Short Report: Antibiotic Use in Pediatric Patients Admitted to a Referral Hospital in Botswana

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Abstract. Inappropriate antimicrobial drug use is well described for hospitalized patients in the United States. Antibiotic use in hospitals in developing countries is less well documented. We evaluated the antibiotics prescribed to 91 pediatric inpatients in Botswana. The results showed that the duration of prescribed therapy can be excessive. Recommendations for potential interventions to reduce antibiotic overuse in this setting are necessary.

Inappropriate antibiotic-prescribing practices have been well described in developed nations1–6 but data are lacking for developing countries. Overuse of antibiotics can result in high prevalence of resistance to commonly prescribed antibiotics, necessitating the use of more expensive second- or third-line agents. Published reports have already documented the presence of bacterial resistance in Botswana, a sub-Saharan African country.3,4 The healthcare system in Botswana is better funded than the systems of most developing countries but there are many competing priorities for the 8.3% of its gross domestic product (GDP) that is devoted to health. By contrast, the United States devotes 15.4% of its GDP to healthcare.5

Given the emergence of antibiotic resistance and limited healthcare resources in Botswana, we evaluated antibiotic-prescribing practices for pediatric patients admitted to a referral hospital in Gaborone, Botswana, over a six-week period. This pilot study aimed to identify areas for future intervention to improve antibiotic use with an ultimate goal of limiting emergence of bacterial resistance and reducing healthcare expenditure in the setting of a developing nation.

A prospective observational chart review was performed on all patients admitted to the inpatient pediatric medical service at the Princess Marina Hospital in Gaborone, Botswana from March 5–April 18, 2007. This service cares for children 0–13 years of age and is the referral center for the southern part of the country. At the time of admission, verbal consent was obtained from the parents to approve the collection of data from the patient’s chart. Data abstraction was performed by either a study physician (PAM) or one of two pediatric nurses (SAI and CAG). Once a patient was admitted, the data abstractors reviewed charts daily until the time of discharge. Data regarding previous medical history including human immunodeficiency virus (HIV) status, physical examination, radiographic and laboratory results, medications, and diagnoses were documented on a de-identified data collection form. The total duration of antibiotic use, excluding anti-tuberculous agents, was calculated for each patient. The total antibiotic duration included the number of continuous inpatient antibiotic days plus any additional days of antibiotics prescribed for continued outpatient therapy. Patients readmitted during the study period were not included in the cohort a second time.

All discharge diagnoses were reviewed for each patient by a pediatric infectious disease physician (BTF). Each admission was categorized as “likely infection” or “not likely infection” on the basis of the presence or absence of clinical, radiographic, or laboratory evidence for a bacterial, atypical bacterial, fungal, or viral infection other than HIV. The groups were then compared with regards to frequency of antibiotic initiation and duration of antibiotic therapy. Additionally, antibiotic-prescribing patterns were evaluated in a subgroup of patients who had a chest radiograph for presumed pneumonia. The duration of antibiotics in patients with radiologically confirmed lobar pneumonia was then compared with the World Health Organization (WHO) recommendation of a 5–7 day course.6

Data were analyzed using Stata version 9.2 software (Stata Corp., College Station, TX). Summary statistics were constructed using frequencies and proportions for categorical data and medians and interquartile ranges (IQRs) for continuous variables. Wilcoxon rank sum test and Pearson’s chisquare test were used for comparisons between groups when appropriate. A P value less than 0.05 was considered statistically significant.

The study was reviewed and approved by the Institutional Review Boards at the Children’s Hospital of Philadelphia, Princess Marina Hospital, and the Botswana Ministry of Health.

From March 5 through April 18, 2007, 106 admitted patients were approached for enrollment into the study cohort. The patient’s primary caregiver declined or was unavailable for verbal consent in 13 cases and two patients had previously been admitted during the study period. This left 91 newly admitted patients for study entry. There were two patients who were readmitted during the study period. These subsequent admissions were not included in the analysis. The cohort was 96% Botswana and 2% Zimbabwean. The median age of patients was 1.5 years (IQR = 5 months–4 years) and 53% were female. Twenty-two percent (20 of 91) of the cohort had underlying HIV infection and included three newly identified patients. Two (2.2%) patients, each with a clinical diagnosis of Pneumocystis jiroveci pneumonia, died during their hospital admission. Table 1 illustrates the primary diagnosis for each patient and the frequency of antibiotic use for each condition. The infectious diagnoses reported in Table 1 were primarily based on clinical evaluations because of limited availability of...
microbiologic testing during the study period. Fourteen specimens were sent for culture (3 blood, 8 cerebrospinal fluid [CSF], 2 stool, and 1 urine). Of these specimens, one CSF specimen yielded a positive culture for Salmonella species.

