Pediatric Cellulitis

Success of Emergency Department Short-Course Intravenous Antibiotics

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Objectives: The administration of 1 to 2 doses of intravenous (IV) antibiotics in the emergency department (ED) followed by discharge on oral antibiotics has become a treatment option for children with cellulitis, despite an absence of evidence supporting this practice. The objective of this study was to determine the failure rate of ED short-course IV antibiotic therapy (IV–short course).

Methods: This retrospective study included children aged 0 to 18 years diagnosed with cellulitis in a pediatric ED during the 2005 calendar year. Treatment was categorized as (*a*) discharge on outpatient oral antibiotics, (*b*) IV–short course, or (*c*) admission for IV antibiotics (IV-admit). Failure was defined by a subsequent visit less than 7 days since the index visit with a change in antibiotic treatment, the administration of IV antibiotics, or hospitalization. A second data abstractor reviewed 10% of the charts to allow calculation of interobserver scores.

Results: There were 321 eligible children, of whom 154 children were treated with oral antibiotics, 85 IV–short course, and 82 IV-admit. A total of 23 patients (7%) met criteria for failure. Compared with IV-admit, the odds ratio of failure among those who received IV–short course was 7.2 (95% confidence interval [CI], 1.6–33.1). Those who received IV–short course were more likely to revisit within 7 days than were children treated with oral antibiotics alone (risk ratio, 2.4; 95% CI, 1.2–4.7); however, revisits were no more frequent than among children in the IV-admit group (risk ratio, 2.8; 95% CI, 0.65–12.1). The total mean duration of hospital stay was significantly less in the IV–short course group compared with the IV-admit group (14.9 vs 118.6 hours; $P < 0.001$).

Conclusions: Children with cellulitis frequently receive IV antibiotics. Short-course IV antibiotic therapy is associated with a high failure rate and prolonged ED stay compared with those in children treated with oral antibiotics alone. However, their clinical similarity to the IV-admit group, shorter length of hospital stay, but high failure rate mandates further evaluation before widespread adoption.

Key Words: cellulitis, antibiotics, intravenous injections

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Cellulitis is an acute pyogenic infection of the dermis and subcutaneous tissues that accounts for up to 1 in every 500 pediatric emergency department (ED) visits[1] and more than 14 million outpatient visits in the United States annually.[2] In the pre–*Haemophilus influenzae* and *Streptococcus pneumoniae* conjugate vaccine era, the bacteremia rate was nearly 20%.[3] However, recent evidence has found the rate to be only 2%, with group A streptococcus being most prevalent.[4] Although management guidelines uniformly recommend the administration of β-lactam antibiotics with activity against penicillinase-producing *Staphylococcus aureus*,[5] the route of administration is less standardized. In one study, 30 different antibiotic treatment regimens were used at 5 institutions, with the interventions varying widely even within institutions.[6] Although blood cultures, intravenous (IV) antibiotic administration, and hospitalization have historically been recommended for select high-risk children,[1] given the current rate of bacteremia, this approach may no longer be required.[4]

With the onset of community acquired methicillin-resistant *S. aureus* (CA-MRSA) infections, there has been an increase in the incidence of ED visits because of skin and soft tissue infections.[2] This increase has been most dramatic among children in the southern United States who have also experienced a dramatic alteration in the selection of antibiotics.[2] Although the rates of CA-MRSA has been lower in Canada than those in the United States, its prevalence has increased dramatically among individuals requiring hospitalization.[7]

