

**Sarah O. Massey**  
L2  
LSU Health Sciences Center, New Orleans, LA

M. Victoria P. Miles, EMT – P, MD  
Assistant Professor of Surgery at LSU Health Sciences Center, New Orleans, LA  
University Medical Center Burn Unit

## **Bloodstream Infections After Burn: Integrating Patient, Burn, and Exposure Characteristics with Microbial Etiology**

### **Introduction:**

Burn patients remain more susceptible to bloodstream infections not only because of an increased frequency of hospital procedures but also a lack of an intact skin barrier. Because bloodstream infections represent a leading cause of severe illness and death within the burn population, it is crucial to understand how comorbidities, burn characteristics, and relevant clinical exposures influence the likelihood of infection. A bacteremia episode will be defined as a positive blood culture, with a new episode defined as a positive culture occurring  $\geq 7$  days after the initial episode, regardless of organism. The primary objective of this paper is to determine which of these characteristics remain associated with bacteremia after adjustments are made for burn severity. The secondary objective aims to recognize which phenotypes have a greater association with specific pathogens and/or recurrent infections.

While past studies have identified the most common pathogens as *Pseudomonas Aeruginosa*, methicillin-resistant *Staphylococcus Aureus*, collective coagulase-negative *Staphylococcus* species, and methicillin-sensitive *Staphylococcus Aureus* in burn populations, a gap remains regarding when these pathogens are most likely to cause infection over the course of hospitalization and which anatomical area is more likely to be colonized by a specific pathogen (**Cabrera et al., 2026**). Additionally, determining which, if any, comorbidities correlate to greater risk of blood stream infection is essential to providing the best treatment for future burn patients with differing health factors. For instance, an emergency department study analyzed the association between positive blood cultures and clinical factors such as age, moderate to severe CKD, solid organ tumor, liver disease, history of chills, and body temperature of over 38.3 °C, however, little research has covered patient qualities in relation to bacteremia in the burn population (**Phungoen et al., 2021**).

### **Methods**

Injury etiology was classified as burn or non-burn. Total burn surface area (TBSA) was categorized as none or not applicable, minor (1-10%), moderate (11-20%), and severe ( $>20\%$ ). The primary outcome was bacteremia, defined as a positive blood culture. Any instances of repeat blood cultures on the same patient more than 7 days after an initial positive culture was

considered a new episode of bacteremia. Time to bacteremia was defined as the number of days from initial admission to the date of a positive blood culture. Cases with unknown sex, injury etiology, or length of stay were excluded from the analysis.

### **Statistical analysis**

Categorical variables were summarized as frequency and percent and compared using Chi-squared tests. Age was summarized as mean and standard deviation and compared using two sample t-tests. Length of stay for the initial admission and time to bacteremia were summarized as median, interquartile range and range.

For cases of bacteremia, the prevalence of microbial organism species identified in blood cultures are reported. Exploratory analyses were performed to see if species with a prevalence greater than 4 were associated with case characteristics (burn locations, inhalation injury). Associations were assessed using Fisher's Exact tests.

