

Effectiveness of Pediatric Outpatient Parenteral Antimicrobial Therapy (OPAT), a Four-Year Experience in a Single Study Center, Saudi Arabia

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Abstract

Background: The outpatient parenteral antibiotic therapy (OPAT) service is becoming increasingly popular worldwide due to its efficacy, safety, and cost-effectiveness. It is considered as an alternative to hospital treatment. However, these services have not yet become an integral part of the healthcare system in Saudi Arabia. The present study is intended to estimate the 30-day readmission rate of OPAT patients, estimate healthcare costs in OPAT services, evaluate patient and family satisfaction, and evaluate catheter-related complications. **Methods:** In this retrospective study, at the Prince Sultan Military Medical City (PSMMC), 80 patients aged ≥ 3 months to < 14 years, stable and kept only for the completion of IV antibiotics were recruited between the period of November 2020 to October 2023. Data on demographic characteristics, antibiotics used, improvement rate, patient satisfaction and cost-effectiveness were collected. **Results:** Significant variations in medical cases are observed, with notable fluctuations in UTI cases and consistent reporting of other medical conditions across the years. Antibiotic usage patterns also vary, with some antibiotics increasing in usage over time. Cost-saving analyses reveal substantial saving associated with outpatient parenteral antibiotic therapy (OPAT) compared to inpatient care, highlighting OPAT's cost-effectiveness. Inferential findings confirm significant differences in the distribution of medical cases and antibiotic usage across the years. The study highlighted the importance of OPAT in providing patient-centered care and managing healthcare expenses efficiently. **Conclusions:** Our study demonstrates that OPAT is a reliable and cost-effective service. It can reduce the direct cost of life-threatening infections compared to completing the course as an in-patient case. We have saved 93.48% of the overall estimated hospital expense through providing OPAT service.

Keywords: Outpatient parenteral antibiotic therapy, hospital treatment, healthcare system in Saudi Arabia, notable fluctuations.

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1. INTRODUCTION

Parenteral antimicrobial therapy (OPAT) is an effective modality for treating patients with many infectious diseases (ID) outside of a hospital setting [1, 2]. By allowing patients to receive treatment as an outpatient, OPAT avoids expenses associated with prolonged hospital stays, reduces exposure to nosocomial pathogens, and allow patients to maintain a normal lifestyle [3]. OPAT is generally regarded as safe, but it necessitates diligent monitoring for any potential complications related to the therapy itself, as well as for signs of treatment failure. This vigilant oversight helps

ensure that patients receiving OPAT continue to benefit from effective treatment while minimizing risks [4].

The most common infections treated via OPAT, include bone and joint infections, skin and soft tissue infections, pulmonary infections, cardiac/bloodstream infections, central nervous system infections, intra-abdominal infections, and urogenital infections [5]. Treatment duration can vary significantly, typically ranging from 2 to 8 weeks or even longer, depending on the type and severity of the infection, as well as individual patient factors. The flexibility of OPAT

allows for tailored treatment plans that accommodate the specific needs of each patient and their infections [6].

The Glasgow Outpatient Parenteral Antimicrobial Therapy (OPAT) service was formally initiated in 2001 with the primary aim of reducing or avoiding hospital admissions for patients with skin and soft-tissue infections (SSTIs) and bone and joint infections (BJIs). The key objectives were to maintain patient safety and optimize recovery and cure from these infections. From the outset, the service emphasized the careful selection of patients to ensure that outpatient management was at least as effective as inpatient care. Additionally, it was crucial that all aspects of care were thoroughly addressed despite the non-inpatient setting to prevent any compromise in the quality of treatment [7, 8].

OPAT is a well-established and cost-effective measure that improves the efficient use of healthcare resources and increases bed availability. It is clinically and cost-effective for a range of infections, allowing for the optimization of hospital bed capacity and patient flow [9]. National good practice recommendations and guidance have emphasized the importance of clinical governance structures around OPAT, with a particular focus on ensuring appropriate clinical management pathways and leadership from a dedicated multidisciplinary team [5, 10, 11].

Only limited published data is available to illustrate OPAT implementation and outcomes in Saudi Arabia [12, 13]. The main objective of this study was to evaluate the effectiveness of Pediatric- OPAT in different aspects in a tertiary center over 4 years in Saudi Arabia.

