Monitoring opioid addiction and treatment: Do you know if your population is engaged?

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ABSTRACT

Background: Assessment of people affected by opioid-related problems and those receiving care is challenging due to lack of common definitions and scattered information. We sought to fill this gap by demonstrating a method to describe a continuum of opioid addiction care in a large, public safety-net institution.

Methods: Using 2017 clinical and administrative data from Denver Health (DH), we created operational definitions for opioid use disorder (OUD), opioid misuse (OM), and opioid poisoning (OP). Six stages along a continuum of patient engagement in opioid addiction care were developed, and operational definitions assigned patients to stages for a specific time point of analysis. National data was used to estimate the Denver population affected by OUD, OM and OP.

Results: In 2017, an estimated 6688 people aged ≥12 years were affected by OUD, OM, or OP in Denver; 48.4% (3238/6688) were medically diagnosed in DH. Of those, 32.5% (1051/3238) were in the medication assisted treatment stage, and, of those, 59.8% (629/1051) in the adhered to treatment stage. Among that latter group, 78.4% (493/629) adhered at least 90 days and 52.3% (329/629) for more than one year. Among patients who received medication assisted treatment, less than one third (31.3%, 329/1051) were adherent for more than one year.

Conclusions: A health-system level view of the continuum of opioid addiction care identified improvement opportunities to better monitor accuracy of diagnosis, treatment capacity, and effectiveness of patient engagement. Applied longitudinally at local, state and national levels, the model could better synergize responses to the opioid crisis.

1. Introduction

The magnitude of the United States opioid crisis is typically monitored by counting the number of deaths involving prescription and illicit opioids (Ahmad et al., 2018; Scholl et al., 2019). However, overdose deaths insufficiently represent other nonfatal effects of addiction or the impact of treatment.

Of nearly 20 million Americans aged ≥12 years who had a substance use disorder in 2016, an estimated 2 million people had an opioid use disorder (Ahrnsbrak et al., 2017). Untreated addiction and

opioid overdoses may result in disability and premature death, with profound social consequences (American Society of Addiction Medicine, 2011a; Leshner, 1997). Through treatment, people living with opioid-induced illnesses can better manage their disease (American Society of Addiction Medicine, 2011b). Steps in addiction treatment among those with opioid-induced illnesses can be described as sequential stages of engagement in care, from screening and detection, to linkage to care, initiation of medication assisted treatment (MAT), and long-term adherence to care (American Society of Addiction Medicine, 2011b; Rinaldo and Rinaldo, 2013; Williams et al.,

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2017).

Near real-time estimates of the proportion of patients within each stage of engagement in opioid addiction care are possible with electronic health records (EHRs) and survey data. These assessments should help identifying people with opioid-induced problems and their transition from diagnosis to long-term maintenance or an opioid free life (Socias et al., 2016; Williams et al., 2017). Challenges exist to that assessment as terms used to describe and classify opioid-induced problems (e.g., misuse, abuse, poisoning, addiction, aberrant use, dependence, nonmedical or nontherapeutic use, physical dependence, and psychological dependence) are inconsistent, overlapping, and ambiguous (Vowles et al., 2015) and dispersed across multiple data sources (e.g., EHRs, health insurance claims, or prescription drug monitoring program registries). Having standard metrics would help assess the impact of treatment on outcomes (Socias et al., 2016; Watkins et al., 2015).

This study sought to fill this gap by demonstrating a method to describe and visualize a continuum of opioid addiction care in Denver.

2. Materials and methods

2.1. Setting

Denver Health (DH) is an integrated, public safety-net institution (Gabow et al., 2003). DH primary care clinics employ certified addictions counselors and waivered clinicians to provide buprenorphine-based medication assisted treatment in the outpatient, primary care setting. These clinics work in a complementary and coordinated fashion with the Outpatient Behavioral Health Services (OBHS). OBHS, a DH substance use treatment clinic, provides outpatient substance and mental health treatment services. Substance treatment includes counseling and MAT therapies in methadone and buprenorphine-naloxone programs. Additionally, DH's emergency department and waivered hospitalists can initiate buprenorphine therapy.

2.2. Data sources

The DH EHR provided clinical documentation, provider order entry, electronic prescribing, test result tracking, active medication, and problem lists. OBHS uses SAMMS™ (Chicago, Illinois) to register and document patient information about substance abuse treatment (e.g., visits, medication orders, and dosing). The two information systems were linked at the individual level to create a combined data set for DH patients aged ≥12 years in 2017.

