

Variability in Emergency Medicine Provider Decisions on Hospital Admission and Antibiotic Treatment in a Survey Study for Acute Bacterial Skin and Skin Structure Infections: Opportunities for Antimicrobial Stewardship Education

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Background. Acute bacterial skin and skin structure infections (ABSSSIs) are a frequent cause of emergency department (ED) visits. Providers in the ED have many decisions to make during the initial treatment of ABSSSI. There are limited data on the patient factors that influence these provider decisions.

Methods. An anonymous survey was administered to providers at 6 EDs across the United States. The survey presented patient cases with ABSSSIs ≥ 75 cm² and escalating clinical scenarios including relapse, controlled diabetes, and sepsis. For each case, participants were queried on their decision for admission vs discharge and antibiotic therapy (intravenous, oral, or both) and to rank the factors that influenced their antibiotic decision.

Results. The survey was completed by 130 providers. For simple ABSSSI, the majority of providers chose an oral antibiotic and discharged patients home. The presence of recurrence or controlled diabetes resulted in more variation in responses. Thirty-four (40%) and 51 (60%) providers chose intravenous followed by oral antibiotics and discharged the recurrence and diabetes cases, respectively. Presentation with sepsis resulted in initiation with intravenous antibiotics (122, 95.3%) and admission (125, 96.1%) in most responses.

Conclusions. Variability in responses to certain patient scenarios suggests opportunities for education of providers in the ED and the development of an ABSSSI clinical pathway to help guide treatment.

Keywords. abscess; antibiotics; cellulitis; education.

Acute bacterial skin and skin structure infections (ABSSSIs), defined by erythema extending ≥ 75 cm², are frequent and challenging infections associated with high direct and indirect costs to both the medical system and society [1]. These infections are responsible for a growing number of emergency department (ED) visits and hospital admissions. Between 2005 and 2010, more than 3 million patients annually received care for a skin or skin structure infection in the ED; furthermore, during that time, ABSSSI-related admissions increased from 1.6% to 1.9% of

total hospitalizations [2, 3]. Guidelines by the Infectious Diseases Society of America (IDSA) recommend that many patients with ABSSSI can be successfully treated in the outpatient setting with either oral agents or outpatient parenteral antibiotic therapy (OPAT) [4]. However, administration of intravenous antibiotics in 1 study was the sole reason provided for admission in 41.5% of skin infection patients [5]. Other reported factors associated with hospital admission include advanced age, fever or clinical instability on presentation, failure of previous antibiotic therapy, and presence of comorbidities [5–7]. That said, many patients with simple ABSSSI are still admitted to the hospital [8].

ABSSSIs are most often caused by Gram-positive cocci, including *Staphylococcus aureus* and *Streptococcus* spp., and more rarely by Gram-negatives and anaerobes [1, 4, 9]. Despite this limited list of likely pathogens, antibiotic therapy for ABSSSIs frequently varies from narrow-spectrum oral agents to empiric administration of a combination of intravenous agents with activity against methicillin-resistant *S. aureus* (MRSA) and *Pseudomonas aeruginosa* (eg, piperacillin/tazobactam) [8, 10].

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As a result, ABSSSI treatment selection is an appropriate target for an Antimicrobial Stewardship Program (ASP) intervention in the hospital setting, including in the ED [11–14]. Given that intravenous antibiotic administration in the ED can be a gateway to hospital admission [5], improved antibiotic choices in the ED for ABSSSI may also reduce unnecessary hospital admission.

ASP interventions in the ED could present unique challenges due to the variety of provider types, rapid patient turnover, and the need for quick treatment decisions. In the absence of a clear ABSSSI clinical pathway in the ED or hospital, an understanding of patient factors that influence emergency medicine (EM) providers to prescribe intravenous therapy or admit a patient with ABSSSI would help to streamline educational efforts as part of ASP interventions. Herein, we surveyed EM providers from 6 US EDs using a case-based questionnaire to capture their treatment decisions for patients with ABSSSI.