The emergence of CA-MRSA has occurred at an inopportune time as there has also been a shift in ED patient care, with outpatient management strategies being increasingly used.[8,9] As a compromise between admission for inpatient antibiotics and immediate discharge on oral antibiotics, some pediatric institutions use day-treatment centers and short-stay units.[9,10] Other institutions have patients return to the ED for ongoing IV antibiotic therapy[8,11] or simply keep patients in the ED, allowing for the administration of multiple doses of IV antibiotics with the hope of avoiding hospitalization. With respect to the latter strategy, commonly used justifications include (*a*) to monitor for evidence of clinical worsening, (*b*) that several doses of IV antibiotic administration followed by oral antibiotics will prevent complications, (*c*) that a visible clinical improvement can occur from the administration of 1 to 2 doses of IV antibiotics, and (*d*) that improvement is necessary before discharge. However, to date, there is no evidence supporting the effectiveness of short-course IV antibiotics in the ED for the treatment of pediatric cellulitis and there is evidence that significant clinical improvement is uncommon within the first 24 hours of initiating IV antibiotic therapy.[9]

Objectives

As evidence-based, cost-effective care has become increasingly important, there is a need to identify diagnostic and treatment practices that are unwarranted. The most significant potential benefit of short-course IV antibiotics in the ED includes a reduction in hospitalization rates; however, potential disadvantages include a high outpatient treatment failure rate, the unnecessary administration of IV antibiotics and performance of laboratory investigations, and a significant impact on ED patient flow. Thus, the object of this study was to determine the failure

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rate of ED short-course IV antibiotic therapy and to determine if the anticipated reduction in the performance of blood cultures in children with cellulitis has occurred. Secondary outcomes included number of revisits within 1 week, ED length of stay, and the utility and frequency of blood culture performance.

METHODS

Setting

The Hospital for Sick Children is an urban, university-affiliated, tertiary-care pediatric hospital in Toronto, Ontario, Canada. The ED sees approximately 50,000 children annually and is staffed by attending physicians 24 hours per day. The study was approved by The Hospital for Sick Children's Research Ethics Board.

Study Design and Selection of Participants

This retrospective study included children aged 0 to 18 years who were evaluated and diagnosed with cellulitis in The Hospital for Sick Children's ED during the 2005 calendar year. Children were identified by searching the hospital's database for *International Classification of Diseases, Ninth Revision, Clinical Modification* codes that corresponded to cellulitis (681 and 682). Chart review was performed by accessing patient charts via the hospital's electronic patient chart system. Children were excluded if they were immunocompromised.

Clinical and Laboratory Assessment

Medical records from eligible patients were reviewed by the investigators, and standard forms were used to record the following: demographic information, historical variables, physical examination upon presentation, diagnostic tests performed, type and route of antibiotics administered, disposition, and complications. Particular attention was paid to potential risk factors for the failure of outpatient management including age; sex; antibiotic pretreatment; preexisting illness; pain assessment; location, size, and precipitating cause of cellulitis; maximum temperature; number of days of fever; white blood cell count; absolute band count; band-to-neutrophil ratio; antibiotics administered; ED management; and training of the treating physician.[3,4] All temperatures reported are adjusted to rectal, with 37.9°C being the upper limit of normal.[1] When no documentation regarding prior physician visits was available, it was assumed that the ED visit was the initial encounter.

The following organisms were considered to be pathogenic when detected in a blood culture: *S. aureus*, group A streptococcus, *S. pneumoniae*, and *H. influenzae*. Contaminants included *Staphylococcus epidermidis*, viridans streptococci, diphtheroids, and micrococcus species.[4] The charts of all children with positive cultures were reviewed by 2 additional investigators to confirm classification of the organism; that is, when a presumed contaminant was isolated, chart review confirming management consistent with such a determination was required. Cultures were considered negative if no organism was found. An additional 10% of charts were randomly selected and reviewed by a second data abstractor (A.K.) to allow the calculation of interobserver reliability for the primary outcome and the 4 clinical features of cellulitis (erythema, swelling, warmth, and pain).

