

# Improving care for individuals with serious infections who inject drugs

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## Abstract

**Background:** Hospitalizations for serious infections requiring long-term intravenous (IV) antimicrobials related to injection drug use have risen sharply over the last decade. At our rural tertiary care center, opportunities for treatment of underlying substance use disorders were often missed during these hospital admissions. Once medically stable, home IV antimicrobial therapy has not traditionally been offered to this patient population due to theoretical concerns about misuse of long-term IV catheters, leading to discharges with suboptimal treatment regimens, lengthy hospital stays, or care that is incongruent with patient goals and preferences.

**Methods:** A multidisciplinary group of clinicians and patients set out to redesign and improve care for this patient population through a health care innovation process, with a focus on increasing the proportion of patients who may be discharged on home IV therapy. Baseline assessment of current experience was established through retrospective chart review and extensive stakeholder analysis. The innovation process was based in design thinking and facilitated by a health care delivery improvement incubator.

**Results:** The components of the resulting intervention included early identification of hospitalized people who inject drugs with serious infections, a proactive psychiatry consultation service for addiction management for all patients, a multidisciplinary care conference to support decision making around treatment options for infection and substance use, and care coordination/navigation in the outpatient setting with a substance use peer recovery coach and infectious disease nurse for patients discharged on home IV antimicrobials. Patients discharged on home IV therapy followed routine outpatient parenteral antimicrobial therapy (OPAT) protocols and treatment protocols for addiction with their chosen provider.

**Conclusion:** An intervention developed through a design-thinking-based health care redesign process improved patient-centered care for people with serious infections who inject drugs.

**Keywords:** injection drug use, opioid use disorder, outpatient parenteral antimicrobial therapy, Substance use disorders

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## Background

As the opioid epidemic has progressed, there has been a significant increase in hospitalizations for serious infections attributable to injection drug use (IDU).<sup>1</sup> The standard of care for adult patients with serious infections such as endocarditis and osteomyelitis resulting from IDU

typically involves extended courses of intravenous (IV) antimicrobial therapy, on the order of six or more weeks. People who inject drugs (PWID) have traditionally been excluded from entry into outpatient parenteral antimicrobial therapy (OPAT) programs because of theoretical concerns about misuse of long-term venous access

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catheters needed in the outpatient setting, with associated assumed risks of overdose or additional infection.<sup>2,3</sup>

The exclusion of PWID from OPAT programs leads to prolonged hospitalizations after the patient is medically stable, as well as self-directed discharge (SDD), with patients leaving the hospital on suboptimal treatment regimens. These experiences create disruption and dissatisfaction for the patient and hospital staff. Lengthy hospitalizations are also costly<sup>4</sup> and can be problematic for patients who have work or childcare commitments. Furthermore, in areas that may have hospital capacity issues, long hospitalizations can exacerbate bed shortages, decreasing availability for other patients in need. In addition, after a SDD when robust discharge planning may not be possible, outpatient providers and clinic staff often spend significant time and resources trying to track down patients to continue care.

Hospitalization offers a unique window to address substance use disorders (SUDs), but unfortunately, too often this opportunity is missed.<sup>5,6</sup> Inadequate attention to the underlying SUD may contribute to behavioral problems during hospitalization resulting in tension, safety problems, burnout for staff,<sup>7</sup> and disproportionate time spent with PWID in relation to others on the unit. Failure to secure appropriate addiction treatment when patients transition to the outpatient setting leaves patients at high risk of relapse of their addiction, infection, readmission, and death, while starting medication for opioid use disorder (MOUD) in the hospital and linking patients directly to care has been shown to be more effective at engaging patients after discharge than detoxification and referral.<sup>8</sup>

In summary, patients who have infections secondary to IDU often have prolonged hospitalizations that are costly, exacerbate bed shortages, and are not aligned with patient preferences. Several institutions have begun to attempt use of OPAT in this population with success.<sup>4,9–16</sup> To better meet the needs of these patients who are frequently admitted to our hospital,<sup>17</sup> we used a health care quality improvement approach informed by design thinking. Our goals were to individualize care with a more patient-centered approach, to prioritize discharge home on OPAT when possible, and to address SUDs during the

hospitalization as well as secure SUD treatment in the outpatient setting. This manuscript explores that process and describes the resulting care delivery model.

## Methods

### Setting

This work took place at Dartmouth-Hitchcock Medical Center (DHMC), a 396-bed tertiary care teaching hospital in Lebanon, New Hampshire (NH), which serves a large rural catchment area across both NH and Vermont. Given the alarming volume of patients admitted with injection-related infections at our institution, a multidisciplinary team was brought together for this work, including clinicians from Psychiatry (Behavioral Intervention Team, 'BIT'), Infectious Diseases (ID), Hospital Medicine, Primary Care, community partners for home health services and outpatient addiction treatment, and patient representatives. The BIT is made up of an attending psychiatrist, multiple associate providers (Advanced Practice Registered Nurse [APRN] and master's prepared therapists), and multiple peer recovery coaches who have themselves experienced SUDs. The BIT's goals include assessment and treatment of SUDs for hospitalized patients, as well as support for patients who are struggling with emotional aspects of illness during hospitalization.

