

# Evaluation of the BEAT Meth Intervention for Emergency Department Patients with Methamphetamine Psychosis

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**Objectives:** Methamphetamine is the second leading cause of overdose death in America and a leading cause of emergency department (ED) visits. Methamphetamine-induced psychosis is a dangerous and difficult-to-treat consequence of methamphetamine use. We describe the pilot implementation and outcomes of a multimodal treatment intervention for ED patients with methamphetamine psychosis, Beginning Early and Assertive Treatment for Methamphetamine Psychosis (BEAT Meth). **Methods:** BEAT Meth was implemented in an urban safety net health system. The protocol includes early identification and treatment of methamphetamine psychosis, a protocolized hospitalization, and support for transitioning patients to specialty addiction treatment. Patients receiving BEAT Meth were compared with ED patients with methamphetamine psychosis who were discharged. Implementation fidelity was measured to assess feasibility.

**Results:** BEAT Meth patients were nearly 3 times more likely to attend an outpatient specialty addiction appointment in the 30 days after discharge than comparison patients (32% vs 11%,  $P < 0.01$ ). Subsequent ED utilization was common among all patients, and there was no significant difference in 30-day ED return rates between BEAT Meth and comparison patients (28% vs 37%,  $P = 0.10$ ). Exploratory analyses suggested that increased attendance at outpatient treatment reduced ED utilization.

**Conclusions:** BEAT Meth is an intervention framework to support identification, management, and treatment engagement of ED patients with methamphetamine psychosis. Treatment strategies like BEAT Meth are necessary to manage the unique challenges of methamphetamine

addiction. These findings will guide clinical care, program development, and research.

**Key Words:** methamphetamine, methamphetamine use disorder, methamphetamine psychosis, program evaluation, emergency department

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Methamphetamine is the second leading cause of overdose death in America after opioids.<sup>1,2</sup> More than 29,000 Americans die every month of noncocaine psychostimulant overdose,<sup>1</sup> and methamphetamine addiction is becoming more frequent among racial minority and historically underserved communities.<sup>3</sup>

The acuity of the methamphetamine epidemic is highly visible in emergency departments (EDs). Methamphetamine is a leading cause of drug-related ED visits.<sup>4</sup> Patients present to EDs for medical illness; psychiatric symptoms, including paranoia and hallucinations; and violence and agitation. Patients often require intensive management and experience coercive interventions such as physical and chemical restraint.<sup>5,6</sup> Methamphetamine use disorder is correlated with high rates of psychosis, mood symptoms, suicidality, and ongoing ED utilization.<sup>7–9</sup> A methamphetamine use diagnosis is also associated with higher mortality after ED discharge.<sup>10</sup>

Methamphetamine-induced psychosis (MIP) is a consequence of methamphetamine use in which patients experience paranoid delusions, hallucinations, and thought process disorganization beyond the initial period of intoxication. MIP occurs in up to 40% of methamphetamine users, can last for months after use, harbors unique challenges for treatment, and portends worse outcomes.<sup>11</sup> Because the symptoms of MIP are indistinguishable from primary psychotic disorders like schizophrenia,<sup>12</sup> additional findings and history are necessary to discern the diagnosis.<sup>13–15</sup> This diagnostic complexity leads to delays in care and undertreatment of both patients' addiction and psychotic symptoms.<sup>11</sup>

The complications and challenges of managing methamphetamine use and MIP in EDs demand new approaches to care. There has been no description or evaluation of an approach to engaging ED patients with methamphetamine use disorder based on best evidence-based practices for psychostimulant addiction treatment, such as the matrix model or contingency management.<sup>16,17</sup> Precedent exists for the management of other substance use disorders in the ED, as through screening, brief intervention, and referral to treatment and buprenorphine induction for patients with opioid use disorders.<sup>18,19</sup> These interventions generally combine active psychological and pharmacotherapeutic management

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during the ED visit and enhanced care coordination to connect patients to postdischarge care. A recent evaluation of a medication algorithm for treating methamphetamine-induced agitation in the ED did not show a reduction in overall medication burden, and the investigators did not study outcomes related to subsequent treatment engagement or addiction recovery.<sup>6</sup>

We describe and evaluate a pilot intervention to treat patients with MIP called Beginning Early and Assertive Treatment for Methamphetamine Psychosis (BEAT Meth). This evaluation describes the implementation of BEAT Meth and initial patient outcomes in a safety net hospital and health system. Unlike a clinical efficacy trial that intends to create generalizable knowledge, a program evaluation aims to improve local processes and prioritizes descriptions of context, implementation, feasibility, and real-world outcomes under practical conditions.<sup>20</sup> Program evaluations optimize the use of local resources, are cost-effective, may demonstrate financial sustainability, and can be conducted quickly in circumstances with urgent clinical needs.