2. METHODS

2.1 Study design, area, and population

In this retrospective study, clinical charts of enrolled patients at a tertiary care center were reviewed from November 2020 to October 2023. The study included all admitted patients with a central line who were enrolled in the hospital's Outpatient Parenteral Antimicrobial Therapy (OPAT) program during this period. The primary outcome measured was the 30-day readmission rate of OPAT patients. Secondary outcomes included factors associated with OPAT failure (such as catheter-related complications, patient and family satisfaction) and healthcare costs. Descriptive analysis was used to present the results.

The study population consisted of pediatric patients aged 1 month to 14 years at the Prince Sultan Military Medical City (PSMMC), a single tertiary care center in Saudi Arabia. The in-house OPAT team selected and evaluated all patients discharged to their homes with parenteral antimicrobial treatment. An infectious disease specialist assessed each patient's clinical stability and developed a systematic treatment

plan, including antibiotic choices and duration. The clinical pharmacist monitored drug interactions and adjusted dosages, as necessary.

Inclusion Criteria:

- Pediatric patients aged 1 month to 14 years at PSMMC.
- Patients must have access to a home telephone.
- Patients must be stable enough to avoid hospital admission except for parenteral antimicrobial administration.

2.2 Measurement tools, data collection, and data analysis

The sample size for this study was a minimum of 50 patients. Data collection involved abstracting demographic and clinical data from the OPAT database, which included gender, age, clinical diagnosis, antibiotic agents used, duration of treatment, hospital readmissions during the treatment period, bed days saved, clinical outcomes, and estimated cost reduction. The analysis evaluated outcomes based on program safety, failure rate, and relapse rate. The primary outcome was the 30-day readmission rate of OPAT patients, with readmission defined as any unplanned hospital admission during the OPAT period or within one month after OPAT completion. Secondary outcomes included factors associated with OPAT failure.

Qualitative and quantitative methods were used to analyze data generated in the present study. The data were analyzed using the Excel tool. Further, the data were sorted based on the similarity and groups. For data analysis, we used statistical software - SPSS version 28. Using bar diagrams, histogram, and pie chart.

2.3 Ethical consideration

The main researchers received ethical approval from the Ethical Committee Prince Sultan Military Medical City, Scientific Research Center, Kingdom of Saudi Arabia. (Proposal ID: 445), Date 14/09/2023.

3. RESULTS

3.1 Descriptive Finding

Table 1, shows there are significant variations in the number of medical cases from 2020 to 2023. But a significant drop was observed in 2020 with only 3 UTI cases and 1 from the category "Others" thus summing up to become just the cases as mentioned above. UTI cases peaked in 2021 at the highest point for that year, with a total of 11. Sepsis had 4 cases and Pneumonia, Meningitis, and Septic Arthritis/Osteomyelitis overall registered one case each with "Others" reporting five for a total of 22. Moving to 2022, the counts were as follows: 4 UTI cases, 3 Sepsis cases; and there were three 3 to 1 case of Meningitis vs. Pneumonia vs. SCA with Fever but no Septic Arthritis a total of "only" 16. This apparent inconsistency of data carried forward into 2023, with a total of 38 cases reported for the year. Though some

categories summed up (e.g., Pneumonia 4, Meningitis 3, Sepsis 3), consistent in reporting were also seen in SCA with Fever, n = 3 and UTI n = 3; no one was recorded to have Septic Arthritis/Osteomyelitis or be "Others."

During all these years the UTI cases have varied considerably and among them, we see a notable increase in 2021.

Table 1: Medical cases from 2020-2023

Year	UTI	Pneumonia	Meningitis	Septic Arthritis / Osteomyelitis	Sepsis	SCA with Fever	Others	Total
2020	3	-	-	-	-	-	1	4
2021	11	1	1	1	4	-	5	22
2022	4	3	3	-	3	3	-	16
2023	3	4	3	-	3	3	-	38

Figure 1 shows in 2020 Ertapenem had 6 cases, while Gentamicin had 2 cases. Cefotrixone cases slightly decreased to 12 cases and no cases were reported for Meropenem, Gentamicin, Teicoplanin, Tazocin,

Ciprofloxacin, Caspofungin, or "Others". In 2023 a significant increase in the use of Cefotrixone in 25 cases. Ertapenem usage fluctuates, with an increase in 2023.

