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ORIGINAL RESEARCH

Acute Bacterial Skin and Skin Structure Infections Treated with Intravenous Antibiotics in the Emergency Department or Observational Unit: Experience at the Detroit Medical Center

Kimberly C. Claeys · Abdalhamid M. Lagnf · Trishna B. Patel ·

Manu G. Jacob · Susan L. Davis · Michael J. Rybak

ABSTRACT

Introduction: Acute bacterial skin and skin structure infections (ABSSSIs) are frequently treated in emergency departments (EDs) or observation units (OUs) initially with intravenous (IV) antibiotics before discharge on oral therapy. This study aims to describe

ABSSSI patients discharged directly from EDs/OUs.

Methods: This is a retrospective cohort study of patients with ABSSSIs treated in EDs/OUs of the Detroit Medical Center from 2012 to 2014. Adults with less than 24 h of IV antibiotics without hospital admission were included. Demographics, clinical characteristics, and severity were compared between ED and OU patients. Resource utilization, including tissue and blood cultures, and use of radiographic analysis was also collected. The primary outcome was 96-h ED revisit/hospitalization.

Results: Analysis included 308 patients; 219 ED and 89 OU. OU patients were significantly more likely to be obese, have COPD/asthma, be diagnosed with cellulitis, and meet at least one systemic inflammatory response syndrome (SIRS) criterion. Tissue cultures were obtained in 21.7% of abscesses in the ED; 67.9% were in uncomplicated abscesses. In the OU tissue cultures were obtained in 48.8% of abscesses and 37.5% were uncomplicated cases. Blood cultures were drawn in 18.3% of ED patients and 56.2% of OU patients, not significantly associated with the presence of SIRS criteria. Radiology was used in the diagnosis of ABSSSIs

K. C. Claeys · A. M. Lagnf · M. J. Rybak
Anti-Infective Research Laboratory, Eugene Applebaum College of Pharmacy and Health Sciences, Wayne State University, Detroit, MI 48201, USA

K. C. Claeys · A. M. Lagnf · T. B. Patel ·
M. G. Jacob · S. L. Davis · M. J. Rybak (✉)
Department of Pharmacy Practice, Eugene Applebaum College of Pharmacy and Health Sciences, Wayne State University, Detroit, MI 48201, USA
e-mail: m.rybak@wayne.edu

S. L. Davis
Department of Pharmacy Practice, Henry Ford Hospital, 2799 W Grand Blvd, Detroit, MI 48202, USA

in 33.5% of ED versus 69.5% OU patients
($p < 0.001$), Plain film radiograph being the
most common. Thirty patients revisited the
ED or required hospitalization within 96 h, 23
from the ED ($p = 0.479$). Prior history of ABSSSI
(adjusted odds ratio [aOR] = 2.382, 95%
confidence interval [CI] 1.264–6.346) and
location on torso/buttocks (aOR = 2.355, 95%
CI 1.067–5.197) were independent predictors.
Conclusions: The low rate of ED revisit/
hospitalization supports the use of OUs for
low acuity ABSSSIs requiring initial IV therapy.
Resource utilization within EDs/OUs for the
management of ABSSSIs needs to be evaluated
for unnecessary testing/procures.

Keywords: Acute bacterial skin and skin
structure infections; Emergency department;
Intravenous antibiotics; Observation unit

INTRODUCTION

Acute bacterial skin and skin structure
infections (ABSSSIs) are among the most
common infections encountered in both
community and hospital settings [1, 2].
According to the 2010 National Hospital
Ambulatory Medical Care Survey (NHAMCS),
diseases of the skin and subcutaneous tissue
account for 4.2% of all emergency department
(ED) visits in the United States [3]. Additionally,
national trends indicate that the rate of ABSSSIs
has increased by approximately 50% since 1997,
with the majority of patients being treated and
released directly from the ED [4, 5]. There is a
wide clinical spectrum of ABSSSIs, from simple
uncomplicated abscesses to life-threatening
necrotizing fasciitis, and agreement upon
severity classification is lacking [6]. Most
ABSSSIs, aside from gangrene and fasciitis, are
treated on an outpatient basis. Although the

majority of patients receive care in the ED and
are not admitted, complications due to ABSSSIs
often lead to hospitalization. It is not presently
known how many revisits/admissions are
represented among the over 600,000 to
800,000 documented admissions for ABSSSIs in
the U.S. annually [2]. Two Canadian studies
have reported outpatient failure rates, resulting
in subsequent admission, of approximately
20–25% for cellulitis exclusively treated in the
ED [7, 8].

