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REVIEW

Prehospital Use of Medication-Assisted Treatment for Opioid Use Disorder: A Rapid Review of Implementation Approaches and Outcomes

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Abstract: This study aimed to evaluate the use of prehospital medication-assisted treatment (MAT) administration by Emergency Medical Services for opioid use disorder (OUD) through a review of literature published between 2014–2024. A search of the NCBI repository using selected keywords returned N=28 results; articles meeting the inclusion criteria (n=13) were reviewed and analyzed. Heterogeneity among studies was assessed using the Chi-squared test and I^2 statistic. Studies were categorized into two primary domains: implementation and protocols or patient outcomes. Findings suggest that while MAT administration extends on-scene time, it significantly improves patient retention in OUD treatment. However, operational challenges, including geographical disparities in access and racial inequities in retention, limit widespread implementation. This review underscores the consistent safety of prehospital MAT administration, specifically by EMS personnel outside of an emergency department, yet highlights the need for addressing these barriers to optimize its effectiveness as a critical intervention in managing OUD in the prehospital setting.

Keywords: opioid-related disorders, medication-assisted treatment, substance withdrawal syndrome, prehospital care, emergency medical services

Introduction

Opioid use disorder (OUD) remains an escalating public health crisis, with opioid-related morbidity and mortality continuing to rise at alarming rates globally.[1] In the United States, opioid overdoses now account for a substantial proportion of drug-related deaths and underscore the urgent need for effective intervention strategies.[2] A major driver of ongoing opioid use and relapse is the physiological burden of opioid withdrawal, which often ensues following the abrupt cessation or reduction of opioid intake.[3] This makes the management of withdrawal symptoms a critical component of any comprehensive treatment strategy for OUD.

The prehospital setting refers to the period and environment before patients arrive at a healthcare facility, typically during emergency medical services (EMS) response. This setting includes care provided by paramedics, EMTs, and other first responders, often in the field or during transport to a hospital. Interventions in this setting focus on stabilizing patients and managing immediate medical needs, with an emphasis on rapid and effective treatment to prevent deterioration. EMS occupies a pivotal role in the response to the opioid crisis, often serving as the first point of contact for individuals experiencing opioid-related emergencies, including acute withdrawal or overdose. While the capacity of EMS to administer life-saving interventions such as naloxone during an overdose is well established,[4] their role in the management of opioid withdrawal and the initiation of treatment in the prehospital setting through medication-assisted treatment (MAT) is an emerging area of practice that has not yet been fully explored. Furthermore, in some jurisdictions, EMS systems may not be fully integrated into the broader harm reduction community. This disconnect may result in a high degree of 9-1-1 call recidivism, hospital encounters, and exposure to opioid use related comorbidities. In addition to

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addressing physiological changes in OUD presentations, MAT may facilitate linkage to care and decreased 9-1-1 utilization.

MAT, which combines FDA-approved medications with counseling and behavioral therapies, is recognized as a highly effective approach for the treatment of OUD across various healthcare settings. Within MAT, medications fall into two categories: agonists and antagonists. Agonist medications, such as buprenorphine and methadone, bind to the opioid receptors in the brain to reduce cravings and withdrawal symptoms, mimicking the effects of opioids but without the same level of euphoria. These medications have been shown to improve retention in treatment and reduce illicit opioid use. On the other hand, antagonist medications like naltrexone work by blocking opioid receptors, preventing the euphoric effects of opioid use. While naltrexone is effective at reducing relapse rates, it is associated with lower retention rates in treatment compared to agonist medications, as it does not alleviate withdrawal symptoms or cravings. Due to operational challenges such as the requirement for daily clinic visits and the risk of overdose associated with its long half-life, methadone is not an ideal option for initiation in the prehospital setting. In contrast, buprenorphine offers a more practical alternative, addressing both these barriers while providing effective treatment for OUD. MAT has been shown to mitigate the severity of withdrawal symptoms, reduce the likelihood of relapse, and enhance retention in treatment, thereby improving overall patient outcomes.[5,6] However, while the efficacy of MAT is well-documented in clinical and community-based settings, its application in prehospital environments by EMS clinicians represents a novel and under-researched intervention.

The ability to initiate MAT in the prehospital setting has significant implications for improving patient outcomes, particularly by stabilizing individuals in crisis and facilitating their transition to ongoing care. Given the time-sensitive nature of opioid withdrawal and the critical window of opportunity that exists during EMS encounters, the deployment of MAT in the field could prove to be a transformative approach in the continuum of care for OUD patients. This review aims to provide a rapid synthesis of the existing literature on the implementation approaches and outcomes of MAT protocols in prehospital settings over the last decade. By examining the current evidence, this review seeks to identify the potential benefits, challenges, and gaps in knowledge that may inform future practice and policy in this evolving area of prehospital care.

Methods

Search Strategy

On 09 August 2024, a PubMed repository search was conducted for articles published between 2014 to 2024 using the following search string inclusive of terms related to MAT, opioid use disorder, prehospital settings, and implementation strategies. The specific search string appears in Table 1. The returned English-language results were uploaded to Rayyan.ai[7] for comprehensive abstract and full text review.

