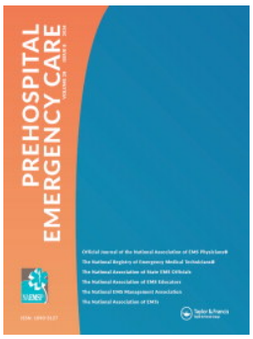

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Feasibility and Safety of a Paramedic-Directed Prehospital Buprenorphine Initiation Protocol for Acute Opioid Withdrawal

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ABSTRACT

Objectives: The epidemic of opioid use disorder (OUD) remains pervasive in the United States. In an effort to increase the availability and timeliness of medications for opioid use disorder (MOUD), several agencies in the United States (US) offer buprenorphine by prehospital providers to selected patients, though published data remains limited. We describe the preliminary safety and feasibility of training all paramedics within a single agency to administer buprenorphine in the field without online medical control to simultaneously treat opioid withdrawal and initiate MOUD.

Methods: Using data from an ongoing quality assurance (QA) database, cases were retrospectively reviewed. Inclusion criteria included administration of buprenorphine by paramedics; cases were excluded if administered prior to EMS arrival on scene (i.e., the patient was given buprenorphine by a bystander or took their own). Data were entered into a REDCap database as part of the ongoing QA process. The primary reported outcome was administration of buprenorphine without complications. Complications were defined as any adverse effects from the administration of medication, including but not limited to new or worsening opioid withdrawal symptoms.

Results: In total, 121 patients met inclusion criteria, 82 were treated for naloxone-induced withdrawal and 39 for withdrawal due to opioid cessation. There were no cases of precipitated withdrawal or worsening of patient condition observed. Adverse effects were limited to three cases of nausea and vomiting post-administration, all of which were present prior to buprenorphine administration. No patients met the primary outcome of adverse effects from medication administration.

Conclusions: In a single prehospital system, the use of buprenorphine appears to be a feasible and safe strategy for treating patients experiencing acute opioid withdrawal.

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Introduction

The epidemic of opioid use disorder (OUD) continues to be a source of substantial morbidity and mortality in the United States (U.S.), claiming 74,702 lives in 2023 (1,2). Additional work is needed to understand how to better support patients with OUD. One large epidemiologic study suggests an opportunity to lower mortality by as much as 50% with targeted interventions (3). Intervention following a non-fatal overdose may represent an opportunity where patients might be more amenable to seek and accept treatment (3,4). After a non-fatal overdose, mortality at one year is estimated at 5-10% (5–7). Of those, 20% will die within the following first month, and 5% in the first 48 h, demonstrating the critical nature of urgent intervention (5). Patients who receive naloxone prehospital demonstrate a 13-fold increase in mortality compared to the general public (8).

Timely access to medications for opioid use disorder (MOUD) is a positive predictor of retention in treatment (9,10). In an effort to expand access, providers outside of specialists in addiction medicine increasingly offer MOUD to more patients (11). There have been several descriptions of prehospital use of buprenorphine for treatment of patients with OUD (12,13). These have a documented rate of precipitated withdrawal of less than 1%, suggesting that it can be done safely in the prehospital setting (12,14,15).

Our objective was to describe the preliminary safety and feasibility of training all paramedics within a single agency to administer buprenorphine in the field without online medical control to simultaneously treat opioid withdrawal and initiate MOUD. In addition, every paramedic in our system carries buprenorphine, similar to all other medications on formulary.

