
Antimicrobial practice

Ambulatory antimicrobial use: the value of an outcomes registry

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The opportunity for treating many serious infections in the community or ambulatory setting is growing. Outpatient parenteral antimicrobial therapy (OPAT) provides many potential advantages to the patient, hospital and clinician, including quality of life, cost savings and reduced risk of hospital-acquired infections due to antibiotic-resistant organisms. However, despite the evolution of this type of care in many countries, there have been continued questions and concerns about its safety and effectiveness. As with many new forms of therapy in medicine, the value of OPAT is in doubt because of the lack of published information concerning outcomes and its impact on patient care. In order to examine the quality of such programmes, an outcome-based registry of patients has been developed for OPAT. The core outcomes measures include clinical effectiveness, eradication of bacteria and adverse antibiotic events. The registry may also be adapted for benchmarking for quality assurance, surveying performance of new antimicrobials, cost effectiveness studies and comparisons of different antibiotics and their side effects.

Introduction

Present healthcare systems are in turmoil related to the introduction of new products and services and their consequences, financial and otherwise. This has brought pressure to evaluate these advances for quality, defined by Donebadian as 'the extent to which care provided is expected to achieve the most favorable balance of risk and benefit'.¹

The area of infectious diseases lends itself well to the study of outcomes, with well-defined diseases and usually curative therapies. There are, however, growing concerns about the overuse of antimicrobials and resulting resistance in microbes. In response, the United Kingdom Antimicrobial Resistance Strategy and Action Plan has set a goal 'to improve the correlation of data on patterns of antimicrobial use, antimicrobial resistant organisms, and the illness due to them'.² The new European health strategy^{3,4} echoes this concern and calls for networks and data collection systems to analyse information for best practices and guidelines to disseminate to providers.

The current evidence-based approach to understanding the treatment of infectious diseases has been helpful, but is

limited in that the 'evidence' is often based on outdated, industry-sponsored articles and the personal perspectives of the authors. The consequences are obvious with the proliferation of practice guidelines that rarely have the same recommendations.

The use of outpatient parenteral antimicrobial therapy (OPAT) was first described in 1974,⁵ yet it is new for many healthcare systems. Its use has grown rapidly in the USA because of cost savings. It is estimated that >250 000 Americans receive OPAT each year.⁶ It is common in China, and is evolving in South America and Europe⁷ as well.

OPAT has become a part of routine recommendations and practice guidelines for many infections, including community-acquired pneumonia and meningitis.^{8–12} It is likely to increase further because of its potential to save the cost of hospital care and improve the allocation of limited healthcare resources.

Many comparative studies of inpatient versus outpatient care have been carried out with regard to economic issues,^{13–15} with a consistent cost saving from outpatient care found when the services provided are similar. The article

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by Board *et al.*¹⁶ is particularly revealing, with cost comparisons of randomized patients. The studies of patient care outcomes that have been carried out have demonstrated good outcomes. In the USA it would no longer be acceptable to randomize patients to inpatient versus outpatient therapy, as the insurance companies would not pay for hospital care, which is estimated to be three or four times more expensive. Randomized comparisons of hospitalized patients with outpatients are also difficult because of different levels of acuity and complexity of care as well as the social or economic issues that often dictate admissions.

From a microbiology perspective, there are also increasing concerns about the percentage of patients with hospital-acquired infection. This is estimated to be 5% of admissions in the USA and to have a prevalence of 9% of hospitalized patients in the UK.¹⁷⁻¹⁹ Each infection is estimated to add more than \$2500 to the cost of care in the USA. The rate of infection in outpatient care seems considerably lower.²⁰ In addition to the risk of nosocomial infections, there is a growing concern about organisms that are increasingly resistant to antibiotics, which seems to be a particular issue in hospitals where the most potent antibiotics are used.²¹⁻²³

With the theoretical advantages and increasing use of OPAT, it is critical that its safety and effectiveness be evaluated and that standards are established to measure outcomes and discover its limitations.^{14,24} Practice guidelines have been written for OPAT in several countries, but need to be updated continually to meet the changing needs and advances.²⁵⁻²⁷ There need to be methods of measuring the risks and benefits of outpatient therapies as people look 'outside the box' of the hospital for solutions to many of today's healthcare problems.

The OPAT Outcomes Registry

A registry of patients receiving OPAT was started through the OutPatient IntraVenous Infusion Therapy Association (OPIVITA). The organization has now become part of the Infectious Diseases Society of America, but the OPAT Outcomes Registry, created by OPIVITA, has continued independently. It now contains information from 24 contributing sites in the USA on >8000 patients who have received >11 000 antibiotic courses. Funding has come from the residual OPIVITA fund, pharmaceutical company grants and the voluntary work of the contributing centres.