Definitions

Cellulitis was defined as the recent onset of soft-tissue erythema associated with signs of infection that included 1 or more of the following: swelling, lymphangitis, fever, pain, or ulceration.[1] Emergency department management was grouped into 3 categories: (1) discharge on outpatient oral antibiotics (PO), (2) ED short-course IV antibiotics (IV–short course), and (3) admission for IV antibiotics with the decision made within 10 hours of physician assessment (IV-admit). Short-course IV antibiotic therapy includes all children who received IV antibiotics in the ED and were either those discharged from the ED without being admitted or those for whom the decision to admit was determined more than 10 hours after the initial physician assessment. Ten hours was chosen to differentiate between IV–short course and IV-admit, as children admitted within that time frame were unlikely receiving ED antibiotics with the goal of discharge, and the decision to admit was likely independent of the response to the initial dose of antibiotics. In our ED, patients are very rarely discharged with instructions to return for a second dose of IV antibiotics.

As the literature does not contain a validated definition of cellulitis treatment success/failure, we determined a priori that, to be successful, the administration of IV–short-course antibiotics in the ED should not be associated with increased return visits after discharge. Our definition is based on local consensus opinion and treatment patterns in this and other centers without 24-hour observation units. Thus, failure was defined as a subsequent ED visit within 7 days accompanied by a change in antibiotic treatment, the administration of IV antibiotics, or hospitalization.[9]

Immunodeficiency was defined as any known primary or secondary immunodeficiency state based on data available to the ED treating physician. The training level of physicians was categorized as either (1) American Board of Pediatrics–Pediatric Emergency Medicine certified, (2) full-time pediatric emergency medicine physician (not American Board of Pediatrics–Pediatric Emergency Medicine certified), and (3) licensed pediatrician who provides part-time ED coverage.

Outcomes

The primary objective was to determine if the proportion of children who failed treatment was significantly different among those who received ED IV–short-course antibiotic therapy compared with the 2 alternate treatment options. Secondary outcomes included total number of ED revisits within 1 week, median length of stay in the ED before disposition determination, and an assessment of the utility and frequency of performance of blood cultures.

Data Analysis

Categorical values are reported as counts and percentages (%), and continuous variables are reported as means (SD) and medians with ranges. Statistical differences in the frequencies of categorical variables were tested with either the Fisher exact test or χ^2 test for trends, and the means of continuous variables were compared using a 2-sample *t* test. When more than 2 groups were present for categorical variables, we used contingency tables with the χ^2 test of independence. A 1-way analysis of variance was used to compare continuous variables when more than 2 groups were present. Interobserver agreement was calculated using the Pearson correlation for the sum of the clinical cellulitis score, whereas the κ coefficient was used to determine agreement for the outcome of treatment failure. Median length of stay was analyzed using the Kruskal-Wallis test. Univariate logistic regression was performed including all potential risk factors (see Clinical and Laboratory Assessment) initially to determine

TABLE 1. Patient Demographics and Clinical Presenting Features (N = 321)

	PO (n = 154)	IV–Short Course (n = 85)	IV-Admit (n = 82)	*P*
Age, mean (SD),	7.2 (4.7)	8.0 (4.6)	6.9 (4.8)	0.27
Male sex, n (%)	76 (49.7)	54 (62.8)	47 (54.7)	0.10
MD prior (yes), n (%)	66 (43.1)	43 (50.6)	55 (64.0)	0.002
Temperature, mean (SD), °C	37.5 (0.71)	38.0 (0.91)	38.2 (1.03)	<0.001
Antibiotics prior (yes), n (%)	39 (25.5)	37 (43.5)	43 (50.0)	<0.001
No. days of symptoms, median	1.0	1.0	2.0	0.15
Symptoms,* n (%)				
Erythema	134/146 (91.8)	82/83 (98.8)	81/82 (98.8)	0.01
Swelling	129/144 (89.6)	72/83 (86.8)	75/81 (92.6)	0.47
Pain	84/128 (65.6)	58/76 (76.3)	59/75 (78.7)	0.09
Warmth	40/101 (39.6)	42/63 (66.7)	47/66 (71.2)	<0.001
No. findings, mean (SD) (maximum = 4)	2.5 (0.93)	3.0 (0.80)	3.2 (0.83)	<0.001

*Reported only for cases where the medical record identified the presence or absence of each finding.