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Methods

Study Design and Setting

The data included in this manuscript were collected as part of standardized quality assurance (QA) processes *via* retrospective chart reviews of patients treated with buprenorphine prehospital (see Selection of Participants). Hennepin EMS is an urban/suburban Emergency Medical Services (EMS) system that covers a service area of 266 square miles and 14 municipalities within Hennepin County, Minnesota, USA. The EMS system is affiliated with Hennepin County Medical Center (Hennepin Healthcare), a Level I Adult and Pediatric Trauma Center and county safety net hospital in downtown Minneapolis. This agency serves a resident and visitor population of nearly 1.5 million people. Ambulance responses are tiered with both advanced life support (ALS) and basic life support (BLS) ambulances. Hennepin EMS employs approximately 185 paramedics for ALS ambulances and 8 EMTs for BLS ambulances. Two paramedics staff each ALS ambulance, and each BLS ambulance is staffed by two emergency medical technicians (EMT). The service responds to nearly 100,000 annual calls for service; approximately 64,000 of these result in transport to a hospital. This project was deemed to be QA by the local institutional review board as this was part of the typical QA process, performed *via* retrospective chart reviews, and deemed minimal risk (16). Therefore, there was no requirement for informed consent. Additionally, we report our findings in accordance with Standards for Quality Improvement Reporting Excellence (SQUIRE) 2.0 guidelines (17).

Responses for patients with opioid use disorder represent an important volume within this agency. During the one year time period after Hennepin EMS deployed buprenorphine in June 2023, there were 2,169 encounters of patients who received naloxone prehospital which includes administrations prior to EMS arrival (i.e., BLS Fire Department First Responders, police, and bystanders) as well as from EMS. There were also 373 patients who had a Primary or Secondary Impression of "Opioid Related Disorders" in which naloxone was not administered.

Protocol Development and Training

The decision to add buprenorphine to the EMS formulary and protocols was initially explored after a multi-disciplinary discussion on the topic of improving collaborative care for patients with OUD. This included representatives with backgrounds in EMS, emergency medicine, medical toxicology, pharmacy and therapeutics, addiction medicine, and internal medicine. Unlike previous studies, the protocol reported here provided buprenorphine for patients with lower COWS scores, included patients as young as 14, included pregnant women, and reflects a paramedic-driven protocolized approach.

The protocols focus on naloxone-induced withdrawal symptoms and opioid withdrawal due to opioid cessation. For those experiencing naloxone-induced withdrawal, the medication is to be administered within 30 min of the last dose of naloxone. The importance of the temporal relationship between naloxone and buprenorphine administration was stressed during training. Additionally, for those experiencing withdrawal due to cessation of opioids, they should not have had any opioids for the last 24 h. The patients were all screened as part of their clinical evaluation to ensure that they were not part of a methadone program and had not ingested methadone within the last 72 h. The temporal criteria described in the previous statements were implemented to minimize precipitation of withdrawal from buprenorphine therapy. If those criteria were met and they had a COWS score of 5 or more, they were offered a single dose of 16 mg buprenorphine per os (PO).

Prior to implementation across the entire system, there was service-wide education of the approximately 171 paramedics and 8 EMTs. This consisted of a 35-minute in-person discussion with a fellowship trained EMS Physician Medical Director. It was held at a semiannual educational session for existing staff and was incorporated into the new-hire training process for those who joined the service afterward. Paramedics were trained on when and how to safely administer buprenorphine to appropriate patients. Although EMTs are not authorized to administer buprenorphine, they received the same training to improve the service-wide understanding and awareness of MOUD. The key points which were covered in this training can be found in Supplemental File Appendix 1. Additionally, the protocol for appropriate use of buprenorphine can be found on the Hennepin EMS Protocol website along with the buprenorphine medication reference sheet (18). The protocol dose of buprenorphine is 16 mg. In June of 2023, the EMS formulary was updated to include buprenorphine for the paramedics and it was made available to appropriate patients.

Each paramedic in the service carries 16 mg of buprenorphine within their controlled medications pouch on their person. Specifically, this is carried as two individually packaged 8 mg-2 mg (buprenorphine-naloxone) tablets. This allows for a par level of two doses per ambulance which is consistent with other medications for the service. The sublingual tablet formulation of buprenorphine was utilized (versus sublingual film) due to affiliated hospital and state insurance formulary as well as cost. The COWS threshold of 5 or more & the inclusion of pregnant patients were decided upon after discussion with experts in Addiction Medicine & Toxicology. We were seeking to remove as many barriers to access and care as possible.

