

Outcomes According to Discharge Location for Persons Who Inject Drugs Receiving Outpatient Parenteral Antimicrobial Therapy

Helen T. D'Couto,^{1,3} Gregory K. Robbins,^{1,2,3} Kevin L. Ard,^{1,2,3} Sarah E. Wakeman,³ Justin Alves,² and Sandra B. Nelson^{1,2,3}

¹Harvard Medical School, Boston, Massachusetts; ²Division of Infectious Diseases and ³Department of Medicine, Massachusetts General Hospital, Boston

Background. Opioid use disorder poses a significant public health risk. Persons who inject drugs (PWID) suffer from high mortality and morbidity secondary to serious infectious diseases, often requiring prolonged courses of outpatient parenteral antibiotics. The goal of this study was to determine the outcomes of PWID discharged to home or to a skilled nursing or rehabilitation facility (SNF/rehab) with parenteral antibiotic treatment under an outpatient parenteral antimicrobial therapy (OPAT) program.

Methods. This is a retrospective observational study. The study population was identified via hospital and OPAT databases using substance use disorder diagnoses and confirmed through chart review. The study population included hospitalized PWID with injection drug use in the preceding 2 years who were discharged between 2010 and 2015 to complete at least 2 weeks of parenteral antibiotics and monitored by the OPAT program. Retrospective chart review was used to describe patient characteristics and outcomes.

Results. Fifty-two patients met inclusion criteria, 21 of whom were discharged to home and 31 were discharged to a SNF/rehab. Of the patients discharged to home, 17 (81%) completed their planned antibiotic courses without complication. Twenty (64%) patients discharged to a SNF/rehab completed the antibiotic courses without complication. Six (11%) patients had line infections, 6 (11%) had injection drug use relapse, and 12 (23%) required readmission.

Conclusions. Persons who inject drugs discharged home were not more likely to have complications than those discharged to a SNF/rehab. Home OPAT may be a safe discharge option in carefully selected patients.

Keywords. central venous access; discharge planning; OPAT; PWID.

Opioid use disorder is a growing public health crisis. An estimated 24.6 million Americans use illicit drugs [1]. Rates of morbidity and mortality from illicit drug use are increasing, with deaths from opioid use nearly quadrupling over the previous 2 decades [2, 3]. Infection is a significant cause of morbidity and mortality in people who inject drugs (PWID). Inpatient admissions for infections associated with injection drug use (IDU) may be twice as expensive as other admissions in PWID [4]. Skin and soft tissue infections are most common in PWID [5, 6], but bacteremia, endocarditis, osteomyelitis, and septic arthritis also occur. These infections are typically treated with prolonged intravenous (IV) antibiotic courses [7, 8]. However long-term parenteral access raises concerns about use of the line for recreational purposes, which may pose additional risks to the patient [9].

Outpatient parenteral antimicrobial therapy (OPAT) programs are increasingly relied upon to facilitate completion of IV antimicrobial treatment courses after hospital discharge [10, 11]. Outpatient parenteral antimicrobial therapy has been effective in the management of several infectious diseases including endocarditis, soft tissue infections, bacteremia, and bone and joint infections [12–15]. Guidelines for the safe administration of OPAT use have been developed. Important features that enable safe OPAT delivery include oversight by an infectious diseases physician, a safe home environment, and reliable communication between patient and caregivers [16]. Research on OPAT has focused predominantly on the non-PWID population [17], and little is known about the use of home OPAT among PWID. The option of completing IV therapy at home is often deemed unsafe in the setting of recent drug use. Alternative solutions are often favored; these include prolonged inpatient admissions, completion of therapy at a skilled nursing or rehabilitation facility (SNF/rehab), and oral antimicrobials. However, these options may cost more and/or may risk diminished efficacy [18]. There is an urgent need to better understand the risks of outpatient parenteral antimicrobials in PWID. In this study, we describe the outcomes of PWID discharged from a single academic medical center either to home or to a SNF/rehab with OPAT management.

