

Abstract

Background: OPAT has been increasingly important in treatment of infections requiring intravenous antibiotics (IVAB) with documented cost savings. An Infectious Disease (ID) POIC can provide cost-effective, qualified evaluation and treatment of serious infections, including cSSSI, as an outpatient, avoiding hospitalization.

Methods: A retrospective review was conducted in 8 ID POICs of all patients treated in 2008 directly with IVAB for cSSSI, not previously hospitalized. cSSSI was defined using FDA guidelines. Economic data was obtained for services provided by the POIC. Mean hospital length of stay (LOS) for cSSSI and corresponding inpatient mean reimbursement values (MRV) were obtained using data from the Healthcare Cost and Utilization Project National Inpatient Sample (HCUP). The mean inpatient LOS for cSSSI and MRV was calculated and compared to actual MRV in the POIC for the same mean LOS.

Results: All sites treated 2430 patients with OPAT from January 1 to December 31, 2008. Of these, 945 (39%) had a primary diagnosis of cSSSI and 376 patients (40%), received treatment directly through the POIC, without prior hospitalization. Males accounted for 53%, mean age was 54. Vancomycin was the predominately utilized antibiotic (37%), followed by daptomycin (23%) and ceftriaxone (17%). Per the HCUP database, mean hospital LOS was 5.1 days for cSSSI. The MRV per day for POIC was \$283 (\$212-\$367) vs. hospital MRV of \$1,225 per day. This was significantly lower inpatient rates (p<0.04). Overall total costs for POIC versus hospital (\$542,681 vs. \$2,349,060 p<0.04) were also significantly lower.

Conclusion: An ID POIC is a cost-effective setting to provide OPAT, avoiding a hospital admission, and significantly saving health care expenditures. Additional comparison studies are warranted.

Introduction

Complicated skin and skin structure infections (cSSSI) result in many hospitalizations every year. In 2006 alone, national data indicated that more than 975,000 patients were treated and discharged from US hospitals for all skin and skin structure infections¹. Of these, 58% were admitted directly from an emergency department. The hospital length of stay ranged from 3-17 days, with over 11,000 eventual in-hospital deaths. Estimated costs to the healthcare system for these patients were \$8.5 billion dollars. Aggregate charges soared above \$24 billion dollars. A large percentage of patients admitted to hospitals for skin and skin structure infections require treatment with intravenous antibiotics. Once admitted, these patients run additional risk of hospital-acquired infections (HAIs). The 2007 CDC report on Direct Medical Costs of HAIs identified 92,011 central line associated bloodstream infections with a healthcare burden annual cost ranging from \$527 million to \$2.1 billion dollars². Recent studies have also indicated that hospitalization of patients with SSTI is an increasing phenomena, possibly linked to growing prevalence of community-acquired Methicillin-resistant *Staphylococcus aureus* (CA-MRSA)^{3,4,5}. In patients presenting to emergency rooms with SSTIs, *S. aureus* was cultured in 59% overall.

While the administration of IV antibiotics in a community outpatient setting has become an increasing common practice over the past 25 years, this does not allow for immediate treatment of SSTIs, particularly cSSSI. This can be provided in an Infectious Disease Physician Office Infusion Center (POIC) where patients receive prompt physician evaluation and diagnosis, and when required, immediate access to intravenous antibiotics (IVAB). Catheters, often peripherally inserted central catheters (PICCs), are placed in the office and first doses of medication administered under close supervision and monitoring. Subsequent administration of antimicrobials is done in the office or home setting with routine follow-up by the physician. Necessary lab work, catheter care and monitoring are generally performed on a weekly basis. Such treatment of serious infections, avoids both an emergency room visit and often an entire hospital admission.

The purpose of the study was to identify frequency and describe patients with cSSSI infections who are treated initially in a POIC with IVAB. Secondly, the goal was to calculate the medical costs of these services compared to the inpatient costs and evaluate the economic impact in potential cost savings in healthcare system.

Methods

A retrospective review was conducted to identify patients during 2008 with cSSSI that were treated with POIC-initiated IVAB, without immediate prior hospitalization. Eight centers participated.

Inclusion Criteria:

- Treatment with IV antibiotics
- Primary or secondary diagnosis of cSSSI, defined as:
 - Infection of the deeper soft tissue
 - Major abscess
 - Surgical wounds
 - Infected diabetic ulcers of the lower extremity
 - Infected ulcers due to other causes (e.g., ulcers associated with vascular insufficiency or decubiti)
 - Superficial infections or abscesses in an anatomical site, such as the rectal area, where the risk of anaerobic or gram-negative pathogen involvement is higher
 - Other complicated skin and soft tissue infections

Methods, cont'd.

