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Pharmacoeconomic Considerations in the Ambulatory Use of Parenteral Cephalosporins

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Abstract

It has been clearly documented that outpatient parenteral antibiotic therapy (OPAT) saves money compared with hospital care for patients who need intravenous antimicrobial therapy. The reduced expenses come primarily from savings in facility and hospital staffing costs. In addition to shortening hospital stay, OPAT programmes can be developed so that hospital care is avoided altogether. However, even with the clear potential for savings, to have a successful programme it is necessary to align the interests of the payers, the physicians, the administrators and the patients.

The cost of OPAT programmes can also be reduced through patient evaluation and careful selection of the appropriate delivery model, antibiotic, dosage intervals and infusion technology. The fact that antibiotics such as ceftriaxone, the aminoglycosides and vancomycin can be given once daily in the elderly offers particular advantages in terms of convenience as well as cost.

In order to achieve cost savings, managed care will increasingly rely on home and outpatient therapy. This pressure will need to be counterbalanced by quality assurance programmes and outcomes measurements.

Since it was first described in the literature in 1974,[1] outpatient parenteral antibiotic therapy (OPAT) has grown rapidly. It is estimated that, in the US, more than 250 000 courses of therapy are provided each year, at a cost of more than $US1.5 billion. The use of OPAT continues to grow at a rate of 15 to 20% per year, and is expected to do so for the next few years.[2] The primary reason for the expansion of this form of therapy is economic, although it brings many other benefits to patients.

Pharmacoeconomic considerations regarding OPAT are multiple, varied, and depend on the perspective being examined. While it is clearly documented that it can be less costly to provide intravenous therapy outside the hospital than inside, there may not be incentives for everyone to do so. The hospital, the payer, the physician, the provider and the patient each have their particular perspective, which may or may not be aligned or oriented to outpatient care.[3] For example, in a system that pays hospitals according to the number of occupied bed days, the hospital and their employees may feel threatened by OPAT. In a system such as in China, where the charge for a hospital bed day is the equivalent of one US dollar, there may be little financial incentive for outpatient care. An additional consideration is that the living conditions of some patients may be inadequate or unsafe.

This discussion of economic issues relating to OPAT considers the cost of hospital care compared

with outpatient care for patients who need parenteral antibiotic therapy. In addition, important decisions regarding OPAT, which affect the cost as well as the quality of patient care, are reviewed.

1. OPAT Programmes versus Hospitalisation

Numerous articles have documented cost savings with OPAT compared with hospital therapy with intravenous antibiotics. Most of these articles examined the direct costs of providing care in one environment compared with another.[4]

Table I provides a list of studies documenting the potential for cost savings resulting from OPAT programmes in the US.[5-17] These studies generally reported the actual costs, which vary considerably, and depend on the year studied as well as the location of the programme. There appears to be a trend, however, to greater cost savings with time. Some of the studies went beyond the assessment of direct cost savings to consider indirect economic benefits in areas such as employment and living expenses.[9] Hindes and colleagues studied the financial benefits to the hospital of an early discharge programme for Medicare patients.[17]

From the standpoint of the insurance company or payer in the US, the usual charge for a day of intravenous antibiotic treatment in hospital is approximately $US1000. Estimates range from $US700 to $US1200 per day for a standard room. OPAT charges vary from $US200 to $US300, although even these numbers are falling because of competition.[18,19]

While the studies of actual costs are relevant to capitated or integrated healthcare delivery systems, the information on charges for hospital *vs* OPAT therapy more reasonably reflect the potential for cost savings in a fee-for-service or contracting situation. From an insurance company standpoint, the cost savings could well be more than $US500 daily. From a patient standpoint there may be no savings, but the ability to return to work to maintain an income may be critical in supporting the family.

