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REVIEW ARTICLE INVITED

A Bundle of the Top 10 OPAT Publications in 2022

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Outpatient parenteral antimicrobial therapy (OPAT) has become more common in clinical settings. Correspondingly, OPAT-related publications have also increased; the objective of this article was to summarize clinically meaningful OPAT-related publications in 2022. Seventy-five articles were initially identified, with 54 being scored. The top 20 OPAT articles published in 2022 were reviewed by a group of multidisciplinary OPAT clinicians. This article provides a summary of the "top 10" OPAT publications of 2022.

Keywords. COpAT; OPAT; outpatient parenteral antimicrobial therapy.

Outpatient parenteral antimicrobial therapy (OPAT) is defined as the administration of ≥2 doses intravenous antimicrobials outside an acute care setting [1]. OPAT falls under the umbrella term "complex outpatient antimicrobial therapy" (COpAT), which includes both oral and intravenous antimicrobials given for a prolonged period and usually requiring outpatient monitoring [2]. The practice of OPAT and COpAT has been expanding in recent years. As a result, publications in the area of OPAT have also been increasing. In this article, we offer a summary of 10 important OPAT publications from 2022 selected by a multidisciplinary group of infectious diseases (ID) practitioners.

METHODS

A Medline search was performed using the key terms "OPAT" and "COpAT" to identify PubMed indexed publications with a citation date between 1 January and 31 December 2022. Identified articles were then reviewed to ensure publication in 2022; articles published (including electronic publication) before 2022 were excluded, as were narrative reviews without new data, opinion pieces, in vitro–only studies, and research limited to the acute care (inpatient) setting was also excluded. Included studies were then assigned a Grading Outcomes–based research in Antimicrobial Therapy (GOAT) score on the same day to minimize the chance of score fluctuation. The GOAT score calculation has been published elsewhere [3]. In short, the score incorporates the journal's impact factor and the article's average number of citations per month since publication.

Of 75 publications identified from the Medline search, 54 met inclusion criteria and were scored. A survey containing the 20 publications with the highest GOAT scores was created, with the articles in alphabetical order by first author's last name. This was sent to a panel of 10 geographically diverse, multidisciplinary OPAT practitioners for selection of the top 10 articles. If a publication on the survey was authored by any member of the panel and received enough votes to be in the top 10 articles, a sensitivity analysis was performed without their votes included. If the article remained in the top 10 without including the authors' votes, then it was included in the review.

The panel was blinded to the GOAT scores (except for L. M. C. K. and K. L. R., who calculated the scores and built the survey). When selecting their top 10 articles, the panel was asked to consider clinical practice applicability, feasibility, and innovation. A 3-way tie for the ninth and tenth articles occurred. A second round of voting was performed for the tied articles, and the 2 with the most votes were included in the top 10 (Figure 1). The panel members were each assigned an article to summarize, avoiding any they may have coauthored. The top 10 articles are presented alphabetically by the first author's last name below and in Table 1 [4–13].

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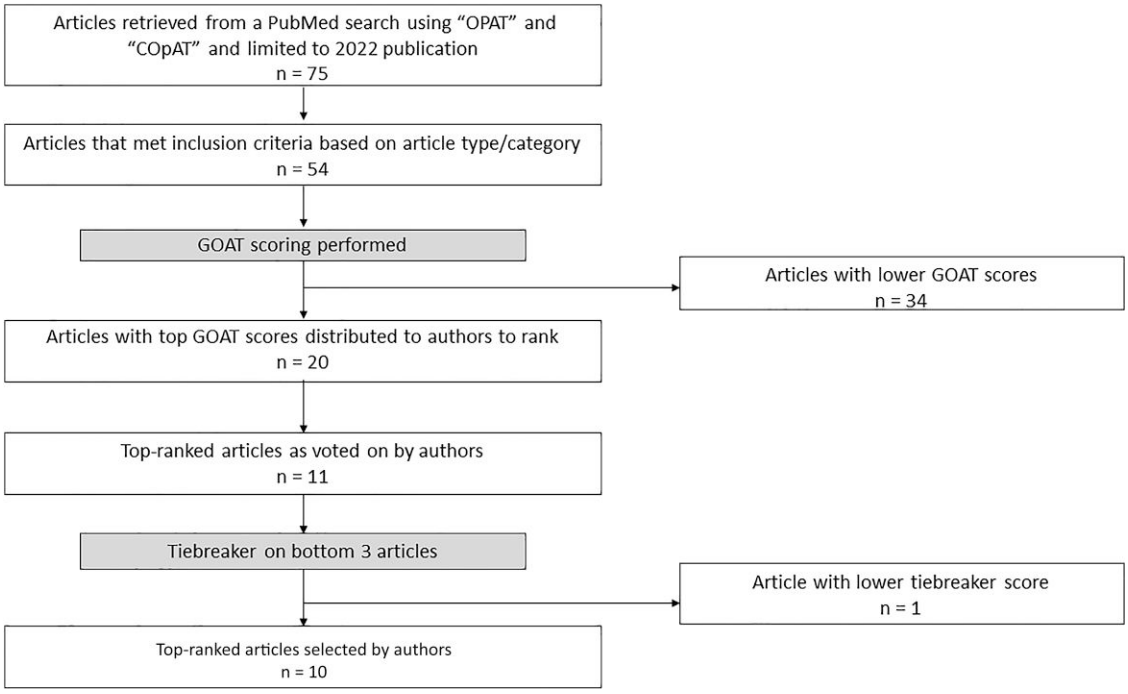

