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Costs of Antimicrobial Stewardship Programs at U.S. Children's Hospitals

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Abstract

The costs of Antimicrobial Stewardship Programs (ASPs) in children's hospitals have not been described previously. We assessed ASP costs using an online survey administered to ASP leaders at U.S. children's hospitals. ASP costs varied from \$17,000-\$388,500 (median \$187,400) annually. Overall costs were not correlated with hospital size.

Keywords

Antimicrobial Stewardship; Cost; and Pediatrics

Introduction

Antimicrobial stewardship programs (ASPs) are recommended to promote judicious antibiotic use and minimize development of antimicrobial resistance [1]. Maintaining a pediatric ASP, however, requires financial investment in the setting of strained healthcare budgets and competing priorities [2].

Published ASP cost evaluations have been mostly done in adult healthcare settings [3]. Cost assessments in pediatric populations have estimated savings solely from antimicrobial use [4,5], used estimates from single centers [6], or only analyzed the cost of salary support for ASP personnel [6]. Estimating annual investments across ASPs in multiple children's hospitals would establish a baseline for cost-benefit studies and help children's hospitals budget for new ASPs. In addition, since ASPs are now included in surveys measuring

hospital quality [7], describing the range of ASP financial support could help frame more precise metrics to compare hospitals.

In this study, we surveyed ASP leaders to estimate the annual ASP costs at children's hospitals in the US to describe the variation of annual costs incurred from pediatric ASPs.

Methods

Study Design and Participating Hospitals

We used a cross-sectional survey study design. Study hospitals were recruited from an ongoing quality improvement collaborative - the Sharing Antimicrobial Reports for Pediatric Stewardship (SHARPS), which focuses on establishing best practices for the use of antimicrobials among hospitalized children [8].

An internet-based survey was sent to the ASP director or a designated representative at participating hospitals. From November 2014 through February 2015, an initial email was sent to recruit participants followed by biweekly reminders to non-respondents. The study team contacted respondents to clarify responses, as needed. The Institutional Review Board at Columbia University Medical Center approved this study.

Survey

The survey queried hospital demographic data and current hospital ASP investment within four categories: personnel, equipment, software, and other. The personnel section assessed annual support for ASP personnel (physician, pharmacist, data analyst, and administrative staff) expressed as a percentage of full time equivalent (FTE). The equipment section inquired about the number and types of equipment purchased for use by ASP personnel (e.g., computers) and those purchased to assist stewardship activities (e.g., multiplex PCR testing). The software section assessed annual costs for commercially or internally developed software, currently being used for the ASP. The last section, assessed costs budgeted for travel and education and whether the ASP had a business plan.

Cost estimates

To estimate the annual cost of ASP personnel FTE support, we used salary and fringe data estimates from the 2014 American Association of Medical Colleges Faculty survey (physician salaries) and National Bureau of Labor Statistics (pharmacist, data analyst, and administrative support). The FTE value from the survey was multiplied by the 50th percentile salary estimate to calculate base salary, and the fringe percentage was subsequently added to this amount to calculate the total salary. To estimate equipment and software costs, we used vendor prices for ancillary equipment (e.g., computers) and costs directly provided by respondents for software and equipment purchases. All costs were expressed in 2014 U.S. dollars. Aggregated annual costs of maintaining ASPs were calculated by excluding one-time costs (e.g. initial cost of purchasing software).

Statistical Analysis

We described hospital characteristics of respondents (number of beds, region, and years since initiation of ASP program). To focus on hospitals with formal ASP leadership, only hospitals providing salary support as percent FTE for a physician and/or pharmacist were included in the final analyses. Costs (median, range) were assessed in each survey category, and aggregate costs were calculated. In exploratory analysis, we calculated Pearson's correlation coefficient between aggregated annual ASP costs and hospital size.

Results

Study Participants

Of 32 hospitals participating in the SHARPS collaborative at the time of the survey, 29 (91%) completed the survey. Respondents were physician leaders (14) or pharmacists in consultation with the physician leader (15).