2.3. Operational definitions and stages in the continuum of engagement in opioid addiction care

We constructed a continuum of engagement in opioid addiction care in DH. Stages in the continuum were guided by previous work (Haber et al., 2016; Socias et al., 2016; Williams et al., 2017, 2019) and refined through consultation with DH stakeholders. The continuum of opioid addiction care included stages for: estimated OUD, opioid misuse (OM), or opioid poisoning (OP) in Denver; diagnosed OUD, OM, or OP in DH; received MAT in DH; adhered to treatment; adhered to ≥90 days of treatment; and adhered to treatment for at least 12 months (labeled persistent adherence) (Table 1).

Definitions for each stage were constructed to allow algorithmic assignment of patients using an annual cohort of the linked patient records. We used *International Classification of Diseases, Tenth Revision, Clinical Modification* (ICD-10-CM) codes (American Psychiatric Association, 2013; Centers for Disease Control and Prevention, 2013) to identify patients with OUD, OM, and opioid poisoning (or opioid overdose) (OP) through the DH organization's patient population in 2017 (Supplementary File 2). We also looked for indicators of direct MAT therapy (i.e., liquid methadone administration) and

buprenorphine-naloxone prescription refill rates at DH pharmacies in DH EHR system to generate patient counts for stages in the continuum of opioid addiction care. Indicators of naltrexone treatment were not evaluated due to poor specificity (used to treat both OUDs and alcohol use disorders) and limited general use (Substance Abuse and Mental Health Services Administration, 2018a). We excluded methadone and transdermal buprenorphine, prescribed for pain.

Analyses were conducted using R version 3.4.1 Microsoft Excel 2010 version. Data collection and analysis took place in 2018.

3. Results

The continuum of opioid addiction care in DH in 2017 can be visualized in Fig. 1. An estimated 6688 people aged ≥12 years in Denver had an OUD, OM or OP as defined by our case criteria. Among these, 3238 patients aged ≥12 years had an ICD-10-CM diagnosis code associated with OUD, OP, or OM for an inpatient, outpatient, or ED treatment in DH.

Approximately one third (n = 1051/3238) of DH patients with diagnosed OUD, OM or OP received MAT at DH. These patients attended at least one dosing visit at OBHS methadone or buprenorphine-naloxone programs (n = 860), received at least one buprenorphine-naloxone prescription by a primary care prescriber at DH (n = 207), or participated in both contexts (n = 16).

Among those receiving MAT, 60% (n = 629/1051) adhered to prescribed treatment at DH. These were patients who attended at least 90% of all their daily dosing visits at the methadone or buprenorphine-naloxone programs of OBHS (n = 493), or patients who filled at least 90% of their buprenorphine-naloxone prescriptions (n = 136) in 2017.

Approximately three-quarters of patients in MAT (78.4%, n = 493/629) with ≥90 days of observation after initiating MAT attended 90% or more of their daily visits at the methadone or buprenorphine-naloxone programs (n = 438), or filled 90% or more of their prescriptions (n = 55) in DH pharmacies.

Finally, two thirds (66.7%, n = 329/493) of patients who had adhered to ≥90 days of MAT were in the persistent adherence stage. These patients attended 90% or more of their daily dosing visits in the methadone or buprenorphine-naloxone programs (n = 327), or filled 90% or more of their prescriptions (n = 2) in DH's pharmacies.

4. Discussion

We defined a continuum of engagement for patients in opioid addiction care, where patients were assigned to specific stages based on review of 2017 data from an EHR and a treatment registry. This previously unavailable model allowed a public, safety-net, healthcare institution to visualize cross-sectional, aggregate counts of people in stages along a continuum of care. As DH clinicians and health system leaders reviewed this visual tool to assess engagement along a continuum of care, several system-wide gaps were revealed; areas for improvement included diagnosis, treatment, engagement, and adherence. The data sources used in this study exist in many other health systems, and our methods could be used by both health systems and local health departments to provide timely surveillance data to develop engaging treatment and overdose prevention interventions.

Only 60% of patients who received MAT at DH adhered to the prescribed treatment in 2017. Innovative programs, such as voucher-based payments for medications for underinsured or uninsured patients and expanded telemedicine use, have attempted to create opportunities for initiating and improving adherence to MAT in other cities (Williams et al., 2017). As a system, DH expanded treatment capacity with extended hours of operation, enhanced points of access (e.g., inpatient, emergency services, and correctional care settings), and increased staff dedicated to treating patients with opioid addiction. Through the Center for Addiction Medicine established in 2019 (Mayor's Office of City and County of Denver (2019); Denver Health, 2019), DH will

Table 1

Definition of Stages in the Continuum of Opioid Addiction Care in Individuals > 12 years of age, Denver Health and Denver County 2017.