In a study by Edelsberg and colleagues,
antibiotic clinical failure rates were
documented for over 10,000 hospitalized
patients, 22.8% of all patients studied [2]. This
was mirrored by Berger and colleagues follow-
up study, which demonstrated failure rates of
16.6–34.1% [9]. These results demonstrated that
patients who initially fail empiric treatment
often require prolonged hospital stays and
intravenous (IV) antibiotics. Alternatively,
some patients are observed in the hospital for
short periods of time, either as brief admissions
or in observation units (OUs). According to the
American College of Emergency Physicians
(ACEP), 70% of patients selected from
treatment in OUs should be discharged before
24 h of care [10]. The use of these OUs allows for
hospital avoidance, decreased resource
utilization, and decreased exposure to the
healthcare environment, and thus a decrease
in adverse events. The use of observation status
has increased by 26% among Medicare
beneficiaries since 2008 [11]. Despite the high
incidence of ABSSSIs treated without hospital
admission, data examining the burden of
illness, processes of care, and decisions used to
determine care are lacking [12–14]. In addition,
many professional societies, including ACEP,
are advocating for more evidence-based,
conscientious use of diagnostic resources to
optimize care and decrease waste within

healthcare [15]. The objectives of this study were to determine the burden of illness and services received for patients with less than 24 h of IV therapy for ABSSSIs before being discharged directly from EDs and OUs.

METHODS

Study Design

This retrospective observational study was completed at the Detroit Medical Center (DMC) between April 2012 and September 2014. Institutional Review Board approval was obtained from Wayne State University with a waiver of informed consent.

Study Setting and Population

The study was conducted at the DMC. The DMC consists of nine hospitals and is the largest healthcare provider for Southeast Michigan. The study was completed at two acute care trauma institutions (Detroit Receiving Hospital and Harper University Hospital) and two community-based hospitals (Sinai-Grace Hospital and Huron Valley Sinai Hospital) within the DMC.

Study Protocol

Patients were screened consecutively using a standardized approach throughout the study period and data was collected retrospectively, after completion of care. Eligible patients were those between 18 and 89 years of age diagnosed with ABSSSI per the treating physician and presenting with at least three of the following local signs/symptoms: pain, tenderness, swelling erythema, warmth, drainage/discharge, induration, and/or lymph node swelling/tenderness.

Patients were excluded from analysis if osteomyelitis/septic arthritis, gas gangrene/necrotizing infections were suspected. Additional exclusion criteria included the presence of prosthetic hardware or invasive devices suspected to be the source of infection but could not be removed, receiving oral antibiotics only, treatment with IV antibiotics for greater that 24 h, odontogenic infections, open burn of greater than 30% of body surface area, pregnant or nursing, or prisoners. For patients with multiple eligible visits during the study period, only the first was included as the index visit. Patients were categorized as receiving care in the ED if all management for the index visit was received within the ED; patients were categorized as receiving care in the OU if they received any services in the OU prior to discharge home.

Measures

Patient-level data collected included demographics, comorbid conditions and Charlson Comorbidity Score, antibiotic history (last 90 days) and hospitalization history (last 180 days) as available, history of ABSSSI as available, type of ABSSSI per Food and Drug Administration definitions [16], complicated versus uncomplicated ABSSSI [1, 17], criteria for systemic inflammatory response syndrome (SIRS), empiric treatment, other therapeutic interventions for ABSSSI (debridement, incision and drainage, amputation), procedures and tests used to aid in the diagnosis of ABSSSI, discharge antibiotic prescription(s), type of insurance, time (in h) till discharge from ED or OU, and 96-h ED revisit/hospitalization. Two previously published severity-scoring systems that have been studied in the management of ABSSSIs were also calculated and compared: the Clinical

Resource Efficiency Support Team (CREST)/Eron Classification and Standardized Early Warning Score (SEWS) (Fig. 1) [18, 19]. The primary outcome of interest was "early" ED revisit or hospital admission, noted to be within 96-h post-initial encounter [20].

