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Inpatient Cost Avoidance and Uncompensated Labor Associated With Different Outpatient Parenteral Antimicrobial Therapy Care Models

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Background. Outpatient parenteral antimicrobial therapy (OPAT) decreases length of stay and inpatient costs while benefiting patients. However, costs in the ambulatory setting are poorly quantified. To address this gap, we examined both inpatient costs avoided and uncompensated labor associated with OPAT delivered via 3 administration models: self-administration (S-OPAT), home care agencies/hemodialysis centers (HH-OPAT), and skilled nursing facilities (SNF-OPAT).

Methods. The length and type of treatment and postdischarge nonbillable encounters were reviewed via the electronic health record for all adult patients admitted to a large urban hospital and discharged on OPAT during two 3-month periods. Average daily inpatient care costs for Texas state hospitals and antibiotic wholesale acquisition costs were used to estimate OPAT costs and savings. Antibiotics with different formulations were converted to equivalent daily doses and their corresponding costs were averaged to estimate a daily cost.

Results. Among 342 patient records examined during the study periods, which accounted for 8656 inpatient days avoided, there were 211.1 nonbillable encounters per 100 patient-days of OPAT for patients discharged in SNF-OPAT, 9.1 in HH-OPAT, and 6.4 in S-OPAT ($P = .028$). The estimated cost avoided per 100 patient-days was $376 400 or approximately $5 430 197 per month.

Conclusions. A substantial burden of uncompensated labor was associated with all OPAT modalities; however, coordinating care with skilled nursing facilities was significantly more demanding when adjusted for days of OPAT. All OPAT models generated significant institutional savings, which are typically overestimated as they fail to account for the uncompensated support provided by the ambulatory care staff.

Keywords. cost; nonbillable visits; outpatient parenteral antimicrobial therapy; savings; uncompensated labor.

Patients suffering from serious infections commonly receive extended courses of intravenous (IV) antibiotics. Often, ongoing treatment with IV antibiotics is the sole factor requiring prolonged hospitalization, which negatively affects patient quality of life and increases healthcare costs. Outpatient parenteral antimicrobial therapy (OPAT) is an alternative strategy that facilitates patient discharge while still providing IV antibiotics. This care may be provided by home health agencies/home infusion pharmacies, patients and families (self-administration), at infusion or hemodialysis centers, or at skilled nursing facilities (SNFs) [1]. Several studies have demonstrated the safety of OPAT as a viable alternative to extended inpatient hospital stays [2–6], yet limited data exist to quantify the costs and savings associated with OPAT programs [7–11], especially in the United States [12]. Furthermore, many published studies are not generalizable or have methodologic limitations [13], complicated by the fact that costs vary based on the patient's medical complexity, location of OPAT services, antibiotics administered, and duration of therapy [14]. Typically, savings reported or inferred from OPAT have focused on inpatient days avoided [3, 8, 11, 15]. However, the ambulatory costs of providing OPAT are not well characterized.

Dedicated OPAT teams that include a combination of registered nurses (RNs), advanced practice providers, pharmacists, and physicians have demonstrated improved outcomes [4, 16–18]. While direct medical costs for OPAT such as medications, supplies, and nursing visits are quantifiable [19], the indirect costs, such as time spent coordinating care between external agencies and managing adverse outcomes, are not well quantified. Payers commonly do not recognize the necessary uncompensated care OPAT teams provide [14, 20, 21], which makes it difficult for specialty and infectious diseases

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clinics to support this work [20]. Notable are the poor outcomes associated with patients receiving OPAT in SNFs that lack the additional support for these specialized services [22–25].

To reduce costs among uninsured patients while still providing necessary medical care, Parkland Health (PH) developed a self-administration (S-OPAT) program wherein patients or their caregivers are educated on proper antibiotic storage and self-administration technique prior to discharge and receive weekly and ad hoc nursing care in the ambulatory infectious diseases clinic, and the PH pharmacy dispenses IV antibiotics and supplies. Every 2 weeks and at the end of therapy, patients are assessed by a physician or advanced practice provider. This program has proven to be both safe and cost-effective [3]. Additionally, the OPAT team also coordinates care for insured patients discharged with home health or home infusion agencies, to hemodialysis centers (HH-OPAT) or to skilled nursing facilities (SNF-OPAT).

