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Maximising the opportunity of a self-administration outpatient parenteral antimicrobial therapy pathway

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Optimisation de la possibilité de l'auto-administration de traitements antimicrobiens parentéraux ambulatoires

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Abstract

Background: The University Hospitals of Leicester NHS Trust outpatient parenteral antimicrobial therapy (OPAT) service has expanded rapidly with more nurse-led direction.

Aims: A retrospective study between 1 July 2014 and 31 December 2019 was undertaken to assess the impact of OPAT expansion on beds released for further utilisation, clinical outcomes, adverse vascular access device (VAD) outcome, and self- and family-administered parenteral antimicrobial therapy.

Method: Data were extracted from the OPAT Patient Management System and from a patient questionnaire survey.

Findings: 1084 completed patient episodes were recorded in 958 patients, rising from 39 episodes in 2014 to 265 in 2019. The number of beds released for further utilisation correspondingly rose from 828 in 2014 to 8462 in 2019. The proportion of patients/family members trained to self-administer rose from 25% to 75%, with clinical cure/improvement of infection remaining high at between 84.6% and 92.8% of patients annually. Serious adverse VAD events remained low throughout. The patient response was generally positive.

Conclusion: Nurse empowerment within OPAT can lead to significant improvements and patient benefits, while maintaining clinical outcomes.

Résumé

Contexte : Le service de traitement antimicrobien parentéral ambulatoire (TAPA) des hôpitaux universitaires du NHS Trust de Leicester a rapidement pris de l'expansion avec l'aiguillage effectué par le personnel infirmier.

Objectif : Une étude rétrospective menée entre le 1^{er} juillet 2014 et le 31 décembre 2019 visait à évaluer les retombées de l'expansion du service de TAPA sur la libération de lits à d'autres fins, les issues cliniques, les issues indésirables liées aux dispositifs d'accès vasculaire (DAV) et l'auto-administration ou l'administration par un proche d'un traitement antimicrobien parentéral.

Méthodologie : Des données ont été extraites du système de gestion des patients sous TAPA et recueillies à l'aide d'un sondage par questionnaire auprès des patients.

Résultats : 1 084 épisodes complets ont été consignés chez 958 patients, passant de 39 épisodes en 2014 à 265 en 2019. Le

nombre de lits libérés à d'autres fins a augmenté parallèlement, en passant de 828 en 2014 à 8 462 en 2019. La proportion de patients/proches formés pour s'auto-administrer ou administrer un traitement a augmenté, passant de 25 à 75 %, alors que le taux annuel d'amélioration des infections/de guérison clinique chez les patients est demeuré élevé entre 84,6 et 92,8 %. Le taux de manifestations indésirables graves liées aux DAV est demeuré faible tout au long de l'étude. La réponse des patients était en général positive.

Conclusion : L'habilitation du personnel infirmier dans le cadre d'un service de TAPA peut entraîner des améliorations et des bienfaits importants pour les patients tout en maintenant les issues cliniques.

Key words: OPAT • Outpatient parenteral antimicrobial

Outpatient parenteral antimicrobial therapy (OPAT) services enable patients who require intravenous (IV) antimicrobial therapy, but who are well enough to receive care outside of a hospital environment, to receive their treatment in the community. This may include self-administration of IV antimicrobials by the patient or a family member/carer or a nurse administering treatment in the patient's home or in a clinic setting.

Across the UK, the number of OPAT services is increasing (Durojaiye et al, 2019), helping to reduce hospital admissions, facilitate early discharge, reduce length of hospital stays, and provide cost-effective care closer to home (Chapman, 2013; Chapman et al, 2019). OPAT features in the NHS strategy for strengthening antimicrobial stewardship (Ashiru-Oredope et al, 2012) and the British Society for Antimicrobial Chemotherapy (BSAC) has a number of workstreams related to OPAT, including drug stability testing and a framework for practice (BSAC, 2021).

The University Hospitals of Leicester NHS Trust (UHL) is one of the largest NHS trusts in the UK, with three hospitals across Leicester serving approximately 1 million residents and increasingly providing specialist services over a much wider area. The infectious diseases department in UHL had previously treated small numbers of patients through an ad-hoc OPAT system (Wiselka and Nicholson, 1997) and subsequently initiated a formal pilot service in 2012, open to taking referrals from all specialties within the Trust. Over a 6-month period, the service treated 65 patients and saved a total of 1316 hospital bed days, which can otherwise be considered as inpatient beds released for further use (Sahota, 2012). Since then, the service has

evolved into a multidisciplinary team, led by an infectious diseases consultant and with virtual ward round input from a microbiology consultant, 4.6 full-time equivalent specialist nurses and a specialist antimicrobial pharmacist.

