

Outpatient parenteral antimicrobial therapy (OPAT) service is associated with inpatient-bed cost savings

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In a cardiology department, there are some patients that require long-term antibiotics, such as those with infective endocarditis or infected prosthetic devices. We describe our experience with intravenous antibiotic therapy for patients with cardiology diagnoses who require a period of antibiotics in our outpatient service during the period of the COVID-19 pandemic. A total of 15 patients were selected to have outpatient antibiotic therapy (age range 36 to 97 years, 60% male). A total of nine patients had infective endocarditis, four patients had infected valve prosthesis or transcatheter aortic valve implantation (TAVI) endocarditis, one patient had infected pericardial effusion while another had infected pericarditis. For these 15 patients there was a total of 333 hospital bed-days, on average 22 days per patient. These patients also had a total of 312 days of outpatient antibiotic therapy, which was an average of 21 days per patient. The total cost, if patients were admitted for those days, assuming a night cost £400, was £124,800, which was on average £8,320 per patient. Three patients were readmitted within 30 days. One had ongoing endocarditis that was managed medically and another had pulmonary embolism. The last patient had a side effect related to daptomycin use. In conclusion, outpatient antibiotic therapy in selected patients with native or prosthetic infective endocarditis appears to be safe for a selected group of patients with associated cost savings.

Introduction

A major contributor to the cost of a patient's care is the number of days occupying hospital beds. In a cardiology department, there are some patients that

require long-term antibiotics, such as those with infective endocarditis or infected prosthetic devices. While most of these high-risk patients require some duration of monitoring for complications and deterioration as inpatients, there are patients who may, after a period of observation, be stable enough to be discharged home with outpatient intravenous therapy. In this report, we describe our experience with intravenous antibiotic therapy for patients with cardiology diagnoses who required a period of antibiotics in our outpatient service during the period of the COVID-19 pandemic.

Method and materials

We included patients discharged between January 2020 and September 2020 who had treatment plans to receive outpatient parenteral antimicrobial therapy (OPAT). Patients were identified via the nurse-led OPAT service. Our trust follows the local guidelines, which are based on the OPAT best practices,¹ and patients were considered appropriate for OPAT referral based on the infection specialist's decision. The OPAT service consists of three infectious disease consultants, one consultant microbiologist, two antimicrobial pharmacists and 2.4 clinical nurse specialists. The OPAT clinical nurse specialists assess the patient while they are in hospital to ascertain if they meet the OPAT criteria. They also liaise with consultants and microbiology to instigate an appropriate treatment plan, consent patients to the service and insert or arrange appropriate intravenous access. Once the patient is discharged, the OPAT nurses review patients in clinic and monitor the bloods, liaise with other specialties and chair the weekly OPAT multi-disciplinary meeting. The actual process of administering the antibiotics at home is undertaken by the local district nursing teams, unless the patient is capable of self-administration. Self-administration involves a six-hour training programme, which is delivered by the OPAT nurses. Occasionally, patients will attend the OPAT clinic