### Approach

*Health care redesign innovation process overview.* We used a health care redesign approach informed by elements of design thinking to improve care for our population of interest. Design thinking focuses on user experience through an empathetic lens and includes multidisciplinary perspectives to develop sustainable solutions to problems.<sup>18,19</sup> Our efforts were directed and funded by the Susan & Richard Levy Health Care Delivery Incubator program, which provided a structured curriculum, project management and research support, informational technology and analytic assistance, and academic and operational mentorship to guide the care redesign process. Team members devoted at least 4 hour per week over 12 months to the project, with clinician time being supported by the incubator program. Given that the voices of PWID are

**Table 1.** Incubator process overview.

Phase	Initiate 3 weeks	Diagnose 9 weeks	Design 32 weeks	Sustain 8 weeks
Goals	Define the Problem and Plan for Teamwork	Understand the Problem from the Patient Perspective	Design a Solution, Implement, Reflect, and Adjust	Operationalize and Scale
Content	<ul style="list-style-type: none"> <li>Develop Problem Statement</li> <li>Create Team Charter</li> <li>Identify Team Roles and Work Expectations</li> </ul>	<ul style="list-style-type: none"> <li>Review Literature</li> <li>Identify Stakeholder and Plan for Engagement</li> <li>Interview Patients and Stakeholders</li> <li>Develop Patient Personas and Create Patient Journey Maps</li> <li>Collect Baseline Data</li> </ul>	<ul style="list-style-type: none"> <li>Brainstorm</li> <li>Design Intervention or Pilot</li> <li>Plan for Evaluation</li> <li>Prototype</li> <li>PDSA Cycles (Plan, Do, Study, Act)</li> <li>Get Feedback from Patients and Stakeholders</li> <li>Create Communication Plan</li> <li>Develop Publication Plan</li> <li>Prepare Business Case</li> </ul>	<ul style="list-style-type: none"> <li>Analyze Project Outcomes</li> <li>Disseminate Findings</li> <li>Write and Submit Publications and Abstracts</li> <li>Submit Business Case for Continued Funding</li> </ul>
Subject matter expert topics	<ul style="list-style-type: none"> <li>Team Building</li> <li>Design Thinking</li> </ul>	<ul style="list-style-type: none"> <li>Human-Centered Design</li> <li>Ecosystem Alignment and Stakeholder Engagement</li> <li>Interviewing Best Practices</li> <li>Electronic Health Record (EHR) Analysis</li> </ul>	<ul style="list-style-type: none"> <li>Prototyping</li> <li>Evaluation Design</li> <li>Biostatistics</li> <li>EHR Building</li> <li>Financial Planning</li> </ul>	<ul style="list-style-type: none"> <li>Change Management</li> <li>Financial Analysis</li> <li>Writing for Academic Publication</li> </ul>
Mentors	Consultations throughout the year with assigned Academic Mentors from The Dartmouth Institute and assigned Operational Mentors from the Dartmouth-Hitchcock Health Executive Leadership Team.			

often marginalized within the health care system, a design-thinking approach seemed ideal for ensuring we incorporated patient perspectives into redesign plans and approaches. By actively seeking out these perspectives throughout through both patient stakeholder interviews and patient representatives on the project team, we hoped our new care approach would meet the needs of PWID and enable us to identify and address potential barriers early in the redesign process.

The Incubator program's process including curricular elements is outlined in Table 1. The team met with both internal and expert consultants in team building, design thinking, human-centered design, stakeholder engagement, medical anthropology, electronic health record (EHR) building and analysis, and financial analysis. The team was also assigned an academic mentor through The Dartmouth Institute for Health Policy and Clinical Practice, as well as an operational mentor from the health system's executive leadership team.

*Understanding the current state: 'diagnose'.* The initial phase of the project was spent fully understanding the current processes at DHMC for PWID with serious infections and analyzing root causes for identified problem areas. We did this in multiple ways. First, to confirm our anecdotal experience around problematic elements in care of this population at the institution, we queried the EHR for hospital admissions for serious infections (any infection which traditionally requires greater than 7 days of IV antimicrobial therapy, such as endocarditis, bacteremia, osteomyelitis, and deep-seated abscesses) among PWID from February 2019 through February 2020. These dates were chosen because it was the most recent year before the coronavirus disease 2019 (COVID) pandemic, which we had observed skewed hospital admission volume for all infections. Chart review was performed to gather data about care received while hospitalized related to both infection and SUD(s), as well as general demographic data and hospital quality measures.

