

Outpatient Parenteral Antimicrobial Therapy Practices Among Pediatric Infectious Diseases Consultants: Results of an Emerging Infections Network Survey

Ritu Banerjee,¹ Susan E. Beekmann² Elizabeth H. Doby,³ Philip M. Polgreen,² Mobeen H. Rathore,^{4,5} and Adam L. Hersh³

¹Department of Pediatric and Adolescent Medicine, Mayo Clinic, Rochester, Minnesota; ²Department of Internal Medicine, Carver College of Medicine, University of Iowa, Iowa City; ³Pediatric Infectious Diseases, University of Utah, Salt Lake City; ⁴Pediatric Infectious Diseases and Immunology, University of Florida College of Medicine, and ⁵Wolfson Children's Hospital, Jacksonville, Florida

Corresponding Author: Ritu Banerjee, MD, PhD, Mayo Clinic, Division of Pediatric Infectious Diseases, 200 First St SW, Rochester, MN 55905. E-mail: banerjee.ritu@mayo.edu.

Received September 6, 2012; accepted November 26, 2012; electronically published January 27, 2013.

We conducted a survey of pediatric members of the Emerging Infections Network regarding outpatient parenteral antimicrobial therapy (OPAT) practices and clinical decision making about OPAT initiation. We identified substantial variation in characteristics and resources of pediatric OPAT practices. Opportunities to improve oversight of OPAT in children should be explored.

Key words. emerging infections network; OPAT; pediatric; stewardship.

For several decades, outpatient parenteral antibiotic therapy (OPAT) has been an approach to effectively complete treatment for a variety of serious infections requiring prolonged therapy [1–4]. Although OPAT offers advantages compared with prolonged hospitalization, the rate of adverse events with OPAT has been reported to be as high as 30% or higher in some studies [2, 5, 6]. Among adults, there is growing evidence that OPAT is overused, and a substantial percentage of OPAT courses are shortened or converted to oral therapy when reviewed by stewardship infectious disease (ID) consultation [7]. Although no similar studies exist for pediatric patients, many children receive prolonged parenteral therapy for osteomyelitis, despite evidence supporting safety of early conversion from parenteral to oral therapy [8].

A previous study conducted among members of the Infectious Diseases Society of America (IDSA) Emerging Infections Network (EIN) in 2004 showed that OPAT management was a significant part of their clinical practice [9]. However, this study did not provide specific analysis about the experiences of pediatric members,

which is likely to be considerably different from those of adult ID specialists. The objectives of this study were to describe OPAT practices and clinical decision making about OPAT initiation among pediatric ID specialists.

METHODS

We conducted an electronic survey of pediatric members of the EIN from May 2012 to June 2012 regarding OPAT. Participants completed an electronic data form (Appendix).

The EIN, a network of ID physicians in North America, includes 281 pediatric ID physicians and represents a significant proportion of the 1307 individuals who have received board certification in pediatric ID since 1994 [10]. Membership is drawn from the Pediatric Infectious Diseases Society (PIDS) and the IDSA. Pediatric members have broad geographic and institutional representation, encompassing 42 states, the District of Columbia, Puerto Rico, 4 Canadian provinces, and more than two-thirds of children's hospitals in the United States.

The survey questions explored characteristics of OPAT practice (including monthly volume, conditions

treated, and antibiotics prescribed) and aspects of clinical decision making regarding OPAT. We included a clinical vignette that described a hospitalized patient with acute hematogenous osteomyelitis caused by methicillin-sensitive *Staphylococcus aureus* (MSSA) who was responding well to intravenous antibiotics. Respondents indicated the likelihood that they would manage this patient with the following strategies: discharge with OPAT for a period before transitioning to oral therapy; use OPAT to complete the entire course of therapy; or discharge with oral therapy without using OPAT. Respondents also indicated whether their decision to use OPAT would have changed if cultures grew methicillin-resistant *Staphylococcus aureus* (MRSA) or were negative. Finally, using a scale from 1 (not important) to 5 (highly important), respondents rated the importance of various clinical and social factors in the decision to use or not use OPAT for osteomyelitis.

RESULTS

The survey was completed by 188 of 281 (67%) pediatric EIN members. Thirty (16%) respondents did not manage OPAT and were excluded from subsequent analyses.

