Outpatient parenteral antibiotic therapy (OPAT) in the United States: Delivery models and indications for use

Alan D Tice MD FACP

The use of intravenous (IV) antibiotic therapy outside hospitals was first reported in the literature in the United States in 1974 (1). What started out with a few children treated with outpatient parenteral antimicrobial therapy (OPAT) for recurrent episodes of pneumonia related to cystic fibrosis grew rapidly to the point where now at least 250,000 patients are treated with OPAT each year in the United States (2). This growth has been brought about by a variety of factors including cost savings, improved technology, long acting antibiotics, patient preference and the leadership of health care professionals. Each community has developed its own systems for providing OPAT, with a variety of providers as well as delivery models. The success of OPAT continues, with a growth rate of 15% to 20% each year, which will likely continue into the near future (2).

OPAT ORGANIZATION MODELS

The organizational structures for OPAT programs in the United States vary considerably (2,4). The predominant infusion provider types in the United States are commercial home infusion companies, which may be local or national. They generally evolve from a pharmacy or a pharmacy-based model and employ nurses. A few OPAT programs have developed from visiting nurse services. Many physicians or physician groups have developed their own programs to treat their own patients in their office or clinic. Often an infectious diseases specialist is in charge of the program to manage patients on OPAT similar to the way an oncologist manages outpatient cancer chemotherapy patients. A growing number of hospitals have developed their own OPAT programs so that they can continue to provide care for the patients previously treated as inpatients. This trend will likely continue if hospitals are to remain the focal point of medical care in communities. No matter what the organizational structure, the most effective and successful OPAT programs function with the combined input from physicians, nurses and pharmacists who must be able to communicate rapidly and function as a team (5).

DELIVERY MODELS FOR OPAT

There are three basic models for delivery of OPAT: the visiting nurse model; the infusion centre model; and the self-administration model. Table 1 outlines the different models, and lists the advantages and disadvantages of each (6). The visiting nurse model involves a nurse going to the home to administer the medication. It is appropriate when there is a well-developed home care nursing service and the nurses are trained in intravenous therapies. This model allows the nurse to evaluate the home environment, which may be quite revealing in regards to social and drug or alcohol abuse problems. It is convenient for the patient, but it may be costly, depending on the time that it takes for the nurse to visit the home and travel between residences. The infusion centre model requires

Infections Limited PS, Tacoma, Washington, USA
Correspondence and reprints: Dr Alan D Tice, Infections Limited PS, 240 Stadium Way South, Tacoma, Washington 98402 USA.
Telephone 253-274-0833, fax 253-274-0877, e-mail alantice@idlinks.com

TABLE 1
OPAT delivery models

Model	Advantages	Disadvantages
Visiting nurse	Opportunity for home inspection; supervised administration; convenience to patient	Cost of nurse time and travel, privacy; safety of nurse
Infusion centre	Medical staff available; access to medications and devices; physician available; supervised administration	Cost of facility; patients must travel to clinic
Self-administration	Reduced staff cost; reduced facility cost; patient autonomy	Patient/caregiver training; unsupervised administration; compliance
Skilled nursing facility	Nursing staff always present; supervised administration	Cost of facility; cost of staff

the patient to travel to a facility to receive their medication. An infusion centre can be established in a hospital clinic, a doctor's office, an emergency department or can even be freestanding (4,7). It offers the advantage of ready access to medicines, medical equipment, and nursing and pharmacy personnel should a problem arise or a change in therapy is needed. In addition, a physician is usually available for immediate evaluation and decision-making as well as routine patient follow-up. This model is less costly because it saves nursing time, but it can be inconvenient or difficult for the patient to travel to the centre daily. The cost of maintaining a facility must also be considered. The self-administration model involves training the patient or caregiver to administer the medication to themselves at home. A variety of options are available for self-administration, from gravity drip bags to computer-operated, battery-powered pumps that allow individual tailoring of the dosing intervals to match the needs of each patient. This model reduces personnel costs as well as facility expenses, but it requires administrative support and more time for education of the patient and their family. There are special challenges involved with self-administration; patients and their caregivers are asked to take an active role in their care and to use sophisticated infusion devices even though they may have little training or knowledge of medicine (7). Generally, patients do well and can help more in self-care than they are given credit for.