Exclusion Criteria:

- Patients < 18 years of age.
- Superficial infections (e.g., simple abscesses, impetigo, and uncomplicated cellulitis), peri-rectal abscesses, gangrene, multiple infected ulcers at distant sites, or infections of third-degree burns.
- Intravenous antibiotics administered ≤ 48 hours.
- Inpatient hospitalization within 72 hours preceding POIC admission.

Patient Selection:

- All patients were identified that were treated with an IVAB in 2008.
- The participating site identified and confirmed from the pharmacy and POIC database those cSSSI patients that had IVAB initiated in the POIC directly from a non-inpatient environment.
- Each patient identified that met criteria was evaluated for demographics, drug therapy received and costs.
- Demographic data collected included age, gender and weight, where available. Data for all drug therapy provided was collected, including drug, dose and duration. Patients receiving multiple agents were identified.

Cost Evaluation:

- POIC Costs: Costs of POIC therapy were calculated as a mean reimbursement value (MRV). This included reimbursement for nursing services, drugs and supplies. Drug costs were calculated at average wholesale price (AWP). Laboratory costs were included at Medicare reimbursement rates. Laboratory data was not available for the entire data set and general assumptions were made for each patient therapy as follows:
 - Laboratory Tests:
 - Chest X-ray (confirmation of IV catheter placement)—initial only
 - CBC with differential—initial and weekly
 - Gram Stain—initial
 - Aerobic Culture—initial
 - Basic Metabolic Panel (BMP)—initial and weekly
 - C-Reactive Protein (CRP)—initial and weekly
 - Drug Specific Laboratory Tests:
 - Vancomycin Patients: Vancomycin level—weekly
 - Daptomycin Patients: Creatinine phosphokinase (CPK)—weekly
- National Inpatient Costs: Inpatient costs were calculated using data from the Healthcare Cost and Utilization Project National Inpatient Sample (HCUP), which is an approximate 20% random sample of US community hospitals. Data was accessed from the 2006 sample, as 2007 data was not then available. The Diagnosis Related Group for complicated cellulitis was used as the basis for the MRV basis, as this most closely and conservatively matched inpatient MRV to outpatient MRV for cSSSI.

Data Analysis:

- HCUP mean length of stay (LOS) and mean costs per patient stay (an underestimate) were used as the MRV for the inpatient data. This inpatient MRV was then compared to the POIC daily cost for the mean LOS.
- Comparison were made between the differences in total MRV of inpatient versus POIC was compared and statistically evaluated with Chi Square with p<0.05 as significant. MRV per day were also calculated and compared with Chi Square. Professional fees were not included in the MRV calculations for either the POIC or HCUP data.

Results

Demographics and Therapy Characteristics:

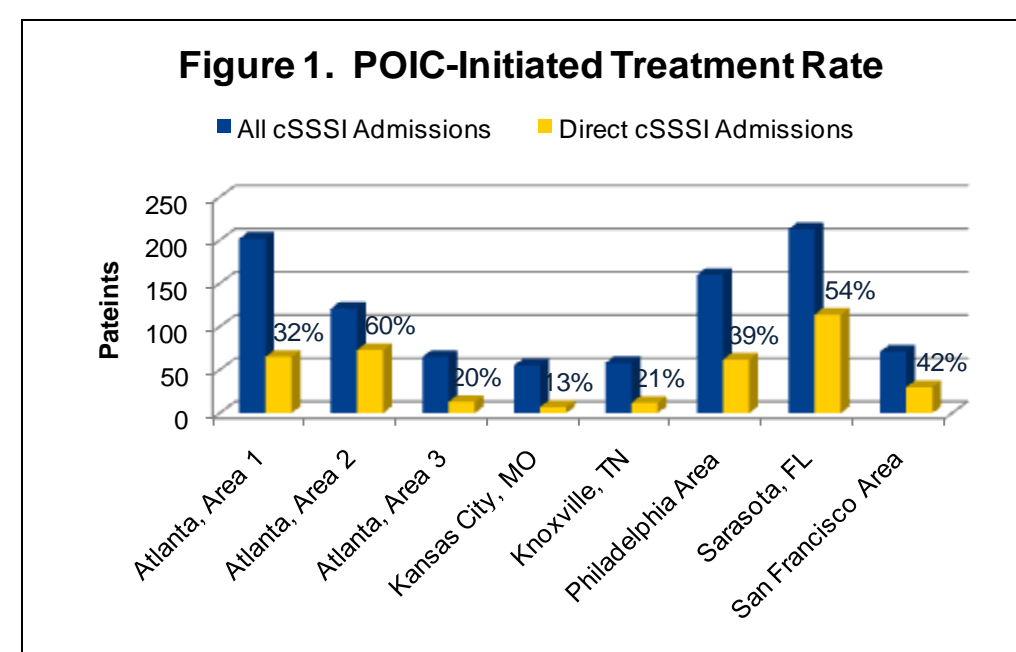
Table 1: Demographics

Site	Gender (n%)		Age, years (mean)
	Female	Male	
All Sites	200 (53)	176(47)	54 (range 19-54)
Atlanta, Area 1	37 (57)	28 (43)	51
Atlanta, Area 2	43 (59)	30 (41)	58
Atlanta, Area 3	4 (31)	9 (69)	43
Kansas City, MO	6 (86)	1 (14)	60
Knoxville, TN	10 (83)	2 (17)	42
Philadelphia	36 (58)	26 (42)	56
Sarasota, FL	52 (46)	62 (54)	56
San Francisco	12 (40)	18 (60)	53

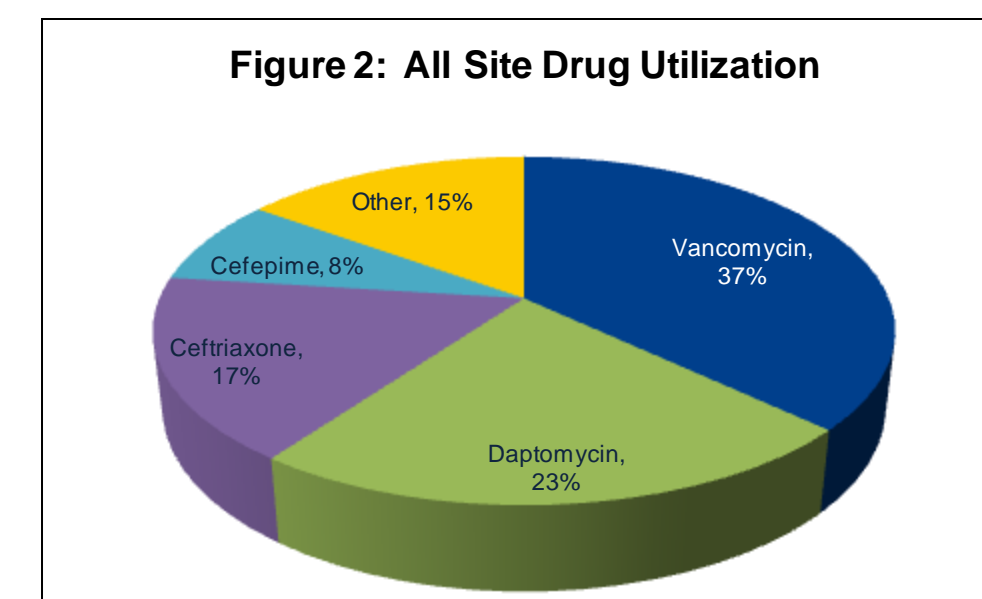
- 2,430 total patients were screened for study inclusion.
- 945 patients overall received IVAB treatment in the POIC for cSSSI during 2008.
- 376 patients had IVAB treatment initiated in the POIC (40% overall).
- The majority of POIC-initiated treatment patients (84%) came from four POICs:
 - Atlanta, Area 1
 - Atlanta, Area 2
 - Philadelphia Area (Newark, DE)
 - Sarasota, FL

Results, cont'd.

- All participating sites had POIC-initiated IVAB treatment patients for cSSSI (range 20-60%)



- Vancomycin was the most prevalent antibiotic utilized and was primary in 6 of 8 sites. One site ranked use of daptomycin first, with vancomycin second and the other ranked ceftriaxone first, followed by daptomycin, then vancomycin.
- Combined, both vancomycin and daptomycin accounted for 60% of all drugs used.
- Twenty different intravenous antimicrobials from numerous therapeutic categories were utilized, including aminoglycosides and anti-fungals.
- Other agents included piperacillin/tazobactam, ertapenem, ceftazidime and aztreonam (1-5%). The remaining twelve agents were each used <1%.
- Elastomeric for home use were the most common administration device utilized (53%), followed by stationary pumps for in-office use (31%) and ambulatory pumps for home use (15%).
- The majority of patients were on one IVAB (88%); 18% (site range 3%-29%) of patients had an IVAB drug change during POIC treatment.



