Delivery of Integrated Care Through an Outpatient Parenteral Antimicrobial Therapy Treatment Center

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Background: The objective of this analysis is to describe and evaluate the clinical experience of delivering outpatient parenteral antimicrobial therapy (OPAT) using the St Vincent Outpatient Treatment Center (SVOTC) as an example. With Infectious Disease of Indiana, the SVOTC offers a unique model in its integrated care delivery, staffing, and monitoring practices for patients who are discharged from the hospital but still require complex care.

Methods: A retrospective cohort from the first 3 years of operation of the SVOTC (January 2010 to December 2012) was examined to determine patient characteristics, clinical characteristics, and outcome of hospital admissions during OPAT. The sample (2684 OPAT patients) comprised those patients treated with the 3 most frequently used antimicrobials in the SVOTC: ceftriaxone, daptomycin, or ertapenem.

Results: Patients were either diverted to OPAT from inpatient hospitalization (n = 1735, 65%) or initiated on OPAT directly as outpatients thereby avoiding hospitalization (n = 949, 35%). Outpatient parenteral antimicrobial therapy was delivered at the SVOTC (57%), self-administered (33%), or delivered at an external site (9%). Overall, 81 patients (3.1%) were hospitalized after being treated with OPAT, and the number of (re) admissions (admissions for those who started either as inpatients or as outpatients) was similar whether patients received OPAT after hospitalization or from the outset. The average treatment duration, including any intervening hospitalization, was 16.9 days.

Conclusions: The unique model at the SVOTC demonstrates transitional care integration in patients requiring OPAT regardless of initiation site and offers a potential mechanism to reduce cost while providing quality care.

Key Words: ceftriaxone, daptomycin, ertapenem, OPAT, readmissions

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Health care costs continue to escalate, and Medicare and Medicaid payments consistently fall below the real costs of providing care.[1] Health care systems must therefore develop strategies to maintain and improve patient care while simultaneously prioritizing cost containment.

Hospitalization costs are an important driver of total health care costs, and there is increasing emphasis on reducing early (≤30 days) readmission after discharge, reducing hospital-acquired infections, expediting outpatient transitions, and implementing other strategies to avoid or limit hospitalization.[2] The Centers for Medicare and Medicaid Services (CMS) has developed several models designed to change patterns of reimbursement and curtail costs; and it appears that hospitals may soon be reimbursed for the total cost of a patient's care—from preadmission to postacute follow-up care—in a single payment, if the recently proposed system of "accountable care organizations" is adopted.

There is a need for a comprehensive, coordinated system of care that prevents unnecessary hospital admissions and reduces length of hospital stay and readmission rates while continuing to provide quality care delivered in line with clinical best practice. Beginning in the late 1970s, it was demonstrated that outpatient intravenous (IV) antibiotic therapy was feasible for patients requiring continued therapy but not requiring hospitalization.[3–5] Owing to factors, such as the growing need for cost-effective options, and advancements in antimicrobials and infusion devices,[6] this practice has become standard and is now called outpatient parenteral antimicrobial therapy (OPAT). The OPAT diagnoses have changed little over the past 20 years, and the increasing availability of once-daily antibiotic therapy has allowed the treatment for these diagnoses to become more streamlined.[7]

St Vincent Outpatient Treatment Center (SVOTC) opened in 2009, in partnership with Infectious Disease of Indiana, to provide an OPAT service to patients from Indianapolis and surrounding areas. The center provides a full range of infusible therapies ("infusibles") and manages disease for an "ambulatory-ill" population consisting of patients who require complex care delivery but not inpatient hospital care. Since 2009, infusion center volume has grown from 2500 to approximately 20,000 patient days of service per year. This currently reflects an average of 50 patients managed daily. Patients are treated in the facility, at another site, or overseen at home using a standard "teach-and-train" model similar to that used by home infusion companies.[7,8] The center is staffed by full-time, highly skilled registered nurses who are encouraged to attain certified infusion nurse status. The center also has an independent pharmacy with trained infusion pharmacy support staff, including an infectious disease (ID)-trained pharmacist. The SVOTC model requires the presence of a board-certified physician during all of the hours the center is open (365 days/year). This physician is present to manage acute problems, triage new patients, and provide additional outpatient consultative oversight. All patients receiving infusion therapy are seen at least once every 7 days by the ID physician and guaranteed follow-up within 7 days after either discontinuing or initiating IV antimicrobials.