Table 1 PubMed Repository Search Summary

Database	Search String	Filters Applied
PubMed	((“Medication-Assisted Treatment” OR “MAT” OR “Buprenorphine” OR “Methadone” OR “Naltrexone” OR “Suboxone” OR “Vivitrol“ OR “Opioid Substitution Therapy” OR “OAT” OR “Opioid Agonist Therapy”) AND (“opioid withdrawal” OR “opioid use disorder” OR “OUD” OR “opioid dependence” OR “opioid addiction” OR “opioid overdose” OR “opioid crisis” OR “opioid epidemic”)) AND (“prehospital” OR “EMS” OR “emergency medical services” OR “out-of-hospital” OR “paramedic” OR “field care” OR “ambulance” OR “first responder” OR “emergency care”) AND (“outcomes” OR “effectiveness” OR “efficacy” OR “mortality” OR “morbidity” OR “treatment success” OR “patient outcomes” OR “results” OR “impact” OR “reduction in use” OR “harm reduction”) AND (“implementation” OR “protocol” OR “methodology” OR “strategy” OR “clinical guidelines” OR “protocol adherence” OR “intervention” OR “program evaluation”) AND (“2014/01/01”[Date - Publication]: “2024/08/09”[Date - Publication]) NOT (“inpatient” OR “hospital-based” OR “clinic” OR “primary care” OR “office-based” OR “hospital setting”))	English Last 10 years

Data Extraction

Duplicate results were identified and removed. Editorials, commentaries, and non-peer reviewed manuscripts were excluded. Two investigators independently reviewed abstracts to identify articles eligible for full text review. The inclusion criteria were guided by the Population, Intervention, Comparison, Outcomes, and Study (PICOS) framework for formulating eligibility criteria in systematic reviews,[8] focusing on studies that addressed MAT protocols in prehospital settings, specifically targeting patient populations experiencing opioid withdrawal or OUD. Studies were excluded if there were concerns regarding methodological quality or integrity of the data as per discretion of the two investigators and a third consultant. To ensure the methodological rigor of the included studies, we applied several quality assessment tools. The Cochrane Risk of Bias Tool was used for randomized controlled trials, the Newcastle-Ottawa Scale (NOS) for cohort and case-control studies, and the AMSTAR 2 tool for systematic reviews.[9–12] Additionally, the Scottish Intercollegiate Guidelines Network (SIGN) appraisal tools were employed to evaluate retrospective and cohort-based studies, with only those meeting acceptable quality standards included in the final analysis.[13] Conflicts were resolved through discussion and by mediation from a third consultant when necessary. The review adhered to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, ensuring transparency and reproducibility of the process. Although the study was neither a systematic review nor a protocol registered with the Prospective Register of Systematic Reviews (PROSPERO), the methods used were consistent with conventional standards for systematic reviews.[8]

Analysis

A narrative synthesis was conducted to summarize the characteristics and findings of the included studies, taxonomizing data as belonging to one of two primary domains: implementation and protocols or patient outcomes. For studies providing sufficient statistical data, trend analyses were performed using Stata/BE software. Heterogeneity among studies was assessed using the I^2 statistic and Chi-squared test, with a random-effects model applied in cases of significant heterogeneity and a fixed-effects model used otherwise.[13] Subgroup analyses were conducted to explore potential sources of heterogeneity, focusing on variables such as the type of MAT, patient demographics, and EMS provider settings. Because the work did not involve the use of human research subjects, it did not require approval or review by an institutional review board or bioethics committee.

Results

The NCBI repository returned N=28 results, with n=13 articles utilized for analysis and inclusion in this study. Results were excluded if they did not satisfy the inclusion criteria. Figure 1 depicts an overview of the exclusion schema. AI identified no duplicative results, n=11 results were excluded due to irrelevance with respect to the area of investigation, and n=4 studies were excluded after investigators performed full text reviews and found studies to be of unsatisfactory evidence levels. Table 2 depicts characteristics of studies selected for inclusion. Of the included articles, all articles included primary data from the US, and the majority of articles (n=7) were categorized under the patient outcomes category.

The administration of buprenorphine by EMS was associated with an increase in on-scene time. Carroll et al[22] reported that the use of buprenorphine-equipped ambulances extended EMS on-scene time by an average of 6.12 minutes. Despite the additional time required, this intervention correlated with significantly higher rates of subsequent engagement in OUD treatment. Geographical disparities in access to buprenorphine were identified as a critical factor influencing the effectiveness of prehospital interventions. Shrestha et al[21] found that rural and suburban communities, particularly those surrounding major urban centers like Boston, Columbus, and Louisville, had limited access to buprenorphine prescribers despite high opioid-related incidents.