Selection of Participants

Participants were screened for inclusion in the QA process if charts included buprenorphine as a documented medication administered by EMS personnel. If patients received a dose of buprenorphine during different encounters with EMS, each encounter was recorded separately. The time period reported in this manuscript is between June 16, 2023 and June 16, 2024. The date was selected arbitrarily as the first year following implementation of this protocol and buprenorphine availability for the service. It should be noted

that the system EMS protocols define adult patients as any patient age 14 and over. In Minnesota, there is a statute that allows for minors to provide valid consent for medical treatment in situations surrounding sexual health or substance use (19).

Additionally, the protocols allow for buprenorphine to be administered to qualifying pregnant patients. These decisions were made after careful discussions with subject matter experts about the risks and benefits of buprenorphine in special populations.

Methods of Measurement

A single trained abstractor (HD) performed structured reviews of data from ESO (ESO Solutions Inc., Austin, Texas, USA) and entered data into REDCap as a part of a standardized QA process to monitor safety of the protocol given its novelty in our system and is consistent with other aspects of QA within the EMS service (20). The system was queried approximately weekly by the trained abstractor, or more frequently if potential concerns were brought forward. The review included timestamps, other interventions including medication administrations, and narrative portions of the chart. For patients transported to Hennepin County Medical Center, additional clinical information was reviewed in the hospital record through Epic (Epic Systems Corporation, Verona, WI). Follow up information was not obtained for patients transported to other hospitals and therefore those patients were excluded in calculations of proportion of patients in treatment. As there are additional privacy protections for Addiction Medicine notes, there was some follow-up information obtained through collaboration with colleagues in Addiction Medicine at our institution. The prescription drug monitoring program (PDMP) was also checked for prescriptions of MOUD to identify follow-up outside the institution. This was conducted to better understand the effectiveness of this prehospital intervention.

The variables in the QA database included: dispatch date and time, age, race, primary impression, buprenorphine indication (opioid cessation versus naloxone induced withdrawal), Clinical Opioid Withdrawal Scale (COWS) score, patient response, buprenorphine complications, transport location, subsequent naloxone administration, time in the emergency department (LOS), disposition location, peer navigator consult order, follow up appointments, treatment program enrollment, buprenorphine prescriptions at 30 days, subsequent EMS contact for overdose requiring naloxone and death at 30 days. These definitions were broad in an attempt to capture all potential aspects of care and complications.

Outcomes

The primary reported outcome was administration of buprenorphine without complications. This was defined as any adverse effect from the administration of medication, including but not limited to new or worsening opioid withdrawal symptoms as defined by the attending paramedic. This was obtained from the prehospital chart documentation which requires documentation of how the intervention affected a patient's condition as either "improved," "no change," or "worsened." Additional information was obtained from the required intervention complication documentation and charted narrative report entered by the EMS providers. Hospital charts, when available, were screened for any reported signs/symptoms consistent with possible precipitated withdrawal or allergic reaction.

Secondary outcome measures include: indication for the administration of buprenorphine, repeat naloxone dosing after buprenorphine administration, possible complications of prehospital administration that were identified in-hospital, the number of patients who received a prescription for buprenorphine after transport from the Emergency Department (ED), the number of patients who engaged with peer recovery services in the ED, repeat prehospital encounters that include naloxone administration within 24 h and 30 days, the number of patients who were known to be engaged in ongoing MOUD, and death at 30 days.

Statistical Analysis

We used descriptive techniques to analyze the data, presenting counts and percentages or medians and interquartile ranges (IQRs) as appropriate. All statistical analyses were performed with Stata (version 15; StataCorp, College Station, TX).

