

# CHARACTERISTICS OF PATIENTS HOSPITALIZED FOR ACUTE BACTERIAL SKIN AND SKIN STRUCTURE INFECTIONS (ABSSSI) FROM 2009-2013

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## ABSTRACT

**Background:** Acute bacterial skin and skin structure infections (ABSSSIs) are a common cause of hospitalization in the United States. This study aimed to characterize the patient population hospitalized for ABSSSI, including comorbidities, pathogens identified, and length of initial inpatient stay.

**Methods:** Adults (>18 years) hospitalized with ≥1 primary ABSSSI diagnosis were selected from the Cerner Health Facts electronic medical record database (2009-2013). Typical causative pathogens for ABSSSI and Gram stain type (positive or negative) were identified from microbiology culture. In addition, patients with methicillin-resistant *Staphylococcus aureus* (MRSA) were also identified. Patients without culture results were classified as 'Unknown'. Length of initial inpatient stay (measured from admission to discharge) was compared between the cohorts with and without MRSA infections descriptively.

**Results:** 11,705 patients were identified: 51.8% were male, mean age was 55 years at admission, and 31.3% were ≥65 years old. 49.7% of the patients were obese, 30.9% were diabetic, 48.9% were hypertensive, and 12.4% were diagnosed with depression. Over half (56.6%) of the patients had no culture results. Of the patients that had an identified ABSSSI-causing pathogen, 63.9% were Gram-positive, including 18.4% with MRSA. 11.9% were Gram-negative and 24.2% were mixed infections (Gram-positive and negative), including 3.6% with MRSA. Median length of stay was longer for patients with MRSA infections than those without MRSA (4.12 vs. 3.97 days,  $P=0.0009$ ). For all comorbidities examined (obesity, diabetes, hypertension, depression, renal failure, and heart failure), median length of stay among patients with a comorbidity was significantly higher than those without.

**Conclusion:** Hospitalized patients with ABSSSI have a number of comorbidities, including obesity, diabetes, hypertension, and depression, which can complicate antibiotic selection. Over half of patients did not have a pathogen identified. When identified, 21.9% involved MRSA and 24.2% were mixed infections (including MRSA). Patients with a MRSA infection experienced longer length of stay. Patient characteristics and pathogen coverage must be considered in antibiotic selection in ABSSSI

## INTRODUCTION

- Acute bacterial skin and skin-structure infections (ABSSSI) impose a large and growing economic burden in the United States. The number of hospital stays due to ABSSSI increased by 85% from 1997 to 2009 [1]. Approximately 11.6 million outpatient care visits each year can be attributed to ABSSSI [2]
- Patients hospitalized with ABSSSI frequently suffer from a range of comorbidities which increase disease burden, including obesity, diabetes, renal impairment, heart failure, hypertension, and depression [3]. Although these comorbidities are likely to lead to worse outcomes, these impacts are not well characterized in the literature.
- Methicillin-resistant *S. aureus* (MRSA) is also an important driver of higher disease burden and worse health outcomes. The involvement of MRSA in skin infections further increases treatment failures, disease recurrence, risk of invasive disease, and contribute to a higher mortality [4]

### OBJECTIVES

- Describe baseline characteristics of hospitalized ABSSSI patients
- Identify patient- and infection-related factors associated with length of the initial inpatient stay

## MATERIALS AND METHODS

### Data Source

The analysis was conducted using Cerner HealthFacts® electronic medical records (EMR) database:

- This is de-identified EMR database containing information from clinical and laboratory systems from over 1,000 hospitals and for over 35,000,000 patients
- The essential data elements include longitudinal data for each patient which contains patient demographic information (e.g., age, gender, and body mass index [BMI])

## MATERIALS AND METHODS

- For each admission, the data include diagnosis codes (ICD-9), DRGs, microbiology information, admission data, and discharge date
- The analysis used data from 2009 to 2013 across various census regions (Northeast, Midwest, South, and West) and facility settings (urban/rural)

### Sample Selection

- Figure 1** illustrates the sample selection flow:
- Inclusion criteria:
  - Patients (age 18 years or older) with at least one primary ABSSSI diagnosis for an inpatient stay in 2009 or later. The index admission was defined as the first inpatient admission with a primary ABSSSI diagnosis
  - Patients treated with parenteral antibiotics (administered intravenously or via injection) during the index admission
  - Patients with body mass index (BMI) or both height and weight data available for the index admission. Limited to patients with BMI between 15 to 100 kg/m<sup>2</sup>
- Exclusion criteria:
  - Inpatient stay with a primary or secondary ABSSSI diagnosis in 3 months prior to the index admission
  - Patients with index admissions that are the result of a transfer from another hospital or healthcare facility

