

Clinical and Anatomical Characteristics of Culture confirmed Staphylococcal aureus Skin and Soft Tissue Infections: A single center Descriptive Cross Sectional Study

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Abstract

Introduction: Skin and soft tissue infections (SSTIs) are common infections caused predominantly by *Staphylococcus aureus*, with varying clinical presentations depending on host and microbial factors. Data describing the distribution of clinical and anatomical culture-confirmed cases in local laboratory settings remains limited.

Methods: A laboratory-based descriptive cross-sectional study was conducted at the Microbiology Department of Jinnah Sindh Medical University (JSMU), Karachi, from January to December 2025. The study included selected culture-confirmed *Staphylococcus aureus* from a single microbiology laboratory. A total of 620 specimens were screened. After exclusions due to non-SSTI origin (n=85), polymicrobial growth (n=70), insufficient records (n=35), and duplicate isolates (n=30), 400 patients with culture-confirmed *Staphylococcus aureus* infections were included using non-probability purposive sampling. Data on demographics, clinical presentation, and infection sites were collected and analyzed using IBM SPSS version 20. Proportions are reported with corresponding denominators, and 95% confidence intervals are key estimates.

Results: 400 patients (one isolate per patient), 54% (n=216) were males and 46% (n=184) were females, with a mean age of 29.6 ± 20.9 years. The most affected age group was 18–42 years (40%). The most common SSTIs were abscesses (41%), followed by surgical site infections (20%) and wound infections (11%). The most frequently recorded anatomical sites were the abdominal wall (20%), the head (10%), and the feet (10%).

Conclusion: This study describes the distribution of clinical presentations and anatomical sites among a sample of culture-confirmed *Staphylococcus aureus* (SSTIs) at a single laboratory. These findings are descriptive and cannot be generalized to the broader population, incidence, risk factors, or treatment patterns.

Introduction

SSTIs are infections of the skin, muscle, and connective tissue caused by bacteria [1]. Mild symptoms, such as warmth, pain, and swelling, are followed by more serious systemic problems, including shock or coma [2,3]. SSTIs, as a broad category, are well described; culture-confirmed *Staphylococcus aureus* SSTIs represent a narrower subset that differs from clinically diagnosed or non-culture infections. Comorbidities, bacterial type, and infection site all affect severity. Severe polymicrobial infections are more likely to occur in people with autoimmune diseases, HIV, or uncontrolled diabetes [3]. SSTIs are divided into four categories by the World Society of Emergency Surgery (WSES) based on severity and etiology [4].

Category one - Non-necrotizing soft tissue infections that are caused by *Staphylococcus aureus* and *Streptococcus pyogenes*. It is subdivided into superficial (folliculitis, impetigo, and furuncles) and deep forms (cellulitis). Generally localized and treated with oral or topical antibiotics, or in more severe cases,

IV drugs. [5, 6, 7] Category two - Necrotizing soft tissue infections (Fournier's gangrene, necrotizing fasciitis, and clostridial myonecrosis) are potentially fatal infections that advance quickly and cause tissue necrosis. They require immediate debridement via surgery and broad-spectrum antibiotics. [8, 9, 10, 11] Category three - Animal bites SSTIs are polymicrobial, and the predominant pathogens inoculated are normal flora of animal or human skin (*Pasteurella*, *Capnocytophaga*, and *Streptococcus* species). [12] Category four - Surgical site infections are commonly caused by *Staphylococcus*, *Streptococcus pyogenes*, *E. coli*, *Citrobacter*, *Enterobacter*, and *Klebsiella*. *Staphylococcus aureus* is carried by 20–30% of the human population in their nose and skin (13). When the skin barrier is breached, *Staphylococcus* can cause infections such as SSTIs, pneumonia, bacteremia, endocarditis, and osteomyelitis. (14). It is difficult to determine the true incidence of SSTIs because they typically resolve in 7–10 days. However, in 2017, Global Health Metrics published that over 4.2 billion new cases of skin and subcutaneous disorders were reported globally, with severe cases mostly in the elderly and those with co-morbidities.

