Approaches to Treating Serious Infection in People Who Inject Drugs: Evidence and Policies

Rapid Review
June 2020

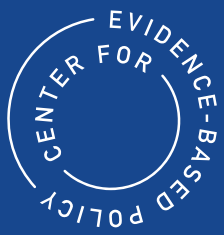


Table of Contents

Overview

Medicaid administrators are interested in strategies for treating serious bacterial or fungal infections in people who inject drugs (PWID) that provide alternatives to antibiotic treatment requiring long-term hospitalization. The goals of identifying alternative treatments include improving patient outcomes, reducing length of stay in the hospital (LOS), and reducing costs. Administrators are interested in infection treatment among individuals who inject illicit drugs of all types, including opioids, methamphetamines, and cocaine.

Researchers at the Center for Evidence-based Policy (Center) identified 6 eligible studies, 1 randomized controlled trial (RCT), and 5 comparative cohort studies which evaluated alternatives to hospitalization (i.e., provide outpatient parenteral antimicrobial therapy [OPAT] in a home or other setting) among PWID. We rated all identified studies as having a high risk of bias.

We also explored 2 state models that integrated medical and behavioral health care in Washington and Vermont, as well as 3 subject matter experts who had experience providing care or had significant knowledge of programs providing care to patients with serious infection in and out of the hospital.

Key Findings

Cure of Infection

- 1 identified cohort study evaluated cure of infection rates among patients on OPAT who were discharged to home, to a skilled nursing facility, or to another location among 4 groups: homeless PWID, housed PWID, homeless people who do not inject drugs, and housed people who do not inject drugs. The study was rated as having high risk of bias due to its small sample and large number of study participants lost to outpatient follow-up (LOF).
    - The authors found that cure of infection was lowest among homeless PWID (47.2%), followed by housed PWID (50.0%) and homeless and housed non-PWID (73.1% and 82.2%, respectively).
    - After adjusting for age, sex, and comorbidities, the authors found that only injection drug use (IDU) and housing status were significantly associated with cure of infection.

Therapy Completion

- 4 identified studies evaluated whether patients completed therapy (i.e., antibiotics) or did not complete therapy (i.e., left the hospital against medical advice, or were LOF), with all 4 studies rated as having a high risk of bias because of small samples and the use of statistics that might overestimate effect size (i.e., odds ratios [OR]).
- 3 of the 4 studies indicated that patients treated at home were more likely to complete therapy. For example, 1 RCT found all 10 patients discharged to home with OPAT finished therapy, whereas only 1 of 10 patients kept in the hospital self-discharged without completing treatment later finishing their antibiotics at home.
- In 3 of the 4 studies, patients perceived to engage in the most drug use or had factors identified as obstacles to achieving cure, such as homelessness or lack of substance use disorder (SUD) treatment, more often received treatment in a medical setting, such as a hospital or skilled nursing facility. For example, authors of a cohort study found that 57% of patients discharged to home (n = 12) were in SUD treatment compared to 16% (n = 5) of those discharged to a skilled nursing facility. In addition, more patients discharged to a skilled nursing facility (13%; n = 4) were LOF than patients discharged to home (5%; n = 1).

Hospital Readmission

- 2 identified studies reported that small numbers (range, 3 to 9) of OPAT patients discharged to home or to a skilled-nursing facility were readmitted to the hospital during treatment, with both studies rated as having a high risk of bias for reasons such as having a small number of participants. Homelessness was cited as a reason for readmission in both studies.
- 3 identified studies reported 30-day hospital readmission after treatment, and all received

a high risk-of-bias rating. All had different comparison groups, but findings from 2 of these studies suggest persons considered higher risk, due to factors such as homelessness, might be more likely to be readmitted.

Inpatient Length of Stay (LOS)

- 3 identified studies explored hospital LOS. All 3 studies received a high risk-of-bias rating and used different comparators. Combined findings suggest different factors may affect hospital LOS for this population.
  - As might be expected, the RCT found patients discharged to complete treatment at home had a shorter LOS in the hospital than patients treated in the hospital (22.4 days, SD 7.1 vs. 45.9 days, SD 7.8; *P* not reported).
  - Patients treated with antibiotics before use of a risk-scoring tool, which is designed to assess a patient's likelihood of achieving infection cure out of the hospital, had a longer LOS than patients treated after use of a rick-scoring tool (42 days vs. 22 days; *P* not provided).
  - Homeless PWID had the shortest hospital LOS compared to housed PWID and non-PWID (15.5 days vs. ≥18.0 days for other groups; $P < .001$).

Total Cost of Care

- 1 study explored costs of care, comparing patient costs before and after use of a risk-scoring tool. We rated the study as having a high risk of bias.
- The direct cost of care per admission was 33% lower after risk-scoring tool use compared with before risk-scoring tool use.

Misuse of Peripherally Inserted Central Catheter Line and Relapse

- 2 identified studies reported patients tampering with peripherally inserted central catheter (PICC) lines, and both were rated as having a high risk of bias.
  - The authors of 1 study found line tampering occurred more often among homeless PWID compared to housed PWID and homeless and housed people who do not inject drugs (35.9% vs. < 2.2% other groups; $P < .01$).
  - In the other study, 1 of 21 patients discharged to home developed a line infection, which was attributed to IDU.

Complications and Infections

- 2 studies, both with a high risk of bias, reported on complications or secondary infection.
  - In 1 study, complications were not significantly different between patients discharged to home and patients discharged to a skilled nursing facility.
  - The other study found reinfection was more common among homeless PWID compared to housed PWID and homeless and housed people who do not inject drugs (13.2% vs. < 4.2% in other groups; $P < .01$).
- 2 high-risk-of-bias studies reported on patient deaths.
  - An RCT found that 1 of 10 patients discharged to home died but reported the death was related to surgical complications.
  - Authors of 1 cohort study found that 1 of 21 patients discharged to home died.

Treatment Models

Treatment Programs

- 3 academic medical centers assessed in this report provide OPAT services to patients discharged to home or to another facility.
- All 3 provide in-hospital care. All 3 also:
  - Reported use of screening or scoring tools or other mechanisms to identify patients most likely to successfully complete treatment when discharged from the hospital.
  - Reported diverse staff, such as addiction medicine and infectious disease physicians, social workers, and nurses, with compositional variation depending on the program.
  - Reported provision of SUD treatment to hospitalized patients. All 3 also began outpatient work, at least in part, to make room for additional infectious disease patients.
  - Relied on community support and relationships with community organizations to continue patient treatment once patients leave the hospital.

- Reported stigma around SUD as one of their biggest challenges.

Medicaid Support for Clinicians Who Treat People with SUD

- Washington and Vermont have developed Medicaid programs to support medical providers offering behavioral health care. These programs were not designed specifically for PWID with serious infection but include potential avenues to support providers caring for this population. Both state programs:
  - Include elements of a hub-and-spoke approach.
  - Offer assistance to providers from additional staff (e.g., nurse care managers).
  - Use collaborative approaches to share information with providers and disseminate best practices.
- While Washington and Vermont use similar models, they report unique funding strategies which could also be applicable to programs treating serious infection among PWID.
  - Vermont uses a bundled payment approach.
  - Washington uses federal grant funds.
- Program and state interviewees credited the provision of medical treatment for SUD and showing medical treatment could be successful for treating SUD as effective ways to reduce SUD stigma.

Background

In the U.S., many different types of drugs are illegally injected, such as heroin, cocaine, methamphetamine, ecstasy, ketamine, and phencyclidine (PCP). Injection of illicit drugs may lead to multiple poor health outcomes, including infection with human immunodeficiency virus (HIV) or hepatitis C, overdose-related injury, and death.[1]

In January 2020, the National Academies Press released a comprehensive report[2] titled *Opportunities to Improve Opioid Use Disorder and Infectious Disease Services*, which explored treatment of serious infection among people with opioid use disorder (OUD).[2] The topics within the National Academies report and the current report overlap, but this report is focused specifically on bacterial and fungal infections treated with antibiotics and does not include treatment for viral infections. In addition, this report explores treatment of infection among people who inject multiple types of drugs, including but not exclusive to opioids.

While a previous analysis of trends showed IDU in the U.S. declined from 1992 to 2002 and then stabilized from 2002 to 2007,[3] a more recent analysis of hepatitis C data suggests IDU is on the rise.[4] From 2004 to 2014, U.S. hepatitis C infections increased from 0.3 to 0.7 cases per 100,000.[4] Reported treatment admissions for opioid injection also rose during this period.[4] In addition to viral infections and physical injury, IDU might lead to bacterial infections, including infections of the soft tissue, bones, central nervous system, and cardiovascular system. These infections are often life threatening, with the most serious being endocarditis.[5]

Hospital admissions for infective endocarditis are also on the rise, with 33,073 admissions in 2008 and 39,805 in 2014.[6] Endocarditis infections identified as IDU-related also increased from 4.3 ± 0.4% in 2008 to 10.0 ± 0.3% in 2014 ($P < .01$).[6] Hospitalization costs for endocarditis are high, sometimes exceeding $50,000 per patient.[7] In North Carolina, hospitalization costs for endocarditis related to IDU increased from $1.1 million in 2010 to 22.2 million in 2015.[7]

At an academic medical center in Florida, the median cost of hospitalization among PWID with serious infections was $39,896 (interquartile range [IQR] $14,158 to $104,912) from July 1, 2013, to June 30, 2014.[8]

Not all of the infections identified among PWID require hospitalization.[9] Some infections are treatable with OPAT.[9] Different types of OPAT exist but are most often intravenous, injected through a peripherally-inserted central catheter (PICC line).[10] While use of OPAT may reduce the costs of treating serious infection among PWID, some practitioners are hesitant to send PWID home with a PICC line for fear they will use it to inject drugs.[10,11]

Multiple studies have compared treatment outcomes among PWID with serious infection to outcomes among people who do not inject drugs.[10,12,13] For example, a retrospective chart review comparing IDU patients at the Cleveland Clinic to propensity-matched patients without IDU found IDU patients who received OPAT did not have less favorable treatment outcomes than patients who do not inject drugs.[10]

PWID differ demographically from people who do not inject drugs.[6] One retrospective study found PWID with endocarditis were younger (mean age 37 vs. 49; $P < .01$), more often female (48% vs. 41%, $P < .01$), and more often on Medicaid (46% vs. 23%; no P provided) compared to endocarditis patients who do not inject drugs.[6] In addition, PWID are often stigmatized by the health care system that may neglect some of their addiction or medical treatment needs.[14] The use of findings from studies that compare these different populations may be limited by comparing PWID to individuals who do not inject drugs, by discrimination in care against PWID, and by health and demographic differences between the 2 groups.

Non-comparative observational studies have also explored OPAT completion among PWID.[15-17] A study of 29 patients receiving OPAT from January 2005 to December 2009 found 28 patients completed their intended treatment, and there were no cases of PICC line abuse or death.[16] A review of case records among PWID receiving OPAT services from July 2015 to December 2017 found 76.2% (n = 28) of OPAT treatments were completed successfully.[15] A retrospective chart review of 205 patients given OPAT at a residential

addiction treatment facility from January 2006 to December 2011 found 73% of patients completed their prescribed antibiotics.[17]

While OPAT may be possible for some PWID with serious infections, others will require inpatient treatment due to the severity of their condition. Hospitalization is sometimes thought of as a reachable moment when patients, confronted by their mortality, may be receptive to addiction services.[18] In hopes of further assisting these patients, some hospitals offer addiction care alongside traditional medical services.[19] Whether treatment occurs inside or outside of a hospital, the practice of integrating infectious disease care with SUD treatment improves both infectious disease-related and SUD-related outcomes.[2]

State Medicaid program administrators are interested in alternative strategies for treating serious infections in PWID, with the goal of improving outcomes, reducing length of stay, and reducing hospitalization costs. This report reviews evidence for alternatives to traditional hospitalization during treatment for serious infection among PWID. It explores programs offered through 3 hospitals that provide both outpatient treatment for infection and inpatient SUD treatment in addition to infection care. It also describes 2 state Medicaid programs designed to increase access to integrated health care among people with opioid use disorder, although these programs were not specifically designed for treatment of PWID hospitalized with serious infection.

Key Questions

K1. What is the effectiveness of alternatives to hospitalization for the treatment of serious infections in PWID?

K2. What alternative strategies, programs, systems of care, or settings of care have been developed for the treatment of serious infections in PWID?

   a. What types of outpatient services are available?

   b. What inpatient alternatives to hospitalization exist (e.g., programs that administer antibiotics at residential treatment facilities)?

K3. What management practices have been proposed for the treatment of serious infections in PWID?

   a. What models exist for providing both infection and SUD treatment simultaneously?

PICO

Population

PWID seeking treatment for serious infections that require antibiotics, such as endocarditis or osteomyelitis

Interventions

Alternatives to intravenous antibiotic treatment (e.g., partial or complete oral antibiotic therapy, long-acting antibiotic formulations), novel systems of care (e.g., simultaneous treatment for SUD and serious infection, recuperative care programs), alternative outpatient sites of care (e.g. recovery centers), or combinations of these interventions

Comparator

Usual care

Outcomes

Clinical and/or microbiological cure of infection, treatment of SUD, abstinence from substance use, inpatient LOS, readmission for infection or infectious sequelae, total cost of care

Methods

To address Key Question 1, Center researchers searched Medicaid Evidence-based Decisions Project (MED) clinical evidence sources, including Ovid MEDLINE and the Cochrane Library in February 2020. We also searched PsycINFO, a database that indexes publications in psychology and SUD treatment research. We considered RCTs and comparative cohort studies exploring outcomes for alternatives to prolonged hospitalization for serious infection among PWID eligible for inclusion. We also identified systematic reviews for the purpose of reviewing their references. We limited the selected studies to those written in English and conducted in the past 10 years. One Center researcher rated the studies included in this report for risk of bias and another reviewed the ratings. See Appendix A for more information about search strategies, inclusion and exclusion criteria, and how we performed the risk of bias assessment.

Table 1. Identified Studies That Explored Alternative Treatments to Prolonged Hospitalization Among Individuals Who Inject Drugs and Have Serious Infections

Author, Year, and Risk of Bias	Location, Sample Size	Patient Characteristics	Inclusion and Substance Use Disorder History	OPAT or Other Treatment
Randomized Controlled Trial				
Fanucchi et al., 2020[20] High risk of bias	University of Kentucky, Lexington N = 20	• Mean age 31.3 years (home); 32.9 years (hospital) • 70% male (both groups) • 100% white (both groups)	• Opioid use disorder • SIRI requiring ≥ 2 weeks IV antibiotics	OPAT in the hospital or at home, with antibiotic home delivery
Cohort Studies				
D'Couto et al., 2018[21] High risk of bias	Massachusetts General Hospital N = 52	• Median age 30 years (home); 33 years (SNF/ Rehabilitation Center • 69% male • 96% white	• Known or suspected IDU in the past 2 years • Requiring ≥ 2 weeks of antibiotics	Patients were put on OPAT and either discharged to home or to an SNF/ rehabilitation center
Eaton et al., 2018[24] High risk of bias	University of Alabama, Birmingham N = 137 (37 pre-IVAT and 100 post-IVAT)	• Mean age 34.5 years (pre-IVAT) and 35.5 years (post-IVAT) • 46% male (pre) and 58% male (post) • 95% white (pre) and 92% white (post)	• High risk: score of 7 to 9 on risk assessment • Medium risk: score of 4 to 6 on risk assessment • Low risk: score of 1 to 3 on risk assessment	• High and medium risk: kept in the hospital as inpatients, with addiction support • Low risk: discharged to home for antibiotics with outpatient addiction care
Camsari et al., 2017[23] High risk of bias	Waycross, Georgia N = 20	• Mean age 38.6 years (high risk), 40.8 years (moderate risk), 49.2 (low risk) • 60% male • Race not reported	• High risk: IDU in the past 12 months or other factors • Medium risk: active SUD but no current IDU • Low risk: SUD in remission • Requiring antibiotics	• High risk: no PICC, kept in hospital or discharged to a medical facility • Medium risk: PICC, discharged to home but daily injections at ambulatory center • Low risk: PICC, discharged to home
Jafari et al., 2015[22] High risk of bias	Vancouver, British Columbia (Canada) N = 165	• Mean age 41 • 57% male • Race not reported	• Any SUD (84%), IDU (39%), opioids (65%), cocaine (58%), methamphetamine (10%) • Deep tissue infection	PICC line with discharge to respite care run by a CTCT

... continued on next page

Table 1. Identified Studies That Explored Alternative Treatments to Prolonged Hospitalization Among Individuals Who Inject Drugs and Have Serious Infections (cont.)

Author, Year, and Risk of Bias	Location, Sample Size	Patient Characteristics	Inclusion and Substance Use Disorder History	OPAT or Other Treatment
Beieler et al., 2019.[25] High risk of bias	Seattle, Washington N = 101	• Mean age 38.8 (homeless) and 41.6 (housed) • 68% male • 81% white	• Aged ≥ 18 years • Discharged with > 2 weeks of IV antibiotic therapy or requiring lab monitoring while on oral antibiotics • Homeless PWID (9%, n = 53) • Housed PWID (8%, n = 48)	OPAT with tamper-evident sticker at home or in respite care, an SNF, shelter/ street, or other

Abbreviations. CTCT: Community Transitional Care Team; IV: intravenous; IVAT: intravenous antibiotics and addiction team; IDU: injecting drug use; OPAT: outpatient parenteral antimicrobial therapy; PICC: peripherally inserted central catheter; PWID: people who inject drugs; SIRI: severe injection related infections; SNF: skilled nursing facility; SUD: substance use disorder.