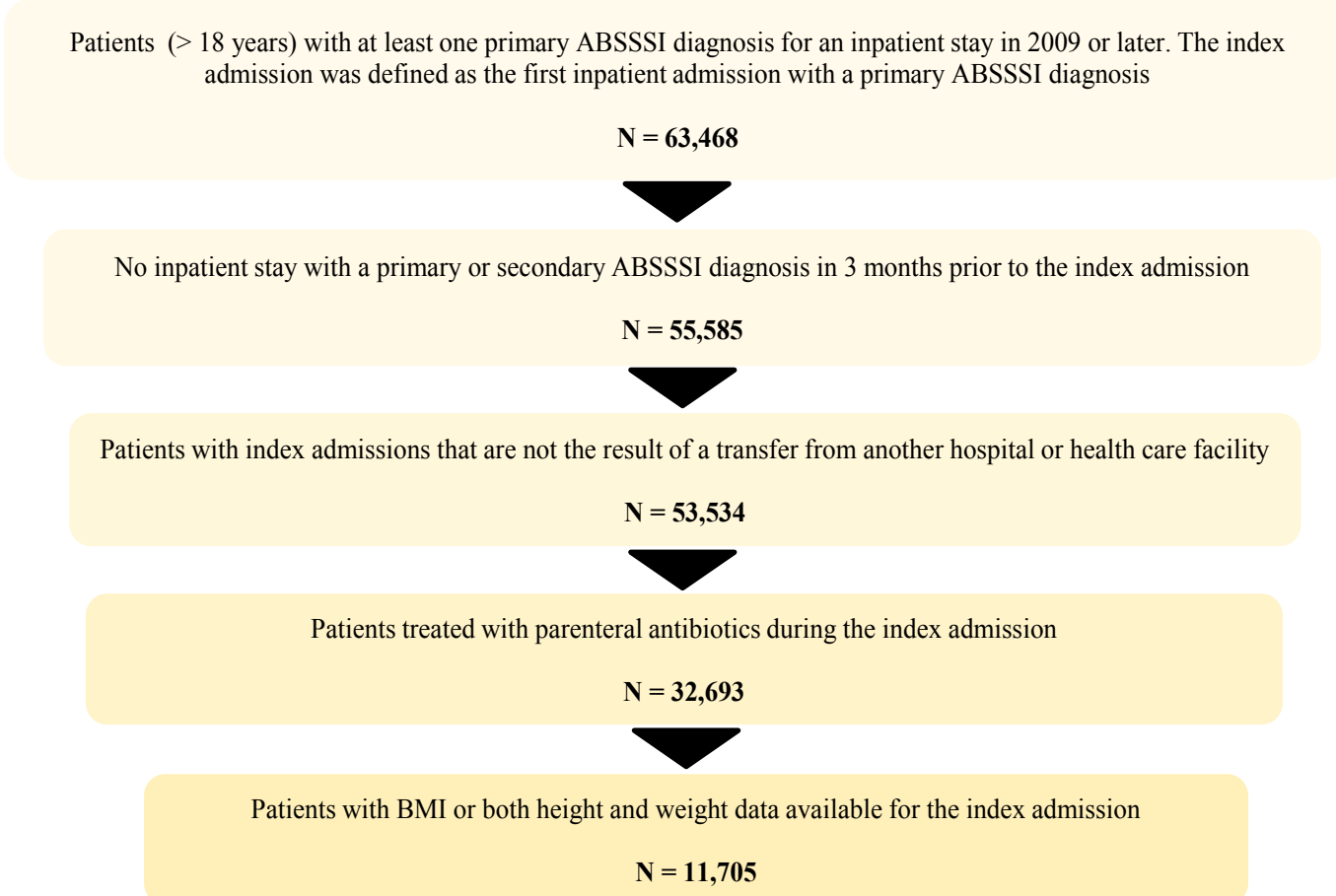
### Measures and Definitions

- Patient characteristics on the index admission
  - Patient demographics, insurance coverage, and infection type
  - Causative pathogen identified from microbiology tests
  - Patient comorbidity conditions were identified by ICD-9 diagnosis codes recorded during the index admission. Diagnosis codes for each condition were defined by Elixhauser Comorbidity Score [5]
- Length of stay measures the duration between the admission date and the discharge date of the initial hospital stay.
  - Discharges followed by admissions within 4 hours were considered as a continuous inpatient stay