Stages	Location	Description	Data sources
Estimated opioid use disorder, opioid misuse, or opioid poisoning	Denver County	People who reported living with an opioid use disorder, who have misused opioids, or who have experienced poisoning caused by an opioid (see Supplementary File 1 for details).	2016 SAMHSA's NSDUH National Survey on Drug Use and Health; 2010 Denver population and 2017 Denver population estimate from the United States Census Bureau
Diagnosed opioid use disorder, opioid misuse, or opioid poisoning	Denver Health	Patients with an ICD-10-CM diagnosis code related to opioid use disorder, opioid poisoning, or opioid misuse in the inpatient, outpatient or emergency department contexts.	Electronic health record (EHR)
Received Medication Assisted Treatment	Denver Health	Patients who attended at least one dosing visit at the methadone or buprenorphine-naloxone programs [OR] outpatients who received at least one buprenorphine-naloxone prescription by a primary care prescriber at DH.	Substance treatment registry and EHR
Adhered to treatment	Denver Health	Patients on methadone therapy were considered adherent if they attended 90% or more of all their daily dosing visits at the methadone program. Patients with buprenorphine-naloxone prescriptions were considered adherent if they filled 90% or more of all their buprenorphine-naloxone prescriptions.	Substance treatment registry and EHR
Adhered to ⩾90 days of treatment	Denver Health	Patients on methadone therapy were considered 90-day adherent if they attended 90% or more of their daily dosing visits at the methadone program for at least 90 days after their initial appointment. Patients with buprenorphine-naloxone prescriptions were considered 90-day adherent if they had 90 days or more of cumulated buprenorphine-naloxone prescriptions and filled 90% or more of prescriptions.	Substance treatment registry and EHR
Persistent adherence (1 year)	Denver Health	Patients on methadone therapy were considered in persistent adherence if they attended 90% or more of their daily dosing visits at the methadone program for at least 365 days after their initial appointment in January 2017. Patients with buprenorphine-naloxone prescriptions were considered 365-day adherent if they had 365 days or more of cumulated buprenorphine-naloxone prescriptions and filled 90% or more of prescriptions.	Substance treatment registry and EHR

Note: ICD-10-CM = *International Classification of Diseases, Tenth Revision, Clinical Modification*; SAMHSA = Substance Abuse and Mental Health Services Administration; SAMMS = Substance Abuse and Medication Management System; Epic = Epic Systems Corporation, Verona, Wisconsin.
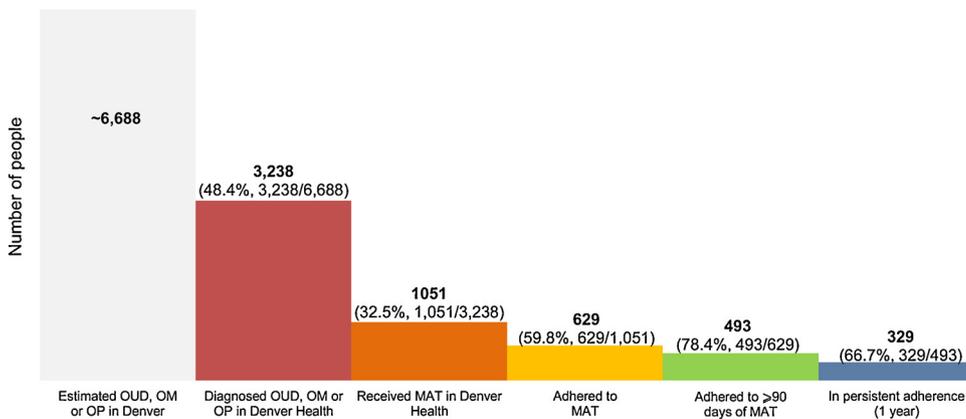

Fig. 1. The Continuum of Opioid Addiction Care in Denver Health in 2017. Estimated opioid use disorder (OUD), opioid misuse (OM), or opioid poisoning (OP) in Denver: Calculated by applying the percentage of Coloradans aged ≥12 years who reported pain reliever use disorder or heroin use in the past year in 2015–2016 to the estimation of the population aged 12 or older in Denver in 2017. Diagnosed opioid use disorder, opioid misuse, or opioid poisoning in Denver Health (DH): Patients ≥12 years with ICD-10 diagnosis codes related to opioid Use Disorder, opioid poisoning, or opioid misuse in the inpatient, outpatient or emergency department contexts in 2017.