Table 2. Identified Studies that Explored Alternative Treatments to Prolonged Hospitalization Among Individuals Who Inject Drugs and Have Serious Infections

Reported Outcome	UAB[24]	MA[21]	GA[23]	U of Kentucky[20]	WA[25]	BC[22,a]
Cure					•	
Completion of Therapy		•	•	•		
Duration of Therapy		•	•			
Outpatient Days		•		•		
Self-Discharge				•		•
LOF		•				
30-Day Readmission	•	•		•	•	
LOS	•			•	•	
Cost of Care	•					
Line Complications		•			•	
Relapse		•	•			
Positive Urine Sample				•		
Death		•		•		
BUP Dose				•		
BUP Adherence				•		
Secondary infection					•	

Note. [a] Other outcomes reported but only for a single group (not comparative). Abbreviations. BC: British Columbia; BUP: buprenorphine; GA: Georgia; LOF: lost to outpatient follow-up; LOS: length of stay; MA: Massachusetts; UAB: University of Alabama, Birmingham; U of Kentucky: University of Kentucky; WA: Washington.

To address Key Questions 2 and 3, we searched MED policy sources and program literature regarding alternative strategies, programs, settings, systems of care, and management practices for treating serious infection among PWID using the following terms alone or in combination: *outpatient parenteral antimicrobial therapy, OPAT, injecting drug use, IDU, people who inject drugs, PWID, antibiotics, endocarditis, osteomyelitis, and serious infection*. We also interviewed 3 subject matter experts identified through the literature and by referral from researchers and medical practitioners, who provide inpatient or outpatient care to PWID with serious infection, as well as key informants from 2 state Medicaid programs (Washington and Vermont). See Appendix A for a detailed report of our methods, a list of key informants, and interview dates.

Evidence Findings

We identified 6 studies for inclusion in the evidence portion of this report (Table 1). All 6 studies varied in their comparison groups and the outcomes assessed. Additional data tables are provided in Appendix B. One study was an RCT[20] comparing outcomes among PWID with serious infection who were completing OPAT at home to those completing it at the hospital. Five of the studies were cohort studies[21-25] comparing outcomes among PWID treated with antibiotics in their homes, skilled nursing facilities (SNFs), respite facilities, or hospitals. Two of these 5 cohort studies differed from the others because these explored the use of risk-identification strategies (a risk-scoring tool and a psychological assessment) meant to identify patients eligible for home treatment.[23,24] One of these 2 studies was unique from the other cohort studies because it compared patient data from before the risk tool was implemented to patient data after risk tool implementation.[24]

All other studies[21-25] compared simultaneous cohorts. One study compared different categories of PWID (e.g., homeless, housed) to those who do not use drugs.[25] Results of comparisons of PWID with those who do not use drugs are outside the scope of this report and are not included in the findings unless included with findings comparing outcomes among PWID. For example, in the study comparing homeless to housed PWID, patients who did not inject drugs were often used as the statistical reference group, making reporting for these individuals a requirement.[25]

All identified studies were rated as having a high risk of bias for multiple reasons. Some reasons included having small samples, not controlling for confounding variables, and using ORs instead of risk ratios, which overestimates the association of interest.[26] The number of participants in each study ranged from 20 to 165 with most studies having fewer than 100 participants.[20-25] For ease of discussion, studies are referred to by their location: British Columbia; Georgia; Massachusetts; University of Kentucky; University of Alabama, Birmingham (UAB); Washington. Outcomes reported also varied by study and are presented in the order listed in Table 2. We collapsed some outcomes when they were similar in nature, such as completion of therapy, patient-directed or

Table 3. Participants Reporting Different Types of Infection in Each Study[a]

Infection Type	UAB[24,b]	MA[21]	GA[23]	UK[20]	WA[25]	BC[22]
Cardiovascular	59 (43%)	14 (27%)	6 (30%)	19 (95%)	29 (29%)	31 (19%)
Bone and Joint	47 (35%)	36 (69%)	4 (20%)	7 (35%)	58 (57%)	68 (59%)
CNS	N/A	N/A	3 (15%)	N/A	20 (20%)	N/A
Skin/Soft Tissue	5 (4%)	N/A	4 (20%)	N/A	26 (26%)	14 (8%)
Bloodstream	14 (10%)	N/A	1 (5%)	N/A	57 (56%)	N/A
Other	11 (8%)	17 (33%)	2 (10%)	N/A	16 (16%)	22 (13%)

Note. [a]Numbers were rounded and some participants may have had more than 1 type of infection; [b]Pre-IVAT and post IVAT participants were added together, and vertebral osteomyelitis and epidural abscess were reported as a single category and are classified as bone and joint; Abbreviations. BC: British Columbia; CNS: central nervous system; GA: Georgia; MA: Massachusetts; UAB: University of Alabama, Birmingham; UK: University of Kentucky; WA: Washington.

self-discharge, and LOF.[20-25] Studies that reported the same outcomes often included very different comparison groups, which sometimes limited our ability to synthesize the results.

Participant Variation

The types of reported infections varied across studies (Table 3), with cardiovascular (e.g., endocarditis) and bone/joint infections (e.g., osteomyelitis) occurring most often.[20-25,27] Not all studies reported the pathogens responsible for infection, but *Staphylococcus aureus* (methicillin-resistant or methicillin-sensitive) was the bacteria mentioned most often.[20,21,23] Authors also indicated participants engaged in different types and levels of drug use, with opioids being the most frequently-used drug type.[20,21,23,24] Methamphetamine and cocaine use were also commonly reported. [20,21,23,24]

Cure of Infection

Only the retrospective cohort study from Washington reported on cure of infection, which it defined as completing therapy with infection resolution.[25] PWID on OPAT were either discharged to respite care (n = 31) or elsewhere (n = 22). The study compared homeless and housed PWID on OPAT to homeless and housed people who do not inject drugs on OPAT.[25] The authors found similar rates of cure of infection between PWID groups who were homeless or housed (48% vs. 45%; $P = .83$), assuming those who were LOF did not achieve cure.[25] Among patients with known outcomes, cure of infection rates did not differ based on whether PWID were homeless or housed.[25] However, when authors explored cure of infection, again assuming those with unknown outcomes were not cured, they found that cure was lowest among homeless PWID (47.2%), followed by housed PWID (50.0%), and homeless and housed non-PWID (73.1% and 82.2%, respectively).[25] After adjusting for age, sex, and comorbidities, the authors found only PWID and housing status were significantly associated with cure, with homeless PWID having the lowest odds of cure (OR, 0.33; 95% CI, 0.18 to 0.59), followed by housed PWID (OR, 0.37; 95% CI, 0.20 to 0.67).[25] The reference group for analyses was housed non-PWID, a healthier population, which limited the relevance of the findings.[25]

Therapy Completion

Four studies explored whether patients completed therapy, but outcome measures varied, with authors reporting the number of patients who finished antibiotics, the number of patients self-discharged from the hospital, or the number of patients LOF.[20-23] It appears that patients discharged to home may experience improved outcomes related to completing treatment. The University of Kentucky RCT found 1 patient (10%) treated in the hospital who self-discharged but completed OPAT at home.[20] No patients treated at home were LOF, and all participants in this study completed therapy.[20] As expected, patients discharged to home completed significantly more days of outpatient IV antibiotics than patients treated in the hospital (mean, 20.1 days, SD, 11.1 vs. mean, 1.8 days, SD, 5.3; $P < .01$).[20]

Two studies found better outcomes related to treatment completion among patients discharged to home, but these studies also kept higher risk patients in medical facilities for treatment.[21,23] In Georgia, patients deemed low risk and discharged to complete OPAT at home more often finished antibiotic therapy compared to their moderate-risk and high-risk counterparts who received antibiotics in ambulatory care or at a medical facility, such an SNF or hospital (100% vs. 90.6% vs. 80.3%, respectively).[23] It should be noted that the recommended treatment duration was shorter for low-risk patients compared to others in the study (low risk: mean, 28 days [range 14 to 70 days]; moderate risk: mean, 32.2 days [range 14 to 42]; high risk: mean, 42.2 days [range 10 to 56]).[23]

In Massachusetts, authors compared LOF among patients discharged to home or to an SNF and found that LOF occurred more often among patients discharged to an SNF than to their home (5%, n = 1 vs. 13%, n = 4).[21] As with the previous study, patients deemed at greater risk of poor outcomes were more often discharged to an SNF.[21] One study did not report statistical significance and differences were not significant in the other.[21,23]

While not the same as being discharged to home, a study exploring outcomes among patients treated at a unique care facility in British Columbia

found self-discharge occurred more often among patients kept in the hospital for treatment than among patients released to the care facility (48 vs. 2; $P < 0.01$).[22] The facility is located in a non-traditional setting (i.e., an old hotel in East Vancouver, BC) and provides patients with private rooms and harm-reduction strategies,[22] which is discussed more in the policy section of this report. The majority of the study was non-comparative, and information regarding patient risk-related behaviors was not provided.[22]

Hospital Readmission

Hospital readmission was reported in 2 ways: patients readmitted to finish therapy or patients readmitted within 30 days of initial therapy completion. Two studies comparing patients discharged to home to patients either kept in the hospital or discharged to an SNF to complete antibiotics, reported 2 patients who discharged to home to complete OPAT were readmitted to the hospital before finishing their antibiotics. Two (20%) of the patients who were discharged to home in the University of Kentucky RCT were rehospitalized during treatment (compared to 90% of those kept in the hospital for treatment).[20] Of these 2 patients, 1 became homeless and was readmitted to finish treatment, and 1 had an antibiotic delivery disruption and was hospitalized until delivery could resume.[20]

In the Massachusetts study comparing patients discharged to home or to an SNF, patients discharged to home had lower hospital readmission rates than those discharged to an SNF (14% [n = 3] vs. 29% [n = 9]).[21] The authors did not consistently report the reasons for readmission, but they did mention 1 readmission occurred when a discharged patient became homeless.[21] One study did not assess whether differences in these measures were significant and differences were not significant in the other.[20,21] Findings from studies assessing hospital readmission while patients completed OPAT suggest homelessness may be a reason why these patients are readmitted to the hospital before completing antibiotic therapy.[20,21]

The Washington study examined how often patients were readmitted to the hospital within 30 days of completing antibiotic treatment, and similarly found homeless PWID were more likely to be readmitted to the hospital within 30 days of completing treatment compared to all other groups, including housed PWID and homeless and housed people who do not inject drugs (26.4% vs. < 16.7% in other groups; $P < .01$).[25]

The authors of the UAB study compared 30-day readmission for patients treated before implementing a risk-scoring tool to 30-day readmission for patients treated after its implementation.[24] The authors found patients were more often readmitted within 30 days of treatment completion before the use of the risk-scoring tool compared to after its use (19% [n = 7] vs. 16% [n = 18]).[24] This may indicate sicker or higher risk patients were more often kept in the hospital. Importantly, the second indicator in the tool is an unstable home environment.[24]

The University of Kentucky RCT also reported 1 (10%) patient who was discharged to home was readmitted 4-weeks after completing antibiotics, compared to 2 (20%) patients who originally

Table 4. Bacterial Infections and Associated Length of Hospital Stay Before and After Risk Tool Use at the University of Alabama [24]

Type of Infection	Median LOS Pre-IVAT (n = 37)	Median LOS Post-IVAT (n = 99)
Infective Endocarditis	43 days	27 days
Vertebral Osteomyelitis/Epidural Abscess	40 days	21 days
Osteomyelitis/Septic Arthritis	46.5 days	8 days
Bloodstream Infection	18 days	10.5 days
Soft-tissue Infection	2 days	16.5 days
Other	N/A days	15 days

Abbreviations. LOS: length of hospital stay; IVAT: intravenous antibiotics and addiction team.

Table 5. Bacterial Infections and Associated Length of Hospital Stay Before and After Risk Tool Use at the University of Alabama[24]

Type of Infection	Number Pre-IVAT (n = 37)	Cost Pre-IVAT	Number Post-IVAT (n = 99)	Cost Post-IVAT
Infective Endocarditis	21 (57%)	$41,018	38 (38%)	$21,460
Vertebral Osteomyelitis/Epidural Abscess	7 (19%)	$38,637	13 (13%)	$25,656
Osteomyelitis/Septic Arthritis	6 (16%)	$24,031	21 (21%)	$10,124
Bloodstream Infection	1 (3%)	$14,000	4 (4%)	$6,671
Soft-tissue Infection	2 (5%)	$20,649	12 (12%)	$10,292
Other	0 (0%)	N/A	11 (11%)	$14,705

Abbreviation. IVAT: intravenous antibiotics and addiction team.

stayed in the hospital during antibiotic treatment.[20] Authors indicated readmissions were not related to treatment location, with the patient from the home group readmitted for surgical complications, and the patients from the hospital group readmitted for reasons unrelated to their original infection.[20]

Inpatient Length of Stay (LOS)

Three studies analyzed patient LOS in the hospital, and all reported results from different comparison groups:[20,24,25]

- The University of Kentucky RCT found, as would be expected, patients discharged from the hospital to complete treatment at home had a shorter mean LOS than patients kept in the hospital to complete antibiotics (22.4 days, SD 7.1 vs. 45.9 days, SD 7.8; significance not assessed).[20]
- Patients in the UAB study who were treated with antibiotics before use of the risk-scoring tool had a longer LOS than patients treated after use of the tool (42 days vs. 22 days; SDs and significance not provided).[24]
- Homeless PWID had the shortest LOS compared to housed PWID and non-PWID in the Washington study (15.5 days vs. ≥18.0 for other groups; P < .001).25 Study authors reported a high number of patients who were LOF,25 which suggests patients in this group may have self-discharged from their treatment location.

UAB authors implemented their scoring tool to shorten LOS for some patients and to reduce hospital costs. They also reported LOS comparisons for different infection types.[24] In this study, the mean LOS declined for most types of infections after use of the risk-scoring tool (Table 4).[24] The greatest reduction was among patients with bone and joint infections (median, -38.5 days).[24]

Total Cost of Care

The UAB study exploring patient outcomes before and after risk tool use also found a 33% reduction in the direct cost of care per hospital admission from before use ($38,716) to after ($26,014).[24] However, per patient per day costs rose ($922 vs. $1,182), as services were concentrated among the highest risk patients.[24] While there were some differences in diagnoses pre-use and post-use, subgroup analysis found lower costs for all infection types after use (Table 5).[24]

Misuse of PICC Line and Relapse

Two studies reported patients tampering with their PICC lines,[21,25] and 3 studies reported relapse or continuing drug use.[20,21,23] While line tampering and relapse are not synonymous, these may happen in concert. Authors of the Washington study found tampering occurred significantly more often among homeless PWID compared to all other groups, including non-homeless PWID (35.9% vs. < 2.2% other groups; $P < .01$).[25] Among patients in the Massachusetts study, 1 of 21 patients discharged to home developed a line complication, which was attributed to IDU.[21] Authors also reported that 5 of 31 patients discharged to an SNF had line complications and 5 of 31 relapsed.[21] Differences between those discharged home or to an SNF were not significant.[21]

Our review of supplementary data tables indicated 3 patients in the line complication and relapse

categories overlapped.[21] It is possible tampering occurred in these cases. It is noteworthy that 68% (n = 21) of patients discharged to an SNF reported ongoing drug use compared to 33% discharged to home (n = 7).[21] Also, 16% (n = 5) of those discharged to an SNF reported active SUD treatment compared to 57% (n = 12) of those discharged to home.[21] Nevertheless, these studies are limited by small samples and were rated as having a high risk-of-bias.

In the Georgia study, which explored patient outcomes by risk group stratification, 40% (n = 4) of patients who were deemed high risk relapsed to their drug of choice during treatment compared to 1 patient who was deemed moderate risk and none who were deemed low risk.[23]

- High-risk relapse: 2 occurred in the hospital, 1 in a nursing home, and 1 after leaving the hospital against medical advice.
- Moderate-risk relapse: 1 occurred at home.[23]

In the University of Kentucky RCT, more patients who were completing antibiotics at home had urine samples test negative for illicit opioids compared to those who remained in the hospital for 12 weeks (OR, 4.2; 95% CI, 1.03 to 17.34). Patients discharged to home also demonstrated 100% adherence to buprenorphine (BUP), a medication used to treat opioid use disorder (OUD), while their catheter was present. However, the odds of retention in outpatient BUP treatment after hospital discharge were not significantly different between groups.[20]

Complications and Infections

In the Massachusetts study, complications appeared no more likely among patients discharged to home compared to patients discharged to an SNF (19% [n = 4] vs. 35% [n=11]; $P > .05$).[21] The authors of the Washington study found homeless PWID who received antibiotics developed secondary bacteremia more often than other groups (13.2% vs. < 4.2% in other groups; $P < .01$).[25] It was not clear where patients received care.[25]

Two studies reported patient deaths during treatment. Among those in the University of Kentucky RCT, 1 patient from the home group was rehospitalized due to a surgical complication and died 4 weeks after completing antibiotics.[20] No one from the hospital group died.[20] The authors of the Massachusetts study also reported 1 death among patients discharged to home compared to none in the SNF group.[21]

Clinical Trials

We found 1 ongoing clinical trial, NCT03761953,[28] which is a pilot single-arm study (n = 15) evaluating the use of oritavancin in the last 2 weeks of treatment of systemic infections with *S. aureus* in opioid users. The estimated completion date was December of 2019, but the study website indicates the study is still recruiting participants and no results have been posted.[28]

Policy Findings

We were unable to find Medicaid programs that specifically target PWID with serious infection who needed IV antibiotics. However, many state Medicaid agencies are creating programs to address the needs of patients with SUD, some of whom inject drugs.[29] We identified and spoke with 3 representatives from 2 states about their programs, including representatives from Washington's state Medicaid agency and from Vermont's Blueprint for Health (BPH), an agency that designs and implements community strategies for improved health. Each state program uses similar, but unique strategies designed to expand the capacity of medical providers to treat people with OUD, which could also be used to expand treatment for PWID with serious infections.