Received 14 February 2018; editorial decision 25 February 2018; accepted 20 March 2018.

Correspondence: Sandra B. Nelson, MD, Massachusetts General Hospital, Division of Infectious Diseases, Cox 5, 55 Fruit Street, Boston, MA 02114 (sbnelson@mgh.harvard.edu).

Open Forum Infectious Diseases®

© The Author(s) 2018. Published by Oxford University Press on behalf of Infectious Diseases Society of America. This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs licence (<http://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits non-commercial reproduction and distribution of the work, in any medium, provided the original work is not altered or transformed in any way, and that the work is properly cited. For commercial re-use, please contact journals.permissions@oup.com
DOI: 10.1093/ofid/ofy056

METHODS

This was a retrospective observational study to assess the safety and outcomes of PWID receiving IV antimicrobial therapy discharged to either home or SNF/rehab. The study was conducted at Massachusetts General Hospital (MGH), which serves both a primary care and tertiary referral population in Boston, Massachusetts. We used the Research Patient Data Registry (RPDR), a centralized clinical database for hospitals in the Partners Healthcare system, to identify patients admitted to MGH between January 1, 2010 and December 31, 2015 with diagnoses of endocarditis, prosthetic joint infection, septic arthritis, and osteomyelitis and a concurrent diagnosis of substance use disorder, including but not limited to those having an opioid use disorder. Within this list, we identified those patients who were also followed by the MGH OPAT program, which enrolls patients who require 2 or more weeks of IV antibiotic therapy after discharge. Diagnosis codes and chart review were used to confirm inclusion of PWID with known or suspected IV drug use in the preceding 2 years. We defined recent IDU as known or suspected IDU (IV, intramuscular, or skin popping) in the 1–24 months preceding admission and ongoing IDU as occurring within the month preceding admission.

Patients discharged to SNF/rehab were included if they were enrolled in the OPAT program for antibiotic monitoring and expected to return to MGH for outpatient follow-up. The majority of patients discharged to state-supported rehabilitation facilities, which includes many patients with IDU, are followed by Infectious Diseases physicians at these facilities and were excluded. Patients who used outpatient infusion centers for antibiotic administration were also excluded.

Data were obtained from the RPDR, electronic medical records (EMR), and OPAT database. The information we collected included demographics of ethnicity, age, and sex, index hospitalization, infectious disease diagnosis, and planned antibiotic course. Details on the substance use history and on planned addictions treatment and monitoring after discharge were abstracted from the EMR. When available, information about safe discharge plan counseling and family involvement in the substance use disorder plan was also included. Extracted outcome data included duration of antimicrobial therapy, line complications (infection, thrombosis), IDU relapse, readmission, loss to follow-up, and death. The MGH OPAT database was used to identify rates of line infections, readmission, and death among all patients enrolled in the MGH OPAT program during part of the same time period (2013–2015) for comparison.

Descriptive statistics of central tendency were used to analyze patient data. The characteristics and outcomes of patients discharged home versus to a facility were compared using 2-sided Fisher's exact tests. The small size of the study population did not permit multivariable modeling. The Partners Institutional Review Board reviewed the study protocol and granted a waiver for informed consent.

RESULTS

Searches of the RPDR and OPAT database identified 170 hospitalized patients with concurrent infectious disease and substance use disorder diagnoses who were enrolled in the MGH OPAT program after discharge. Of these 170 patients, 52 met inclusion criteria: 21 were discharged home and 31 were discharged to SNF/rehab. Of the 118 patients excluded, the majority (109, 92%) could not be confirmed as having known or suspected IDU in the 24 months preceding admission. Seven (6%) patients were discharged without an IV line, and 3 (2%) patients had OPAT courses that were outside of our study period; these were also excluded.