PO indicates oral antibiotics alone; IV–short course, short-course IV antibiotic therapy (children in this group may have ultimately been admitted); IV-admit, decision to admit for IV antibiotics determined in <10 hours.

predictors of treatment failure. Those significant at the 0.2 level were then included in a multiple-predictor model.

Sample size was calculated based on the primary outcome, the failure rates of oral antibiotics alone compared with the failure of ED IV–short-course antibiotics. To have 80% power to detect a 10% difference between the failure rates of the 2 therapeutic options (20% for short-course IV, 30% for oral),[10] 293 subjects were required. All *P* values are 2-sided, with a value of less than 0.05 used to indicate statistical significance, without adjustment for multiple comparisons. Data were analyzed using SPSS version 16.0 (SPSS, Inc, Chicago, Ill).

RESULTS

Characteristics of Patients

During the study period, our ED evaluated and treated a total of 48,815 children. Our initial search identified 340 patients. Nineteen patients were ineligible, leaving 321 patients, aged 10 days to 17.9 years, who met all inclusion criteria. There were 15 patients younger than 1 year; 3 were younger than 1 month, 2 of whom were admitted for IV antibiotics. Overall, 165 (51%) of the eligible cellulitis cases had seen a physician before their ED presentation, 120 (37%) were receiving oral antibiotics, and the median duration of symptoms was 1 day. At the time of ED presentation, 34% (n = 109) were febrile, 92% (n = 295) had 2 or more signs of infection on examination, and 27% (n = 85) had all 4 features (Table 1). The number of clinical findings was significantly different between the 3 treatment groups ($P < 0.001$); however, it was not significantly different between the IV–short course and the IV-admit groups ($P = 0.15$). Interrater reliability was very good with a Spearman ρ of 0.77 ($P < 0.001$) for the features of cellulitis and a $\kappa = 0.78$ ($P < 0.0.001$) for the outcome measure of treatment failure.[12]

In 29% of the cases, no portal of entry was identified (Table 2); insect bites (21%) and trauma (19%) were most commonly noted. The portal of entry was not significantly different between groups ($P = 0.08$). Overall, extremities (leg, foot, arm, hand) accounted for 64% of cases (Table 2), with significant difference noted between groups ($P = 0.03$). Children in the IV-admit group were more likely to have cellulitis in the head and neck area; those in the PO and IV–short course groups were more likely to have cellulitis of an extremity.

Abscesses occurred in 9.3% of patients (30/321), with 7 diagnosed during a subsequent visit. Wound cultures were sent on 14.6% of patients (47/321) and were positive on 29. Although antibiotic resistance was reported for 5 (17.2%) of the positive cultures, only 1 organism was resistant to oxacillin, whereas 3 were resistant to clindamycin.

Intravenous antibiotics were administered to 167 children (52%) in total (Table 3). Most patients received IV cefazolin (70%), in accordance with our institution's dosing recommendation (50 mg/kg per day divided every 8 hours for mild to

TABLE 2. Possible Source and Location of Cellulitis (N = 321)

	PO (n = 154)	IV–Short Course (n = 85)	IV-Admit (n = 82)	*P*
Possible source				
None identified	41 (26.8)	26 (30.2)	26 (30.2)	
Insect bite	33 (21.6)	20 (23.3)	13 (15.1)	
Trauma	31 (20.3)	18 (20.9)	12 (14.0)	
Skin abnormality	19 (12.4)	11 (12.8)	7 (8.1)	
Dental	6 (3.9)	4 (4.7)	11 (12.8)	0.08
Recent immunization	7 (4.6)	5 (5.8)	3 (3.5)	
Other*	24 (15.4)	2 (2.3)	14 (16.3)	
Location				
Eyes	9 (5.8)	5 (5.9)	5 (6.1)	
Head/neck	25 (16.2)	12 (14.1)	22 (26.8)	
Extremity	107 (69.5)	60 (70.6)	38 (46.3)	0.03
Other†	13 (8.4)	8 (9.4)	17 (20.7)	

Values are n (%).