Data Analysis

Descriptive statistics were determined for patient demographics, comorbid conditions, severity of illness per CREST/Eron and SEWS, services/diagnostic procedures received, and outpatient antibiotics prescribed. Characteristics were compared between ED and OU patients to determine possible differences in the treatment pattern. Student t test, Mann–Whitney U test, or Wilcoxon rank sum test was used for continuous and ordinal variables and Pearson's Chi-squared or Fisher's exact test was used for categorical variables. Correlations were determined through Spearman Rank-Order Correlation. A multivariable logistic regression analysis was conducted to determine independent risk factors for the primary outcome of interest. Variables significantly associated with the outcome on univariate analysis ($p \leq 0.1$) or with clinical and scientific rationale were included in the explanatory model using backwards-stepwise logistic regression. Data analysis was conducted using SPSS Statistics (Version 22.0. Armonk, NY: IBM Corp.).

CREST CLASSIFICATION				
	Systemic Toxicity	**Comorbidities**	**Oral vs. IV**	**Outpatient vs. Inpatient**
CREST I	No signs	None	Oral	Outpatient
CREST II	May or may not have systemic illness	Peripheral vascular, obesity, venous insufficiency	IV	Hospital for 48h then outpatient
CREST III	Significant – confusion, tachycardia, tachypnea, hypotension	Unstable	IV	Hospital
CREST IV	Sepsis syndrome	Unstable	IV +/- surgical debridement	Hospital

Standardized Early Warning System				
Parameter	**Score**			
	3	2	1	0
Respiratory (breaths/m)	≤ 8 or ≥ 36	31 - 35	21 - 30	9 - 20
Oxygen saturation (%)	<85	85 - 89	90 - 92	≥ 92
Temperature (°C)	< 34	34 - 34.9 or ≥ 38.5	$35 – 35.9$ or $38 – 38.4$	36 - 37.9
Systolic BP (mmHg)	≤ 69	70 - 79 or ≥ 200	$80 – 99$	100 - 199
Heart rate (bpm)	≤ 29 or ≥ 130	30 - 39 or 110 - 129	$40 – 49$ or 100 - 109	50 - 99
Responsiveness	Unresponsive	Painful stimuli	Verbal stimuli	Alert

Fig. 1 Clinical Resource Efficiency Support Team (CREST) Classification and Standardized Early Warning System (SEWS) Score (adapted from [1, 18, 23])

This was an institutional review board approved, retrospective, observational study at an urban, academic medical center. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was waived by Wayne State University institutional review board.

RESULTS

In total, 1877 patients' electronic medical records were reviewed for study inclusion, of these 1569 were excluded from the current study. Reasons for exclusion are detailed in Fig. 2. The remaining 308 were included in the final analysis, with 219 (71.1%) treated in the ED and 89 (28.9%) sent to the OU. Patient characteristics varied considerably according to setting of care (Table 1). Uncomplicated abscesses were often managed in the ED while

Fig. 2 Study Consolidated Standards of Reporting Trials (CONSORT)

cellulitis was more commonly treated in the OU. Patients with comorbid conditions such as obesity (BMI ≥ 30 kg/m^2) or asthma/COPD were more likely to have a stay in the OU ($p = 0.05$, $p = 0.008$, respectively). Criteria for SIRS, except for temperature, were also significantly associated with OU treatment. Socioeconomic factors, such as insurance, had no significant impact on setting of care.