Figure 1. Selection of articles. Abbreviations: COpAT, complex outpatient antimicrobial therapy; GOAT, Grading Outcomes–based research in Antimicrobial Therapy; OPAT, outpatient parenteral antimicrobial therapy.

PUBLICATION SUMMARIES

Evaluation of Opportunities for Oral Antibiotic Therapy in Bone and Joint Infections

Bone and joint infections (BJIs) are a common problem requiring prolonged antibiotic therapy. The oral versus intravenous antibiotics (OVIVA) trial for BJIs demonstrated equivalent treatment outcomes in patients switched to oral therapy compared with those who received intravenous therapy [14]. The use of highly bioavailable oral therapy for infections such as BJIs is becoming more widespread and reduces the need for vascular access placement.

Bhagat et al [4] performed a retrospective review of patients with BJIs treated with intravenous therapy who would meet eligibility criteria for oral therapy using the OVIVA guidance at a single institution. Exclusions comprised *Staphylococcus aureus* bacteremia, endocarditis, other current infection, septic shock, or illness without optimal oral therapy options (per the OVIVA protocol). Using microbiologic data, potential oral therapy candidates were identified via record review. Assessment of those who could have received oral therapy and associated theoretical cost savings was evaluated using wholesale acquisition cost medication pricing, vascular access procedure costs, and weekly laboratory monitoring costs. Adverse events (AEs) during the treatment course were identified.

In total, 281 patients were identified (of 445 reviewed) who received ≥6 weeks of intravenous therapy for BJIs and who would have been candidates for oral therapy. Diagnoses included prosthetic joint infections (PJIs) in 56% and nonvertebral osteomyelitis in 32%. Surgical debridement and/or implant removal was performed in 96% of patients. Commonly isolated organisms included coagulase-negative *Staphylococcus* species (25%) and *S aureus* (23%). A peripherally inserted central catheter (PICC) was used in 89% of patients, and 48% were set up with home infusion, while 37.5% were referred to a skilled nursing facility.

The most common intravenous medications administered included cefazolin (65%), ceftriaxone (56%), vancomycin (30%), and cefepime (15%). In total, antibiotics were used for 12 069 days, including 10 327 outpatient days. A total of 260 patients received care from ID physicians, and 25% of patients had a change in therapy, most commonly in response to an AE (68%). A vascular access problem occurred in 4.6% of patients, and 2% experienced *Clostridioides difficile* infection (CDI). The calculated theoretical mean cost savings (medications and laboratory tests) was $3270.69 per patient if oral therapy would have been implemented. Additional costs not found in the medical record, such as staff time and care coordination, were not accounted for.

The study by Bhagat et al [4] supports consideration of oral therapy for BJIs and demonstrates overall potential cost savings when implementing oral therapy compared with intravenous therapy, using the OVIVA criteria. In addition, the data suggest the possibility of reduced AE related to vascular access issues in patients who are candidates for oral therapy for BJIs.