While the PH OPAT program captures the costs of the weekly clinic visits for S-OPAT patients as a clinic encounter, the "behind the scenes" supportive care and coordination provided for S-OPAT patients without a corresponding billable visit is unknown. Furthermore, the time and effort needed to care for patients receiving OPAT through other pathways, such as via home health agencies and SNFs, is equally elusive. We sought to quantify the burden of uncompensated care provided by the OPAT team to better inform staffing needs, assure patient safety, and serve patients. Additionally, we sought to quantify the savings and costs avoided for the healthcare system using a generalizable methodology and measures that are standardized and practical.

METHODS

Setting

Parkland Health is an 882-bed safety-net hospital serving the 2.4 million residents of Dallas County. In 2023, 44% of patients served by PH were uninsured [26]. PH is eligible to use the 340B program, which requires manufacturers participating in Medicaid to provide outpatient drugs at significantly reduced prices to stretch scarce federal resources as far as possible to reach more patients and provide more comprehensive services [27].

Demographic information, comorbidities, number of discharge medications, the number and duration of antibiotics administered, postdischarge emergency department (ED) visits, hospital readmissions, treatment complications, and nonbillable encounters were collected from the electronic health record (EHR) for every adult patient discharged on OPAT during two 3-month periods (April–June 2021 and January–March 2022). Two separate time periods were chosen to capture differences in outcomes related to staffing changes, which have been reported previously [28]. Endpoints concluding OPAT therapy included completion of antimicrobial treatment, patient death, patient transfer or loss to follow-up, and a switch to oral antimicrobial therapy.

Nonbillable encounters were defined as any encounter recorded in the EHR on any day without a corresponding billable patient visit. Inpatient days avoided were defined as days postdischarge on which the patient received OPAT. An average daily inpatient cost of stay of $3764 for Texas state hospitals [29] and antibiotic wholesale acquisition costs (WACs) from the Texas Department of State Health Services from 2021 [30] were used to estimate generalizable expenses and inpatient costs avoided because of OPAT services.

Total days of OPAT were multiplied by the daily hospital-adjusted expense per inpatient day to determine costs avoided from inpatient care for each OPAT modality. The antibiotic costs avoided were calculated by multiplying the cost of the average equivalent daily dose for each antibiotic used by its treatment duration and adding them together for each OPAT modality. Cost estimates were reported separately and not added to the estimated inpatient cost avoided because the average daily hospital-adjusted expense per inpatient day already included the cost of antibiotics. Because the PH pharmacy incurred costs for the antibiotics supplied to uninsured patients via S-OPAT, the average daily equivalent costs of 340B drugs were multiplied by length of treatment to estimate net ambulatory antibiotic costs for the S-OPAT group. Ambulatory costs for HH-OPAT and SNF-OPAT antibiotics were not readily available.

Patient data were collected via manual chart review with a standardized instrument (Research Electronic Data Capture [REDCap]). The study was approved by the University of Texas Southwestern Medical Center institutional review board and the PH research review committee.

Statistical Analysis

Descriptive statistics were employed to summarize patients' demographic characteristics and outcomes. Continuous variables were summarized with mean, median, and standard deviation, and categorical variables were summarized using frequency and percentage. OPAT care groups were compared using 1-way analysis of variance for continuous variables and χ^2 test and Fisher exact test for categorical variables. The significance level was defined as a 2-sided P value $<.05$. All statistical analyses were performed using SPSS version 28 (IBM Corporation).

RESULTS

Patient Characteristics and Outcomes

Of 345 total patients, 3 patient records with OPAT type not specified were excluded, leaving 84 (24.6%) who received OPAT via SNF-OPAT, 117 (34.2%) via HH-OPAT, and 141 (41.2%) via S-OPAT. The characteristics of the groups differed. The mean patient age was 53.4 years, with significant differences between groups ($P = .02$), a lowest average age of 50.9 years in the S-OPAT group, and a highest average age of 55.3 in the HH-OPAT group (Table 1). There were significant differences in the mean number of comorbidities, which was highest in the

HH-OPAT group (2.4) and lowest in the S-OPAT group (1.5) ($P < .01$). In addition, the mean number of medications at discharge had a high of 13.2 in the SNF-OPAT group and a low of 10.8 in the S-OPAT group ($P = .01$). The mean length of OPAT therapy was similar among groups (23 days for HH-OPAT, 23.8 days for SNF-OPAT, and 28.3 days for S-OPAT). Importantly, we found no differences between groups for the percentage of patients who required an ED visit while on OPAT (28.6% for SNF-OPAT, 29.9% for HH-OPAT, 29.8% for S-OPAT) or an ED visit within 30 days of discharge (27.4% for SNF-OPAT, 28.2% for HH-OPAT, 24.8% for S-OPAT). The percentage of patients readmitted while on OPAT (14.3% for SNF-OPAT, 14.5% for HH-OPAT, 14.9% for S-OPAT), or readmitted within 30 days of hospital discharge (13.1% for SNF-OPAT, 14.5% for HH-OPAT, 13.5% for S-OPAT), and the number of readmissions when adjusted per 100 person-days of therapy (Table 1) were similar.