One hundred and six (80.4%) ED patients and 66 (74.2%) OU patients were determined to be CREST/Eron Class I, suggesting treatment with oral antibiotics on an outpatient basis would be appropriate. The remainder were Class II, indicating a short observation period with IV antibiotics is appropriate. There was no significant correlation between CREST/Eron Class and setting of care. The median (interquartile range) SEWS was 0 (0–1) for ED patients and 1 (0–1) for OU patients and this was significantly correlated with setting of care ($p = 0.01$). Patients with a SEWS score ≥ 1 were almost twice as likely to be treated in the OU compared to the ED (odds ratio [OR] 1.96, 95% confidence interval [CI] 1.17–4.13, $p = 0.017$).

Not surprisingly, there were also considerable differences in the management and utilization of resources in patients treated in the ED compared to the OU, where patients received care for a longer period of time (median 20.56 versus 3.46 h) and were overseen primarily by Internal Medicine physicians. An important difference was the collection of cultures from purulent lesions. Of the 129 ED patients with purulent lesions, 28 (21.7%) had cultures obtained, 67.9% of these were collected from uncomplicated abscesses. In the OU cultures were obtained in 16 of 33 (48.8%) of purulent lesions, with 37.5% from uncomplicated cases. Blood cultures were drawn from 40 (18.3%) ED patients and 50 (56.2%) OU patients. There was no association
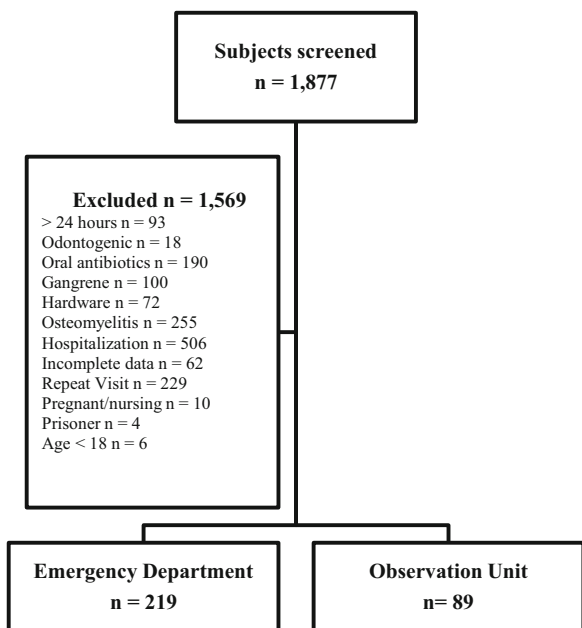
Table 1 Demographics by setting of care

Characteristics	Emergency department ($n = 219$)	Observation unit ($n = 89$)	p value
Age, median (IRQ)	41 (28–50)	46 (33–55)	0.083[a]
Male sex	121 (55.3)	42 (47.2)	0.143
Charlson score, median (IQR)	1 (0–2)	1 (0–2)	0.539[a]
Comorbidities			
Diabetes mellitus	31 (14.2)	19 (21.3)	0.121
Obesity (BMI $\geq$30 kg/m^2)	23 (10.5)	17 (19.1)	0.042
Chronic kidney disease	12 (5.5)	1 (1.1)	0.118[b]
Liver disease	5 (2.3)	5 (5.6)	0.159[b]
COPD/asthma	16 (7.3)	16 (18.0)	0.005
Injection drug use	23 (10.5)	11 (12.4)	0.637
Peripheral vascular disease	6 (2.7)	0 (0.0)	0.115[b]
Prior MRSA infection	4 (1.8)	3 (3.4)	0.410[b]
Prior history of ABSSSI	42 (19.2)	23 (25.8)	0.194
Prior hospitalization, 180 days	15 (6.8)	10 (11.2)	0.201
Prior antibiotics, 90 days	30 (13.7)	20 (22.5)	0.058
Primary location of ABSSSI			0.004
Head/neck	48 (21.9)	6 (6.7)	0.001
Hand	18 (8.2)	13 (14.6)	0.091
Arm	37 (16.9)	18 (20.2)	0.489
Leg	35 (16.0)	26 (29.2)	0.008
Foot	14 (6.4)	6 (6.7)	0.910
Trunk/buttocks	65 (29.7)	20 (22.5)	0.200
SIRS at presentation			
Fever (temperature $\geq$38.0 °C)	46 (21.0)	23 (25.8)	0.356
WBC >11,000 or <4000	15 (6.8)	15 (16.9)	0.007
Heart rate $\geq$90 beats/min	84 (38.4)	53 (59.6)	0.001
Respiratory rate $\geq$ 20/min	5 (2.3)	9 (10.1)	0.003[b]
Insurance type			
Medicaid	64 (29.2)	32 (36.0)	0.248
Medicare	26 (11.9)	7 (7.9)	0.303
Private	38 (17.4)	18 (20.2)	0.553
None	81 (37.0)	23 (25.8)	0.061