A cross-sectional study was conducted at Jinja Regional Referral Hospital in Uganda to determine the prevalence of skin and soft tissue infections (SSTIs). The study found a prevalence of 66.4% in laboratory-confirmed cases. There were 178 confirmed SSTI cases, with males accounting for 56.7% and those aged 19 to 35 accounting for 29.8%. The accident and emergency unit had the lowest prevalence at 43.7%, while the pediatric ward had the highest at 80%. These results demonstrate that both general and vulnerable hospital populations bear a heavy burden of SSTIs. About 5.7–8.4% of all skin infections observed in a dermatology outpatient department at a tertiary hospital in Punjab (Kharian) were SSTIs. [15] A 2023 study from a hospital in Peshawar, Pakistan, found that cellulitis, abscesses, and infected ulcers were the most common SSTIs in the emergency room. 53.1% of patients required surgery, and 84.2% received antibiotics. [16] A 2022 study conducted at a District Hospital in Pakistan reported a high prevalence of skin and soft tissue infections (SSTIs) in diabetic patients, 86.51% overall, with 89.95% of diabetic females and 82.87% of diabetic males affected. [17]

These studies include all SSTIs and are not limited to laboratory-confirmed *Staphylococcus aureus* infections, thereby limiting comparability. There is limited local data on the clinical and anatomical distribution of culture-confirmed *Staphylococcus aureus* SSTIs in microbiology laboratories in Pakistan. This study aims to describe the clinical presentations and anatomical distributions of selected culture-confirmed *Staphylococcus aureus* SSTI cases in a single-center laboratory setting.

Material and Methods

Study Population and Unit Of Analysis

We conducted a laboratory-based descriptive cross-sectional study on patients from the Microbiology Department of JSMU Laboratory, Karachi, Pakistan, from January to December 2025. Only one culture-positive isolate per patient was included. Duplicate samples and repeat infections from the same patient during the study period were excluded.

Sample Selection:

A total of 620 specimens were screened. After exclusions due to non-SSTI origin (n = 85), polymicrobial growth (n = 70), insufficient records (n = 35), and duplicate isolates (n = 30), 400 patients with culture-confirmed cases.

Age Groups:

Children: 0–12, Adolescents: 13–17, Adults 1: 18–42, Middle-aged (Adults 2): 43–64, Elderly: ≥65

Inclusion Criteria

Patients with a confirmed diagnosis of *Staphylococcus aureus* infection were included in the study. Confirmation was performed by routine culture using a wound swab, pus aspirate, or tissue sample.

Exclusion Criteria

Patients with Duplicate isolates, repeat infections, polymicrobial cultures without explicit attribution, colonization samples, non-SSTI specimens, and insufficient records were excluded.

Case Definition:

Clinical diagnoses (abscess: localized collection of pus; surgical site infection: infection at the surgical incision; wound infection: infection in traumatic wounds; cellulitis: diffuse infection without abscess, etc.) were assigned based on clinician-provided information on laboratory request forms and medical records. Ambiguous cases were classified based on clinician documentation.

Patient Matching:

Unique patients were identified using name, age, and hospital record number. Only the first isolate per person was included.

Sample Clarification

Using non-probability purposive sampling, these findings are exploratory and not representative of the general SSTI population.

Ethics

Ethical approval

was obtained from the Institutional Review Board of JSMU (Ref: JSMU/IRB/2025/-622). As this was a retrospective laboratory-based study, the relevant clinical history and data were recorded in a questionnaire, and informed consent was taken. Information regarding name, age, gender, drug history, signs, and symptoms was collected on the questionnaire. All gathered data was kept highly confidential.

Specimen Collection and Processing:

Specimens included wound swabs, pus aspirates, and tissue samples. Samples were cultured on standard media (like blood agar and mannitol salt agar) and incubated at 35–37°C for 24–48 hours. Identification of *Staphylococcus aureus* relied on colony morphology, Gram staining, catalase test, and coagulation test. Laboratory quality control method adhered to standard microbiological protocols, and internal quality control procedures were followed.