1.1 Pharmacoeconomic Considerations Relating to OPAT

To best understand the pharmacoeconomic considerations relating to OPAT, multiple factors must be examined. These are outlined in table II. Some of the high costs of hospital care result from the cost of constructing and maintaining the building and facilities. However, the cost of maintaining the professional and support staff required for the

Table I. Estimated cost savings of OPAT programmes in the US

Study	No. of cases	Primary infections	Primary antibiotics	Duration of OPAT (days)	Savings per day ($US)
Antoniskis et al.[5]	13	Osteomyelitis, bacteraemia, endocarditis	Various	22	165
Poretz et al.[6]	150	Osteomyelitis	Various	20	>142
Rehm and Weinstein[7]	38	Bone, joint and soft tissue	Cefazolin and others	19	305
Eron[8]	500	Osteomyelitis, wound infections	Cefazolin, ceftriaxone, others		160
Poretz et al.[9]	83	Osteomyelitis, soft tissue	Ceftriaxone	18	>150
Kind et al.[10]	315	Bone, joint, skin and soft tissue	Various		350
Manzella et al.[11]	45	Osteomyelitis	Nafcillin, cefazolin, others		162
Graves et al.[12]	37	Osteomyelitis, wound infections	Various	23	202
Harris et al.[13]	23	Various	Various		222
Kane et al.[14]	27	Cystic fibrosis	Aminoglycosides + ticarcillin or piperacillin	10.2	609
Williams et al.[15]	56	Cellulitis, osteomyelitis	Ceftriaxone	5.1	262
Tice[16]	538	Osteomyelitis, soft tissue	Ceftriaxone	18.6	>300
Hindes et al.[17]	48	Osteomyelitis, endocarditis	Various	22	276

OPAT = outpatient parenteral antibiotic therapy.

Table II. Cost considerations for intravenous antibiotic therapy. This table lists the cost factors in providing intravenous antibiotic therapy with designation of which costs are greater for hospitals or outpatient care

	Greatest cost		
	hospital	same	outpatient
Direct costs			
Facilities, maintenance	X		
Staff/nursing, other	X		
Food and clothing	X		
Physician visits	X		
Communication systems			X
Antibiotics		X	
Equipment and supplies		X	
Laboratory testing		X	
Indirect costs			
Lost productivity	X		
Social support	X		
Adverse effects		X	
Secondary infections	X		

nursing, food, and clothing of the patients may be even greater.

The only aspect of patient care associated with higher costs for OPAT than for inhospital therapy is the need for rapid and sophisticated communication systems, such as fax machines, pagers and cellular phones. Although there may be some variations between OPAT and inhospital therapy in the costs for antibiotics, equipment, supplies and laboratory testing, these are usually small. It is obvious that antibiotic costs represent a far greater percentage of the overall cost for OPAT than for hospital care. In addition to direct expenses, there are indirect costs to consider. These include costs relating to the patient's productivity at home, and are often overlooked.

If patients can be treated outside the hospital, it is usually possible for them to return to work or school.[19] Patients may be productive and gainfully employed despite receiving intravenous therapy. Time out of work also seems to be less if patients are not hospitalised.[20] Additionally, the cost of social support may be less if patients remain at home, where family members can provide care.

Another economic benefit resulting from OPAT is the reduction in the cost of nosocomial infections, since outpatient care may reduce expenses as well as morbidity and mortality. Approximately 5% of hospitalised patients develop an infection during their confinement,[21] and the frequency of nosocomial infection increases with each day of hospital stay. Each infection is estimated to cost $US2100, with a total cumulative cost of more than $US2 billion each year to the US healthcare system. It is also important to consider the cost of multidrug-resistant organisms, which are becoming increasingly prevalent and are a more frequent problem in hospitalised patients than in the community. The full impact of the morbidity and mortality associated with nosocomial infections is beyond the scope of economic analyses.

Other indirect costs to consider include those resulting from the adverse effects of antibiotics or therapy. These are similar for the hospital and outpatient settings. There is also the cost of treatment failure to consider. If an infection is not eradicated, re-treatment involves considerable cost. This would probably be similar for inpatient and outpatient therapy if the same antibiotic were used; however, superinfections are probably more frequent in the hospital and hospital costs would be higher if a nosocomial infection were caused by a multidrug-resistant organism.