Care coordination allows patients to return to their primary care physician for ongoing management after treatment of the acute event. Patients are monitored for (re)admission (admissions for those who started either as inpatients or as outpatients) within 7 to 42 days of discharge, depending on diagnosis. Laboratory services, basic wound care, pharmacy medication reconciliation, and peripherally inserted central catheter line placement are also available on site.

This study reports selected clinical and economic outcomes from the first 3 years of experience delivering OPAT at the SVOTC.

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MATERIALS AND METHODS

This was a retrospective observational study examining selected clinical characteristics, antimicrobial use, and hospitalization after OPAT in a group of patients treated at the SVOTC from January 2010 to December 2012. Admission data including demographics, diagnosis, and insurance coverage were collected on arrival for all patients presenting for treatment at the SVOTC over the course of the 3-year data collection period. All antimicrobials prescribed for index infections during this period were recorded. Patients were monitored while on antimicrobial therapy by weekly physician visits and daily nurse evaluation where appropriate. Patients requiring (re)admission were identified and recorded in the paper record. Readmissions were then reviewed and specific information recorded on a readmission case report form.

The sample analyzed includes OPAT with the 3 IV antimicrobials most frequently used by the SVOTC, which are ceftriaxone, daptomycin, or ertapenem. Patients receiving other antimicrobial therapy and patients receiving combination antimicrobial therapy were excluded. Patients who require antimicrobials multiple times a day for certain specific bacterial isolates (e.g. *Pseudomonas*) were also excluded from this analysis. Patients may be included in the sample more than once for each eligible episode of infection treated through the SVOTC. For categorical variables, descriptive statistics were presented by frequency and percentage of the sample population. For numerical variables, mean and standard deviation or median and interquartile range were presented. Categorical variables were compared using χ^2 or Fisher exact tests and continuous variables were compared using Student *t* tests. A *P* value of 0.05 or less was considered statistically significant. Analyses were performed using SAS 9.3 (SAS Institute, Cary, NC).

RESULTS

Sample Characteristics

Patient flow is depicted in Figure 1. Of a total estimated 3662 infections treated at the infusion center during the time period covered, 669 were excluded from this analysis because they were treated with antimicrobials other than ceftriaxone, daptomycin, or ertapenem. Of 2993 episodes treated with the antimicrobials of interest, 309 were treated with combination antimicrobial therapy. Thus, 2684 episodes treated with monotherapy were included in the final sample for analysis.

Sample characteristics are shown in Table 1. The mean age of the sample was 52.2 years, and 50.7% were men. Most patients had commercial insurance (n = 1538, 57.3%), followed by Medicare (n = 781, 29.1%), self-pay (n = 245, 9.1%), and Medicaid (n = 113, 4.2%). Patients were either diverted to OPAT from hospitalization (n = 1735, 64.6%) or initiated on OPAT from the outset after diagnosis, thereby avoiding hospitalization (n = 949, 35.4%). Points of service for OPAT delivery were the SVOTC (n = 1537, 57.3%), self-administration (n = 880, 32.8%), or administration at an external site (n = 250, 9.3%).

Antibiotic Use and Hospital (Re)Admissions While on OPAT Service

The most common infections in this population were (see Table 1): skin and soft tissue (49.9%), bone and joint (17.1%), intra-abdominal (7.4%), genitourinary (6.9%), sepsis (4.9%), pulmonary/respiratory (4.3%), device-related (4.0%), endovascular (2.0%), ear-nose-throat (1.5%), or other infection (2.1%). Antibiotic use in the sample was 39.2% daptomycin (n = 1053), 35.0% ertapenem (n = 939), and 25.8% ceftriaxone (n = 692).