METHODS

Study Design

This was a multicenter study conducted in 6 EDs across the United States. Participating centers included Hartford Hospital (Hartford, CT), Cape Fear Valley Medical Center (Fayetteville, NC), Baylor University Medical Center at Dallas (Baylor, TX), University of Colorado Hospital (Aurora, CO), Baptist Memorial Hospital–Memphis (Memphis, TX), and Baystate Medical Center (Springfield, MA). The study was approved by the institutional review board at each participating hospital. A short 12-item anonymous survey was administered to local ED providers. By completing the survey, providers were giving permission to participate in the study. No Protected Health Information was collected. Questionnaires were distributed by the clinical ED or ASP pharmacists at each institution over a 6-month time period between December 2016 and May 2017; this was frequently done at monthly department meetings. Eligible providers included EM physicians, including MD/DO attendings, residents, or fellows, as well as advanced practice providers (APPs), including advanced practice registered

nurses (APRNs) and physician assistants (PAs). Any students or other members of the clinical team (eg, pharmacists, nurses, etc.) were excluded, and providers who previously participated were not permitted to retake the survey.

Survey Tool

Eight case-based survey questions were designed to assess treatment decisions based on the same patient presenting to the ED with various clinical scenarios escalating in severity (Table 1) from simple ABSSSI (Case 1) to recurrent infection (Case 2), concurrent controlled diabetes (Case 3), or sepsis (Case 4). Each case was then followed by the same questions pertaining to decisions on choice of intravenous vs oral antibiotic treatment and hospital admission. Data were also collected on provider type, years of experience, and ranking of the following patient/antibiotic characteristics considered important in the treatment of ABSSSI: patient comorbidities, patient severity of presentation, patient adherence to antibiotic therapy, antibiotic microbiological spectrum of activity, antibiotic cost, antibiotic treatment schedule, antibiotic route of administration, and antibiotic adverse event profile. Finally, providers were asked how often they engaged patients directly and involved them in their preferences for ABSSSI treatment.

Analyses

Survey results were descriptively reported as the proportion of participants selecting each response for each question. The ranking of specific antibiotic/patient characteristic importance was based on the mode score from 1 (most important) to 8 (least important). Questions with no response were included by adjusting the denominator of each individual question, as required. Responses to cases were assessed by provider type (MD vs APP) and years of clinical practice experience (>5 years vs ≤ 5 years). Odds ratios with 95% confidence intervals (CIs) were generated to compare survey results by provider type and years of clinical practice experience. All analyses were performed in Sigma Plot, version 13.0 (Systat Software Inc., San Jose, CA).

Table 1. Case-Based Survey Questions to EM Providers

Case	Description	Survey Questions and Answer Options ^a
Case 1: Simple ABSSSI	An adult patient presents to the ED with cellulitis on the lower leg, where the lesion size is ≥75 cm ² (larger than the average cell phone). The patient is afebrile, has a normal white blood cell count, and has no comorbidities; this is their first ABSSSI presentation.	How would you treat this patient? a. An oral antibiotic b. 1–2 doses of IV antibiotic followed by an oral antibiotic c. A full IV antibiotic course
Case 2: Recurrent ABSSSI	After completing treatment as outlined above, the patient returns to the ED approximately 30 days later with a second ABSSSI episode at the same site.	Where would you send this patient? a. Admit to inpatient unit b. Admit to observation unit c. Discharge the patient home with further instructions
Case 3: Controlled diabetes	Assume the patient described in Case 1, presenting with first episode of ABSSSI, has insulin-dependent but controlled diabetes.	
Case 4: Septic patient	Assume the patient described in Case 1 presenting with a first episode of ABSSSI is tachycardic, febrile, and has a white blood cell count of 15 000 cells/microliter.	

Abbreviations: ABSSSI, acute bacterial skin and skin structure infection; ED, emergency department; EM, emergency medicine; IV, intravenous.

RESULTS

Providers

Out of a total of 443 EM providers employed in the 6 participating EDs at time of the study, 130 (29.3%) completed the survey. The numbers of providers included by site were as follows: n = 30 (Hartford, CT), n = 26 (Baystate, MA), n = 23 (Baylor, TX), n = 19 (Cape Fear, NC), n = 17 (Baptist-Memphis, TN), and n = 15 (Univ. Colorado, CO). All providers answered every survey question, except for Case 3 (n = 129), Case 4 (n = 128), and the question about engaging patients in antibiotic preference (n = 125). Physicians accounted for the majority of respondents (85, 65.4%), with 51 (39.2%) listed as attendings and 34 (26.2%) as residents or fellows. APPs accounted for 45

(34.6%) of the remaining respondents. Participants reported less than 1 year (20, 15.4%), 1–5 years (58, 44.6%), >5–10 years (16, 12.3%), and >10 years (36, 27.7%) of experience.