**Table 2.** Stakeholders.

Stakeholder departments and teams
Addiction Treatment Program (ATP), Psychiatry (outpatient services)
Behavioral Intervention Team (BIT), Psychiatry (inpatient services), including Recovery Coaches
Community non-DHMC outpatient addiction treatment providers
Cardiac Surgery
Care Management (Case Management)
Emergency Department
Home health agencies (main affiliated partner Visiting Nurse and Hospice of New Hampshire and Vermont, 'VNH')
Home infusion affiliated partner New England Life Care (NELC)
Hospital Medicine
Infectious Disease [including outpatient parenteral antimicrobial therapy (OPAT) program]
Nursing
Patients with lived experience
Primary Care
Risk Management

Second, to better define the problem, we built a detailed flow map of the baseline process for management of these patients. The baseline map highlighted two main logistical challenges that could be anticipated in attempts to improve care for this population. First, the lack of a clear system to identify PWID with serious infections early during their hospitalization impeded timely evaluation by appropriate teams, in particular, ID and BIT. Second, communication between multiple teams of providers was cumbersome, creating challenges for care coordination. The flow map further highlighted that a single clinician was usually responsible for a decision about appropriate options for continued infection treatment when the patient became medically stable. This individual was the ID attending physician, who alone did not usually have all information (such as full knowledge of the patient's social situation) and expertise (such as training in psychiatry or addiction medicine) needed to make a decision about risks of home IV therapy. Finally, there was no clear step in care where referral for outpatient addiction treatment was ensured.

*Stakeholder interviews.* The flow map identified groups of stakeholders at each step. The stakeholder groups are outlined in Table 2. We then identified individuals from each group for interviews. Project team members in some cases were considered stakeholders for this purpose. Outside of the project team, for groups at DHMC, leaders in each clinical area were approached for interviews, and the leader either engaged with the interview or assigned a team member to be interviewed. For organizations outside of DHMC, in most cases, we similarly had known leadership contacts with whom we connected, who either spoke to us themselves or referred us to their team members. In instances of addiction treatment facilities where we did not have a known contact, a call was made to their administrative staff with the request for an interview with the appropriate party. To identify patients, a chart review of recent admissions of patients treated for infections related to IDU was completed by the psychiatrist on the project team to identify appropriate stakeholders. Patients were contacted using the contact information available in the EHR, and those who

agreed to participate were interviewed by the psychiatrist or a peer recovery coach. Families of patients were also included when possible.

An interviewer guide which included questions regarding care experiences related to medical treatment of infections and opioid use disorders (OUDs) was developed with input from a medical anthropologist experienced in the understanding of the qualitative experience of patients in the health care setting (see Appendix 1). Interviews were conducted by our project team recovery coach and psychiatrist. Interviewers were encouraged to listen for barriers and facilitators to care and probe on questions related to what a patient would truly need, even if outside of traditional clinical care models.

We finally performed a stakeholder ecosystem analysis to uncover areas of misalignment with key stakeholders and to identify ways to overcome those obstacles to facilitate change.

In addition to the needs assessment and interviews, we undertook a review of the literature and performed benchmarking through communication with colleagues at institutions who had already implemented programs for improving care for patients with infectious complications of IDU.

*Description of the intervention: 'design'.* Taking together findings from all of the above, we designed an intervention composed of four main aspects as part of a clinical care pathway. We worked with all stakeholders who would be directly involved in the process to create policies and workflows both within DHMC and at partner agencies, and provided educational sessions on addiction, overdose management, and stigma reduction to our home health partners. We also created new partnerships with addiction treatment providers in the community who would receive referrals for SUD care of patients being discharged on OPAT. Select providers engaged patients in innovative ways, such as offering telehealth video intake appointments prior to discharge to facilitate the transition.

*Intervention refinement: 'sustain'.* Over the first several months of implementation, several challenges arose. These were addressed through the iterative nature of the redesign process, in a manner similar to the concept of 'Plan, Do, Study,

Act' (PDSA) cycles. Details of these lessons learned and modifications are described below.

## Results

### *Stakeholder interviews*

Almost all parties were enthusiastic about the concept of redesigning care, as all parties expressed dissatisfaction with the existing state. Care Management and hospital leadership expressed difficulties around long hospitalizations reducing access to care for other patients. Medical care providers shared frustrations with regard to inability to consistently provide standard of care treatment, as well as frustration around behavioral issues when patients remain admitted for long IV antibiotic courses. Providers also discussed uncertainties about decision making based on lack of knowledge about all aspects of the patient's care; for example, ID physicians commented that they are often uncertain about how to evaluate and manage the patient's SUD, and how to think about this in the context of overall options for care. Providers, nurses, and case managers felt that communication with various care teams to collaborate on a care plan would be important to decision making in this population, and development of a clinical care pathway, a method used for a number of other common conditions at the institution to improve care, was proposed by Care Managers. Given that the ultimate goal of discharge on home IV therapy would rely on agreement and engagement with home health agencies, we gave this special attention during stakeholder interviews, to elicit concerns and needs of health care workers who would go into patients' homes. A main concern from home health providers surrounded lack of sufficient knowledge about addiction and appropriate interventions if a patient were to be found intoxicated, as well as liability around use of naloxone.