ABSSSI acute bacterial skin and skin structure infection, *BMI* body mass index, *COPD* chronic obstructive pulmonary disease, *IQR* interquartile range, *MRSA* methicillin-resistant *Staphylococcus aureus*, *WBC* white blood cell count

[a] Wilcoxon rank sum test

[b] Fisher's exact test

between the presence of systemic toxicity (SIRS) or comorbid conditions and the use of blood cultures. Radiology was used to aid in the diagnosis of ABSSSIs in 69 (31.5%) of ED and 59 (66.3%) of OU patients ($p < 0.001$), the majority (89.5%) through plain-film radiograph, followed by ultrasound (7.5%) and CT (5.2%). There was no significant difference in the use of radiology in complicated versus uncomplicated infections, either abscesses (30.1% versus 32.3%) or cellulitis (53.5% versus 63.4%). Initial laboratory assessment was obtained in all patients; C-reactive protein and erythrocyte sedimentation rate were not routinely measured.

The most common empiric IV antibiotics were clindamycin, vancomycin, and ampicillin/sulbactam, respectively (Table 2). Patients with abscesses, both complicated and uncomplicated, were significantly more likely to receive clindamycin in the ED ($p = 0.001$) while vancomycin was more common in uncomplicated abscesses and cellulitis in the OU ($p = 0.001$ and 0.033, respectively). The most common discharge antibiotics were oral clindamycin and trimethoprim/ sulfamethoxazole (TMP/SMX) in both the ED and OU. More patients with complicated abscesses in the ED compared to OU received an agent providing empiric coverage for community acquired methicillin-resistant *Staphylococcus aureus* (CAMRSA) (TMP/SMX, clindamycin, and doxycycline) ($p = 0.019$). Among patients with cellulitis, 88 (71.0%) were prescribed an agent active against CAMRSA. For patients with uncomplicated abscesses that underwent incision and drainage 64 (91.4%) received a discharge antibiotic, primarily those active against CAMRSA.

Thirty patients (9.7%) from the entire cohort, 23 (10.5%) ED and 7 (7.9%) OU experienced the primary endpoint of 96-h ED revisit or hospitalization. Among the entire cohort 30-day infection-related admission was low (23, 7.5%), with no significant difference between patients seen in the ED versus OU. Univariate analysis (Table 3) demonstrated that prior history of ABSSSI, prior history of MRSA, meeting SIRS criteria for alteration in body temperature, and ABSSSI located on the torso/ buttocks were risk factors for 96-h ED revisit. Due to the limited number of subjects experiencing the primary outcome, only these variables were tested in the regression model. Through multivariable backwards-logistic regression (Table 4), prior history of ABSSSI (adjusted odds ratio [aOR] 2.38 [95% CI 1.26–6.35]) and location on the torso/buttocks (aOR 2.36 [95% CI 1.07–5.20]) were independently associated with 96-h ED revisit or hospitalization. Among the subset of patients managed only in the ED, prior history of ABSSSI (aOR 3.03 [95% CI 1.19–7.80]) and meeting SIRS criteria for temperature (aOR 2.51 [95% CI 1.00–6.35]) were independently associated with 96-h ED revisit or hospitalization.