Data Collection:

Data included age and gender. Clinical diagnosis and anatomical site. Variables such as drug history and symptoms were not analyzed and are not reported.

Statistical Analysis:

Data were analyzed using SPSS version 20. Continuous variables: mean $\pm$ SD and Categorical variables : counts and percentages. 95% confidence intervals were calculated for key proportions, and no inferential statistical testing was performed.

Data analysis

Data were analyzed using IBM SPSS Statistics version 20. Because the age distribution was asymmetrical, we examined both mean and median values; age is reported as mean $\pm$ standard deviation in the Results for comparability with other studies, while categorical variables (sex, clinical diagnosis, and anatomical site) are summarized as counts and percentages. Proportions are reported with denominators and 95% confidence intervals for key estimates. No inferential statistical testing was performed, in keeping with the study's descriptive nature.

Results

- This study included 620 specimens and 400 *Staphylococcus aureus* samples. Out of a total of 400 samples, 54% (n = 216) were identified as male, while the remaining 46%(184) were identified as female.
- The mean age of the patients was 29.6 ± 20.9 years. The patients were further categorized into five age groups, including Children (0–12 years, 25%), Adolescents (13–17 years, 9%), Adults1 (18-42 years, 40%), middle-aged (Adult2) (43–64 years,15%), and Old age (65 years and above, 11%). This categorization enabled a more refined analysis of the data by age group. All proportions are presented as n/N (%). Mostly the patients belonged to the adult1 age group (40%), then children (25%), then adult2 (15%), then old age people (11%), and least to the adolescent age group (9%) (Chart 1.1)
- Various SSTIs were observed, with abscesses being the most common, accounting for 41% of cases. Then come surgical site infections at about 20% and wound infections at 11%. Impetigo and Carbuncles were also relatively frequent, consisting of 9% and 8%, respectively. Cellulitis accounts

for about 5% of cases, and less common presentations include injection site infections (3%), animal bites (2%), and furuncles (1%). (Chart 1.2)

- The sites of SSTIs seen were as follow: The anatomical sites of SSTIs identified were: abdominal wall (20%), head (10%), feet (10%), breast (8%), hand (7%), leg (6%), axillae (5%), chest (5%), perineum (4%), arm (4%), dorsum of body (3%), perianal (3%), knee (3%), thigh (3%), gluteal (3%), inguinal (2%), ear (2%), face (1%), and scrotum (1%) (Chart 1.3).

Patients with several infection sites were assigned a primary site based on clinician documentation.

Discussion

SSTIs have a wide range of clinical manifestations that vary depending on the causative bacteria and, to some extent, host susceptibility. *Staphylococcus aureus* is the most prevalent cause of SSTIs. It is a harmful microbe that is developing resistance to commonly used antibiotics, making it difficult to remove. The purpose of this study was to accurately map the clinical presentation, which is critical for quick diagnosis, suitable empirical therapy, and minimizing consequences. Insufficient surveillance and underreporting have created a considerable gap in understanding these patterns at the local level.

In this study, 54% of the samples were male, and 46% were female. In a UK study by Cristinacce et al., 48% of *Staphylococcus aureus* isolates were from female samples and 52% from male samples [18]. According to a study by Mohanty et al. in India, the incidence rate of skin and soft tissue infections caused by *Staphylococcus aureus* was 42.2% in the female group and 57.5% in the male group. [19] In a study conducted by Habib et al. in Punjab, 72.6% of patients with *Staphylococcus aureus*-induced SSTI were females, and 27.4% were males. [20]. Sex distribution varied across studies; this study was not designed to assess sex based risk differences.