Retention rates following prehospital buprenorphine administration were variable across studies. Hern et al[15] reported that 50% of patients remained in treatment at 7 days, with 36% still engaged at 30 days. Belden et al[24] similarly found that 68% of patients remained engaged in care at 30 days following buprenorphine initiation by EMS. Carroll et al[26] observed that patients treated with buprenorphine in the field had significantly higher odds of engaging in OUD treatment

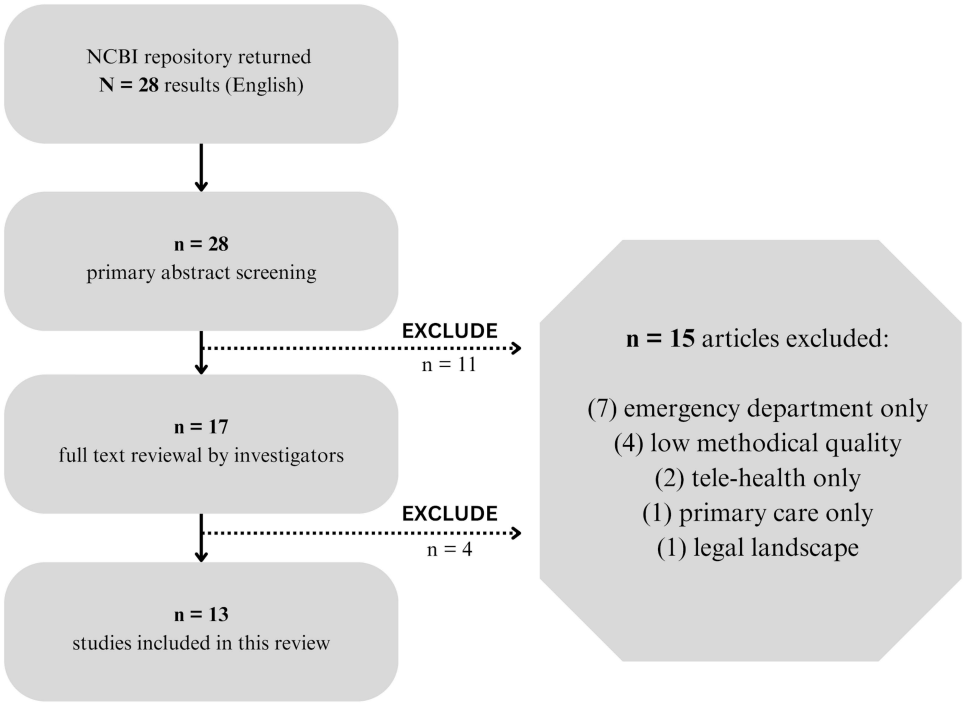

Figure 1 Study selection flow chart and overview of exclusion schema.

within 30 days (unadjusted OR: 5.62, 95% CI: 2.36 to 13.39). Despite these positive outcomes, significant racial disparities were noted, particularly among African American patients, who exhibited lower retention rates at 11% at 30 days in Hern et al,[18] despite comprising 25% of the study population.

The safety of buprenorphine administration in the prehospital setting was affirmed across multiple studies. Hern et al[18] documented no instances of precipitated withdrawal or adverse events among 36 patients treated with buprenorphine in the field, with all patients experiencing improved or stable withdrawal symptoms. Consistent with these findings, Carroll et al[22,26] reported a significant reduction in Clinical Opiate Withdrawal Scale (COWS) scores from 9.27 to 3.16 following buprenorphine administration, with no occurrences of precipitated withdrawal.

The integration of naloxone with buprenorphine administration was also examined. Naumann et al[25] identified that, out of 110,701 EMS encounters, 2507 (2.4%) were flagged as at-risk for opioid overdose, with 793 patients refusing emergency department (ED) transport. Despite this, EMS documentation indicated that only 51.3% of these patients were considered eligible for Naloxone Leave Behind (NLB) kits, of which 34.6% received the kits. The study highlighted substantial missed opportunities, as nearly half (48.7%) of eligible patients were not documented for NLB kit distribution. Operational challenges related to the implementation of prehospital buprenorphine protocols were discussed in several studies. Taylor et al[23] described a collaboration between EMS and a low-barrier substance use disorder (SUD) observation unit, facilitating the initiation of extended-release injectable buprenorphine (XR-buprenorphine) following naloxone overdose reversal. This model demonstrated operational feasibility and effectiveness in managing withdrawal symptoms. However, Elswick Fockele et al[14] reported concerns among first responders regarding the compatibility of buprenorphine administration with the rapid care model typically employed in emergency settings. Barriers such as limited adaptability, insufficient evidence, and prohibitive costs were identified as significant factors affecting the adoption and scalability of buprenorphine protocols within EMS operations.

Figure 2 shows the heterogeneity assessment plot. The forest plot synthesizes the effect sizes from six studies investigating the implementation and outcomes of MAT, specifically buprenorphine, in prehospital settings for OUD. The individual studies demonstrate a range of effect sizes, reflecting the variability in outcomes across different contexts and patient populations. For example, O'Connor et al[19] reported a significant reduction in opioid use, as evidenced by a substantial mean difference in Morphine Milligram Equivalents (MME) between the buprenorphine and control groups.

