



## Clinical Research

# Inpatient Care versus Subacute Care for Long Term Intravenous Antibiotics: Cost from the Patient Perspective

July 9, 2016 [Clinical Research](#), [July-September 2016: Volume 8 Issue 3](#)

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### Abstract

**Background:** Treatment of osteomyelitis often requires antibiotics over an extended period. Underinsured patients are often kept in an acute care setting for the duration of treatment rather than a subacute care facility or at home for antibiotic administration due to difficulties with placement in lower-level care settings. This provides a significant financial burden on both the hospitalized patient and the hospital system. This report highlights the wide discrepancy between costs to the patient between care settings.

**Methods:** A theoretical patient scenario based on a current patient scenario was described to billing officers at a large tertiary care center with affiliated extended care facilities and home healthcare services. Costs to the patient for antibiotics, as well as room and board were obtained.

**Findings:** Six weeks of inpatient care with dual-therapy broad-spectrum antibiotics and basic nursing care costs \$50,980. Similar care at an extended care facility costs \$31,072, while similar services provided by home health nursing costs \$12,307.

**Conclusions:** The uninsured patient population is placed with a large financial burden when undergoing long-term antibiotic treatment. Practitioners and care coordinators should evaluate the proper setting for treatment for patients on an individual basis and strive to find appropriate placement amidst financial challenges. Charitable care that provides medications and potentially other medical needs at a reduced rate for patients with limited financial resources and no insurance should be considered. These efforts will reduce the cost of treatment to the patient and in turn reduce the burden on the hospital system.

### Background:

Due to the complexity and diversity of patient health issues, there is little recent literature analyzing the cost of inpatient versus outpatient care for patients with osteomyelitis who are otherwise medically stable. Osteomyelitis, without other systemic symptoms, typically requires at least 4 weeks of parenteral antibiotics (1). Patients who are under- or uninsured, often remain in an acute-care setting for longer periods than necessary since they have limited or no funding for home health or medical equipment. Furthermore, many private nursing facilities and rehabilitation centers have limited funding to accept these patients, leading to prolonged hospitalization and difficulty in coordinating post-hospital care (2).

Despite federal mandates that patients are required to purchase insurance, 13% of patients ages 18-64, decreased from 18.4% in 2013. Additionally, 18% of adults are covered by government insurance, which has the lowest reimbursement rate to hospitals and care facilities (3). Given that average hospital reimbursement rates are approximately 15%, and Midwest hospitals write off 11.4% of total gross revenue as “uncollectable” (4), it is surprising that long hospitalizations solely for intravenous (IV) antibiotics continue to occur.

Recent media highlights the fact that new policy holders under the Affordable Care Act are sicker and costlier to insurers than predicted, leading to more hospital admissions, physician visits, and insurance claims (5). With increased demand on hospital systems and payers, and financial challenges for these patients, healthcare workers should be aware of costs and burdens associated with prescribed care and make attempts to minimize them when possible. Grayson, et al analyzed 20 patients – 10 with osteomyelitis, 5 with endocarditis, 4 with vascular graft or pacemaker sepsis, and 1 with chronic cellulitis – and found a cost reduction of \$112 per day over the 538 days of combined care when comparing inpatient stay versus home healthcare (6). Nursing care was delivered daily and included initial assessment and a 30 minute visit as well as dressings and other consumable medical supplies. In this study, home treatment was well-tolerated and cure was achieved in 18 of the patients. Payment of hospital overhead, salaried positions, and ancillary staff were thought to be the primary difference in cost.

Milkovich also demonstrated significant cost savings and benefits of home IV antibiotic therapy over hospital-based care (7-8). Increased mobility in patients undergoing home treatment improved quality of life and increased productivity. Patients who are able to return to work or daily activities will also have the benefit of maintaining an income during their treatment course, which would not be possible while hospitalized.

The purpose of this study is to determine the overall cost for patients undergoing a 6-week treatment of IV Vancomycin and Cefepime for osteomyelitis in the inpatient or outpatient setting. Bringing this information to light will help practitioners, care coordinators, and hospital administrators eliminate unnecessary costs to the patient and health system.