Patients with an infectious diagnosis were more likely to be given antibiotics than those with a non-infectious diagnosis (Table 2). Among patients with a non-infectious diagnosis, those prescribed antibiotics were more likely to have fever at presentation (63% versus 22%; $\chi^2 = 3.97, P = 0.046$) than those not prescribed antibiotics. Data on antibiotic duration was available for 92% of patients prescribed antibiotics. Durations of antibiotic use were similar for patients with or without an infectious diagnosis (Table 2). In our cohort, seven of nine patients with gastroenteritis received antibiotics. Unfortunately, we did not collect data regarding the presence of bloody stools and thus it is difficult to comment on the appropriateness of antibiotics in these seven patients. Lastly, the duration of antibiotic use in most patients with suspected bacterial pneumonia was longer than WHO recommendations. However, it was still encouraging that the median total duration for suspected bacterial pneumonia of 9.5 days was less than the often recommended 10-day course in developed nations.

On the basis of the WHO guidelines for diarrhea therapy, the presence of blood in the stool is the primary determining factor of whether an infection was diagnosed or not (Table 2). Although antibiotic initiation practices were reasonable, the ultimate duration of prescribed antibiotics was a concern for various reasons. First, the duration of antibiotic use for those with and without an infectious diagnosis was similar. Second, it is likely that some of the infectious diagnoses were viral in etiology, making prolonged courses of antibiotic therapy in these patients unnecessary. Similar practices have been well described in developed nations.

For certain diagnoses, such as gastroenteritis, it is not always clear whether the etiology is viral or bacterial. On the basis of the WHO guidelines for diarrhea therapy, the presence of blood in the stool is the primary determining factor for initiating treatment with antibiotics. In our cohort, seven of nine patients with gastroenteritis received antibiotics. Unfortunately, we did not collect data regarding the presence of bloody stools and thus it is difficult to comment on the appropriateness of antibiotics in these seven patients. Lastly, the duration of antibiotic use in most patients with suspected bacterial pneumonia was longer than WHO recommendations. However, it was still encouraging that the median total duration for suspected bacterial pneumonia of 9.5 days was less than the often recommended 10-day course in developed nations.

On the basis of these data, the goal of limiting the overuse of antibiotics should focus on timely cessation of antibiotic use in patients without an infection. A number of barriers exist that may challenge this focus. The lack of laboratory studies to distinguish viral from bacterial infections may have promoted continued antibiotic use. Negative blood culture results at 24–48 hours are often used to justify termination of antibiotic use in developed healthcare systems. The limited number of blood cultures results available during the study period may have contributed to the continuation of antibiotic use in a subset of patients.

Additionally, this cohort had a high prevalence of underlying HIV infection. Physicians appropriately may have had a heightened concern for invasive bacterial infections. Again, we anticipate that availability of negative culture data would have limited the duration of antibiotic use even in HIV-infected patients. Lastly, the estimated number of nurses (2.65/1,000 population) and physicians (0.4/1,000 population) in Botswana is much less than in the United States (9.37 nurses/1,000 population).
population and 2.56 physicians/1,000 population). Shortages of medical personnel limit the ability for closer monitoring of patients, which may lead to more liberal antibiotic-prescribing practices.

Previous studies have documented unnecessary use of antibiotics in children in Botswana in the outpatient setting. This study is the first assessment of pediatric inpatient antibiotic use for this region and suggests that antibiotic exposure in patients with or without an infection can be reduced. Potential interventions to achieve this reduction include ensuring an uninterrupted supply of blood culture bottles, physician education and a daily review of diagnoses among patients prescribed antibiotics to identify those no longer in need of therapy.

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