Seven patient interviews were completed. All patient participants showed a clear understanding of the relationship between IDU and infectious complications, and a receptiveness to addressing SUDs at the time of receiving medical treatment. No patient expressed concerns that an indwelling long-term IV catheter would increase risk for substance use. The interviews confirmed the team's observation that prolonged hospital stays caused major disruptions for patients with family

relationships, job responsibilities, and finances. While there was general acknowledgment that hospitalization was required for parts of medical care to be completed, a general sense of ‘being able to heal better at home’ was related by most patients. All patients expressed an interest in home OPAT treatment were it to be appropriate for them.

Patients repeatedly communicated the need for easy and enhanced communication with the care team, and favored a single team member who could be identified as a point person. Communication needs included questions about medical treatment, but also help in trouble-shooting other care coordination and transportation needs. Many patients also stated that attending numerous visits at DHMC, if required after discharge, would be impossible due to living long distances from the hospital and having unreliable access to transportation.

#### *Baseline cohort*

Our baseline data included 64 hospitalizations for serious infections among patients with SUDs with concern for IDU (mainly OUD), among 57 unique patients. See Table 3 for key findings about this cohort.

#### *Features of the implemented program*

In the first aspect of the intervention, PWID with serious infections are identified early in their hospital course through collaboration between the BIT recovery coach and the ID OPAT nursing team, who review their respective patient consult lists to identify appropriate patients. The OPAT nurse reviews the inpatient ID consult lists daily because of their duties which include coordination of home services and patient teaching at discharge. The BIT recovery coach sees inpatients with SUDs for support and therefore routinely reviews the list of patients seen by their team.

This is supported by multiple reports developed through the EHR with the assistance of the DHMC Analytics group, in addition to BIT’s existing EHR audit on some hospital units that identifies patients through nursing administration of the Drug Abuse Screening Test–10 (DAST-10) on admission.<sup>20</sup> Once a patient is identified with a serious infection and SUD, a secure chat function is used within the EHR to make

appropriate parties aware of the patient and clinical situation.

Second, all PWID with serious infections are seen by BIT, specifically including a peer recovery coach, for assessment of the patient’s SUD, readiness for treatment, social situation, likelihood of misusing a long-term IV catheter, as well as treatment planning both for the inpatient setting and transition to long-term outpatient treatment with a provider in the community. This represents a change from the prior practice, in which BIT was variably involved with this patient population during hospitalizations and did not take primary responsibility for setting up outpatient transitions of addiction care.

Third, a multidisciplinary structured care conference was developed, modeled on experience at other institutions such as the ‘OPTIONS-DC’ conference described by Sikka *et al.*<sup>14</sup> at Oregon Health Sciences University. In our model, this conference is held with all teams involved in the patient’s care to discuss the case and develop an individualized plan for both addiction and infection treatment. This typically includes the primary team, ID physician, OPAT RN, BIT, Care Management, Social Work, inpatient floor nurse and supervisor, and clinical liaisons from the hospital’s affiliated partners for home infusion services and home health care nursing, New England Life Care (NELC), and Visiting Nurse and Hospice for New Hampshire and Vermont (VNH), respectively. The conference is coordinated by the OPAT nurse and BIT recovery coach.

At this conference, criteria for candidacy for home IV antibiotics, developed based on literature review and the diverse experience of our team, are reviewed (see Table 4) as a basis for discussion. A key criterion for candidacy for enrollment in OPAT is engagement with specific treatment for SUD(s), including MOUD if medically appropriate, either in the form of methadone, buprenorphine-naloxone, or buprenorphine extended-release. If medically appropriate, MOUD is required as a condition of enrollment to OPAT. Outside of this, other appropriate treatment is defined by BIT clinicians in shared decision making with patients, and may include individual or group counseling, intensive outpatient or inpatient rehabilitation. The main outputs of the meeting include a plan for SUD

**Table 3.** Baseline cohort key findings.

	Before intervention (February 2019–February 2020)
Total admissions	64
Total patients	57
Addiction addressed in some way during admission	77% (49/64)
• In-hospital counseling/therapy plus MOUD	34% (22/64)
• In-hospital counseling/therapy only	9% (6/64)
• In-hospital MOUD only	20% (13/64)
• Outpatient addiction treatment plan set up	50% (32/64)
• MOUD prescribed on discharge	22% (14/64)
Discharge on daily IV antimicrobials at home	8% (5/64)
Discharge on daily IV antimicrobials in an infusion center	6% (4/64)
Discharge on weekly IV antimicrobial infusion	8% (5/64)
Transfer to acute rehabilitation facility or swing bed for IV antibiotics	20% (13/64)
In-hospital for duration of IV course	34% (22/64)
Discharge home on oral antibiotics	23% (15/64)
Average Length of stay	
Overall	21 days
SDDs removed	24 days
SDD	20% (13/64 admissions)
MOUD, medication for opioid use disorder; SDD, self-directed discharge.	