*Other includes postoperative wound, nail bed, foreign body, animal bite, and burn.

†Other includes torso, pelvis, buttock, and multiple sites.

TABLE 3. Outcomes According to ED Management Groups

	PO (n = 154)	IV–Short Course (n = 85)	IV-Admit (n = 82)	*P*
Revisit with any change to management, n (%)	8 (5.2)	13 (15.3)	2 (2.4)	0.002
Any ED revisit, n (%)	15 (9.8)	18 (20.9)	2 (2.3)	<0.001
Revisit with admission, n (%)	4 (2.6)	3 (3.5)	2 (2.4)	0.89
≥3 Doses of IV antibiotics, n (%)	0	23 (26.7)	0	<0.001
≥4 Doses of IV antibiotics, n (%)	0	7 (8.1)	0	<0.001
Time to disposition ≥10 h, n (%)	0	38 (44.7)	0	<0.001
Time to disposition ≥20 h, n (%)	0	4 (4.7)	0	0.004
Time to ED disposition, h	0.5	9.8	2.5	0.003
Total length of stay,* h	0.5	14.9	118.6	<0.001

*Total length of stay includes time in ED as well as time as an admitted patient when appropriate. Data were unavailable for patients who were transferred from the ED to an inpatient unit at a community hospital (n = 25).

moderate infections) (Table 4). Twenty-seven percent (n = 85) of the total cohort received IV–short-course therapy. In this subgroup of children, 23 (27%) received 3 or more doses of IV antibiotics, of whom 13 were admitted, whereas 62 patients (73%) were discharged after administration of 2 or less doses of IV antibiotics.

Outcomes

A total of 35 patients (11%) revisited the ED after discharge. This was significant between all 3 groups ($P < 0.001$) and significant even when comparing only patients who were discharged to home (ie, PO versus IV–short course; $P = 0.19$). When the IV–short course (0.033 revisits/person day) was compared with the IV-admit group (0.012/person day) and analyzed based only on available person days, the revisit rate ratio is not significantly different (2.8; 95% confidence interval [CI], 0.65–12.1). However, when compared with PO only (0.014/person day), the difference is significant (2.4; 95% CI, 1.2–4.7). The average time to ED revisit was significantly longer among children in the IV-admit group (105.4 vs 39.0 hours; $P < 0.001$).

Twenty-three (7.2%) of the 321 patients met our definition of failure (revisit with change in management). Most (n = 13; 62%) of the failures occurred in the IV–short course group. The odds ratio (OR) of failure was significantly higher among those who received IV–short-course antibiotics. Compared with the IV-admit treatment option, the OR of failure among those who received IV–short course was 7.2 (95% CI, 1.6–33.1). Relative to the PO treatment group, the OR was 3.2 (95% CI, 1.3–8.3). Univariate regression identified location of cellulitis, total white blood cell count, absolute band count, absolute polymorphonuclear count, band-to-neutrophil ratio, and ED treatment plan as potential predictors of failure. Treating physician training was not associated with the overall failure rate ($P = 0.93$). Following multiple logistic regression, only ED treatment plan remained significant ($P < 0.003$).

Median time from initial physician evaluation until disposition was significantly greater among those who received IV–short-course antibiotics ($P < 0.001$). This was associated with a significantly greater number of children receiving 3 or more doses of antibiotics before disposition determination. Children who received IV–short course, however, had a significantly shorter total stay than the IV-admit group.