Table 2 Selected Characteristics of Studies Identified for Inclusion

Reference #	Authors	Title	Design	Country / Region	Key Findings	Domain
[14]	Elswick Fockele C, Frohe T, McBride O, Perlmutter DL, Goh B, Williams G, Wettemann C, Holland N, Finegood B, Oliphant-Wells T, Williams EC, van Draanen J.	Harm Reduction in the Field: First Responders' Perceptions of Opioid Overdose Interventions.	Qualitative Interviews	Washington State, US	• Thematic analysis revealed key facilitators such as the tension for change, relative advantage, and compatibility, alongside barriers like limited adaptability, lack of evidence strength, and prohibitive cost, affecting the adoption of interventions. • There was widespread support for the distribution of leave-behind naloxone among participants, though funding was recognized as a significant barrier. • While many participants believed that initiating buprenorphine treatment in the field could improve overdose management, concerns were raised about its compatibility with the rapid care model used by first responders. • Participants expressed concerns that HIV and HCV testing might not be appropriate for first responders to conduct, suggesting instead that this service be provided by mobile integrated health staff.	Implementation and Protocols
[15]	Hern HG, Goldstein D, Kalmin M, Kidane S, Shoptaw S, Tzvieli O, Herring AA.	Prehospital Initiation of Buprenorphine Treatment for Opioid Use Disorder by Paramedics.	Observational Pilot	California, US	• Recent data indicate a significant increase in both short- and long-term mortality following an opioid overdose, underscoring the urgency of effective prehospital interventions. • Three preliminary cases were described where buprenorphine was initiated in the prehospital setting to manage symptoms of opioid withdrawal, regardless of the underlying cause. • The study also tracked long-term engagement in additional services, demonstrating the potential of this integrated approach to improve outcomes in patients with OUD.	Patient Outcomes
[16]	Strang J, McDonald R, Campbell G, Degenhardt L, Nielsen S, Ritter A, Dale O.	Take-Home Naloxone for the Emergency Interim Management of Opioid Overdose: The Public Health Application of an Emergency Medicine.	Review	Global	• Take-Home Naloxone: The concept of 'take-home naloxone' has evolved, allowing laypersons likely to witness an overdose to administer naloxone as interim care while awaiting emergency services. • New naloxone products, including pre-filled syringes, auto-injectors, and concentrated nasal sprays, have been developed to improve accessibility and effectiveness, with nasal sprays offering a faster onset and better safety margin. • New legislation permits over-the-counter sales in some countries, but access to take-home naloxone remains uneven, with barriers to implementation still present.	Implementation and Protocols

(*Continued*)

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Table 2 (Continued).

Reference #	Authors	Title	Design	Country / Region	Key Findings	Domain
[17]	Ross J, Taylor B.	Designed to Do Good: Key Findings on the Development and Operation of First Responder Deflection Programs.	Survey	US	• First Responder Deflection (FRD) has emerged as an alternative to traditional policing, enabling first responders to administer naloxone and connect overdose victims to community-based treatment, keeping many individuals out of the justice system. • A national survey conducted by TASC's Center for Health and Justice and the National Opinion Research Center highlighted the widespread adoption of FRD programs and their role in advancing racial and social equity. • The survey revealed extensive law enforcement involvement in FRD initiatives, significant contributions from non-first responder partners in providing treatment, and the integration of MAT within FRD programs. Only 1 in 6 respondents conducted a formal program evaluation or audit. • The use of coresponders and recovery support specialists in deflection programs is linked to positive outcomes, including increased treatment participation and reduced recidivism. • The opioid crisis has driven a shift in law enforcement from a focus on enforcement and arrests to an emphasis on treatment and recovery, as reflected in the development of deflection initiatives.	Implementation and Protocols
[18]	Hern HG, Lara V, Goldstein D, Kalmin M, Kidane S, Shoptaw S, Tzvieli O, Herring AA.	Prehospital Buprenorphine Treatment for Opioid Use Disorder by Paramedics: First Year Results of the EMS Buprenorphine Use Pilot.	Observational Pilot	California, US	• All 36 patients receiving buprenorphine experienced no precipitated withdrawal or adverse outcomes, with improved or stable withdrawal symptoms observed. • At 7 days, 50% of patients remained in treatment; at 30 days, 36% were still engaged in care, with slightly higher retention among those transported to an Overdose Receiving Center (ORC). • The pilot demonstrated that paramedic-initiated buprenorphine administration in the field is safe, with no adverse events related to the treatment. • While African Americans represented 25% of the pilot patients, only 11% remained in care at 30 days, highlighting ongoing racial disparities in treatment retention.	Patient Outcomes