Table 1. Summary of Top 10 OPAT Publications From 2022

Reference (Year)	Study Design	Primary and Secondary Outcomes	Strengths and Limitations
Bhagat et al (2023) [4]	Retrospective cohort study of patients being treated for BJIs who met criteria for oral antibiotics	Primary outcome: of 445 patients treated for BJIs, 281 (73.9%) met criteria for oral antibiotics Secondary outcomes: theoretical cost savings of $3270.69 per patient; AEs: vascular access complications in 4.6%, medication ADEs in 15%, and CDI in 2%	Strengths: application of OVIVA trial criteria to real-world US population with similar findings; large patient cohort Limitations: single-center study may limit generalizability; oral antibiotic criteria limited to OVIVA trial criteria and microbiologic data, not including allergies, interactions, or ability to take oral medications
Browning et al (2022) [5]	Single-center prospective cohort study of AEs in an OPAT service	Of 4160 admissions: major AEs in 3.3% (1.54/1000 d) and minor AEs in 56.2% (26.4/1000 d); AEs more likely to occur in first 2 wk of treatment	Strengths: very large data set over multiple years; results align with prior findings for risk factors for AEs Limitations: single-center study may limit generalizability
Douiyeb et al (2022) [6]	Retrospective cohort study of risk factors associated with readmission in patients receiving intravenous antibiotics without a formal OPAT program	Primary outcome: of 247 patients reviewed, 25 were readmitted within 30 d after discharge Secondary outcomes: antibiotic AEs in 6.48%, line-related complications in 8.5%, non-OPAT complications in 1.62%, and treatment failure in 0.4%	Strengths: large patient cohort; results align with prior findings on risk factors for readmission Limitations: no access to laboratory results outside of own institution; single-center study may limit generalizability
Gilchrist et al (2022) [7]	Retrospective reporting and benchmarking of a national OPAT registry	Over a 5-year period, 57 organizations participated encompassing 27 841 OPAT episodes and 442 280 treatment days; AEs included vascular access complications (1.4/1000 d), device infections (0.3/1000 d), and other AEs (1.9/1000 d)	Strengths: very large, comprehensive data set from national registry over multiple years; data received from healthcare facilities with different OPAT service structures Limitations: specific antimicrobials could not be linked to diagnoses or treatment durations, and specific AEs could not be linked with antimicrobials
Manning et al (2022) [8]	Open label, prospective, randomized pilot trial comparing short-course (2-wk) vs standard-course (6-wk) antibiotic durations for DAIR	Primary outcome: 59.7% chance that an individual selected from the short-course group would have a higher DOOR than in the standard-course group Secondary outcomes: clinical cure at 12 mo, 71% vs 76%; Oxford joint score at 12 mo, 34 vs 41.5; major ADEs, 12.9% vs 17.2%; median duration of intravenous antibiotics, 15 vs 42 d	Strengths: DOOR analysis done by blinded assessor; most patients received their random assignment of antibiotic duration Limitations: highly selective patient population may limit generalizability; no pretrial sample size calculation
Pericàs et al (2022) [9]	Multicenter prospective observational cohort study evaluating outcomes of patients with endocarditis completing their treatment at the hospital (HBAT) vs those receiving OPAT	Primary outcome: of individuals receiving HBAT, 14.4% were readmitted vs 18.2% of OPAT recipients ($P = .004$) Secondary outcomes: 12-mo mortality rate, 8.2% vs 8.1%; recurrences, 2% vs 2.6%	Strengths: large sample; propensity analysis conducted Limitations: subgroup of patients not fulfilling OPAT GAMES criteria deemed not candidates for surgery, potentially creating bias; use of hospital-at-home model may limit generalizability
Rivera et al (2022) [10]	Descriptive survey of OPAT pharmacists in the United States	Among 22 pharmacists stating that their institution had a formal OPAT practice, the top 5 functions of OPAT pharmacists included adjusting medications based on laboratory values, ordering safety/monitoring laboratory tests, changing medications based on tolerance or ADEs, follow-up on overdue or outstanding laboratory results, and changing medications based on susceptibility results; a benchmark of 1 OPAT pharmacist for every 45–75 OPAT recipients was proposed	Strengths: first survey and description of OPAT pharmacist clinical practice; establishes a preliminary benchmark for pharmacists working in OPAT Limitations: small sample
Staples et al (2022) [11]	Retrospective cohort of matched patients receiving antibiotics in inpatient (IPAT) vs outpatient (OPAT) setting	Primary clinical outcome: of 1842 matched subjects, 35.6% of OPAT patients vs 39.0% of IPAT patients experienced a composite of AKI, venous thromboembolism, CDI, neutropenia, unplanned hospital readmission, and death (aOR, 1.04 [95% CI, .83–1.30]; $P = .73$) Primary cost outcome: OPAT associated with average adjusted cost savings of $17 579 CAD (95% CI, $14,131-$21 027 CAD; $P < .001$)	Strengths: large sample; real-world IPAT control group Limitations: no microbiology data for individual patients; no individual-level cost data; patients starting OPAT as outpatients (vs during hospitalization) excluded
Thijs et al (2022) [12]	Single-center prospective observational cohort of patients receiving CIV	Therapeutic vancomycin plasma concentrations in 68.5% of 35 CIV treatments, readmission in 8.6%, and clinical cure in 100%; 100% of those completing survey were at least satisfied with CIV in OPAT	Strengths: provides patient perspective regarding CIV Limitations: small sample; limited generalizability of home health model to other locations
Yagnik et al (2022) [13]	Single-center retrospective quasi-experimental cohort evaluating IVPB vs IVP	IVPB vs IVP in OPAT recipients: median hospital stay, 12 vs 11 d ($P = .03$); all-cause readmission within 30 d of OPAT, 11% vs 11% ($P = .99$); mortality rate, 4% vs 6% ($P = .75$)	Strengths: creative reassessment of challenging situation; comparable comparison group Limitations: small sample; single-center study may limit generalizability