Survey Responses

Participant choices for admission and intravenous vs oral antibiotic therapy for cases are presented in Figure 1. Variability in responses for recommended treatment and disposition was observed for the recurrent ABSSSI and controlled diabetes cases, and less so for the septic patient. The least variability was observed for the simple ABSSSI case, with most providers discharging the patient home on oral antibiotic therapy. Notably, 34 (40%) and 51 (60%) providers chose to give 1–2 intravenous doses in the ED and discharge the patient on oral therapy for the

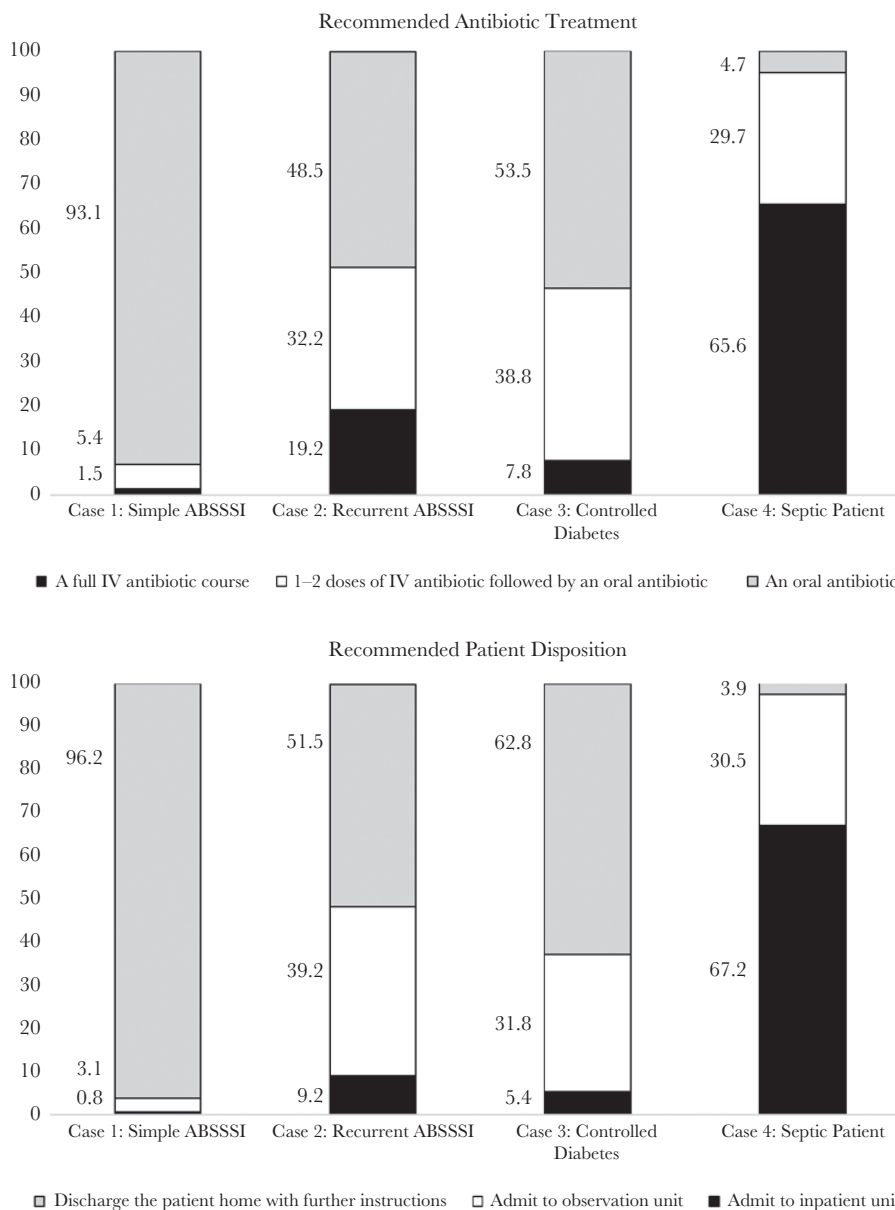


Figure 1. Percentage of providers selecting each response for the 4 cases. Abbreviations: ABSSSI, acute bacterial skin and skin structure infection; IV, intravenous.