We also spoke with 3 subject matter experts who provide care through hospital programs that treat PWID with serious infections or who have knowledge of such programs. We discuss these hospital programs first, followed by the Medicaid programs in Washington and Vermont.

Treatment Programs

We interviewed individuals from 3 hospitals with programs which provide treatment to PWID with serious infection in or out of the hospital (Oregon Health & Science University [OHSU], University of British Columbia [UBC], UAB staff, personal communication). In 2 cases, separate programs provide inpatient and outpatient care, working together to ensure patients receive the most appropriate types of services (OHSU, UBC staff, personal communication). In the third case, the

same program provides both types of care (UAB staff, personal communication). The programs have several things in common, including:

- Use of screening or scoring tools or other mechanisms to identify patients most likely to successfully complete treatment when discharged from the hospital.
- Diverse staff, such as addiction medicine and infectious disease doctors, social workers, and nurses, with some variation in composition depending on the program.
- Provision of SUD treatment to hospitalized patients. All 3 also began outpatient work, at least in part, to increase infectious disease treatment capacity in the hospital.
- Reliance on community supports and relationships with community organizations to continue treatment once patients leave the hospital (OHSU, UBC, UAB staff, personal communication).

The 2 U.S. programs also work with community organizations to provide patients with peer support (OHSU, UAB staff, personal communication). We begin by discussing the program at UAB, followed by the programs at the University of British Columbia (UBC), and OHSU.

University of Alabama at Birmingham (UAB)

The intravenous antibiotics and addiction team (IVAT) at UAB is unique in its region (UAB staff, personal communication). The IVAT program was examined in the study by Eaton et al.[22] that compared hospital LOS and costs before and after implementation of a risk-scoring tool, as described in the Evidence Findings portion of this report. Developed in 2016, IVAT was initially championed by infectious disease doctors who were members of hospital leadership (UAB staff, personal communication). IVAT also includes a multidisciplinary team, with around 30 infectious disease doctors, 2 addiction medicine doctors, and a part-time social worker (UAB staff, personal communication). The IVAT team uses a 9-point risk scale to determine whether a patient should receive inpatient or outpatient treatment for their infection. Table 6 shows a blank scoring form for the IVAT risk-assessment scoring tool.

The IVAT process begins when a physician caring for a patient with an acute bacterial infection requiring IV antibiotics and a known or suspected history of IV drug use orders an electronic consultation.[30] The request triggers individual consultations from addiction medicine and infectious disease doctors who later confer about appropriate care.[30] Consultation also includes administration of the 9-point risk-scoring tool by the staff social worker to determine which patients are most eligible for outpatient care (UAB staff, personal communication).[24]

Table 6. Intravenous Antibiotics and Addiction Team (IVAT) 9-Point Risk Assessment Scoring Tool to Determine Patients Eligible for Outpatient Care

Risk Factor	Score (0-1)
1. Cravings	
2. Unstable home environment	
3. Dual Psychiatric diagnosis	
4. History of drug overdose	
5. History of multiple relapses	
6. Polysubstance abuse	
7. Family history of addiction	
8. History of Trauma	
9. Limited willingness to change	
Total Score =	

Note. This tool was developed by Eaton et al., 201824 but has not yet been validated.

The tool was developed by 2 addiction medicine doctors based on their experience and the literature, but it has not yet been validated (UAB staff, personal communication). Patients who score 1 to 3 are deemed low risk and are discharged to home to complete their course of antibiotics, along with outpatient addiction care provided through the community (UAB staff, personal communication).[24] As mentioned in the Evidence Findings portion of this report, a comparison of data from 37 PWID treated for serious infections before implementation of the risk-scoring tool to data from 100 patients treated after implementation of the tool found a reduction in mean LOS from 42 days to 22 days, and a reduction in direct hospital costs of 33% per admission ($38,716 to $26,014).[24]

Patients who score 4 to 6 are deemed moderate risk and those who score 7 to 9 are deemed high risk. Moderate-risk and high-risk patients are kept in the hospital during treatment for infection and

are offered group SUD therapy, opioid agonist therapies, and are assessed weekly for discharge readiness.[31] A social worker provides counseling when needed (UAB staff, personal communication). An addiction medicine doctor may also provide additional mental health care when required (UAB staff, personal communication).

For patients who receive BUP, a challenge identified at UAB is the prevalence of abstinence-only models of care and related strict treatment guidelines. BUP is only administered twice daily, at 8 am and 8 pm (UAB staff, personal communication). Patients sometimes miss receiving these medications because they are away from their rooms, either for medical procedures or personal reasons (e.g., smoking a cigarette outside). In addition, patients who miss these medications or are deemed at risk of not taking them are sometimes required to complete reoccurring urine screens to ensure BUP adherence (UAB staff, personal communication).

After the completion of treatment and discharge, patients are referred to outpatient addiction treatment through appropriate medical and community resources (UAB staff, personal communication). Partnerships with these organizations are informal, but providers do collaborate on projects, such as a grant that provided funds for Federally Qualified Health Centers (FQHCs) to train family medicine residents to prescribe naloxone for emergency reversal of an opioid overdose (UAB staff, personal communication).

Patients do not receive follow-up care from the hospital after discharge, as community providers are separate organizations from the hospital, and IVAT does not have the capacity to follow patients once they leave hospital care (UAB staff, personal communication). UAB defines success when a patient is seen at the hospital and receives infectious disease treatment and an OUD prescription (UAB staff, personal communication). Following patients to track outcomes and ensure patients receive needed services in the community is a goal and might occur if they are able to fund a nurse practitioner or social worker who could dedicate more time to the project (UAB staff, personal communication).

University of British Columbia (UBC)

The University of British Columbia (UBC) has developed a robust program to treat patients with addiction while also providing complex medical services using a model of SUD care focused on harm reduction. The program operates out of St. Paul's Hospital, a large urban hospital in Vancouver, Canada (UBC staff, personal communication). Inpatient and outpatient services are provided for PWID with serious infections, including 2 options for patients discharged during antibiotic treatment (UBC staff, personal communication).

UBC's greatest capacity for treatment is through inpatient services. The hospital has had an inpatient addiction team for some time, and it consists of physicians, an addiction nurse in the emergency room, and 2 social workers (UBC staff, personal communication). In addition, in 2013 UBC began the Clinical Addiction Medicine Fellowship Program. The program includes around 24 interdisciplinary fellows that allows the program to treat around 90 patients at once. The program's primary goal is to stabilize patients and connect them to a system of interlinked hospital providers for inpatient treatment and, after discharge, 1 of 6 community health centers (CHC) for continuing care (UBC staff, personal communication). CHCs are staffed by family physicians and provide full-service wrap-around primary care with an emphasis on SUD services (UBC staff, personal communication). While in the hospital, patients receive antibiotics and SUD treatment services that align with their level of readiness for change.

An inpatient SUD treatment plan may include a variety of programs from alcoholics anonymous to learning safe injection practices (UBC staff, personal communication). Once patients are discharged, they receive referrals to CHCs to continue SUD care. CHCs are not bound by any formal agreement to accept patients, but rarely turn patients away (UBC staff, personal communication). However, CHCs nearly always have a waitlist (UBC staff, personal communication). Program success is defined as antibiotic completion, and the optimum scenario for care includes patient admittance, stabilization, assistance with achieving goals, receipt of simultaneous addiction and infection treatment,

and receipt of continuing care through a CHC (UBC staff, personal communication).

PWID with serious infections may also receive SUD services through the Rapid Access Addiction Clinic (RAAC) at St. Paul's Hospital (UBC staff, personal communication). This free outpatient clinic also follows a harm reduction SUD treatment model. Patients whose medical conditions are stabilized are able to receive antibiotics through an outpatient antibiotic therapy clinic at the hospital and come to the RAAC for SUD care (UBC staff, personal communication).[32] Patients are allowed to use drugs while they receive antibiotics as long as they are not disruptive. RAAC is located at the hospital and open 7 days a week, with 2 physicians providing care Monday through Friday and 1 nurse and 1 physician providing care on weekends.[32] Addiction medicine providers are also able to attend at the antibiotic clinic for urgent addiction issues if flagged by an infectious disease doctor (UBC staff, personal communication).

The second outpatient option is the Community Transitional Care Team (CTCT) mentioned in the study by Jafari et al.[22] and covered in this report.[22] CTCT is a community model of care established by the Vancouver Coastal Health Authority and Providence Health Services Authority established to reduce hospital LOS and release acute care beds.[22] Initially intended for homeless patients, but not exclusive to them, the CTCT provides a home-like alternative to hospital care[22] by housing patients on the second floor of what was once a hotel in the heart of the Downtown Eastside neighborhood of Vancouver.[22,33] The CTCT can house 9 patients.[22] Each room includes a bed and kitchenette (UBC staff, personal communication).[22] Meals and standard amenities are provided.[33]

When deciding on a course of treatment, patients are asked if they are interested in receiving care at the CTCT, which may be inappropriate for those attempting abstinence as it is located across the street from a clean needle facility (UBC staff, personal communication). Addiction services are provided at the patient's desired level, with the CTCT also focusing on harm reduction. Patients are able to use drugs in their rooms, including injectable opiates and cigarettes.[22,33] Patients with a PICC line are asked to sign an agreement to not use the PICC line to inject drugs.[33] In addition, green chlorhexidine-impregnated caps, or antiseptic-containing caps that twist onto IV access points for disinfection, are used to help monitor and reduce this type of complication.[33,34] When patients are found to have used their PICC line to inject drugs, providers take an individualized, non-punitive approach, often switching the patient to oral antibiotics.[33]

The CTCT is staffed by a 24-hour nurse, mental health workers, and family physicians who see patients daily during the week (UBC staff, personal communication).[22] Clinical care includes medication management, wound care, and lab work.[22] Staff are connected to local clinical and community supports and emphasize multidisciplinary care to address complex medical needs, addiction, and socioeconomic issues.[33] Hajek et al.[33] reported preliminary findings from a retrospective review of those at the CTCT and hospital found treatment completion was greater among those at the CTCT when compared to patients who remained in the hospital, but this study is not yet published. Additionally, of the patients identified as homeless (59 or 36%) when admitted to the CTCT between January 1, 2005, and December 30, 2009, all were discharged into a stable housing situation when they finished antibiotic therapy.[33]

In-depth interviews were conducted with 8 CTCT participants and 25 health service providers, and supplemented with informal conversations and observations, to derive themes around treatment of PWID with serious infection.[22] Results from this limited dataset suggest patients were satisfied with CTCT treatment and felt less stigmatized at this facility compared to other medical settings.[22]

Oregon Health & Science University (OHSU)

OHSU began providing transitional care to vulnerable populations through the Care Transitions Innovation (C-TraIn) program in 2010.[35] C-TraIn is a hospital based program that uses 4 primary components to improve patient outcomes as they transition home:

- Nurse coaching and education, including phone calls and home visits for the highest risk patients after discharge
- Pharmacy care with patient education, reviewing medications, encouraging providers to prescribe low-cost medications, and providing 30 days of medications at discharge to patients without drug coverage

- Linking patients to primary care providers
- Monthly quality improvement meetings across providers to improve system integration[36]

Multiple patients who received care through C-TraIn had SUD. In late 2014 and early 2015, OHSU providers conducted an assessment to explore treatment needs in this population.[37] The providers asked 185 patients who screened positive for alcohol or drug use about their substance use and experiences with medical care.[37] A majority of the individuals who indicated substance use in the preceding 3 months said they wanted to cut back or quit (58% of 109 who used alcohol and 67% of 68 who used cocaine, amphetamines, inhalants, sedatives, hallucinogens, or opioids).[37] In addition, 54% of participants with moderate-risk to high-risk opioid use reported a strong interest in medication to assist with their addiction.[37]

Interviews with 32 patients (46% reported amphetamine use and 65% reported opioid use) revealed hospitalization could serve as a wake-up call providing motivation for change among some patients.[18] Participant responses also indicated complex treatment needs and valuing of providers who understood SUD.[18] In 2015, findings from the needs assessment led to the development and implementation of another program called the Improving Addiction Care Team (IMPACT) 2015 (OHSU staff, personal communication). IMPACT provides hospitalized patients with SUD the following services: assessment, withdrawal management, addiction medication, counseling and behavioral SUD treatment, peer engagement and support, and linkages to community-based addiction care.[38] IMPACT is available to anyone with an SUD diagnosis, excluding those who only use tobacco (OHSU staff, personal communication). IMPACT was limited to cardiology patients when it first began but has since expanded across the institution (OHSU staff, personal communication). IMPACT is grounded in theories of harm reduction and trauma-informed care (OHSU staff, personal communication).

The IMPACT team includes addiction medicine physicians, a nurse practitioner, a physician's assistant, social workers, and peer mentors who have experienced SUD and SUD recovery themselves (OHSU staff, personal communication). The team is small relative to the scope of OHSU, but works closely with other care providers, particularly infectious disease doctors (OHSU staff, personal communication).

For patients, their work with IMPACT begins when they are referred to the program by inpatient providers who suspect they have an SUD (OHSU staff, personal communication). An IMPACT addiction medicine doctor and social worker then visit the patient either together or separately.[39] Patients receive a comprehensive assessment, which explores substance use, mental health, recovery supports, their understanding of their acute hospitalization, and their readiness to change.[39] IMPACT providers offer SUD education and treatment to patients at the level to which they are receptive (OHSU staff, personal Communication). The treatment offered may also include pharmacotherapy and, when appropriate, providers ensure patients have naloxone (Narcan).

Providers also discuss stigma and reframe addiction as a chronic, treatable disease (OHSU staff, personal communication).[38,39] When patients are not interested in SUD treatment, providers work with them to reduce harm and reassess readiness to change throughout their hospitalization (OHSU staff, personal Communication). IMPACT providers continue to work with patients throughout their hospitalization and may guide pain management.[39]

The frequency of patient visits by IMPACT providers depends on need and hospital LOS (OHSU staff, personal communication). The IMPACT team also arranges for SUD care after discharge and provides rapid access pathways to community care (OHSU staff, personal Communication). Sometimes, patients work with peer-support specialists after discharge or with an OHSU transitional care team, such as C-Train (OHSU staff, personal Communication).[40]

Findings from the needs assessment showed high rates of readmission and longer than anticipated LOS, particularly among patients who required long-term IV antibiotics for endocarditis or osteomyelitis (mean LOS 21.75 days; range, 1.00 to 51.00 days).[37] Providers were wary of utilizing PICC lines when discharging PWID out of concern they would use the lines to inject drugs. Simultaneously, some patients treated in the hospital struggled to stay in the hospital, often self-discharging (OHSU staff, personal communication).

At the same time, OHSU clinicians believed patients wanted residential treatment services but could not access them, so the providers developed a pilot program to offer SUD treatment and long-term IV antibiotics in a medically enhanced residential treatment (MERT) setting, dubbed the MERT model (OHSU staff, personal communication).[41] The intention of the pilot was for patients to complete their 6-week to 8-week course of antibiotic therapy in residential treatment instead of in the hospital (OHSU staff, personal communication).

Clinicians identified 45 patients in need of IV antibiotics to treat endocarditis, osteomyelitis, bacteremia, or another condition.[41] Eighteen of the 45 (40%) patients were ineligible for the study.[41] Of these, 6 had treatment needs that exceeded the facility's capabilities, 6 self-discharged from the hospital, 2 had insurance barriers, 2 had active law enforcement warrants, 1 was disruptive with staff, and 1 died.[41] Twenty of the 45 identified patients declined to participate: 13 did not want to enter residential treatment, 6 did not want to be away from their friends and family, and 1 because of concerns related to antibiotics (OHSU staff, personal communication).[41]

In the end, clinicians identified 7 patients willing to try the program.[41] Only 3 completed their course of antibiotic therapy, with the other 4 patients self-discharging from the treatment facility (OHSU staff, personal communication).[41] Of the original 45 patients, 18 were ineligible, 20 declined participation, and 4 self-discharged from the facility, causing the pilot project to end after 6 months due to low recruitment and retention.[41]

IMPACT providers learned valuable lessons from the MERT model, specifically regarding patient resistance to the high demands of residential treatment.[41] They received a letter from a homeless woman with SUD who self-discharged from the hospital after 25 days because doctors did not listen when she said she wanted to leave (OHSU staff, personal communication). Doctors read the letter and asked what they could do differently.

The combination of the letter, findings from the IMPACT needs assessment, the observation that PWID were self-discharged before completing treatment, and the findings from the MERT model pilot led IMPACT providers to form OPAT and IMPACT Next Steps Discharge Conference (OPTIONS-DC).[42] This is a multidisciplinary, structured case conference that reviews individual patient risks and potential treatment options, including discharging patients home with IV antibiotics (OHSU staff, personal communication). OPTIONS-DC creates space for understanding and contextualizing patient's risks and protective factors (OHSU staff, personal communication).

When a patient comes to the hospital with a serious infection and is identified as a PWID, a doctor and social worker assess the person either together or separately (OHSU staff, personal communication). This is part of the IMPACT process and includes identifying whether patients are in withdrawal, confirming or refuting the patient's SUD diagnosis, identifying patient risks (e.g., history of overdose), potentially starting the patient on SUD treatment medication, and providing the patient with SUD education.[39] If the diagnosis is treatable through outpatient antibiotics, the patient is medically stabilize, and it is known how long treatment will take, an OPTIONS-DC conference is held with the patient's infectious disease team, IMPACT, and the medical team (OHSU staff, personal communication). The patient does not attend the conference but is aware of it and is also asked to identify the safest best place to receive treatment (OHSU staff, personal communication).