There were a total of 82 hospital (re)admissions from OPAT (3.1%) (Table 1). Patient data broken down by hospitalization status at OPAT initiation, and during OPAT service, are shown in Table 2. The OPAT posthospital and OPAT-only groups differed significantly in terms of demographics, insurance, diagnoses, and treatment-related variables. The point of service for patients starting as outpatients was primarily SVOTC (72.5%). It is of note that only 5.2% of patients initiating treatment as outpatients were uninsured versus 11.3% of patients with an inpatient initiation ($P < 0.0001$). Readmissions and primary admissions from OPAT were similar for both groups (3.3% vs 2.5%, $P = 0.241$; Table 2). Overall readmission and primary admission from OPAT by diagnosis ranged from 1.6% for genitourinary to 11.1% for endovascular (not shown). Figure 2 shows (re)admissions from OPAT for previous inpatients and those initiated as outpatients for the 5 most common diagnoses. The only significant difference between these 2 groups was found in patients with sepsis ($P = 0.038$).

DISCUSSION

Hospitals are under increasing pressure to bring in revenue to cover shortfall in payments from Medicare and Medicaid, and

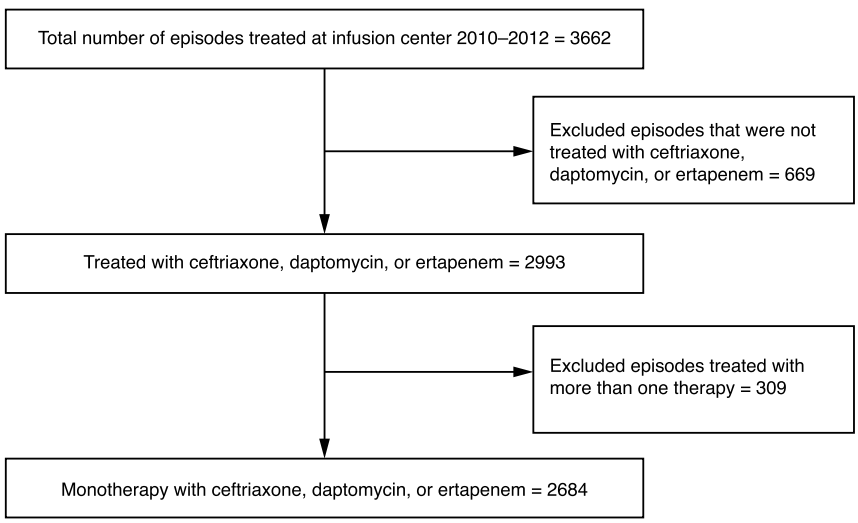

FIGURE 1. OPAT research cohort flow diagram.

TABLE 1. Description of Study Population

	n = 2684*†
Age (mean ± SD), y	52.2 ± 17.7
Male	1361 (50.7)
Outpatient at start of OPAT	949 (35.4)
Insurance	
Commercial	1538 (57.3)
Medicare	781 (29.1)
Uninsured	245 (9.1)
Medicaid	113 (4.2)
Point of OPAT service‡	
SVOTC	1537 (57.3)
Self-administration	880 (32.8)
External site	250 (9.3)
Hospital admission while on OPAT service	82 (3.1)
Treatment duration, d	
Mean ± SD	16.9 ± 14.4
Median (IQR)	13 (15)
Antibiotic treatment	
Daptomycin	1053 (39.2)
Ertapenem	939 (35.0)
Ceftriaxone	692 (25.8)
Diagnosis	
Skin and soft tissue infections	1339 (49.9)
Bone and joint infections	459 (17.1)
Intra-abdominal infections	199 (7.4)
Genitourinary infections	186 (6.9)
Sepsis	131 (4.9)
Pulmonary/respiratory infections	116 (4.3)
Device-related infections	106 (4.0)
Endovascular infections	54 (2.0)
Ear-nose-throat infections	39 (1.5)
Other§	55 (2.1)

*n (%) unless otherwise noted.

†Percentages may not equal 100% owing to rounding or missing data.

‡Points of OPAT service include: outpatient treatment center with daily administration at the SVOTC, self-administration daily at home using gravity or push, or external site with administration at a facility other than the SVOTC. All patients received weekly follow-up with an infectious disease physician at St Vincent regardless of point of service.

§Other diagnoses include those that involved the central nervous system, ophthalmological infections, gynecological infections, sexually transmitted infections, and uncategorized or not specified infections.