recurrent ABSSSI and controlled diabetes cases, respectively. Comparisons in responses by type of provider and experience level are provided in Table 2. Compared with PHYs, APPs were 2.59 (95% CI, 1.23–5.47) times more likely to select 1–2 doses of IV antibiotic followed by oral therapy for the controlled diabetes case; APPs were also 56% (95% CI, 0.07–0.79) less likely to choose oral antibiotics for this case. For the septic case, APPs were 2.19 (95% CI, 1.01–4.74) times more likely to choose to admit the septic patient to an inpatient unit. There was no difference in responses by years of experience.

When queried about how often providers asked patients about their antibiotic preference (ie, involving patients in the

treatment decision-making process), 7 (5.6%), 36 (28.8%), 61 (48.8%), and 21 (16.8%) indicated always, frequently, rarely, and never, respectively. The rank order of the 8 factors influencing providers' antibiotic treatment decisions is provided in Table 3.

DISCUSSION

Despite guidelines supporting transitions of care to outpatient treatment for low-risk patients with ABSSSI, observational studies indicate that providers couple hospitalization with administration of parenteral antibiotics, regardless of the absence of need for other services that can only be provided in the hospital and availability of outpatient intravenous antibiotic

Table 2. Case Scenario Answers by EM Provider Type and Experience

Cases and Answer Options	EM Provider Type			Experience in Years		
	PHY n = 85	APP n = 45	OR (95% CI)	≤5 n = 78	>5 n = 52	OR (95% CI)
Case 1: Simple ABSSSI						
Recommended treatment						
1–2 doses of IV antibiotic followed by oral antibiotic	4 (4.7)	3 (6.7)	1.45 (0.31–6.76)	3 (3.8)	4 (7.7)	2.08 (0.45–9.72)
A full IV antibiotic course	1 (1.2)	1 (2.2)	1.91 (0.12–31.26)	0	2 (3.9)	N/A
An oral antibiotic	80 (94.1)	41 (91.1)	0.64 (0.16–2.52)	75 (96.2)	46 (88.5)	0.31 (0.07–1.29)
Patient disposition						
Admit to observation unit	3 (3.5)	1 (2.2)	0.62 (0.06–6.15)	3 (3.8)	1 (1.9)	0.49 (0.05–4.86)
Admit to inpatient unit	0	1 (2.2)	N/A	0	1 (1.9)	N/A
Discharge home	82 (96.5)	43 (95.6)	0.79 (0.13–4.89)	75 (96.2)	50 (96.2)	1.00 (0.16–6.20)
Case 2: Recurrent ABSSSI						
Recommended treatment						
1–2 doses of IV antibiotic followed by oral antibiotic	25 (29.4)	17 (37.8)	1.46 (0.68–3.12)	29 (37.2)	13 (25.0)	0.56 (0.26–1.23)
A full IV antibiotic course	17 (20.0)	8 (17.8)	0.86 (0.34–2.19)	12 (15.4)	13 (25.0)	1.83 (0.76–4.41)
An oral antibiotic	43 (50.6)	20 (44.4)	0.78 (0.38–1.61)	37 (47.4)	26 (50.0)	1.11 (0.55–2.24)
Patient disposition						
Admit to observation unit	32 (37.7)	19 (42.2)	1.21 (0.58–2.53)	29 (37.2)	22 (42.3)	1.24 (0.61–2.54)
Admit to inpatient unit	10 (11.8)	2 (4.4)	0.35 (0.07–1.67)	8 (10.3)	4 (7.7)	0.73 (0.21–2.56)
Discharge home	43 (50.6)	24 (53.3)	1.12 (0.54–2.30)	41 (52.6)	26 (50.0)	0.90 (0.45–1.82)
Case 3: Controlled diabetes						
Recommended treatment						
1–2 doses of IV antibiotic followed by oral antibiotic	26 (30.6)	24 (54.6)	2.59 (1.23–5.47)	34 (43.6)	16 (31.4)	0.58 (0.27–1.21)
A full IV antibiotic course	8 (9.4)	2 (4.6)	0.45 (0.09–2.20)	7 (9.0)	3 (5.9)	0.62 (0.15–2.52)
An oral antibiotic	51 (60.0)	18 (40.9)	0.44 (0.21–0.93)	37 (47.4)	32 (62.8)	1.77 (0.87–3.62)
Patient disposition						
Admit to observation unit	26 (30.6)	15 (34.1)	1.13 (0.52–2.46)	26 (33.8)	15 (28.9)	0.81 (0.38–1.74)
Admit to inpatient unit	6 (7.1)	1 (2.3)	0.30 (0.03–2.57)	5 (6.5)	2 (3.9)	0.58 (0.11–3.13)
Discharge home	53 (62.4)	28 (63.6)	0.99 (0.47–2.10)	46 (59.7)	35 (67.3)	1.43 (0.69–2.99)
Case 4: Septic patient						
Recommended treatment						
1–2 doses of IV antibiotic followed by oral antibiotic	28 (33.3)	10 (22.7)	0.58 (0.25–1.34)	20 (26.3)	18 (34.6)	1.54 (0.71–3.30)
A full IV antibiotic course	50 (59.5)	34 (77.3)	2.16 (0.97–4.84)	54 (71.1)	30 (57.7)	0.61 (0.29–1.26)
An oral antibiotic	6 (7.1)	0	N/A	2 (2.6)	4 (7.7)	3.17 (0.56–17.96)
Patient disposition						
Admit to observation unit	27 (31.8)	12 (26.7)	0.78 (0.35–1.74)	20 (25.6)	19 (36.5)	1.67 (0.78–3.57)
Admit to inpatient unit	54 (63.5)	32 (71.1)	2.19 (1.01–4.74)	56 (71.8)	30 (57.7)	0.54 (0.26–1.12)
Discharge home	4 (4.7)	1 (2.2)	0.94 (0.17–5.35)	2 (2.6)	3 (5.8)	2.33 (0.38–14.43)