The goal of OPTIONS-DC is to prioritize patient OPAT preferences and to provide SUD treatment at the patient's level of receptiveness.[43] The IMPACT team uses multiple tools in its assessment, such as a PICC safety assessment, which are published and available in Englander et al.[39] During the OPTIONS-DC conference, providers discuss multiple items, such as a summary of the patient's infectious disease (e.g., treatment duration, dosage), illicit drug use history, goals and perspective, results of a PICC assessment, whether the patient is stable for discharge, insurance options, and whether the patient has a working cell phone.[39]

OPTIONS-DC is an important part of the ongoing work to improve treatment for PWID at OHSU; it is a small circle overlapping with the larger circle of IMPACT (OHSU staff, personal communication). Although different from IMPACT, it is unlikely OPTIONS-DC would be successful without it

(OHSU staff, personal communication). Center researchers did not identify any published studies documenting quantitative outcomes of the OPTIONS-DC initiative. However, 2 identified conference abstracts reported outcomes.[42,43] Strnad et al.[42] qualitatively analyzed 10 months of conference notes and patient records (sample size not provided), as well as a provider feedback survey (n = 30). They found the average conference length was 28 minutes and a majority of providers agreed or strongly agreed the conference was an effective use of their time and would recommend the conference structure to colleagues (demonstrated with a bar graph, but sample size not provided).[42]

Gore et al.[43] reviewed 31 OPTIONS-DC conferences from February 2018 to March 2019 and found the meetings resulted in altered treatment plans to align with patient preferences in 16 cases, and changed treatment to an outpatient setting in 13 cases. OPAT was planned at discharge for 15 patients, with 11 completing their course of therapy.[43] Overall, 10 patients were discharged to home, 4 to SNFs, 4 to homeless shelters, and 2 to residential treatment facilities.[43]

Program Similarities

We identified multiple commonalities among the programs and some differences related to funding and institutional support, program evaluation, and challenges.

Funding and Institutional Support

All 3 programs credited the uncompensated work of dedicated providers as important to their success (OHSU, UBC, UAB staff, personal communication). The 2 U.S. programs also reported applying for and receiving federal and foundation grant funds to carry out parts of the work (OHSU and UAB staff, personal communication). Two programs reported a challenge faced was the need for resources beyond current levels, especially additional funding (UBC, UAB staff, personal communication). In Canada, providers are paid fees-for-service through the national health system. However, many of the PWID treated in the programs are in poverty, homeless, and not part of the formal system (UBC staff, personal communication). These patients do not file income taxes, lack a social security number, and are uninsured (UBC staff, personal communication). In such cases, providers are not reimbursed for care by the national health system; instead, the hospital provides funding to cover these services (UBC staff, personal communication).

Alabama remains a Medicaid non-expansion state and many of the PWID seen at UAB are uninsured (UAB staff, personal communication). In contrast to UBC, the UAB program receives no funds from the hospital due to competing demands for the limited funds available (UAB staff, personal communication). With the exception of grant funds obtained by providers, the UAB program is largely unfunded (UAB staff, personal community). Medicaid expansion might be a solution that could provide payment for services and also better continuity in overall care (UAB staff, personal communication).

Two programs reported receiving funds from their institutions. UBC's program is housed in a Providence Hospital, originally founded by the Sisters of Providence,[44] which provides care for patients unable to pay (UBC staff, personal communication). IMPACT was initially funded by the OHSU hospital, with OHSU's CEO as one of the program sponsors (OHSU staff, personal communication). IMPACT staff maintains a close relationship with hospital leadership, something critical to their success in obtaining and maintaining institutional support (OHSU staff, personal communication).

IMPACT also reported traditional billing covers a portion of costs, including a Medicaid case rate with one of Oregon's coordinated care organizations.[39] Initial and subsequent addiction medicine consults are billed with codes 99221-99223 and 99231-99233, respectively.[39] Peer-support specialists are employed by a community organization and have no mechanism to bill within the hospital (OHSU staff, personal communication).[39] Social work services are bundled with hospital diagnosis-related group (DRG)-based payment, so IMPACT social workers do not bill directly.[39] DRG-based payments occur when inpatient admission cases are divided into categories and a payor, originally Medicare, pays hospitals a flat rate per case for inpatient care.[45] Rates are based on costs for the average patient, with some variance for geographic differences in

things such as provider salary, and traditionally have not included costs for direct medical education or outpatient services.[45]

The single rate is an incentive for hospitals to be more efficient.[45] Implementation of the 2016 21st Century Cures Act required the Centers for Medicare and Medicaid Services (CMS) to develop some DRGs related to outpatient surgeries, and CMS has begun to experiment with even more diverse bundles as discussed in more detail below.[46]

Evaluation

OHSU's IMPACT had conducted the most robust evaluation of its program compared with the other 2 institutions, with multiple publications and conference presentations.[18,38,47] This evaluation effort was unfunded and was largely completed by OHSU students and faculty (OHSU staff, personal communication). This is also true of UAB's program, which did not include a formal evaluation but did assess some outcomes as part of providers' academic work (UAB staff, personal communication). UAB also evaluated cost measures to demonstrate to hospital leadership the importance and cost-savings benefits of the work and it should be funded (UAB staff, personal communication).

Because UAB and UBC are unable to follow patients once discharged, there is no effective means of evaluating long-term program outcomes. Instead, providers monitor standard measures, such as the number of patients enrolled and visits received (UBC, UAB staff, personal communication). UBC also collects measures for the training element of their program, such as the number of providers who enroll in the program or complete training (UBC staff, personal communication). UBC providers are participating in an initiative to develop a shared data system to connect providers and allow them to explore additional outcomes, and write and publish manuscripts (UBC staff, personal communication).

Challenges

The challenge identified most often by the 3 programs was the stigma surrounding IDU and the need for hospital staff and service providers to overcome it to ensure prompt, quality care (OHSU, UBC, UAB staff, personal communication). In addition, support from nurses is especially important, as was mentioned during multiple interviews (OHSU, UAB staff, personal communication). Two individuals from UBC and UAB who were interviewed indicated additional funds for training could help reduce IDU stigma (UBC, UAB staff, personal communication). However, a third interviewee suggested the best way to overcome stigma was to provide appropriate care focused on harm reduction because it results in changes in the organizational culture (OHSU staff, personal communication).

The individuals interviewed also discussed how abstinence-only models of care are problematic, yet nonetheless remain prevalent, and in some regions are better understood than risk-reduction models (OHSU, UBC, UAB staff, personal communication). Abstinence-only models lead to stigma, as patients are blamed for their addictions (OHSU, UBC, UAB staff, personal communication). Abstinence-only models can create more problems than stigma, and may lead to difficulties around things, such as medication distribution and potential harm to patients (UAB staff, personal communication).

UAB cited a number of additional challenges, mostly related to a lack of funds or enough staff time to champion the program to leadership, to build connections through the community, and to ensure patients receive the care they need (UAB staff, personal communication). A dedicated staff person, such as a nurse care manager (NCM), would extend physician's time by taking on some of their responsibilities and ensure patients receive necessary care (UAB staff, personal communication). This person would also have the capacity to focus specifically on the program, to ensure it is functioning properly, and identify program needs (UAB staff, personal communication).

Medicaid

Multiple mechanisms exist within Medicaid to expand or provide care for people with SUD.[48,49] For example, as of April 24, 2020, 28 states had Section 1115 demonstration waiver projects related to providing or improving SUD care.[50] Although many state Medicaid programs are working on improving SUD treatment, we did not find specific systems, programs, or settings of care related to Medicaid that focused on PWID with serious infections. Because we were unable to find such programs, we focused on Medicaid

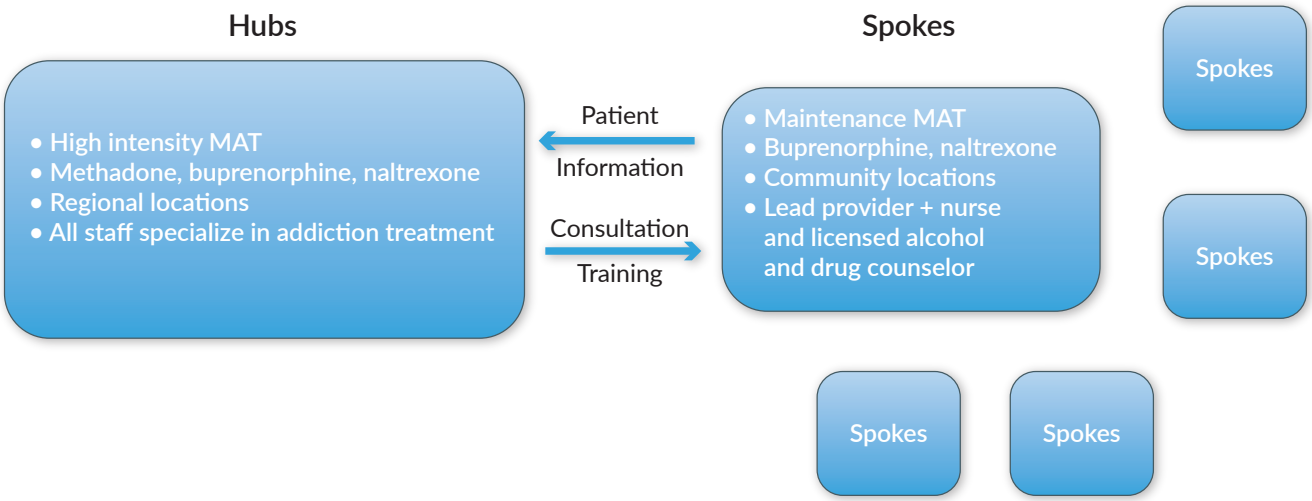
programs that support medical providers who treat PWID. Before we describe these programs, we first describe a data dashboard and toolkit being constructed to assist PWID with serious infection receive treatment.

Washington had developed a dashboard to track PWID seen in an emergency room or admitted to the hospital for serious infections, including endocarditis and osteomyelitis (Washington Medicaid staff, personal communication). The dashboard also tracked patient comorbidities, such as whether patients have hepatitis C and HIV (Washington Medicaid staff, personal communication). At the time the report was written, the dashboard was being redesigned. It is hoped the dashboard will help identify people who are not receiving regular care and provide data for managed care plans on who might benefit from case-management services (Washington Medicaid staff, personal communication). The dashboard was the inspiration of a Medicaid Deputy Medical Director interested in determining whether people are being connected with care services (Washington Medicaid staff, personal communication). This information could additionally be used to identify which patients might benefit from risk screening and potentially receiving treatment at home.

The State Opioid Treatment Authority (SOTA) is responsible for regulating the establishment and operation of opioid treatment programs. SOTAs are located within different state agencies, with a complete list of SOTA contact information available through the Substance Abuse and Mental Health Services Administration (SAMHSA).[51] In Washington, the SOTA is housed within Medicaid.

The Washington SOTA received complaints that SNFs refused to provide or facilitate continued access to OUD medications, including methadone and BUP, to PWID needing care (Washington Medicaid staff, personal communication). SOTA personnel called the SNFs and confirmed this had indeed occurred, finding it was due to facilities not believing they were allowed to provide methadone dosing for OUD clients who were taking methadone and needed to be admitted. The SNFs may not prevent patients from entering the facilities due to any medications they are currently taking because such denial of service is illegal (Washington Medicaid staff, personal communication). In response, the SOTA met with the SNF regulatory agency in Washington, the State Department of Social and Health Services (DSHS) (Washington Medicaid staff, personal communication). Later the SOTA and DSHS representatives met with the organization representing SNFs in the state (Washington Medicaid staff, personal communication). It was determined SNFs required additional education and support around this subject (Washington Medicaid staff, personal communication).

Figure 1. Hub and Spoke Model Showing High-Intensity MAT Providers Specializing in Addiction Support as Hubs and Maintenance MAT Providers as Spokes[56]



Adapted. https://blueprintforhealth.vermont.gov/about-blueprint/hub-and-spoke

The SOTA is currently creating a toolkit and PowerPoint designed to help overcome stigma and provide information to SNFs about their ability to provide and facilitate continued access to OUD medications to patients who need these treatments during their care (Washington Medicaid staff, personal communication). In addition, the SOTA has worked with the Washington Attorney General to create educational material regarding the requirement people not be discriminated against due to the medications they are taking in health care, housing, employment, or other services (Washington Medicaid staff, personal communication). A developed infographic can be found through the Attorney General's website.[52]

Supporting Medical Providers Who Treat PWID

Although not specific to PWID who have serious infections, many Medicaid programs are working to develop robust integrated care models for SUD treatment that could affect patients in this population by providing access to a pool of medical providers better suited to treat them. We spoke with personnel at 2 state Medicaid agencies in Washington and Vermont working to expand access to behavioral health services and medical care for people with OUD. Program functions overlap with the needs and care of PWID with serious infections, but are not specific to PWID. The programs focus on improving the ability of medical providers to support the behavioral health needs of their patients.[29] Vermont and Washington do this by providing support systems, specifically NCMs, to medical practitioners who have opioid dependency treatment waivers (Washington Medicaid staff, BPH staff, personal communication).

Treatment waivers originated in 2000 with the expansion of the Drug Addiction Treatment Act (DATA) and allow medical providers who receive 8 hours of training to prescribe BUP in an office-based setting for up to 30 patients.[53] Providers can apply to treat up to 100 patients after 1 year.[53] In 2018, the SUPPORT Act expanded to allow some practitioners to treat up to 100 patients their first year and up to 275 patients in year 2 and beyond.[53] The SUPPORT Act also extended BUP prescribing privileges to clinical nurse specialists, certified registered nurse anesthetists, and certified nurse midwives until October 1, 2023.[53]

Washington and Vermont provide logistic and administrative support to waivered providers so they can see more patients and encourage additional providers to seek waivers (Washington Medicaid staff, BPH staff, personal communication). Multiple elements exist within each state's system, but both rely on the work of additional support staff, including NCMs, similar to what UAB personnel state they want for their program (Washington Medicaid staff, BPH staff, personal communication).

The goal of the programs in Washington and Vermont is to increase patient access to opioid treatment by enhancing the capacity of medical providers to treat patients with OUD in an office-based setting (Washington Medicaid staff, BPH staff, personal communication). Vermont has a hub-and-spoke model that divides the state into 5 regions.[54] Each region includes a hub clinic organized around an opioid treatment provider (OTP) who provides services to clinically complex patients and dispenses methadone and BUP in an addiction treatment center (Figure 1).[19,50,54,55]

Waivered physicians or Office-Based Opioid Treatment providers are spokes that connect to a hub for consultation and assistance with patient screening, referral, and treatment.[19,50,54,55] Within this model, waivered providers also have access to at least one medication-assisted treatment (MAT) team that includes a full-time registered nurse and a master's-level licensed behavioral health provider for each 100 Medicaid patients.[54] Nurses meet with and assess new patients.[54] They also provide logistics support (e.g., contracts, insurance authorizations), authorize BUP refills, and oversee diversion control (e.g., random call-backs).[54]

The work of the MAT team nurse is further supported by a licensed, master's-level behavioral health provider who coordinates counseling services and referrals to the hub when patients need support beyond what the spokes can provide, manages acute crises, provides brief supportive counseling, and helps with practical issues (e.g., housing).[54] When a patient has a positive drug test, the MAT team works to evaluate his or her needs and provides additional clinical support.[54]

MAT teams are employed by Vermont Blueprint for Health and work in spoke offices embedded within practices to the extent needed to support patient load (BPH staff, personal communication).[54] The

MAT team meets regularly with spoke physicians to discuss cases, protocols, and coordination among staff (BPH staff, personal communication). The program in Vermont is primarily practice-based and relies on practitioners in private practice and in hospitals for dissemination into hospitals (BPH staff, personal communication). This has been successful, and some hospitals are now using incentives for providers to seek waivers (BPH staff, personal communication).

Washington surveyed clinicians to find out why they were either not using their DATA waivers at all or were not using them to the extent available (Washington Medicaid staff, personal communication). Waivered clinicians told Medicaid officials that patients with OUD required too much time to treat (Washington Medicaid staff, personal communication). To assist the clinicians, Washington implemented a model based on models in Vermont and Massachusetts (Washington Medicaid staff, personal communication). Washington also uses a hub and spoke approach, with the state providing funds to hubs to hire NCMs and to spokes to hire care coordinators (Washington Medicaid staff, personal communication).[57]

The Massachusetts model, originally developed in 2003 at Boston Medical Center, does not use a hub and spoke approach but is built around NCMs who assist patients and prescribing physicians through the treatment process.[58,59] All 3 models (Vermont, Washington, and Massachusetts) rely on less-credentialed or differently credentialed professionals to support physicians, nurse practitioners, or physician's assistants as they provide medical care and behavioral health support to people with OUD. While the models are not specific to PWID with serious infections, similar supports are present or desired in all of the earlier hospital models discussed, and there may be an opportunity to combine approaches and provide support staff to clinicians caring for this population.

The Washington model is built around NCMs. It uses hubs and spokes to administer care and extend the reach of agencies in the network.[57] NCMs support the work of hubs by providing logistical support, patient care, and case management (Medicaid, personal communication).[60] NCM duties include screening, OUD medication education, assisting with OUD medication inductions, taking vital signs, drug testing, lab work, medical assessments, charting, care planning, stabilization, observation and maintenance, follow-up care coordination, relapse prevention, and individual self-management support.[60]

Care coordinators support the work of spokes by expediting Medicaid enrollment; by conducting screenings, assessments, and evaluations; by providing patient education; and by coordinating OUD referrals.[60] They also participate in data collection; facilitate referrals for infectious disease screenings, housing, employment, withdrawal management, transportation, and behavioral health counseling referral; and provide warm hand-offs to OUD medication providers when patients transfer from current treatment.[60] Originally, NCMs had to be registered nurses (Washington Medicaid staff, personal communication). Practitioners in rural areas identified hiring registered nurses as a challenge, and in 1 area the NCM role is filled by a combined medical assistant and SUD counselor (Medicaid staff, personal communication).[57]

Washington's model includes 11 Opioid Treatment Networks (OTN) in 6 areas across the state.[61,62] In terms of hubs and spokes, Washington's model differs because its hubs are not required to be OUD treatment centers but can be any program with providers who have expertise in OUD treatment and a capacity to lead a network in providing medication for people with OUD.[57] In traditional hub and spoke models, the hub is the center of expertise for treating SUD, with spokes relying on them when they need additional support to provide behavioral health care in their practice.[57] In Washington, OUD treatment expertise may be spread throughout the network, with the hub functionally managing it.[57] Sites qualified to apply include organizations such as jails, emergency departments, and syringe exchange programs.[57]

Washington's OTNs vary from one to another, having evolved differently over time (Medicaid staff, personal communication). Washington OTNs include a variety of different providers including a tribal wellness center, a Catholic community service organization, community health centers, and hospitals.[63] Washington's program goals include increasing and improving the state's behavioral health infrastructure by increasing the number of medical providers who have waivers, increasing the use of waivers by providers, improving

medical practitioners' ability to treat patients with behavioral health needs, and improving the ability of practitioners to refer patients to prescribers if the practitioners themselves are unable to act as prescribers (Washington Medicaid staff, personal communication).