IQR indicates interquartile range.

outpatient care is the sole revenue source to have increased steadily since 1990.[9] As well as costing approximately 65% less than an inpatient stay,[3,10] outpatient care has the added advantages of reducing the risk of nosocomial infection,[11] and being more convenient and comfortable for patients than a hospital stay.[12] The availability of outpatient infusion therapies is limited and, at present, Medicare provides no universal coverage for outpatient infusion services under Medicare Part A (hospital) or Part B (medical). An attempt at coverage with a Medicare Part D (prescription drug benefit) supplement has been largely ineffective and various bills before the US Congress have failed to progress. As such, the majority of Medicare patients must remain hospitalized, be transferred to an extended care facility, or attend an outpatient infusion center to continue receiving infusibles to complete therapy. Patients with private health insurance may be eligible for additional home infusion benefits but may still need or request to have care administered at an outpatient facility on a daily basis.

TABLE 2. Study Population by Hospitalization Status at OPAT Initiation

	Inpatient Start n = 1735*†	Outpatient Start n = 949*†	*P*
Age: ± SD, y	51.4 ± 17.3	53.7 ± 18.1	0.001
Male	945 (54.5)	416 (43.8)	<0.001
Insurance			<0.001
Commercial	960 (55.3)	578 (60.9)	
Medicaid	84 (4.8)	29 (3.1)	
Medicare	489 (28.2)	292 (30.8)	
Uninsured	196 (11.3)	49 (5.2)	
Unknown	6 (0.4)	1 (0.1)	
Point of OPAT service‡			<0.001
SVOTC	849 (48.9)	688 (72.5)	
Self-administration	680 (39.2)	200 (21.1)	
External site	191 (11.0)	59 (6.2)	
Admission from OPAT	58 (3.3)	24 (2.5)	0.241
Treatment duration, d			0.003
Mean ± SD	17.5 ± 13.9	15.8 ± 15.2	
Median (IQR)	14 (15)	10 (16)	
Treatment			<0.001
Ceftriaxone	491 (28.3)	201 (21.2)	
Daptomycin	592 (34.1)	461 (48.6)	
Ertapenem	652 (37.6)	287 (30.2)	
Diagnoses			<0.001
Skin and soft tissue infections	853 (49.2)	486 (51.2)	
Bone and joint infections	278 (16.0)	181 (19.1)	
Intra-abdominal infections	168 (9.7)	31 (3.3)	
Genitourinary infections	72 (4.2)	114 (12.0)	
Sepsis	112 (6.5)	19 (2.0)	
Pulmonary/respiratory infections	95 (5.5)	21 (2.2)	
Device-related infections	77 (4.4)	29 (3.1)	
Endovascular infections	45 (2.6)	9 (1.0)	
Ear-nose-throat infections	6 (0.4)	33 (3.5)	
Other§	29 (1.7)	26 (2.7)	

*n (%) unless otherwise noted.

†Percentages may not equal 100% owing to rounding or missing data.

‡Points of OPAT service include: outpatient treatment center with daily administration at the SVOTC; self-administration daily at home using gravity or push; or external site with administration at a facility other than the SVOTC. All patients received weekly follow-up with an infectious disease physician at St Vincent regardless of point of service.

§Other diagnoses include those that involved the central nervous system, ophthalmological infections, gynecological infections, sexually transmitted infections, and uncategorized or not specified infections.

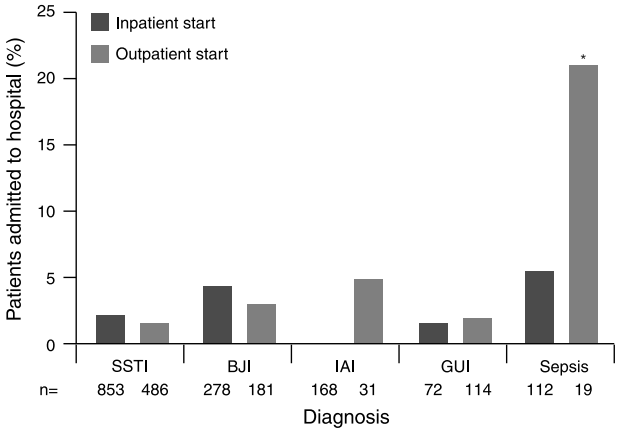

FIGURE 2. Admission to hospital while on OPAT service for top 5 most common diagnoses. Sepsis includes the following diagnoses: bacteremia, group A streptococci, group B streptococci, salmonella, sepsis, toxic shock syndrome, and typhoid. *$P < 0.05$. BJI indicates bone and joint infections; GUI, genitourinary infections; IAI, intra-abdominal infections; SSTI, skin and soft tissue infections.