The mean age of patients in this study was 29.6 ± 20.9 years. 40% of patients were in the 18–42 age group, 25% in the 0–12 age group, 15% in the 43–64 age group, 11% in the 65 + age group, and 9% in the 13–17 age group. A study conducted in the USA by Suaya et al showed that most patients with staphylococcal SSTIs were in the 45–64 age group, the second most common age group was 18–45, and the least common was 1–17. [21] In another study by Bouvet et al., conducted in France, the median age of patients was 51 years. [22] In another study conducted by Akram et al. in Lahore, Pakistan, the largest number of samples was collected from people aged 15–30 years. [23]

These studies suggest that the most common age groups acquiring SSTIs from *Staphylococcus aureus* are 18–64 years old. The reason could be that individuals in these age brackets may have underlying skin conditions or risk factors that make them more susceptible to SSTIs. This can include conditions such as eczema, psoriasis, or diabetes, which can compromise the skin barrier and make it easier for *Staphylococcus aureus* to invade and cause infections. Other factors, such as lifestyle choices, such as body piercing, tattoos, and use of shared gym equipment or locker rooms, can also increase the risk of skin exposure to *Staphylococcus aureus*. Additionally, individuals in this age range may engage in

behaviors such as shaving or hair removal, which can create microabrasions and increase the risk of infection. These observations reflect underlying clinical or behavioral factors, but such variables were not measured in this study. *Staphylococcus aureus* is also a common cause of healthcare-associated SSTIs. People aged 18 to 42 may be more likely to interact with healthcare facilities, thereby increasing their risk of hospital-acquired infections, including SSTIs caused by *Staphylococcus aureus*. The most common infections caused by *Staphylococcus aureus* in this study were abscesses (41%), surgical site infections (20%), and wound infections (11%). According to the study by Kumar et al in the USA, *Staphylococcus aureus* was commonly isolated from abscesses and cellulitis. [24] In another study conducted in China by Zhao et al., cutaneous abscess was the most common infection, followed by cellulitis and impetigo. [25] A study conducted by Sina et al. in Benin, Africa, found that 37% of the collected strains originated from abscesses, followed by pyomyositis patients (27%). [26] In a study conducted in Nepal by Ansari et al. (2015), *Staphylococcus aureus* was predominantly isolated from abscesses (53%), with pyomyositis accounting for 22.7% and furuncles for 13.6%. [27] Abscesses may serve as the body's defense mechanism against pathogens. The prevalence of abscesses can be attributed to factors such as inadequate hand hygiene, infrequent bathing, skin abrasions and trauma, and environmental contamination, which facilitate the entry of pathogens into the body.

In this study, the most common sites of SSTIs were the abdominal wall (20%), head (10%), feet (10%), and breast (8%). In a study conducted by Ellis et al. in the USA, *Staphylococcus aureus* was isolated from SSTI lesions commonly located on the upper extremities. [28] In another study in Canada by Vayalumkal et al, the most common sites were the upper and lower extremities. [29]

In this study, the most common site of SSTIs was the abdominal wall. There are several reasons why SSTIs are relatively common in this area. Firstly, the abdominal wall is covered by a relatively thin layer of skin and subcutaneous tissue compared to other parts of the body. This makes it more susceptible to trauma, skin breaks, and breaches in its protective barrier. Many surgical procedures involve the abdominal wall, such as abdominal surgeries (e.g., appendectomy, hernia repair, cesarean section) and laparoscopic procedures. The abdominal wall is frequently involved due to postoperative or procedure-related infections, but this study did not stratify cases by surgical history. Lastly, obesity is a risk factor for SSTIs, including those on the abdominal wall. Excess body fat can cause skin folds and creases, providing a breeding ground for moisture and bacteria. Additionally, impaired circulation in obese individuals can hinder the body's ability to fight infection.

A recent study shows that cellulitis remains a prevalent SSTI, accounting for 12.9% of cases, although abscesses are the most common clinical presentation [30]. Impetigo continues to represent a significant global health concern, especially in low or middle-income countries, where poor hygiene leads to its persistence. These findings showed the continued public health importance of impetigo as a common SSTI across the population [31]. A recent Pakistani study found that furunculosis accounted for approximately 25–30% of community-based SSTIs, while carbuncles were relatively rare, accounting for 1–2% of cases [20].