Nonbillable Encounters by OPAT Group

Among the 342 patients, 283 patients (82.7%) had a total of 719 nonbillable encounters recorded in the EHR during the study period, or 2.1 encounters per patient (Table 2). Overall, the mean number of nonbillable encounters was highest in the SNF-OPAT group (2.6) followed by HH-OPAT (2.1), then S-OPAT (1.8) ($P = .02$). Nurse and provider encounters followed the same trend although the reverse trend was true for "other" encounters. A total of 8.3 nonbillable encounters/100 person-days of therapy was calculated, with significant differences between groups, including a high of 11.1 nonbillable encounters/100 person-days for the SNF-OPAT group, followed by 9.1 for HH-OPAT, and a low of 6.4 for the S-OPAT group ($P = .03$; Table 2).

Cost Avoidance Associated With OPAT

Overall, 8656 hospital days (25.3 days/patient) were avoided during the 6-month study period; 1979 days in the SNF-OPAT group (23.6 days/patient), 2693 days in the HH-OPAT group (23.0 days/patient), and 3984 days in the S-OPAT group (28.3 days/patient), with no significant difference in days per patient between groups ($P = .11$) (Table 3). This translates into an estimated total inpatient cost avoidance of $32 581 184 for the 6-month study period, or an average of $5 430 197 per month, and $376 000 per 100 patient-days of avoided cost for each group (Table 3). Using WAC data, the total estimated inpatient antibiotic costs avoided by the health system were $1 187 644 ($505 588 from SNF-OPAT, $383 240 from HH-OPAT, and $298 816 from S-OPAT) (Table 3). Given that drug acquisition costs were already included in the average hospital-adjusted expense per inpatient day data used, we estimate that antibiotic costs contributed to approximately 4% of inpatient costs. Using 340B drug pricing, we estimated the cost of providing ambulatory antibiotics for the S-OPAT group for PH to be $33 785.

DISCUSSION

OPAT enhances patient outcomes and decreases costs, though costs beyond length of stay and readmissions avoided are rarely captured. In our cohort, 83% of patients required nonbillable care (~2 nonbillable encounters/patient). When normalized for total length of treatment for each group, the rates varied from 6.5 (S-OPAT) to 12 (SNF-OPAT) nonbillable encounters/100 patient-days, even though SNF-OPAT had the smallest proportion of OPAT patients. Furthermore, while encounters with nurses accounted for the bulk of healthcare interactions, the differences in rates of SNF-OPAT patients requiring higher-billing providers were even more dramatic, over double that of the S-OPAT group.

A major strength of our analysis is that we compared healthcare utilization among patients managed by 3 different OPAT models, SNF included. Importantly, many OPAT programs do not routinely follow patients discharged to an SNF [31].

Table 1. Patient Characteristics and Outcomes, Stratified by Outpatient Parenteral Antimicrobial Therapy Group

Characteristic	Total	SNF-OPAT	HH-OPAT	S-OPAT	*P* Value
Patients	342 (100)	84 (24.6)	117 (34.2)	141 (41.2)	
Age, y, mean (SD)	53.4 (13.9)	54.8 (13.5)	55.3 (14.5)	50.9 (13.3)	.02
Female sex	111 (32.5)	20 (23.8)	37 (31.6)	54 (38.3)	.09
No. of comorbidities, mean (SD)	2.0 (1.4)	2.3 (1.4)	2.4 (1.4)	1.5 (1.2)	<.01
No. of discharge medications, mean (SD)	12 (5.7)	13.2 (5.5)	12.6 (6)	10.8 (5.3)	.01
Days of therapy, mean (SD)	25.4 (21.3)	23.8 (16.4)	23 (15.5)	28.3 (27.1)	.11
Readmission while on OPAT	50 (14.6)	12 (14.3)	17 (14.5)	21 (14.9)	.99
Readmissions within 30 d	47 (13.7)	11 (13.1)	17 (14.5)	19 (13.5)	.95
Visited ED while on OPAT	101 (29.5)	24 (28.6)	35 (29.9)	42 (29.8)	.98
ED visits within 30 d	91 (26.6)	23 (27.4)	33 (28.2)	35 (24.8)	.82
Readmissions/100 person-days of therapy	0.7	0.6	0.8	0.6	.75

Data are presented as No. (%) unless otherwise indicated.