Received Medication Assisted Treatment: Patients who attended at least one dosing visit at DH methadone program (n = 1075), OR patients who received at least one suboxone prescription by a primary care prescriber at DH (n = 207), minus patients in both contexts (n = 16).

Adhered to treatment: Patients who attended at least 90% of their scheduled dosing visits at DH methadone program (n = 532), OR patients who filled at least 90% of their suboxone prescriptions (n = 136).

Adhered to ⩾90 days of treatment: Patients with 90 days or more of scheduled dosing visits who attended 90% or more of their visits at DH methadone program (n = 440), OR patients with 90 days or more of cumulated suboxone prescription days and filled 90% or more of their prescriptions (n = 55) in DH's pharmacies.

Persistent adherence: Patients with 365 days of scheduled daily dosing visits who attended 90% or more of their scheduled dosing visits at DH methadone program (n = 329), OR patients with 365 days or more of cumulated suboxone prescription days and 90% or more of their prescriptions (n = 2) in DH's pharmacies.

deliver services that include prevention and education, harm reduction, formal treatment and management of addiction disorders, along with post-treatment services, tools and resources that support ongoing recovery. Strategies employed by European countries, including simplifying transfer of stable patients from specialist services to continuing treatment in primary care or identifying sources of support and training to encourage physicians to actively provide treatment (Stover, 2011), could be considered in the United States.

Consistent with widespread capacity challenges across the United States (Williams et al., 2017; Williams and Bisaga, 2016), our findings show that many of the DH patients diagnosed with opioid-induced problems have not received MAT. Evidence suggests that there are limited treatment capacity and resources at a national level. A 2012–2014 Massachusetts study reported that only 30% of approximately 18,000 adults with a nonfatal drug overdose visit to an ED received MAT for opioid addiction (Larochelle et al., 2018). Although

increasing state and federal efforts seek to reduce barriers to care, the gap between the number of people needing treatment and the capacity to treat them is still substantial (Substance Abuse and Mental Health Services Administration, 2018b).

The continuum of care model, first developed for HIV (Gardner et al., 2011), has served as a conceptual model to describe similar efforts (Socias et al., 2018; Williams et al., 2019, 2018). Such continuum models provide a way to recycle information to more fully understand and identify opportunities for improvement. The large gap in our model, between diagnosis and treatment initiation, highlighted concerns with engagement strategies and treatment capacity. Although our approach provided a cross-sectional view from one health care system, a repeated measure could also be built from longitudinal data across multiple providers, creating a periodic jurisdictionwide assessment. The framework could help optimize care for OUD and design strategies to actively address gaps along the continuum of care.

4.1. Limitations

The estimation of the number of persons living with an opioid-induced problem in Denver was not the main focus of our study, but was useful to provide context to both the local situation and the development of our analysis. Because the estimate is based on self-reported data, this is likely an underestimation of the OUD, OP, and OM burdens.

This study accessed information from within DH and might underestimate the rate of fulfilling prescriptions at non-DH pharmacies. However, considering many of the safety-net patients are unlikely to be diagnosed and have received MAT at other health care organizations, this is unlikely to significantly alter our results. We are working to consolidate healthcare data and this type of jurisdictional monitoring system across health care providers (Bacon et al., 2018).

5. Conclusions

A health-system level view of the continuum of opioid addiction care helped us integrate, summarize, and visualize information, and identify improvement opportunities to better monitor accuracy of diagnosis, treatment capacity, and effectiveness of patient engagement. Applied longitudinally at local, state and national levels, the model could better synergize public health, public safety and healthcare responses to the current opioid crisis.

Contributors

JTP designed the study, and led analysis, interpretation and writing. All co-authors contributed substantially to: study design; analysis and interpretation of data; drafting or revision of the manuscript; and approval of the final version. JTP was hosted by Denver Public Health for his CDC Public Health Informatics Fellowship Program.

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention

Ethics approval and consent to participate

The Centers for Disease Control and Prevention determined that this investigation was exempt from human subjects research regulations. The Colorado Multiple Institutional Review Board approved the study (protocol 18–1935) and a full waiver of participant consent.

Availability of data and material

Availability of anonymized datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declaration of Competing Interest

No conflict declared.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.drugalcdep.2019.07.002.

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