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Brian R Lee

Alison C Tribble

Jeffrey S Gerber

Adam L Hersh

Matthew P Kronman

See next page for additional authors

Authors
Brian R Lee, Alison C Tribble, Jeffrey S Gerber, Adam L Hersh, Matthew P Kronman, and Jason G Newland

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Research Brief

Inappropriate antibiotic surgical prophylaxis in pediatric patients: A national point-prevalence study

Brian R. Lee MPH, PhD[1], Alison C. Tribble MD[2], Jeffrey S. Gerber MD, PhD[3], Adam L. Hersh MD, PhD[4], Matthew P. Kronman MD, MSCE[5] and Jason G. Newland MD, MEd, FPIDS[6] on behalf of the SHARPS Collaborative[a]

[1]Division of Health Services and Outcomes Research, Department of Pediatrics, Children's Mercy Kansas City, Kansas City, Missouri, [2]Division of Pediatric Infectious Diseases, Department of Pediatrics, University of Michigan, Ann Arbor, Michigan, [3]Division of Infectious Diseases, Department of Pediatrics, Perelman School of Medicine at the University of Pennsylvania, Children's Hospital of Philadelphia, Philadelphia, Pennsylvania, [4]Division of Pediatric Infectious Diseases, Department of Pediatrics, University of Utah, Salt Lake City, Utah, [5]Division of Pediatric Infectious Diseases, Department of Pediatrics, University of Washington, Seattle, Washington and [6]Division of Pediatric Infectious Diseases, Department of Pediatrics, Washington University in St Louis, St Louis, Missouri

In the United States, surgical procedures account for up to 450,000 pediatric admissions each year,[1,2] with antibiotic prophylaxis administered for >50% of surgeries.[3–5] National guidelines provide procedure-specific recommendations for antimicrobial prophylaxis, including drug and dosing, in an effort to reduce surgical site infections.[5] The 2017 Centers for Disease Control and Prevention (CDC) guideline recommends only a single dose of perioperative prophylaxis for clean and clean-contaminated cases.[6]

Despite these guidelines, inappropriate surgical prophylaxis use continues to be common. In a pediatric study of surgical antibiotic prophylaxis in 348,119 procedures, 35.4% of antibiotic prophylaxes were considered inappropriate, with interhospital variability ranging from 15.6% and 52.7%.[3] In another study, Voit et al[7] found that 28% of surgical procedures had excess duration of antibiotic prophylaxis prior to the new recommendation eliminating postoperative doses in low-risk surgeries. In this multisite study, we aimed to determine the prevalence of inappropriate surgical prophylaxis among hospitalized children.

Methods

Study sample

A point-prevalence survey (PPS) was conducted in 32 children's hospitals to document antimicrobial prescribing among hospitalized patients. Data were collected during 6 quarterly cycles from September 2016 to December 2017. Patients <18 years of age with an active antimicrobial order at 8:00 AM on the day of the PPS were eligible for inclusion. This methodology has been used in similar studies.[8,9] A chart review of the electronic medical record was performed, and patient data (eg, age, sex, medical service type, and underlying chronic conditions) and antimicrobial characteristics (eg, name, route, indication, appropriateness) were recorded in a Research Electronic Data Capture (REDCap) online database. Additionally, for antibiotics, data were collected regarding when or if the antimicrobial stewardship program (ASP) would have routinely reviewed this antibiotic. For this post-hoc analysis, we selected those patients who were receiving an antibiotic with an EHR-documented indication for surgical prophylaxis.

Study outcome

The primary outcome was whether the antibiotic was inappropriate or not, which was recorded on the day of the PPS. The determination of inappropriate antibiotic administration was completed by the physician(s) and/or clinical pharmacist(s) involved with the institution's ASP. Several factors were considered when assigning appropriateness, including drug, route, and indication. If the antibiotic was recorded as inappropriate, the reviewer indicated the primary reason for inappropriateness from a prespecified list (ie, pathogen–drug mismatch, surgical prophylaxis duration >24 hours, unnecessary duplicate therapies, intravenous medication that could be administered orally, or other with free text response). A standard operations manual that provided clear definitions of inappropriateness was given to each participating institution.