Results

Characteristics of Study Subjects

A total of 129 records with buprenorphine documentation were screened for inclusion and 8 were excluded. There were 7 charts that indicated that buprenorphine was taken prior to EMS arrival (e.g., patient's home medication) and 1 patient initially accepted the medication then subsequently spit it out (Figure 1). Of the 121 patients who received buprenorphine from EMS, the median age was 34 years (IQR 27-41, range 19-82 years). The primary charted EMS impressions were opioid related disorder (42%) or overdose unspecified (50%) for the majority of cases (Table 1). Additional EMS primary impressions are outlined in Supplementary Table 1. There were 82 cases of buprenorphine administration for naloxone-induced withdrawal and 39 for withdrawal due to opioid cessation (Table 2). Of the 82 cases of buprenorphine following naloxone administration, 65 were noted to have received naloxone prior to EMS arrival, either by bystanders, fire, or police crews (79%) and 17 were administered by paramedics (21%). There were 21 COWS scores missing from documentation. Of the 100 scores recorded, the median COWS score was 18 (IQR 12-24; range 7-41), with 45% being categorized as having moderate withdrawal. The COWS scores were not required to be recorded post-administration and therefore were not included in the analysis.

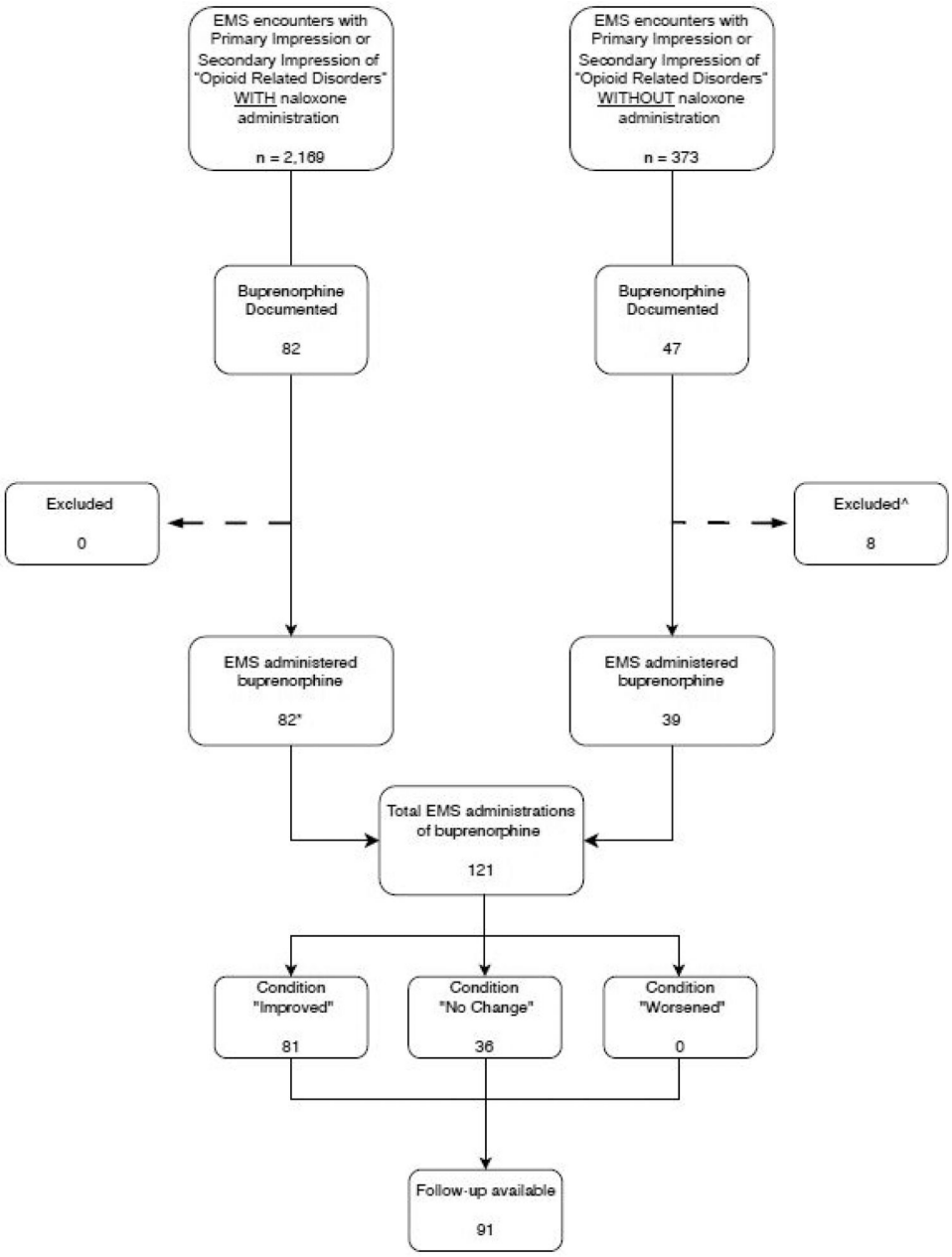

Figure 1. Flow chart of patient enrollment.
* Of the 82 patients who received buprenorphine, 65 received naloxone before EMS arrival (bystanders, First Responders, etc.) and 17 received naloxone from EMS.
^ 8 cases were excluded: There were 7 charts that indicated that buprenorphine was taken prior to EMS arrival (e.g., patient's home medication) and 1 patient initially accepted the medication then subsequently spit it out. All 8 of the excluded charts were calls for opioid cessation related withdrawal.

Table 1. Patient demographics, characteristics.

Variables	Value
Female Gender	50/121 (41.32%)
Male Gender	71/121 (58.68%)
Race	
American Indian/Alaska Native	13/121 (10.74%)
Black, Non-Hispanic	30/121 (24.79%)
Hispanic/Latino	7/121 (5.79%)
Native Hawaiian/Pacific Islander	1/121 (0.83%)
White	42/121 (34.71%)
Other/Unknown	28/121 (23.14%)
Age, median (IQR), y	34 (27,41) range 19-82
Primary EMS Impression	
Opioid Related Disorder	51/121 (42.15%)