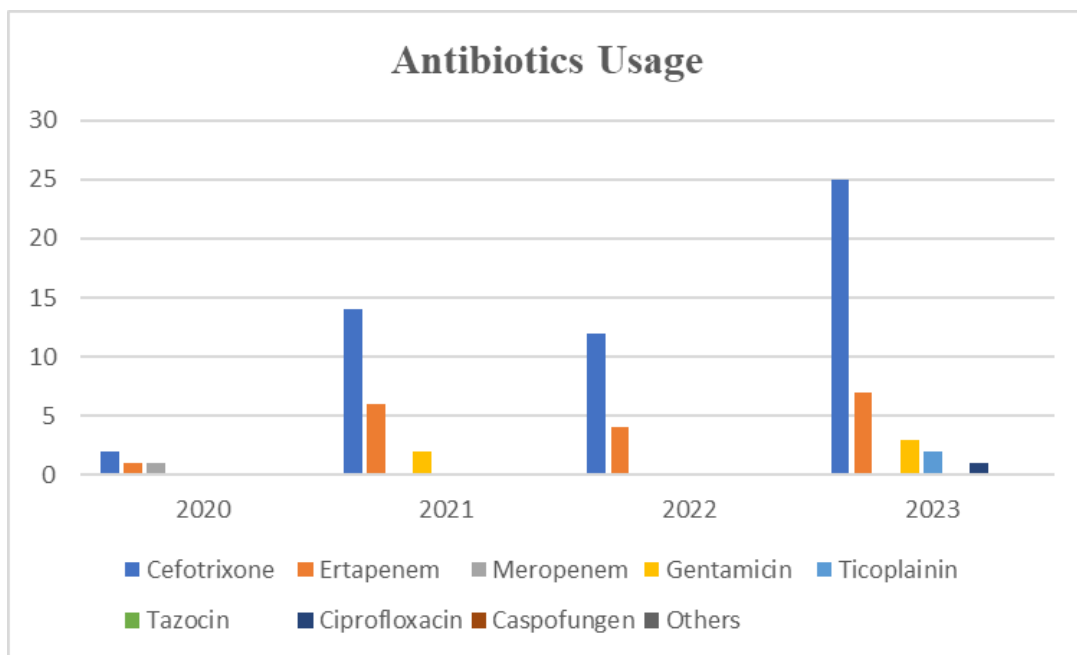


Figure 1: Antibiotics Usage from 2020-2023

As shown in Figure 2, inpatient costs from 2020 to 2023 for Saudi Arabia Riyals. Recorded firstly, substantial savings with OPAT versus inpatient care occurred across the whole period. Costs Last year, all pandemic-related expenses for inpatient and OPAT were reduced by 139,555. "Major savings were done as SAR

301,827 in the year 2021 and total of SAR 276,000 in the year 2022." Savings for 2023 are also substantial at SAR 113,648 In conclusion, OPAT is associated with substantial cost saving compared to inpatient care across all years.

