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DEMOGRAPHICS OF CULTURE POSITIVE PATIENTS IN THE ADMISSION PERIOD WITH SKIN AND SKIN STRUCTURE INFECTION IN THE US: A MULTICENTER EVALUATION OF PATHOGEN DISTRIBUTION

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ABSTRACT

Background: Acute bacterial skin infections account for >12 million infections annually in the US. The demographics and underlying conditions are shifting and the etiology of these infections was previously considered to be Staphylococcal, this study sought to confirm this viewpoint.

Methods: We analyzed the first positive bacterial skin/wound isolates for patients discharged with a primary or secondary ICD10 code for skin and skin structure infection (SSTI) from 68 US acute care hospitals from 2015-2017 in the BD Insights Research Database (Franklin Lakes, NJ). Gram-negative (GN) and Gram-positive (GP) bacterial pathogens were categorized as admission period (ADM) if collected within 3 days of admission and hospital-onset (HO) if collected ≥ 3 days from hospital admission.

Results: Skin infections were reported in 51,503 patients in whom 17,651 (34%) had a skin/wound culture taken of which 11,911 yielded a positive culture (68%) for GN, GP and mixed GN/GP pathogens. Of 11,911 admissions with positive skin/wound cultures, 86% (10,213) were collected in the ADM. Episodes with cultures during the ADM period, 80.1% (8,185), 35.1% (3,584), and 28.6% (2,294) were positive for GP, GN, and mixed GN/GP pathogens. In the ADM cohort GN and mixed GN/GP patients were significantly older, had higher mortality, ICU admission and ALarMS score than GP alone. Comorbidities tended to occur more frequently in the GN and mixed GN/GP patients cohort.

Conclusion: Patients with Gram negative and mixed GN/mixed admitted with acute skin infections tended to be older, sicker and more required ICU admission than GP infected patients.

TABLE 1. US HOSPITAL CHARACTERISTICS.

BD Sites: n=68	
Region	
Northeast	5 (7.4%)
South	32 (47.1%)
Midwest	26 (38.2%)
West	5 (7.4%)
Urban/Rural	
Urban	62 (91.2%)
Rural	6 (8.8%)
Medical School Affiliation	
Major	4 (5.9%)
Limited	12 (17.6%)
Graduate	2 (2.9%)
No Affiliation	50 (73.5%)
Bed size	
<100	12 (17.6%)
100-300	27 (39.7%)
>300	29 (42.6%)

Short-term acute hospitals: Acute & Critical Access, excludes Children's & Specialty sites.

INTRODUCTION

Acute bacterial skin infections are a common infection in all healthcare settings in the US. It was found that both the total number and rate of SSTI-related visits to ambulatory physicians increased from 1997 to 2005. Total visits increased by 65% from 8.6 million (95% CI, 7.0 million to 10.2 million) in 1997 to 14.2 million (95% CI, 11.7 million to 16.8 million) in 2005, and the overall rate of ambulatory visits increased by 50% from 32.1 (95% CI, 26.1-38.1) visits/1000 population in 1997 to 48.1 (95% CI, 39.4-56.7) (P=.003 for trend) in 2005 [1]. Recently, in a large US-based multicenter retrospective cohort of ambulatory and inpatient encounters among nearly 50 million commercially insured individuals aged 0–64 years, Miller and coworkers reported that not only did 2.3 million cases of SSTI occur between the years 2005 and 2010, but also that during this time period, the incidence of SSTIs was far higher than that of either urinary tract infections or pneumonia. [2]. Kaye and colleagues noted that the absolute volume of SSTI hospitalizations rose from 641,863 in 2005 to 752,770 in 2011, as did the SSTI diagnoses as a proportion of all admissions, going from 1.6% to 2.0% [3]. Based on the available evidence, SSTI is a high-volume condition in both in- and outpatient settings and some studies show a rising incidence in recent history. Moreover, the concept of healthcare or hospital acquired compared with community acquired infections has demonstrated the presence of mixed and gram-negative mono infections [4]. We used a large national multicenter database to ascertain the demography several types of SSSI and the underlying comorbidities.

TABLE 2. CULTURE DISTRIBUTION BY PATHOGEN CATEGORY AND ADMISSION VS. HOSPITAL-ONSET (HO) TIME PERIODS (CULTUTE TYPE CATEGORIES ARE NOT MUTUALLY EXCLUSIVE).