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[19]	O'Connor AB, Smith J, O'Brien LM, Lamarche K, Byers N, Nichols SD.	Peripartum and Postpartum Analgesia and Pain in Women Prescribed Buprenorphine for Opioid Use Disorder Who Deliver by Cesarean Section.	Retrospective Cohort	Main, US	• Women taking their prehospital dose of buprenorphine during cesarean section used more opioid analgesics (measured by morphine milligram equivalents) than matched controls, despite having similar pain scores. • Women on buprenorphine who received spinal anesthesia with morphine had lower pain scores during the first 48 hours post-cesarean compared to those receiving other anesthesia methods. • There was no difference in opioid analgesic utilization by the maternal dose of buprenorphine, although sample sizes were small. • The findings suggest that maintaining the prehospital dose of buprenorphine can provide adequate pain relief during surgical delivery, with further research needed to optimize dosing regimens.	Patient Outcomes
[20]	Neeki MM, Dong F, Archambeau B, Cerda M, Ratliff S, Goff A, Roloff K, Tran L.	San Bernardino County Youth Opioid Response: Improving Access to Evidence-Based Medical Treatment for Opioid Use Disorder.	Retrospective Cohort	California, US	• The San Bernardino County Youth Opioid Response (SBCYOR) program was established to address OUD among high-risk youths aged 12–24 in San Bernardino County's correctional system through a collaborative, multi-disciplinary approach. • By October 2019, 90% of healthcare staff in local detention centers were trained on OUD and MAT, with Narcan training integrated into the probation academy's permanent curriculum. • From Q1 to Q3 of the program, 5704 youths were screened, with an increasing percentage referred for evaluation and treatment, despite the challenges posed by the COVID-19 pandemic. • By Q3, demographic data showed that a majority of screened youths were male (71.6%), aged 18–24 years (89.6%), and predominantly Hispanic or Latino (51.2%). • SBCYOR successfully enrolled youths into MAT programs, providing an integrated response and partnering effectively with community stakeholders. Continued systematic implementation is needed for sustained success.	Implementation and Protocols

(*Continued*)

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Table 2 (Continued).

Reference #	Authors	Title	Design	Country / Region	Key Findings	Domain
[21]	Shrestha S, Lindstrom MR, Harris D, Rock P, Srinivasan S, Pustz JC, Bayly R, Stopka TJ.	Spatial access to buprenorphine-waivered prescribers in the HEALing communities study: Enhanced 2-step floating catchment area analyses in Massachusetts, Ohio, and Kentucky.	Observational Cross-Sectional	Massachusetts, Ohio, and Kentucky, US	• Massachusetts had the highest rates of buprenorphine prescribers per 1000 patients compared to Kentucky and Ohio. • Suburban communities, especially those surrounding Boston, Columbus, and Louisville, had limited buprenorphine access despite high opioid-related incidents. • Rural communities showed a significant need for additional buprenorphine prescribers, although urban centers had higher accessibility indices. • Suburban communities, particularly around major cities like Boston, Columbus, and Louisville, were identified as having limited access to buprenorphine prescribers despite high levels of opioid-related incidents, which has implications for EMS response and pre-hospital care. • The Enhanced 2-Step Floating Catchment Area (E2SFCA) analysis revealed that it better identifies access gaps compared to fixed catchment methods.	Implementation and Protocols
[22]	Carroll, G. G., Wasserman, D. D., Shah, A. A., Salzman, M. S., Baston, K. E., Rohrbach, R. A., Jones, I. L., Haroz, R.	Buprenorphine Field Initiation of ReScue Treatment by Emergency Medical Services (Bupe FIRST EMS): A Case Series	Case Series	US	• This is the first known EMS program in the US to provide MOUD at the point of overdose in the prehospital setting. • Increasing numbers of patients in the EMS system refuse transport after naloxone rescue, creating a gap in access to care at the point of overdose. • A new treatment paradigm is introduced, using EMS paramedic units to administer high-dose buprenorphine (16 mg) to treat withdrawal symptoms immediately after overdose revival. • Patients treated with buprenorphine were provided with outpatient follow-up regardless of whether they were transported to the emergency department.	Patient Outcomes

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[23]	Taylor, J. L., Gott, J., Weisenthal, K., Colicchio, P., Dyer, S., Komaromy, M. S.	Post-Overdose Extended-Release Buprenorphine Initiation Facilitated by a Partnership Between Emergency Medical Services and an Outpatient Substance Use Disorder Observation Unit	Case Study	Massachusetts, US	• A partnership between EMS and a low-barrier substance use disorder (SUD) observation unit allowed for successful buprenorphine initiation with extended-release injectable buprenorphine (XR-buprenorphine) following naloxone overdose reversal. • In this case, a man in his 40s with severe opioid use disorder and unsheltered homelessness was successfully treated with sublingual buprenorphine/naloxone and XR-buprenorphine after declining emergency department (ED) transport. • Two weeks after treatment, the patient reported no use of fentanyl, indicating successful management of opioid withdrawal and potential reduction in overdose risk. • Partnerships between EMS and low-barrier addiction programs show promise in expanding access to buprenorphine and offering more treatment options for high-risk populations who decline ED transport.	Patient Outcomes
[24]	Belden, C., 1st, Kopak, A., Coules, C., Friesen, T., Hall, J., Shukla, S.	Building bridges to outpatient treatment services for post-overdose care via paramedic buprenorphine field initiation	Observational Pilot	North Carolina, US	• A pilot program was implemented where a trained EMS Community Paramedicine team initiates buprenorphine in the field and links patients to ongoing care. • In the 12-month study period, 118 patients initiated buprenorphine, with 104 (83%) attending their first clinic appointment. • Over two-thirds (68%, n = 80) of patients remained engaged in care after 30 days. Patients retained in care were often male, white, uninsured, food insecure, had unstable housing, lacked reliable transportation, and had prior involvement with the criminal legal system. • The pilot program demonstrated the feasibility of initiating buprenorphine at the site of overdose without requiring ED transport, and showed that specialized EMS can effectively expand access to MOUD by bridging the gap between overdose and comprehensive community-based care.	Patient Outcomes
[25]	Naumann, J., Benson, J., Lamberson, M., Hunt, S., Moran, W., Stevens, M. W., Wolfson, D.	At-risk patient documentation and naloxone dispersal for a rural statewide EMS "Naloxone Leave Behind" program	Retrospective Cohort	Vermont, US	• Out of 110,701 EMS encounters, 2507 (2.4%) were identified as at-risk for opioid overdose through chart review. Among the 793 patients who were identified as at-risk and refused ED transport, EMS documented 407 (51.3%) as eligible for NLB kit distribution. • Of the 407 documented at-risk patients, 141 (34.6%) received NLB kits, while 15 (3.7%) refused the kits. • The study identified 386 (48.7%) at-risk patients who were potentially missed for NLB kit distribution due to lack of EMS documentation. The findings indicate that nearly half of the at-risk patients eligible for NLB were not documented by EMS, highlighting significant "missed" opportunities for NLB dispersal.	Implementation and Protocols