The OPAT Outcomes Registry provides information about the infections being treated commonly (Figure), the pathogens found and the primary antibiotics used. Additional information is available on the OPAT website (<http://www.opat.com>). It also provides information for sites to compare their own programme over time and to benchmark themselves and their experience with the aggregate of the other sites.

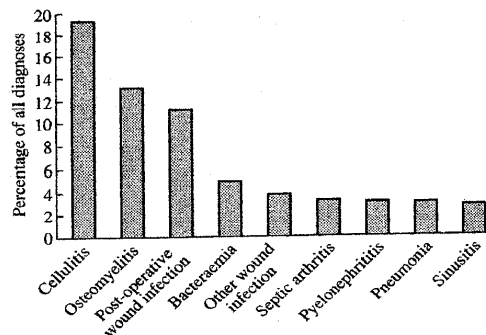


Figure. Top 10 infections treated in the OPAT Outcomes Registry of 24 sites in the USA from 1997 to 2000.

Outcomes indicators have also been developed for patients treated with OPAT. These include measures of clinical and bacterial outcome, as well as programme success or failure. Adverse effects sufficient to stop therapy are also recorded (Table 1).^{14,24}

OPAT turns out to be a good area to investigate the treatment of infectious diseases as the patients are less complex than those in the hospital, yet the treatments are the same and may have serious adverse effects.²⁸⁻³⁰

Studies of OPAT risks and benefits are particularly important from a safety standpoint as serious infections are being treated in a new environment without the safeguards and supervision of the hospital environment. They may also involve new technology and social issues that are not well understood. Using the outcome indicators of Table 1, outcomes can be assessed with findings as indicated in Table 2. This information can also be used to compare centres with the aggregate and to track changes over time.

Because of confidentiality issues, information collected at the various sites is stripped of any specific patient identities before it is entered into the central database.

The International OPAT Outcomes Registry

After developing the OPAT Outcomes Registry in the USA, funding was received for an International Registry. Over the last 3 years, 1141 cases have been entered from the UK (three sites), Italy (six sites) and Canada (three sites). This information can be used for sites to compare with aggregate data from their own country or from the entire registry database.

Some interesting comparisons include the diagnoses treated, antibiotics used for OPAT, sites of care and administration routes (Table 3). As is demonstrated, osteomyelitis and soft tissue infections are the commonly treated

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Table 1. Outcome measurements for OPAT²⁴

Outcome measure	Responses	Subcategories
Bacterial status	culture negative persistent organism new organism	
Clinical status as reported by physician	improved failed no change	
Physician expectations	met did not meet	
Programme outcome	completed did not complete	died non-compliance complication patient preference hospitalization
Antibiotic use	completed ended early	adverse drug reaction (type noted) resistant organism persistent organism patient preference clinical failure

Table 2. Outcomes measures from the United States OPAT Outcomes Registry based on 7892 cases and 10 844 courses of antibiotic therapy provided from 1997 to 2001

Clinical outcomes [no. (%)]	
improved	7189 (96.6)
failed	92 (1.2)
no change	153 (2)
Bacterial outcomes [no. (%)]	
no culture	6614 (88.8)
culture negative	666 (8.9)
persistent pathogen	109 (1.5)
new pathogen	60 (0.8)
Programme outcomes [no. (%)]	
completed	7096 (92.2)
ended early	323 (4.1)
hospitalized	275 (3.5)
died	39 (0.5)
Antibiotic outcomes [no. (%)]	
completed	8715 (82.1)
adverse event	492 (4.6)
clinical failure	78 (0.7)
resistant organism	44 (0.4)
Adverse events (<i>n</i> = 593) (%)	
rash	34
nausea/vomiting	12.8
fever	11.4
nephrotoxicity	7

infections in the UK and North America. Ceftriaxone is the most frequently used antibiotic in the UK, Italy and the USA, whereas cefazolin is the primary antibiotic used in the OPAT sites in Canada. The significance of these differences is unclear, but the variations in antibiotic use should provide useful insight into which regimens are most effective and best tolerated. The variations between countries also provide insight into the opportunities to treat new infections and the mechanisms involved in developing treatment regimens.

The Dundee OPAT Outcomes Registry

The OPAT Outcomes Registry can also be used to evaluate and track OPAT on a local basis. It can also be adapted to provide information on issues of local interest, such as economic factors and patient satisfaction. The introduction of such quality indicators for evaluating our local practice in Dundee, Scotland (Table 4) has proved valuable in terms of informing internal quality improvement and service development. We hope that it will be used externally to identify best practices. For example, one of the core economic factors we used was inpatient bed days saved. Our data demonstrate the cost efficiency of the programme in terms of reducing or preventing hospitalization³¹ and illustrated the potential opportunity it provides in terms of resource reallocation. This led to local health managers being convinced to provide investment and funding for the

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Table 3. National comparisons from the International OPAT Outcomes Registry^a