DISCUSSION

The types of ABSSSIs seen in EDs and OUs are diverse and there is a high degree of variability in the management strategies employed. Our study demonstrated that patients with complicated infections, especially cellulitis or infections involving the leg, and presence of at least one of the SIRS criteria, excluding temperature alterations, were more likely to have been upgraded to the OU. Ninety-six-hour ED revisit or hospitalization was relatively uncommon with only 9.7% of the entire cohort experiencing this endpoint. This is likely a reflection of the overall low acuity of these patients. Few parameters were associated

Table 2 Antimicrobial therapy by setting of care (emergency department versus observation unit)

Antibiotic	Emergency department ($n = 219$)	Observation unit ($n = 89$)	p value
Empiric IV therapy			
Empiric vancomycin	31 (14.2)	35 (39.3)	<0.001
Empiric clindamycin	128 (58.4)	26 (29.2)	<0.001
Empiric ampicillin/sulbactam	37 (16.9)	19 (21.3)	0.415
Discharge antibiotic			
Amoxicillin/clavulanate	19 (8.7)	12 (13.4)	0.214
Cephalexin	41 (18.7)	7 (7.8)	0.049
Clindamycin	106 (48.4)	30 (33.7)	0.027
Doxycycline	8 (3.7)	1 (1.1)	0.455[b]
Linezolid	1 (0.5)	1 (1.1)	0.495[b]
None	16 (7.3)	18 (20.2)	0.002
TMP/SMX	17 (7.8)	22 (24.7)	<0.001
Dual therapy[a]	36 (16.4)	8 (9.0)	0.107

CAMRSA community acquired methicillin-resistant *Staphylococcus aureus*, *IV* intravenous, *TMP/SMX* trimethoprim–sulfamethoxazole

[a] Coverage of CAMRSA and *streptococcal species*

[b] Fisher's exact test

with 96-h ED revisit or hospitalization upon multivariable analysis. Of note, a history of recurring ABSSSIs as well as prior MRSA infection were linked to the primary outcome. One factor that has previously been shown to increase risk of outpatient failure is meeting SIRS criteria [21]. Based on this, the Infectious Diseases Society of America (IDSA) guidelines recommend initial inpatient management for patients with SIRS criteria. A study by Volz and colleagues found that patients with infections on their hands were three times more likely to require escalation of care [22]. Additionally, a white blood cell count $\geq$15,000/mm^3 and female gender have been independently associated with failure to be successfully discharged from the OU [12]. The presence of fever (temperature $\geq$38 °C) was the most commonly reported predictor for requiring a

hospital stay of $\geq$24 h or failure of ED/OU status [13, 22]. In our cohort, the presence of fever was found to be significantly linked to 96-h ED revisit/admission among those treated in the ED, likely a signal of requiring upgrade to the OU. Future research should aim to determine if these parameters can be generally applied to determine which patients are likely to require escalation of care to avoid subsequent ED revisits.

Severity of illness was evaluated using two scoring systems not commonly employed in the United States—the CREST/Eron Classification and the SEWS [18, 19]. These systems were employed because there is currently not a commonly used or validated tool in the United States. Neither correlated with site of care, suggesting that the management decisions in the ED/OU setting for ABSSSI are likely based

