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Treatment of Osteomyelitis in Infectious Disease Physician-Operated Infusion Centers (POICs)

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Abstract

Background: Osteomyelitis (OSTEO) has traditionally been evaluated and treated initially in an inpatient setting. Infusion centers in POICs allow for rapid treatment of serious infections requiring outpatient antimicrobial parenteral therapy (OPAT), avoiding hospital admissions and potentially decreasing costs.
Methods: A retrospective review of patients was conducted in eight POICs treating OSTEO directly into the centers from January 1, 2008 to December 31, 2008. All patients receiving antibiotics were screened through the centralized pharmacy system for primary diagnoses of OSTEO. Patients were enrolled who were treated in the POIC and not admitted to an inpatient facility. Evaluation included patient demographics, drug, administration and length of therapy. Mean reimbursement values (MRV) from a national database for mean inpatient length of stay (LOS) were compared to the actual MRV for OPAT for the same LOS.
Results: 206 patients received OPAT in the POIC, accounting for 44% of all treated patients.

POIC Location (State)	Total OSTEO Patients	Direct OPAT Patients	% Direct OPAT	MRV / Day ($)	Estimated Savings ($)
CA	45	25	56	323	355,440
DE	81	42	52	312	601,574
FL	87	49	56	300	707,482
GA	46	24	52	314	343,296
GA	47	27	57	252	402,278
GA	22	6	27	359	83,232
MO	50	15	30	273	220,464
TN	92	18	20	315	257,299
Total	**470**	**206**	**44**	**306**	**2,971,066**

The mean age was 56 and males accounted for 58%. Primary drug was vancomycin (31%). Per the national database, mean inpatient LOS for OSTEO was 9.6 days, equating to a MRV value/ day of $1,804 vs $306 for POIC patients (p< 0.05) for the same number of days. Estimated overall MRV was $3,567,590 (inpatients) vs. $605,146 (POIC) (p<0.05). Treatment in the POIC saved almost $3 million in healthcare expenditures by avoiding hospital admission.
Conclusion: OSTEO can be treated by qualified ID physicians with OPAT without hospitalization. This method of treating serious and often recurrent infections is shown to be significantly less costly than hospitalizations.

Introduction

Osteomyelitis (OSTEO) can be an extension of cSSSI, an unintended result of medical intervention, or a spontaneously occurring infection. The culprit organisms are most frequently *S. aureus* and streptococci, but others may be involved. OSTEO treatment frequently requires intravenous antibiotics (IVABs) and extended durations of therapy. Admission to the hospital should not be a requirement for the initiation of IVABs. Hospital admission places patients at risk for medical errors and the acquisition of hospital acquired infections that can cause further morbidity and mortality. Additionally, the costs accompanying hospital admission are traditionally higher than outpatient IVAB administration costs. Insurers are increasingly recognizing outpatient antibiotic therapy as a viable, cost-effective alternative to hospitalization. Physicians who have the capability of offering initial IVABs to patients can bypass hospitalization but still provide needed treatment at the same level of care. Data from one physician office infusion center (POIC) indicated that 38% of all patients receiving IVAB had treatment initiated in the POIC (internal Healix data).

The purpose of this study is to evaluate utilization of office-initiated IVAB in an ID POIC as well as associated therapy characteristics and cost difference between office-initiated care in a POIC and hospitalization for patients with OSTEO.

Methods

A retrospective review of patients was conducted in eight POICs treating OSTEO who had patients that were initiated on IVAB in the infusion centers during the time period of January 1 through December 31, 2008. All patients receiving intravenous antibiotics were screened through the centralized pharmacy system for primary diagnosis of OSTEO. Patients were selected for the study who were treated in the POIC and not admitted to an inpatient facility for treatment of OSTEO within 3 days prior to initiation of therapy in the infusion center. All patient eligibility was verified by individual study sites.

Evaluation and data collection included patient demographics, medication (name, dose, route, device utilized and frequency), and duration of therapy. The average age for the entire cohort was calculated as well as the average age by individual site. The office-initiated patients treated for OSTEO were calculated for the cohort as well as for each site. This was calculated as the percentage of patients who had no inpatient admission for treatment of OSTEO from the total number of patients with office-initiated treatment for OSTEO at each site. The total number of intravenous antimicrobials utilized was recorded, the frequency of each antibiotic utilized was calculated, and the most frequent antimicrobial utilized was determined. The mean dose of each antimicrobial used was calculated for each site as well as the cohort. The mean duration of therapy in days was calculated for each site as well as the cohort. The utilization of different infusion devices was collected and the incidence of each device utilized was calculated as a percentage of the cohort.

