practical Applications

Healthcare providers should integrate comprehensive care approaches to address methamphetamine use disorder and its associated complications, combining substance use therapy with dental treatments to effectively manage oral health issues (Hanson et al., 2019; Rommel et al., 2016). Tailored interventions and ongoing support programs are crucial to mitigate relapse risks identified by Hill (2024) and Moeeni et al. (2016). Investing in standardized screening tools, supporting FDA-approved medications clinical trials, and applying for grant programs like the Drug-Free Communities Support Program and the Substance Abuse Prevention and Treatment Block Grant can enhance treatment outcomes and address systemic challenges (Dunn et al., 2023; (CDC, 2023b); NASADAD, 2021). Through these measures, healthcare providers can better support individuals affected by methamphetamine use disorder and alleviate its impact on both individuals and healthcare systems. Further study was needed to develop tailored interventions to address challenges posed by the methamphetamine epidemic on healthcare systems and better support affected individuals.

CONCLUSION

The study explored the challenges faced by substance use disorder treatment providers amidst the methamphetamine epidemic. While the research hypothesis remained inconclusive due to the complex nature of methamphetamine addiction and treatment outcomes, the data revealed varying effectiveness of pharmacological interventions. Conclusive evidence was found regarding the increase in methamphetamine use and its associated oral health complications, methamphetamine-induced psychosis, and susceptibility to blood-borne viruses.

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APPENDIX

Semi-Structured Interview Questions for the Nurse Practitioner:

1. Can you describe the impact you have observed the methamphetamine epidemic having on the healthcare system, particularly in terms of patient admissions and healthcare resource allocation?
2. What are some common physical health complications you encounter in patients with methamphetamine use disorder, and how do you approach their management?
3. How do you address the mental health implications of methamphetamine use disorder in your patients, and what challenges do you face in providing mental health support?
4. Can you discuss any strategies or interventions you find effective in managing withdrawal symptoms for patients recovering from methamphetamine addiction?
5. How do you collaborate with other healthcare professionals, such as counselors or social workers, to provide comprehensive care for patients struggling with methamphetamine addiction?
6. Have you noticed any specific trends or patterns in the demographic characteristics of patients seeking treatment for methamphetamine use disorder?
7. What are some barriers or challenges you encounter in providing care for individuals with methamphetamine addiction, and how do you navigate them?
8. How do you educate patients and their families about the risks associated with methamphetamine use and the importance of seeking treatment?
9. Without identifying anyone in particular, can you share any success stories or positive outcomes you have witnessed in patients undergoing treatment for methamphetamine addiction?

10. In your opinion, what are the most urgent needs or areas for improvement in addressing the methamphetamine epidemic within the healthcare system?

Semi-Structured Interview Questions for the Substance Use Counselor:

1. How has the methamphetamine epidemic impacted the demand for substance use counseling services, and what challenges does this present for you in your role?
2. What are some common motivations or triggers for individuals seeking treatment for methamphetamine addiction, and how do you address them in counseling sessions?
3. Can you discuss the role of family dynamics and social support systems in the recovery process for individuals with methamphetamine use disorder?
4. How do you approach relapse prevention strategies with your clients, particularly considering the high rates of relapse associated with methamphetamine addiction?
5. What evidence-based therapeutic approaches or interventions do you find most effective in treating methamphetamine addiction?
6. Have you observed any particular barriers or stigmas that individuals with methamphetamine addiction face when accessing or engaging in substance use counseling?
7. How do you tailor your counseling approach to meet the unique needs of clients with co-occurring mental health disorders and methamphetamine addiction?
8. Can you share any strategies or techniques you use to build rapport and trust with clients who may be hesitant or resistant to treatment?
9. What are some of the biggest misconceptions or myths you encounter regarding methamphetamine addiction, and how do you address them with your clients?

10. In your experience, what are the most critical components of a comprehensive treatment plan for individuals recovering from methamphetamine addiction, and how do you collaborate with other healthcare professionals to coordinate care?