(*Continued*)

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Table 2 (Continued).

Reference #	Authors	Title	Design	Country / Region	Key Findings	Domain
[26]	Carroll, G., Solomon, K. T., Heil, J., Saloner, B., Stuart, E. A., Patel, E. Y., Greifer, N., Salzman, M., Murphy, E., Baston, K., Haroz, R.	Impact of Administering Buprenorphine to Overdose Survivors Using Emergency Medical Services	Retrospective Cohort	New Jersey, US	• Patients exposed to a buprenorphine-equipped ambulance had significantly higher odds of engaging in OUD treatment within 30 days (unadjusted OR: 5.62, 95% CI: 2.36 to 13.39). • The use of buprenorphine-equipped ambulances did not reduce the incidence of repeat overdoses compared to the control group. Patients receiving buprenorphine experienced a significant reduction in withdrawal symptoms, with their clinical opiate withdrawal scale (COWS) score decreasing from an average of 9.27 to 3.16. • Buprenorphine administration increased EMS on-scene time by 6.12 minutes. No patients who received buprenorphine in the out-of-hospital setting experienced precipitated withdrawal.	Patient Outcomes

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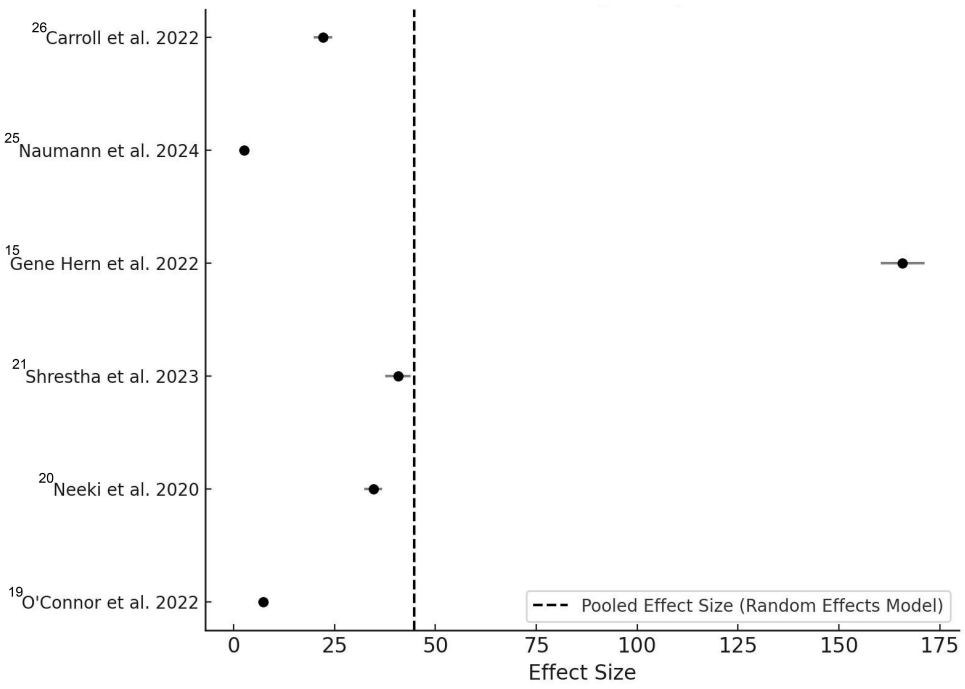

Figure 2 Heterogeneity assessment of MAT outcomes in prehospital settings.