Of the 21 patients discharged home, 18 (86%) patients had a history of opioid IDU, 2 (9%) had a history of both opioid and cocaine IDU, and 1 (5%) patient had a history of cocaine IDU (Table 1). Cocaine use history was more common among those discharged to SNF/rehab (14, 45%). Patients discharged to SNF/rehab had a higher rate of ongoing IDU than of those discharged home (68% vs 33%, $P < .05$). Among all patients, the 2 most common diagnoses were osteomyelitis (36%) and endocarditis (25%). Methicillin-sensitive *Staphylococcus aureus* (MSSA) was the most common organism isolated (54%), followed by methicillin-resistant *S aureus* (17%). The most common IV antibiotics administered after discharge were cephalosporins (46%) and penicillins (37%).

Documentation of discharge planning was reviewed for addictions medication treatment and monitoring after discharge, inclusion of family members in discharge planning, and safety counseling (Table 1). Patients discharged to home had more documented substance use disorder discharge planning than those discharged to SNF/rehab. Twelve (57%) PWID discharged home versus 5 (16%) discharged to SNF/rehab received any substance use disorder treatment ($P < .05$). Most patients (20, 95%) discharged home received counseling on the risks of discharge with an IV catheter, compared with 13 (42%) of those discharged to SNF/rehab ($P < .05$). Family members were more commonly involved in discharge plans for PWID discharged home (8, 38%) than for those discharged to SNF/rehab (5, 16%), although this was not statistically significant. Five (24%) patients discharged to home versus 2 (6%) patients discharged to SNF/rehab had routine toxicology monitoring while on OPAT ($P > .05$).

Complications of OPAT therapy included line infections, relapse of IDU, loss to follow-up, readmission, and death (Table 2). Overall complications were not more likely among PWID discharged to home compared with those at SNF/rehab (4 [19%] vs 11 [35%], $P > .05$). There were also no differences in rates of individual complications between the 2 groups. One (5%) patient discharged to home had a line infection compared with 5 (16%) discharged to a rehabilitation facility. One (5%) patient discharged to home had documented relapse of IDU compared with 5 (16%) patients at SNF/rehab. Loss to

Table 1. Characteristics of Patients Discharged to Home and Rehabilitation

Complications	Discharged to Home (n = 21)	Discharged to Rehab (n = 31)	PValue (Fisher's Exact Test)
Demographics			
Gender			
Female	6 (29%)	10 (32%)	
Male	15 (71%)	21 (68%)	
Ethnicity			
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%)	.01
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	
Treatment			
Penicillins	11 (52%)	8 (26%)	
Vancomycin	3 (14%)	7 (23%)	
Cephalosporins	7 (33%)	17 (55%)	
Daptomycin	3 (14%)	3 (10%)	
Fluoroquinolones	0	1 (3%)	
Carbapenems	0	1 (3%)	
Substance Abuse Treatment			
Medication	9 (43%)	5 (16%)	.06
Counseling	9 (43%)	3 (10%)	.01
Toxicology Monitoring	5 (24%)	2 (6%)	.10
IV risk counseling	20 (95%)	13 (42%)	<.01
Family involvement	8 (38%)	5 (16%)	.11

Abbreviations: IV, intravenous; MRSA, methicillin-resistant *staph aureus*; MSSA, methicillin-susceptible *staph aureus*.

follow-up occurred in 1 (5%) patient discharged to home and 4 (13%) patients discharged to SNF/rehab. Readmission rates were also similar among patients discharged to home (3, 14%) and to SNF/rehab (9, 29%). For reference, in the overall MGH

Table 2. Outcomes of Patients Discharged to Home Versus Rehabilitation

Patient, Diagnosis, and Treatment Factors	Discharged to Home (n = 21)	Discharged to Rehab (n = 31)	PValue (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

OPAT population not stratified by drug use, 1.4% of patients (33 of 2096) suffered a line infection, 24 percent (540 of 2214) were readmitted during their treatment course, and 2 percent (44 of 2215) of patients died during their OPAT course.