Table 3 Univariate analysis of 96-h revisit or hospital admission

Characteristics	96 h revisit (*n* = 30)	No revisit (*n* = 278)	*p* value
ED setting of care	23 (76.7)	19 (70.5)	0.479
CREST/Eron class II	8 (26.7)	57 (20.5)	0.701
Comorbid conditions			
Diabetes	6 (20.0)	44 (15.8)	0.566
Prior ABSSSI	12 (40.0)	53 (19.1)	0.008
Prior MRSA infection	3 (10.0)	4 (1.4)	0.003[a]
Morbid obesity	6 (20.0)	34 (12.2)	0.250
Charlson comorbidity score (IQR)	1.0 (0.0–1.3)	1.0 (0.0–2.0)	0.601
Surgical intervention	12 (40.0)	137 (49.3)	0.345
Antibiotics 90 Days	3 (10.0)	47 (16.9)	0.382
SIRS criteria on presentation			
Body temp >38 or <36	11 (36.7)	28 (20.9)	0.049
HR >90 beats/min	14 (46.7)	123 (44.2)	0.800
RR >20 breaths/min	1 (3.3)	13 (4.7)	1.000[a]
WBC >12,000 or <4000	4 (13.3)	26 (9.4)	0.485
Site of infection			
Arm	3 (10.0)	52 (18.7)	0.319[a]
Leg	7 (23.3)	54 (19.4)	0.631
Head/neck	3 (10.0)	51 (18.3)	0.320
Buttocks/torso	13 (43.3)	72 (25.9)	0.042
Hand	1 (3.3)	30 (10.8)	0.197[a]
Foot	3 (10.0)	17 (6.1)	0.427[a]
Type of ABSSSI			
Complicated cellulitis	3 (10.0)	35 (12.6)	0.682[a]
Complicated abscess	6 (20.0)	57 (20.5)	0.948
Uncomplicated cellulitis	9 (30.0)	77 (27.7)	0.789
Uncomplicated abscess	11 (36.7)	88 (31.7)	0.577
Empiric antibiotics			
Ampicillin/sulbactam	3 (10.0)	53 (19.1)	0.319[a]
Discharge antibiotics			
Combination therapy	6 (20.0)	38 (13.7)	0.408
Tissue culture available	6 (20.0)	49 (17.6)	0.802

ABSSSI acute bacterial skin and skin structure infection, *CREST* Clinical Resource Efficiency Support Team, *HR* heart rate, *IQR* interquartile range, *MRSA* methicillin-resistant *Staphylococcus aureus*, *RR* respiratory rate, *WBC* white blood cell

[a] Fisher's exact test

Table 4 Multivariable regression analysis of risk factors for 96-h ED revisit or hospital admission

Factor	Unadjusted OR	95% CI	p value	Adjusted OR	95% CI	p value
Prior ABSSSI	2.83	1.29–6.23	0.013	2.38	1.26–6.35	0.014
Prior MRSA	7.61	1.62–35.79	0.020	4.38	0.80–24.20	0.072
Temperature >38 or <36 °C	2.19	0.99–4.87	0.061	2.20	0.97–5.00	0.059
Location Torso/Buttocks	2.19	1.01–4.73	0.042	2.36	1.07–5.20	0.038

ABSSSI acute bacterial skin and skin structure infection, *CI* confidence interval, *OR* odds ratio, *MRSA* methicillin-resistant *Staphylococcus aureus*

on factors not included in current criteria. Comorbid conditions requiring additional management and optimization may be influencing these decisions. Neither CREST/Eron nor SEWS has been validated to determine ABSSSI management in ED versus OU specifically. Marwick and colleagues observed that 70% of patients in CREST/Eron Class II (normally recommended to treat as inpatient with IV antibiotics for up to 48 h) could be treated on an outpatient basis [19]. In our study there was no significant difference in the amount of CREST/Eron Class II patients between ED and OU, supporting the previous finding. Physiological parameters within SEWS were better able to differentiate patients that were upgraded to the OU, which also mirrors findings from Marwick and colleagues in their attempt to prospectively validate a modified CREST/Eron Classification system [23]. Higher CREST/Eron Class or SEWS were not associated with 96-h ED revisit/hospitalization. Even though severity scoring could potentially identify patients requiring observation for a period of up to 48 h, our results suggest that the majority of patients, especially those with uncomplicated cellulitis or abscess, do not need this extended period of healthcare exposure. Aligned with data on outpatient parental antimicrobial therapy data (OPAT), use of OUs with or without subsequent OPAT

can lead to reduced hospital costs, decreased healthcare exposure and risk of adverse events, and improve patient care [10, 24, 25].