All data are number (%) and odds ratio with 95% confidence interval of the difference between APP vs PHY and >5 years' vs ≤5 years' experience.

Abbreviations: ABSSSI, acute bacterial skin and skin structure infection; APP, advanced practice provider; CI, confidence interval; EM, emergency medicine; IV, intravenous; OR, odds ratio; PHY, physician.

Table 3. Rank Order of Factors Influencing Provider Decisions When Selecting Antibiotics for Treatment of ABSSSI

Factor	Mode
Severity of infection presentation	1
Presence of patient comorbidities	2
Microbiological spectrum of activity	3
Route of administration	4
Patient adherence	5
Adverse event profile	5
Antibiotic treatment schedule	6
Antibiotic cost	8

Ranked by mode (1 = most important; 8 = least important).

Abbreviation: ABSSSI, acute bacterial skin and skin structure infection.

strategies [5, 8, 10]. The purpose of this study was to identify EM provider treatment hypothetical choices for hospital admission and route of antibiotic administration based on escalating clinical scenarios commonly observed in patients with ABSSSI. In brief, we observed good agreement in treatment strategies for ABSSSI patients first presenting with simple cellulitis but variability in provider selections when ABSSSI patients presented with infection recurrence, controlled diabetes, or sepsis. With few exceptions, the type of provider and experience level did not significantly influence the choices. These observations could prove useful in targeting ASP education efforts to EM providers or when developing a clinical pathway in the ED for treatment of patients with ABSSSI.