Training and Technical Support

A commonality in both state programs (Vermont and Washington) and 1 hospital-based program (OHSU) is the use of learning collaboratives to share information across provider networks, which builds practitioners' comfort and abilities to treat people with SUD and PWID. OHSU is using the Extension for Community Healthcare Outcomes (ECHO) platform to disseminate knowledge about IMPACT and OPTIONS-DC to other hospital providers in Oregon, with more ECHOs planned for the future (OHSU staff, personal communication).

Project ECHO originated at the University of New Mexico and uses a hub-and-spoke approach to connect specialists with non-specialists through web-based communications technology.[64] ECHO sessions generally begin with a short didactic session from the specialist, followed by a discussion of related cases.[64] ECHO connects providers through a statewide network that links rural generalists with urban specialists in a way not previously possible. Similar to the work in Oregon, ECHO could be used to support clinicians in providing SUD treatment as they provide treatment for serious infections among PWID.

Vermont used a Quality Improvement (QI) approach to develop similar learning collaboratives. Collaborative sessions are a combination of in-person and teleconference support, with a didactic or expert presentation followed by practice-based learning through case discussion.[65] In Vermont, most training sessions are small groups that focus on process and practice improvements to team-based care, as well as integration of OUD medications into primary care (BPH staff, personal communication).[65] NCMs and counselors are required to participate (BPH staff, personal communication). If providers are unable to attend, the NCMs and care coordinators take information back to their practices and share it with staff (BPH staff, personal communication).

Washington is also using a learning collaborative approach by contracting with the Advancing Integrated Mental Health Solutions (AIMS) Center at the University of Washington to provide routine training.[57]

Program Funding

Multiple mechanisms exist that might fund programs for treating serious infection among PWID. While the Washington and Vermont programs are not specific to this population, similar strategies could be used to assist in this work. Washington and Vermont fund their programs differently. Vermont's program was initially supported with funds from the Patient Protection and Affordable Care Act Section 2703 State Plan Amendment.[66] Section 2703 allows for home health services delivered through community health teams and provides a bundled, monthly rate (subsidized by Medicaid or state grants) for 1 standard clinical service and 1 medical service per patient per month. Hubs receive the monthly bundled, per-patient rate for each home health member who receives a home health service documented in the clinical chart of the hub.[67]

Spoke payments are based on the costs of employing 1 full-time RN and 1 full-time licensed clinical case manager for every 100 patients seen, across multiple providers.[67] Patient counts come from the average monthly number of unique patients in each health service area with a BUP pharmacy claim paid by Medicaid in the most recent 3-month period.[67] Spoke staff are hired by and deployed to prescribing practices by a lead administrative agent, Vermont Blueprint for Health (BPH, personal communication).[67] Home health services are documented in the clinical records of prescribing organizations.[67] Under the initial terms of Section 2703, Vermont collected a 90/10 match for costs directly linked to home health services, with remaining services matched at the state match rate.[66] The program was partially implemented in 2013 and fully implemented in 2014 (BPH staff, personal communication). The 90/10-match rate expired in 2015, but the political will existed to continue the program with a normal match rate (BPH staff, personal communication).

The Washington initiative is largely supported by grant funds, particularly State Opioid Response (SOR) and State Targeted Response (STR) funds offered through the SUPPORT Act (Washington Medicaid staff, personal communication). Washington offers funds to waivered practitioners

who demonstrate the need and willingness to comply with program requirements, and practitioners use funds to hire NCMs and care coordinators (Medicaid staff, personal communication). As part of overall health care integration efforts, Washington also transitioned its behavioral health funds from behavioral health to managed care organizations (MCOs) in January 2020 (Medicaid staff, personal communication). This change allows Medicaid recipients to access insurance for all of their health needs through 1 organization. It also makes it easier to integrate medical and behavioral health services.

Evaluation

Washington has put a number of elements into place to evaluate its program, including a data dashboard developed through 1115 demonstration waiver funds. This dashboard shows the number of new BUP prescriptions by waivered physicians across the state (Washington Medicaid staff, personal communication). It might be possible to explore linking the elements of this dashboard to the one described above exploring PWID receiving emergency room or hospital care for serious infection. This linkage could potentially show whether PWID receiving treatment in the hospital for serious infection are also receiving BUP.

Most other elements of Washington's program evaluation focus on collecting the detailed data SAMHSA requires for SOR reporting, including a 30-minute questionnaire that clients complete with providers (Washington Medicaid staff, personal communication). Washington would like to develop screening benchmarks to determine whether patients are connecting to the care they need (Medicaid staff, personal communication). Better data transfer across electronic health records (EHR) would also allow more robust evaluation efforts (Medicaid staff, personal communication).

Currently, Washington is able to determine whether providers are enrolling people into Medicaid, but it is not clear to what extent patients are staying enrolled (Washington Medicaid staff, personal communication). It is also not clear whether individuals receiving new prescriptions for MAT are staying on their medications (Washington Medicaid staff, personal communication). Continued Medicaid enrollment and medication use would also be important among PWID receiving antibiotic treatment at home.

Vermont evaluates the number of patients receiving MAT prescriptions and the number of prescribers who see Medicaid beneficiaries. Each quarter, data are reviewed to determine whether the number of providers seeing 10 or more patients has increased. Annually, the costs of addiction treatment, mental health care, and general care among beneficiaries are compared to the same costs among non-beneficiaries.[68] In addition, overall spending and measures such as outpatient emergency room visits and inpatient discharges are reviewed.[68] Some member health information, such as body mass index and screenings for clinical depression, is reviewed by organizations that report it to the state's clinical data registry.[68]

HEDIS quality measures are also reviewed and multiple journal articles and external reviews have been published.[54,69,70] From 2012 to 2016, the number of waivered physicians in Vermont rose from 173 to 283 (a 64% increase).[54] The use of this model has led to a dramatic increase in the number of patients served, from 3.76 per 1,000 people in 2012 to 10.56 per 1,000 people in 2016.[54] Among beneficiaries, there is a strong indication of increased spending on OUD treatment and lower spending on other health care (BPH staff, personal communication).[68] Patients also spend an average of 10 months in treatment (BPH staff, personal communication).

Challenges

In Washington, many SUD providers lack experience with the rules and regulations of the Medicaid system (Medicaid staff, personal communication). A primary challenge that has arisen since monies were shifted from behavioral health to MCOs has been confusion among behavioral health providers as they submit for reimbursement and sometimes miss details required to process payment (Washington Medicaid staff, personal communication). This is also a challenge for MCOs who support providers as they learn the new system (Washington Medicaid staff, personal communication).

In addition, providers in small practices do not have the capacity to see as many patients who have been prescribed BUP as large practices, and some providers still do not use their waivers (Medicaid staff, personal communication). Most of the providers using waivers to provide BUP

prescriptions are in larger clinics, particularly FQHCs, or are addiction medicine doctors who also serve in primary care (Washington Medicaid staff, personal communication). Providers who have the infrastructure and are interested in providing care to this population have been early adopters of the program (Washington Medicaid staff, personal communication).

There is a lack of comfort treating PWID, but testimonials and feedback from the early adopters are encouraging other providers to participate in the program (Washington Medicaid staff, personal communication).

Patient access to care is also an issue. Washington has been able to enroll a large proportion of patients without insurance in Medicaid, but many practices are still unable to treat Medicaid beneficiaries (Medicaid staff, personal communication). Discussed above, it has been challenging to convince SNFs to provide OUD medications to PWID who have serious infections (Washington Medicaid staff, personal communication). As a result, patients who do not require treatment in a hospital sometimes remain in hospitals for months waiting for acceptance from a facility that will assist with all their treatment needs (Washington Medicaid staff, personal communication). As discussed above, the SOTA in Washington is working on a toolkit to encourage SNFs to provide OUD medications to PWID.

Findings from the Evidence section of this report indicate PWID with serious infections discharged to SNFs to complete antibiotics completed their antibiotics less often and were readmitted to the hospital more often than PWID with serious infections discharged to home for the duration of their antibiotic therapy. [21,23] Risk screening might help to send more patients home to complete their treatment instead of lingering in hospitals. Washington credits its success to working with providers who are early adopters who then share messages of success with their colleagues (Washington Medicaid staff, personal communication).

In Vermont, the biggest organizational challenge was in developing program logistics, which has been partially overcome by working with trusted local health leadership (BPH staff, personal communication). In terms of providing treatment, the biggest challenge is determining how to grow the program to meet demand (BPH staff, personal communication). The staffing model might have been too highly credentialed, as there are many tasks which NCMs are doing that could be completed by licensed practical nurses (BPH staff, personal communication). Vermont credits its success to the use of multidisciplinary teams and a culture shift that occurred once providers saw medical treatment worked for addiction (BPH staff, personal communication). Vermont would like to do more in terms of peer support by ensuring access to people who need it (BPH staff, personal communication).

Discussion

We found limited literature comparing outcomes for PWID with serious infections treated with OPAT or in the hospital. More research is needed to understand OPAT successes and failures in this population. Some studies were identified in the search that explored this topic but failed to meet inclusion criteria:

- 4 studies compared PWID with endocarditis who were treated with surgery or without. The studies did not clearly differentiate which patients were discharged to home for antibiotic treatment or treated at another location.[27,71-73]
- Ziu et al. (2014)[74] explored disease-management-related outcomes among PWID with spinal infections. However, all patients were kept in the hospital.[74]
- Buehrl et al. (2017)[75] explored OPAT use among patients discharged to home, to an SNF, or to a rehabilitation facility. Treatment success or failure were the only outcomes reported by discharge location, but success was undefined and failure included a wide range of possible outcomes.

In addition, the experts asked to peer review this report identified an additional study published after we had completed the initial search in February 2020. Marks et al. (2020)[76] explored the use of oral antibiotics to treat serious infection among PWID who self-discharged while receiving IV antibiotic treatment in the hospital. Of the 293 patients included in the study, readmission occurred significantly more often ($P < .01$) among patients who self-discharged without oral antibiotics (n = 46; 68.7%) compared to those

Table 7. Suggested Elements of an OPAT Bundle with Potential Additional Elements for PWID in Italics

Components	Key Aspects of Components
Care Consultation & Patient Selection	• Provided by infectious disease and addiction medicine doctors, NCMs, or care coordinator • Before intravenous access • Before discharge home • Patient aware of risks • Appropriate home environment/adequate support • No clinical contraindications to discharge from hospital • Willingness to comply with follow-up plan • Insurance/copayment issues resolved
Patient/Family Education	• Vascular access education/sterile technique/teach-back method • *Potential use of technologies to reduce complications from PICC line use for IDU (e.g., chlorhexidine-impregnated caps)* • Emergency contact numbers for patients • Physician responsible until patient seen in clinic • Side effects of medication • Potential complications
Care Transition	• Infectious disease appointment handed to patient before discharge • *Addiction assistance appointment handed to patient before leaving* • Clear communication between inpatient and outpatient services • *Follow-up appointment with NCM or care coordinator* • ID/OPAT plan documented in discharge summary • Safety labs ordered as part of discharge plan
Outpatient Monitoring	• Safety labs: identify missing labs, address lab anomalies, adjust medications as needed (dose, duration, medication change) • *Appointments with addiction medicine provider or other support professional* • *Peer supports* • PICC line care and removal at end of therapy • Change in management: communication between ID and infusion company/ rehabilitation facility • Monitoring of microbiological cure, laboratory cure
OPAT Program Measures	• Patient satisfaction • Readmission rates • *Number of patients who receive SUD treatment* • Program improvements, audit

Source. Adapted from Muldoon et al. (2013).[78] Abbreviations. ID infectious disease; IDU: injection drug use; IV: intravenous; NCM: nurse care manager; OPAT: outpatient parenteral antimicrobial therapy; PICC: peripherally inserted central catheter; SUD: substance use disorder.

who received IV antibiotics in the hospital (n = 43; 31.5%) and those who received oral antibiotics at self-discharge (n = 27; 32.5%).[76]

Hazards ratios adjusted for infection type and pathogen also showed the 90-day readmission risk was higher among patients who did not receive oral antibiotics at self-discharge (adjusted hazard ratio (AHR) = 2.32; 95% CI, 1.41 to 3.82) compared to those who completed IV antibiotics in the hospital.[76] No difference in 90-day readmission risk was found between patients who received oral antibiotics at self-discharge (AHR = 0.99; 95% CI, 0.62 to 1.62) compared to those who completed IV antibiotics in the hospital.[76] Patients who consulted with an addiction medicine provider also had a decreased risk of 90-day readmission compared to those who did not have such a consult (AHR = 0.57; 95% CI, 0.38 to 0.86).[76]

The available literature suggests OPAT is a viable alternative to prolonged hospitalization for some patients, particularly those who are housed. Discussions with program providers also suggest medical stabilization, seriousness of infection, and the availability of familial or community support indicate which patients are more likely to be successfully treated for infection with OPAT. There are multiple avenues for discharge (e.g., home, SNF) and OPAT has the potential to be less costly than hospitalized care.

The literature and interviews also suggest this course of treatment might not be the correct form of care for all patients, and how it is administered may vary substantially. Medical providers have found ways to provide OPAT to patients and state programs have found ways to support providers who want to integrate medical and behavioral health care. A review of the literature and interviews with state programs and subject matter experts suggests state programs could assist practitioners in multiple ways, such as providing support staff in the form of NCMs or care coordinators, which is something 1 program already expressed was a need.

Vermont implemented bundled payments for hubs through the Patient Protection and Affordable Care Act Section 2703 State Plan amendment. One subject matter expert also suggested bundled payments as a potential strategy Medicaid could use to create an incentive for hospital treatment. Bundled payments, also known as episode-based payments, occur when the costs for a single procedure or treatment are predetermined and paid at a set rate. As mentioned previously, this type of payment originated as a way for Medicare to encourage hospital providers to increase their efficiency of care. Bundled payments have since begun to spread to outpatient and combined inpatient and outpatient services.

When costs for care exceed the predetermined price, such as when a patient is readmitted to the hospital, the provider makes up the difference. When costs are less than the predetermined price, the provider keeps the difference. We previously completed a report on bundled payments related to home- and community-based services.[77]

Bundled payments exist in a number of areas and have been proposed for OPAT.[78] The main components for a standard OPAT bundle would be similar to those for an OPAT bundle among PWID. An OPAT bundle for PWID must include all aspects of treatment necessary for patient success, including multiple avenues for addiction care, such as peer supports and social workers, and receipt of antibiotics.

Table 7 is adapted from Muldoon et al.[78] and presents suggestions for elements in a standard OPAT bundle, with some additions for PWID shown in italics. This is not meant to be exhaustive, but presents a way to start thinking about what a bundle could look like and the elements needed to create it. Consultation with infectious disease and addiction medicine providers is needed to compete and refine the table.

Care Consultation and Patient Selection

Muldoon et al.,[78] recommends patients receive infectious disease consultation before receiving a PICC line and before discharge because of the likelihood of improved outcomes from this type of care. Subject matter experts indicated PWID would also benefit from consultation with an addiction medicine doctor to provide the same kind of expertise around their addiction, and an NCM or care coordinator to assist them in accessing community supports and follow-up care once they have returned to the community.

Care Transition

Communication might be key to successful patient discharge, as compromised follow-up plans lead to poor-health outcomes.[78] Beyond standard discharge measures, PWID should receive a follow-up appointment with an addiction medicine provider. A follow-up appointment with an NCM or care coordinator could also help ensure receipt of follow-up care.

Outpatient Monitoring

Besides standard OPAT care, PWID may need follow-up care from behavioral health providers. This is also a time when patients might benefit from peer-support assistance. Medicaid is able to pay for peer supports through several Medicaid funding authorities in the Social Security Act.[79]

OPAT Program Measures

Program measures would be similar to those proposed by Muldoon et al.[78] Data on SUD treatment and connecting patients to SUD treatment facilities could also be collected. State programs might also want to collect data regarding complications of PICC-line abuse.

Treatment guidelines and risk-assessment tools are needed, and state programs could assist in developing these for their providers. Developing such tools is complex. Risk factors and protective factors are likely to vary substantially in this population, and their effects could either depend on each other (e.g., interactions with sex, age) or on other social and environmental factors (e.g., presence or absence of discrimination in the community). Convening top researchers in this area and comparing existing tools may be a place to start. Care collaboratives also appear to be one way to disseminate such information and grow networks of providers skilled in treating this population. Teleconference technologies may be especially useful in rural states with geographically dispersed providers.

The National Academy of Sciences reports the integration of infectious disease treatment and SUD treatment improves outcomes.[2] In its 2020 report, the Academy made multiple recommendations to Congress and federal agencies such as the Substance Abuse and Mental Health Services Administration and the Health Resources and Services Administration.[2] The recommendations that pertain directly to Medicaid include:

- Not requiring prior authorization for medications to treat OUD, and allowing providers the ability to prescribe what they think is best in terms of formulation, dose, and treatment without lifetime limits.
- Revising policies so more than 1 service is billable within a single day (e.g., allowing 1 behavioral and 1 physical health service in the same day).