In this service review, the authors present findings of a retrospective study conducted between 1 July 2014 and 31 December 2019 to evaluate the impact of expansion of the OPAT service on the number of hospital inpatient bed days saved, clinical efficacy and the patient experience. The authors have concentrated on the increasing use of self-administration by patients and the adverse event rate associated with OPAT care.

Outpatient Therapy

Methods

Patient selection

Adult patients were eligible for OPAT if they were current inpatients or outpatients under the care of a hospital consultant who provided shared clinical care and responsibility for OPAT. All referrals were considered individually, but the broad criteria are detailed below.

OPAT inclusion criteria

- Age ≥16 years
- Able to give verbal or written consent
- Identification of a suitable antimicrobial regimen
- Placement of adequate venous access
- Medically fit to be discharged from hospital
- Suitable home environment

OPAT exclusion criteria

- No suitable antimicrobial regimen appropriate for outpatient therapy
- Medical or biochemical instability
- Moderate to high risk of harm associated with reduced monitoring due

OPAT patient process pathway

All eligible patients were assessed by the OPAT nurses, who made the decision with the patient and their family/carers as to whether antimicrobials would be administered by the nurses or whether the patient/family/carer would train to administer (Figure 1). In reaching this joint decision, a variety of patient factors were taken into consideration:

- Physical characteristics, such as mobility, dexterity, vision and cognition
- Social factors, including work/education commitments, access to transport

Figure 1. The outpatient parenteral antimicrobial therapy (OPAT) pathway

- Availability of family/carers at the appropriate times of day for antimicrobial administration
- Situations where the patient expressed a strong preference for nurse-administered care or the OPAT nurses considered that it would be in the best interests of the patient to have daily nurse contact.

The OPAT self-administration infusion system

Patients/carers who were unable to mix their antimicrobials in the traditional way, but who were considered otherwise suitable for self-administration, were trained to use aseptically filled pre-mixed elastomeric devices. External pharmaceutical providers supplied the pre-mixed devices, for which appropriate stability data were available.

In October 2016, continuous 24-hour infusion devices of flucloxacillin, benzylpenicillin and piperacillin with tazobactam also became available. Prior to this, these beta-lactam antibiotics were either self-administered in the standard manner of divided doses throughout the day by the patient (but only a minority felt they could manage this), or an alternative class of antimicrobial was used, if considered appropriate. Individuals for whom these beta-lactam antibiotics were considered the best treatment choice, but where self-administration was not possible, had previously had to remain in hospital for the duration of their therapy.

Individuals for whom pre-mixed products were considered particularly appropriate included elderly people or those with dexterity issues, patients on complex, multidrug regimens and those for whom continuous beta-lactam antibiotics were the preferred treatment. These patients were supplied with an elastomeric device, which contains an elastomeric 'balloon': as this deflates over time, it gently pushes the antimicrobial through the IV infusion set that carries the medication from the device into the catheter/port, providing a consistent, reliable and accurate flow rate.

Data collection

The OPAT Patient Management System (PMS) was developed by the OPAT initiative arm of the BSAC and enables patient level data to be entered into an electronic database for use during care. Until recently, anonymised data from the PMS were sent to the National OPAT Registry System (NORS, www.opatregistry.com) to enable national data to be collected. Activity and outcomes between 1 July 2014 and 31 December 2019 were collated from these systems. The following data were extracted:

Number of patients receiving OPAT therapy

- Primary infective diagnoses occurring in five or more patient episodes
- Number of patients self-administering, or receiving OPAT delivery by a relative/carer, through an OPAT nurse or at an OPAT clinic or local hospital
- Patient infection and OPAT outcomes by patient episodes; and the number of severe vascular access device (VAD) events. This included thrombus related to line, local or systemic infection.

Other events, including leaking or misplaced VADs or medical adhesive-related skin injuries (MARSI), were not recorded.

The BSAC OPAT initiative requires two outcomes to be allocated to each patient before their data can be uploaded to the PMS and NORS. The first is the infection outcome comprising clinical cure, clinical improvement or failure. The authors amalgamated the first two categories and slightly modified the latter definition to include cases in which there was progression or non-response of infection despite OPAT, or where the patient required unplanned admission, unplanned surgical intervention, or unexpectedly died.