This study is limited by purposive sampling, a single-centered design, and the inclusion of only culture-confirmed *Staphylococcus aureus* cases, thereby excluding milder or non-cultured SSTIs. These findings are not generalized to the wider population. Potential explanations, such as behavioral or clinical risk factors, were not measured in this study and cannot be confirmed, and it does not provide evidence for guiding empirical therapy, as antimicrobial susceptibility was not included.

Limitations

This study has several limitations, including a single-center design, purposive sampling, inclusion of only culture-confirmed cases, potential misclassification, missing clinical variables, no susceptibility data, referral bias, and no outcome data.

Conclusion

This study describes the clinical and anatomical distribution and proportions of culture-confirmed *Staphylococcus aureus* SSTIs in a single laboratory setting. These findings should be interpreted as frequency patterns within the studied cohort, not as measures of disease burden, incidence, or risk factors.

Declarations

Conflict of Interest: The authors declare no conflict of interest.

Ethics Approval/IRB Statement: Ethical approval was obtained from the Institutional Review Board of JSMU with letter no JSMU/IRB/2025/-622. Patient confidentiality was maintained, and all procedures adhered to the principles outlined in the Declaration of Helsinki.

Informed Consent Statement: Verbal informed consent was obtained from all patients from whom samples were collected for this study.

Clinical Trial Registration: N/A

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Data Availability Statement: The datasets generated and analyzed during the current study are not publicly available due to patient confidentiality, but are available from the corresponding author on reasonable request.

Large-Language Model (LLM)

Generative AI Use Statement: The authors declare that generative AI tools were used only for minor language editing and that all final content was critically reviewed and approved by the authors.

Authors Contribution Statement

1. Dr. Mahnoor Shahzeb:
Manuscript writing, Data analysis and Final review
2. Dr. Suresh Kumar:
Data interpretation and Review
3. Hamza Reaz Aziz
Manuscript writing, Data interpretation and Review
4. Kirsh Kumar
SPSS data entry
5. Maham Ejaz
Figures and Referencing