Seventeen (81%) patients discharged home completed the planned OPAT course and had no known complications from IDU (Supplementary Table 1). We were particularly interested in the circumstances of those 4 (19%) patients discharged to home who had complications. One patient being treated for MSSA endocarditis developed a line infection, which was attributed to documented injection drug relapse; he completed his treatment with oral therapy. The second patient was being treated for pseudomonal vertebral osteomyelitis and was lost to follow-up at the end of his treatment course; unsuccessful attempts were made through law enforcement to find the patient to remove the peripherally inserted central catheter. The third patient passed away from cardiac arrest thought to be due to thromboembolic disease from bacterial endocarditis; he had a negative toxicology screen and injection drug relapse was not suspected. A fourth patient required readmission to complete parenteral antibiotics due to unanticipated homelessness. Complications among patients discharged to SNF/rehab are detailed in Supplementary Table 2.

DISCUSSION

This retrospective review provides an important clinical experience of a cohort of PWID discharged from the hospital on OPAT. Given the worsening IDU and opioid crisis [19], PWID represent a growing proportion of patients requiring long-term parenteral antibiotics for increasingly complex infections [7]. In this cohort of patients discharged to home or to SNF/rehab, a majority were able to safely complete their OPAT courses. The group of patients discharged home on OPAT did not have a significantly higher rate of complications, including rates of injection drug relapse, readmission, line complication, and follow-up, compared with those who were discharged to a rehabilitation facility. For carefully selected patients, discharge to home may be a safe and lower cost alternative to prolonged inpatient admissions or SNF/rehab stays, which carry their own

risks. Acknowledging these groups were not identical at baseline, and future randomized studies should optimally be done to better compare outcomes.

Addressing the opioid crisis itself is crucial to controlling the rate of infections resulting from IDU. The route and practice of injection, such as skin popping and unclean needle use, are contributing to the incidence of infections and are being addressed through harm reduction strategies including education and safe needle exchanges [20, 21]. Integration of addiction care in the treatment of PWID with infections is equally important in reducing complications. In one study, patients being treated for endocarditis associated with IDU were found to have low rates of addiction counseling or treatment [22]. Although more patients discharged to rehabilitation in our study had ongoing IDU at the time of admission, fewer of these patients were receiving substance use disorder treatment at the time of discharge (addiction counseling and/or medication), which may also increase the risk of OPAT complication.

Several guidelines have been proposed for identifying patients in general who are safe candidates for OPAT, but none have been developed that specifically address PWID. Available guidelines recommend that OPAT candidates for discharge home be medically stable, understand the OPAT plan, and have access to transportation and systems for smooth communication; patients with substance use disorder are generally not believed to be suitable candidates for home OPAT [23, 24]. In our study, carefully selected patients were able to complete their OPAT course at home. Characteristics in our study that were associated with adverse OPAT outcomes included lack of family involved in discharge planning, which is similar to what is seen in non-PWID settings [13]. Time since last IDU may also be a factor in complication risk; more patients selected for home discharge in this study had not used within the month before their admission.

Increased time since last IDU was also associated with a decreased risk of complications for PWID in OPAT in another study [25]. Based on our experience and other published studies, we propose additional considerations for safe OPAT discharge for PWID: these include patient engagement in addiction care including strong consideration for initiation of pharmacotherapy [26, 27], a reliable patient support network including family and/or friends who understand the treatment plan and are aware of the patient's substance use disorder, consultation with outpatient addiction providers if applicable, and prior evidence of abstinence from IDU. The patient should also be vested in the decision; the patient should be counseled about the risks associated with indwelling IV access, acknowledge those risks, and agree with the decision for OPAT discharge. In some settings, tamper-proof access devices may also be considered. Among highly selected PWID receiving OPAT in Singapore, tamper-proof seals were used for patients who received daily infusions at an infusion center, and we found similar rates of successful completion of OPAT in our cohort [28].