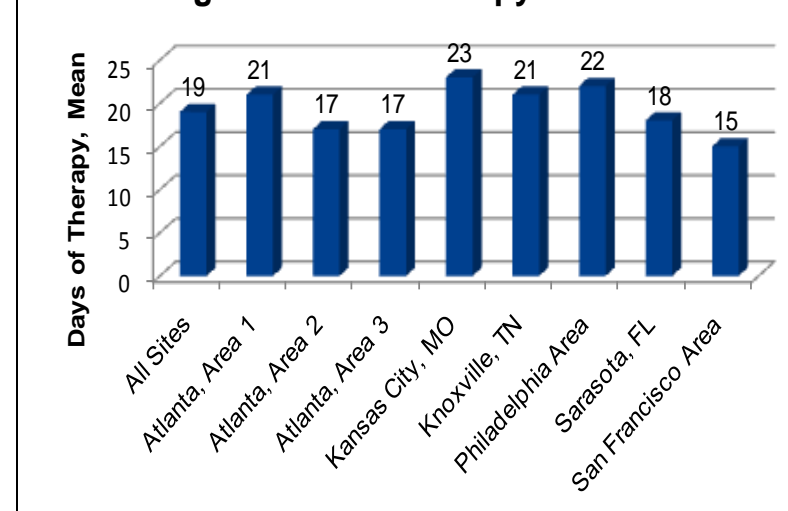
- Drug doses were within acceptable ranges for all drugs utilized.
- The mean dose of vancomycin was 1.3 grams, with the other commonly used agents noted on Table 2. The mean dose for piperacillin/tazobactam was 4.2 grams, ertapenem was 1 gram and ceftazidime was 1.5 grams.
- Daptomycin dose was calculated as mg/kg/dose for the 60% of patients for whom weight was available. The dose was 4-6 mg/kg/day for 48/67 (72%) and 6-8mg/kg/day for 19/67 or 28%. No patients received doses >8mg/kg/day.
- Mean therapy duration was 19 days across all sites (site range: 15-23 days).

Table 2. Drug Dosing, mg (mean) (N=376)

Sites	Vancomycin	Daptomycin*	Ceftriaxone	Cefepime
All Sites	1307	509	1801	1869
Atlanta, Area 1	1467	691	2000	1950
Atlanta, Area 2	1233	479	1913	2000
Atlanta, Area 3	1342	532	1668	n/a
Kansas City, MO	1366	550	2000	2000
Knoxville, TN	1417	529	2000	2000
Philadelphia Area	1215	511	1400	1800
Sarasota, FL	1161	368	1625	1748
San Francisco Area	1251	409	1800	n/a

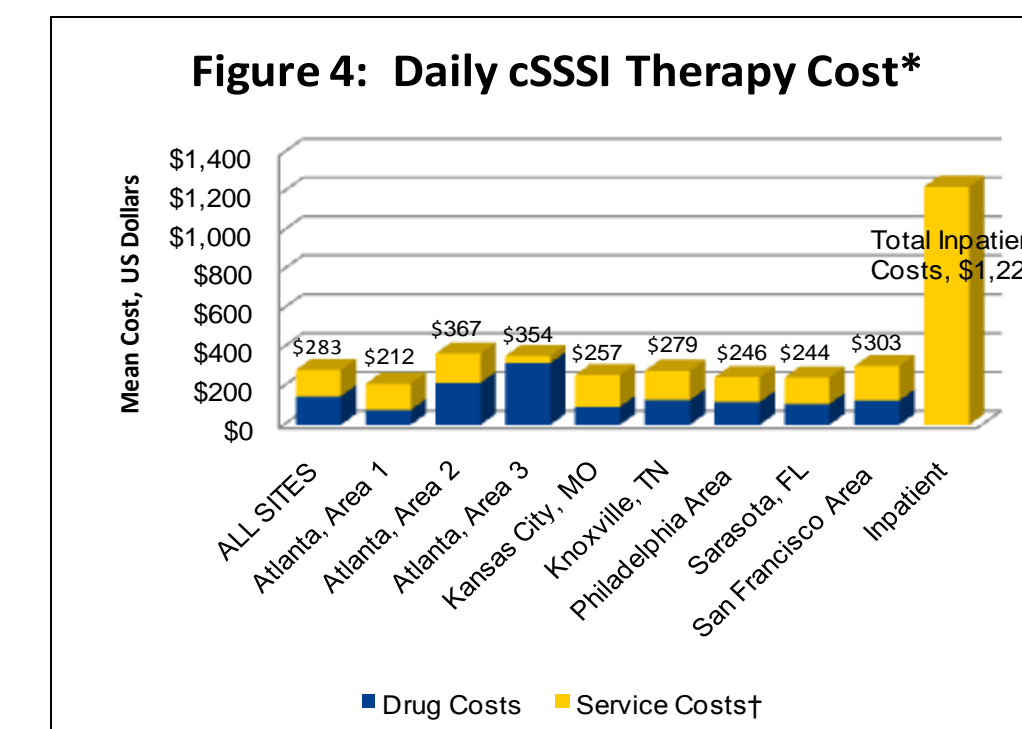
*Where data available, < 6 mg/kg was the most commonly used dosing schema (72%); no doses > 8mg/kg were utilized.