treatment (including details of the treatment provider and intake) and a shared decision about candidacy for home IV antibiotic therapy, or, if not a candidate, an alternate plan for long-term infection treatment. This meeting and plan is documented as a note in the EHR, similar to documentation for a ‘tumor board’. Results of the meeting are communicated to the patient by the clinical provider(s).

Prior to discharge, patients approved to go home on OPAT undergo placement of a long-term IV catheter, typically a peripherally inserted central catheter (PICC). We do not use a special device on the line to prevent tampering. Patients then receive education on OPAT, risks of long-term IV catheters, and harm reduction strategies for both infection (such as sterile injecting supplies and vein care) and overdose (such as avoidance of using alone and use of naloxone, which the patient

is given before leaving the hospital). They also sign an agreement acknowledging risks, benefits, and alternatives of enrollment into OPAT and use of long-term IV catheters, and an agreement allowing ID and BIT providers to communicate with their outpatient addiction treatment provider. Once discharged, patients receive enhanced support in the outpatient setting through regular (at least weekly) phone check-ins with both the BIT recovery coach and an OPAT RN throughout their course of antibiotics. The recovery coach and OPAT RN coordinate care and assist the patient with navigation in the health care system as well as any social issues that arise which may interfere with care. The OPAT RN communicates with visiting nurse staff at the initiation of the OPAT course to discuss the case, and initially, a weekly video or phone check-in between these nurses was also implemented. The patient is followed with routine OPAT care in the ID clinic,

**Table 4.** Criteria for enrollment in OPAT program.

<b>Inclusion criteria: must be present</b>
Patient interested and willing to participate
Patient mental status allows full understanding of potential risks/benefits
Engaged in treatment for addiction including medication
Home discharge otherwise expected (e.g., no PT/OT rehab needs)
Safe home environment (running water, refrigeration, heat in winter, no abusive relationships)
Age ≥ 18
Agreeable to sharing information among care providers
<b>Relative Contra-Indications: require discussion</b>
Severe stimulant, benzo, or alcohol use disorder
Lack of support system at home
Co-habitants actively using substances at home
No access to reliable communication method
<b>Strict Contra-Indications</b>
Lack of stable housing during the period on IV antibiotics (can be temporary during this time)
Behavior suggesting inability to engage productively with healthcare team
Current incarceration
Cardiac surgery this admission
OPAT, outpatient parenteral antimicrobial therapy.

which typically includes a 2-week post-discharge visit with a provider and a similar visit at the anticipated end of the therapy. The patient or family administers the antimicrobials. Patients receive routine weekly visits from the home health nurse, as per usual OPAT protocols, to change the dressing on the IV line, draw labs, and check in on symptoms. If problems arise, it is up to the home health nurse to decide if additional visits are needed. Safety labs, and in appropriate cases, inflammatory markers, are collected weekly unless the ID provider has a specific concern and specially orders labs more frequently. We do not collect toxicology screens as part of the program; this is left to addiction treatment providers if they feel it is appropriate.

The BIT recovery coach contacts the outpatient addiction treatment provider if needed periodically through the antibiotic treatment course. Treatment

for the SUD is managed per usual protocols by the community provider with whom BIT coordinated to continue care after discharge; this may be through DHMC's Addiction Treatment Program (ATP) or another local provider depending on availability and the patient's preferences, home location, and transportation situation. The ATP is an outpatient SUD treatment clinic with multiple providers who serve the local community and beyond with MOUD, counseling, and harm reduction services. Both BIT and ATP are part of the Department of Psychiatry, and they directly communicate about mutual patients.

*Lessons learned: iterative implementation*

The project launched in mid-October, 2020. Since that time, we have encountered a number of challenges in implementation. The plan that was created for early identification of patients for the care pathway missed several patients, who



were only identified later in their hospital course. As a result, for some patients, issues around discharge timing made it impossible to go through the full process for decision making and optimization of care. To address this, we first modified our EHR reporting system. We then analyzed the process of identification through value stream mapping to point out problem areas. Subsequently, we returned to stakeholder discussions and identified that an existing hospital process of daily interdisciplinary rounds (IDRs), which take place on each unit, could be leveraged for identification of patients by various members of the primary team, nursing, or Care Management team. Next, we created an order within the EHR that the Care Manager enters during the IDR which triggers notification to the OPAT nursing team that the patient requires review for potential inclusion in the pathway for PWID with serious infections. This has improved early patient identification.