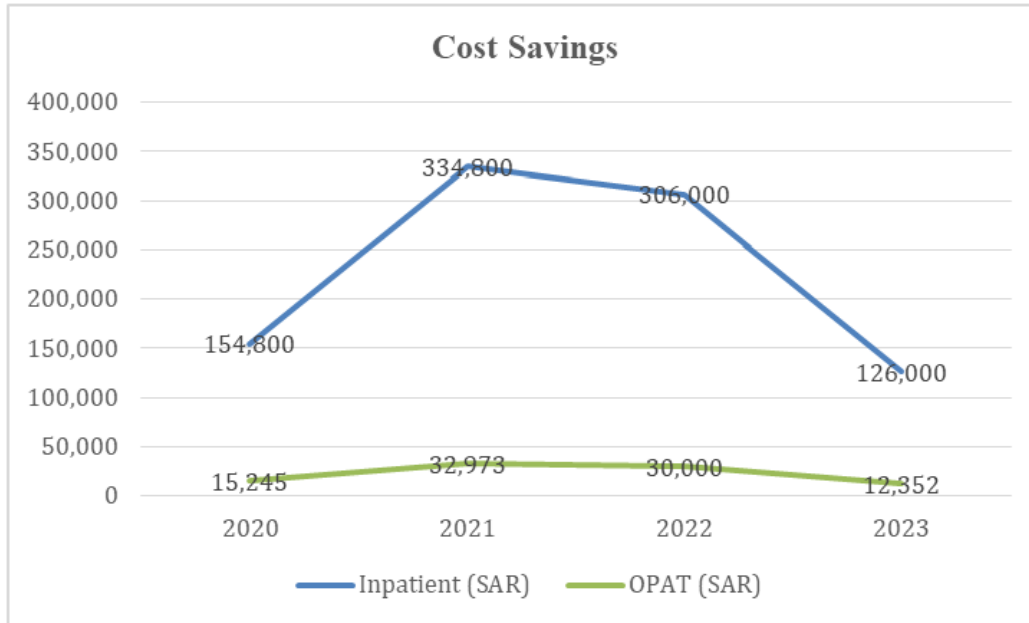


Figure 2: Cost Savings from 2020-2023

Table 2 shows, that from 2020 to 2021, the total days saved in managing various medical conditions at the hospital more than doubled from 85 to 175, with significant improvements in the management of UTIs, sepsis, and the introduction of effective treatments for pneumonia, meningitis, and arthritis. the total number of days saved at home in pediatrics OPAT over 2022 and 23 by treating a range of different conditions. Urinary tract infection decreased in the saved days where 37 in

2022 and became 23. Pneumonia, the number of days saved increased from 8 in 2022–23 to 18 in 2023. The days saved reduced dramatically from 103 in 2022 to 13 in 2023 for Meningitis. In 2023, for sepsis the days saved were also 10 and 15 in the previous year. SCA with Fever had days saved of 8 and 6 in 2022 and 2023, respectively. Total Days Saved: between the two years 170 and 70 days it is noted that there was a substantial decrease in total days saved.

Table 2: Days Saving from 2022 and 2023

Year	UTI	Pneumonia	Meningitis	Sepsis	Arthritis	SCA with Fever	Others	Total
2020	24	-	-	-	-	-	61	85
2021	95	10	10	40	6	-	18	175
2022	37	8	103	15	-	8	-	170
2023	23	18	13	10	-	6	-	70

3.2 Inferential finding

Table 3 shows the Chi-Square Test Results To determine if there is a significant difference in the distribution of categorical variables (e.g., types of medical cases, types of antibiotics used) across different years. Medical Cases: The p-value is less than 0.05,

indicating a significant difference in the distribution of medical cases across the years. Antibiotics Usage: The p-value is also less than 0.05, indicating a significant difference in the distribution of antibiotics usage across the years.

Table 3: Chi-Square Test

Statistic	Value
Chi-Square Test for Medical Cases	
Chi-Square (χ^2)	63.215
P- Value	0.000
Degrees of Freedom	24
Chi-Square Test for Antibiotics Usage	
Chi-Square (χ^2)	40.145
P- Value	0.000
Degrees of Freedom	27

Table 4 shows the paired T-Test for Cost Savings (2020 vs. 2021) and (2022 vs. 2023). The significant change in both Inpatient and OPAT cost savings between 2020 and 2021 is apparent, as shown above. However, the major gap between 2020 and 2021 is related to a significant increase in cost savings for

inpatient treatment along with OPAT. All of which imply an increase in terms of cost-efficiency regarding both types of treatments throughout this time. There is no statistically significant difference in the mean cost-saving differences between those from 2022 to 2023 for both the Inpatient and OPAT treatments.