## METHODS

### Setting

Denver Health is a safety net health system in Colorado. Emergency services at Denver Health Medical Center include a level 1 trauma center for adults, a level 2 trauma center and urgent care for children, an adult urgent care center, and a psychiatric emergency service (PES) providing care in both an 18-bed unit and via consultation to primary emergency medical teams. The PES team has a board-certified psychiatrist, nurses, post-graduate trainees, and advanced practice providers on site 24/7. The total emergency service volume is approximately 130,000 patient encounters per year; PES volume is approximately 5,000 patient encounters per year. The medical center has a 57-bed adult inpatient psychiatric service.

Before the BEAT Meth intervention, from April 2016 through April 2020, the incidence of ED visits with an amphetamine-related diagnosis was 3.1%. Of these 16,706 visits, 5,734 (34%) were evaluated in the PES and 13,168 (79%) resulted in discharge, a discharge rate consistent with national practice.<sup>4</sup> PES patients are evaluated by a psychiatric and multidisciplinary team that provides safety planning, therapeutic interventions, and intensive discharge planning.<sup>21</sup> Most patients are not evaluated by the medical ED before treatment in the PES. Within the health system, patients may be referred to inpatient psychiatry or medicine, a substance treatment program offering American Society of Addiction Medicine level 3.2 withdrawal management and level 3.1 residential treatment, or specialty outpatient addiction services offering contingency management through a matrix model framework.

### BEAT Meth Intervention

BEAT Meth is a pilot multimodal intervention implemented by multiple clinical services in May 2020. The intervention comprises guidance on early diagnosis of MIP in the ED and PES, protocolized medication and behavioral management, ongoing assessment and management in an acute inpatient psychiatric service, and enhanced discharge planning to support connection to addiction treatment with contingency management.<sup>22</sup>

During the evaluation period, patients were evaluated for the BEAT Meth intervention by the PES psychiatrist and referred for treatment if there was evidence of MIP and the patient's clinical status suggested a need for more than 23 hours of acute treatment. The patient was moved to the PES, the psychiatrist ordered initial medication treatment, and the patient was admitted to inpatient psychiatry. Insurance preauthorization was obtained for behavioral health hospitalization when required. On inpatient psychiatry, the patient completed detoxification, received treatment for acute psychiatric and medical symptoms, and benefitted from diagnostic clarification more than 72 hours. The protocol advised a specific medication regimen and targeted medical screening, including for hepatitis C and human immunodeficiency virus. The original protocol envisioned a more robust peer component, including Crystal Meth Anonymous meetings for patients on the hospital unit. However, the COVID pandemic precluded these visits, and no virtual alternative proved viable.

To improve care coordination for these patients, BEAT Meth leveraged an addiction counseling team that was developed to assist with care coordination for patients receiving ED-based buprenorphine induction. This counseling team met with patients, enrolled them in an outpatient addictions clinic, and supported care transition through phone follow-up and logistical support (eg, transportation assistance).

BEAT Meth was introduced and updated through iterative quality improvement. Several changes were made in the protocol since May 2020. For example, the initial protocol included instructions for oral vitamin C and cranberry juice along with a urine pH on day 2 to acidify urine and speed methamphetamine excretion.<sup>23</sup> However, this protocol element did not correlate with lower urine pH or a reduction in the length of stay and was discontinued. The original protocol also included long-acting oral benzodiazepines for each day of the hospital admission. Inpatient providers felt serial doses were unnecessary, and the protocol was accordingly revised to include only a single long-acting benzodiazepine dose in the ED or early in the inpatient stay. A prepopulated order set in the electronic medical record (EMR) was introduced to facilitate ordering protocol elements. Referrals to the addiction treatment team were eventually automated via the medical record. Table 1 describes the BEAT Meth protocol at the end of the evaluation period.