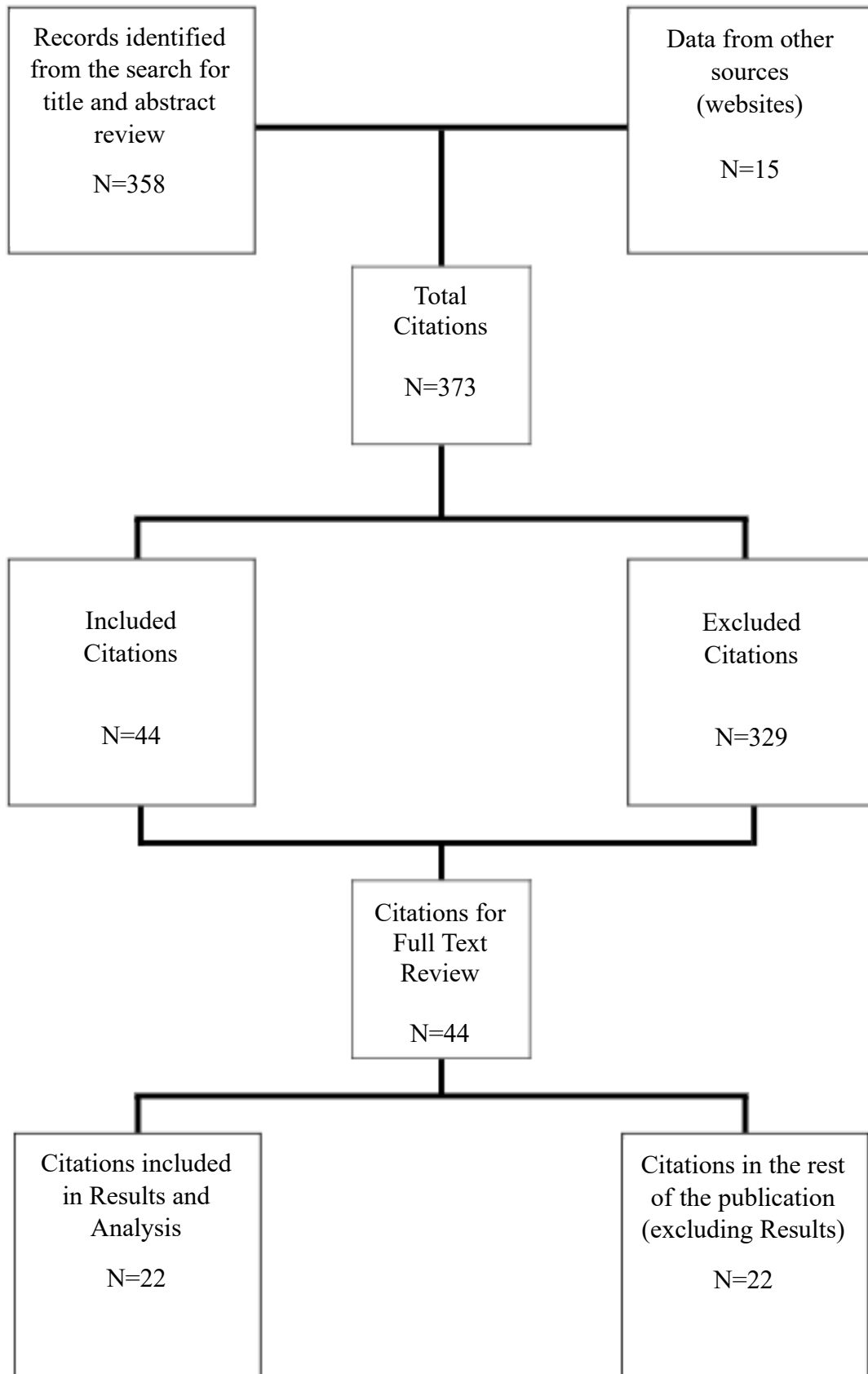


Figure 1: PRISMA diagram used in this study (Adapted from Moher et al., 2009). ok

Research articles and peer-reviewed literature were located using Marshall University's PubMed research database. Google Scholar was an alternative resource when the desired information was unavailable within the specified database. The search involved key terms such as 'methamphetamine epidemic' OR 'substance abuse' AND 'adverse effects' OR 'treatment admissions' OR 'hospitalizations' OR 'meth-induced psychosis' OR 'oral health complications' OR 'blood-borne viruses.' The search identified 373 relevant citations and citations were excluded (N=329) if they did not meet inclusion principles. Articles were included (N=29) if they described challenges presented by methamphetamine abuse. Articles from other sources (N=15) were also included in this search. These 44 references were subject to full-text review, and these 22 citations were included in the data abstraction and analysis. 22 references were included in the Results section.