Data analysis

The frequency of inappropriate surgical prophylaxis was calculated, stratified by surgical specialty (otolaryngology, orthopedic, cardiovascular, neurosurgery, urology, cosmetic or reconstructive, general surgery, other) and whether the ASP would routinely review the antibiotic. Additionally, we evaluated the variability in inappropriate surgical prophylaxis across the participating institutions. Analyses were completed using SAS version 9.4 software (SAS Institute, Cary, NC). Institutional review board approval was obtained for all sites.

Author for correspondence: Brian R. Lee, E-mail: blee@cmh.edu

[a]SHARPS Collaborative authors: Holly Maples, Hoang Huynh, Kanokporn Mongkolrattanothai, Hayden Schwenk, Betty P. Lee, Fouzia Naeem, Brenik Kuzmic, Amanda Hurst, Sarah Parker, Jennifer Girotto, Nicholas Bennett, Rana F. Hamdy, Benjamin M Hammer, Shannon Chan, Katie Namtu, David Berman, Preeti Jaggi, AJ Fernandez, Craig Shapiro, Margaret Heger, George Johnson, Sameer J Patel, Leslie Stach, Tony Scardina, Kristen Nichols, John Manaloor, Kelly Flett, Sarah Jones, Rosemary Olivero, Sara Ogrin, Terri L. Stilwell, Jennifer Goldman, Karisma Patel, Diana Yu, Miranda Nelson, David Rosen, Andrea Green, Jennifer Zweiner, Joshua Courter, David Haslam, Saul R Hymes, Preeti Jaggi, Jessica Tansmore, Talene Metjian, Kelly Lee, Sandra Arnold, Luis Castagnini, Sarah Kubes, Marc Mazade, Michelle Crawford, Kathryn Merkel, Marisol Fernandez, Michael Chang, Hillary Orr, Adam Hersh, Jared Olsen, Scott Weissman, Adam Brothers, Ritu Banerjee, Jessica Gillon, Sheryl Henderson, Erin McCreary, and Elizabeth Lloyd.

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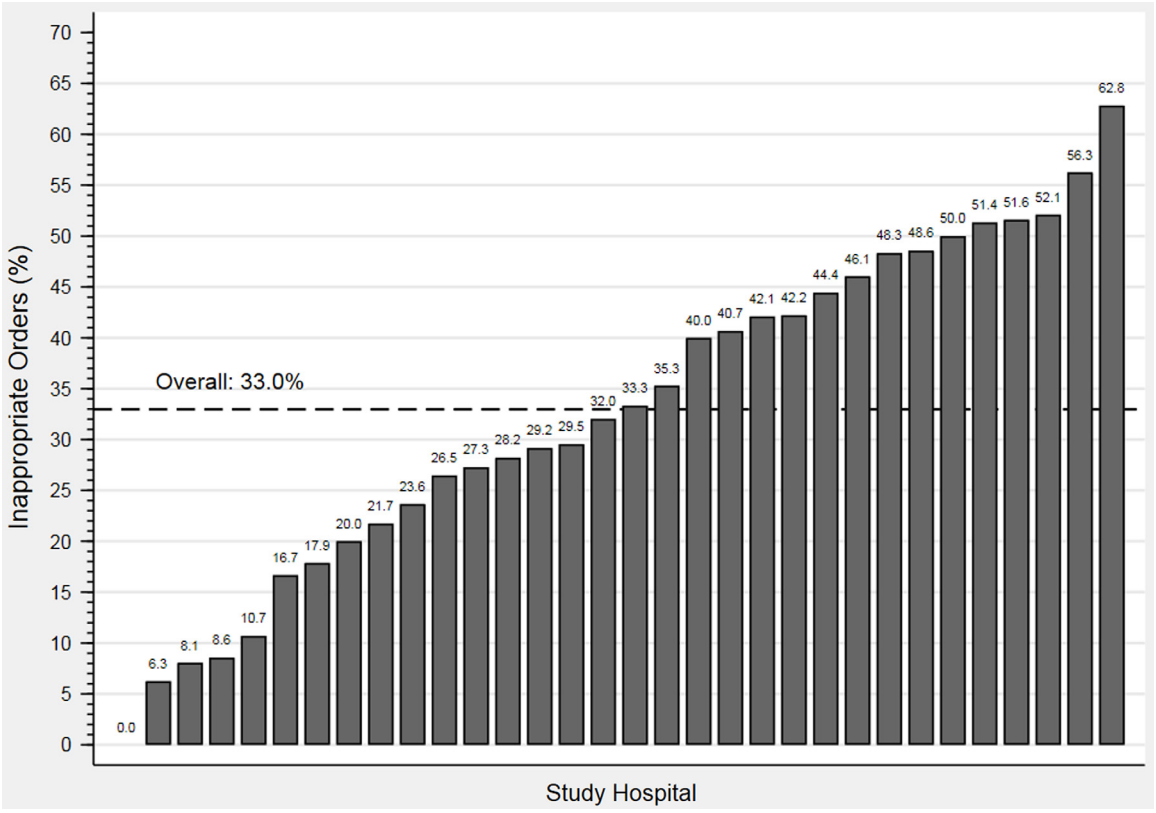