Culture Type	Onset, N (% of Admissions)		Overall N (%)
	ADM	HO	
Monomicrobial GP	4,190 (41.0%)	649 (38.2%)	4,839 (40.6%)
MRSA	3,126 (30.6%)	465 (27.4%)	3,591 (30.1%)
Mixed GN and GP	2,924 (28.6%)	466 (27.4%)	3,390 (28.5%)
Polymicrobial GP	1,894 (18.6%)	243 (14.3%)	2,137 (17.9%)
Monomicrobial GN	805 (7.9%)	206 (12.1%)	1,011 (8.5%)
Polymicrobial GN	325 (3.2%)	80 (4.7%)	405 (3.4%)
P. aeruginosa	1,134 (11.1%)	234 (13.8%)	1,368 (11.5%)
Overall GN	3,584 (35.1%)	708 (41.7%)	4,292 (36.0%)
Overall GP	8,185 (80.1%)	1,240 (73.0%)	9,425 (79.1%)
Total Admissions	**10,213 (85.7%)**	**1,698 (14.3%)**	**11,911**

METHODS

- We analyzed the first positive bacterial skin/wound isolates for patients discharged with a primary or secondary ICD10 code for skin and skin structure infection (SSTI) from 68 US acute care hospitals (Table 1.) from 2015-2017 in the BD Insights Research Database (Franklin Lakes, NJ).
- Gram-negative (GN) and Gram-positive (GP) bacterial pathogens were categorized as admission period (ADM) if collected within 3 days of admission and hospital-onset (HO) if collected ≥ 3 days from hospital admission.
- The 2-sided Fisher's exact test was used to test for significance.

TABLE 3. PATIENT DEMOGRAPHICS FOR CULTURE POSITIVE SSSI WITH GN, GP AND MIXED ORGANISMS DURING THE ADMISSION PERIOD.

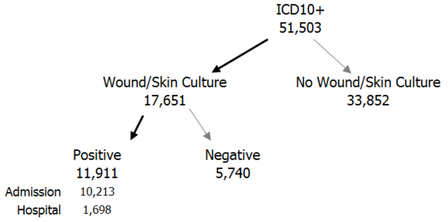
Comorbidity	GN	GP	Mixed
Hypertension	809 (71.6%)*	3,652 (60.0%)	2,026 (69.3%)^
Fluid and Electrolyte Disorders	429 (38.0%)	2,126 (34.9%)	1,216 (41.6%)^
Diabetes W/ Chronic Complications	365 (32.3%)*	2,244 (36.9%)	1,203 (41.1%)^
Deficiency Anemias	394 (34.9%)*	1,696 (27.9%)	1,149 (39.3%)^
Obesity	324 (28.7%)	1,617 (26.6%)	825 (28.2%)
Renal Failure	353 (31.2%)*	1,162 (19.1%)	846 (28.9%)^
Chronic Pulmonary Disease	214 (18.9%)	1,067 (17.5%)	551 (18.8%)
Congestive Heart Failure	224 (19.8%)*	771 (12.7%)	580 (19.8%)^
Peripheral Vascular Disease	194 (17.2%)*	720 (11.8%)	577 (19.7%)^
Depression	147 (13.0%)	897 (14.7%)	426 (14.6%)
Weight Loss	211 (18.7%)*	503 (8.3%)	475 (16.2%)^
Hypothyroidism	151 (13.4%)	715 (11.8%)	397 (13.6%)^
Diabetes	148 (13.1%)*	599 (9.8%)	328 (11.2%)^
Other Neurological Disorders	116 (10.3%)*	496 (8.2%)	322 (11.0%)^
Drug Abuse	40 (3.5%)*	559 (9.2%)	181 (6.2%)^
Paralysis	117 (10.4%)*	286 (4.7%)	299 (10.2%)^
Coagulopathy	63 (5.6%)*	254 (4.2%)	170 (5.8%)^
Psychoses	46 (4.1%)	312 (5.1%)	150 (5.1%)
Valvular Disease	52 (4.6%)	223 (3.7%)	132 (4.5%)^
Liver Disease	54 (4.8%)	248 (4.1%)	109 (3.7%)
Rheumatoid Arthritis/Collagen Vas	48 (4.2%)	224 (3.7%)	90 (3.1%)
Alcohol Abuse	39 (3.5%)	215 (3.5%)	100 (3.4%)
Solid Tumor W/Out Metastasis	27 (2.4%)	102 (1.7%)	57 (1.9%)
Metastatic Cancer	25 (2.2%)*	56 (0.9%)	47 (1.6%)^
Chronic Blood Loss Anemia	11 (1.0%)	64 (1.1%)	46 (1.6%)
Peptic Ulcer Disease	6 (0.5%)	32 (0.5%)	26 (0.9%)
Pulmonary Circulation Disease	13 (1.2%)	46 (0.8%)	15 (0.5%)
Lymphoma	4 (0.4%)	35 (0.6%)	20 (0.7%)
AIDS	0 (0.0%)*	22 (0.4%)	8 (0.3%)
Total Admissions	**1,130 (11.2%)**	**6,084 (60.0%)**	**2,924 (28.8%)**