Figure 3: IVAB Therapy Duration



Cost Analysis:

- Average daily cost, calculated as MRV was \$283 (range \$212 - \$367) including drug cost; \$136 without drug cost. Drugs accounted for 52% of daily cost. Daily inpatient costs averaged \$1,225 per day.
- When treatment in the POIC treatment was provided in avoidance of a hospital stay of 5.1 days, savings were \$942 per day. This was statistically significant at p<0.04.



*p<0.04 for POIC daily cost versus inpatient daily costs, N=376.
†Service costs include supplies, administration, and laboratory

- Regional cost differences were calculated. Hospital charges were highest in the northeast, followed by the west. The same percentage increase in POIC charges was not seen.
- In total, the 376 cSSSI patients who had POIC-initiated treatment (bypassing 5.1 days of hospitalization) saved approximately \$1.8 million in healthcare costs.

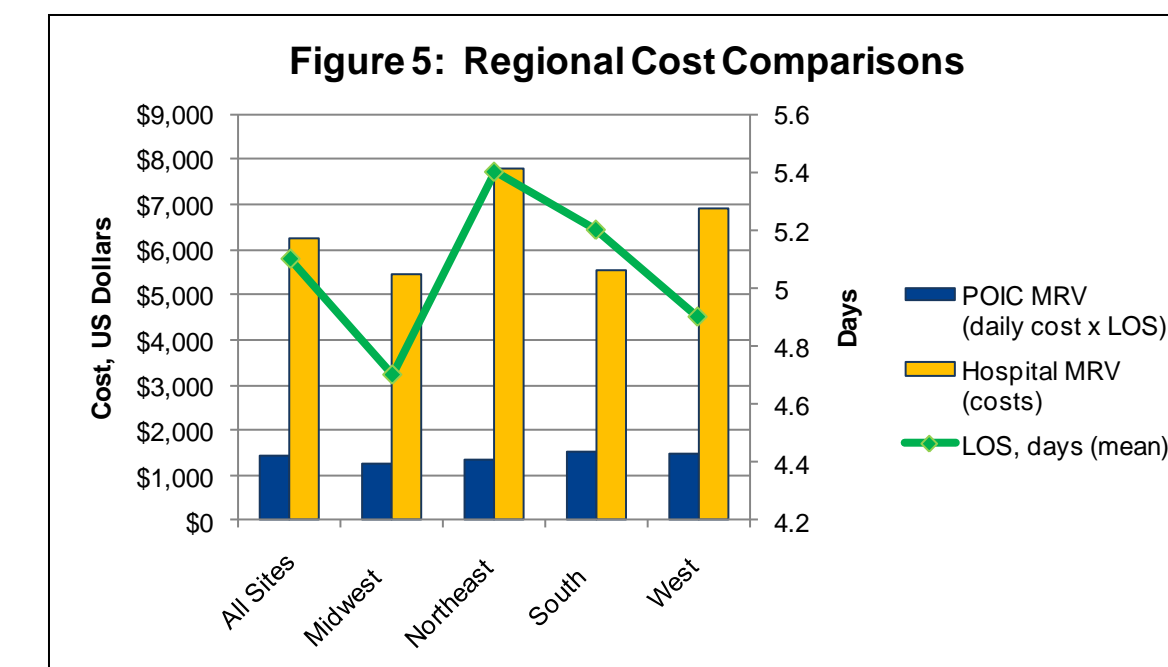
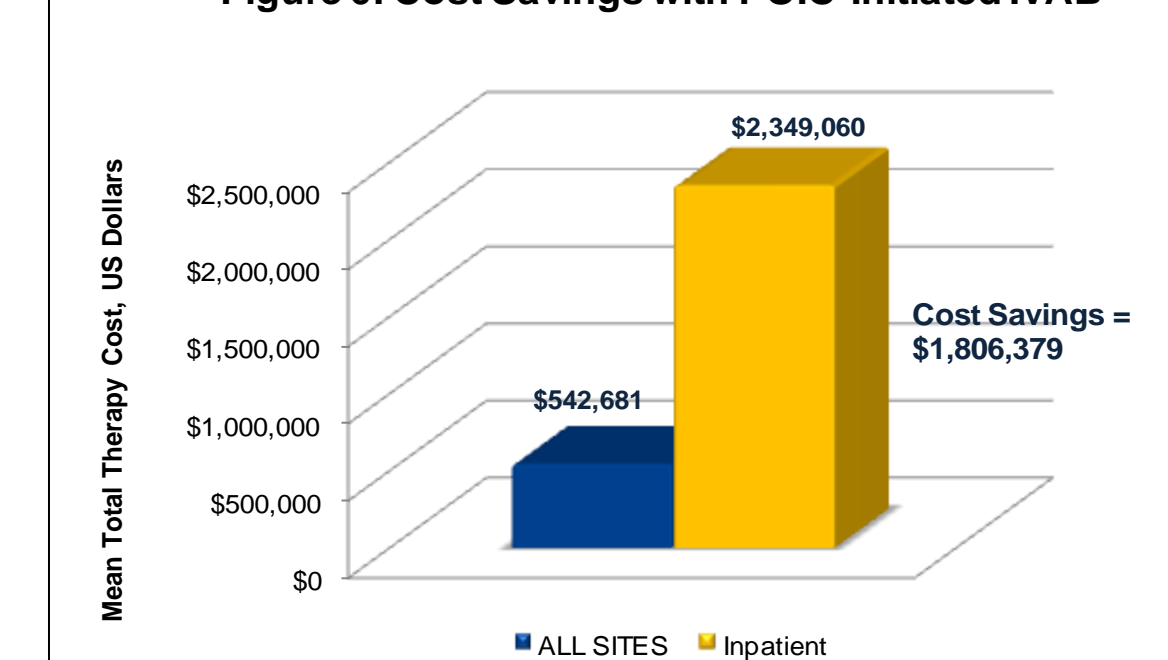


Figure 6: Cost Savings with POIC-Initiated IVAB*



*p<0.04 for POIC versus inpatient costs, N=376.

Discussion

- POIC-initiated treatment with IVAB for cSSSI was shown to be common (40%), with urgent care Infectious Disease practices treating up to 60% of these patients without a hospital admission.
 - Rates of POIC-initiated treatments may have varied by several influences, including practice physician availability and referral patterns.