Overdose, unspecified	60/121 (49.59%)
Other[a]	10/121 (8.26%)

[a]See supplementary table.

Main Results

There were no documented cases of a patient who experienced new-onset withdrawal symptoms or worsening of opioid withdrawal symptoms after the administration of buprenorphine by paramedics. There were 3 cases of patients who experienced nausea and vomiting both before and after the administration of buprenorphine, and each case was documented "no change" per paramedics post buprenorphine administration. Therefore, there were no documented new complications from buprenorphine administration while in the care of the paramedics or in the single ED for which outcomes were available (Hennepin County Medical Center Emergency Medicine). Eighty-five (70%) of

Table 2. Buprenorphine administration.

Variables	EMS
Indications	
Naloxone Induced Withdrawal	82/121 (67.77%)
Opioid Cessation Withdrawal	39/121 (32.23%)
Naloxone Administration	
N/A (Not Naloxone Related)	39/121 (32.2%)
Prior to Arrival (Fire, PD, Bystander)	65/82 (79.27%)
By EMS	17/82 (20.73%)
COWS (median, IQR)	18 (12, 24) range 7-41
<5	0/121 (0%)
5-12 (Mild)	25/121 (20.66%)
13-24 (Moderate)	54/121 (44.63%)
35-36 (Moderate - Severe)	17/121 (14.05%)
>36 (Severe)	4/121 (3.31%)
Not documented	21/121 (17.35%)
Patient Response	
Improved	85/121 (70.25%)
No Change	36/121 (29.75%)
Worsened	0/121 (0%)
Complications	
None	118/121 (97.52%)
Nausea/Vomiting	3/121 (2.48%)
Transport Destination	
Hennepin Healthcare System	91/121 (75.21%)
Other Hospital	29/121 (23.97%)
Not Transported[a]	1/121 (0.82%)
Time of Day of EMS Call	
AM (07:00 - 14:59)	40 / 121 (33.1%)
PM (15:00 - 22:59)	54 / 121 (44.6%)
Night (23:00 - 06:59)	27 / 121 (22.3%)

[a]One patient was left at the scene after a medical control call.

121 patients had a documented improved response to buprenorphine, 36 (30%) had no change, and no (0%) patients had a worsened response. For the three patients who experienced continuing nausea and vomiting: The first and second patient both had elevated COWS scores of 15 and 37 (with anxiety, vomiting, and tachypnea as primary symptoms) initially and continued vomiting after buprenorphine administration. There was no follow up COWS documented for either patient. The third patient vomited after administration (was severely nauseated prior) and received droperidol for nausea with improvement.