Most respondents reported that their institutions' pediatric ID service was usually involved in decisions to initiate (77%) and manage (72%) OPAT. However, 89% noted that ID consultation was not required to initiate OPAT at their institutions. Although 84% of respondents regularly managed patients with OPAT, the monthly patient volume varied widely, from <2/month to >10/month. Respondents initiated or managed OPAT for a variety of indications, most commonly osteomyelitis, followed by endovascular and central nervous system infections and pneumonia (Figure 1A). The antimicrobials used most frequently for OPAT by respondents were ceftriaxone, cefazolin, and vancomycin (Figure 1B). One hundred four (67%) respondents felt that line or drug-associated complications occurred in 10% or fewer cases.

Most (94%) respondents reported that their institution had a team for peripherally inserted central catheter placement. Less than one-half reported use or availability of other OPAT-related resources such as the IDSA OPAT guideline (48%), a local OPAT guideline (18%), a nurse or healthcare professional to assist with OPAT management (43%), or an infusion center (34%). Revenue sources reported to support OPAT management included: outpatient visit charges (51% of respondents), inpatient consult charges (36%), support from hospital or healthcare system (18%), support from home care

agency (12%), or income from infusion center (4% of respondents). Thirty-two percent of respondents did not know the revenue source for OPAT management, and 5% reported OPAT services were not financially supported.

Regarding the use of OPAT for the child described in the clinical vignette with MSSA osteomyelitis, respondents were divided. Thirty-nine percent reported they would usually discharge the patient with OPAT for a period of time before transitioning to oral antibiotics, 38% would usually discharge the patient with oral antibiotics without using OPAT, and 10% would usually use OPAT for the entire course. Outpatient parenteral antibiotic therapy practices may be influenced to some extent by pathogen; 33% felt they would be more likely to use OPAT if the infection was caused by MRSA. If cultures were negative, 36 (23%) reported they would be more likely to use OPAT, whereas 54 (35%) reported they would be less likely to use OPAT. Respondents reported that patient compliance (home environment and ability to tolerate oral medications) and evidence of efficacy of parenteral vs oral medication were the most important considerations in their decision to use or not use OPAT for treatment of osteomyelitis, although they felt a variety of other factors also influenced their decision (Figure 1C).

DISCUSSION

We report results from a survey of a large network of pediatric ID specialists regarding OPAT practices and clinical decision making about OPAT initiation. Our study has the following important findings: (1) most pediatric ID providers manage OPAT, but supportive resources and infrastructure may be limited, and many members may underestimate the complication rates associated with OPAT; (2) ID consultation is not typically required to initiate OPAT; (3) osteomyelitis is the most common condition managed with OPAT, but there is significant variation in OPAT use for this condition.

Outpatient parenteral antibiotic therapy use in pediatrics is common, as evidenced by 84% of respondents managing at least 1 patient on OPAT each month. Despite frequent use, less than one-half of respondents had or used national or local OPAT guidelines or support staff to assist with OPAT management, and some noted that their OPAT services were not financially supported. This suggests that many pediatric OPAT programs may lack adequate resources and infrastructure to perform appropriate follow-up of OPAT patients. Outpatient parenteral antibiotic therapy management is time-consuming and typically