### Evaluation of Feasibility and Fidelity

The feasibility of the protocol was assessed by ascertaining the proportion of BEAT Meth protocol elements that were completed based on an audit of the EMR. For example, the protocol calls for ordering an antipsychotic. An audit of the EMR was conducted to assess whether the medication was ordered and then whether the medication was administered. Because some elements were dropped as the protocol evolved, elements were only included if they were included in the protocol at the time of encounter. Figure 1 lists the protocol elements that were considered in monitoring fidelity to the protocol.

### Comparison Cohorts

We compared patients who were admitted on the BEAT Meth protocol with patients with MIP who were treated in the

**TABLE 1.** Description of the BEAT Meth Intervention

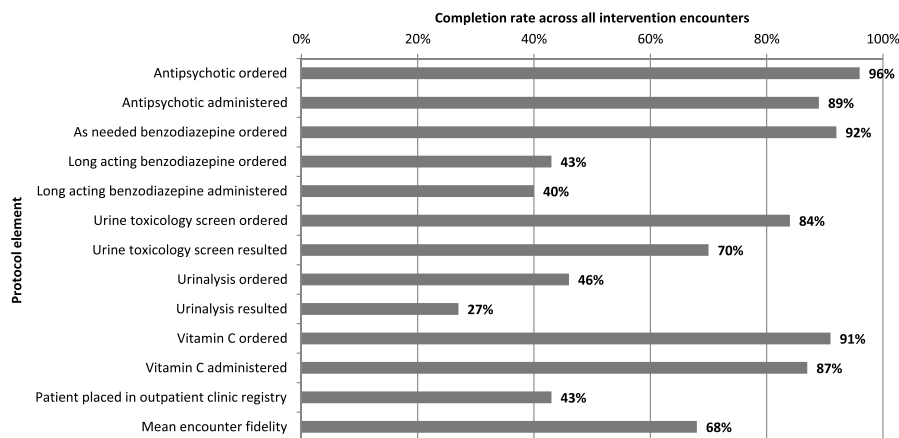
Goals	Tasks	Hours after Presentation to ED
Location: ED/PES		
Treat acute symptoms	<ul style="list-style-type: none"> <li>• Move patient to PES</li> <li>• Prescribe antipsychotic: first dose in ED/PES and continue while symptoms persist                             <ul style="list-style-type: none"> <li>○ Options: risperidone, 1–2 mg po; olanzapine, 5–10 mg po; perphenazine, 4–8 mg po</li> </ul> </li> <li>• Prescribe 1 dose of long-acting benzodiazepine                             <ul style="list-style-type: none"> <li>○ Options: clonazepam, 0.5–1 mg po; diazepam, 10–20 mg po; clorazepate, 15–30 mg po</li> </ul> </li> <li>• Prescribe short-acting benzodiazepines as needed                             <ul style="list-style-type: none"> <li>○ Option: lorazepam, 2 mg po q4h as needed for anxiety or agitation</li> </ul> </li> </ul>	0–6
Exclusion of alternate diagnoses	<ul style="list-style-type: none"> <li>• Exclude concurrent intoxication or withdrawal</li> <li>• Exclude delirium</li> <li>• Exclude primary psychotic disorder</li> </ul>	0–6
Determination of diagnosis	<ul style="list-style-type: none"> <li>• Ascertain diagnosis of MIP</li> </ul>	0–6
Laboratory evaluation	<ul style="list-style-type: none"> <li>• Obtain urine toxicology</li> </ul>	As soon as possible
Consider eligibility	<ul style="list-style-type: none"> <li>• Admit the patient to behavioral health if after 6 hours in the ED/PES their symptoms remain impairing such that they are likely to require more than 24 hours of care and cannot safely be treated in a less restrictive treatment setting</li> </ul>	6
Initiate intervention	<ul style="list-style-type: none"> <li>• Use diagnosis methamphetamine-induced psychotic disorder (F15.959)</li> <li>• Use the standardized methamphetamine psychosis order set at admission</li> </ul>	6
Location: inpatient		
Stabilization of psychiatric and withdrawal symptoms	<ul style="list-style-type: none"> <li>• Continue antipsychotic</li> <li>• Offer double meal portions</li> <li>• Continue to offer as needed benzodiazepine</li> </ul>	6–48
Stabilization of medical symptoms	<ul style="list-style-type: none"> <li>• Assess and treat comorbid conditions</li> </ul>	6–48
Treatment of co-occurring conditions	<ul style="list-style-type: none"> <li>• Screen for infectious diseases based on substance use and sexual behaviors</li> <li>• Assess for tobacco cessation medications</li> </ul>	6–24
Discharge planning	<ul style="list-style-type: none"> <li>• Prepare discharge plan by the second morning of admission</li> <li>• Consider relapse prevention medications</li> <li>• Reduce polypharmacy</li> <li>• Enroll in substance use services, including by placing patient in outpatient treatment registry and evaluating for residential treatment</li> <li>• Confirm diagnosis of MIP</li> <li>• Prescribe time-limited prescription for antipsychotic on discharge if indicated; a typical course is up to 30 days with clear recommendations for discontinuation</li> </ul>	24–48; goal: discharge by 72 hours