* p < .0397 for GN vs. GP; ^ p < .0300 for GN + Mixed vs. GP

RESULTS

- Skin infections were reported in 51,503 patients in whom 17,651 (34%) had a skin/wound culture taken of which 11,911 yielded a positive culture (68%) for GN, GP and mixed GN/GP pathogens (Figure 1.).
- Of 11,911 admissions with positive skin/wound cultures, 86% (10,213) were collected in the ADM period. Thus 14% were acquired during hospitalization (Table 2.).
- Episodes with cultures during the ADM period, 80.1% (8,185), 35.1% (3,584), and 28.6% (2,294) were positive for GP, GN, and mixed GN/GP pathogens (Table 2.).
- In the ADM cohort GN and mixed GN/GP patients were significantly older, had higher mortality, ICU admission and ALarMS score than GP alone (Table 4.).
- HO infections tended to be GN, Polymicrobial GN or *P aeruginosa*.
- Comorbidities tended to occur more frequently in the GN and mixed GN/GP patients cohort (Table 3).
- GN and GN/Mixed infections extended hospital length of stay and thus associated costs and expenses when compared to GP infections.

FIGURE 1. CASE TREE FOR ADMISSIONS WITH AN ICD10 CODE FOR SSSI.



CONCLUSION

- Patients with Gram negative and mixed GN/mixed admitted with acute skin infections were older, were sicker as observed with ALarMS score, they were more frequently admitted to the ICU than patients infected with gram positive pathogens.
- Gram-negative and GN/Mixed infections is associated with an extra >1.5 days longer hospital stay
- In turn this significantly increased hospital costs by >$3,500.
- In terms of impact on hospital budget GN and GN/Mixed infections lead to a higher hospital payment and lower gain per case.
- Further study is required to determine the contribution of infection and antimicrobial use to the length of stay.

TABLE 4. OUTCOMES FOR CULTURE POSITIVE SSSI WITH GN, GP AND MIXED ORGANISMS DURING THE ADMISSION PERIOD.

	GN (n=1,130)	GP (n=6,084)	Mixed (n=2,924)
Age y (avg ± SD, med)	62.6 ± 16.1*^	55.5 ± 17.3	61.0 ± 16.3^
%Male	51.7%*^	57.4%	56.6%^
ALarMS (avg ± SD)	46.8 ± 21.3*^	37.6 ± 19.7	45.7 ± 20.9^
ICU admission	19.4%*^	12.0%	20%^
Mortality	3.4%*^	1.3%	3.1%^
Financial Outcomes	**GN (n=1,036)**	**GP (n=5,687)**	**Mixed (n=2,665)**
LOS (days, avg ± SD, med)	8.3 ± 7.9, 6*	6.5 ± 7.3, 5	8.2 ± 9.3, 6^
Hospital Cost ($, avg ± SD, med)	15,485 ± 17,907, 10181*	12,925 ± 15,530, 8,504	16,818 ± 19,616, 10,808^
Hospital Payment ($, avg ± SD, med)	15,311 ± 21,421, 10,535*	12,239 ± 15,363, 8,665	15,090 ± 19,498, 10,130^
Gain/Loss per Case ($, avg ± SD, med)	-173 ± 16,321, 73	-685 ± 11,612, -166	-1,727 ± 14,937, -669^

* p < .0001 for GN vs. GP; ^ p < .0208 for GN + Mixed vs. GP

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