A related problem was coordinating the time of the multidisciplinary conference to take place far enough in advance of discharge to allow sound decision making with all needed information at hand as well as the opportunity to set up outpatient services, but not so far ahead of discharge that the plan would need to change in the interim. In part, changing the process for early patient identification was used to help with this timing. However, the team also modified our initial practice, which was to hold a multidisciplinary conference on each patient weekly from the time of identification early in the admission until discharge. This was felt to be too onerous in terms of time by all care teams and represented another challenge in the overall process, in which attendance by all teams at conferences was not always consistent. Thus, the practice was changed to hold the conferences once the patient was expected to discharge within the next 7 days (or less if a < 7-day discharge was expected). This has assisted both with timing and participation in conferences.

After discharge, communication has been challenging with both home care providers and patients. The OPAT nurse originally contacted the home health field nurse weekly to provide additional support/resources and to assist in the identification and mitigation of problems as they arose. Upon retrospective review of the communication between the home health nurse and OPAT nurse, it was thought that this weekly

communication did not provide additional value, while taking significant time and effort, and so this was abandoned in favor of development of efficient communication paths that can be utilized by home health staff on an as-needed basis when a concern arises.

Communication with patients after discharge met with difficulties around patient responsiveness. This patient cohort often has various psychosocial factors that can take priority during their OPAT course; this can hinder the frequency in which the patient communicates to their medical care team. Several patients were more responsive and engaged in text message communications than with phone calls or messages on the electronic patient portal. To address this, we initiated a practice of proactively identifying multiple methods of reaching patients through various modalities and pre-approved alternate contacts; we also obtained a program cell phone with ability for secure text messaging between the recovery coach and patient. Including this communication option has been beneficial to check in with patients and provide reminders about upcoming appointments to encourage their continued engagement in treatment for both their infection and SUD. An additional barrier to reaching some patients was a lack of access to phones. We subsequently engaged with the University of Vermont Center on Rural Addiction (CORA), an organization which is providing mobile phones free of charge to patients in our program.

Finally, comfort with recommending OPAT for PWID by health care providers has been challenging. This is a new and minimally tested practice, and there remains hesitancy around safety. This hesitancy is expected, and the project itself is intended to provide further evidence around this practice which may help better inform decision making in the future. We have already shared some of our initial safety findings and are planning further education on the topic of treatment options for PWID with serious infections in the near future to help address this also.

## Discussion

Using a human-centered design approach, we were able to deeply explore the challenges around optimal care for PWID with serious infections and redesign this care at our institution, with the goal of more patient-centered approaches that both

consistently address SUDs and make it possible to promote the use of OPAT in this population. We carefully considered the perspectives of all involved parties, and in particular, through the methodology promoted by the incubator process, benefited from direct input of patients with lived experience both in interviews and on the project team. We think this element was particularly important given the prevalent stigma faced by PWID.<sup>21</sup> The general emphasis on understanding perspectives of all stakeholders was also crucial when creating a process that included so many individuals and teams, which is often the case in complex care. With the help of the incubator staff, we also were able to maximize the expertise of individuals versed in areas such as medical anthropology and health care system operations, including institutional leaders who could both guide with ‘big picture’ perspectives, and advocate to break down barriers to change when needed.

Our intervention intentionally mirrors the experience of others who have reported initial success with this population, in terms of implementation of a multidisciplinary care conference for collaborative discussion and decision making,<sup>14,22</sup> use of a peer recovery coach for engagement with patients,<sup>23</sup> creation of criteria or a risk tool to assist with decisions around candidacy for OPAT,<sup>4,12,15</sup> requirement of engagement with treatment for addiction,<sup>10,12</sup> and active management for both infection and addiction after discharge.<sup>10,12</sup> However, our intervention and experience differed in some key ways, mostly related to the rural nature of our location and patient population, as well as available resources and capacity. This need to adapt a local solution that would work in our setting is where key elements of the design-thinking process were crucial. While other programs leveraged pre-existing hospital-based bridge clinics within their own health care system<sup>10,12</sup> for outpatient SUD treatment, we did not have the ability to do this, both because of lack of such robust existing resources at our institution and also because of feedback from patients who made it clear that they would not be able to attend numerous visits at DHMC, often due to living significant distances from the medical center and not always having routine access to transportation. Public transportation is extremely limited in our setting. As such, we instead built partnerships with existing outpatient addiction treatment providers in the region, some of whom provided telehealth services for patients, coinciding with the COVID

pandemic. In addition, different from experiences reported in the literature so far,<sup>10</sup> we did not increase the frequency of in-person clinical touchpoints with patients on OPAT after discharge for either substance use or ID care as compared with routine practice. Also due to our specific setting, though we uniquely and greatly benefited from close relationships, shared goals, and direct project team input with a home health nursing agency (VNH) which is part of the Dartmouth Health (DH) network and a home infusion company (NELC) which is owned in part by DH, we could not limit our home health agency partnerships to our direct affiliates because these agencies do not provide coverage to our entire catchment area. Thus, we forged relationships with multiple home health nursing agencies to move this work forward throughout the region.