Abbreviations: ADEs, adverse drug events; AEs, adverse events; AKI, acute kidney injury; CAD, Canadian dollars; CDI, *Clostridioides difficile* infection; CI, confidence interval; CIV, continuous infusion vancomycin; DAIR, debridement, antibiotics, and implant retention; DOOR, desirability of outcome ranking; GAMES, Grupos de Apoyo al Manejo de la Endocarditis in Espana; HBAT, hospital-based antibiotic treatment; IPAT, inpatient parenteral antibiotic treatment; IVP, intravenous push; IVPB, standard intravenous piggyback; OPAT, outpatient parenteral antibiotic treatment; OVIVA, oral versus intravenous antibiotics.

Safety of Prolonged Outpatient Courses of Intravenous Antibiotics: A Prospective Cohort Study

While OPAT practice is generally considered safe, the incidence of AEs related to OPAT is reported to range widely between 2% to 44%, with an AE rate of 2.24 to 4.5 per 1000 antimicrobial days [15]. Central venous access device (CVAD) complications occur in 0% to 25%, with major events in up to 14% [16]. Current available evidence is based largely on retrospective data and meta-analysis.

Browning et al [5] performed a single-center prospective observational study in Australia that quantified AEs of adults admitted to the OPAT service from 2009 to 2019. Nurses experienced in OPAT entered AEs in real time into a codified database. AEs included 11 types considered major and 7 considered minor grade, consisting of CVAD-related events, metabolic abnormalities, gastrointestinal intolerances, CDI, and allergic reactions. The study included 4160 admissions (median length of stay, 20 days) and 88 432 patient-days of observation from 3060 individuals. Of these, 136 patients (3.3%) experienced ≥1 major AE (1.54 per 1000 patient-days; 95% confidence interval [CI], 1.29–1.82), most commonly acute kidney injury (AKI) (43 of 136 [32%]) and severe cytopenia (42 of 136 [31%]). The risk of a major AE peaked during the second week of OPAT. Minor AEs were common, occurring in 38.3% of encounters (1592 of 4160; 26.4 per 1000 patient-days [95% CI, 25.4–27.5]).

Vancomycin was the only antimicrobial that significantly increased the risk of major AKI (hazard ratio, 7.68 [95% CI, 2.91–20.3]) or any major event (2.70 [1.53–4.76]) when compared with benzylpenicillin. Piperacillin-tazobactam exposure increased the risk of reported diarrhea by 2.5 times. Central venous catheter-related complications, primarily minor (pain or bleeding), were 71% of the AEs (1658 of 2338). Major CVAD-related AEs included 8 central catheter–associated bloodstream infections and 15 deep venous thromboses.

The study by Browning et al [5] demonstrated that overall OPAT AEs are common and peak in week 2, but the incidence of major AEs is low. The rigorous nature of weekly multidisciplinary OPAT rounds with an ID physician on call at all hours, requirements for ID consultation before enrollment, and consistent CVAD and elastomeric device use may limit external validity to less-intensive programs. The low AE rate may also reflect limited patients with hematologic disorders and few high-toxicity drugs such as amphotericin and aminoglycosides. This study reinforces current safety monitoring practices and provides valuable information for risk-benefit analysis when considering OPAT.