### Statistical Analysis

- Patient and hospital characteristics were summarized descriptively
- Differences of length of stay between patient groups were assessed using Wilcoxon rank-sum test

FIGURE 1: SAMPLE SELECTION OF ABSSSI PATIENTS



### Patient Population

- 11,705 patients met the sample selection criteria

### Characteristics of ABSSSI Patients

Table 1 and Table 2 show the characteristics of all selected ABSSSI patients

- Mean age of sample was 55 years and 31% were ≥65 years old. Over half of the patients (52%) were male.
- Fifty percent of patients were obese and 49% were hypertensive.
- Patients diagnosed with diabetes constitute 31% of the patient population.
- Twelve percent of patients had renal failure and depression, respectively.
- Around 10 percent of patients were diagnosed with heart failure

### Microbiological Findings

- Over half (57%) of the patients had no microbiology test results.
- Of the patients that had an identified ABSSSI-causing pathogen (N=5,078) [Figure 2]:
  - 64% were Gram-positive (G+), including 19% infected with MRSA
  - 12% were Gram-negative (G-)
  - 24% were mixed infections (Gram+ and G-), including 4% with MRSA

FIGURE 2. PATIENTS WITH KNOWN PATHOGEN BY GRAM STAIN AND EXISTENCE OF MRSA

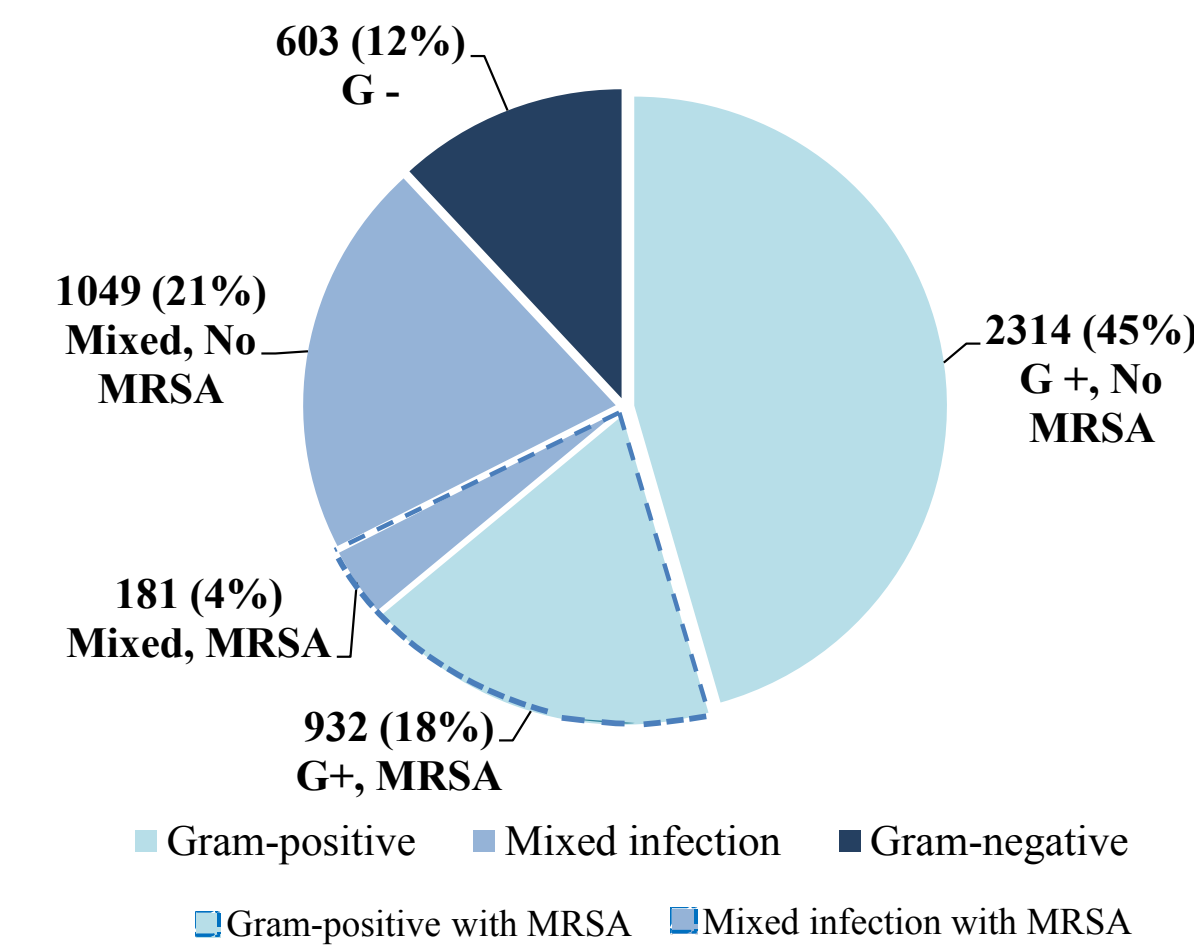


TABLE 1. INFECTION TYPE

Type of ABSSSI	N	%
Abscess only	123	(1.1%)
Cellulitis only	344	(2.9%)
Abscess and cellulitis	8,454	(72.2%)
Surgical wound infection	2,557	(21.8%)
Non-surgical wound infection	87	(0.7%)