Fig. 1. Inappropriate surgical prophylaxis by study hospital.

Results

Overall, 32 hospitals participated in at least 1 of 6 PPSs. Clinical characteristics from 13,051 patients who were actively receiving antimicrobial treatment were recorded during the study period. Of these, 1,324 patients (1,477 orders) were receiving antibiotics for surgical prophylaxis. The most commonly prescribed surgical prophylaxis antibiotic was cefazolin (n = 788, 53.4%) followed by clindamycin (n = 85, 5.8%), vancomycin (n = 85, 5.8%), cefoxitin (n = 69, 4.7%), and piperacillin/tazobactam (n = 54, 3.7%).

Overall, 485 surgical prophylaxis antibiotics (33.0%) were categorized as inappropriate. The most common reason was due to prophylaxis of >24 hours (n = 387, 79.8%). Other inappropriate reasons for surgical prophylaxis included prophylaxis not indicated (n = 32, 6.6%) and antibiotic too broad (n = 29, 6.0%). The frequency of inappropriate surgical prophylaxis was higher among otolaryngologic surgery patients (62.7%; 95% confidence interval [CI], 52.6–72.1) cosmetic or reconstructive surgery patients (40.7%; 95% CI, 30.0–52.2), and neurosurgery patients (40.3%; 95% CI, 34.2–46.6) compared with orthopedic surgery patients (15.5%; 95% CI, 11.1–20.7) and cardiovascular surgery patients (24.5%; 95% CI, 20.1–29.3). Of the 485 surgical prophylaxis prescriptions reviewed that were determined to be inappropriate, most (n = 258, 53.2%) would not have been routinely reviewed by the ASP. Inappropriate surgical prophylaxis varied significantly across the 32 hospitals, from 0.0% to 62.8% (Fig. 1).

Discussion

This study demonstrates the continued and consistent inappropriate use of surgical antibiotic prophylaxis in children. Similar to previous studies,[3,4,10] 33% of surgical antibiotic prophylaxis was considered inappropriate. The most common reason for inappropriate use was prolonged duration of prophylaxis for >24 hours. In light of the new CDC guideline recommending no doses for low-risk procedures, our inappropriate rate is likely an underestimate. In addition, institutional-level inappropriateness in this study varied from 0 to 63%, which agrees with prior research.[3]

This study has several limitations. First, the PPS methodology provides a 1-day glimpse of antimicrobial use within a hospital which may not be entirely comprehensive of all surgeries, including procedures where prophylaxis was not given. However, the prevalence of inappropriate use from our study shows similarity with prior research. Lastly, categorizing an antibiotic as inappropriate or not was a perceived determination by ASP team members within each institution, which may have introduced some differential classification. However, an operations manual was used to help standardize the definition of inappropriateness. Moreover, only a trained ASP physician and/or clinical pharmacist was permitted to make the determination.