Respondents represented hospitals with median size of 302 beds (IQR 258–595), and a median ASP duration of 2 years (IQR 0–10 years). Respondent hospitals were located in the Northeast (5), Midwest (11), South (8), and Western (5) regions of the U.S. Three ASPs that did not provide physician or pharmacy FTE salary support were excluded, leaving 26 hospitals for analysis.

Estimated cost for ASP personnel

All 26 ASPs provided salary/fringe support for physicians (FTE range: 0.1–0.8, median: 0.3), with annual estimated costs ranging from \$17,000–\$134,100 (median: \$50,700). Twenty-two (85%) ASPs provided support for pharmacists (FTE range: 0.3–1.0, median: 0.5), with cost estimates ranging from \$45,700–\$152,300 (median: \$76,100) annually. Five (19%) ASPs provided support for data analysts (FTE range: 0.2–0.5, median: 0.2), costing \$29,100–\$72,800 (median: \$36,400) annually. No ASPs had dedicated salary support for administrative staff. Total FTE support was more strongly correlated with increasing pharmacist vs. physician FTE (correlation coefficient 0.9 vs. 0.6). The distribution of physician vs. pharmacist FTE support did not vary significantly with hospital size.

Cost for software and equipment

Five (19%) ASP budgets included the cost of commercial ASP software \$58,300–\$145,000 (median: \$70,000) and six (23.1%) had purchased equipment for use by ASP personnel at a median cost of \$900 (range: \$800–\$1500). No ASPs budgets included the cost of laboratory equipment.

Other Annual Costs

Four (15%) ASPs supported education or training for hospital personnel, seven (27%) provided travel funds for ASP-related activities, and one funded personnel recruitment. Only 10 (38%) ASPs had formal business plans.

Overall costs and correlation with hospital size

Overall ASP budgeted costs, excluding one-time costs, varied from \$17,000-\$388,500 (median: \$187,400) annually. In exploratory analysis, there was no significant correlation between hospital size and institutional ASP costs (Pearson Correlation Coefficient = 0.2) (Figure 1).

Discussion

In this study, we estimated the median annual cost for a pediatric ASP as \$187,400. However there was substantial variability in institutional financial support among large children's hospitals with formal stewardship programs ranging from \$17,000 to nearly \$400,000 annually. Institutional commitment to ASP is now included in quality measures used to rank children's hospitals [7]. However, measures, which rely on binary responses, lack precision and may not capture the potentially significant differences in financial support for ASPs shown in this study.

The bulk of ASP budgets were dedicated to salary support for core ASP personnel: physician and pharmacist. While this corroborates prior data on investments for pediatric ASPs [9], it is unknown if this allocation of resources remains adequate, or whether this investment is balanced against the value derived from ASP activities. However, pediatric ASPs that dedicate financial resources have shown greater reductions in antibiotic use [10]. Few surveyed ASPs had a written business plan, which is an indicator of institutional financial oversight and sensitivity to cost concerns.

The observed variation in ASP costs was not correlated with hospital size, a potential surrogate for the number of antibiotic stewardship interventions required. This may indicate that financial support reflects institutional commitment rather than perceived need based on hospital characteristics. This also suggests that ASPs might vary in cost effectiveness, an area for future study.

This study has limitations. Study participants were mostly freestanding children's hospitals with relatively recently formed ASPs; therefore our results may not be generalizable to smaller centers or programs that have been sustained longer. Our study also may not reflect pediatric ASP costs in community hospitals, or pediatric centers that are part of larger adult facilities. Because we only included hospitals with FTE support for physician or pharmacist, these estimates do not reflect ASP costs for hospitals that support stewardship activities without formal programs. Costs for personnel were estimated indirectly, though we used current regional salary and fringe estimates. We did not include "one-time" implementation costs, since most hospitals could not determine costs of ASP initiation.

In conclusion, we observed substantial variation in financial support for ASP across children's hospitals. Further studies should link ASP costs to reductions in antibiotic use, and patient outcomes.

Acknowledgments

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Figure 1.
Distribution of ASP costs in U.S. dollars and number of hospital beds. The median cost is shown.