Secondary Results

Of a total of 121 patients, 91 (75%) were transported to Hennepin County Medical Center, 29 (24%) were transported to other local hospitals, and 1 (1%) was left on scene after discussion with medical control. Almost half (45%) of calls related to naloxone administration occurred during the PM shift (15:00 to 22:59). The ED follow up was available for the 91 patients transported to Hennepin County Medical Center and is available in Table 3. The median ED LOS was 355 min to discharge, regardless of discharge location. While in the ED, only 2 encounters had naloxone re-administered (3%) for bradypnea. Peer navigator consult orders were placed for 15 of 91 (16%) patients during the ED visit. Approximately half of patients (47%) were discharged with a new buprenorphine prescription written by an ED provider. Patients discharged to various locations including home (47%), shelters/street (27%), detox (10%), jail (8%), or other location (2%). Several required inpatient medical admission for various indications (5%). No patients had repeated EMS contact with Hennepin EMS requiring naloxone administration within 24 h of ED discharge and 17 (19%) had repeated contact with naloxone administration within 30 days. There were 11 patients (12%) known to be engaged in treatment (inpatient or outpatient programs) or had ongoing MOUD at 30 days. There were no documented patient deaths at 30 days.

Discussion

We found that paramedics were able to safely administer buprenorphine in the prehospital setting after a 35-minute training session using a paramedic-driven protocol. Unlike previous descriptions of prehospital buprenorphine, the protocol reported here provided buprenorphine for patients with lower COWS scores, included patients as young as 14, included pregnant women, and reflects a paramedic-driven protocolized approach.

Existing literature examining the use of prehospital buprenorphine is sparse. The Bupe FIRST EMS Study by Carroll et al., examined three patients from a case series of 21 patients. The investigators demonstrated a similar rate of improvement and no complications, though all three cases had to be routed through an online medical control physician familiar with the initiative (12). To our knowledge, our study is the first that uses a paramedic-driven protocol. A follow up retrospective matched cohort study of 230 patients by Carroll et al., evaluating adherence to outpatient treatment programs demonstrated significantly greater odds of patients engaging in an opioid use disorder treatment program at 30 days of EMS contact for opioid overdose and prehospital buprenorphine administration (21). Hern, et al., published a similar case series of three patients experiencing opioid withdrawal in the prehospital setting. Like the two aforementioned studies, these administrations required the use of online medical control prior to administration and described significantly longer training times versus ours (4 h versus 35 min) (13). A subsequent publication included a larger sample of 36 patients and reported no precipitated withdrawal and positive rates of treatment retention at short term follow up of 30 days (14). Compared to the existing U.S. literature on prehospital buprenorphine, our study differs in several aspects. As we report on 121 subjects with no episodes of precipitated withdrawal, our data contribute substantially to the safety of prehospital buprenorphine. Second, our paramedics underwent 35 min of education prior to deployment to allow for administration without an online medic control call, highlighting the feasibility of adopting such a protocol in similar EMS systems and streamlining care for patients undergoing the extremely unpleasant effects of opioid withdrawal. Last, this study included both naloxone induced opioid withdrawal as well as opioid withdrawal secondary to opioid cessation, suggesting prehospital buprenorphine may be effective and safe for opioid withdrawal regardless of the cause.

The goal of this prehospital administration was two-fold. Immediately, it is to help manage patients' symptoms of opioid withdrawal. Additionally, the patients will arrive at the

Table 3. Patient follow-up.