In conclusion, a significant portion of surgical antibiotic prophylaxis is inappropriate. This study specifically highlights the prolonged durations of prophylaxis being provided. Future studies are needed to better estimate the overall rate of inappropriate surgical prophylaxis, the factors that drive prolonged surgical prophylaxis, and the best interventions to improve the use of surgical antibiotic prophylaxis.

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Conflicts of interest. All authors report no conflicts of interest relevant to this article.

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Association between use of diagnostic tests and antibiotic prescribing for pharyngitis in the United States

Daniel J. Shapiro MD[1], Laura M. King MPH[2], Katherine E. Fleming-Dutra MD[2], Lauri A. Hicks DO[2] and Adam L. Hersh MD, PhD[3]

[1]Division of Pediatric Emergency Medicine, Department of Pediatrics, Boston Children's Hospital, Boston, Massachusetts, [2]Office of Antibiotic Stewardship, Division of Healthcare Quality Promotion, National Center for Emerging Zoonotic and Infectious Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia and [3]Division of Pediatric Infectious Diseases, Department of Pediatrics, University of Utah, Salt Lake City, Utah

Pharyngitis is a common reason for outpatient antibiotic prescribing in the United States.[1,2] With few exceptions, antibiotics should be prescribed for pharyngitis only after confirmation of group A *Streptococcus* (GAS) by laboratory testing.[3] Because rapid antigen-detection tests (RADTs) have a specificity >95% but a sensitivity that is often <90% compared to throat cultures, national guidelines recommend performing cultures when RADTs are negative in children, but not in adults.[3,4] Inappropriate antibiotic prescribing for pharyngitis occurs when antibiotics are prescribed without testing or when antibiotics other than narrow-spectrum penicillins are chosen for nonallergic patients.[3,5] Because the prevalence of GAS among cases of pharyngitis is estimated to be 20%–30% in children and 5%–15% in adults, prescription rates higher than these thresholds suggest overuse.[1,3] Appropriate laboratory testing for pharyngitis in patients who are prescribed antibiotics is a Healthcare Effectiveness Data and Information Set (HEDIS) performance measure in children, and it will expand in 2020 to include adults.[5] Our objectives in this study were to describe use of laboratory testing and antibiotic prescribing for GAS in the United States.

Author for correspondence: Daniel Shapiro, E-mail: daniel.shapiro@childrens.harvard.edu

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Methods

We performed a cross-sectional analysis of data from the 2014–2016 National Ambulatory Medical Care surveys, annual surveys of visits to office-based physicians conducted by the National Center for Health Statistics.[6] Data included tests performed (test results not available), diagnoses using *International Classification of Diseases, Ninth and Tenth Revisions, Clinical Modification* (ICD-9-CM and ICD-10-CM) codes, and medications. National estimates were generated by applying visit weights to the multistage probability sample.

We included visits by children (aged 3–17 years) and adults (aged ≥18 years) with acute pharyngitis, streptococcal sore throat, or acute tonsillitis (ICD-9-CM codes 462–463, 034 and ICD-10-CM codes J02–J03). Laboratory tests included RADTs and throat cultures. In analyses of antibiotic prescribing, we excluded visits with additional diagnoses potentially warranting antibiotics (eg, urinary tract infection or pneumonia).[1] Recommended antibiotics included narrow-spectrum penicillins.[3] Antibiotics were identified using Multum Lexicon therapeutic class and generic drug codes.

The main outcomes were (1) the proportions of visits for pharyngitis in which laboratory tests were performed (overall and among visits with antibiotics prescribed); (2) the proportion of visits in which an antibiotic prescription was not associated with performance of a laboratory test; and (3) the proportion of antibiotic prescriptions that were in the recommended category. Estimates and 95% confidence intervals (CIs) accounted for the