Our study had several important limitations. First, the small sample size limited our ability to perform statistical analyses. Furthermore, many PWID in need of IV antimicrobial therapy after discharge were not able to be included in the study because they were either treated with oral therapy, completed IV antibiotics as an inpatient, or were discharged to SNF/rehab with internal OPAT oversight and were not monitored by the MGH OPAT program. Although we compared patients discharged to home with those discharged to a rehabilitation facility, it is important to note that these were not matched cohorts and were not equivalent at baseline. Patients who were perceived to be higher risk for injection drug relapse or medication nonadherence would have been more likely to be discharged to a SNF/rehab than to home. In addition, patients with more severe or complex infections and significant comorbidities may also have been more likely to have been discharged to SNF/rehab. As such, direct comparisons between the 2 groups are not necessarily valid. More data and/or prospective studies are needed to evaluate the safety and efficacy of OPAT for PWID as well as the utility of specific interventions before discharge.

CONCLUSIONS

In conclusion, amidst the growing opioid and IDU epidemic, outpatient treatment options for long-term antibiotic therapy are desperately needed. This retrospective study of a single large tertiary hospital shows that the majority of PWID needing long-term antibiotics and deemed safe for discharge from the hospital to home or to SNF/rehab for OPAT by their primary medical team were able to safely complete their parenteral antibiotic course. Discharge planning that includes counseling and treatment for substance use disorder and involves family members may increase success. Further studies are needed to develop a screening tool to identify PWID who can safely be sent home on OPAT.

Supplementary Data

Supplementary materials are available at *Open Forum Infectious Diseases* online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

Acknowledgments

We are grateful to Sara Lammert for assistance in teaching us how to use the Research Patient Data Registry (RPDR).

Author contributions. H. T. D. and S. B. N. contributed to the initial study idea and concept. All authors had a role in the final study design. G. K. R. and H. T. D. designed the RPDR searches. K. A. assisted with the statistical analysis design. H. T. D. collected data and performed primary data analysis. All authors had a role in manuscript preparation and editing.

Financial support. This study was conducted without external funding.

Potential conflicts of interest. All authors: No reported conflicts of interest. All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest.