## Methods:

A theoretical patient scenario based on a representative patient under our care was described to financial and billing officers at a large tertiary care center with affiliated extended care facility and home health service. The scenario involved:

“A 45 year old otherwise healthy and ambulatory male with mandibular osteomyelitis required removal of hardware by the plastic surgery team. The patient has a 2cm superficial wound from operative debridement requiring daily wound checks. The patient is stable and ready for discharge by post-operative day 2. Infectious disease has recommended 6 further weeks of IV Vancomycin (1g IV q12h) and Cefepime (2g IV q12h) for broad spectrum coverage.”

Each setting was asked to describe costs incurred during the care of that patient, including room cost, nursing care, laboratory costs, and IV infusions. Once data were received from each source, costs were then evaluated and compared via a detailed economic analysis. Vancomycin and cefepime are a common antibiotic regimen at our institution for chronic osteomyelitis, although any medication could be input into this model. All costs were collected from our large, 1,176 bed tertiary care center with associated 120 bed extended care facility, and home health company that made 201,240 visits in 2014. Costs were collected and reported in 2015 US dollars.

## Results:

In the inpatient setting, financial officers describe little variability in cost of care or flexibility in charges. Given that the majority of these patients require a private room due to length of stay and presence of multiple or resistant bacteria, costs for this setting of care were used. An inpatient private room with nursing care costs \$949 per day, compared to a private room at an extended care facility, which costs \$475 per day. In both settings, this includes cost of the room, basic necessities for daily hygiene such as soap, tissue products, linen services, and a regular diet. It also includes the cost of daily nursing care – including vital sign monitoring, dressing changes as ordered by the physician, patient hygiene care, and any other prescribed tasks – by a single nurse and nursing assistant if a nurse is caring for more than 4 patients simultaneously. This does not include cost of specialty dressing supplies or physician fees. Inpatient laboratory tests – complete blood count, basic metabolic panel, erythrocyte sedimentation rate, c-reactive protein, and vancomycin trough – cost \$740, but are discounted 40% to \$440 for patients who are self-pay (Table 1). For this analysis, we assume weekly laboratory testing, which is conservative. Actual cost differences between care settings would increase with more frequent testing.

**Table 1.** Cost of laboratory tests typically ordered for patients with chronic infection. Reported as charge to the patient in our healthcare system.

	<b>Inpatient and Extended Care Facility*</b>	<b>Home Health Care</b>
<b>Complete Blood Count</b>	\$87.60	\$40.56
<b>Basic Metabolic Panel</b>	\$133.80	\$50.08
<b>Erythrocyte Sedimentation Rate</b>	\$39.60	\$35.69
<b>C-Reactive Protein</b>	\$72.00	\$72.47
<b>Vancomycin trough</b>	\$111	\$135.20
<b>Total</b>	\$444.00	\$334.00

\*Rates reflect direct charge to a self-pay patient, which is discounted 40% from rates charge to insurance companies, or \$740.00.

Home care nursing visits cost \$100 per visit and include antibiotic infusion, wound checks, and dressing changes. When possible, nurses teach patients or family to infuse antibiotics, limiting visits to once per day or as needed. Our home healthcare service receives antibiotics from an outpatient supplier and is able to charge slightly less due to this. Individually, antibiotics are \$41.46 per dose for vancomycin and \$41.20 per dose for cefepime. However, if patients receive more than one antibiotic per day with our home health care service, the antibiotic with lesser cost is given at a \$20 per day discount. Laboratory tests are most commonly sent to a private laboratory contracted through the home health company, and these costs are also displayed in Table 1. Prices

were calculated based on daily home visits, although in reality this will vary between patients from once weekly to twice daily, with cost remaining \$100/visit.

Inpatient and extended care facility antibiotics are received from the same pharmacy within our system, and therefore have the same associated cost. Hospital cost, or wholesale acquisition cost, of these antibiotics at our institution is \$2.65 per dose for vancomycin, and \$3.55 per dose for cefepime. The associated mark-up presented in Table 2 is the patient charge. Laboratory tests at the extended care facility are also processed in the hospital laboratory so have an identical cost.