Risk Factors for Readmission Among Patients Receiving OPAT: A Retrospective Cohort Study

While OPAT is generally considered safe and effective, people receiving OPAT are still at risk for AEs including, antibiotic-related AEs, and hospital readmission within 30 days. Douiyeb et al [6] performed a retrospective cohort study at a large tertiary medical center in Amsterdam that assessed patients discharged with OPAT from January 2016 until December 2018. The primary outcome was the identification of risk factors associated with readmission within 30 days after discharge with OPAT in a hospital without a formal OPAT team. Secondary outcomes included complications and monitoring frequency during OPAT.

Overall, this study included 247 patients discharged with OPAT. The median age was 62 years, and 64% of patients were male. The most common indications for OPAT were osteomyelitis (17%) and prosthetic infections (14%), and the most frequent causative organisms were *S aureus* (32%) and *Pseudomonas* spp. (13%). Most patients received OPAT via a PICC line (84%). The most common antibiotic group prescribed was penicillins (37%), followed by cephalosporins (26%) and vancomycin or aminoglycoside (15%). Of the 247 patients included, 25 (10%) were readmitted within 30 days, with treatment failure (44%) and catheter-related events (25%) the 2 most common reasons for readmission. A total of 41 patients (16%) experienced complications with OPAT treatment, of which 51% were catheter related and 39% were antibiotic related. Sixty-eight percent of patients were monitored weekly, and therapeutic drug monitoring (TDM) was performed weekly in 51% of the patients receiving medications requiring TDM.

The study by Douiyeb et al [6] identified discharge with vancomycin or aminoglycoside and infected prosthetic material as independent predictors for readmission within 30 days after discharge with OPAT. The first finding is consistent with findings of other studies [15, 17] and is expected given the potential for nephrotoxicity with these agents. The second finding has been described elsewhere [18], but this is the first study to identify infected prosthetic material as an independent predictor for readmission. This study provides additional data for readmission risk factors in patients receiving OPAT. It also highlights the importance of appropriate monitoring, especially TDM in patients discharged on vancomycin or an aminoglycoside. Furthermore, hospitals may benefit from the addition of an OPAT team that can assist with appropriate use and monitoring of parenteral antibiotics to minimize risk of readmission and adverse drug events (ADEs) after discharge with OPAT.

OPAT in the United Kingdom: Findings From the BSAC National Outcomes Registry (2015–2019)

While OPAT programs are increasing globally, they are not subject to regulatory oversight nor have mandatory reporting. As such, it may be difficult to benchmark programs and evaluate areas for improvement.

The British Society for Antimicrobial Chemotherapy (BSAC) launched a national OPAT initiative in 2009, creating

the National Outcomes Registry System in 2015. OPAT programs across the United Kingdom voluntarily report OPAT indications, antimicrobial use, AEs, and clinical outcomes. Gilchrist et al [7] summarized key findings from the first 5 years of reporting available. Fifty-seven organizations submitted data, accounting for 27 841 patient episodes and 442 280 OPAT treatment days. Of the 26 436 adult patient episodes, the most frequent infection types were skin and soft-tissue infections, BJIs, and respiratory infections. Ceftriaxone (44.8%), teicoplanin (15.1%), and ertapenem (10.6%) were the most common antimicrobials used. The median treatment days was 16.7 days. Vascular device complications and AEs occurred at rates of 1.4 and 1.9 events per 1000 patient-days, respectively. Overall infection cure or improvement was achieved in 92.4%.

This is the largest report of OPAT program data available and can be used by other institutions to compare their program metrics. In addition, Gilchrist et al [7] suggest useful benchmarks for rates of vascular device complications and other AEs in adults receiving OPAT.

Short- Versus Standard-Course Intravenous Antibiotics for Periprosthetic Joint Infections Managed With Debridement and Implant Retention: A Randomized Pilot Trial

While the OVIVA trial demonstrated noninferiority of early transition to oral antibiotics in adult patients with a variety of BJIs, only a small proportion of participants included in these studies underwent a DAIR (debridement, antibiotics, and implant retention) procedure for PJIs [14].