References

1. U.S. Department of Health and Human Services. Results from the 2013. National Survey on Drug Use and Health: Summary of National Findings. Rockville, MD; 2014. Available at: <http://www.samhsa.gov/data/sites/default/files/NSDUHresultsPDFWHTML2013/Web/NSDUHresults2013.pdf>. Accessed 1 August 2017.
2. Rudd RA, Paulozzi LJ, Bauer MJ, et al. Increases in heroin overdose deaths - 28 States, 2010 to 2012. *MMWR Morb Mortal Wkly Rep* 2014; 63:849–54.
3. Trecki J, Gerona RR, Schwartz MD. Synthetic cannabinoid-related illnesses and deaths. *N Engl J Med* 2015; 373:103–7.
4. Stein MD, Sobota M. Injection drug users: hospital care and charges. *Drug Alcohol Depend* 2001; 64:117–20.
5. Bassetti S, Hoffmann M, Bucher HC, et al. Infections requiring hospitalization of injection drug users who participated in an injection opiate maintenance program. *Clin Infect Dis* 2002; 34:711–3.
6. Binswanger IA, Kral AH, Bluthenthal RN, et al. High prevalence of abscesses and cellulitis among community-recruited injection drug users in San Francisco. *Clin Infect Dis* 2000; 30:579–81.
7. Gordon RJ, Lowy FD. Bacterial infections in drug users. *N Engl J Med* 2005; 353:1945–54.
8. Scheidegger C, Zimmerli W. Infectious complications in drug addicts: seven-year review of 269 hospitalized narcotics abusers in Switzerland. *Rev Infect Dis* 11:486–93.
9. Kim JB, Ejiofor JI, Yamine M, et al. Surgical outcomes of infective endocarditis among intravenous drug users. *J Thorac Cardiovasc Surg* 2016; 152:832–41. e1.
10. Chary A, Tice AD, Martinelli LP, et al. Experience of infectious diseases consultants with outpatient parenteral antimicrobial therapy: results of an emerging infections network survey. *Clin Infect Dis* 2006; 43:1290–5.
11. Tice A. Outpatient parenteral antimicrobial therapy as an alternative to hospitalization. *Int J Clin Pract Suppl* 1998; 95:4–8.
12. Rehm S, Champion M, Katz DE, et al. Community-based outpatient parenteral antimicrobial therapy (CoPAT) for *Staphylococcus aureus* bacteraemia with or without infective endocarditis: analysis of the randomized trial comparing daptomycin with standard therapy. *J Antimicrob Chemother* 2009; 63:1034–42.
13. Andrews MM, von Reyn CF. Patient selection criteria and management guidelines for outpatient parenteral antibiotic therapy for native valve infective endocarditis. *Clin Infect Dis* 2001; 33:203–9.
14. Mackintosh CL, White HA, Seaton RA. Outpatient parenteral antibiotic therapy (OPAT) for bone and joint infections: experience from a UK teaching hospital-based service. *J Antimicrob Chemother* 2011; 66:408–15.
15. Muldoon EG, Switkowski K, Tice A, et al. A national survey of infectious disease practitioners on their use of outpatient parenteral antimicrobial therapy (OPAT). *Infect Dis (Lond)* 2015; 47:39–45.
16. Tice AD, Rehm SJ, Dalovisio JR, et al. Practice guidelines for outpatient parenteral antimicrobial therapy. IDSA guidelines. *Clin Infect Dis* 2004; 38:1651–72.
17. Matthews PC, Conlon CP, Berendt AR, et al. Outpatient parenteral antimicrobial therapy (OPAT): is it safe for selected patients to self-administer at home? A retrospective analysis of a large cohort over 13 years. *J Antimicrob Chemother* 2007; 60:356–62.
18. Mertz D, Viktorin N, Wolbers M, et al. Appropriateness of antibiotic treatment in intravenous drug users, a retrospective analysis. *BMC Infect Dis* 2008; 8:42.
19. Dart RC, Severson SG, Bucher-Bartelson B. Trends in opioid analgesic abuse and mortality in the United States. *N Engl J Med* 2015; 372:1573–4.
20. Schuckit MA. Treatment of opioid-use disorders. *N Engl J Med* 2016; 375:357–68.
21. Sawangjit R, Khan TM, Chaiyakunapruk N. Effectiveness of pharmacy-based needle/syringe exchange programme for people who inject drugs: a systematic review and meta-analysis. *Addiction* 2017; 112:236–47.
22. 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; 129:481–5.
23. Seaton RA, Barr DA. Outpatient parenteral antibiotic therapy: principles and practice. *Eur J Intern Med* 2013; 24:617–23.
24. Marculescu CE, Berbari EF, Cantey JR, et al. Practical considerations in the use of outpatient antimicrobial therapy for musculoskeletal infections. *Mayo Clin Proc* 2012; 87:98–105.
25. Buehrle DJ, Shields RK, Shah N, et al. Risk factors associated with outpatient parenteral antibiotic therapy program failure among intravenous drug users. *Open Forum Infect Dis* 2017; 4:ofx102.
26. Shanahan CW, Beers D, Alford DP, et al. A transitional opioid program to engage hospitalized drug users. *J Gen Intern Med* 2010; 25:803–8.
27. Kushel M. Improving care for hospitalized, opioid-dependent patients: a promising start. *JAMA Intern Med* 2014; 174:1377–8.
28. Ho J, Archuleta S, Sulaiman Z, et al. 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; 65:2641–4.