Mean reimbursement values (MRV) were obtained from the 2006 Healthcare Cost and Utilization Project Nationwide Inpatient Sample for the OSTEO diagnostic related group (DRG) and mean inpatient LOS. These MRV were compared to the actual MRV for OPAT for the same LOS. MRV for the POIC included actual reimbursement for all therapies and supplies provided, including routine laboratory studies. Drug costs were calculated as average wholesale price (AWP). Comparisons between inpatient costs and POIC treatment were made using Chi Square with p< 0.05 as significant. Mean costs per day were calculated for each site as well as for the total cohort. Additionally, costs per OSTEO episode were calculated for each site as well as for the cohort.

Results

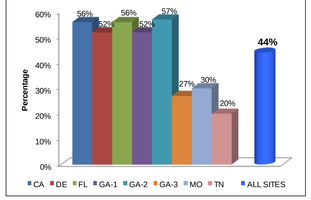
Demographics:

Table 1: Demographics (n=206)

Characteristics	ALL SITES	CA (n=25)	DE (n=42)	FL (n=49)	GA-1 (n=24)	GA-2 (n=27)	GA-3 (n=6)	MO (n=15)	TN (n=18)
Gender, n (%)									
Female	86 (42)	10	20	16	9	11	3	10	7
Male	120 (58)	15	22	33	15	16	3	5	11
Mean Age, years (range)	56 (18-95)	58	56	54	57	54	67	55	62

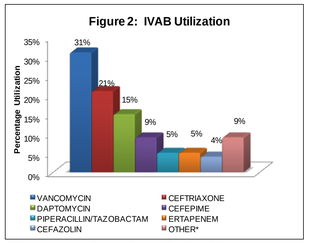
- In 2008, the evaluated POICs treated 460 OSTEO patients; 206 were office-initiated (44%).
- Office-initiated therapy rates varied by site (20% - 57%).
- Mean patient age was 56 years, but range of adult patients was widely varied.

Figure 1: Office-Initiated Treatment Rates



Therapy Characteristics:

Figure 2: IVAB Utilization



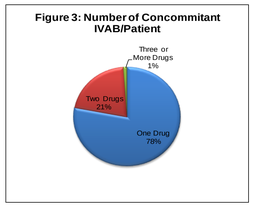
*Other drugs included Amikacin, Ampicillin/Sulbactam, Aztreonam, Clindamycin, Fluconazole, Gentamicin, Imipenem/Cilastatin, Meropenem, Metronidazole, Oxacillin, Tigecycline

Table 2: Mean Dose by IVAB, mg (n=206)

Drug	ALL SITES	CA (n=25)	DE (n=42)	FL (n=49)	GA-1 (n=24)	GA-2 (n=27)	GA-3 (n=6)	MO (n=15)	TN (n=18)
Cefazolin	2112	2447	x	x	x	x	2000	2000	2000
Cefepime	1815	2000	1875	1350	1983	2000	2000	x	1500
Ceftriaxone	1988	2042	2000	1697	2000	1974	2000	2250	1944
Daptomycin*	510	470	566	517	663	464	500	440	456
Ertapenem	938	1000	x	1000	1000	1000	x	1000	625
Pip/Tazo†	3622	x	3857	3375	2438	x	x	3938	4500
Vancomycin	1276	1162	1117	1172	1259	1339	1257	1200	1701

* The most utilized daptomycin dosing was 6-8mg/kg (28 patients) followed by < 6mg/kg (11 patients); weight data was unavailable for 9 daptomycin patients
† Piperacillin/Tazobactam

Figure 3: Number of Concommitant IVAB/Patient



- The majority of patients were treated with one IVAB at a time; 21% were treated with two concomitant IVABs.
  - All POICs followed this trend except GA-1, where 42% of patients were treated with two concomitant IVABs.
- 59 patients (29%) had IVAB medication changes during POIC therapy (site range: 13% - 50%).