Table 1. Patient characteristics, diagnosis, treatment and outcomes

Patient	Age	Sex	Main diagnosis	Treatment	Outcome
1	72	F	Native mitral valve endocarditis	Surgery with tissue mitral valve replacement. IP ABX and OP ceftriaxone 2 g BD for 15 days	Readmissions with unwell and raised CRP
2	97	M	Native valve infective endocarditis	IP ABX and 12 days of OP ceftriaxone 2 g OD	Readmission with pulmonary embolism
3	78	F	Native tricuspid endocarditis	IP ABX and 16 days of ceftriaxone 2 g BD	None
4	47	F	Pericarditis	IP ABX and 18 days of ceftriaxone 2 g OD and teicoplanin 80 mg	None
5	68	M	Late prosthetic aortic valve endocarditis	IP ABX and 12 days of ceftriaxone 2 g OD	None
6	36	M	Infected pericardial effusion	IP ABX and 36 days of ceftriaxone 2 g OD	None
7	66	M	Native aortic and pulmonary valve endocarditis	IP ABX and 20 days of ceftriaxone 2 g BD	None
8	52	M	Native aortic valve endocarditis	Revision of total hip replacement. IP ABX and 28 days of ceftriaxone 2 g BD	None
9	46	F	Early prosthetic valve endocarditis	IP ABX and 13 days of ceftriaxone 2 g BD	None
10	85	F	Late prosthetic aortic valve endocarditis	IP ABX and 14 days for daptomycin 350 mg and rifampicin	Readmission with elevated CK. Daptomycin switched to flucloxacillin 4 g/day
11	75	M	Late prosthetic aortic valve endocarditis	IP ABX and 29 days of OP ceftriaxone 2 g OD	None
12	69	F	Native mitral valve endocarditis	IP ABX and OP flucloxacillin 12 g/day for 22 days	None
13	64	M	Native mitral valve endocarditis	IP ABX and OP benzylpenicillin 7.2 g/day for 19 days	None
14	84	M	Late prosthetic tissue aortic valve endocarditis	IP ABX and had OP ceftriaxone 2 g OD for 30 days	None
15	86	M	Suspected late prosthetic tissue aortic valve endocarditis	IP ABX and OP ceftriaxone 2 g OD for 28 days before admission with shortness of breath	None

Key: ABX = antibiotics; BD = twice daily; CK = creatine kinase; CRP = C-reactive protein; F = female; IP = inpatient; M = male; OD = once daily; OP = outpatient

Table 2. Length of stay and treatment and cost savings

Variable	Results
Total inpatient days for initial treatment	333 days
Average days per patient	22 days
Total outpatient days for antibiotics	312 days
Average days of outpatient antibiotics per patient	21 days
Total days for initial treatment and outpatient antibiotics	645 days
Savings from inpatient bed days if cost was £400/night	£124,800
Savings from inpatient bed days per patient	£8,320

breath, rigors, chest pain, cough, confusion and sweats. A total of nine patients had infective endocarditis, four patients had infected valve prosthesis or transcatheter aortic valve implantation (TAVI) endocarditis, one patient had infected pericardial effusion while another had infected pericarditis. All but one patient had multiple cardiovascular and non-cardiovascular comorbidities. There were six patients with prosthetic valves and one patient had an early infection while the other five patients had late infections. Blood cultures isolated a variety of organisms including *Staphylococcus* and *Streptococcus* species. The most common treatment was inpatient antibiotics followed by a period of outpatient antibiotics, which was typically once or twice daily ceftriaxone 2 g. Other treatment regimens included benzylpenicillin or flucloxacillin as continuous infusions, daptomycin and rifampicin and a combination of ceftriaxone and teicoplanin. Three patients were readmitted within 30 days. One had ongoing endocarditis that was managed medically and another had pulmonary embolism. The last patient had a side effect related to daptomycin use.

Table 2 shows the length of stay, treatment and associated cost savings. For these 15 patients there was a total of 333 hospital bed-days, on average 22 days per patient. These patients also had a total of 312 days of outpatient antibiotic therapy, which was an average of 21 days per patient (range six to 36 days). The total cost, if patients were

daily to receive their antibiotics, but this is not feasible for patients on long-term treatment.

Data were collected from electronic records on the age, sex, presentation, past medical history, investigation results, diagnosis and outcomes for patients. Investigations of interest were organisms isolated from blood cultures, echocardiogram findings and relevant imaging. The treatments patients received including type of outpatient antibiotic, duration

of treatment and any readmissions or adverse outcomes were collected.

Results

A total of 15 patients were selected to have outpatient antibiotic therapy (**table 1**). The age of these patients ranged from 36 to 97 years and 60% were male. Most patients presented to hospital feeling generally unwell with other symptoms, such as shortness of

Table 3. Average drug costs per day per regimen

Medicine	Regimen	Cost per day*
Ceftriaxone vials for injection	2 g OD	£19.16
Ceftriaxone vials for injection	2 g BD	£38.32
Teicoplanin vials for injection	800 mg OD	£14.64
Daptomycin + rifampicin	IV 350 mg OD + PO 600 mg BD	£62.00 + £2.46
Flucloxacillin vials for injection	4 g/day IV	£12.00
Flucloxacillin elastomeric device	12 g/day	Not stated
Benzylpenicillin elastomeric device	7.2 g/day	Not stated

*Prices from *British National Formulary* July 2021

Key: BD = twice daily; IV = intravenous; OD = once daily; PO = per oral

admitted for those days, assuming a night cost of £400, was £124,800, which was on average £8,320 per patient. The average cost for each drug regimen is shown in **table 3**.