Variables	EMS
Repeat EMS Contact with Naloxone	
Within 24 h	0/91 (0%)
Within 30 days	17/91 (18.68%)
ED LOS median, in minutes (IQR)[a]	355 (251-541) range 27 - 1142
ED Disposition[a]	
Home	43/91 (47.25%)
Shelter/Street	25/91 (27.47%)
Detox Facility	9/91 (9.89%)
Jail	7/91 (7.69%)
Inpatient Admission	5/91 (5.49%)
Other[b]	2/91 (2.2%)
Redose of Naloxone in ED[a]	
N/A (Not Naloxone Related)	27/91
Yes	2/64 (3.13%)
No	62/64 (96.87%)
Peer Navigator Consultation in ED[a]	
Yes	15/91 (16.48%)
No	71/91 (78.02%)
N/A (Admitted)	5/91 (5.5%)
Buprenorphine Prescription at Discharge[a]	
Yes	43/91 (47.25%)
No	48/91 (52.75%)
Retained in treatment or ongoing MOUD at 30 days[a]	
Yes	11/91 (12.08%)
No/Unknown	80/91 (87.91%)
Death at 30 days[a]	0/91 (0%)

[a]ED/treatment specific follow up was only available for the patients who were transported to Hennepin County Medical Center.
[b]Other includes 1 patient who eloped and 1 who was sent directly to Addiction Medicine Clinic..

ED having completed most, if not all, of their buprenorphine induction for MOUD. Afterward, they can be discharged from the ED with a bridging prescription of buprenorphine and information for a clinic where they can continue their follow-up.

One way that the hospital affiliated with the EMS service attempted to improve access to care was to contract with a community-based recovery organization to provide Certified Peer Recovery Specialists (CPRS) to consult on patients during their time in the ED. This was made available to any patients with a substance use disorder (SUD) but was specifically incorporated for those patients with OUD. The patients had an opportunity to speak with a CPRS who could provide the patient with numerous options to engage in ongoing care and treatment. This service was utilized when available, though did not have 24-h coverage.

Our EMS service has very high transport rates for patients with OUD. This is at least partially because when buprenorphine was added to the EMS formulary, the system had a protocol that required all patients who receive naloxone be transported to the ED for ongoing evaluation and monitoring. This may have included utilizing a Peace or Health Officer Hold (e.g., law enforcement officer) to mandate transport and evaluation through the state statute allowing such for emergencies surrounding substance use or mental health concerns. The transport decision was not impacted by the administration of prehospital buprenorphine. The EMS system reevaluated this practice and ultimately elected to cease this practice on March 4, 2024. The change in stance was made in response to new internal ED data regarding the patient requiring repeat doses of naloxone. Although that decision was not related to prehospital buprenorphine implementation, it did occur about 9 months after the initiation of buprenorphine in this EMS system. Despite this change, approximately 90% of patients who receive naloxone continue to be transported to a hospital.

The standard dose of 16 mg buprenorphine came from a discussion with internal subject matter experts from Addiction Medicine, Toxicology, & Pharmacy. This dose is also consistent with other recommended protocols and prehospital studies showing it was well tolerated, decreased withdrawal symptoms and was associated with a nearly 6-fold increase in the odds of engagement with treatment within 30 days (15,21). After the initial dose of 16 mg was administered, if the patient needed additional buprenorphine for ongoing withdrawal symptoms, it was to be given in the ED after transport. This was chosen as the transport times for this prehospital service are typically quite short (i.e., less than 12 min).

The protocols were intentionally created to allow as many patients as safely possible the chance to take buprenorphine. It was also highlighted that all patients 14 years old and over are treated with the adult protocols and that there is no exclusion for pregnancy. While other prehospital buprenorphine protocols had an exclusion for pregnancy, we found no reason to exclude them. These criteria were meant to be inclusive for patients and practical for prehospital personnel.

As the prehospital literature to this point has been growing, it has not included protocols that are paramedic-driven with a threshold of a COWS score of at least 5, included all patients aged 14 and older, and no exclusion for pregnancy. While there is theoretical risk of precipitated withdrawal associated with high dose buprenorphine induction with a low COWS score, the subject matter experts with whom we consulted in the creation of this protocol felt the risk was

low and that paramedics had the necessary medications and protocol guidance to treat any worsening withdrawal. Additionally, we set clear guidance for timing of buprenorphine administration after naloxone. In an effort to ensure ongoing safety and monitoring, there was a predefined monitoring plan for QA in which the data was to be abstracted by the EMS Pharmacist (HD).