Enacting policies to ensure individuals previously enrolled in Medicaid are automatically enrolled again when released from incarceration. At the state and local level, stigma was the challenge most often cited by providers. Historically, abstinence-based models have pervaded our culture. All interviewees spoke about reframing addiction care from abstinence-only to medical models of treatment. These models recast IDU from a moral failing to a disease treatable with medication and support.

Multiple people who were interviewed also suggested that one of the best ways to overcome stigma is to show medical treatment helps patients. Providing payment bundles to treat serious infections that include addiction services, and helping providers to develop treatment guidelines for these patients and risk tools to identify who would be better treated at home, could save state programs money and increase our understanding of addiction as a disease.

References

1. Wejnert C, Hess KL, Hall HI, et al. Vital signs: trends in HIV diagnoses, risk behaviors, and prevention among persons who inject drugs—United States. *MMWR Morb Mortal Wkly Rep*. 2016;65(47):1336-1342. doi: 10.15585/mmwr.mm6547e1.

2. National Academies of Sciences Engineering and Medicine. Opportunities to improve opioid use disorder and infectious disease services: Integrating responses to a dual epidemic. 2020; https://doi.org/10.17226/25626. Accessed January 31, 2020.

3. Tempalski B, Pouget ER, Cleland CM, et al. Trends in the population prevalence of people who inject drugs in U.S. metropolitan areas 1992-2007. *PLoS One*. 2013;8(6):e64789. doi: 10.1371/journal.pone.0064789.

4. Zibbell JE, Asher AK, Patel RC, et al. Increases in acute hepatitis C virus infection related to a growing opioid epidemic and associated injection drug use, United States, 2004 to 2014. *Am J Public Health*. 2018;108(2):175-181. doi: 10.2105/AJPH.2017.304132.

5. Gray ME, Rogawski McQuade ET, Scheld WM, Dillingham RA. Rising rates of injection drug use associated infective endocarditis in Virginia with missed opportunities for addiction treatment referral: a retrospective cohort study. *BMC Infect Dis*. 2018;18(1):532. doi: 10.1186/s12879-018-3408-y.

6. Deo SV, Raza S, Kalra A, et al. Admissions for infective endocarditis in intravenous drug users. *J Am Coll Cardiol*. 2018;71(14):1596-1597. doi: 10.1016/j.jacc.2018.02.011.

7. Fleischauer AT, Ruhl L, Rhea S, Barnes E. Hospitalizations for endocarditis and associated health care costs among persons with diagnosed drug dependence—North Carolina, 2010-2015. *MMWR Morb Mortal Wkly Rep*. 2017;66(22):569-573. doi: 10.15585/mmwr.mm6622a1.

8. Tookes H, Diaz C, Li H, Khalid R, Doblecki-Lewis S. A cost analysis of hospitalizations for infections related to injection drug use at a county safety-net hospital in Miami, Florida. *PLoS One*. 2015;10(6):e0129360. doi: 10.1371/journal.pone.0129360.

9. Muldoon EG, Switkowski K, Tice A, Snydman DR, Allison GM. A national survey of infectious disease practitioners on their use of outpatient parenteral antimicrobial therapy (OPAT). *Infect Dis (Lond)*. 2015;47(1):39-45. doi: 10.3109/00365548.2014.967290.

10. Vazirian M, Jerry JM, Shrestha NK, Gordon SM. Outcomes of outpatient parenteral antimicrobial therapy in patients with injection drug use. *Psychosomatics*. 2018;59(5):490-495. doi: 10.1016/j.psym.2018.02.005.

11. Rapoport AB, Fischer LS, Santibanez S, Beekmann SE, Polgreen PM, Rowley CF. Infectious diseases physicians' perspectives regarding injection drug use and related infections, United States, 2017. *Open Forum Infect Dis*. 2018;5(7):ofy132. doi: 10.1093/ofid/ofy132.

12. Morrisette T, Miller MA, Montague BT, Barber GR, McQueen RB, Krsak M. Long-acting lipoglycopeptides: "lineless antibiotics" for serious infections in persons who use drugs. *Open Forum Infect Dis*. 2019;6(7):ofz274. doi: 10.1093/ofid/ofz274.

13. Ramirez VN, Carwile JL, Rokas K, Craig W, Kinna T. Injection drug use and care charges for infective endocarditis. *Journal of Maine Medical Center*. 2020;2(1). https://knowledgeconnection.mainehealth.org/jmmc/vol2/iss1/12.

14. Serota DP, Vettese T. New Answers for Old Questions in the Treatment of Severe Infections from Injection Drug Use. *J Hosp Med*. 2019;14:E1-E7. doi: 10.12788/jhm.3342.

15. O'Callaghan K, Tapp S, Hajkowicz K, Legg A, McCarthy KL. Outcomes of patients with a history of injecting drug use and receipt of outpatient antimicrobial therapy. *Eur J Clin Microbiol Infect Dis.* 2019;38(3):575-580. doi: 10.1007/s10096-018-03461-3.

16. Ho J, Archuleta S, Sulaiman Z, Fisher D. Safe and successful treatment of intravenous drug users with a peripherally inserted central catheter in an outpatient parenteral antibiotic treatment service. *J Antimicrob Chemother.* 2010;65(12):2641-2644. doi: 10.1093/jac/dkq355.

17. Jewell C, Weaver M, Sgroi C, Anderson K, Sayeed Z. Residential addiction treatment for injection drug users requiring intravenous antibiotics: a cost-reduction strategy. *J Addict Med.* 2013;7(4):271-276. doi: 10.1097/ADM.0b013e318294b1eb.

18. Velez CM, Nicolaidis C, Korthuis PT, Englander H. "It's been an experience, a life learning experience": a qualitative study of hospitalized patients with substance use disorders. *J Gen Intern Med.* 2017;32(3):296-303. doi: 10.1007/s11606-016-3919-4.

19. Shanahan CW, Beers D, Alford DP, Brigandi E, Samet JH. A transitional opioid program to engage hospitalized drug users. *J Gen Intern Med.* 2010;25(8):803-808. doi: 10.1007/s11606-010-1311-3.

20. Fanucchi LC, Walsh SL, Thornton AC, Nuzzo PA, Lofwall MR. Outpatient parenteral antimicrobial therapy plus buprenorphine for opioid use disorder and severe injection-related infections. *Clin Infect Dis.* 2020;70(6):1226-1229. doi: 10.1093/cid/ciz654.

21. D'Couto HT, Robbins GK, Ard KL, Wakeman SE, Alves J, Nelson SB. Outcomes according to discharge location for persons who inject drugs receiving outpatient parenteral antimicrobial therapy. *Open Forum Infect Dis.* 2018;5(5):ofy056. doi: 10.1093/ofid/ofy056.

22. Jafari S, Joe R, Elliot D, Nagji A, Hayden S, Marsh DC. A community care model of intravenous antibiotic therapy for injection drug users with deep tissue infection for "reduce leaving against medical advice". *Int J Ment Health Addict.* 2015;13:49-58. doi: 10.1007/s11469-014-9511-4.

23. Camsari UM, Libertin CR. Small-town America's despair: infected substance users needing outpatient parenteral therapy and risk stratification. *Cureus.* 2017;9(8):e1579. doi: 10.7759/cureus.1579.

24. Eaton EF, Mathews RE, Lane PS, et al. A 9-point risk assessment for patients who inject drugs and require intravenous antibiotics: focusing inpatient resources on patients at greatest risk of ongoing drug use. *Clin Infect Dis.* 2019;68(6):1041-1043. doi: 10.1093/cid/ciy722 Accessed March 10, 2020.

25. Beieler A, Magaret A, Zhou Y, Schleyer A, Wald A, Dhanireddy S. Outpatient parenteral antimicrobial therapy in vulnerable populations: people who inject drugs and the homeless. *J Hosp Med.* 2019;14(2):105-109. doi: 10.12788/jhm.3138.

26. Davies HT, Crombie IK, Tavakoli M. When can odds ratios mislead? *BMJ (Clinical research ed).* 1998;316(7136):989-991. doi: 10.1136/bmj.316.7136.989.

27. Rudasill SE, Sanaiha Y, Mardock AL, et al. Clinical outcomes of infective endocarditis in injection drug users. *J Am Coll Cardiol.* 2019;73(5):559-570. doi: 10.1016/j.jacc.2018.10.082.

28. ClinicalTrials.gov. NCT03761953. Oritavancin for *Staphylococcus aureus* infections in opioid users. 2020; https://clinicaltrials.gov/ct2/show/study/NCT03761953. Accessed February 3, 2020.

29. Hinde J, Hayes J, Mark T, Bernstein S, Karon S. State and local policy levers for increasing treatment and recovery capacity to address the opioid epidemic: final report. U.S. Department of Health and Human Services Assistant Secretary for Planning and Evaluation Office of Disability, Aging and Long-Term Care Policy; 2017.

30. Eaton EF, Lee RA, Westfall AO, et al. An integrated hospital protocol for persons with injection-related infections may increase MOUD use but challenges remain. *J Infect Dis.* In press.

31. Rolfe RJ, Mathews RE, Rodriguez JM, et al. Implementation of a standardized protocol for hospitalized patients who inject drugs and require long-term antibiotics reduces length of stay without increasing 30-day readmissions. *Open Forum Infect Dis.* 2017;4(suppl_1):S340-S341. doi: 10.1093/ofid/ofx163.811.

32. Providence Health Care. Rapid Access Addiction Clinic (RAAC). 2020; http://www.providencehealthcare.org/rapid-access-addiction-clinic-raac. Accessed April 23, 2020.

33. Hajek J, Chamberlaine M, Baldwin N, Joe R. A community-based innovative model of care for the management of severe bacterial infections in persons who use injection drugs. *JAMMI.* 2019. doi: 10.3138/jammi.2019.05.24.02.

34. Moureau NL, Flynn J. Disinfection of needleless connector hubs: clinical evidence systematic review. *Nurs Res Pract*. 2015;2015:796762. doi: 10.1155/2015/796762.

35. Englander H, Kansagara D. Planning and designing the care transitions innovation (C-TraIn) for uninsured and Medicaid patients. *J Hosp Med.* 2012;7(7):524-529. doi: 10.1002/jhm.1926.

36. Englander H, Michaels L, Chan B, Kansagara D. The care transitions innovation (C-TraIn) for socioeconomically disadvantaged adults: results of a cluster randomized controlled trial. *J Gen Intern Med.* 2014;29(11):1460-1467. doi: 10.1007/s11606-014-2903-0.

37. Englander H, Weimer M, Solotaroff R, et al. Planning and designing the improving addiction care team (IMPACT) for hospitalized adults with substance use disorder. *J Hosp Med.* 2017;12(5):339-342. doi: 10.12788/jhm.2736.

38. Englander H, Collins D, Perry SP, Rabinowitz M, Phoutrides E, Nicolaidis C. "We've learned it's a medical illness, not a moral choice": qualitative study of the effects of a multicomponent addiction intervention on hospital providers' attitudes and experiences. *J Hosp Med.* 2018;13(11):752-758. doi: 10.12788/jhm.2993.

39. Englander H, Mahoney S, Brandt K, et al. Tools to support hospital-based addiction care: core components, values, and activities of the improving addiction care team. *J Addict Med.* 2019;13(2):85-89. doi: 10.1097/ADM.0000000000000487.

40. New Directions Northwest Inc. 2020; https://newdirectionsnw.org/. Accessed April 23, 2020.

41. Englander H, Wilson T, Collins D, et al. Lessons learned from the implementation of a medically enhanced residential treatment (MERT) model integrating intravenous antibiotics and residential addiction treatment. *Subst Abus.* 2018;39(2):225-232. doi: 10.1080/08897077.2018.1452326.

42. Strnad L, Douglass A, Young K, et al. 742. The development, implementation, and feasibility of multidisciplinary treatment planning conference for individuals with unstable substance use disorders and active infections requiring prolonged antimicrobial therapy: the OPTIONS-DC model. *Open Forum Infect Dis.* 2019;6(Supplement_2):S331-S332. doi: 10.1093/ofid/ofz360.810.

43. Gore SJ, Strnad L, Englander H, Gregg J, Sikka M, Sikka M. 788. Outcomes of multidisciplinary care conferences for patients with substance use disorders requiring prolonged antimicrobial therapy for severe infections. *Open Forum Infect Dis.* 2019;6(Supplement_2):S349-S349. doi: 10.1093/ofid/ofz360.856.

44. Providence Health Care. St. Paul's Hospital. 2020; http://www.providencehealthcare.org/hospitals-residences/st-paul%27s-hospital. Accessed April 23, 2020.

45. Brady T, Robinson B, Davis T. Medicare hospital prospective payment system: how DRG rates are calculated and updated. Office of Inspector General, Office of Evaluation and Inspections, Region IX; 2001.

46. Cortese DA, Landman N, Smoldt RK. Making bundled payments work: leveraging the CMS DRG experience. 2018; https://catalyst.nejm.org/doi/full/10.1056/CAT.18.0179. Accessed April 20, 2020.

47. Englander H, Dobbertin K, Lind BK, et al. Inpatient addiction medicine consultation and post-hospital substance use disorder treatment engagement: a propensity-matched analysis. *J Gen Intern Med.* 2019;34(12):2796-2803. doi: 10.1007/s11606-019-05251-9.

48. Centers for Medicare and Medicaid Services. Re: new service delivery opportunities for individuals with a substance use disorder. 2015; https://www.medicaid.gov/sites/default/files/federal-policy-guidance/downloads/SMD15003.pdf. Accessed April 27, 2020.

49. Medicaid.gov. 1115 Substance Use Disorder Demonstrations. 2020; https://www.medicaid.gov/resources-for-states/innovation-accelerator-program/program-areas/substance-use-disorders/1115-substance-use-disorder-demonstrations/index.html. Accessed April 27, 2020.

50. Kaiser Family Foundation. Waivers with behavioral health provisions: approved and pending as of April 24, 2020. 2020; https://www.kff.org/medicaid/issue-brief/medicaid-waiver-tracker-approved-and-pending-section-1115-waivers-by-state/#Table5. Accessed April 27, 2020.

51. Substance Abuse and Mental Health Services Administration. State Opioid Treatment Authorities. 2020; https://dpt2.samhsa.gov/regulations/smalist.aspx. Accessed June 3, 2020.

52. Attorney General of Washington and Washington State Human Rights Commission. Medications for opioid use disorder: Know your rights and responsibilities. 2020; https://agportal-s3bucket.s3.amazonaws.com/uploadedfiles/Another/Supporting_Law_Enforcement/KnowYourRights-Opioid-Tx_english.pdf. Accessed June 3, 2020.

53. Substance Abuse and Mental Health Services Administration. Statutes, regulations, and guidelines. 2020; https://www.samhsa.gov/medication-assisted-treatment/statutes-regulations-guidelines. Accessed April 27, 2020.

54. Brooklyn JR, Sigmon SC. Vermont hub-and-spoke model of care for opioid use disorder: development, implementation, and impact. *J Addict Med.* 2017;11(4):286-292. doi: 10.1097/ADM.0000000000000310.

55. Moses K, Klebonis J. Designing Medicaid health homes for individuals with opioid dependency: considerations for states. In: Services CfMaM, ed. *Health Home Information Resource Center Brief*: Centers for Medicare and Medicaid Services; 2015:1-7.

56. State of Vermont Blueprint for Health. Hub and spoke. 2020; https://blueprintforhealth.vermont.gov/about-blueprint/hub-and-spoke. Accessed April 23, 2020.

57. Reif S, Brolin MF, Stewart MT, Fuchs TJ, Speaker E, Mazel SB. The Washington State Hub and Spoke Model to increase access to medication treatment for opioid use disorders. *J Subst Abuse Treat*. 2020;108:33-39. doi: 10.1016/j.jsat.2019.07.007.

58. Alford DP, LaBelle CT, Kretsch N, et al. Collaborative care of opioid-addicted patients in primary care using buprenorphine: five-year experience. *Arch Intern Med*. 2011;171(5):425-431. doi: 10.1001/archinternmed.2010.541.

59. LaBelle CT, Han SC, Bergeron A, Samet JH. Office-Based Opioid Treatment with Buprenorphine (OBOT-B): Statewide Implementation of the Massachusetts Collaborative Care Model in Community Health Centers. *J Subst Abuse Treat*. 2016;60:6-13. doi: 10.1016/j.jsat.2015.06.010.

60. State of Washington Health Care Authority. Opioid treatment networks. 2018; http://www.wsha.org/wp-content/uploads/Opioid_Treatment_Networks_Document_RFA.pdf. Accessed June 1, 2020.

61. Washinton State Health Care Authority. Washington State hub and spoke project. 2020; https://www.hca.wa.gov/about-hca/behavioral-health-recovery/washington-state-hub-and-spoke-project. Accessed April 27, 2020.

62. Washington Department of Social and Health Services. Washington State targeted response: Hub and Spoke Project. 2017; https://www.hca.wa.gov/assets/program/hub-spoke-letter-of-intent.pdf. Accessed April 27, 2020.

63. Washinton State Health Care Authority. Washington State medication assisted treatment hub and spoke network 2020 directory. 2020; https://www.hca.wa.gov/assets/program/hub-and-spoke-directory.pdf. Accessed April 27, 2020.

64. University of New Mexico School of Medicine. Project ECHO. 2020; https://echo.unm.edu/. Accessed April 25, 2020.

65. Nordstrom BR, Saunders EC, McLeman B, et al. Using a learning collaborative strategy with office-based practices to increase access and improve quality of care for patients with opioid use disorders. *J Addict Med*. 2016;10(2):117-123. doi: 10.1097/ADM.0000000000000200.