Total cost for a 6 week inpatient stay was \$50,980.80. A similar stay at an extended care facility was \$31,072.8, and 6 weeks of outpatient nursing care, weekly laboratory testing, and daily home antibiotic infusion was \$12,307. This is an overall cost reduction of \$19,908.00 for an extended care setting and \$38,673.36 for care in an outpatient setting.

Lastly, our extended care facility does have a charity program for a select number of patients per year based on income and assets with respect to the Federal Poverty Guidelines (9) and family size. If a patient is uninsured or “private pay” their financial situation is closely analyzed by administrators. If they are deemed to qualify, their room rate is reduced to \$250 per day, and antibiotics are given at hospital cost plus an additional 10%, or \$2.91 per dose for vancomycin and \$3.90 for cefepime. Unfortunately, we were not able to find details regarding the number of patients able to accepted into this program, nor acquire exact criteria for this decision for purposes of this study, as decisions are made on a case-by-case basis and vary by year. Total cost for this stay is \$13,736, similar in cost to outpatient home care in our system.

Table 2 summarizes the cost for 6 weeks of care requiring nursing care, laboratory monitoring, and parenteral dual antibiotic treatment for broad spectrum coverage.

**Table 2.** Costs of care for a six week period. Costs reported as charge to the patient in our healthcare system. Laboratory assumes weekly CBC, BMP, ESR, CRP, and vancomycin trough. Nursing care includes routine vital signs, wound care and medications prescribed by the physician, and patient hygiene. Laboratory testing includes tests in Table 1.

Setting	Room + Nursing Cost	IV Vancomycin (per dose)	IV Cefepime (per dose)	Laboratory testing	Six week total
	(per day)			(per week)	
<b>Inpatient</b>	\$949	\$43.20	\$57.50	\$444.00	\$50980.80
<b>Extended Care Facility</b>	\$475	\$43.20	\$57.50	\$444.00	\$31072.80
<b>Extended Care Charity Program*</b>	\$250	\$2.91	\$3.90	\$444.00	\$13736.04
<b>Home Health Care</b>	\$100	\$41.46	\$31.20	\$334.00	\$12307.44

\*May be subsidized in specific “private pay” patients for \$250/d after analysis of resources, which reduces daily cost to \$263.66 or a 6 week total of \$11,073.72. Qualifications based on US Federal Poverty Guidelines (9).

## Discussion:

Cost of medical care continues to increase, as does the number of patients who are insured via government programs, such as Medicaid (3). Fortunately, there are fewer uninsured patients, with the initiation of the Affordable Care Act (ACA), but this has caused an increased burden on the hospital system and insurance companies with increased accessibility to care. In 2012, prior to the ACA, 75 million people reported difficulty paying off medical bills or paying off medical debt; this is a rise from 58 million in 2005 (4). While this may decrease with recent changes in coverage, more patients will be seeking healthcare, so pressures to control cost will remain for physicians and hospital systems. With this in mind, hospitals and providers are searching for solutions to reduce the debt burden on patients and the system.

The patient scenario given to three different healthcare settings led to substantial cost differences, and these are not surprising. Charge to an uninsured or self-pay patient for a 6 week inpatient stay is \$50,981. There are instances, such as systemic illness, concomitant comorbidities, unsafe home environment, or lack of social support, when an inpatient stay is appropriate and these costs may be justified. Furthermore, patients with a history of IV drug abuse, prior catheter-related infections, or in an immunocompromised state may be unable to receive a long-term IV catheter and may not meet criteria for discharge. However, given that a subacute monitored care setting, such as an extended care facility may charge only half the rate of an acute care hospital, this option should be pursued aggressively by hospital administrators, care coordinators, and healthcare providers. In our system, if a patient meets standards applied by financial officers, the extended care facility may be able to reduce this cost by another 50%, reducing the financial burden on the patient to \$13,736 (Table 2).