The second outcome is the OPAT outcome related to the overall OPAT process, and comprises success, partial success, failure or indeterminate (readmission due to an event unrelated to the infection or treatment). The authors amalgamated the first two categories in their service review.

Simple statistics in the form of percentages were used to analyse data.

Patient satisfaction questionnaire

Anonymous patient satisfaction questionnaires were sent to 105 patients who were treated by the OPAT team in 2016. Patients were asked if they agreed, disagreed or had a neutral opinion towards a series of questions relating to the OPAT service, including the self-administration training and support provided to them by the OPAT team.

Results**Patient episodes**

Over the study period, 1084 completed patient episodes were recorded in 958 patients. The number of patient episodes and bed days saved increased year by year. Over the study period, the proportion of patients referred for OPAT in order to facilitate early discharge from hospital was significantly higher than those referred for admission avoidance (*Table 1*), and patients were predominantly referred from within the University Hospitals of Leicester NHS Trust or from the corresponding community Trust, the Leicestershire Partnership Trust. A small proportion of patients were accepted directly from hospitals outside the region. This occurred mainly when the patient lived within the area served by the Trust and had been receiving care in another hospital within the UK, but was considered well enough to be discharged home to complete their IV antimicrobial therapy.

Primary infective diagnoses

The most frequent primary infective diagnoses were diabetic foot infections, with or without osteomyelitis (117/1084, 10.8%), upper and lower urinary tract infections (110/1084,

Table 1. Patient demographics, 1 July 2014–31 December 2019

	2014 n (%)	2015 n (%)	2016 n (%)	2017 n (%)	2018 n (%)	2019 n (%)
Number of patients receiving OPAT	39	124	156	208	217	265
Total completed patient episodes	40	130	174	221	233	286
Total bed days saved	828	3524	4340	5858	5661	8462
Episode referral type						
Early discharge from hospital	37 (92.5)	122 (93.8)	165 (94.8)	201 (91.0)	206 (88.4)	255 (89.2)
NHS hospital admission avoidance	3 (7.5)	8 (6.2)	9 (5.2)	20 (9.0)	27 (11.6)	31 (10.8)
Episode referral location						
Leicester hospitals	40 (100)	129 (99.2)	174 (100)	219 (99.1)	229 (98.3)	282 (98.6)
Regional hospitals	0 (0)	1 (0.8)	0 (0)	2 (0.9)	4 (1.7)	4 (1.4)

10.1%), prosthetic knee-joint infections (105/1084, 9.7%), and osteomyelitis (100/1084, 9.2%). Other infections treated varied and included, among others, intra-abdominal infections, septic arthritis, other prosthetic joint infections, bacterial meningitis, malignant otitis externa, skin and soft-tissue structure infections, vascular graft infections and tuberculosis.

Antimicrobial administration method

The percentage of bed days saved due to patients and their relatives or carers learning to administer IV antimicrobials

Figure 2. Bed days saved over the study period between 2014 and 2019

significantly increased over the study period (Figure 2). Administration in the OPAT clinic stayed relatively static, but there was a decrease in the number of nurse-administered antimicrobials at home.

Infection outcome

The percentage of patient episodes where the patient's infection was considered to have been cured or improved during their OPAT treatment ranged between 84.6% and 92.8% (Table 2), and remained relatively stable over the study period.

OPAT outcome

The percentage of patient episodes where the OPAT outcome was deemed to have been successful or partially successful ranged between 75% and 91.4% (Table 2). The trend was an increase in successful/partially successful outcomes over time, with a corresponding reduction in failures.

Serious vascular access device events

The number of serious events related to VADs was low overall (range 0–3.15% patient episodes each year) (Table 3). There were 11/1084 (1.01%) cases of thrombus and 2/1084 (0.18%) cases of catheter-related bloodstream infection (CRBSI).

Table 2. Infection and OPAT process outcomes, 1 July 2014–31 December 2019

	2014 n = 40 (%)	2015 n = 130 (%)	2016 n = 174 (%)	2017 n = 221 (%)	2018 n = 233 (%)	2019 n=286 (%)
Infection outcome						
Cured/improved	34 (85.0)	110 (84.6)	148 (85.1)	205 (92.8)	204 (87.6)	261 (91.2)
Failed	6 (15.0)	20 (15.4)	26 (14.9)	16 (7.2)	29 (12.4)	25 (8.7)
Outcome of OPAT processes						
Success/partial success	30 (75.0)	112 (86.2)	147 (84.5)	202 (91.4)	202 (86.7)	256 (89.5)
Failure	7 (17.5)	14 (10.8)	19 (10.9)	9 (4.1)	13 (5.6)	17 (5.9)
Indeterminate	3 (7.5)	4 (3.1)	8 (4.6)	10 (4.5)	18 (7.2)	13 (4.5)