Abbreviations: ED, emergency department; HH-OPAT, patients receiving outpatient parenteral antimicrobial therapy from a home healthcare agency, infusion center, or at hemodialysis; OPAT, outpatient parenteral antimicrobial therapy; SD, standard deviation; SNF-OPAT, patients receiving outpatient parenteral antimicrobial therapy at a nursing home; S-OPAT, patients self-administering antimicrobials via the Parkland Health program.

Table 2. Nonbillable Encounters by Outpatient Parenteral Antimicrobial Therapy Care Model

Patient Encounters	Total	SNF-OPAT	HH-OPAT	S-OPAT	*P* Value
Patients	342 (100)	84 (24.6)	117 (34.2)	141 (41.2)	
Nonbillable encounters	719 (100)	220 (30.6)	244 (33.9)	255 (35.5)	
Patients with nonbillable encounters	283 (82.7)	77 (91.7)	102 (87.2)	104 (73.8)	<.01
Total nonbillable encounters, mean (SD)	2.1 (2.1)	2.6 (2.4)	2.1 (2.0)	1.8 (2.0)	.02
RN encounter, mean (SD)	1.7 (1.7)	2.2 (1.9)	1.7 (1.5)	1.5 (1.7)	.02
Provider encounter, mean (SD)	0.3 (0.8)	0.4 (1.2)	0.3 (0.9)	0.2 (0.5)	.03
Other encounter, mean (SD)	0.1 (0.4)	0	0.1 (0.3)	0.2 (0.6)	.02
Nonbillable encounters/100 person-days of therapy	8.3	11.1	9.1	6.4	.03

Data are presented as No. (%) unless otherwise indicated.

Abbreviations: HH-OPAT, patients receiving outpatient parenteral antimicrobial therapy from a home healthcare agency; infusion center or at hemodialysis; RN, registered nurse; SD, standard deviation; SNF-OPAT, patients receiving outpatient parenteral antimicrobial therapy at a nursing home; S-OPAT, patients self-administering antimicrobials via the Parkland Health program.

Table 3. Costs Avoided in Association With Outpatient Parenteral Antimicrobial Therapy

Therapy	Hospital Days Avoided	Hospital Days Avoided/Patient[a]	Inpatient Cost Avoided	Antibiotic Cost Avoided[b]	Estimated Annual Savings
S-OPAT	3984	28.3	$14 995 776	$298 816	$29 991 552
HH-OPAT	2693	23.0	$10 136 452	$383 240	$20 272 904
SNF-OPAT	1979	23.6	$7 448 956	$505 588	$14 897 912
Total	8656	25.3	$32 581 184	$1 187 644	$65 162 368

Abbreviations: HH-OPAT, patients receiving outpatient parenteral antimicrobial therapy from a home healthcare agency; infusion center or at hemodialysis; SNF-OPAT, patients receiving outpatient parenteral antimicrobial therapy at a nursing home; S-OPAT, patients self-administering antimicrobials via the Parkland Health program.

[a] $P = .11$.

[b] Inpatient cost avoided already includes an estimate of antibiotic costs avoided; hence, antibiotic costs calculated using wholesale acquisition costs were not used when calculating estimated savings.

Previous work has shown that those receiving SNF-OPAT have worse outcomes and more complaints about lapses in medical care, infection prevention, and the physical environment compared to HH-OPAT [22–25, 32]. Higher rates of 30-day readmissions among patients discharged to an SNF have been reported by surgical specialties too [33]. However, the outcomes for SNF-OPAT patients in our cohort were comparable to patients in the HH-OPAT and S-OPAT groups, perhaps attributable to the significantly increased effort required to follow these patients, ensuring that orders were implemented correctly, blood tests were drawn, results checked, medications adjusted, and follow-up appointments completed. Given that nonbillable encounters in the SNF-OPAT group were double that of the S-OPAT group (managed exclusively by PH), our results reflect these challenges.