Finally, to our knowledge, our use of a collaborative OPAT RN and SUD peer recovery coach team as care coordinators and navigators in the outpatient setting during OPAT treatment is also unique to our program. Patients expressed a clear need for this help which was accomplished through this team of health care workers, with an emphasis on persistence and creativity in communicating with patients despite many challenges. Numerous examples from our experience thus far suggest that some patients would not have successfully completed care without this support, and thus it should be emphasized that this aspect of the intervention was incredibly important. Similar to findings of others,<sup>23</sup> the peer recovery coach specifically also has helped significantly with initial engagement of patients while in the hospital, who may not have otherwise opened up to the medical team.

Our experience and findings are limited in a number of ways. We describe a program that has worked well for our rural center, but not all aspects may be applicable to urban or suburban settings. The project and its outcomes were also affected by COVID pandemic, which coincided with the timing of development and implementation of the pilot. The pandemic directly affected the project team’s ability to engage in the design process. More importantly, local health care utilization patterns were affected by the pandemic, resulting in a lower admission volume of patients in this population than expected. In addition, ensuring that all staff were educated about new practices was difficult due to staffing challenges.

Our findings in general confirm and expand the experience of others, and add to the literature by describing the redesign development process, with the inclusion of patient perspectives, unique aspects for rural settings, and implementation challenges. We hope that this description will be helpful to clinicians in other centers who experience similar struggles with this patient population, which continues to grow. We expect to report outcomes of our intervention in a future manuscript.

## Declarations

### *Ethics approval and consent to participate*

The project was reviewed by the Dartmouth-Hitchcock Health Institutional Review Board and was determined not to qualify as human subjects research, and therefore further review and approval was not required. There was no requirement for consent to participate as this was deemed not human subjects research.

### *Consent for publication*

Not applicable.

### *Author contributions*

**Colleen Kershaw:** Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Writing – original draft; Writing – review & editing.

**Jon D Lurie:** Formal analysis; Funding acquisition; Investigation; Methodology; Writing – review & editing.

**Charles Brackett:** Conceptualization; Funding acquisition; Investigation; Methodology; Writing – review & editing.

**Elias Loukas:** Conceptualization; Funding acquisition; Investigation; Methodology; Project administration; Writing – review & editing.

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**Sarah Mullins:** Conceptualization; Data curation; Project administration; Writing – review & editing.

**Christine Gooley:** Investigation; Project administration; Writing – review & editing.

**Melissa Borrows:** Investigation; Project administration; Writing – review & editing.

**Shoshana Bardach:** Methodology; Project administration; Resources; Writing – review & editing.

**Amanda Perry:** Conceptualization; Investigation; Methodology; Project administration; Resources; Writing – review & editing.

**Elizabeth Carpenter-Song:** Data curation; Investigation; Methodology; Writing – review & editing.

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**Danielle Pierotti:** Conceptualization; Project administration; Writing – review & editing.

**Ericka Bergeron:** Conceptualization; Project administration; Writing – review & editing.

**Erin McMahon:** Project administration; Writing – review & editing.

**Christine Finn:** Conceptualization; Funding acquisition; Investigation; Methodology; Project administration; Writing – review & editing.

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### *Competing interests*

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

*Availability of data and materials*

Not applicable.