Numerous investigations have examined the appropriateness of antibiotic prescribing for ABSSSIs in EDs, especially with the rising prevalence of CAMRSA [26–29]. Pallin and colleagues evaluated data form 2007–2010 NHAMCS using the quality measures of overuse, underuse, and misuse. Overuse was defined as use of any antibiotic for abscess patients with successful incision and drainage or use of CAMRSA agents in patients with cellulitis (no purulence). In our study, over 80% of patients with incision and drainage were prescribed antibiotics on discharge and over 60% of patients with cellulitis were prescribed an agent active against CAMRSA. Double coverage against both *streptococcal* spp. and CAMRSA was also a common occurrence, which increases the risk of adverse drug events and resistance [30]. These data support the need for improvement initiatives in prescribing patterns for ABSSSIs.

Diagnostics procedures were significantly different in patients treated in the ED versus OU, which is not surprising based on the difference in time receiving care and specialty of the treating physicians. Routine blood cultures, drawn in over 50% of OU patients, have not been shown to improve clinical

outcomes, and are not recommended routinely by the IDSA for the treatment of skin and skin structure infections [21, 31, 32]. The American Board of Internal Medicine developed the Choose Wisely Campaign to limit unnecessary tests and procedures in the treatment of various medical conditions [15]. ACEP, a partner organization, lists the use of antibiotics and cultures in uncomplicated abscesses after incision and drainage with medical follow-up among their top 10 unnecessary procedures and tests [33]. Our data demonstrate that in the ED over 60% of cultures were taken in uncomplicated abscesses. It is important to note, however, that due to the retrospective nature of the study we cannot assess if appropriate outpatient follow-up was available or if the cultures and susceptibility data from the ED was conveyed to each applicable patient. Our findings are similar to Jenkins and colleagues wherein arguably avoidable healthcare resources were employed for diagnostic testing [26]. Among the 322 inpatients included in their analysis, 47–58% of patients had blood cultures drawn, of which 13 patients were bacteremic. Radiological data were also commonly used to rule/out deeper sites of infection. Among patients with cellulitis, 94% received a plain film radiograph, with a positive yield of only 1%. It is important to note, however, that Jenkins and colleagues studied hospitalized patients with ABSSSSIs where our cohort was entirely treated in the ED/OU setting.

Limitations

There are several limitations to this study that should be addressed. First, the study was retrospective in nature, and thus relied on proper documentation within electronic medical charts. This may be especially important for history of MRSA and size of the lesion. The study was also single centered, which may limit the external generalizability of the results. It is unclear what differences in practice patterns or patient acuity may exist among patients treated for ABSSSIs at other institutions. In addition, the fact that DMC is only one of several large academic medical centers within the Detroit metropolitan area makes it likely that some ED revisits were missed. Much like the study with Pallin and colleagues, patients with incision and drainage may have been prescribed outpatient antibiotics due to a large area of induration around the lesion, thus falsely increasing the cases in our quality measure of overuse [28]. The study consists of patients treated with IV antibiotics only, but the decision to administer IV versus orally is also highly subjective and may contribute to our inability to discern differences between settings of care or 96-h ED revisit/hospitalization. Lastly, resource utilization for follow-up in ambulatory care clinics was not evaluated.

CONCLUSION

Data regarding the decision strategies and processes of care in patients with ABSSSIs with low acuity, especially those treated in OUs, are relatively unreported. This study demonstrated the subjective nature of determining patient level of care as well as the varied diagnostic tests/procedures and prescribing patterns for patients discharged with ABSSSIs. Resources utilized in the diagnosis and management of these lower acuity ABSSSIs should be critically evaluated to determine necessity and benefit to the patient. Additionally, few differences in patient presentation were significantly linked to the decision to escalate care to OU status.

Across both settings, ED revisit or hospitalization within 96 h was infrequent; suggesting that short observation and less than 24 h of IV therapy followed by oral therapy is appropriate management for many ABSSSIs, particularly in patients with no prior history of infection. Several considerations, such as past history of ABSSSI, temperature alterations at presentation, or certain locations of ABSSSIs may be important indicators for need to escalate care. There is, however, a need for more evidence-driven guidance of patient disposition and resources necessary to optimize patient outcomes while decreasing wasteful use of finite and costly resources.

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