Another strength of our approach is the use of a normalized unit of measure that accounts for duration of outpatient therapy. Methodological differences in reporting patient outcomes could alter perceived risks, safety, and estimates of burden. The increased time required to coordinate care of SNF-OPAT patients was not immediately apparent when data were viewed solely in terms of nonbillable encounters over time. However, when normalized to 100 person-days of therapy, the burden posed by SNF-OPAT required a disproportionate amount of resources. Our findings suggest the need to standardize the use of normalized OPAT metrics that account for patient time on therapy to facilitate comparison of OPAT costs, safety, and quality. Such a metric could facilitate appropriate reimbursement for the increased care required.

On average, S-OPAT patients were younger and had fewer comorbidities. They were also carefully evaluated to ensure they had sufficient support to self-administer antimicrobials. This intensive upfront evaluation process with required weekly follow-up decreases the hidden time required for patient care as measured by nonbillable visits. Furthermore, nonbillable encounters for the S-OPAT group were roughly half those of other groups. In addition to the intense follow-up, this may be explained in part by shared laboratory and pharmacy services and an integrated EHR, suggesting the potential to improve efficiency with full integration of reference laboratory data, EHR data sharing, and all pharmacy and nursing services. Our model of S-OPAT consolidates all of these functions under a single, unified care delivery model. The burden may be different for patients receiving HH-OPAT via contracted agencies with less integration of pharmacy, nursing, laboratory, and EHR services.

Like other investigators, our data demonstrate that OPAT services decrease healthcare system costs. For a large safety net hospital system, an estimated 17 312 days of inpatient treatment were avoided over 6 months, which conservatively

translates into an estimated cost avoidance of $65 162 368 annually. Additionally, the value of OPAT programs is often measured by decreased ED visits and 30-day readmissions. Our results for ED visits and 30-day readmissions for patients discharged on OPAT were comparable to results reported by other large OPAT programs in the literature [3, 5, 34–36], with no differences across OPAT modalities.

For patients, OPAT increases autonomy and improves quality of life [1]. For the hospital, OPAT can increase bed capacity and thereby revenue. Based on WAC estimates, the inpatient costs avoided were largely driven by hospital operating costs, as antibiotic costs represented approximately 4% of total inpatient costs. However, using the more generalizable metric of 100 patient-days of OPAT therapy, we found a cost avoidance of $376 400 across all OPAT modalities, suggesting that OPAT has the potential to reduce costs even for healthcare systems with lower capacity.

There are several limitations to our study. Our long-standing S-OPAT program is relatively unique, and already included nurses, care coordinators, providers, and pharmacists. Hence, our well-developed processes and infrastructure may not capture the resources needed in less established programs, reducing generalizability. We chose to look at 2 cohorts of patients in 2 separate time frames, which may have changed resources available in our clinic and OPAT referral patterns. In addition, we only recorded nonbillable encounters that were documented in the EHR, which is an underestimation as our experience suggests that only a portion of nonbillable encounters are electronically documented. Another limitation is that nonbillable encounters served as an easily quantifiable proxy measure for uncompensated time and actual time spent was not captured, so we cannot accurately determine uncompensated labor costs for OPAT patients. More limited staff in the 2022 versus 2021 study period makes this even more likely due to reduced data-entry capacity. Additionally, the S-OPAT program preferentially uses daptomycin instead of vancomycin, which is not the case at many other institutions and may also contribute to why the S-OPAT group had fewer encounters. Vancomycin use has been associated with increased need for staff resources [13, 14]; hence, our findings likely underestimate the resources required compared to other OPAT programs.

Furthermore, we did not do a formal cost-effectiveness or economic analysis. WACs provide a reasonable estimate of antibiotic costs but do not represent the true costs paid by healthcare institutions, which vary significantly based on institutional contracts. Similarly, inpatient costs avoided do not represent the net savings associated with OPAT, as they do not account for any reimbursement for the hospitalization, or the ambulatory costs of providing OPAT.

Although our study is not a comprehensive analysis of the true costs of OPAT, it does demonstrate substantial health system savings while also demonstrating unrecognized costs for care provided by ambulatory staff. As institutions and payors increasingly recognize the value of infectious diseases specialty-related care, standardizing and adjusting OPAT metrics for patient volume and duration of treatment and evaluating the resources needed to achieve these metrics would enable better benchmarking and comparison between programs. Finally, while patients discharged to SNFs have a substantially higher burden of uncompensated care, our outcomes demonstrate that these patients do just as well as patients discharged to home when specific efforts are made to support the care of these patients. Additional research is needed to quantify the burden of uncompensated care required to run an effective OPAT program and standardize metrics used to evaluate the overall impact that OPAT has on the greater healthcare ecosystem.

Notes

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