As noted previously, common reasons for hospital admission of patients with ABSSSI include advanced age, clinical instability, the presence of certain comorbidities, recurrence or reinfection, and provider perception that these infections require intravenous therapy [5–7]. We are not aware of any other studies in the literature that have directly measured EM provider hypothetical decisions in the treatment of ABSSSI. Beginning with the simple cellulitis case scenario (Case 1: Simple ABSSSI), 93.1% and 96.2% of providers selected an oral antibiotic and discharge home with further instructions, respectively. This case was written to explicitly state that the patient presented with their first ABSSSI, no systemic inflammatory response syndrome (SIRS), and no comorbidities. Age was not noted, nor was the precise size of the lesion, only that it was ≥ 75 cm². Although both ≥ 65 years of age and larger lesion size (ie, 313–367 cm²) were significantly associated with hospital admission in 1 study, neither of these patient factors was listed as a reason for admission [5]. IDSA guidelines recommend oral therapy in the outpatient setting for the treatment of a simple skin infection in patients such as Case 1, and it appears that most EM providers surveyed would have followed these recommendations [4].

Case 2 portrayed the same ABSSSI patient described earlier, only with a recurrent infection or relapse approximately 30 days later. In contrast to Case 1, there was significant variance in treatment strategies for this patient. Oral antibiotic therapy,

intravenous followed by oral therapy, and full intravenous courses were selected by 48.5%, 32.2%, and 19.9% of providers, respectively. Discharge home was selected in 51.5%, followed by admission to an observation unit in 39.2%. The frequent selection of the observation unit is supported by a growing trend in this strategy among Medicare beneficiaries [15]. However, in practice, ABSSSI is not a common diagnosis in medical or surgical observation units. In a single-center study of ABSSSI patients receiving intravenous antibiotics for less than 24 hours, 28.7% were sent to the observational unit. Notably, these patients more frequently had comorbid conditions and met criteria for SIRS, which were not characteristics described in Case 2 in our study [16].

In the study by Talan and colleagues, failure of prior antibiotic therapy was significantly associated with admission to the hospital (present in 16% of admissions vs 6.0% of discharges) but was not directly listed by physicians as a reason for admission [7]. An important distinction here may be the difference between treatment “failure” and “recurrence/relapse.” Recurrence/relapse is generally accepted as cellulitis that has improved after completing a course of antibiotics but that subsequently reappeared, whereas treatment failure is clinically accepted as lack of improvement during the course of antibiotics. Treatment failure, from a clinical perspective, is unlikely to occur 30 days out from presentation as antibiotic therapy would have been completed well before then. Patients with previous cellulitis may have annual recurrence rates as high as 20% [17, 18]. A number of factors including edema, venous insufficiency, tinea pedis, unresolved or past trauma, obesity, tobacco use, cancer, and homelessness can all contribute to infection recurrence; therefore, IDSA guidelines recommend evaluation of risks and resolution of these factors in addition to oral penicillin or monthly injections with intramuscular penicillin [4]. These treatments can be accomplished in the outpatient setting for a patient with no signs of systemic infection. Consistent with the guidelines, physicians surveyed in our study most commonly selected oral therapy in the outpatient setting overall, yet >50% of providers chose a regimen that included IV antibiotics for Case 2. Further ASP education, along with implementation of a clinical pathway, may be helpful to identify appropriate candidates for either oral therapy or OPAT (including the use of single-dose, long-acting lipoglycopeptides) and avoid unnecessary observation use or hospital admission in these scenarios.

Diabetes is among the most common underlying comorbidities present in patients with ABSSSI, existing in 10% of patients presenting with an episode [19]. Patients with diabetes are 3-fold more likely to acquire infection and often have lower clinical success rates [20]. However, a recent comparison of patients with and without diabetes in the ABSSSI clinical trials for dalbavancin, a long-acting lipoglycopeptide antibiotic, observed similarly high success rates after 14 and 30 days [21]. Case 3 portrayed a patient with stable, controlled diabetes, as

opposed to diabetic ketoacidosis or hyperglycemic hyperosmolar syndrome, the latter 2 requiring immediate medical intervention. Thirty-nine percent of providers chose to administer 1–2 doses of an intravenous antibiotic followed by an oral agent to complete therapy; furthermore, roughly half of the providers selected an oral-only antibiotic regimen. Sixty-three percent were comfortable discharging the patient home, followed by 31.8% admitting the patient to an observation unit. Very few providers selected hospital admission with a full intravenous course. We found APPs to be less likely than EM physicians to prescribe a full oral course for patients with diabetes. Like Case 2, further ASP educational efforts could focus on identifying appropriate candidates for oral therapy vs OPAT. Furthermore, improvements in appropriate antibiotic therapy could have a beneficial downstream effect on reducing observation status use in patients with stable comorbidities who could complete therapy as an outpatient.