From the perspective of a hospital administrator, OPAT may be of benefit if there is a fixed payment for the care of all patients served regardless of the site of service. On the other hand, if the hospital is paid by the number of occupied bed days and receives no additional money for OPAT, outpatient care may be discouraged. OPAT may also be discouraged in a capitated system if beds are full or overflowing, since the vacated bed would be promptly filled and the cost of parenteral antibiotic therapy for outpatients would be added to the financial burden of the hospital.[22] In most countries, there is a request for additional monies for OPAT rather than a reallocation of hospital monies for home care. Incentives for OPAT vary considerably between different countries.[23]

2. Additional Economic Considerations

There are economic considerations in addition to the comparisons of costs of hospital and outpatient care for patients needing intravenous antibiotic therapy. If a decision to use OPAT is made, decisions affecting cost, such as the model of delivery, the antibiotic to be used and the dosage interval, are required. Table III outlines some of the options that have significant cost implications. These factors can make OPAT programmes even less expensive and, in the US, more competitive.

2.1 Avoiding Hospital Admission

While most studies of OPAT focus on the economic benefits of shortening hospital stays through early discharge, another option should be considered. Many patients can receive OPAT without being hospitalised at all. Admission procedures are often the most laborious and costly part of hospital care and commonly lead to at least a 2-day stay. In our practice, more than half the patients we treat with OPAT are never admitted to the hospital.[24] The money saved by avoiding a day or two in the hospital is often more than is needed for an entire course of OPAT.

2.2 Delivery Model for OPAT

The choice of a delivery model for OPAT is also important in determining the cost of therapy.[24] The visiting nurse model offers significant advantages in terms of inspection of the home and supervised administration, but the expense of the home nurse visit may be prohibitive compared with the costs of other models. In the US, charges for a nurse visit to the home average $US90 to $US100.

The infusion centre model is one in which the infusions or injections are provided in a clinic or a practitioner's office. It is less costly with regard to nurse travel and delivery time, but an infusion facility must also be maintained for patient care.

The self-administration model offers the advantages of low facility costs as well as reduced staffing, since the patient or family do most of the work in the home. However, the self-administration model requires additional staff time for patient training, and there may be a greater reliance on expensive infusion devices.

In any delivery model, the value of the team of physician, nurse and pharmacist should not be overlooked. Their ability to design and coordinate the best treatment programme is essential in limiting costs and assuring quality.[25]

Table III. Economic decisions in outpatient parenteral antibiotic therapy

Decision	Options	Considerations
Hospitalisation	Early discharge	
	Avoid	
Delivery model	Visiting nurse	Cost of nurse time and travel
	Infusion centre	Facility cost
	Self-administration	Patient training
Antibiotic	Selection	Safety, tolerability, effectiveness
	Use	Once daily ideal
Technology	Vascular access	Restarts costly
	Infusion devices	Expense of purchase or rental

2.3 Antibiotic Selection and Use

The price of the antibiotic is a small percentage of the overall healthcare costs for treating patients with infections in the hospital, but it represents a significant part of such costs in the outpatient setting. In addition to the cost of the antibiotic itself, there are other factors relating to antibiotic use in OPAT that have economic implications and need to be considered. In all 3 delivery models, antibiotics that can be given infrequently have advantages. In each situation, the less often a medication is administered, the less equipment is necessary, the less staff time is needed and the less trouble and interference there are in the patient's life.

There is a particular advantage associated with parenteral antibiotics that can be given once daily, such as ceftriaxone and the aminoglycosides.[26] Vancomycin may also be given once daily or even less frequently in the elderly, as there is a gradual deterioration in renal function with aging. Some new drugs may be given even less often; teicoplanin has, for example, been given 3 times weekly

for osteomyelitis.[27] A new antiviral, cidofovir, needs to be given only every other week for suppression of cytomegalovirus infections.[28] Other antibiotics, such as penicillin, cephalosporins and clindamycin, should be given more frequently, which presents additional obstacles.