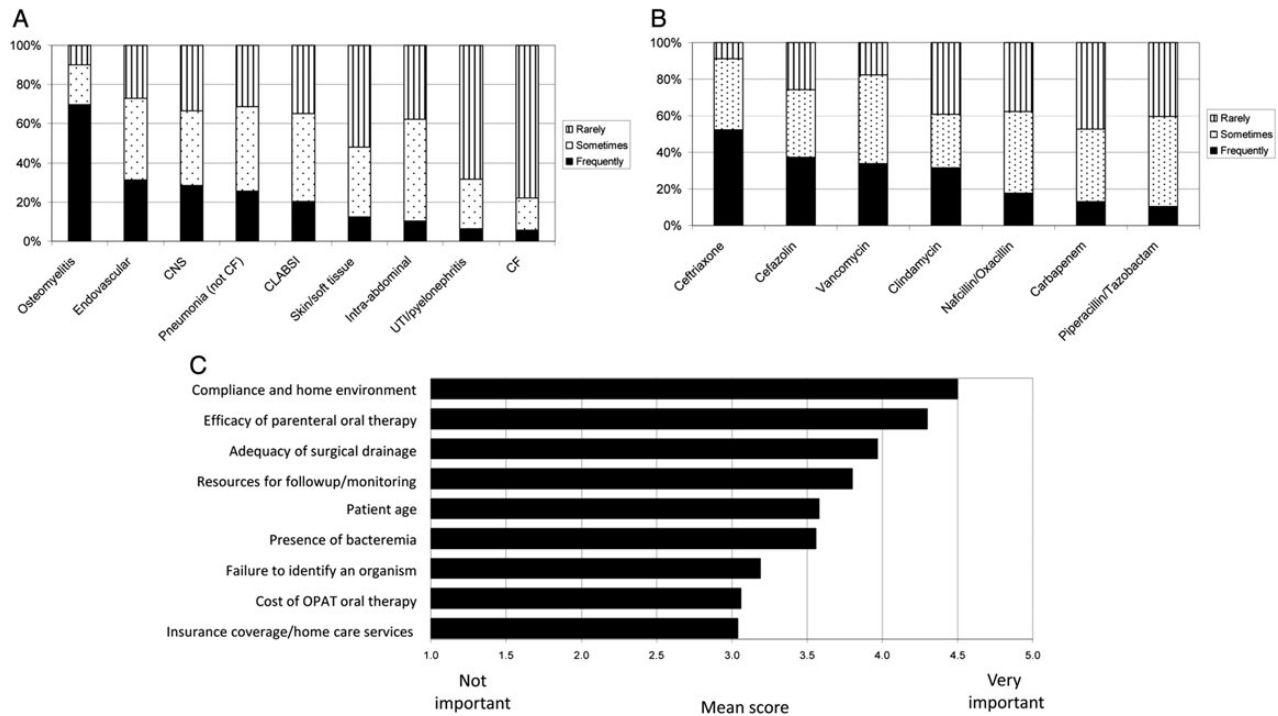


Figure 1. Outpatient parenteral antimicrobial therapy (OPAT) practices and clinical decision making among 158 pediatric infectious disease specialists. *A*, Clinical indications managed with OPAT. The bars show the percentage of respondents using OPAT rarely, sometimes, or frequently for each indication. *B*, Antimicrobial type and frequency of use for OPAT. The bars show the percentage of respondents using each drug rarely, sometimes, or frequently. *C*, Bars illustrate factors that impact decisions to use OPAT for osteomyelitis. Respondents rated each factor from 1 (not important) to 5 (very important). Abbreviations: CF, cystic fibrosis; CLABSI, central line-associated bloodstream infection; CNS, central nervous system; UTI, urinary tract infection.

involves weekly laboratory monitoring and communicating with patients, primary caregivers, home care agencies, pharmacies, infusion centers, or other consulting services [11]. Poorly supported OPAT management programs may compromise patient safety. Indeed, OPAT complications may result in hospitalizations or unplanned healthcare visits, some of which can be associated with significant morbidity [5, 6]. If OPAT patients are not followed closely, adverse events may not be appropriately attributed to OPAT. This may, in part, explain our findings that the majority of respondents significantly underestimated the risk of OPAT-related complications.

We found that in most respondents' institutions, neither antimicrobial stewardship program (ASP) input nor ID consultation is required to initiate OPAT. Data from adult patients suggest that when such oversight occurs, OPAT use is reduced with resulting benefits in terms of patient safety, cost, and convenience to patients [7]. Because this and similar studies have been limited to adult patients, it is important to determine whether similar improvements to patient care would occur with greater oversight of OPAT for pediatric patients.

Our results highlight the significant variation in OPAT use among pediatric ID providers, especially for osteomyelitis. Nearly 50% of respondents chose to manage the

child in the vignette with at least an initial period of OPAT, whereas a similar proportion opted to treat the same child with oral therapy without using OPAT. Furthermore, if the patient had negative cultures, some providers were more likely to use OPAT, whereas others were less likely to use OPAT. Decisions to use OPAT are complex, and reasons for the variability in OPAT use by pediatric ID providers should be further explored. Individual experience with OPAT management, institutional culture regarding OPAT, and availability of resources likely contribute to frequency of OPAT use. Respondents reported that uncertainty about the relative efficacy of intravenous vs oral therapy was a very important consideration in their decision to use or not use OPAT, which suggests that there is a need for (1) prospective randomized trials or (2) multicenter pooled outcomes analysis of OPAT vs oral therapy of infections in children. Such studies could also provide information for development of pediatric-specific OPAT guidelines (including the future PIDS/IDSA osteomyelitis guideline) to assist providers who treat complicated infections in children.