The final case introduced a patient presenting with 3 of 4 SIRS criteria, thereby meeting the 2012 Surviving Sepsis Campaign (SSC) definition of sepsis [22]. It should be noted that the updated 2017 SSC guidelines no longer include SIRS but rather add other clinical/laboratory requirements; however, the optimal definition of sepsis is under debate, with many practitioners still using SIRS criteria to guide treatment decisions [23–25]. Based on SIRS alone, the majority of EM providers chose to administer a full intravenous course of antibiotics and admit to an inpatient unit. These responses are largely in agreement with the providers' documented highest priority of infection severity for influencing factors (Table 3); they are also concordant with the IDSA guidelines, which recommend admission for patients who present with clinical instability [4]. However, 30.5% did select an observation unit. This may reflect differences in sepsis definitions, as well as the aforementioned trend in increased admissions to these units. It should be noted that there are multiple noninfectious etiologies of fever, tachycardia, tachypnea, and leukocytosis, and a patient may still be a suitable candidate for outpatient therapy if he or she has cellulitis, along with known noninfectious causes for positive SIRS criteria with no other signs of organ dysfunction [26]. In the recent, multicenter, double-blind randomized controlled trial comparing single dose with weekly dalbavancin for ABSSSI, 42.4%–44.4% of participants had SIRS on presentation, and approximately half of the patients were successfully treated completely in the outpatient setting [27]. The identification of OPAT candidates for this scenario has the most potential to reduce unnecessary observation or admission.

An interesting observation among the antibiotic characteristics influencing treatment decision was the lower priority given to antibiotic cost, treatment schedule (how many times per day the drug is administered), patient adherence, and adverse events. Lack of concerns over antibiotic cost may reflect current ASP restrictions in place at these institutions, which may limit

use of the most expensive agents to infectious diseases consult service or ASP approval. Treatment schedule and patient adherence go hand in hand; less frequent dosing increases adherence and has been linked to improved outcomes in skin infections [28, 29]. Following patient characteristics (severity of infection, comorbidities) and microbiological spectrum of activity (ie, getting the right antibiotic), the next most important consideration was route of administration. Historical practices have primarily reserved intravenous therapy for patients who were admitted while utilizing oral therapy in the outpatient setting. However, the availability of oral antibiotics with excellent bioavailability, as well as the long-acting, single-dose lipoglycopeptides, clearly defines a paradigm shift in how ABSSSI can be managed in the ED [26].

There are several limitations to our study. First, the study was conducted at 6 EDs throughout the United States; however, some regional differences in antibiotic use or admission practices may not be accounted for. Our study was also not large enough to analyze any site effects for the participating providers. Second, our survey questions were not validated in advance, and we did not ask any open-ended questions to identify reasons for selections. Although the latter may have helped us understand selections, it also may have reduced the number of participants as EM provider time is scarce. As a result, we attempted to encourage participation by balancing collection of data that broadly reflects influences on treatment decisions with survey burden. That said, a strength of the abbreviated case design was that it focused providers' decisions on what was different between cases (ie, infection recurrence, diabetes, sepsis). Finally, our questions on antibiotic therapy selection did not query specific generic drug names or treatment with 1 vs 2 agents (eg, vancomycin plus piperacillin/tazobactam or trimethoprim-sulfamethoxazole plus cephalexin). Nonetheless, we acknowledge that these would be important topics to be covered in ASP education while expanding on appropriateness of oral vs intravenous therapies.

CONCLUSIONS

This survey study revealed variability in EM provider hypothetical decisions for admission and selected route of antibiotic therapy in patients presenting with different ABSSSI scenarios. ASP education efforts should specifically address antibiotic selection for patients presenting with comorbidities, infection recurrence/relapse, or sepsis, as there are many treatment strategies that can be considered for an individual patient. The development of an ABSSSI clinical pathway may also be justified to align patient treatment plans and provide decision support for ED disposition.

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