Fatima Rehman

Final manuscript compilation and Review

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Figures

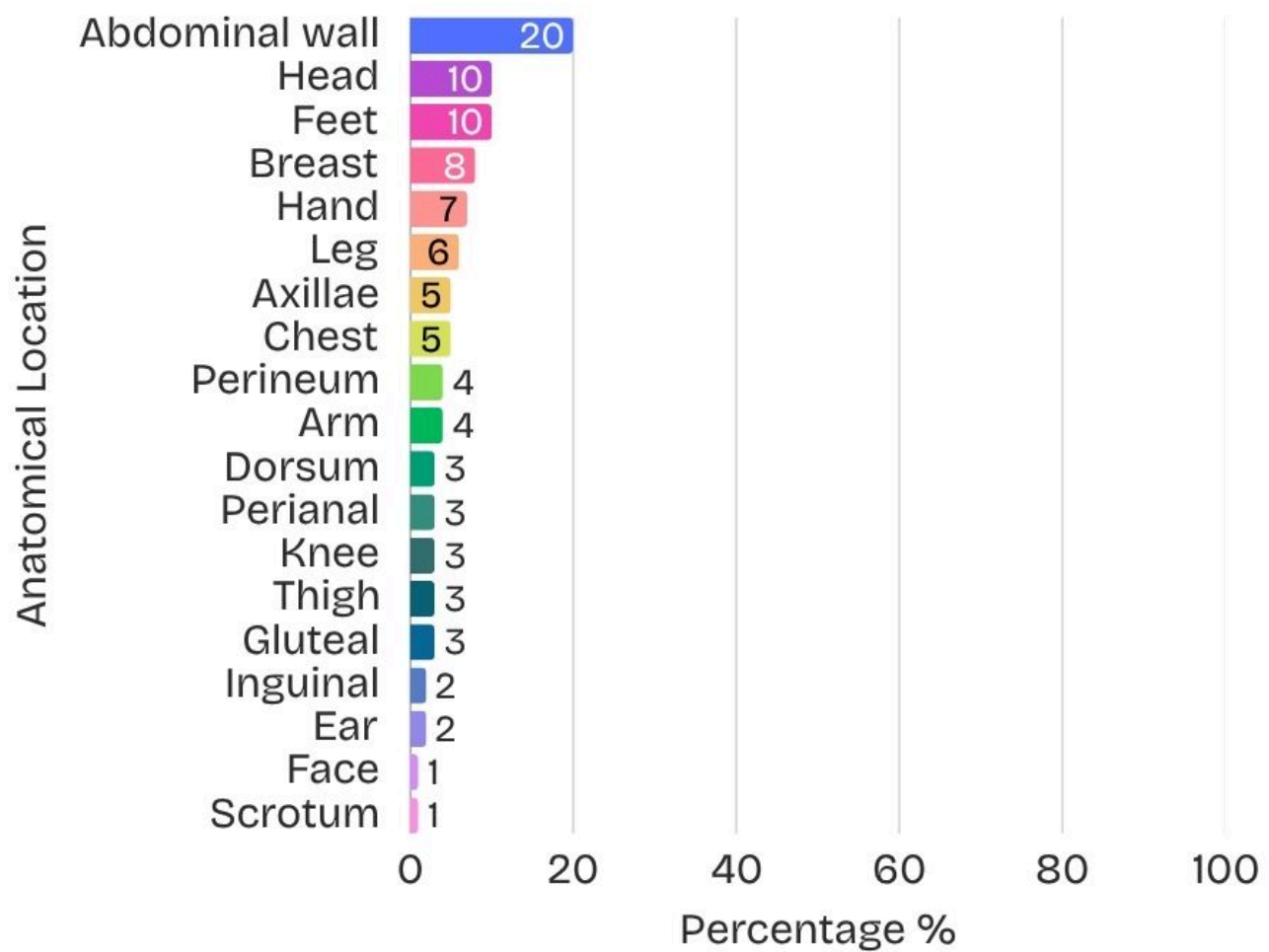


Figure 1

Percentage distribution of culture-confirmed *Staphylococcus aureus* skin and soft tissue infections by primary anatomical site (N = 400)