In this open-label, randomized pilot trial, Manning et al [8] compared short (2 weeks) versus standard (6 weeks) duration of parenteral antibiotics, using a desirability of outcome ranking (DOOR) end point specifically designed for PJIs managed with DAIR. The DOOR approach to PJIs considers the potential risks as well as benefits of antibiotic therapy. A 7-point DOOR ordinal score was developed to account for survival at 12 months, clinical cure of PJIs, and treatment-related AEs.

Sixty adults with an early PJI (within 30 days of the index arthroplasty) or late-acute PJI (>30 days after index arthroplasty but with ≤21 days of symptoms before diagnosis, in the absence of a sinus tract) of the hip or knee joint were randomized to receive a short versus standard duration of parenteral antibiotics, with both groups receiving a minimum total antibiotic duration of 12 weeks. Clinical care was achieved in nearly 75% of patients, with no differences between groups. There was approximately 60% probability that short-course treatment was better than the standard course, using the novel DOOR outcome. Major AEs related to PICC lines or antibiotics occurred in 15% of participants. Eleven major AEs occurred in 9 participants (5 in the standard-course and 4 in the short-course group). A PICC-associated deep venous thromboses and CDI occurred in 1 participant each in the standard-course group. AKI occurred in 9 patients (5 in the standard-course and 4 in the short-course group). No PICC-associated bloodstream infections occurred in either group. The findings of this small pilot trial [8] support the growing body of evidence suggesting that carefully selected patients with PJI managed with DAIR may be able to safely undergo early transition to oral antibiotics.

OPAT Versus Hospitalization for Infective Endocarditis: Validation of the OPAT-GAMES Criteria

International criteria describing which patients with infective endocarditis (IE) may receive OPAT are restrictive [19]. In earlier work, the authors proposed a new set of criteria for which IE patients might receive OPAT, OPAT-GAMES (Grupos de Apoyo al Manejo de la Endocarditis in Espana) [20]. The OPAT-GAMES criteria consider IE patients with the following as ineligible for OPAT: advanced liver cirrhosis, major central nervous system emboli, undrained splenic or renal abscess, vertebral abscess requiring intervention, periannular complications, severe postsurgical complications, difficult-to-treat microorganisms, and active person using intravenous drugs. In the current study, Pericàs et al [9] assessed the OPAT-GAMES criteria in a large cohort to determine their utility in identifying patients at higher risk of OPAT complications.

Pericàs et al performed the study in 35 Spanish centers from January 2008 through December 2018, before implementation of the OPAT-GAMES criteria. Attending physicians determined whether patients would receive OPAT or hospital-based therapy for the duration of treatment. When ordered, OPAT was provided via hospital-at-home programs, including daily nursing visits. Patients receiving hospital-based therapy for the duration of treatment, OPAT recipients meeting OPAT-GAMES criteria, and OPAT recipients not meeting OPAT-GAMES criteria were compared. Propensity score analyses were performed.

Of 3547 patients who survived the initial admission, 2279 received hospital-based therapy, and 1268 received OPAT. Two-thirds of patients who completed hospital-based therapy and three-quarters of those receiving OPAT met OPAT-GAMES criteria. Cardiac surgery was associated with a lower 1-year mortality risk, while Charlson comorbidity score was associated with higher mortality risk. OPAT recipients meeting OPAT-GAMES criteria and patients receiving hospital-based therapy had similar rates of readmission, death, and recurrence. OPAT recipients not meeting OPAT-GAMES criteria had more readmissions than patients receiving hospital-based therapy. Meanwhile, OPAT recipients meeting OPAT-GAMES criteria and those not meeting OPAT-GAMES criteria each had shorter inpatient stays than patients receiving hospital-based therapy (19 and 17 days shorter, respectively).

These data inform international guidelines as to which IE patients may be good OPAT candidates. However, although patients receiving OPAT who did not meet OPAT-GAMES criteria had increased readmissions, they did not have

increased mortality rates and their hospital stays were 17 days shorter than those of patients treated in the hospital. Those deciding on OPAT eligibility may wish to balance hospital length-of-stay measures with readmission measures. In addition, understanding the role of the OPAT-GAMES IE criteria in the setting of transition to oral antibiotics will be important.

Survey of Pharmacists on Their Roles and Perceptions of OPAT in the United States

OPAT teams are usually multidisciplinary and may include at least 1 physician, nurse, pharmacist, advanced practice provider, and others [21]. However, the current number and function of clinical pharmacists practicing in OPAT in the United States is unknown.