It is also possible to provide IV therapy in a skilled nursing facility, which may have nearly the same level of nursing skills as the hospital at less expense. A nursing home may be particularly helpful for a patient with drug or alcohol problems, senility, or an inadequate home situation. The choice of delivery model for OPAT also depends on the experience and resources available. If the organization base is a visiting nurse service, OPAT would likely be provided in the home. If the base is a hospital clinic or a physician's office/clinic, it may be more reasonable to begin with an infusion centre model by converting an examination room into an infusion room or using an empty hospital bed. With time and sufficient volume, the infusion centre can be expanded to provide for training in self-administration. With any of the models, an infusion centre can be developed to provide expertise in the use of vascular access and infusion devices (8,9).

A fully developed OPAT program should be able to provide any delivery model and be able to switch from one to the other depending on need. For example, a patient may initially need to be seen daily in the office for evaluation or dressing changes of a wound infection; then they can be converted to a self-administration model when they are stable and a prolonged course of IV therapy is needed. For some people, the infusion centre model is preferred because of their fear of modern technology and the reassurance that they feel in coming to see the medical staff at an office or clinic daily.

The antibiotic to be used may also affect which delivery model is used. If an antibiotic is to be dosed more often than every 8 h, the most reasonable model is self-administration using a gravity system or, ideally, a multi-dose pump that can administer the antimicrobial automatically during sleep. If the drug needs to be given bid or tid, the visiting nurse and infusion centre model are possible, but more difficult and depend on the hours that the clinic is open. Fortunately, most infections can be treated with an antimicrobial that can be given once daily (10,11). In the United States, this includes ceftriaxone (12-14), the aminoglycosides (15,16), azithromycin (17), doxycycline (18) and some of the newer quinolone antibiotics (15,19). In the elderly, there is a decline in renal function such that vancomycin should also probably be given once daily (20,22). Amphotericin B and IV pentamidine may also be given on an outpatient basis, but usually the infusion centre model is used because of their toxicity (23,24). Amphotericin B is commonly given in the author's practice on Monday, Wednesday and Friday, with laboratory studies drawn before the infusion is started and results reported urgently. It is also possible to use ganciclovir or foscarnet to treat or suppress cytomegalovirus infections with once daily dosing (25,26) or to use cidofovir, which needs to be given only every other week (27,28).

In the United States, the choice of infusion provider and delivery model also depends on the payer. There, Medicare, the government health insurance program for the elderly, does not pay for OPAT unless it is provided by a doctor or under a doctor's direct supervision in the office, or in a hospital-based outpatient clinic. Some private insurance companies may refuse to pay for infusion pumps or provide such a low reimbursement that only an infusion centre model is possible. Private insurance companies also have exclusive contracts with specified home infusion providers.

INFECTIONS TO BE TREATED

The infections that lend themselves to OPAT vary greatly. Initially, the infections treated were those that recurred often, such as those associated with cystic fibrosis (1), or those that required a prolonged course of therapy, such as osteomyelitis

TABLE 2
Infections treated with outpatient parenteral antibiotic therapy

Stiver et al (Winnipeg – 1982) (35)		Williams Minneapolis, Minnesota–1995) (36)		Tice (Tacoma, Washington – 1996) (37)	
Infection	**Cases**	**Infection**	**Cases**	**Infection**	**Cases**
Osteomyelitis/ septic arthritis	45	Cellulitis	156	Skin and soft tissue	270
Endocarditis	14	Osteomyelitis	132	Osteomyelitis	14
Pneumonia	10	Lyme disease (late stage)	102	Septic arthritis	51
Bacteremia	9	Pyelonephritis	89	Pelvic infection	28
Blastomycosis	6	Septic arthritis	68	Extranodular tissue	26
Actinomycosis	2			Respiratory	20
Soft tissue	9			Endocarditis	18
Total	95		547		527

TABLE 3
Infections amenable to outpatient parenteral antibiotic therapy

Infections	References
Hospitalize first	
Meningitis	41,42,43
Endocarditis	30,39,44-47
Suspected sepsis	41,48
Acute infections	
Cellulitis	49-52
Wound infections	36,38,53,54
Pneumonia	31,32,36,40,55-57
Pyelonephritis	32,38,58,59
Chronic infections	
Osteomyelitis	29,47,60–63
Diabetic foot infections	64,65
Sinusitis	36,59,61,66
HIV-related infection	
Cytomegolovirus	24,38,63,67–69
Pneumocystis carinii	70,71
Chronic fungal infections	60,62,68

TABLE 4
Delivery models used by Outpatient Intravenous Infusion Therapy Association centres