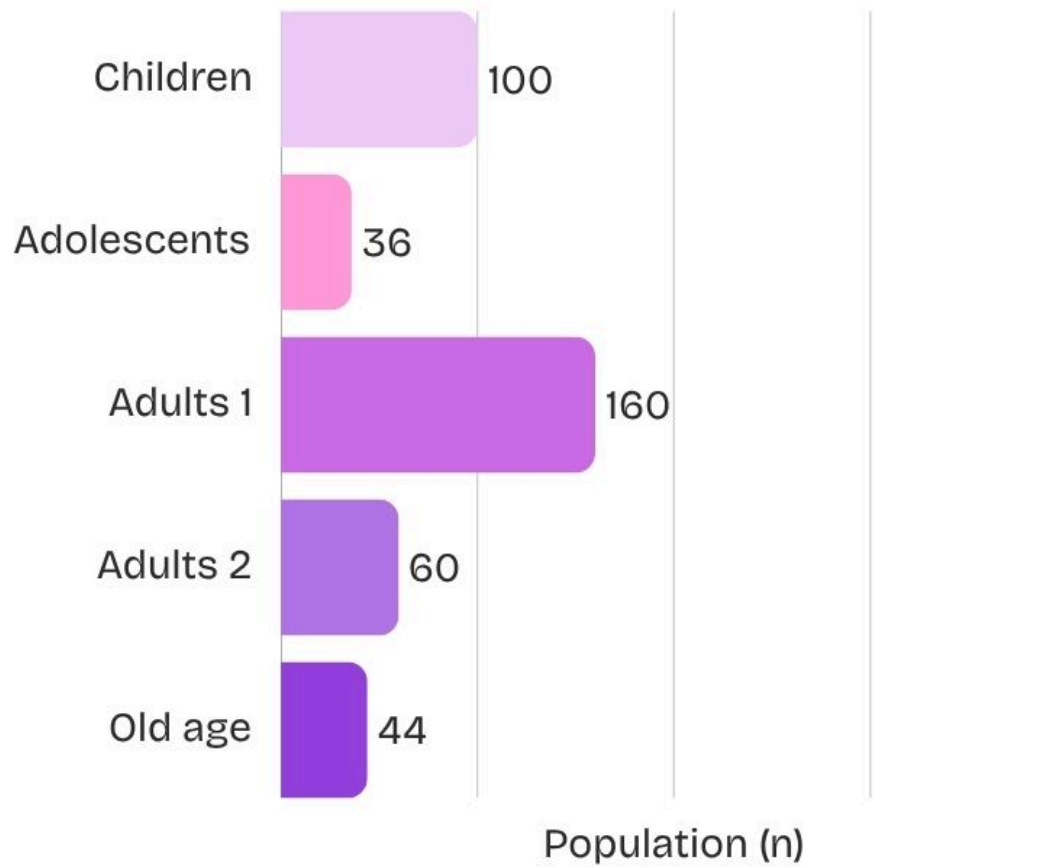


Figure 2

Number of patients with culture-confirmed *Staphylococcus aureus* skin and soft tissue infections in each age group (N = 400)

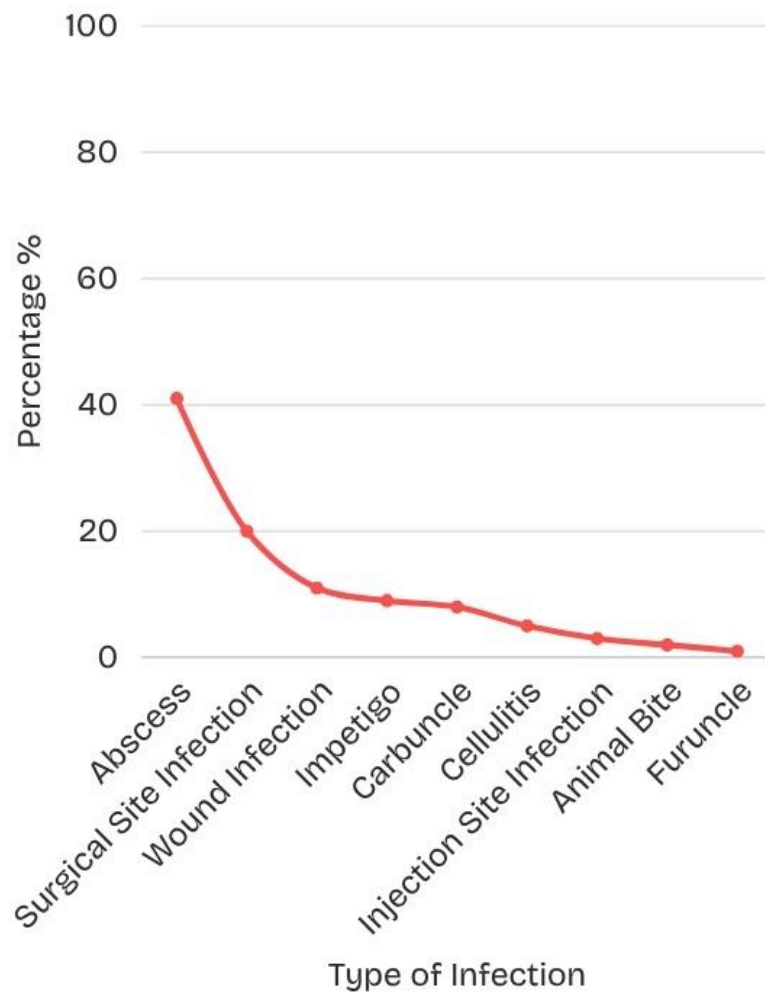


Figure 3

Percentage distribution of clinical presentations among patients with culture-confirmed *Staphylococcus aureus* skin and soft tissue infections (N = 400)