Discussion

These findings suggest that OPAT in cardiology patients can be associated with significant cost savings without major adverse outcomes for patients. While we observed that 20% of patients returned to hospital, it is noted that these patients are a high-risk group. However, once they are initiated on antibiotics and found to be stable, some can be selected to go home and have outpatient intravenous antibiotic therapy. Keeping patients in hospital is not only associated with a high cost, due to inpatient bed costs, but also places patients at risk of hospital-acquired infections, such as pneumonias and *Clostridium difficile*, which can be a major problem when patients are on antibiotics.

An important aspect of an OPAT service is patient selection. A study of 80 patients with infective endocarditis from a single centre over 12 years found that patients with cardiac failure, renal failure or teicoplanin therapy were at increased odds of OPAT failure, defined by readmission or switch of antibiotics.² Using the same definition for failure, the rate of failure in this study was 26% compared with the 31.3% reported in the study, as three patients were readmitted and one patient had changed from daptomycin to flucloxacillin because of elevated creatinine kinase. A previous review

suggests that patients with native valve endocarditis should have at least two weeks of treatment in hospital where complications are most likely to occur and consideration for OPAT for two or four more weeks when life-threatening complications are less likely.³ In a Spanish study, the safety of outpatient antibiotics has also been demonstrated for 392 patients with uncomplicated viridans-group *Streptococci* infective endocarditis of which 16% of patients were readmitted while 4% died.⁴ In the UK, a retrospective review of 36 patients with infective endocarditis found that outpatient therapy is safe for infective endocarditis as well as prosthetic valve endocarditis and other cases at higher risk of complicated disease. Rates of adverse events occurred in a third of patients of which more than half were associated with lines.⁵ We have built on these findings by considering the cost benefit of outpatient therapy, which is considerable. Furthermore, it appears to be a safe alternative compared with a prolonged inpatient admission, where patients could be potentially at risk of contracting COVID-19, and may have associated improvements in patient satisfaction.

A recent trial of 400 patients with left-sided endocarditis, randomised antimicrobial therapy to intravenous or oral routes after initial treatment. It was found that changing to oral antibiotics was non-inferior to intravenous antibiotics.⁶ The approach of oral antibiotics may be associated with further saving as the cost associated with the nurse administering therapy to patients can be reduced. In a low-risk population, it is likely

Key messages

- Outpatient antibiotic therapy in selected patients with native or prosthetic infective endocarditis appears to be safe for a selected group of patients
- Once they are initiated on antibiotics and found to be stable, some can be selected to go home and have outpatient intravenous antibiotic therapy
- The benefits, above safe patient care, include a major saving in costs, which can be more than £8,000 on average per patient

that oral antibiotic treatment is safe. However, in a high-risk population, the nurse visit is an opportunity to review these patients for deterioration and complications, which is not possible if the patient is discharged with self-administered oral antibiotic therapy. In our current evaluation, there was no mortality in the cohort and tissue mitral valve replacement was urgently performed in one patient who required surgery. A larger comparative study is needed to better understand the safety of part-home delivered antibiotic therapy for infective endocarditis.

In conclusion, OPAT in selected patients with native or prosthetic infective endocarditis appears to be safe for a selected group of patients. The benefits above safe patient care include a major saving in costs, which can be more than £8,000 on average per patient ●

Conflicts of interest

None declared.

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None.

Study approval

This work was conducted as a clinical audit and health service evaluation. Following trust policies, it was registered with the audit department and was assigned a reference number of CA31221.

Editors' note

Supplementary tables providing more patient and microbiological details are available on request from the author.

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