Table 3. Serious vascular access device events, 1 July 2014–31 December 2019

	2014 n = 40 (%)	2015 n = 130 (%)	2016 n = 174 (%)	2017 n = 221 (%)	2018 n = 233 (%)	2019 n = 286 (%)
Catheter-related bloodstream infection (CRBSI)	0 (0)	1 (0.77)	0 (0)	0 (0)	0 (0)	1 (0.35)
Line-related infection (local)	0 (0)	0 (0)	0 (0)	1 (0.45)	2 (0.86)	1 (0.35)
Thrombus (deep and superficial)	0 (0)	0 (0)	0 (0)	0 (0)	4 (1.72)	7 (2.45)
Total complications	0 (0)	1 (0.77)	0 (0)	1 (0.45)	6 (2.58)	9 (3.15)

Patient experience

Of the patients who were sent the questionnaire, 32/105 (33.6%) responded. The response was generally positive, with 29 patients (90.6%) agreeing that receiving antibiotic treatment at home was better than receiving it while in hospital (Figure 3).

Discussion

The study set out to assess the impact of expansion of the authors' OPAT service on the number of hospital beds available for further utilisation (bed days) and clinical efficacy and, in particular, to evaluate the increasing use of self/family administered drug delivery. The authors have demonstrated that, as patient numbers increased, they were able to maintain high levels of infection cure/improvement, and there was a reduction in failures of the OPAT process over the years. The data recorded by the authors support the national recommendations, which indicate that OPAT is a safe alternative to hospitalisation for selected patients (Chapman et al, 2019).

The subsequent patient survey, albeit small, is encouraging, in that it indicates support for the service among the patients treated. Formal cost-effectiveness analysis was beyond the scope of this article, and is a complex issue, which would need to take into consideration tariffs and trim points associated with inpatient admissions, cost of drugs and nursing services, and the income generated from home visits and outpatient attendances.

The increasing implementation of nurse-led training for patients and their carers/families to administer IV antimicrobials at home, where appropriate, has been significant, ranging from around 25% of patients in 2014 to around 75% in 2018 and 2019. This has allowed the service to increase the number of patients who can benefit from it, because it frees up the OPAT nursing staff to concentrate on administering antimicrobials to patients who are unable or unwilling to train to self-administer. The authors' service

Figure 3. Responses to the patient questionnaire (n = 32)

previously relied on nurses from a private provider to assist with drug administration at home, which was costly, but have not needed to use such providers for several years, dramatically reducing the costs associated with running the service and allowing the service to employ additional nurses directly through the implementation of a successful business case.

This empowerment of patients is an excellent example of nurses being supported by the national nursing framework to lead change and adding value to the services provided by the NHS, through resource management and innovation (NHS England, 2016). The nurses have developed a competency-based assessment tool to determine whether patients/families are competent to self-administer, together with step-by-step instructions on administration technique, which are given to each patient on discharge to guide them through each drug administration.

Alongside low levels of both clinical failure and failure of the OPAT processes, it is reassuring to see that the number of serious VAD events was low overall across the study period and, in particular, there were very low numbers of CRBSIs. It is important that constant monitoring of this is undertaken

and reviewed as part of clinical governance processes. In relation to thrombi resulting from the placement of VADs, the authors' department has undertaken a review of cases that have occurred, and they are creating a guideline on management of these events, in conjunction with haematology colleagues. The patients experiencing CRBSIs were reviewed carefully and alterations made to the mode of their subsequent antimicrobial delivery, where appropriate.

The advances in technological design of antimicrobial delivery systems has contributed towards the service being able to increase the number of patients self-administering therapy at home, through the use of easy-to-use elastomeric devices, including 24-hour infusors of beta-lactam antibiotics. The latter have pharmacokinetic advantages over multiple daily doses, translating into clinical benefit (Vardakas et al, 2018), and enable narrower spectrum agents to be used in line with antimicrobial stewardship guidelines (Ashiru-Oredope et al, 2012). Drug stability testing, such as that undertaken by the BSAC, will potentially enable more antimicrobials to be administered via elastomeric devices in the future. This is an exciting area of development and heralds the inclusion of patients with very complex infections within OPAT services.