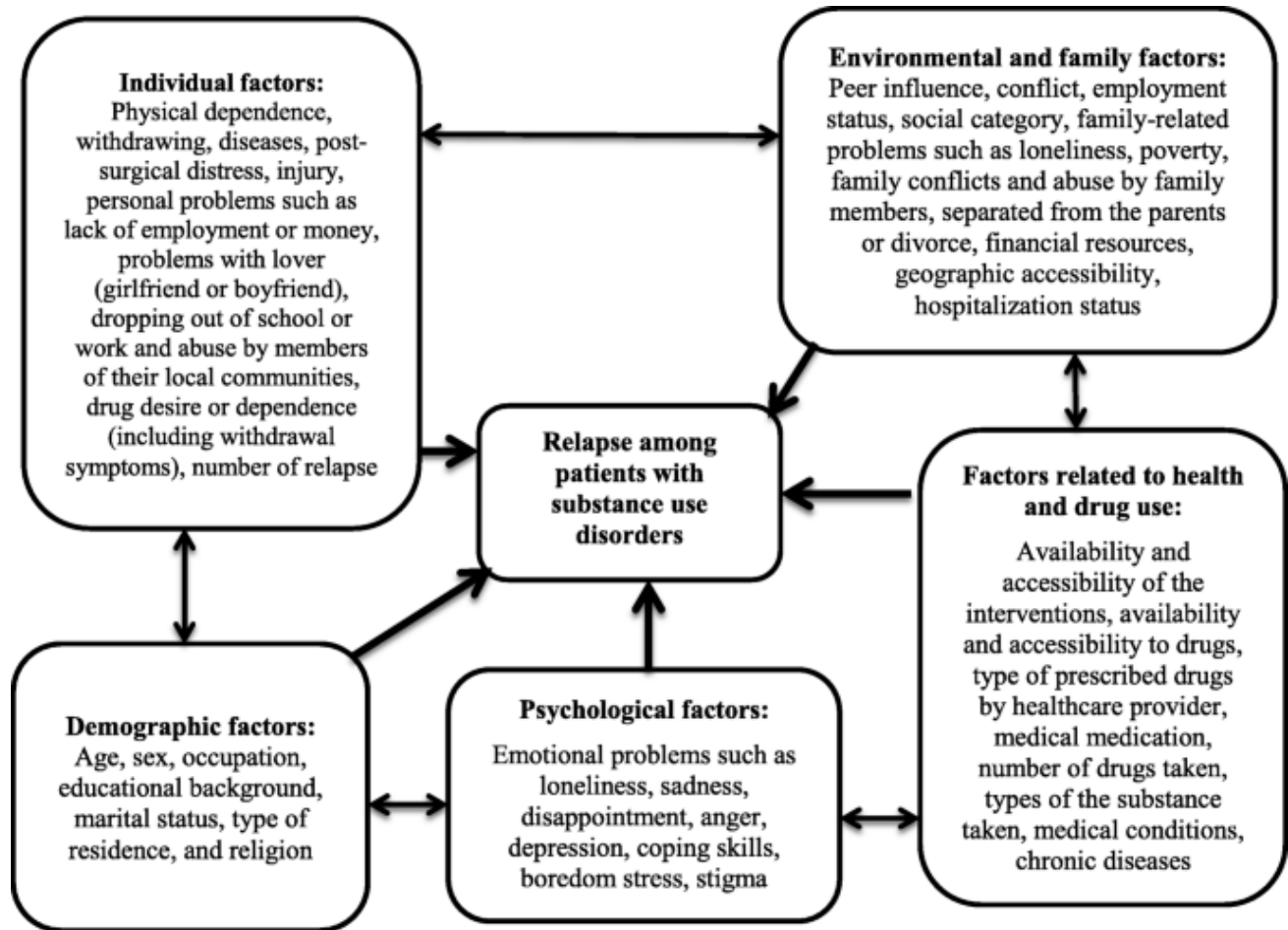


Figure 2: The conceptual framework adopted from Kabisa et al. (2021) categorized relapse determinants into environmental, interpersonal, socio-demographic, intrapersonal, and physical factors, with environmental factors encompassing drug availability and accessibility, interpersonal factors including peer influence and social conflicts, socio-demographic characteristics such as age and education, intrapersonal factors involving negative emotions, and physical factors comprising diseases and dependence, thereby illustrating the multifaceted nature of methamphetamine abuse treatment challenges.

Adjusted Prevalence of Past-Year Methamphetamine Use, Use Disorder, and Injection Among Adults Aged 18 to 64 Years		
Variable	Weighted % (95% CI)	
	Methamphetamine use without MUD or injection (n = 194 554)	MUD without injection (n = 194 465)
<i>NSDUH year</i>		
2015	0.38 (0.33-0.44)	0.28 (0.22-0.35)b
2016	0.30 (0.23-0.38)	0.20 (0.15-0.26)b
2017	0.28 (0.23-0.36)b	0.33 (0.26-0.43)
2018	0.36 (0.29-0.45)	0.37 (0.30-0.47)
2019 (Reference)	0.40 (0.31-0.50)	0.41 (0.32-0.52)
<i>Age group, years</i>		
18-23 (Reference)	0.24 (0.19-0.29)	0.16 (0.13-0.19)
24-34	0.31 (0.26-0.37)b	0.32 (0.27-0.39)b
35-49	0.44 (0.38-0.52)b	0.47 (0.38-0.57)b
50-64	0.40 (0.32-0.50)b	0.33 (0.23-0.47)b
<i>Sex and sexual orientation</i>		