Our study has limitations. Responses regarding OPAT programs and clinical practice, especially for a vignette, may not represent actual practice. Furthermore, responses

may be subject to recall bias. The generalizability of the OPAT practices of EIN members to all pediatric ID practices is uncertain. We did not assess the extent to which OPAT use varied by the presence of comorbidities. Our survey may not have adequately captured all of the clinical and social factors that contribute to decision making regarding OPAT use.

Notwithstanding these limitations, our results demonstrate substantial variation in the characteristics and resources of pediatric OPAT practices and also in the frequency of OPAT use. There is a need for more study of pediatric OPAT programs including clinical outcomes and development of practice guidelines that focus on the unique needs of children and their families. There are also opportunities to study the impact of expanding the role of pediatric ASPs and ID consultation around OPAT use to improve patient care. However, to address the variation in OPAT use for multiple clinical conditions, better evidence is needed regarding not only the benefits of OPAT relative to oral therapy but also to determine the optimal duration of therapy necessary to achieve cure.

Acknowledgments

We thank Jason Newland (Children's Mercy Hospitals and Clinics, Kansas City, MO) for thoughtful review of this manuscript.

Disclaimer. The contents of this work are solely the responsibility of the authors and do not necessarily represent the official views of the Centers for Disease Control and Prevention.

Financial support. This publication was supported by Cooperative Agreement Number 5U50CK000187 from the Centers for Disease Control and Prevention. This work was also supported by the H. A. and Edna Benning Foundation (to E. H. D.).

Potential conflicts of interest. All authors: No reported conflicts.

All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

References

1. Rathore MH. The unique issues of outpatient parenteral antimicrobial therapy in children and adolescents. *Clin Infect Dis* 2010; 51(Suppl 2):S209–15.
2. Gomez M, Maraqa N, Alvarez A, Rathore M. Complications of outpatient parenteral antibiotic therapy in childhood. *Pediatr Infect Dis J* 2001; 20:541–3.
3. Goldenberg RI, Poretz DM, Eron LJ, et al. Intravenous antibiotic therapy in ambulatory pediatric patients. *Pediatr Infect Dis* 1984; 3:514–7.
4. Maraqa NF, Gomez MM, Rathore MH. Outpatient parenteral antimicrobial therapy in osteoarticular infections in children. *J Pediatr Orthop* 2002; 22:506–10.
5. Ruebner R, Keren R, Coffin S, et al. Complications of central venous catheters used for the treatment of acute hematogenous osteomyelitis. *Pediatrics* 2006; 117:1210–5.
6. Barrier A, Williams DJ, Connelly M, Creech CB. Frequency of peripherally inserted central catheter complications in children. *Pediatr Infect Dis J* 2012; 31:519–21.
7. Shrestha NK, Bhaskaran A, Scalera NM, et al. Antimicrobial stewardship at transition of care from hospital to community. *Infect Control Hosp Epidemiol* 2012; 33:401–4.
8. Zaoutis T, Localio AR, Leckerman K, et al. Prolonged intravenous therapy versus early transition to oral antimicrobial therapy for acute osteomyelitis in children. *Pediatrics* 2009; 123:636–42.
9. Chary A, Tice AD, Martinelli LP, et al. Experience of infectious diseases consultants with outpatient parenteral antimicrobial therapy: results of an emerging infections network survey. *Clin Infect Dis* 2006; 43:1290–5.
10. American Board of Pediatrics Web site. Available at: <https://www.abp.org/ABPWebStatic/?anticache=0.6254662510594952>. Accessed 14 November 2012.
11. Tice AD, Rehm SJ, Dalovisio JR, et al. Practice guidelines for outpatient parenteral antimicrobial therapy. *IDSA guidelines. Clin Infect Dis* 2004; 38:1651–72.