Table 4: T-Test for Cost Savings

Statistic	Inpatient (SAR)	OPAT (SAR)
Cost Savings (2020 vs. 2021)		
Difference	180,000	17,728
Degrees of Freedom	1	1
Critical T-Value (p=0.05)	±12.706	±12.706
p-value	0.04	
Cost Savings (2022 vs. 2023)		
Difference	-180,000	-17,648
Degrees of Freedom	1	1
Critical T-Value (p=0.05)	±12.706	±12.706
p-value	0.07	>0.05

4. DISCUSSION

The core aim of Outpatient Parenteral Antibiotic Therapy (OPAT) is to provide superior patient-centered healthcare services closer to home while mitigating the risks associated with hospital stays, such as adverse events and readmissions. The findings substantiate the efficacy of OPAT, showcasing a minimal incidence of therapy complications and hospital returns. Given its potential to curtail healthcare expenses, the integration of OPAT programs is advocated. Despite a growing presence in Saudi Arabia, OPAT availability varies considerably, partly due to its perceived additional cost burden on the healthcare system. This study, unique in its comprehensive assessment of OPAT's effectiveness in Saudi Arabia, fills a crucial knowledge gap. Particularly, the results align with previous research, underscoring OPAT's positive outcomes and financial benefits when compared to traditional inpatient care models [14].

A successful approach for treating patients with severe infectious diseases (ID) outside of a hospital environment is outpatient parenteral antibiotic therapy (OPAT), as mentioned in a study done among patients who have infectious diseases. Routine assessments of all home care parenteral antimicrobial requests were made from February to December 2019, the results indicated outpatient antimicrobial stewardship, through remote assessment by an infectious disease specialist, was effective and safe in the OPAT setting [15]. Patients can maintain a regular lifestyle and save money by receiving therapy at home or an OPAT clinic, which also lessens their exposure to nosocomial infections and hospital costs [16]. Although OPAT is usually regarded as safe, it must be closely watched for therapy-related issues and treatment failure. The last study indicated infected prosthetic material as an independent predictor of readmission in OPAT patients. In a different predictive investigation, we found out that discharge from hospital

was associated with increased chances of readmission [14], not in line this study results, the finding substantiates the efficacy of OPAT, showcasing a minimal incidence of therapy complications and hospital returns. These findings collectively emphasize the importance of adaptability and efficiency in healthcare delivery to optimize patient care while managing costs effectively. In this study patient costs versus outpatient parenteral antibiotic therapy (OPAT) costs were compared, showing substantial savings with OPAT across all years. Major savings were observed in 2021 and 2022, with a reduction in pandemic-related expenses. In 2023, substantial savings were still noted, indicating the continued cost-efficiency of OPAT compared to inpatient care. These results line with a study done among 342 patients in 2 periods (April–June 2021 and January–March 2022), gave a well-established OPAT program, greater health care utilization [17].

In the Chi-Square Test, significant differences were found in the distribution of medical cases and antibiotics usage across the years, as indicated by low p-values (< 0.05), in line with a retrospective cohort study done in New Zealand, between 2014 and 2018, indicated the distribution of medical cases managed and the patterns of antibiotic usage, demonstrating the evolving nature of the OPAT service and its adaptability to changing healthcare needs and antibiotic stewardship practices [18]. Antibiotic use can be distributed in different ways in a population, and the association between the distribution of use [19]. This suggested the frequencies of medical cases and antibiotic usage vary significantly from year to year. A significant change in cost saving between 2020 and 2021 was observed for both inpatient and OPAT treatments. However, there was no statistically significant difference in the mean cost saving between 2022 and 2023 for both types of treatments. The findings provide valuable insights into the healthcare landscape and underscore the importance

of adaptability and efficiency in healthcare delivery. A study done at Al Hada Armed Forces Hospital, Taif, Saudi Arabia. A review of patient records spanning from November 2020 to October 2022, the results indicated OPAT service not only positively impacted patient care but also led to significant cost savings, exceeding 2 million riyals. These savings were primarily driven by the reduction in hospitalization duration and the more efficient allocation of resources. Additionally, this improvement contributed to the avoidance of 673 patient days of hospitalization, thereby freeing up resources for more critical cases [20].

5. LIMITATIONS

The findings may primarily apply to the healthcare context of Saudi Arabia and might not be universally applicable to other healthcare systems. The study's reliance on data from a single healthcare facility or region may limit the generalizability of the findings to broader populations.

6. CONCLUSION

The statement highlights the potential for Outpatient Parenteral Antibiotic Therapy (OPAT) to be utilized safely for pediatric patients.

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