To answer these questions, Rivera et al [10] distributed a survey through the American College of Clinical Pharmacy ID Practice and Research Network email listserv in 2021. Of the 87 respondents, 27 practiced in OPAT. For the 22 pharmacists who reported having a formal OPAT team, the team most commonly consisted of physicians, pharmacists, and nurses. The top 5 functions of OPAT pharmacists included adjusting medications based on laboratory values, ordering safety/monitoring laboratory tests, changing medications based on tolerance or ADEs, follow-up on overdue or outstanding laboratory results, and changing medications based on susceptibility results. However, the top 3 most important functions for OPAT pharmacists were adjusting medications based on laboratory values, patient review for OPAT appropriateness, and changing medications based on tolerance or ADEs.

The results of this survey show there is a significant number of ID-trained pharmacists working in OPAT in the United States. Moreover, it suggests that there is likely a discrepancy between the OPAT pharmacist functions that are currently being performed and those that are most important. A benchmark of 1 OPAT pharmacist for every 45–75 OPAT recipients was proposed.

Outpatient Versus Inpatient Intravenous Antimicrobial Therapy: A Population-Based Observational Cohort Study of AEs and Costs

Understanding the use of OPAT and its benefits have, in the past, been limited to retrospective reviews of a single institution with variability in prescribing practices, outcomes, and management of these patients [22,23]. Furthermore, cost analyses of OPAT programs often lack a realistic comparator group and describe heterogeneous practice models [24]. Longitudinal evaluation of OPAT with a similar comparator group provides valuable economic and clinical data for those considering implementation and for programs currently existing.

Staples et al [11] conducted a retrospective observational cohort study of patients with hospital admission for a bacterial infection requiring intravenous antimicrobials including osteomyelitis, septic arthritis, PJI, epidural abscess, endocarditis, *S aureus* sepsis, and *Streptococcus pneumoniae* meningitis from 2012–2018 in British Columbia. The OPAT study group was identified using an administrative code for clinical OPAT services that is part of the fee-for-service payment structure in Canada. Because of this identification method and use of an administrative database, an implied duration of intravenous antimicrobial therapy was assigned to each patient based on Infectious Diseases Society of America (IDSA) guidelines. Patients not receiving the administrative code were assigned to the inpatient parenteral antimicrobial therapy (IPAT) comparator group. The primary outcome compared the incidence of AEs occurring within 90 days of the index hospital admission among the matched groups. The cost analysis estimated direct healthcare costs over the 90-day interval using estimates from hospital costs and a case mix–based relative cost weight.

The matched cohort was composed of 921 OPAT and 921 IPAT recipients. OPAT recipients were primarily male (67.8%), with a median age of 62 years. The most common admission diagnoses were osteomyelitis (38.2%) and joint infection (36.7%). Hospital readmission was more likely in the OPAT group (30.5% vs 23%), but this group was less likely to experience CDI (1.2% vs 3.1%). OPAT recipients spent, on average 32.5 total fewer days in the hospital. Cost analysis suggested a cost savings of $17 579 Canadian Dollars (CAD) in the OPAT group compared with the IPAT group (95% CI, $14 131–$21 027 CAD).

This study suggests substantial cost savings for patients obtaining OPAT services with a similar AE profile, though a potential confounder includes increased complexity in the IPAT compared with OPAT the group and use of an administrative database with coding identifying patients. Ultimately, this study could inform hospital systems considering OPAT program implementation or continuation.

Clinical Efficacy and Safety of Continuous Infusion Vancomycin in Patients Treated at Home in an OPAT Program

With the 2019 IDSA vancomycin guidelines recommending a transition to area under the curve–based monitoring for vancomycin, the ideal modality for administering and monitoring vancomycin in the outpatient setting is still not well established [25]. Continuous infusion vancomycin (CIV) offers many practical benefits for monitoring in the outpatient setting. There are limited prospective data on the use of CIV in the OPAT setting and even fewer data on patients' opinions of CIV.