ED, emergency department; MIP, methamphetamine-induced psychosis; PES, psychiatric emergency services.

PES and discharged. These evaluation data were obtained based on encounters starting May 1, 2020, through November 30, 2021.

Intervention patients were identified as such if one of the following criteria were met: (1) added to the electronic tracking registry that was used during the initial rollout of the protocol,

(2) received the BEAT Meth order set in the EMR, or (3) identified as a BEAT Meth patient by the addiction counseling team upon referral. These multiple criteria reflect intervention enhancements during the course of the study period. If a patient had multiple BEAT Meth admissions, only the first encounter was used.



**FIGURE 1.** Implementation fidelity of BEAT Meth protocol elements (111 patients).

A comparison cohort included patients who were treated in and discharged from PES with both a urine toxicology result positive for amphetamine and also an amphetamine-related diagnosis (F15.150, -151, -159, -250, -251, -259, -951, -959, F19.950). This more specific description was used to increase the likelihood that the patient's presentation related to methamphetamine. Only a patient's first encounter in the study period was included. Patients were excluded from the comparison cohort if they received the BEAT Meth intervention at any point during the study period (in which case the patient was analyzed in the intervention cohort). PES clinicians were advised to use the MIP diagnosis for all patients considered for the pathway, but the use of the diagnosis was infrequent, and for this evaluation a broader diagnosis set was used.

To assess the effect of the BEAT Meth protocol versus a typical psychiatric admission, supplemental analyses compared intervention patients to a historical cohort of patients who were admitted to inpatient psychiatry with a methamphetamine-related diagnosis. This methodology is described in Appendix 1 (<http://links.lww.com/JAM/A366>).

## Outcomes

The primary outcomes of this evaluation were subsequent ED utilization and successful connection to outpatient addiction treatment. A patient was considered to have returned to the ED if they had an ED encounter within 30 days of discharge from the index encounter. Successful connection to treatment was defined as the patient having an encounter at the health system's local addiction treatment program within 30 days of discharge from the index encounter. Secondary outcomes included subsequent hospital admissions and length of stay in the ED or inpatient units as derived from rooming data in the EMR. Patients lacking follow-up data were presumed to have not returned to the ED, been hospitalized, or attended outpatient treatment.

Covariables included demographic, diagnostic, and treatment information. All data were obtained from the local EMR and managed using Microsoft SQL Service v18 (Redmond, WA) and Python v3.7. Outcome variables were correlated with cohort in unadjusted pairwise analyses, and the effect of covariables was further assessed through multivariable logistic regression. Statistical analyses were conducted with SAS Enterprise Guide v7.1 (Cary, NC). Exploratory analyses were conducted to identify improvement opportunities. Missing data are reported as such in analyses. Established guidelines were followed for reporting.<sup>24</sup> This project was approved as a program evaluation activity by the local quality improvement review committee, which is authorized by the Colorado Multiple Institutional Review Board.

## RESULTS

From May 2020 to November 2021, there were 111 patients admitted on the BEAT Meth protocol. These patients were compared with 275 patients who were seen in the PES and discharged. Table 2 describes these 2 cohorts. Fidelity to the BEAT Meth intervention was excellent: the mean protocol adherence was 68% (SD, ±20%). Figure 1 demonstrates the completion rate for specific protocol elements.