If a patient needs to self-administer a drug more frequently than every 8 hours, a significant disruption of sleep and daily routine results. In such situations, an infusion device such as a computer-operated, battery-driven pump may be of benefit. A pump can provide antibiotics in any dosage schedule required,[29] from continuous infusion to once daily. However, the added expense of infusion devices may not justify their advantages.

Several studies have examined the costs of delivery and the actual drug costs for antibiotics with different half-lives. Grizzard and colleagues found that ceftriaxone was slightly less expensive than cefazolin or ceftazidime to provide in the hospital but much less expensive to provide at home or in a clinic setting.[30] A more recent study by Hitt et al. suggested that ceftriaxone was less costly to provide than a continuous infusion of cefotaxime for the first few days of therapy but not thereafter. The latter study assumed that the treatment programme had expertise in continuous infusion techniques and could obtain and use infusion pumps at no cost.[31]

Another economic consideration in the selection of an antibiotic relates to vascular access. With drugs that can be given once daily, vascular access is of less concern. If an infusion centre or a visiting nurse model is used, the line can be checked daily and restarted if need be. It is also possible to give intravenous infusions once daily and remove the needle between doses – or to simply give intramuscular injections.

For antibiotics that must be given more than once daily or for those that cause phlebitis, such as vancomycin and oxacillin, a longer-lasting central line may be needed, at significant added expense. Most cephalosporins and the aminoglycosides cause little phlebitis and may be given through a peripheral line for prolonged periods.

3. Managed Care

The changes managed care is bringing to medicine include economic constraints as well as accountability.[32] Outpatient care is very attractive to managed-care administrators, since it can clearly save money. However, even though it is associated with tremendous cost savings compared with hospital care, there is growing pressure in the US to ratchet down the costs of OPAT as well.

The competitive bidding that has accompanied the evolution of managed-care systems has reduced the training requirements for nurses providing home care and discouraged physicians from participating in management and supervision. How low prices can go without the quality of care being compromised is uncertain.

There have been few studies of the quality of outpatient care or methods designed to measure the impact of cost cutting. One study of children with cystic fibrosis and an acute lung infection found they did as well with OPAT as with hospitalisation.[33] Information regarding community-acquired pneumonia suggests a comparable quality of care at home and an earlier return to work.[20] An Australian study that randomised elderly patients to hospital or home care found complications to be greater in the hospital.[34] There are not, however, good measures for determining to what extent costs can be cut back without sacrificing quality.

It is important to recognise that, with OPAT, the quality of care for serious infections should be comparable to that in the hospital. Otherwise, it would be difficult to justify discharging patients. Physicians are liable for their discharge.[35] The cost of legal services and patient compensation for bad outcomes will not be discussed further, but may also be a significant economic consideration.

The impact of managed-care pressures on OPAT is only now becoming evident, and must be approached cautiously.[32] With some of the cost-cutting pressures, it may be possible to develop a more efficient programme with a focused and efficient team effort.[25] It may also be possible to develop better quality assurance.[36] Hopefully, pressure to contain costs and assure quality will

lead to better team efforts and ensure the appropriate use of drugs and close follow-up of patients.

Some programmes have taken on financial risk through bundling of services. Risk-sharing contracts can be developed, and can include a portion or all of the components of OPAT care – such as the intravenous tubing, mixing of medications, the antibiotic, laboratory studies, nursing care and even the physician's visits.[37] To capitate OPAT care on a per member per month basis represents a significant risk; the incentives may greatly increase the number and percentage of patients treated with OPAT. A flat rate per diem is safer.

4. Conclusions

The pharmacoeconomic considerations relating to OPAT are complex. While there appears to be no question that the cost of intravenous antibiotic therapy can generally be reduced by treatment outside the hospital, a number of factors must be examined. It is important to consider the perspectives of the payer, the hospital, the provider and the patient. Each should have incentives to encourage OPAT.

In addition to comparisons of the direct and indirect economic benefits of OPAT and inhospital therapy, there are other important decisions to be made. Decisions on the selection of the delivery model, the antibiotic, vascular access and infusion devices can also affect the cost of outpatient care. Although managed care will encourage the growth of OPAT in developed countries, it must be moderated by ongoing studies of quality assurance.

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