66. Casper KL, Folland F. Essential elements of Vermont's "hub and spoke" health homes model. 2016; http://www.njamha.org/links/publicpolicy/AATOD_whitepaper1.pdf. Accessed April 23, 2020.

67. Berliner A. Vermont health homes for beneficiaries receiving medication assisted therapy for opiod addiction: health home state plan amendment. 2014; http://www.chcs.org/media/VT_13-001_Approvalpackage.pdf. Accessed April 27, 2020.

68. Vermont Blueprint for Health. Hub regional profile. 2017; https://blueprintforhealth.vermont.gov/sites/bfh/files/Blueprint-Hub-Profile-2017.pdf. Accessed April 24, 2020.

69. Mohlman MK, Tanzman B, Finison K, Pinette M, Jones C. Impact of medication-assisted treatment for opioid addiction on Medicaid expenditures and health services utilization rates in Vermont. *J Subst Abuse Treat*. 2016;67:9-14. doi: 10.1016/j.jsat.2016.05.002.

70. Rawson R, Cousins SJ, McCann M, Pearce R, Van Donsel A. Assessment of medication for opioid use disorder as delivered within the Vermont hub and spoke system. *J Subst Abuse Treat*. 2019;97:84-90. doi: 10.1016/j.jsat.2018.11.003.

71. Shetty N, Nagpal D, Koivu S, Mrkobrada M. Surgical and medical management of isolated tricuspid valve infective endocarditis in intravenous drug users. *J Card Surg*. 2016;31(2):83-88. doi: 10.1111/jocs.12682.

72. Straw S, Baig MW, Gillott R, et al. Long-term outcomes are poor in intravenous drug users following infective endocarditis, even after surgery. *Clin Infect Dis*. 2019;03:03. doi: 10.1093/cid/ciz869.

73. Rodger L, Glockler-Lauf SD, Shojaei E, et al. Clinical characteristics and factors associated with mortality in first-episode infective endocarditis among persons who inject drugs. *JAMA Netw Open*. 2018;1(7):e185220. doi: 10.1001/jamanetworkopen.2018.5220.

74. Ziu M, Dengler B, Cordell D, Bartanusz V. Diagnosis and management of primary pyogenic spinal infections in intravenous recreational drug users. *Neurosurg Focus*. 2014;37(2):E3. doi: 10.3171/2014.6.FOCUS14148.

75. Buehrle DJ, Shields RK, Shah N, Shoff C, Sheridan K. Risk factors associated with outpatient parenteral antibiotic therapy program failure among intravenous drug users. *Open Forum Infect Dis*. 2017;4(3):ofx102. doi: 10.1093/ofid/ofx102.

76. Marks LR, Liang SY, Muthulingam D, et al. Evaluation of partial oral antibiotic treatment for persons who inject drugs and are hospitalized with invasive infections. *Clin Infect Dis*. 2020. doi: 10.1093/cid/ciaa365 Accessed 6/25/2020.

77. Byers J, Bennett A, Curtis P, Harrod C. *Payment method redesign and quality measures for home- and community-based services*. Portland, Oregon: Center for Evidence-based Policy, Oregon Health & Science University; 2017.

78. Muldoon EG, Snydman DR, Penland EC, Allison GM. Are we ready for an outpatient parenteral antimicrobial therapy bundle? A critical appraisal of the evidence. *Clin Infect Dis*. 2013;57(3):419-424. doi: 10.1093/cid/cit211 Accessed March 24, 2020.

79. Centers for Medicare and Medicaid Services. CMS letter: peer supports. 2007; https://www.integration.samhsa.gov/workforce/CMS_letter_with_date.pdf. Accessed April 27, 2020.

80. Higgins JPT, Green S. Cochrane handbook for systematic reviews of interventions. 2011. Accessed April 20, 2017.

81. National Heart, Lung, and Blood Institute. Quality assessment tool for observational cohort and cross-sectional studies. 2018; https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools. Accessed May 30, 2018.

82. National Institute for Health and Care Excellence. Developing NICE guidelines: the manual. *NICE*. 2014; https://www.nice.org.uk/media/default/about/what-we-do/our-programmes/developing-nice-guidelines-the-manual.pdf. Accessed December 15, 2015.

83. Scottish Intercollegiate Guidelines Network. Methodology checklist 3: cohort studies. 2012; http://www.sign.ac.uk/checklists-and-notes.html. Accessed May 30, 2018.

84. Scottish Intercollegiate Guidelines Network. Methodology checklist 2: randomised controlled trials. 2015; http://www.sign.ac.uk/checklists-and-notes.html. Accessed May 9, 2017.

Appendix A. Methods

Clinical Evidence Methods

Search Strategy

We searched Medicaid Evidence-based Decisions Project (MED) clinical evidence sources to identify randomized controlled trials (RCTs) and comparative cohort studies including the terms: *hemorrhagic septicemia*, *endocarditis*, *tetanus*, *clostridium*, *botulism*, *bacteremia*, *sepsis*, *meningitis*, *staphylococcus*, *osteomyelitis*, *anti-bacterial agent*, *antibiotic*, *intravenous substance abuse*, *intravenous drug use*, *intravenous drug misuse*, *injecting drug abuse*, *injecting drug use*, *injecting drug misuse*, *IV drug abuse*, *IV drug use*, *IV drug misuse*, *IDU*, *outpatient parenteral antimicrobial therapy*, *severe injection related infections*, *outpatient parenteral antibiotic therapy*, *peripherally inserted central catheter*. We limited searches of sources to citations published after January 1, 2010.

We searched the following MED evidence sources:

- Agency for Healthcare Research and Quality (AHRQ)
  - Evidence-based Practice Centers (EPC) Reports
  - Effective Health Care (EHC) Program
- Canadian Agency for Drugs and Technologies in Health (CADTH)
- Cochrane Library (Wiley Interscience)
- National Institute for Health and Care Excellence (NICE), Evidence
- Ovid MEDLINE including In-Process & Other Non-Indexed Citations and Epub Ahead of Print
- Veterans Administration Evidence-based Synthesis Program (ESP)
- PsycINFO

Ovid MEDLINE Search Strategy

Database: Ovid MEDLINE(R) <1946 to February Week 1 2020>, Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations <1946 to February 12, 2020>, Ovid MEDLINE(R) Epub Ahead of Print <February 12, 2020>

Search Strategy:

1. Hemorrhagic septicemia.mp.
2. Endocarditis.mp.
3. Endocarditis, Bacterial/ or Endocarditis/ or Endocarditis, Subacute Bacterial/ or Endocarditis, Non-Infective/
4. Tetanus/
5. Tetanus.mp.
6. Clostridium/
7. Clostridium.mp.
8. Botulism.mp.
9. Botulism/

10. Bacteremia.mp.
11. Bacteremia/
12. Sepsis.mp.
13. Sepsis/
14. Meningitis/ or Meningitis, Bacterial/
15. Meningitis.mp.
16. Staphylococcus/
17. Staphylococcus.mp.
18. Osteomyelitis.mp.
19. Osteomyelitis/
20. exp Anti-Bacterial Agents/
21. Antibiotic*.mp.
22. Anti-bacterial agent*.mp.
23. or/1-22
24. exp Substance Abuse, Intravenous/
25. IDU.mp. (2938)
26. ((intravenous or inject* or IV) adj2 (substance* or drug*) adj2 (use* or abuse* or misuse*)).mp.
27. or/24-26
28. 23 and 27
29. Limit 28 to English language
30. Limit 29 to yr="2010 - 2020"

Database: Ovid MEDLINE(R) <1946 to February Week 1 2020>, Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations <1946 to February 12, 2020>, Ovid MEDLINE(R) Epub Ahead of Print <March 15, 2020>

Search Strategy:

1. Outpatient parenteral antimicrobial therapy.mp
2. Severe injection related infections.mp.
3. Outpatient parenteral antibiotic therapy.mp.
4. Peripherally inserted central catheter.mp.
5. ((intravenous or inject* or IV) adj2 (substance* or drug*) adj2 (use* or abuse* or misuse*)).mp.

6. or/1-4

7. 5 and 6

Cochrane Library Search Strategy

Search Name: IDU - Final Search

Date Run: 13/02/2020 19:14:25

Comment:

ID Search Hits

1. Hemorrhagic septicemia

2. Endocarditis

3. MeSH descriptor: [Endocarditis] explode all trees

4. Tetanus

5. MeSH descriptor: [Tetanus] explode all trees

6. Clostridium

7. MeSH descriptor: [Clostridium] explode all trees

8. Botulism

9. MeSH descriptor: [Botulism] explode all trees

10. Bacteremia

11. MeSH descriptor: [Bacteremia] explode all trees

12. Sepsis

13. MeSH descriptor: [Sepsis] explode all trees

14. Meningitis

15. MeSH descriptor: [Meninges] explode all trees

16. Staphylococcus

17. MeSH descriptor: [Staphylococcus] explode all trees

18. Osteomyelitis

19. MeSH descriptor: [Osteomyelitis] explode all trees

20. Anti-bacterial agent*

21. MeSH descriptor: [Anti-Bacterial Agents] explode all trees

22. Antibiotic*

23. #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22

24. ((intravenous OR inject* OR IV) near2 (substance* OR drug*) near2 (use* OR abuse* OR misuse*))

25. MeSH descriptor: [Substance Abuse, Intravenous] explode all trees

26. IDU

27. #24 OR #25 OR #26

28. #23 AND #27

Inclusion Criteria

Population

People who inject drugs (PWID) seeking treatment for serious infections that require antibiotics, such as endocarditis or osteomyelitis.

Interventions

Alternatives to intravenous antibiotic treatment (e.g., partial or complete oral antibiotic therapy, long-acting antibiotic formulations), novel systems of care (e.g., simultaneous treatment for SUD and serious infection, recuperative care programs), alternative outpatient sites of care (e.g. recovery centers), or combinations of these interventions

Comparator

Usual care

Outcomes

Clinical and/or microbiological cure of infection, treatment of SUD, abstinence from substance use, inpatient length of stay (LOS), readmission for infection or infectious sequelae, total cost of care

Exclusion Criteria

We excluded studies if they were not published in English or were published before January 1, 2010.

Risk of Bias Assessment

Risk of Bias in Included Studies

We assessed the risk of bias in the included RCTs and comparative cohort studies using standard instruments developed and adapted by MED that are modifications of instruments used by several renowned, respected organizations.[80-84] One experienced researcher independently rated the methodological quality of the included studies. A second experienced researcher reviewed each assessment. Disagreement was managed by discussion.

Randomized Controlled Trials

Low-risk-of-bias RCTs included a clear description of the population, setting, intervention, and comparison groups; a random and concealed allocation of patients to study groups; low dropout rates; and intention-to-treat analyses. Low-risk-of-bias RCTs also have low potential for bias from conflicts of interest and funding source(s). Moderate-risk-of-bias RCTs have incomplete information about methods that might mask important limitations or a meaningful conflict of interest. High-risk-of-bias RCTs have clear flaws that could introduce significant bias.

Cohort Studies

Low-risk-of-bias cohort studies include a sample representative of the source population, have a low loss to follow-up, and measure and consider relevant confounding factors. These studies also list funding source(s) and have a low potential of bias from conflicts of interest. Moderate-risk-of-bias cohort studies might not have measured all relevant confounding factors nor adjusted for such factors in statistical analyses, have loss to follow-up which could bias findings, consist of a sample not representative of the source population, or have potential conflicts of interest that are not addressed. High-risk-of-bias cohort studies have a clear, high risk of bias that would affect findings.

Policy Methods

Search Strategy

We conducted a search of Medicaid Evidence-based Decisions Project (MED) policy sources to identify relevant policy briefs, national policy summaries, laws, regulations, and guidance using the terms *integrated care*, *substance use*, *injecting drug use*, *infection*, *antibiotics*, *outpatient parenteral antimicrobial therapy*, *severe injection related infections*, *severe infections*, *outpatient parenteral antibiotic therapy*, *OPAT*, *peripherally inserted central catheter*, *endocarditis*, *and osteomyelitis*. Additionally, we conducted a Google search using the terms *PICC line*, *peripherally inserted central catheter*, *outpatient parenteral antibiotic therapy*, *OPAT*, *injecting drug use*, *Medicaid*, *serious infection*, *endocarditis*, *osteomyelitis*, *antibiotics*, *IV drug use*, *intravenous drug use*, *substance use*, and *integrated care* and reviewed key sources from reference lists. For state-specific policy, we searched state websites, provider manuals, and relevant laws and regulations for Washington and Vermont.

We also interviewed officials in Washington and Vermont and subject matter experts.

We searched for federal, state, and major private payer policies using the following sources: The Medicare Coverage Database; Medicaid agency websites, provider manuals, and related state statute or administrative rule websites in Washington, Vermont, and Massachusetts; private payer websites including Aetna, Cigna, BlueCross BlueShield (Regence and Anthem), and UnitedHealthcare. Search terms included *integrated care*, *substance use*, *injecting drug use*, *outpatient parenteral antimicrobial therapy*, *severe injection related infections*, *outpatient parenteral antibiotic therapy*, *OPAT*, *peripherally inserted central catheter*, *PICC line*, and *peripherally inserted catheter*.

Policy Sources Searched

- AcademyHealth
- Alliance for Health Policy
- American Public Human Services Association
- Center for Budget and Policy Priorities
- Center for Health Care Strategies, Inc.
- Center for Public Health Law Research
- Centers for Disease Control and Prevention
- Centers for Medicare & Medicaid Services
- Commonwealth Fund
- Congress.gov
- Health Resources and Services Administration (HRSA)
- Health Systems Evidence (McMaster University)
- Henry J. Kaiser Family Foundation
- Mathematica Policy Research
- National Academy for State Health Policy
- National Association of State Medicaid Directors
- National Governors Association
- RAND
- Robert Wood Johnson Foundation
- Substance Abuse and Mental Health Services Administration
- Urban Institute

Interview Contacts

Washington

Christopher Chen
Associate Medical Director
Washington State Health Care Authority
March 4, 2020

Charissa Fotinos
Deputy Chief Medical Officer
Apple Health
March 9, 2020

Jessica Blose
Washington State Opioid Treatment Authority
Manager of Behavioral Health Clinical Support
Washington State Health Care Authority
May 22, 2020

Vermont

Beth Tanzman
Executive Director
Vermont Blueprint for Health
April 24, 2020

Subject Matter Experts

Paxton Bach
Associate Director
Clinical Addiction Medicine Fellowship Program
British Columbia Centre on Substance Use

Clinical Assistant Professor
Department of Medicine
University of British Columbia
February 28, 2020

Honora Englander
Associate Professor of Medicine
Division of Hospital Medicine, School of Medicine
Oregon Health & Science University
March 10, 2020

Ellen Eaton
Assistant Professor
Division of Infectious Diseases
University of Alabama at Birmingham
March 4, 2020

Appendix B. Additional Study Information

Table B1. Identified Studies Which Explored Alternative Treatments to Prolonged Hospitalization Among People Who Inject Drugs (PWID) and Have Serious Infections

Author, Year, Location, Trial Number	Patient Cohort (Number, age, percent male)	Program Description
Randomized Controlled Trial (RCT)		
Fanucchi et al., 2020[20] University of Kentucky Medical Center, Lexington NCT03048643	20 patients with opioid use disorder and SIRI requiring ≥ 2 weeks IV antibiotics: • 10 in the outpatient group • 10 in the inpatient group • Mean ages 31.3 (outpatient) and 32.9 (inpatient) • 30% male in each group • 100% White in each group	Participants received a substance use disorder assessment and infectious disease consultation and were randomized to either OPAT or usual care: OPAT and usual care: • Buprenorphine in the hospital and for 12 weeks following discharge. • Frequent outpatient physician appointments • Weekly counseling • Urine drug testing OPAT: • Discharged to home when medically stable with OPAT • Antibiotic home delivery • Catheter dressing changes at ID clinic Usual Care: Discharged after antibiotic completion
Cohort Studies		
D'Couto et al., 2018[21] Massachusetts General Hospital	52 PWID with known or suspected IDU in the past 2 years and admitted to hospital with a diagnosis requiring ≥ 2 weeks antibiotic therapy (e.g., endocarditis, osteomyelitis, septic arthritis): • 21 discharged to home • 31 discharged to SNF/rehabilitation • Mean age 30 in the home group and 33 in the SNF group • 69% male • 96% White	Data analysis of patients who were included in the Research Patient Data Registry, a centralized clinic database for hospitals in the Partners Healthcare System Discharged to home: patients who were enrolled in the OPAT program for antibiotic monitoring and expected to return to the hospital system for outpatient follow-up Discharged SNF/rehabilitation: patients who were enrolled in OPAT program for antibiotic monitoring and expected to return to the hospital system for outpatient follow-up; majority discharged to state-supported facilities (patients followed by infectious disease physicians at these facilities were excluded, as were patients who used outpatient infusion centers)

... continued on next page

Table B1. Identified Studies Which Explored Alternative Treatments to Prolonged Hospitalization Among People Who Inject Drugs (PWID) and Have Serious Infections (cont.)