## RESULTS

Table 1. Case characteristics

|                                     | All          | No<br>Bacteremia | Bacteremia  | p-value |
|-------------------------------------|--------------|------------------|-------------|---------|
| All, % (n)                          | 100.0 (1485) | 100.0 (1420)     | 100.0 (65)  |         |
| Age, mean (std)                     | 46.1 (17.7)  | 45.9 (17.6)      | 52.4 (19.6) | 0.0038  |
| Sex, % (n)                          |              |                  |             | 0.8439  |
| Female                              | 25.1 (373)   | 25.1 (356)       | 26.2 (17)   |         |
| Male                                | 74.9 (1112)  | 74.9 (1064)      | 73.9 (48)   |         |
| Race, % (n)                         |              |                  |             | 0.8737  |
| White                               | 48.8 (724)   | 48.6 (690)       | 52.3 (34)   |         |
| Black or African American           | 37.1 (551)   | 37.1 (527)       | 36.9 (24)   |         |
| Asian/Pacific Islander              | 1.3 (19)     | 1.3 (18)         | 1.5 (1)     |         |
| Hispanic or Latino                  | 8.1 (120)    | 8.2 (117)        | 4.6 (3)     |         |
| Other or Not Available              | 4.8 (71)     | 4.8 (68)         | 4.6 (3)     |         |
| Injury Etiology, % (n)              |              |                  |             | 0.9147  |
| Burn                                | 88.8 (1319)  | 88.8 (1261)      | 89.2 (58)   |         |
| Non-Burn                            | 11.2 (166)   | 11.2 (159)       | 10.8 (7)    |         |
| Etiology Category, % (n)            |              |                  |             | <.0001  |
| Flame                               | 37.1 (551)   | 35.9 (509)       | 64.6 (42)   |         |
| Scald                               | 25.1 (372)   | 25.6 (364)       | 12.3 (8)    |         |
| Flash                               | 8.4 (125)    | 8.8 (125)        |             |         |
| Electrical                          | 6.7 (100)    | 6.9 (98)         | 3.1 (2)     |         |
| Contact                             | 6.0 (89)     | 6.1 (86)         | 4.6 (3)     |         |
| Chemical                            | 5.3 (78)     | 5.3 (75)         | 4.6 (3)     |         |
| Friction/Shearing                   | 4.9 (73)     | 5.1 (73)         |             |         |
| Rash/Skin Infection                 | 3.6 (54)     | 3.4 (48)         | 9.2 (6)     |         |
| Inhalation Injury Only              | 1.4 (21)     | 1.5 (21)         |             |         |
| Other (cold, trauma, radiant)       | 1.5 (22)     | 1.5 (21)         | 1.5 (1)     |         |
| Total burn surface area, %          |              |                  |             | <.0001  |
| Not applicable/unknown              | 17.9 (265)   | 18.0 (256)       | 13.9 (9)    |         |
| Mild (1-10)                         | 56.7 (842)   | 58.8 (835)       | 10.8 (7)    |         |
| Moderate (11-20)                    | 14.7 (218)   | 14.8 (210)       | 12.3 (8)    |         |
| Severe (>20)                        | 10.8 (160)   | 8.4 (119)        | 63.1 (41)   |         |
| Full-thickness burn surface area, % |              |                  |             | <.0001  |
| Not applicable/unknown              | 57.4 (853)   | 58.9 (836)       | 26.2 (17)   |         |
| Mild (1-10)                         | 30.7 (456)   | 31.1 (442)       | 21.5 (14)   |         |
| Moderate (11-20)                    | 6.3 (94)     | 6.0 (85)         | 13.9 (9)    |         |
| Severe (>20)                        | 5.5 (82)     | 4.0 (57)         | 38.5 (25)   |         |
| Burn location <sup>a</sup>          |              |                  |             |         |
| Head, % (n)                         | 33.9 (503)   | 32.6 (463)       | 61.5 (40)   | <.0001  |
| Neck, % (n)                         | 18.5 (274)   | 17.0 (241)       | 50.8 (33)   | <.0001  |
| Trunk, % (n)                        | 35.6 (528)   | 33.9 (481)       | 72.3 (47)   | <.0001  |

|                          |             |             |            |        |
|--------------------------|-------------|-------------|------------|--------|
| Upper extremity, % (n)   | 52.6 (781)  | 51.6 (733)  | 73.9 (48)  | 0.0004 |
| Lower extremity, % (n)   | 43.4 (644)  | 42.5 (603)  | 63.1 (41)  | 0.0010 |
| Buttocks, % (n)          | 11.3 (168)  | 9.9 (141)   | 41.5 (27)  | <.0001 |
| Genitalia, % (n)         | 4.8 (71)    | 3.9 (56)    | 23.1 (15)  | <.0001 |
| Inhalation Injury, % (n) |             |             |            | 0.0005 |
| No                       | 91.7 (1361) | 92.2 (1309) | 80.0 (52)  |        |
| Yes                      | 8.4 (124)   | 7.8 (111)   | 20.0 (13)  |        |
| Sepsis Diagnosis, % (n)  |             |             |            | <.0001 |
| No                       | 92.7 (1377) | 96.0 (1363) | 21.5 (14)  |        |
| Yes                      | 7.3 (108)   | 4.0 (57)    | 78.5 (51)  |        |
| Length of stay, days     |             |             |            | <.0001 |
| median (IQR)             | 6 (1,15)    | 5 (1,14)    | 38 (15,57) |        |
| range                    | 0-405       | 0-405       | 1-123      |        |