**TABLE 2.** Demographic and Diagnostic Description of Patients by Cohort

	BEAT Meth Intervention (n = 111)	Discharge (n = 275)
Male sex, n (%)	58 (52%)	193 (70%)
Age, median (interquartile range)	34.5 (12.8)	39.0 (15.0)
Race/ethnicity, n (%)		
Non-Hispanic White	62 (56%)	139 (51%)
Non-Hispanic Black	19 (17%)	48 (17%)
Hispanic	21 (19%)	75 (27%)
Other non-Hispanic	7 (6%)	9 (3%)
Insurance, n (%)		
Medicaid	83 (75%)	216 (79%)
Medicare	10 (9%)	25 (9%)
Commercial	2 (2%)	12 (4%)
Uninsured	16 (14%)	22 (8%)
Homeless, n (%)	58 (52%)	135 (49%)
Any ED use in preceding 30 days, n (%)	30 (27%)	89 (32%)
Diagnoses at encounter, n (%)		
Attention deficit hyperactive disorder	14 (13%)	9 (3%)
Anxiety-related disorder	31 (28%)	27 (10%)
Primary psychotic disorder	74 (67%)	63 (23%)
Posttraumatic stress disorder	12 (11%)	16 (6%)
Personality disorder	14 (13%)	36 (13%)
Depressive disorder	20 (18%)	20 (7%)
Bipolar disorder	20 (18%)	22 (8%)
Malingering	2 (2%)	19 (7%)
Any above mental health diagnosis	92 (83%)	140 (51%)
Additional substance use disorder diagnoses, n (%)		
Alcohol	27 (24%)	43 (16%)
Cannabis	44 (40%)	25 (9%)
Cocaine	17 (15%)	18 (7%)
Opioid	27 (24%)	43 (16%)
Hallucinogen	6 (5%)	5 (2%)
Inhalant	1 (1%)	0
Sedative-hypnotic	2 (2%)	5 (2%)
Any additional substance use diagnosis	76 (68%)	101 (37%)

## Primary Outcomes

Patients on the BEAT Meth pathway were less likely to return to the ED within 30 days than comparison patients who discharged from the PES (28% vs 37%), but this difference did not reach statistical significance in pairwise ( $P = 0.10$ ) or multivariable analyses ( $P = 0.055$ ). Patients with recent ED utilization and who were homeless were more likely to return to the ED within 30 days regardless of intervention status.

Intervention patients were significantly more likely to engage in follow-up addiction treatment within 30 days of discharge (32% vs 11%,  $P < 0.01$ ). This difference persisted in multivariable analysis controlling for age, race and ethnicity, insurance status, homelessness, and recent ED utilization. Table 3 describes outcomes by cohort, and Table 4 describes multivariable analyses of the primary outcomes.

## Secondary and Exploratory Outcomes

Additional analyses were used to understand challenges and opportunities in implementation of the intervention. Rates of ED utilization and subsequent hospitalization were high in both cohorts, and the intervention was not correlated with a decrease in ED visits or hospitalization within 30 days. Restraint rates were higher among intervention patients (8% vs 1%,  $P < 0.01$ ). Attendance at outpatient treatment was significantly

**TABLE 3.** Unadjusted Comparisons of Clinical Course and Outcomes by Cohort

	BEAT Meth Intervention (n = 111)	Discharge (n = 275)	Test of Association
<b>Clinical course</b>			
Median length of ED stay, hours (IQR)	9.55 (11.97)	13.48 (10.69)	U = 14.40, P < .0001*
Median length of inpatient admission, hours (IQR)	62.67 (47.11)	—	—
Restraint or seclusion in ED or inpatient, n (%)	9 (8%)	4 (1%)	χ <sup>2</sup> (1) = 8.81, P = 0.002
<b>Outcomes after discharge</b>			
<b>ED return</b>			
Within 7 days	16 (14%)	49 (18%)	χ <sup>2</sup> (1) = 0.43, P = 0.51
Within 30 days	31 (28%)	103 (37%)	χ <sup>2</sup> (1) = 2.76, P = 0.10
<b>Hospitalization</b>			
Within 7 days	5 (5%)	7 (3%)	χ <sup>2</sup> (1) = 0.46, P = 0.50
Within 30 days	12 (11%)	14 (5%)	χ <sup>2</sup> (1) = 3.26, P = 0.07
<b>Follow-up in outpatient addiction treatment</b>			
By 30 days	35 (32%)	29 (11%)	χ <sup>2</sup> (1) = 23.69, P < 0.0001

\*Mann-Whitney U test.

ED, emergency department; IQR, interquartile range.

correlated with ED utilization. Among intervention patients, outpatient treatment attendance was more common (35%) among patients who did not return to the ED within 30 days than among patients who did return to the ED (23%). Intervention patients had a shorter length of stay in the ED, as patients were moved to alternative levels of care more quickly (Table 3). Too few patients were discharged to residential treatment services to inform comparative analyses. There was no observed correlation between the presence of an additional mental health diagnosis and the outcomes, and there was no significant change in intervention fidelity during the study period.