Author, Year, Location, Trial Number	Patient Cohort (Number, age, percent male)	Program Description
Eaton et al., 2018[24] University of Alabama Hospital	37 discrete patients during the pre-IVAT period and 100 during the post-IVAT period: • Mean age of both groups 35 • 46% and 58% male, respectively • 95% and 92% White, respectively • Indication for prolonged IV antibiotics (e.g., bloodstream infections, infective endocarditis, bone and joint infections)	IVAT intervention with the goal of stratifying PWID according to their risk of ongoing IDU while receiving IV antibiotics 9-point risk assessment assessed cravings, home environment, dual psychiatric diagnoses, history of overdose, relapse, trauma, use of multiple drugs, family history of addiction, and willingness to change • Low-risk patients (1–3 points) discharged for the duration of antibiotics and who participated in outpatient addiction care • Medium-risk patients (4-6 points) were kept as inpatients and offered group therapy, opioid agonist therapy, and discharge readiness assessment • High-risk patients (7–9 points) were kept as inpatients and offered group therapy, opioid agonist therapy, and discharge readiness assessment
Camsari et al., 2017[23] Waycross, Georgia	20 patients seen by infectious disease services and referred for psychiatry consultation: • 10 classified as high risk, 5 as moderate risk, 5 as low risk • Mean age across groups from 38.6 to 49.2 years • 60% male • Race not reported	Patients needing a PICC line for discharge received a drug addiction consultation and psychosocial risk profile to aid in decision making around patient disposition: • High risk (active or history of IDU disorder with acute concerns for other addictive or psychiatric disorders or psychosocial issues): patients either kept in hospital or discharged to a nursing home, a long-term acute care setting, or an ambulatory infusion center with daily peripheral line insertion for the days therapy was needed • Moderate risk (history of IDU in remission for at least 12 months or no history, but with an active opioid, cocaine, or methamphetamine use disorder): patients approved for hospital discharge with PICC line but received antibiotic injections at an ambulatory center, random drug screens, psychiatry and infectious disease follow-up appointments • Low risk (history of IDU in full remission, including from any other addictive disorder except alcohol or cannabis, for at least 12 months): patients received OPAT with a PICC line and routine infectious disease and psychiatric care

... continued on next page

Table B1. Identified Studies Which Explored Alternative Treatments to Prolonged Hospitalization Among People Who Inject Drugs (PWID) and Have Serious Infections (cont.)

Author, Year, Location, Trial Number	Patient Cohort (Number, age, percent male)	Program Description
Jafari et al., 2015[22]	165 patients with deep tissue infection: • Mean age 41 years • 57% male • 84% used at least one illicit drug and of them 39% used injection drugs	CTCT, which is a community care model taking up to 9 residents: • Independent rooms (private bathroom, shower, cable TV, telephone, kitchenette, fridge, dining room, adjustable bed, and meals/nutritional requirements) • Care (medication management, wound care, lab work, and IV antibiotic therapy) • Staff accompaniment to appointments (specialists, labs, X-rays, CT and MRI, physiotherapy, occupational therapy, banking, and addiction support) Usual care
Beieler et al., 2019[25] Seattle, Washington	101 homeless (52%) or housed (48%) PWID with serious infection: • Mean age 38.8 (homeless) and 41.6 (housed) years • 68% male • 81% White	• Hospitalized patients discharged with OPAT, including tamper-evident stickers on lines which nurses evaluated daily • Follow-up care from infectious disease specialists • Abstinence was not required • Patients were discharged to home or to respite care, an SNF, shelter/street, or other

Abbreviations. CTCT: Community Transitional Care Team; ID: infectious disease; IDU: injecting drug use; IVAT: intravenous antibiotics and addiction team; OPAT: outpatient parenteral antimicrobial therapy; PICC: peripherally inserted central catheter; PWID: people who inject drugs; SIRI: severe injection-related infections; SNF: skilled nursing facility

Table B2. Fanucchi et al. (2020) Patient Characteristics Among PWID Treated For Serious Infection in the University of Kentucky RCT[20]

Characteristics	Usual Care	OPAT
Age in years (mean, range)	32.9 (26, 38)	31.3 (21, 48)
Female (n, %)	7 (70)	7 (70)
Race, White (n, %)	10 (100)	10 (100)
Hepatitis C antibody positive (n, %)	9 (90)	10 (100)
Hepatitis C RNA detectable (n, %)	2 (20)	7 (70)
Hepatitis B surface antigen positive (n, %)	1 (10)	2 (20)
Human immunodeficiency virus (n, %)	0 (0)	0 (0)
Tobacco use, current (n, %)	10 (100)	8 (80)
Endocarditis, modified Duke criteria (n, %)	9 (90)	10 (100)
Tricuspid valve (n, %)	6 (60)	8 (80)
Mitral and/or aortic valves (n, %)	2(20)	1 (10)
Endocarditis, valve(s) replaced (n, %)	1(10)	1 (10)
Osteomyelitis or septic arthritis (n, %)	4 (40)	3 (30)
Pathogenic organism:		
Methicillin-resistant *S. aureus* (n, %)	8 (80)	3 (30)
Methicillin-sensitive *S. aureus* (n, %)	2 (20)	3 (30)
Streptococcus and *Enterococcus* (n, %)	0 (0)	3 (30)
Substance use disorder, current, DSM-5		
Opioid use disorder, severe (n, %)	10 (100)	10 (100)
Stimulant use disorder (n, %)	5 (50)	5 (50)
Addiction Severity Index-Lite composite[a]		
Medical	0.84 (0.07)	0.91 (0.04)
Drug use	0.28 (0.04)	0.25 (0.03)

Note. [a] Mean, ± standard error of the mean; Abbreviations. PWID: people who inject drugs; RCT: randomized controlled trial; OPAT: outpatient parenteral antimicrobial therapy.

Table B3. D'Couto et al. (2018) Patient Characteristics Among PWID Enrolled In OPAT and Discharged To Home or To an SNF/Rehabilitation[21]

Characteristics	Discharged to Home (n = 21)	Discharged to SNF/Rehab (n = 31)
Female	6 (29%)	10 (32%)
Male	15 (71%)	21 (68%)
Black	1 (5%)	0
Hispanic	0	0
Asian	0	0
White	20 (95%)	30 (97%)
Other/Unknown	0	1 (3%)
Age (Median, Range)	30 (23–51)	33 (24–61)
Injection Drug History:		
Ongoing	7 (33%)	21 (68%)
Within 24 months	14 (67%)	10 (32%)
Opioids	20 (95%)	28 (90%
Cocaine	3 (14%)	14 (45%)
Admission Information		
Diagnosis:		
Endocarditis	8 (38%)	6 (19%)
Osteomyelitis	6 (29%)	13 (42%)
Prosthetic Joint Infection	1 (5%)	1 (3%)
Septic Arthritis	5 (24%)	10 (32%)
Other	3 (14%)	14 (45%)
Pathogen:		
MRSA	3 (14%)	6 (19%)
MSSA	12 (57%)	16 (52%)
Other Gram positive	6 (29%)	8 (26%)
Other Gram negative	2 (10%)	4 (13%)
Fungal	1 (5%)	0
Substance Abuse Treatment:	12 (57%)	5 (16%)
Medication	9 (43%)	5 (16%)
Counseling	9 (43%)	3 (10%)
IV risk counseling	20 (95%)	13 (42%)
Family involvement	8 (38%)	5 (16%)

Abbreviations. MRSA: Methicillin-resistant S. aureus; *MSSA: Methicillin-sensitive* S. aureus; *PWID: people who inject drugs; OPAT: outpatient parenteral antimicrobial therapy; SNF: skilled nursing facility.*

Table B4. Beileler et al. (2019) Characteristics and Outcomes Among Homeless PWID, Housed PWID, Homeless Non-PWID, and Housed Non-PWD[25]

	Homeless PWID n = 53 (%)	Housed PWID n = 48 (%)	Homeless Non-PWID n = 45 (%)	Housed Non-PWID n = 450 (%)	P Value
Mean Age (years)	38.8	41.6	49.4	53.9	< .001
Male	33 (62.3)	36 (75.0)	37 (82.2)	290 (64.4)	.05
White	44 (83.0)	38 (79.2)	25 (55.6)	330 (73.3)	< .001
Black	5 (9.4)	6 (12.5)	15 (33.3)	46 (10.2)	
Other	4 (7.6)	4 (8.4)	5 (11.1)	77 (17.1)	
Discharge Location:					
Respite	31 (58.5)	1 (2.1)	19 (42.2)	1 (0.2)	< .001
Home	4 (7.6)	29 (60.4)	10 (22.2)	266 (59.1)	
Inpatient/SNF	6 (9.5)	14 (29.2)	12 (26.7)	165 (36.7)	
Shelter/street	8 (15.1)	1 (2.1)	2 (4.4)	1 (0.2)	
Other	4 (7.5)	3 (6.3)	2 (4.4)	17 (3.8)	
Clinical Cure (Excluding Unknown):					
Yes	25 (89.3)	24 (92.7)	37 (92.5)	329 (88.7)	.85
No	3 (10.7)	2 (7.7)	3 (7.5)	42 (11.3)	
Unknown	25	22	5	79	
Clinical Cure:					
Yes	25 (47.2)	24 (50.0)	37 (82.2)	329 (73.1)	< .001
No	28 (52.8)	24 (50.0)	8 (17.8)	121 (26.9)	
Hospital Length of Stay	15.5	21.8	18.2	18.0	< .001
Secondary bacteremia	7 (13.2)	2 (4.2)	1 (2.2)	6 (1.3)	< .001
Line Tampering	19 (35.9)	1 (2.1)	1 (2.2)	3 (0.7)	< .001
30-Day Readmission	21 (39.6)	10 (20.8)	10 (22.2)	107 (23.8)	.07
Related to OPAT	14 (26.4)	8 (16.7)	4 (8.9)	59 (13.1)	.004

Abbreviations. Non-PWID: People who do not inject drugs; PWID: people who inject drugs; SNF: skilled nursing facility.

Table B5. Eaton et al. (2018) Patient Characteristics Among PWID Treated Before and After Risk-Scoring Tool Use[24]

Characteristics	Before Risk Tool (n = 37)	After Risk Tool (n = 99)
Age, years:		
Mean (SD)	34.51 (7.47)	35.48 (10.07)
Median (IQR)	32 (11)	36 (12)
Race, No. (%):		
White	35 (95)	91 (92)
Black	2 (5)	6 (6)
Other	0 (0)	2 (2)
Sex, No. (%):		
Male	17 (46)	57 (58)
Female	20 (54)	42 (42)
Insurance, No. (%):		
Uninsured	21 (57)	50 (50)
Medicaid	12 (32)	30 (30)
Medicare	3 (8)	6 (6)
Commercial	1 (3)	13 (13)
IVAT risk assessment score:		
Low	N/A	(1–3) … 23 (23)
Medium	N/A	(4–6) … 52 (53)
High	N/A	(7–9) … 9 (9)
Missing	N/A	… 15 (11)
Primary diagnosis, No. (%):		
Infective endocarditis	21 (57)	38 (38)
Vertebral osteomyelitis/epidural abscess	7 (19)	13 (13)
Osteomyelitis/septic arthritis	6 (16)	21 (21)
Bloodstream infection	1 (3)	4 (4)
Soft-tissue infection	2 (5)	12 (12)
Other	0 (0)	11 (11)
Surgery performed, No. (%)	20 (54)	44 (44)
Type of surgery, No. (%):		
Cardiothoracic	11 (52)	12 (27)
Neurosurgery	5 (24)	15 (34)
Orthopedic	3 (14)	12 (27)
Other	2 (10)	5 (11)
Admissions, No.:	37	111
Length of stay, mean, days	42	22
Readmission within 30 days, No. (%)	7 (19)	18 (16)
Total direct costs, $	1,432,497	2,887,515
Direct costs per admission, mean, $:		

… continued on next page

Table B5. Eaton et al. (2018) Patient Characteristics Among PWID Treated Before and After Risk-Scoring Tool Use[24] (cont.)

Characteristics	Before Risk Tool (n = 37)	After Risk Tool (n = 99)
Total	38,716	26,014
Daily	922	1,182
Direct costs per admission by service, mean:		
Nursing	16,305	9,139
Pharmacy	8,829	5,720
Surgery	4,986	3,474
Intensive care unit	2,568	2,081
Laboratory	952	865
Radiology	625	549
Respiratory	1,020	438
Heart center	82	386

Abbreviations. IQR: interquartile range; IVAT: intravenous antibiotics and addiction team; PWID: people who inject drugs; SD: standard deviation.

Table B6. Fanucchi et al. (2020) Outcomes Among PWID Treated for Serious Infection in the University of Kentucky RCT[20]

Mean (SD)	Usual Care	OPAT	Statistical Analysis
Hospital LOS	45.9 (7.8)	22.4 (7.1)	t(17) = 6.9, *P* < .01
Days of outpatient antibiotics	1.8 (5.3)	20.1 (11.1)	t(17) = −4.5, P < .001
BUP discharge dose[a]	16 (0.0)	14.8 (2.7)	
BUP 12-week follow-up dose[a]	14.3 (3.6)	15.6 (3.5)	
Urine screen negative[b]	NR	NR	OR 4.2; 95% CI 1.03 to 17.34; *P* = .049
Retention in BUP treatment[c]	NR	NR	OR, 3.4; 95% CI, 0.68 to 13.50; *P* = .088

Note. [a] BUP Milligrams; [b]For illicit opioids during outpatient buprenorphine/naloxone treatment; [c] After discharge. Abbreviations. BUP: buprenorphine; LOS: hospital length of stay; OPAT: outpatient parenteral antimicrobial therapy; PWID: people who inject drugs; RCT: randomized controlled trial.

Table B7. D'Couto et al. (2018) Outcomes Among PWID Discharged to Home or to SNF/Rehabilitation[21]

Diagnosis and Treatment Factors	Discharged to Home (n = 21)	Discharged to SNF/ Rehab (n = 31)	P Value (Fisher's Exact Test)
Any complication	4	11	.23
Line complications	1	5	.38
Injection drug use relapse	1	5	.38
Loss to follow-up	1	4	.64
Readmission	3	9	.72
Death	1	0	.40

Abbreviations. PWID: people who inject drugs; Rehab: Rehabilitation; SNF: skilled nursing facility.

Table B8. Beieler et al. (2019) Cure of Infection Among Homeless and Housed PWID and People Who Do Not Inject Drugs[25]

Characteristics	Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)
Homeless PWID	0.33 (0.18, 0.59)	0.33 (0.18, 0.59)
Housed PWID	0.37 (0.20, 0.67)	0.37 (0.20, 0.67)
Homeless non-PWID	1.70 (0.77, 3.76)	1.70 (0.77, 3.76)
Housed non-PWID	Reference	Reference

Abbreviations. Non-PWID: People who do not inject drugs; PWID: people who inject drugs.

Table B9. Camsari et al. (2017) Outcomes Among PWID Discharged to Home or to SNF/Rehabilitation[23]

Risk Category	No. of Patients (M/F)	ID Diagnosis, No.	Age, Mean, Median, Years	Recommended for Therapy, Mean, Median, Days	Compliance with Therapy, Mean (%), Median, Days
High	10 (7/3)	Endocarditis, 5 Epidural abscess, 2 Diskitis, 1 Fascial abscess, 1 Pneumonia, 1	38.6, 42	40.2, 42	32.3 (80.3), 42
Moderate	5 (2/3)	Thigh abscess, 1 Septic arthritis, 1 Pneumonia, 1 Prosthetic joint arthritis, 1 Osteomyelitis, 1	40.8, 34	32.2, 21	29.4 (90.6), 21
Low	5 (3/2)	Endocarditis, 1 Meningitis, 1 Soft tissue infection, 2 MSSA septicemia, 1	49.2, 52	28, 28	28 (100), 28

Abbreviations. F: female; ID: infectious disease; M: male; No: number; PWID: people who inject drugs; SNF: skilled nursing facility

Table B10. Camsari et al. (2017) Outcomes Among PWID Discharged to Home or to SNF/Rehabilitation[23]

Risk Category	Patients, No.	Primary Drug of Choice, No.	Relapse During Treatment	Relapse Venue
High	10	Opioids, 8 Methamphetamine, 1 Cocaine, 1	4	Hospital, 2 Nursing home, 1 Self-discharge, 1
Moderate	5	Opioids, 2 Cocaine. 2 Cannabis, 1	1	Home
Low	5	Opioids, 3 Cocaine, 1 Alcohol, 1	0	

Abbreviations. No: number; PWID: people who inject drugs; SNF: skilled nursing facility

Suggested citation: Chapman S, Leof A, Harrod C. *Approaches to treating serious infection in people who inject drugs: evidence and policies.* Portland, OR: Center for Evidence-based Policy, Oregon Health & Science University; 2020.

Acknowledgments: We would like to thank Dr. Sandra A. Springer from the Yale School of Medicine and Dr. Zoe Weinstein from the Boston University School of Medicine for their assistance as external peer reviewers. Peer reviewers did not receive any compensation and declared no conflicts of interest.

Conflict of Interest Disclosures: No authors have conflicts of interest to disclose. All authors have completed and submitted the Oregon Health & Science University form for Disclosure of Potential Conflicts of Interest, and none were reported.

Funding/Support: This research was funded by the Center for Evidence-based Policy's Medicaid Evidence-based Decisions Project and CLOUD: Curated Library about Opioid Use for Decision-makers at Oregon Health & Science University.

About the Center for Evidence-based Policy and the Medicaid Evidence-based Decisions Project

The Center for Evidence-based Policy (Center) is recognized as a national leader in evidence-based decision making and policy design. The Center understands the needs of policymakers and supports public organizations by providing reliable information to guide decisions, maximize existing resources, improve health outcomes, and reduce unnecessary costs. The Center specializes in ensuring that diverse and relevant perspectives are considered, and appropriate resources are leveraged to strategically address complex policy issues with high-quality evidence and collaboration. The Center is based at Oregon Health & Science University in Portland, Oregon.

The Medicaid Evidence-based Decisions Project (MED) is housed at the Center. Its mission is to create an effective collaboration among Medicaid programs and their state partners for the purpose of making high-quality evidence analysis available to support benefit design and coverage decisions made by state programs. Further information about MED and the Center is available at http://centerforevidencebasedpolicy.org/.

Center for Evidence-based Policy

Oregon Health & Science University

3030 SW Moody, Suite 250
Portland, OR 97201

Phone: 503-494-2182
Fax: 503-494-3807
http://centerforevidencebasedpolicy.org/