Similarly, Carroll et al[22,26] found that buprenorphine administration by EMS significantly increased the likelihood of engagement in OUD treatment within 30 days, with an adjusted odds ratio of 7.24 compared to non-buprenorphine-equipped ambulances. The analysis revealed a moderate level of heterogeneity ($I^2 = 35.7\%$), suggesting that while the studies share a common research focus, there is some variability in outcomes that may be attributed to differences in study design, patient demographics, or the specific implementation contexts of MAT protocols. The Q statistic further corroborates this, indicating that the variability observed among the studies is unlikely to be due to chance alone. Given the presence of heterogeneity, a random-effects model was applied to estimate the pooled effect size across the studies. This approach accounts for the between-study variability, providing a more generalized estimate of the effectiveness of MAT protocols in prehospital settings. The pooled effect size, represented by the dashed line in the plot, suggests a positive overall impact of buprenorphine-based MAT across diverse settings, though the magnitude of the effect varies depending on the specific conditions of each study. Subgroup analyses, implicitly reflected in the inclusion of studies focusing on different patient demographics, EMS settings, and types of MAT, further illuminate the context-specific factors influencing the effectiveness of these interventions. For instance, Hern et al[18] reported higher retention rates in treatment at opioid resource centers (ORCs) compared to non-ORC facilities, highlighting the importance of specialized care environments in supporting ongoing treatment for OUD.

Discussion

The utilization of MAT in the prehospital setting remains underexplored, with limited but promising evidence suggesting that such interventions may enhance long-term patient outcomes. Despite the encouraging preliminary data, there is significant heterogeneity in the medications utilized, the methods of implementation and evaluation, and the extent to which these programs integrate with broader OUD services. This variability is not unexpected, given the ongoing debate regarding the integration of addiction care within EMS. However, these challenges should not be perceived as insurmountable barriers to the expansion of prehospital MAT programs. Existing data indicate that prehospital MAT is not only safe, with minimal adverse outcomes reported, but also effective in improving access to care and increasing the likelihood of subsequent treatment engagement among OUD patients.[4,14,16,17] Evidently, implementation of MAT must

be informed by EMS system specific factors such as local protocols, barriers to care, and the specific types of clinicians authorized to dispense buprenorphine or other therapies.

Several studies have highlighted the importance of initiating pharmacological management of SUD in the prehospital environment, with particular attention to the administration of buprenorphine, methadone, and naltrexone in the ED.[6,15,18,22,23] As emergency physicians become more proficient in the use of these medications, their application in the prehospital context by EMS personnel represents a logical extension. However, the widespread implementation of buprenorphine administration by EMS necessitates the acceptance of this practice by advanced life support clinicians, agency medical directors, and OUD patients alike. Transitioning OUD care to the prehospital setting could offer a more patient-centered approach, particularly for individuals who have limited interaction with the healthcare system and might otherwise decline care beyond acute overdose management. For patients who refuse transport to the ED, alternative prehospital interventions, such as take-home naloxone programs and facilitated linkage to community-based SUD clinics and resources, may provide critical support. The success of prehospital MAT programs appears to be closely linked to the availability and accessibility of these follow-up resources, which are essential for addressing racial and geographic disparities in treatment outcomes. The high rate of care refusal following overdose treatment may reflect patient and systems-specific factors.[27,28] In addition to the patient reaching a state of contemplation and engagement, the lack of available buprenorphine or other medication assisted strategy may serve as a disincentive for patients who might otherwise consent to hospital transport. Indeed, MAT programs should exist within a broader landscape of harm reduction programs that can be tailored to patient presentation, condition, and EMS system structure.

The administration of a single dose of buprenorphine by EMS for opioid withdrawal has been shown to effectively alleviate withdrawal symptoms.[18,21–24,26] This not only reduces patient discomfort—especially following naloxone administration—but may also diminish the immediate compulsion to use opioids to relieve withdrawal symptoms.[29] By mitigating these symptoms, EMS-administered buprenorphine may extend the period of abstinence, thereby providing patients with the clarity and motivation needed to pursue further treatment. Nevertheless, there is currently no consensus on the optimal dosage of buprenorphine in this setting, highlighting the need for future studies to explore patient outcomes across various dosing regimens. For example, the Maryland Institute for Emergency Medical Services Systems (MIEMSS) authorizes mobile integrated health clinicians to administer an initial sublingual dose of 16 mg of buprenorphine, up to a total of 24 mg.[30] In many jurisdictions, EMS protocols may not permit any type of buprenorphine titration. Establishing an evidence based dose for prehospital induction would contribute meaningfully to existing standards of care for EMS initiated MAT.

In addition to the potential for MAT to address OUD in the prehospital setting, there is emerging evidence that medications traditionally used for SUD treatment, such as buprenorphine and methadone, may serve as viable alternatives to conventional opioid analgesics in prehospital pain management.[18,19,22] Notably, only one study has examined the use of buprenorphine as a prehospital analgesic,[19] underscoring the need for further research in this area.

To ensure the safe and effective use of these medications, specialized training for EMS personnel is essential. Until further research provides a robust evidence base to inform standardized protocols, consultation with medical control should be required when administering these treatments in the field. As the body of evidence grows, it will be crucial to refine these protocols in collaboration with local resources to ensure that prehospital care is both comprehensive and responsive to the evolving needs of diverse patient populations.

The extension of on-scene time observed with the administration of buprenorphine by EMS personnel raises important considerations regarding its impact on EMS operations and patient outcomes. It is essential to note that previous research has consistently demonstrated a weak correlation between scene time and patient outcomes in many emergency scenarios, particularly in non-life-threatening conditions.[31,32] Thus, while the administration of buprenorphine may result in a modest increase in on-scene time, this should not be construed as a negative consequence, especially when balanced against the substantial benefits of initiating OUD treatment in the prehospital setting.