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**References**

- Ronan MV and Herzig SJ. Hospitalizations related to opioid abuse/dependence and associated serious infections increased sharply, 2002–12. *Health Aff* 2016; 35: 832–837.
- Fanucchi L, Leedy N, Li J, *et al.* Perceptions and practices of physicians regarding outpatient parenteral antibiotic therapy in persons who inject drugs. *J Hosp Med* 2016; 11: 581–582.
- Rapoport AB, Fischer LS, Santibanez S, *et al.* Infectious diseases physicians' perspectives regarding injection drug use and related infections, United States, 2017. *Open Forum Infect Dis* 2018; 5: ofy132.
- 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* 2018; 68: 1041–1043.
- Gray ME, Rogawski McQuade ET, Scheld WM, *et al.* 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: 532.
- Rosenthal ES, Karchmer AW, Theisen-Toupal J, *et al.* Suboptimal addiction interventions for patients hospitalized with injection drug use-associated infective endocarditis. *Am J Med* 2016; 129: 481–485.
- Horner G, Daddona J, Burke DJ, *et al.* 'You're kind of at war with yourself as a nurse': perspectives of inpatient nurses on treating people who present with a comorbid opioid use disorder. *PLoS ONE* 2019; 14: e0224335.
- Liebschutz JM, Crooks D, Herman D, *et al.* Buprenorphine treatment for hospitalized, opioid-dependent patients: a randomized clinical trial. *JAMA Intern Med* 2014; 174: 1369–1376.
- D'Couto HT, Robbins GK, Ard KL, *et al.* Outcomes according to discharge location for persons who inject drugs receiving outpatient parenteral antimicrobial therapy. *Open Forum Infect Dis* 2018; 5: ofy056.
- Fanucchi LC, Walsh SL, Thornton AC, *et al.* Outpatient parenteral antimicrobial therapy plus buprenorphine for opioid use disorder and severe injection-related infections. *Clin Infect Dis* 2020; 70: 1226–1229.
- Hase R, Yokoyama Y, Suzuki H, *et al.* Review of the first comprehensive outpatient parenteral antimicrobial therapy program in a tertiary care hospital in Japan. *Int J Infect Dis* 2020; 95: 210–215.
- Price CN, Solomon DA, Johnson JA, *et al.* Feasibility and safety of outpatient parenteral antimicrobial therapy in conjunction with addiction treatment for people who inject drugs. *J Infect Dis* 2020; 222: S494–S498.
- Rolfé RJ Jr, 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: S340–S341.
- Sikka MK, Gore S, Vega T, *et al.* 'OPTIONS-DC', a feasible discharge planning conference to expand infection treatment options for people with substance use disorder. *BMC Infect Dis* 2021; 21: 772.
- Solomon DA, Price C, Johnson JAA, *et al.* Can integration of addiction treatment facilitate safe discharge on OPAT for patients with infectious complications of injection drug use? *Open Forum Infect Dis* 2019; 6: S341–S342.
- Suzuki J, Johnson J, Montgomery M, *et al.* Outpatient parenteral antimicrobial therapy among people who inject drugs: a review of the literature. *Open Forum Infect Dis* 2018; 5: ofy194.
- de Gijssel D, DesBiens M, Talbot EA, *et al.* Tracking substance use complications: a collaborative analysis of public health and academic medical center records on drug use-associated infective endocarditis. *J Infect Dis* 2020; 222: S437–S441.
- Ferreira FK, Song EH, Gomes H, *et al.* New mindset in scientific method in the health field: design thinking. *Clinics* 2015; 70: 770–772.
- Roberts JP, Fisher TR, Trowbridge MJ, *et al.* A design thinking framework for healthcare management and innovation. *Healthc* 2016; 4: 11–14.
- Yudko E, Lozhkina O and Fouts A. A comprehensive review of the psychometric properties of the Drug Abuse Screening Test. *J Subst Abuse Treat* 2007; 32: 189–198.

21. Paquette CE, Syvertsen JL and Pollini RA. Stigma at every turn: health services experiences among people who inject drugs. *Int J Drug Policy* 2018; 57: 104–110.
22. 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: 85–89.
23. Collins D, Alla J, Nicolaidis C, *et al.* ‘If It wasn’t for him, I wouldn’t have talked to them’: qualitative study of addiction peer mentorship in the hospital. *J Gen Intern Med*. Epub ahead of print 12 December 2019. DOI: 10.1007/s11606-019-05311-0.

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## Appendix 1

### Note taking template for patient interviews

#### Current Inpatient

*Interviewer note: listen for barriers and facilitators and probe on questions related to what a patient would truly need, even outside of traditional clinical care, to make this model work. Ask about specifics!*

#### Question

What is your understanding of why you are here?

What is important to you about your health right now? ALT: What are you doing right now (or what do you plan to do) to take care of your health?

Have your providers discussed a treatment plan with you? If so, what do you think could get in the way of that? Does it seem realistic? What changes would you have to make to make this work?

What has been your longest stretch of sobriety? What was working well for you during that time?

What’s happening with substance use disorder now? What would be the most helpful thing to address your addiction?

What is it like for you to be in the hospital?

What are the challenging aspects of being in the hospital? Are there positive things about being in the hospital?

Could you describe the type of treatment you are receiving for your infection and addiction?

If you have had a prior experience with an infection caused by injecting drug use and it is back again, could you walk me through what happened last time? ALT: Have you faced significant health problems in the past? How does this compare?

For patients who did have a prior experience,

1. What got in the way of you completing the recommended treatment for your infection?
2. What would have helped you to complete the recommended course of treatment for your infection?
3. What happened to your health after you left the hospital last time?

Assume that you could leave the hospital but still needed IV antibiotics every day for several more weeks. What would be the ideal way that would work for you? OR Design a system that would work for you.

*If the patient has trouble responding, ask more specific probes:*

- What if it involved someone coming to your home every day?
- What if it involved you traveling somewhere daily? Two times per week? One time per week? How far could you travel?
- What if it meant giving yourself the injection? Do you think it could be triggering for you to use again?
- What if it involved video conferencing with your healthcare provider?
- How much time do you think you could devote to this?

What else should I know that I haven’t asked?