---

Table 3. Bacteremia characteristics

|                                       | Bacteremia<br>Cases<br>(n=65) |
|---------------------------------------|-------------------------------|
| Days to first episode                 |                               |
| median (IQR)                          | 8 (5,15)                      |
| range                                 | 1-219                         |
| Number of episodes                    |                               |
| 1                                     | 73.9 (48)                     |
| 2                                     | 21.5 (14)                     |
| 3                                     | 4.6 (3)                       |
| Microbial species, % (n)              |                               |
| <i>Achromobacter xylosoxidans</i>     | 4.6 (3)                       |
| <i>Acinetobacter baumannii</i>        | 4.6 (3)                       |
| <i>Acinetobacter pittii</i>           | 1.5 (1)                       |
| <i>Aeromonas hydrophila</i>           | 3.1 (2)                       |
| <i>Alcaligenes faecalis</i>           | 3.1 (2)                       |
| <i>Candida albicans</i>               | 1.5 (1)                       |
| <i>Clostridium tertium</i>            | 1.5 (1)                       |
| <i>Elizabethkingia meningoseptica</i> | 1.5 (1)                       |
| <i>Klebsiella aerogenes</i>           | 1.5 (1)                       |
| <i>Enterobacter cloacae</i> complex   | 7.7 (5)                       |
| <i>Escherichia coli</i>               | 7.7 (5)                       |
| <i>Klebsiella pneumoniae</i>          | 10.8 (7)                      |
| <i>Leclercia adecarboxylata</i>       | 1.5 (1)                       |
| <i>Pantoea agglomerans</i>            | 1.5 (1)                       |
| <i>Proteus vulgaris</i>               | 1.5 (1)                       |
| <i>Pseudomonas aeruginosa</i>         | 40.0 (26)                     |
| <i>Pseudomonas stutzeri</i>           | 3.1 (2)                       |
| <i>Serratia marcescens</i>            | 7.7 (5)                       |
| <i>Staphylococcus aureus</i>          | 27.7 (18)                     |
| <i>Staphylococcus epidermidis</i>     | 3.1 (2)                       |
| <i>Staphylococcus hominis</i>         | 1.5 (1)                       |
| <i>Stenotrophomonas maltophilia</i>   | 3.1 (2)                       |
| <i>Streptococcus pneumoniae</i>       | 1.5 (1)                       |
| <i>Streptococcus pyogenes</i>         | 4.6 (3)                       |

Table 4. Association between microbial organism species identified in blood culture and burn characteristics.

|                                     | Head          | Neck   | Trunk  | Upper<br>Extremity | Lower<br>Extremity | Buttocks | Genitalia | Inhalation    |
|-------------------------------------|---------------|--------|--------|--------------------|--------------------|----------|-----------|---------------|
| <i>Achromobacter xylosoxidans</i>   | 1.0000        | 1.0000 | 0.5545 | 0.5610             | 1.0000             | 0.5655   | 0.5513    | <b>0.0065</b> |
| <i>Acinetobacter baumannii</i>      | 1.0000        | 1.0000 | 0.5545 | 0.5610             | 0.2904             | 0.5655   | 0.5513    | 0.4940        |
| <i>Enterobacter cloacae</i> complex | 0.1474        | 0.3553 | 0.3110 | 0.3147             | 0.1486             | 0.6415   | 0.3253    | 1.0000        |
| <i>Escherichia coli</i>             | 0.6412        | 0.6724 | 1.0000 | 1.0000             | 1.0000             | 0.6415   | 1.0000    | 0.2593        |
| <i>Klebsiella pneumoniae</i>        | 0.4145        | 0.7085 | 1.0000 | 0.3659             | 0.4085             | 1.0000   | 0.6576    | 0.3287        |
| <i>Pseudomonas aeruginosa</i>       | <b>0.0107</b> | 0.2075 | 0.5793 | 0.1517             | 0.4428             | 0.7988   | 1.0000    | 0.3450        |
| <i>Serratia marcescens</i>          | 1.0000        | 1.0000 | 0.6113 | 0.5995             | 0.6438             | 0.3926   | 1.0000    | 1.0000        |
| <i>Staphylococcus aureus</i>        | 1.0000        | 0.5874 | 1.0000 | 0.5299             | 0.5670             | 0.5748   | 0.7430    | 0.4888        |
| <i>Streptococcus pyogenes</i>       | 1.0000        | 0.6132 | 0.1833 | 0.5610             | 0.5495             | 0.2601   | 1.0000    | 0.4940        |

Assessed for organisms that were present in at least 3 cases.

- *Achromobacter xylosoxidans* was more often present in cases with an inhalation injury vs those without (3/13 vs 0/52; p=0.0065)
- *Pseudomonas aeruginosa* was more often present in cases with a burn injury to the head vs those without (21/40 vs 5/25; p=0.0107)