From a system-level perspective, the implementation of prehospital buprenorphine administration, coupled with robust care coordination and harm reduction strategies, may enhance overall EMS system efficiency. By addressing the underlying drivers of recurrent EMS utilization, such as untreated OUD, these interventions have the potential to reduce call volumes over time. Patients who receive buprenorphine in the prehospital setting are more likely to engage in

follow-up care, which may decrease the frequency of emergency calls related to opioid withdrawal or overdose. This anticipated reduction in call volume would allow EMS resources to be more strategically deployed, thereby improving response times and availability for other emergent situations. Moreover, the integration of harm reduction strategies, such as naloxone leave-behind programs and on-scene buprenorphine administration, positions EMS as a critical component of the continuum of care for OUD patients. These interventions not only provide immediate symptom relief but also facilitate timely connections to long-term treatment and support services, which are crucial for sustained recovery. This approach aligns with public health objectives that prioritize comprehensive, patient-centered care, addressing both the acute and chronic dimensions of OUD. The theoretical benefits of these interventions extend beyond individual patient outcomes to the broader EMS system. By decreasing the incidence of preventable, high-frequency calls, EMS systems may experience enhanced operational efficiency, ensuring that resources are readily available for high-acuity cases. Furthermore, the improved patient outcomes resulting from early intervention and coordinated care may contribute to a reduction in overall healthcare expenditures, as patients are less likely to require recurrent emergency services or prolonged hospitalizations.

The incorporation of care coordination and harm reduction strategies into EMS protocols represents a paradigm shift in the delivery of prehospital emergency care. Historically, EMS has been centered on rapid stabilization and transport to definitive care. However, the ongoing opioid crisis underscores the need for EMS systems to adopt a more holistic approach that addresses the complex, multifaceted needs of patients with OUD. The administration of buprenorphine in the field is a critical first step in this direction, offering immediate therapeutic intervention that can serve as a gateway to long-term treatment. Effective care coordination is essential to ensure that the benefits of prehospital interventions are sustained beyond the initial encounter. After administering buprenorphine, EMS personnel can play a pivotal role in linking patients to community-based treatment resources, such as substance use disorder clinics, peer support programs, and other recovery services. Establishing these connections is crucial for maintaining the continuity of care initiated in the prehospital setting, thereby reducing the risk of relapse and improving long-term treatment retention.

The success of prehospital buprenorphine programs is contingent upon strong partnerships between EMS agencies, dispatch centers, healthcare providers, and community organizations. Collaborative efforts are necessary to create efficient referral pathways, enabling patients to transition smoothly from emergency care to ongoing treatment and support. Such integration not only enhances patient outcomes but also strengthens the overall capacity of the healthcare system to address the opioid crisis effectively.

Limitations

This review has several limitations. First, the literature search was performed using only a single database, which increases the likelihood of missing relevant studies that may be indexed elsewhere. Expanding the search to include additional databases would help address this issue. Second, restricting the search to studies published from 2014 onward may have led to the exclusion of earlier, foundational research that could be critical to understanding the broader context. Third, although efforts were made to assess the quality of the included studies, meta-analyses inherently depend on the methodological soundness of the individual studies. Differences in study designs are a frequent source of heterogeneity. Fourth, the process of manual screening and data extraction introduces the possibility of human error or bias, which could be reduced by employing dual independent reviewers at all stages of the review. Fifth, while standard parameters like confidence intervals and statistical tests were used to assess heterogeneity and publication bias, these methods still involve a degree of subjectivity. A more detailed quantification of specific clinical endpoints could enhance the practical application and implementation of the findings. EMS system structure represents another potentially confounding variable. There is no unified protocol for EMS initiated MAT, and states may have individual, specific restrictions on which types of EMS clinicians are authorized to administer buprenorphine. EMTs and paramedics not affiliated with an existing Mobile Integrated Health program may therefore be excluded from participation in MAT programs.

Conclusion

This review highlights the underexplored yet critical role of medication-assisted treatment in the prehospital management of opioid use disorder, presenting evidence that suggests its potential to improve patient retention and long-term

treatment outcomes. Despite promising findings, the heterogeneity in implementation strategies, variability in medication use, and the presence of operational challenges—such as geographic and racial disparities—pose significant barriers to the widespread adoption of prehospital MAT. The reviewed data consistently indicate the safety of these interventions; however, the extension of on-scene time and the requisite specialized training underscore the need for further empirical investigation and the development of refined protocols. Future research should prioritize the resolution of these operational barriers by establishing evidence-based consensus on optimal dosing regimens and exploring the dual role of MAT medications for both OUD management and analgesia in the prehospital context. Additionally, comprehensive prospective studies are necessary to assess the impact of prehospital MAT on health disparities and to optimize its integration within EMS frameworks. The development of rigorous, standardized guidelines supported by ongoing collaboration with local resources and continuous evaluation will be essential to ensure that EMS personnel are adequately prepared to implement MAT effectively, thereby enhancing the continuum of care for OUD patients in the prehospital environment.

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Author Contributions

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