The nurses and antimicrobial pharmacists in the authors' Trust are all independent medical prescribers, which further empowers them to take ownership of the clinical management of patients and makes OPAT processes more efficient. Future work in this area could include expansion of the nursing and pharmacy roles to become advanced clinical practitioners, which would allow them to take on some of the management of some clinical cases such as cellulitis, and the monitoring of patients on complex oral stepdown regimens.

Over the years, the authors have encountered a number of concerns from other clinicians over the training of patients and families to self-administer, and these anxieties sometimes were communicated to patients prior to or during their training (*Box 1*). Patients themselves were sometimes fearful of being taught to self-administer, although their anxieties were often allayed following a detailed discussion and demonstration of the technique. A future initiative planned is to identify 'OPAT link nurses' in order to empower nursing colleagues in the management of midlines on the hospital wards and instil confidence in patients, families and staff, allowing rapid training and smooth discharge processes.

Box 1. Common questions asked by patients/referring teams	
Question	Response
How can patients be trusted to self-administer intravenous (IV) medicines when even registered nurses need special training to do this?	<ul style="list-style-type: none"> Patients are taught the principles of aseptic non-touch technique and they are assessed to the same competence standard as that which is expected of a registered nurse They only have to remember and be competent in how to administer the specific medicine they are taking, which helps them to become experts in giving the particular antibiotic they are receiving
How safe is it? What if they get it wrong?	<ul style="list-style-type: none"> Our figures show very low numbers of serious line-related adverse events, such as infections, despite the high numbers of patients self-administering Patients can be seen in the clinic or at home the same day, 7 days a week, in the event of any concerns about their lines
What support is there for patients who are self-administering IV antimicrobials at home?	<ul style="list-style-type: none"> All patients are seen a minimum of once weekly, either in the OPAT medical/nursing clinic or at home by one of the OPAT specialist nurses to provide ongoing support, weekly blood tests and line dressing changes Patients have telephone access to the OPAT specialist nurses 7 days a week and can always be seen the same day if they need any extra training or assistance
How do you reduce the risk of line infections?	<ul style="list-style-type: none"> All patients are taught how to care for their line at home, especially with regards to showering and bathing. They are taught the signs of line infection and all consent to contacting the OPAT team at once in the event of any of these occurring All patients have their line insertion site cleaned and a new dressing applied at least weekly
How do you assess competence in IV administration by patients or carers?	<ul style="list-style-type: none"> We have our own patient pathway/passport document. This contains a competency framework against which we assess patients before they are allowed to self-administer independently The framework includes domains such as aseptic non-touch technique, drug handling, line flushing, line clamping and sharps disposal
Do you experience any resistance from clinical staff on the wards who may be sceptical of the safety of patients giving their own IV antibiotics?	<ul style="list-style-type: none"> We have come across this, but we can usually allay these fears by showing colleagues our processes and our outcome data We have built excellent relationships with the discharging wards so that self-administration via OPAT is now promoted and encouraged by the ward nursing staff before patients even come into contact with the OPAT team

Conclusion

The expansion of the OPAT nursing team at the Trust has been an exciting journey, and over 5 years has led the authors from a situation in which they relied on private nursing providers to administer antibiotics to patients to one where 75% of patients and their families are trained to self-administer IV antibiotics at home. Nurse empowerment, coupled with innovative antimicrobial delivery system technology, has enabled the authors' OPAT service to provide a patient-centred service with stable clinical outcomes. The hope is that this may give other OPAT services the confidence to consider increasing the proportion of their patients who undertake self or family/carer-administered therapy.

Key Points

- Outpatient antimicrobial therapy (OPAT) services enable patients to safely receive intravenous (IV) antibiotics at home rather than in hospital.
- The OPAT service described in this article rapidly expanded, but clinical outcomes in terms of cure or improvement of infection remained stable, and serious line-related adverse events were low.
- The proportion of patients and families/carers trained to administer IV antibiotics by OPAT nurses rose from 25% to 75% over 5 years.
- Nurse empowerment in OPAT services is critical in order for referring colleagues and for patients to have confidence in the service, especially during training in self-administration.

CPD Reflective Questions

- Reflect on how training patients and their families to self-administer antimicrobials could impact on the patient, the OPAT team and the Trust. Include potential positive and negative outcomes
- Consider what changes might need to be made to OPAT documentation if a team were to move more patients on to a self-administration model of care. Focus on issues around the assessment of patient competence and accountability
- Consider the clinical governance issues that OPAT services might need to address on an ongoing basis

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Declaration of interest

JB and LM have received honoraria for speaking at a Baxter symposium. The other authors have no conflict of interest to declare.

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