Model		Delivery method	
Self-administration	53%	Gravity	31%
Infusion centre	32%	Syringe pump	23%
Visiting nurse	16%		
		Computer pump, Elastomeric pump	22% 10%
		Intravenous push	10%

Information gathered from 19 centres that participated in the OPIVITA registry. They describe the primary delivery model used to treat patients during 1070 courses of therapy during 1997 and 1998

TABLE 5
Infections treated at Outpatient Intravenous Infusion Therapy Association centres

Infections	Percentage
Soft tissue	24
Bone and joint	20
Postoperative wound	9
Septicemia	5
Endocarditis	2

Information gathered from 19 centres that provided 1070 courses of therapy over one year

(29), endocarditis (30) or HIV-related cytomegalovirus retinitis (24). These patients were usually hospitalized, stabilized and then discharged early. With time and experience, however, other infections have been treated with early discharge even though their course of therapy may be a week or less. There is also a growing tendency to treat acute infections without hospitalization. This has been possible for pneumonia (31), pyelonephritis (32), and skin and soft tissue infections (33,34).

Table 2 illustrates the variety of infections that have been treated with OPAT by series from Winnipeg, Minneapolis and Tacoma, Washington (35-37). These numbers reflect the ability to treat a wide variety of infections and the transition that has occurred over time to include acute as well as chronic infections. There are an increasing number of reports on the use of OPAT for specific diseases. A list of diseases with references is displayed in Table 3. It now appears that there is no contraindication to OPAT by infection, although patients may need to be hospitalized for other reasons, such as the control of diabetes, heart disease, wound care, social problems or the need for surgery. Patients with infections such as meningitis, endocarditis and possible sepsis should be hospitalized initially. Even those infections may be treated with OPAT for the last part of IV therapy if they respond promptly and patients are stable (38). Some physicians even routinely treat endocarditis patients without initial hospitalization (39).

REGISTRY OF OPAT PATIENTS

Information has been collected from OPAT programs in North America. The first data comes from a network of physician-directed OPAT centres that provided information about their patients through a registry organized by the Outpatient Intravenous Infusion Therapy Association (OPIVITA). Nineteen centres across the country provided information during 1997 and 1998. The delivery models used at the centres

TABLE 6
Sample of patients managed by Infections Limited, Tacoma, Washington, USA (weekend in July 1998)

Infections			
Hosptial (39 patients)		**Clinic (41 patients)**	
Infection	**Patients**	**Infection**	**Patients**
Respiratory	6	Osteomyelitis	9
Osteomyelitis	6	Soft tissue	7
Wound	5	Septic arthritis	6
Bacteremia	5	Endocarditis	5
Abdominal	4	Cellulitis	3
Fever and neutropenia	4	Postoperative wound	3
Postoperative wound	3	Respiratory	2
Cellulitis	3	Other	6
Other	6		
Total	39	Total	41

Sample of patients being managed by Infections Limited on intravenous antimicrobial therapy. The sample was taken during a weekend in July 1998

are presented in Table 4. There was considerable variation among centres, some of which provided exclusively the infusion centre model. The types of infection treated at the centres are presented in Table 5. Again, there was considerable variation among the centres but a relative frequency of infections treated are comparable with the series reported in Table 2.

Infections Limited is an independent, private infectious diseases unit in Tacoma, Washington. The six infectious diseases specialists there provide the majority of infectious diseases care for the community of 500,000 people through both hospital and office care. The OPAT program was started in 1981 with now over 500 patients treated each year through the clinic (37,40). The clinic provides all three delivery models for OPAT and works with several skilled nursing facilities. The most frequently used delivery model is self-administration followed by the infusion centre model, with only a few nursing visits to the home (37). The Infections Limited program has made a transition from initially hospitalizing all patients before beginning OPAT to starting two-thirds of patients directly on OPAT when referrals are made. The Infections Limited OPAT program has developed to the point where the IV antibiotic therapy is usually provided for more outpatients than inpatients. A representative sample of the infections treated by our group in the hospital compared with the clinic is shown in Table 6. Of significance is the relative frequency of osteomyelitis and HIV-related infections treated in our outpatient program.

CONCLUSIONS

The types of OPAT programs that have evolved in the United States vary considerably. They are different in terms of organizational structure as well as the models used for delivery. This diversity results from the unique characteristics and interests of each community. In addition, these programs will continue to evolve and respond to the needs and leadership of each community. The infections treated vary with the programs, but there are no contradictions by infection. OPAT continues to provide an opportunity to improve patient care and reduce the cost of care for serious infections.

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