It should be noted that two patient cases had naloxone administered in the ED after buprenorphine administration. Both cases were encounters with the same patient on different dates and times and in both cases, naloxone was administered for bradypnea and hypoxemia with some positive response in one of the two encounters. Concern for polysubstance use was present. This did not occur in any other patient in this cohort during this timeframe. It remains unclear the mechanism behind these incidents in the same patient.

When possible, there was information gathered on their discharge prescription for buprenorphine from the ED. This was an area in which the QA data was utilized after the first 50 cases in an attempt to improve the prescribing of bridge prescriptions. After the first 50 prehospital cases, it was found that about 50% of those patients had a prescription for buprenorphine upon discharge from the ED. This information was shared with the ED faculty with recommendations on ways to increase prescribing. This feedback may be part of why this program has approximately 12% of patients who were transported to Hennepin County Medical Center to be in either outpatient or inpatient treatment or have a known ongoing buprenorphine prescription at 30 days. Although the data surrounding retention in treatment after prehospital buprenorphine is sparse, the Bridge notes that 24% of patients were retained in treatment at 30 days with their first 100 doses (15).

Limitations

There are several limitations to this study. These data are limited to a single EMS service. All the data was compiled by a single abstractor as part of a QA initiative. Comprehensive substance testing was not available for all patients and the possibility of polysubstance use is quite high. Therefore, it is not possible to know exactly which substance(s) were present prior to EMS arrival in this cohort of patients.

It is also possible our study was underpowered to detect adverse events. Though we observed no instances of precipitated withdrawal, it is possible with additional patients cases would occur. Furthermore, our definition of precipitated withdrawal was qualitative only. Future work should focus on obtaining higher quality data and a more robust assessment of precipitated withdrawal to better characterize the safety of this practice. The ED complications were not standardized during collection and therefore were judgment of the clinician abstractor, which may not have captured all complications.

Within the EMS charting system, the options for patient responses and complications are standardized and nonspecific and thus the single abstractor had to rely on these documentation choices as well as a narrative to determine the incidence of new or worsened withdrawal symptoms. Lack of detailed documentation and follow up COWS score limited the ability to elaborate on details of cases that had documented effects of nausea and vomiting. Additionally, due to lack of preexisting data sharing agreements with other local hospital systems the exploratory outcome measures were only available if the patient was transported to the hospital that is affiliated with the EMS service. Therefore, there is incomplete follow-up data for those patients transported to other hospitals.

For those patients who receive a consult for CPRS services in the ED, it is possible that they were not seen by the service prior to discharge. As that service does not utilize the same electronic health record (EHR), we were unable to confirm if those consultations took place. It is also possible that both treatment engagement and ongoing MOUD prescription data is missing from the cohort due to inability to see all follow up information or if patients followed up outside of the institution. Public record death data was also unable to be linked and it is possible that death within 30 days occurred that was not recorded in the EHR.

Conclusions

In this description of QA data *via* retrospective chart review in a single prehospital system, the use of buprenorphine is feasible to treat patients experiencing opioid withdrawal (either naloxone-induced or from opioid cessation). This intervention appeared to be safe and resulted in reported clinical improvement of 70% of patients. In these 121 consecutive patients, there were no documented complications following buprenorphine administration. Further research is required to determine if these single service results are applicable on a broader scale.

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Author contributions

AER, NSS, HMD, JBC, MAP, MAM, TMK conceived and designed the study. AER, HMD, NSS, TMK contributed to data collection and monitoring. AER, HMD performed the data analysis. AER, NSS, HMD, MCP, AMS, BED, MAP, AJB, TMK drafted the initial manuscript and made final editorial decisions; all authors contributed substantially to its revision.

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The authors did not use a generative artificial intelligence (AI) tool or service to assist with preparation or editing of this work. The author(s) take full responsibility for the content of this publication.

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Data availability Statement

We are happy to share our aggregated data with a proper data use agreement.

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