Figure 4: Duration of Therapy

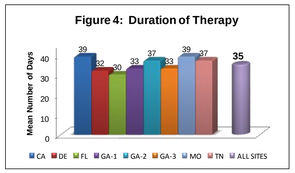
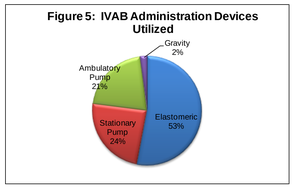


Figure 5: IVAB Administration Devices Utilized



Cost Data:

- Mean daily cost for office-initiated IVAB for OSTEO treatment is $302 (site range: $241 - $359).
  - MRV for OSTEO inpatient treatment is $1804 per day, with a low range of estimated hospital costs only at $1,242 to a high range of charge at $3,442.
  - Mean daily cost savings using office-initiated POIC treatment is $1,502 (range $940 - $3,140; p<0.05).
- Mean episodic cost for office-initiated OSTEO IVAB treatment is $9,729 (based on 34 therapy days).
- Average episodic cost for OSTEO inpatient treatment is $11,924 (based on 9.6 therapy days).
- In all sites, the entire therapy for office-initiated treatment for OSTEO was less than the lowest mean cost for an inpatient stay of 9.6 days. These patients then would likely discharge for additional costly IVAB therapy.
- Mean healthcare cost savings for 206 office-initiated treatments for OSTEO ranged between $1.8 million to $6.2 million, based on 1,978 inpatient days prevented. This was highly significant at p<0.0001.

Table 3: Mean Cost of POIC Episode of Care (entire therapy)

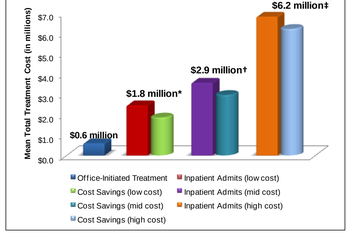
Cost, US Dollars	ALL SITES	CA	DE	FL	GA-1	GA-2	GA-3	MO	TN
Daily Cost	$302	$323	$313	$300	$314	$252	$359	$241	$315
Episodic Cost	$9,729	$11,258	$9,183	$8,482	$9,838	$7,662	$11,889	$9,827	$9,689

Table 4: Mean Cost of Inpatient Stay*

Cost, US Dollars	INPATIENT (Low)	INPATIENT (Mid)	INPATIENT (High)
Daily Cost	$1,242	$1,804	$3,442
Episodic Cost	$11,924	$17,318	$33,051

* Based upon 9.6 day mean stay

Figure 6: Cost Savings with Office-Initiated Treatment (n=206)*



*, †, ‡ p < 0.0001 for cost savings

Discussion

- Physicians can successfully manage OPAT for treatment of OSTEO directly from their physician-operated infusion center, providing essential reduction in health care costs.
- Vancomycin and daptomycin were two of the most utilized IVABs, indicating that proven or suspected methicillin-resistant microbes were common.
- POIC patients can receive multiple IVABs if indicated.
  - Concomitant administration of IVABs can occur simultaneously or sequentially.
  - Simultaneous administration can occur via a multi-lumen PICC or via a combination drug device (assuming IV drug compatibility).
- Appropriate mean dosing was verified for the most utilized IVABs.
  - Dosing was assumed to be adjusted appropriately based on kidney or liver function as this data was not collected.
- POIC mean therapy duration was approximately five weeks, slightly shorter than the usual eight week therapy duration for OSTEO.
- Average daily POIC treatment cost was statistically significantly less than comparator inpatient cost (p<0.05) both overall and for individual POICs. Cost savings for POIC therapy at 9.6 days versus all ranges of inpatient costs was significantly lower (p<0.0001).
- Average treatment cost for the entire POIC admission (mean 34 therapy days) was still lower than average inpatient treatment cost for just 9.6 days of treatment. (p = NS), indicating that an entire course of therapy for OSTEO can be completed in the POIC for the same cost as the average hospitalization for partial therapy.
- Limitations:
  - Hospital cost data may reflect more complicated OSTEO therapy and patients requiring surgical interventions. This detail is unavailable.
  - No data for local hospital cost comparison.
  - Microbiology, surgical interventions, outcomes and recurrence of infection was not evaluated.
  - Further study is warranted to confirm these initial findings.

Conclusion

- Osteomyelitis treatment with IVAB can be successfully initiated and treated in an infectious disease POIC.
- The ID POIC can provide a variety of IVAB drugs, including multiple drugs and administration devices (including self-administration devices) needed for OSTEO therapy.
- Office-initiated treatment for osteomyelitis patients in a POIC, without prior hospitalization, results in highly significant healthcare cost savings and should be considered where possible as a therapy option.
- With avoidance of hospitalization, there is potential decrease in morbidity and mortality due to hospital acquired infections and other associated complications.

Acknowledgments

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