	UK	Italy	Canada	USA
Top diagnoses				
cellulitis	44.8	9.9	22.7	19.3
osteomyelitis	19.1	18.6	15.7	13.1
prosthetic joint infection	7.2	0.5	4	2.2
post-operative wound infection	4.9	1.4	1.6	11.1
septic arthritis	3	5.7	7.9	3.3
bronchitis	0.2	14	20	0.9
pneumonia	0.7	15	0.8	3.1
bacteraemia	1.2	0	0.3	4.9
wound infection—other	3	0	0.9	3.7
Top antibiotics				
ceftriaxone	49.6	36.8	6.6	32.8
teicoplanin	31	18.3	0	0
gentamicin	7.9	0.7	4.4	2.3
meropenem	3.7	0.2	2	0.4
vancomycin	2.5	0.7	7.7	18.8
cefazolin	0.3	0	23.3	5.5
ceftazidime	0	5.7	12.8	3.3
tobramycin	0	0.2	11.9	2.2
amikacin	0	8.7	0.2	0.2
levofloxacin	0	3.2	0.4	1.3
clindamycin	0	0.5	15	3.3
oxacillin	0	0	0	3.3
Antibiotic route				
iv	100	71	100	99.7
im	0	29	0	0.3
Site of care				
infusion centre—hospital	52.6	50.2	9.2	0
home—visiting nurse/doctor	24.2	19	15	7.2
administered by self/family member	19.9	29.5	45.7	60.6
nursing home	2.5	0	0.4	1
infusion centre—clinic	0.5	0.7	0	29.5

^aAll values are percentages.

OPAT programme. In addition, we hope that the development of clinical outcome indicators in infection will provide us with the evidence base and experience to further develop national indicators, which exist in other therapeutic areas of Scotland.³² The development of robust datasets like this outcomes registry underpins this overall process.

Future applications of the Registry

The effectiveness of new anti-infectives can be assessed with the Registry. It would allow the collection of up-to-date information in a standardized format and provide outcome indicators when antibiotics are released for general use. There would not be the time delay found in reporting about new antibiotics through publications. The Registry

can also avoid the possible bias involved in studying the patients selected for Phase II and III trials as it would present data on all patients treated with the selected antibiotics. This would create a means of tracking the antibiotics that are really being used and what they are being used for in the country. It would also allow a continual follow up for adverse effects of new antibiotics that would be timely and give an ongoing mechanism to compare adverse events of new antibiotics with those of old ones.

The information gathered by the OPAT Outcomes Registry can be used for a variety of other purposes as well. The indicators of clinical, bacterial and programme outcomes can be used to evaluate different treatment regimens, and gain insight into the most effective antibiotic dosing, and duration of therapy. This information can be

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Table 4. Quality indicators for infections treated with intravenous antibiotics in the outpatient and home setting between April 1998 and August 2001 in Tayside, Scotland, UK

Infections treated (%) ^a	
skin/soft tissue infections	54.5
osteomyelitis/septic arthritis	22.2
bacterial endocarditis	3.7
others	19.6
Clinical outcomes (%)	
cure	97.2
no change	1.8
worse	1
adverse drug reactions	2.4
unscheduled re-admission	3
PICC ^b complications	1
Microbiological outcomes (%)	
positive culture pre-treatment	20
positive culture post-treatment	0
Economic outcome	
no. patients treated	470
total no. inpatient bed days saved	6693
additional daily cost (£) of OPAT drugs per person	<6
Patient satisfaction (%)	
treatment met or exceeded expectations	98.5
preferred service to inpatient treatment	96.5
would choose this form of treatment again	96.5

^aThese include meningitis, complicated urinary tract infections, MRSA wound infections and bacteraemia, chest infections, cutaneous leishmaniasis, etc.

^bPICC, peripherally inserted central catheter.

presented in an interactive format on the Internet or through pocket PC devices. It will allow an added perspective in antibiotic decision-making with continual updating and a critical mass of data that will provide statistically significant values for analysis with many disease states. This will provide a system that incorporates a true learning process with a real-time, live database.

The Registry data can also be used to monitor antibiotic resistance by collecting microbiology findings at the start and end of therapy. This can provide reflections of the levels of antibiotic resistance in serious infections in the community and identify organisms that develop resistance during therapy.

Conclusion

The OPAT Outcomes Registry provides a means of evaluating the risks and benefits of OPAT. It can also provide information about the use and value of OPAT with potential applications in the understanding of antibiotic

use in serious infections, as well as monitoring safety data. It can be brought to a level of ready access through computer applications and the Internet.

The number of contributing centres and the volume of patient data entered are obviously critical in increasing the value and relevance of the data to patient care. New sites (for further information consult <http://www.opat.com>) and research funding are welcome.

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Received 28 March 2001; returned 11 July 2001; revised 3 September 2001; accepted 8 October 2001