Laboratory investigations were performed in 175 cases (48%) (Table 5). Among children who had a complete blood cell count performed, there were no significant differences between groups with respect to mean white blood cell, neutrophil, band counts, or band-to-neutrophil ratio. Blood cultures were performed on 159 children (50%). One culture (0.6%) grew a pathogen (*S. aureus*), whereas 3 (1.9%) grew contaminants. The child with *S. aureus* bacteremia was an inpatient at a community hospital that was transferred to our tertiary-care center because of deterioration in his clinical status. As per hospital protocol, the child was assessed in our ED to determine the need for critical care unit admission. While being evaluated, a blood culture was performed in the ED. Of the 3 children with positive cultures deemed to be contaminants, 1 child was initially admitted, and the other 2 were discharged. Two of the 3 patients returned to the ED within 7 days, and 1 child was prescribed a different oral antibiotic. All 3 families were contacted by telephone regarding the positive culture, and at that time, all were clinically improved.

DISCUSSION

Cellulitis remains a common pediatric problem, accounting for nearly 1 of every 150 children seen in a pediatric ED. Most children continue to undergo laboratory investigations, and just more than 50% are treated with IV antibiotics despite evidence

TABLE 4. Antibiotics Administered, Including IV and Oral Routes

Antibiotic Route	Antibiotic	No. Treated (%)*
IV	Cefazolin	117 (70.1)
	Clindamycin	35 (21.0)
	Penicillin	13 (7.8)
	Cloxacillin	9 (5.4)
	Ceftriaxone	9 (5.4)
	Other†	15 (9.0)
Oral	Cephalexin	175 (79.5)
	Clindamycin	18 (8.1)
	Amoxicillin-clavulanate	12 (5.4)
	Cloxacillin	5 (2.2)
	Other‡	10 (4.5)

*Total number of patients treated with IV antibiotics in the ED was 167. Total number of patients treated with oral antibiotics either in or upon discharge from the ED was 220. Percentage totals are greater than 100% as some patients received more than 1 antibiotic.

†Includes ampicillin, cefotaxime, cefuroxime, gentamicin, piperacillin with tazobactam, and vancomycin.

‡Includes amoxicillin, cefuroxime, clarithromycin, and penicillin.

TABLE 5. Laboratory Investigations of Patients According to ED Treatment Plan

	PO (n = 154)	IV–Short Course (n = 85)	IV-Admit (n = 82)	*P*
Complete blood count performed, n (%)	15 (9.7)	80 (94.1)	80 (97.6)	<0.001
White blood cell, mean (SD), $\times 10^9$/L	11.4 (4.7)	12.1 (4.9)	13.8 (7.3)	0.16
Neutrophils, mean (SD), $\times 10^9$/L	6.9 (3.7)	7.2 (4.3)	8.5 (5.7)	0.21
Bands, mean (SD), $\times 10^9$/L	0.12 (0.21)	0.30 (0.82)	0.51 (0.99)	0.17
Bands: neutrophils, mean (SD)	0.012 (0.001)	0.030 (0.067)	0.046 (0.081)	0.16
Blood culture performed, n (%)	9 (5.9)	76 (89.4)	74 (90.2)	<0.001

indicating that bacteremia is extremely uncommon. In our cohort, more than half of the children who do receive IV antibiotics are treated with IV–short-course therapy. However, we found that this therapeutic approach resulted in failure 15% of the time.

Short-course IV antibiotics were administered to 27% of children in our cohort in an attempt to optimize resource allocation by avoiding admission if possible. This approach is particularly enticing in EDs that do not have a dedicated observation/short-stay unit in combination with institutional inpatient bed shortages.[13] However, to date, there have been no publications reporting on the success of ED IV–short-course therapy. In fact, in a recent retrospective review from a pediatric institution, a greater failure rate was reported among children treated with IV antibiotics compared with those who received oral antibiotics alone (14% vs 9%).[8] Of note, among those treated with IV antibiotics, the failure rate was significantly lower if probenecid was added to cefazolin (8% vs 31%). In a similar vein, we found that children treated with IV–short-course antibiotics do not fare well either, as they were more likely to experience a therapeutic failure than children in the IV-admit and PO antibiotic groups. Despite receiving prolonged ED treatment, presumably to prevent sequelae of cellulitis, these patients had more ED follow-up visits and required more therapeutic interventions than children who were discharged on oral antibiotics. This may in part be due to the slow clinical improvement seen in children receiving IV antibiotics as has recently been reported by Gouin et al,[9] who found that only 20% of children with moderate to severe cellulitis experience a significant clinical improvement within 24 hours of IV antibiotic administration.