An outpatient treatment center, such as the SVOTC supports the goals of OPAT by providing an integrated care delivery structure, with full-time ID physician and ID pharmacist oversight, and the employment and training of highly skilled specialist infusion nurses. Having specialized OPAT staff available on site has been shown to improve efficacy and safety outcomes, as demonstrated in a recent evaluation of the impact of multidisciplinary team review on OPAT outcomes.[13] Additionally, recent articles report that ID consultation improved care[14] and decreased unnecessary treatment.[15]

In this study, the antimicrobials used were agents that had pharmacokinetic properties allowing once-daily dosing. Patients transitioning to OPAT from an inpatient status were routinely converted to one of these three agents before discharge, if clinically appropriate. Daily dosing allows OPAT to be continued easily in patients without home infusion benefits. It also allows less manipulation of port access in all patients, and in select individuals, it allows daily peripheral access to be used, thereby eliminating central access complications, such as deep venous thrombosis.

Thirty-day hospital readmission rates, and associated costs, have been excessive for several years. According to analyses of Medicare claims data from 2003 and 2004, and remaining steady between 2007 and 2010, almost 20% of Medicare beneficiaries were rehospitalized within 30 days of discharge, and the estimated cost to Medicare of unplanned rehospitalizations in 2004 was US $17.4 billion.[16,17] Estimates from 2010 run as high as US$17 billion, representing approximately 20% of the entire Medicare budget.[16] More than 75% of these readmissions were considered preventable by CMS.

Matters to note for the SVOTC model of care are largely issues seen in the general OPAT population. Some patients are not able to visit the clinic every day, for a variety of reasons. Not all antimicrobials are an option for all patients owing to factors, such as dosing and concomitant treatments. This model requires a significant amount of physician oversight: 24-hour-a-day availability, every day of the year. Patients that are sent home with OPAT via the teach-and-train model commonly used by commercial insurance providers still have significant oversight but less frequent monitoring than the population visiting the SVOTC on a daily basis.

Limited conclusions can be drawn from comparisons between studies carried out at different sites as patient cohorts are dissimilar based on regional care variances, but the feasibility of and cost savings delivered by OPAT have been demonstrated in numerous reports (reviewed in MacKenzie et al[18]). We attempted to define similar patient populations to compare readmissions data. Overall, Chapman et al[19] reported a 6.3% readmission rate versus 3.1% in the current study. For skin and soft tissue infections specifically, Seaton *et al.*, with a 63% outpatient start rate, reported