Finally, if a patient is deemed a candidate for outpatient care and has the appropriate social support and home environment, this option is most financially feasible at \$12,307. In addition, the patient may continue to work, care for dependents, and participate in daily activities as deemed appropriate, further reducing overall costs of the illness by maintaining income. For many patients, home care is appropriate and they may be discharged with long-term IV access, such as a PICC line. However, as previously stated, for some patients we recognize that home care is not always a viable option. Similarly, not all patients will be able to be properly educated on infusion, and will require more visits than modeled in this study.

For patients who remain uninsured, Medicaid expansion and Marketplace enrollment have streamlined the application process, increased eligibility, and made health insurance more affordable as a whole (10). While rates of uninsured patients are declining because of these changes, there is still a large number of patients who are paying out of pocket for medical care and require creative discharge planning. Care coordinators should work towards assisting these patients in finding health care coverage when possible to minimize the financial impact on the patient and the healthcare system, and if possible gain placement in an extended care facility if still needed.

We recommend that hospital systems, when able, consolidate the care for medially stable patients requiring IV antibiotics whose care needs or high risk social situation are unsafe for discharge home into an extended care facility or nursing ward with reduced overhead cost. This will improve the financial burden on the hospital system and the patient. In addition, for patients with limited financial resources and no insurance, charitable or reduced cost care should be considered. Hospital systems can develop a metric to identify qualified patients and provide care and medications at a lower rate. Because charitable care is often assumed in some of this patient population because of an inability to pay high medical bills, it makes sense to reduce the financial burden on the patient as well.

Another potential option for hospital systems that do not have a charity system or associated subacute care facility or home health system would be to contract with private organizations to create a streamlined process of discharging patients to more appropriate levels of care while minimizing the cost to both facilities.

The main limitation of this study is that the data and financial figures are theoretical data from a single institution. Lack of described comorbidities is another limitation, however for simplicity of the model, osteomyelitis without systemic manifestations was described. Furthermore, while this case was described as 6 weeks of antibiotic treatment post-discharge, it does not take into account the inpatient care that precedes this decision, which will vary by patient. Finally, not all patients with osteomyelitis will require a full 6 weeks of parenteral antibiotics, and may be treated with oral antibiotic therapy, allowing for earlier discharge from an acute care setting. A directed effort to identify causative pathogens with the goal of narrowing antibiotic coverage should always be encouraged and cultures should be obtained prior to the initiation of antibiotics in stable patients whenever possible.

In spite of these limitations, the data presented here are applicable to current practice, as cost savings are exemplified in this simplified scenario. This study also serves as a model for a future prospective analysis using patient information and billing data, and may be used by hospital systems to understand the financial impact of our recommendations or other attempts to safely reduce cost.

In conclusion, inpatient care is unsurprisingly the most expensive of all care settings, with a 6 week cost of over \$50,000. Cost to the patient may be reduced by nearly half when patients are placed into extended care facilities, and quartered if they are candidates for home care and home infusion. Because of costs and morbidities associated with prolonged antibiotic therapy, physicians should confirm osteomyelitis and obtain sufficient cultures via bone biopsy prior to initiation of antibiotic care in stable patients. Safe options to shorten the duration of parenteral therapy or use of oral therapy should be discussed with infectious disease colleagues. Social workers, hospital administrators, and healthcare providers should strive to place these patients into the lowest-cost setting when possible. It may be in an institution's interest to open a hospital ward or make arrangements with extended care facilities with lower overhead. Because charges billed to an uninsured patient with limited financial resources are less likely to be paid, institutions should develop criteria for identifying patients who can receive medications or other care at a reduced rate to reduce the burden on those patients.

**Acknowledgements:** Research reported in this publication was supported by the Washington University Institute of Clinical and Translational Sciences grant UL1 TR000448 from the National Center for Advancing Translational Sciences (NCATS) of the National Institutes of Health (NIH) and the Children's Discovery Institute. The content is the sole responsibility of the authors and does not necessarily represent an official view of the NIH.

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