### Supplemental Comparisons

To isolate the effect of the BEAT Meth intervention relative to a nonprotocolized psychiatric admission, we compared intervention patients with psychiatric inpatients with methamphetamine-related diagnoses who were admitted before the intervention period (Appendix 1, <http://links.lww.com/JAM/A366>). Compared with this additional cohort, BEAT Meth patients were significantly less likely to have an ED visit in the 30 days after discharge (28% vs 50%, P < 0.01) and more likely to follow-up with addiction services (32% vs 13%, P < 0.01).

## DISCUSSION

This program evaluation describes the benefits of a pilot multimodal intervention for ED patients with MIP. Patients

receiving the BEAT Meth intervention were nearly 3 times as likely to engage in specialty addiction treatment than comparison patients who received a robust level of emergency psychiatric care. Lessons from this intervention posit promise for the successful treatment of patients presenting to EDs with severe symptoms of methamphetamine use.

Existing models of substance treatment in the ED are poorly suited to addressing MIP. Compared with patients with alcohol or opioid use disorders, patients with MIP have more severe symptoms of agitation, psychosis, and thought process impairment and require a longer period of initial treatment.<sup>5</sup> These symptoms drive substantial ED utilization, and more than one third of patients in this study had another ED visit within 30 days of discharge. This utilization reflects not only the medical and psychiatric symptoms of methamphetamine use but also the presence of social confounders such as homelessness that impede treatment and recovery. Although BEAT Meth did not correlate with reduced ED utilization in primary analyses, these findings suggest that improving outpatient follow-up, addressing the effects of homelessness, and targeting patients with very recent ED utilization should be core components of efforts to prevent ED use among patients with MIP.

Multifaceted interventions such as BEAT Meth are needed to help patients with methamphetamine use disorder access to care regardless of where they present to care. BEAT Meth applies a comprehensive approach to care using our best knowledge of how to treat stimulant use disorders through

**TABLE 4.** Multivariable Correlations with Primary Outcomes

	Emergency Department Return in 30 Days, OR (95% CI)*	Engagement in Outpatient Addiction Treatment by 30 Days, OR (95% CI)†
BEAT Meth intervention	0.61 (0.37–1.01)	<b>4.14 (2.32–7.38)</b>
Age	0.99 (0.96–1.01)	0.99 (0.97–1.02)
Non-Hispanic White race/ethnicity	1.50 (0.92–2.42)	1.79 (0.93–3.44)
Medicaid insurance	0.86 (0.51–1.45)	1.75 (0.84–3.65)
Homeless	<b>1.77 (1.13–2.75)</b>	0.70 (0.39–1.24)
ED visit in previous 30 days	<b>2.26 (1.43–3.59)</b>	1.29 (0.71–2.35)

Statistically significant differences are in bold.

\*Logistical model P = 0.0008.

†Logistical model P < 0.0001.

CI, confidence interval; ED, emergency department; OR, odds ratio.

supportive care transitions, contingency management, and a matrix model of treatment.<sup>16</sup> Although the described protocol is specific to one health system, core components of BEAT Meth are readily replicable. These components include the following:

- early recognition of MIP,
- protocolized medication management,
- withdrawal management of sufficient monitoring and duration,
- clearly defined roles for different services encountering patients with MIP,
- referral processes to connect patients to evidence-based addiction treatment, and
- monitoring of intervention adherence and patient outcomes.

Taken together, these elements make explicit to clinicians and patients that methamphetamine use disorder and MIP are treatable. The practicality and the feasibility of the intervention are demonstrated by a high observed fidelity to protocol and a reduction in ED length of stay. Patients engaged in follow-up at a higher rate even than historical patients with methamphetamine-related diagnoses who were admitted to inpatient psychiatry before availability of the protocol.