Thijs et al [12] performed a single-center prospective observational study of a nurse-compounded and -administered CIV protocol in Belgium. Patients were seen twice weekly for monitoring and assessment by an interdisciplinary OPAT team. At the end of therapy, patients were administered an electronic patient satisfaction survey. The study consisted of 32 patients who had a total of 35 OPAT treatments with CIV. The majority of

patients in this study were male (65.7%), with a median age of 61 years. The most common indication for CIV was BJI (85.7%) with methicillin-resistant *Staphylococcus epidermidis* as the causative pathogen (65.7%). The median outpatient duration of CIV was 18 days, with 68.4% of CIV random levels within the defined therapeutic range of 20–25 mg/L.

Three patients (8.6%) experienced ADEs, 2 attributed to CIV, with all leading to discontinuation of vancomycin. In remaining 32 OPAT courses, patients completed the planned CIV course and were evaluable for clinic cure. All patients were deemed clinically cured. In addition, 2 patients (5.7%) had adverse catheter events that were managed with cessation of vancomycin. Only 12 patients were eligible for the electronic patient satisfaction survey, with 7 completing the survey. All patients were at least satisfied with their CIV OPAT course, with (71.4%) very satisfied.

This study represents continued data showing that CIV is a reasonable option for patients needing vancomycin in the outpatient setting. Of note, the model described in this study may be more intensive (daily nurse compounding and administration of CIV, twice-weekly clinic follow-ups) than many OPAT programs can sustain. Despite the small number of respondents, the patient satisfaction survey does provide some initial evidence that patients can be satisfied with CIV modalities.

Implementation of Intravenous Push Antibiotics for Outpatients During a National Fluid Shortage After Hurricane Maria

Interest in rapid intravenous push (IVP) administration of common antibiotics has increased over the past decade, in part owing to the recognition that this approach may reduce delays in empiric antibiotic therapy for patients with sepsis [26]. While many studies have reported the safety of this approach [27,28], relatively little has been published about the efficacy of antibiotics given by IVP. In September 2017, Hurricane Maria devastated Puerto Rico, a major producer of the small volume intravenous fluid bags used for standard intravenous piggyback (IVPB) antibiotic infusions. This supply chain disruption produced a months-long national shortage, compelling several medical centers to explore IVP β-lactam administration.

Yagnik et al [13] retrospectively compared the efficacy of ceftriaxone, cefazolin, cefepime, and daptomycin given via OPAT for osteomyelitis or IE by either IVP or IVPB, using a quasi-experimental before-after design. The authors identified 105 OPAT treatment courses administered via IVP from November 2017 to June 2018 and compared them with 95 OPAT treatment courses administered via IVPB during the same period 1 year earlier. Patients in the IVP group were older (mean age, 51 vs 47 years, respectively; $P = .01$) and less often treated with daptomycin (39% vs 55%; $P = .03$), but other demographic and clinical features were similar between groups. Clinical outcomes were nearly identical, including all-cause readmission at 30 days and 1 year, emergency department visits at 30 days and 1 year, and mortality rates. Patients learned how to administer antibiotics more readily by IVP than by IVPB, with 92% in the IVP group being able to "teach back" proper administration technique to their nurse within 3 attempts versus 71% of those given antibiotics by IVPB. Perhaps on account of this, the median hospital stay was marginally shorter in the IVP group (11 vs 12 days for IVPD; $P = .03$).

The work by Yagnik et al [13] is only the second publication reporting the efficacy of β-lactam antibiotics given by IVP versus IVPB; the first, examining 213 patients with gram-negative bacteremia, used a similar before-after design also in the context of the Hurricane Maria shortage, and similarly found equivalent clinical outcomes [29]. To our knowledge, this is the first study of clinical outcomes with IVP administration of daptomycin. These data, while limited, suggest that OPAT with β-lactams and daptomycin may safely be given by rapid IVP, yielding similar clinical efficacy, and that this approach may be easier for patients to learn.

CONCLUSIONS

Our multidisciplinary group of OPAT clinicians summarized the panel's "top 10" OPAT publications from 2022. Common themes that emerged from the top 10 articles included OPAT in BJIs, AEs and readmission factors, and alternative methods of administering OPAT. Compared with the 2021 top 10, the use of oral antibiotics remained central to multiple articles, while the treatment of patients with substance use disorder did not appear central to this year's selections. A review of this article will provide a summary of impactful OPAT-related publications from 2022.

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member of the Washington Academy of Physician Assistants; and is cochair of the IDSA Advanced Practice Provider interest group. K. L. R. has received honoraria from PharmCon. All other authors report no potential conflicts. All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest.

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