Homosexual men	0.65 (0.38-1.10)b	0.36 (0.19-0.69)
Lesbian women	0.30 (0.15-0.61)	0.20 (0.09-0.44)
Bisexual men	0.55 (0.27-1.11)	0.37 (0.23-0.59)
Bisexual women	0.30 (0.21-0.41)	0.29 (0.22-0.38)
Men, unknown sexual orientation	0.17 (0.07-0.43)	0.63 (0.19-2.09)
Women, unknown sexual orientation	0.34 (0.14-0.80)	0.17 (0.05-0.55)
Heterosexual men	0.35 (0.31-0.40)	0.35 (0.30-0.41)b
Heterosexual women (Reference)	0.32 (0.26-0.39)	0.27 (0.22-0.33)
<i>Educational attainment</i>		
<High school education	0.44 (0.35-0.55)b	0.40 (0.32-0.51)b
High school diploma	0.40 (0.33-0.49)b	0.37 (0.32-0.44)b
Some college courses	0.32 (0.27-0.37)	0.30 (0.25-0.37)b
≥College degree (Reference)	0.24 (0.17-0.34)	0.14 (0.09-0.24)
<i>Annual household income, \$</i>		
<20 000	0.42 (0.33-0.53)b	0.38 (0.32-0.45)b
20 000-49 999	0.35 (0.29-0.43)	0.33 (0.26-0.41)b
50 000-74 999	0.29 (0.23-0.37)	0.31 (0.21-0.45)
≥75 000 (Reference)	0.28 (0.23-0.35)	0.21 (0.16-0.28)

Figure 3: The Adjusted Prevalence of Past-Year methamphetamine Use, Use disorder, and Injection Among Adults Aged 18 to 64 Years, adapted from Han et al., 2021: Table 2, revealed a correlation between lower levels of education and income with higher rates of methamphetamine use, use disorder, and injection, highlighting socioeconomic factors as significant determinants in substance misuse behaviors.