Although our failure rate was 15% in children who received IV–short-course antibiotics, it is unknown how these children would have fared on oral antibiotics (PO) alone as the 2 groups were not identical. Those who received IV–short-course antibiotics were more likely to have already seen a physician, to be taking oral antibiotics, and to have a higher temperature and a more impressive clinical examination. Thus, these children were clinically more similar to children in the IV-admit group and presumably were more ill than those managed on PO antibiotics alone. The potential benefit of this therapeutic intervention is that their total length of stay was significantly shorter than the IV-admit group.

The findings of the current study concur with previous research regarding the performance of blood cultures.[4,8,9,14,15] Our true positive rate (0.6%) was lower than that reported in 1998, before widespread *S. pneumoniae* vaccination,[4] but similar to that recently reported by others.[8,9] The ratio of false positive to true positive of the other studies additionally seems to be similar to ours, with a preponderance of contaminants in approximately a 3:1 ratio.[4,8] We concur with previous findings that high-risk patients can be readily identified.[4] Nonetheless, despite the limited value of routinely performing laboratory investigations, we and others[9] have found that blood cultures are still performed in more than 90% of those who receive IV antibiotics. In keeping with other Canadian data,[16] the incidence of CA-MRSA was very low and does not seem to justify a change in antibiotic treatment patterns.

We attempted to determine predictors of failure in our sample of 321 patients. In particular, we attempted to determine if the peripheral white blood cell and band counts predict the need for prolonged IV antibiotics. Although univariate analysis did find that laboratory investigations were potentially associated with failure, after multivariate analysis, only the method of treatment remained significant, reinforcing the limited role of laboratory investigations in such children.[4,17]

LIMITATIONS

The retrospective design of this study may have introduced bias in the method of chart identification for data abstraction. In addition, we do not have any information on patients who may have failed therapy if they did not return to our ED and patients who were transferred to another institution for hospitalization. The latter point is of importance as these children likely were medically complex or had less severe disease than were children in the IV-admit who remained at our institution. Thus, the patients with missing data on length of stay likely had shorter stays than as reported in Table 3; therefore, the benefit of IV–short course over IV-admit is likely exaggerated as reported in the revisit risk ratios.

The data were also limited in terms of the description of the cellulitis, as size was infrequently documented. Definitions were created for this study as there do not exist validated definitions of treatment failure or IV–short-course antibiotics. Our definitions were based on consensus opinion at our institution in light of the nature of emergency medicine and the overcrowding problem in hospitals and pediatric EDs.[13,18] Although we created 3 groups for analysis and compared the IV–short course group to both of the others, they clinically were more similar to the IV-admit group. Hence, without prospective data collection, because of the baseline differences, we cannot conclusively conclude that children in the IV–short course group would have been successfully managed on oral antibiotics alone.

CONCLUSIONS

In summary, this is the first study describing the use of ED IV–short-course antibiotics for pediatric cellulitis. We found that patients selected to receive IV–short-course antibiotics are at increased risk of requiring a prolonged ED stay, admission, or a revisit after discharge compared with children treated with oral antibiotics alone. However, in children for whom admission is being considered, IV–short course may be a reasonable alternative. Further prospective research on pediatric cellulitis is required to better justify when the use of IV antibiotics is indicated and to better define criteria for hospitalization. Regardless of

treatment selected, the use of ancillary investigations and cultures in low-risk children should be discontinued.

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