Other/unknown	140	(1.2%)

TABLE 2. PATIENT CHARACTERISTICS

Demographics	N	%
Patient Count	11,705	
Male, N (%)	6,064	(51.8%)
Age at admission, years, Mean (SD)	54.86	(18.48)
Age at admission distribution, N (%)		
18-30 years	1,319	(11.3%)
31-44 years	2,191	(18.7%)
45-54 years	2,349	(20.1%)
55-64 years	2,185	(18.7%)
≥ 65 years	3,661	(31.3%)
Race, N (%)		
Asian	94	(0.8%)
Black	1,676	(14.3%)
Hispanic	349	(3.0%)
Native American	150	(1.3%)
White	8,930	(76.3%)
Other	365	(3.1%)
Not Reported	141	(1.2%)
BMI, kg/m <sup>2</sup> , Mean (SD)	32.30	(10.24)
BMI distribution, kg/m <sup>2</sup> , N (%)		
Underweight (BMI ≤ 18.5)	217	(1.9%)
Normal (18.5 < BMI ≤ 25)	2,601	(22.2%)
Overweight (25 < BMI ≤ 30)	3,064	(26.2%)
Obese (30 < BMI ≤ 40)	3,738	(31.9%)
Morbid obesity (BMI > 40)	2,085	(17.8%)
Year of admission, N (%)		
2009	594	(5.1%)
2010	1,470	(12.6%)
2011	2,202	(18.8%)
2012	3,397	(29.0%)
2013	4,042	(34.5%)
Insurance coverage, N (%)		
Medicaid	1,495	(12.8%)
Medicare	3,787	(32.4%)
Other Public	207	(1.8%)
Private	3,377	(28.9%)
Blue Cross/Blue Shield	1,129	(9.6%)
Other Private	2,248	(19.2%)
Self	1,157	(9.9%)
Not Reported	1,682	(14.4%)
Comorbidities <sup>1</sup>	N	%
Hypertension	5,725	(48.9%)
Diabetes	3,615	(30.9%)
Obesity	5,823	(49.7%)
Renal failure	1,349	(11.5%)
Congestive heart failure	1,138	(9.7%)
Depression	1,456	(12.4%)

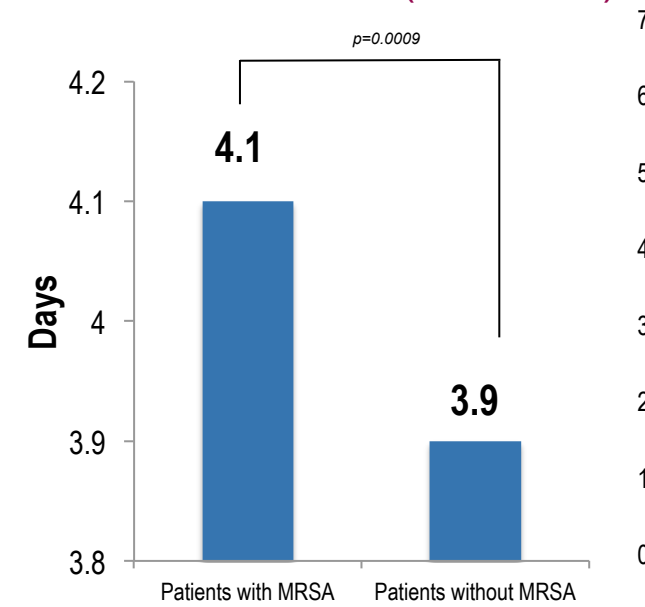
<sup>1</sup> Obesity is defined by BMI > 30. Other comorbidity conditions are defined by ICD-9 codes at admission.