- POIC-initiated treatment can be provided with a variety of IVAB drug classes, including higher risk therapies such as aminoglycosides.
- Vancomycin and daptomycin were the most frequently utilized IVAB, likely indicating a high incidence of proven or suspected MRSA infection.
 - Microbiological data was not evaluated but would be useful in future studies.
- cSSSI treatment cost in the POIC is significantly less than that in the hospital when compared to HCUP data.
 - Average daily savings with POIC-initiated treatment = \$942.
 - Average length of cSSSI inpatient admission = 5.1 days (per HCUP data).
 - Average episodic cost savings based on above = \$4,804.20.
- POIC-initiated treatment for 376 cSSSI patients to the eight studied centers saved approximately \$1.8 million in healthcare costs during year 2008.
- Limitations: HCUP data reflected 2006 statistics; prospective comparison studies would confirm findings.

Conclusion

- cSSSI patients can bypass hospitalization and be successfully treated with IVAB in an ID POIC. Potential for costly HAIs are avoided. This physician based setting allows for prompt evaluation and immediate treatment of serious infections.
- The ID POIC can provide IVAB therapies by multiple administration methods, including devices dispensed from a pharmacy to administer at home.
- POIC-initiated IVAB can lead to statistically significant healthcare cost savings by allowing for cSSSI treatment in a non-hospital setting.

References

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