Despite attempts to control for symptom severity in analyses, there are unavoidable differences between the intervention and the comparison groups. The indication for hospital-level care in this pilot required that intervention patients have severe symptoms. That BEAT Meth nevertheless proved effective in engaging patients calls into question the prevailing management of ED patients with MIP. Nationally, most ED patients with methamphetamine-related ED visits are discharged; this large number undoubtedly includes many patients who would benefit from an escalation of care. There are several reasons that patients with MIP may be discharged from the ED. Acute methamphetamine withdrawal induces irritability, sleepiness, and disengagement; these symptoms are often perceived by ED clinicians as disinterest in recovery. Patients with MIP are impulsive and felt to be at risk of violence in hospital settings, although, in fact, the low observed use of restraints here suggests that this risk is not high with active treatment. Furthermore, the sense that existing addiction programs are not suited to care for patients with methamphetamine use constitutes a persistent barrier for patients accessing, and clinicians referring to, treatment.<sup>25</sup> The success of BEAT Meth undermines these misconceptions. More proactive treatment for the large population of ED patients with MIP has potential to improve outcomes, including reducing overdose risk.

The BEAT Meth intervention framework supports ongoing improvements in quality, accessibility, and research. One opportunity for improvement is incorporating relapse prevention medications such as mirtazapine,<sup>26</sup> naltrexone and bupropion,<sup>27</sup> or other new treatments as they become available.<sup>28</sup> Given our focus on ED patients with MIP, the initial protocol focused on acute symptom control and treatment engagement. Future iterations of the intervention will be expanded to include patients with lesser symptom severity, such as patients with methamphetamine use disorder, but not MIP. This protocol can be adapted for patients encountered by paramedics, crisis teams, and correctional care providers. Long-term studies of patients after ED-based buprenorphine induction suggest that robust outpatient care is necessary to maintain early treatment success<sup>29</sup>; similarly, better

integration of specialty services and residential treatment options into the BEAT Meth framework can improve treatment engagement and reduce ED utilization after discharge. These data can inform future clinical trials for patients with MIP.

This work supports the use of outpatient treatment engagement and ED utilization as outcomes, indicating successful ED-based treatment for methamphetamine use disorder and MIP. We selected these outcomes for their importance in clinical practice and sustainability of monitoring for quality improvement. Generally, connection to outpatient care is a core assessment measurement for ED-based addiction treatment programs.<sup>30</sup> Although laboratory-confirmed abstinence and objective symptom severity would be of interest, acquiring these data for this real-world program implementation in a safety net health system among underserved patients with significant social stressors—about half of patients were homeless—is not practical. Loss to follow-up and nonadherence exceed 15% even in rigorous randomized trials of methamphetamine use disorder treatments.<sup>27,31</sup> Objective and externally acquired measurements of patient-centered outcomes are important for ascertaining the effectiveness of methamphetamine use disorder treatments. Our future work will report outcomes from community hospital utilization, mortality, law enforcement encounters, and arrests through partnerships with regional health information exchanges and public health and safety departments.

Despite our close monitoring of protocol adherence (Fig. 1), this methodology cannot describe why certain protocol elements were less frequently implemented. In many instances, deviation from protocol may have been warranted. For instance, many clinicians anecdotally reported feeling as though a long-acting benzodiazepine was not often needed, and this element was one of the least frequently completed. Only 43% of intervention patients were included in the outpatient clinic registry—this low rate may arise from challenges contacting the addiction counseling team, a patient's preferences for alternative care on discharge, or outright patient refusal. Ongoing quality improvement and qualitative research will help us refine the intervention and adapt it to different care settings and patient acuity.

There are additional limitations to this report. These findings are limited in their generalizability given its report as a program evaluation and setting in a single health system. The real-world setting for this evaluation introduces patient and diagnostic heterogeneity; description of patients and outcomes were pulled from the EMR and not verifiable against alternative data sources. There is a risk of bias in cohort construction, as sicker patients were referred for BEAT Meth, although this bias is likely toward the null. We cannot entirely isolate which specific protocol components are most effective or the value of the overall intervention compared with a higher level of care, although Appendix 1 (<http://links.lww.com/JAM/A366>) describes secondary analyses that support the intervention's unique benefits.

## CONCLUSIONS

Patients presenting to EDs with MIP are often difficult to manage and engage in treatment. Staff struggle to work with these patients and may in turn experience burnout.<sup>32</sup> The growing and lethal epidemic of methamphetamine challenges our

health systems, medical staff, and patients. Yet the positive outcomes of this pilot BEAT Meth intervention suggest that we have the tools to treat even patients with the most severe manifestations of methamphetamine addiction. Changing the culture around the management of methamphetamine use can mitigate the worst risks of this addiction, expand access to treatment for patients, and offer hope to the most despairing clinicians and patients.

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