## RESULTS

### Relationship between Length Of Stay And Patient Characteristics

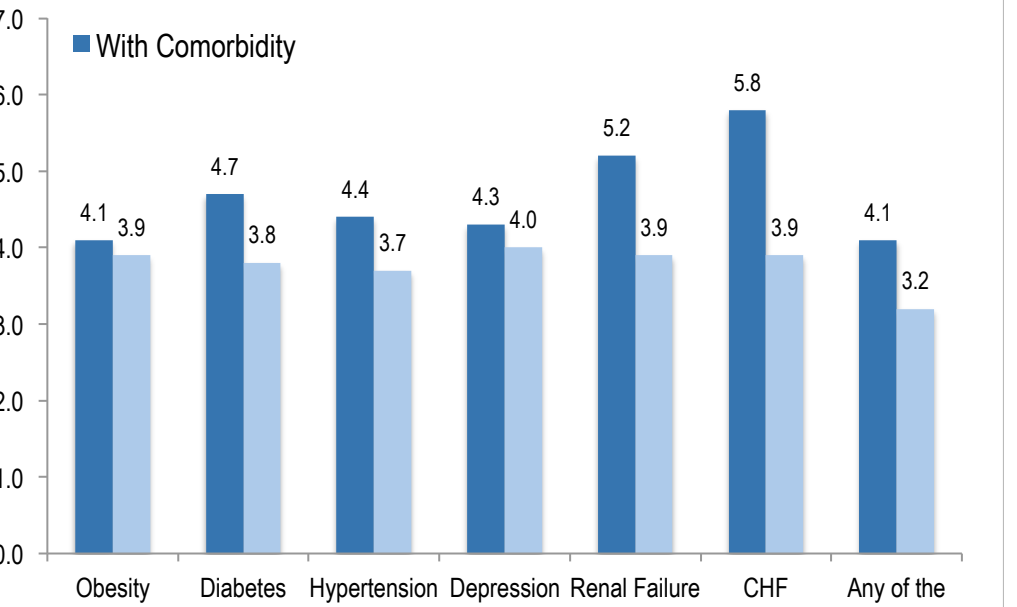
- Median length of stay was higher for patients with MRSA infections than those without MRSA (4.1 vs. 3.9 days,  $p=0.0009$  based on Wilcoxon rank-sum test)
- For all comorbidities examined (obesity, diabetes, hypertension, depression, renal failure, and heart failure), median length of stay among patients with the comorbidity was higher than those without: ranging from 0.16 days longer for obese patients to 1.87 days longer for patients with congestive heart failure ( $p<0.0001$  for every comorbidity type based on Wilcoxon rank-sum test)

FIGURE 3. MEDIAN LENGTH OF STAY AMONG PATIENTS WITH AND WITHOUT MRSA (N = 5,078)



Note: p-value obtained based on Wilcoxon rank-sum test

FIGURE 4. MEDIAN LENGTH OF STAY AMONG PATIENTS WITH AND WITHOUT COMORBIDITIES (N = 11,705)



Length of stay between patients with and without each comorbidity are significantly different ( $p<0.0001$ )

## CONCLUSION

- Hospitalized patients with ABSSSI have a number of co-morbidities, including obesity, diabetes, hypertension, and depression which can complicate antibiotic selection
  - Over half of the patients did not have a pathogen identified from microbiology tests; when identified 21.9% involved MRSA, and 24.2% were mixed infections (including MRSA)
  - LOS varies according to comorbidity status and causative pathogen; with a high level of statistical significance, comorbidities and MRSA infection associate with longer LOS
  - Patient characteristics and pathogen coverage must be considered in antibiotic selection in ABSSSI
- ### Limitations
- This study was conducted in the Cerner electronic medical record database and the majority of index hospitalizations included for analysis were from urban hospitals with most of the hospitals affiliated with a teaching facility and having more than 300 beds, which might not be generalizable to all the hospitals in the US
  - Medical charts are not available in the source EMR database to confirm the diagnosis and the comorbidity profile of patients. In addition, over half of patients had no microbiology test results recorded in the data.

### Disclosure

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