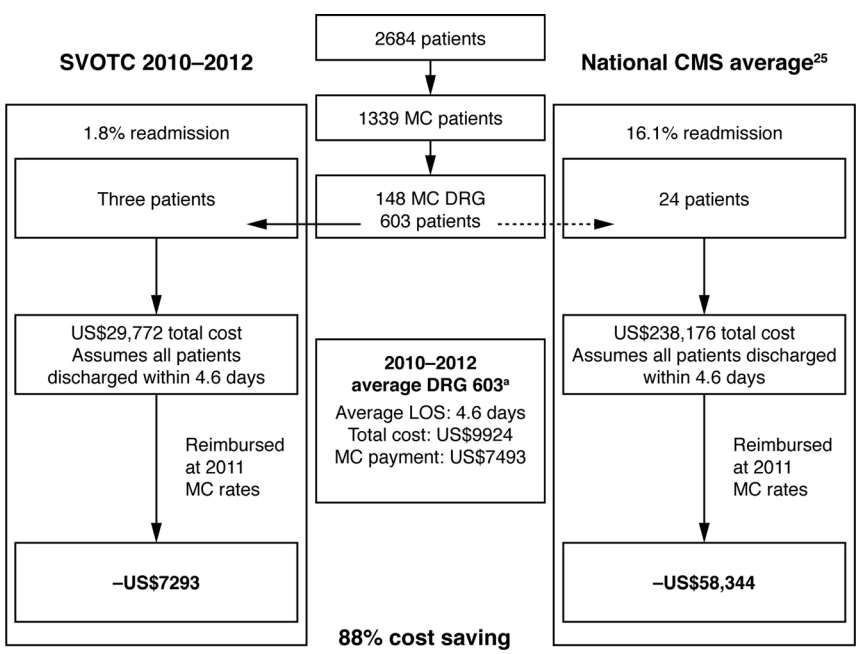

FIGURE 3. Cost comparison to national CMS average—cellulitis example. Shown is a comparison of projected costs for this model versus national average for cellulitis patients, utilizing 2011 CMS national readmission rates. A, St Vincent Hospital 2010–2012 reported reimbursement/cost data. LOS indicates length of stay; MC, Medicare.

6% admission,[20] compared with 1.8% in the current study's comparable cohort. Three studies in patients with infective endocarditis diverted to OPAT from an inpatient setting reported a 14% to 23% admission rate versus 8.9% in a comparable subgroup from the current study.[21–23] One recent study, Allison et al,[14] reported a high readmission rate of 26% among medically complex patients, and suggested targeted interventions for specific subpopulations. Another recent study, Skorodin et al,[24] reported a 2.5% readmission rate among patients with various diagnoses (bone and joint infections, 31%; skin and soft tissue infections, 28.9%; and genitourinary infections, 19.4%).

In our study population, the cohort with the highest admission rate was that of sepsis patients initially treated as outpatients. We postulate that these were patients diverted by the initial caregiver, but they were not deemed to be appropriate for outpatient care when presenting to the SVOTC. It should be noted that even in this small subpopulation, many patients were able to be managed without inpatient admission.

Overall, the hospital admission and readmission rates in our patients at the SVOTC were at or below those in other published reports. Interestingly, the rate of admission from the SVOTC was not statistically different between those who were outpatients when treatment was initiated and those who received inpatient care. We believe this shows that this integrated model of delivery is capable of meeting the needs of ambulatory patients regardless of previous therapy and severity of initial signs and symptoms.

Although the populations are not directly comparable, it is of interest to compare the cost savings associated with this OPAT model with those available nationally for cellulitis, the most common infection treated. There were 148 Medicare patients with a diagnosis of cellulitis (DRG 603) in our sample. Using the 2011 CMS-reported national cellulitis readmission rate of 16.1%,[25] the projected actual cost to our local hospital of 24 readmissions (16% of 148) would be US$164,112. The CMS-reported reimbursement for any cellulitis admission coded DRG 603 to our facility in 2010 to 2012 was an average of US$7493 per patient or a total of US$86,904 for the projected 24 patients, generating a projected loss of US$77,208. Using a demonstrated readmission rate of 1.8% for our current cohort and the same CMS reimbursement numbers for 2010 to 2012, the total cost to the SVOTC for readmission of 3 patients (1.8% of 148) was US$29,772, generating an overall revenue loss of US$7293: 90% less than the CMS-reported national average (Fig. 3). Such gaps between admission cost and CMS reimbursement will likely continue to increase. If the CMS further penalizes readmissions, achieving significant savings by avoiding any admission will become paramount; this need will be even more critical if the CMS adopts proposed nonpayment for any readmission within 30 days of discharge.

An additional benefit seen in this study is avoiding initial admissions. This has significant impact on both patient outcomes and overall cost of care. In a recent study, patients who were admitted for longer than 48 hours had higher readmission rates and lengths of stay owing to hospital-acquired infections.[11] Limiting exposure to hospitals will decrease overall cost without sacrificing outcomes in appropriate patients. Health systems with capitated reimbursement structures will benefit from models such as this simply by providing care in the outpatient setting at substantial cost savings.

CONCLUSIONS

The integrated model for delivery of OPAT at the SVOTC delivers care resulting in very low readmission and admission rates, subsequently minimizing hospital utilization, in a population including patients diverted from primary clinic offices, emergency rooms, and surgical outpatient suites.

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