A Prospective Audit for Initiating a Pediatric Antimicrobial Stewardship Program utilizing the Antibiotic Management Score (AMS) in an Urban Medical Center 

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Abstract

BACKGROUND
Antimicrobial stewardship programs (ASPs) promote the appropriate use of antimicrobials by selecting the optimal dose, duration, and route of administration. The ASP has the potential to improve efficacy, reduce treatment-related costs, minimize drug-related adverse events, and limit the potential for emergence of antimicrobial resistance.

OBJECTIVE

To audit the quality of antibiotic prescribing in children with positive blood cultures by utilizing the antibiotic management score (AMS) prior to initiating an ASP at our children's hospital.

METHODS

A 2-year retrospective chart review (2010-2011) was performed for all episodes of positive blood cultures in the pediatric inpatients. 7 antibiotic management variables (empiric therapy, dose, duration, frequency, de-escalation, targeted therapy and drug levels) were evaluated for each episode and appropriate management was determined. A score of 0 was considered as optimal management. For inappropriate management, variable 1 point was added to the Antibiotic Management Score (AMS), up to a maximum of 6 (or 7 if antibiotic drug levels where relevant) per treatment course.

RESULTS

101 episodes of positive blood cultures (age range 0-20 years) were identified. 40% of cases were treated in the NICU, 60% in pediatric inpatient units. The following groups of bacteria were identified: 41 Coagulase-negative staphylococci, 17 S. aureus, 24 Gram-negative bacteria, and 2 Group B streptococci. A total of 621 antibiotic management variables for all cases were evaluated. The average AMS for the institution was 1.08. 48.5% of patients received suboptimal antibiotic therapy (AMS > 0) with a mean AMS of 2.2 per episode. The AMS was significantly increased in pediatric compared to neonatal units (1.4 vs. 0.8; p = 0.04). Patients with poor outcome (death or microbiological failure) had significantly higher AMS than those with good clinical outcomes (mean AMS = 2.3 vs. 0.88; p = 0.01).

CONCLUSIONS

The composite cumulative AMS allows quantification of deviation from management guidelines. The AMS is thus useful for monitoring the impact of ASP on quality of antibiotic prescribing and patient outcome for individual units or clinical syndromes such as bacteremia.

Methods

- A 2-year retrospective chart review of bloodstream infections in pediatric patients at SUNY Downstate Medical Center from 2010 to 2011.
- Data collected included demographic characteristics, clinical presentation, focus of infection, causative organisms and sensitivities.
- Poor outcome was defined as mortality and/or bacteremia > 5 days duration.
- Antibiotic management score (AMS) consisted of 7 variables: presumptive therapy, dose, frequency, target levels (where applicable), de-escalation, targeted therapy, duration.
- Appropriate/inappropriate management determined by use of national guidelines and standard references (i.e. IDSA guidelines, Feigin & Cherry).
- A score of 0 on the AMS was considered as high quality prescribing.
- For each inappropriate management variable 1 point was added to the AMS, up to a maximum of 6 (or 7 if antibiotic drug levels where relevant) per treatment course.
- A logistic regression was conducted, predicting clinical failure.
- Covariates- Central line, ID Consult & blood sample prior to antibiotics were introduced first, then the 6 predictors of interest in forward selection fashion, using p<0.15 as the entry criterion.
- In a second model, the sum of the 6 predictor items was used instead of individual items, the Hosmer-Lemeshow lack of fit test was applied to this model.

Results

- 101 episodes of positive blood cultures (age range 0-20 years) were identified.
- 40% of cases were treated in the NICU, 60% in pediatric inpatient units.
- The AMS was significantly increased in pediatric compared to neonatal units (1.4 vs. 0.8; p = 0.04). 48.5% of patients received suboptimal antibiotic therapy (AMS > 0) with a mean AMS of 2.2 per episode (Fig.2).
- 2 of the 6 predictor items of interest were selected into the model: empiric therapy and targeted therapy. Adjusted odds ratio (95% confidence intervals) were 0.23 (0.05,1.04) for empiric therapy (p=0.056) and 0.240 (0.06,0.93) for targeted therapy (p=0.043). Area under the receiver operating characteristic curve (ROC) for this model was 0.78, suggesting moderate predictive utility of the 2 items used jointly.
- Patients with poor outcome (death or microbiological failure) had significantly higher AMS than those with good clinical outcomes (mean AMS = 2.3 vs. 0.88; p = 0.001) and for cases of true pathogens (mean AMS =2.2 vs. 0.76; p=0.04) (Fig. 4,5).
- In the model that substituted item sum for individual items, adjusted odds ratio was 1.77 (1.21,2.58) for each 1-unit increase in predictor score (p=0.003) area under the ROC curve for this model was 0.75, i.e., the 6-item summary performs slightly less well than the best 2 items used in additive fashion.

Conclusion

- The composite cumulative AMS allows quantification of deviation from management guidelines for individual units or conditions; correlation of AMS with clinical outcome validates its relevance for monitoring management of patients with positive blood cultures.
- Differences between NICU and Pediatrics may reflect higher consensus among providers on management in NICU.
- The AMS may be a useful tool further study as a benchmark for antibiotic management.
- The use of empiric and targeted therapy variables in an additive fashion could serve as a promising predictor in resource limited settings at a minimum to evaluate ASP interventions.
- Our study has the following limitations: retrospective chart review; limited number of clinical outcome variables used and small number of patients with poor clinical outcomes.

References

1. Society for Healthcare Epidemiology of America; Infectious Diseases Society of America Pediatric Infectious Diseases Society. Policy Statement on Antimicrobial Stewardship by the Society for Healthcare Epidemiology of America (SHEA), by the Infectious Diseases Society of America (IDSA), and the Pediatric Infectious Diseases Society (PIDS). Infect Control Hosp Epidemiol 2012;33;33:322-327