2020-05-23

# Skin and Soft Tissue Infections in the Emergency Department

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Hahn School of Nursing and Health Science

DOCTOR OF PHILOSOPHY IN NURSING

# SKIN AND SOFT TISSUE INFECTIONS IN THE EMERGENCY DEPARTMENT

By

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A dissertation presented to the

FACULTY OF THE HAHN SCHOOL OF NURSING AND HEALTH SCIENCE

UNIVERSITY OF SAN DIEGO

In partial fulfillment of the

Requirements for the degree

DOCTOR OF PHILOSOPHY IN NURSING

March 2020

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DISSERTATION

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ABSTRACT

**Background/Purpose**: Skin and soft tissue infections (SSTI) represent a diverse group of infections varying in clinical presentation and degree of severity. The International Classification of Diseases (ICD) codes for patients presenting with cellulitis or abscess account for $5.5 billion in annual health care costs and 1.4% of all hospital admissions nationally. Outcome data is needed to inform admission and management decisions, to prevent unnecessary hospitalizations, inconsistent hospital admission clinical characteristics, and overuse of antibiotics. The purpose of this study is to examine relationships among sociodemographics, physical examination findings, and treatment modality and management in patients with SSTIs.

**Theoretical/Conceptual Framework**: Web of Causation Theoretical Framework explores multiple causative factors, allowing each to have equal prominence, which ultimately creates a non- linear approach to evaluation, allowing for an understanding of the etiology and patient specific characteristics as influential factors to any process disease and its management guided this study.

**Method:** A retrospective, cohort design. A convenience sample (N = 857) of patients, aged 18 and older diagnosed with a SSTI to an upper or lower extremity, receiving Emergency Department (ED) services at a high-volume Southern California rural ED, January 1, 2016 through December 31, 2018 was used for this study. Data were extracted from the electronic health record. Descriptive and inferential analyses.

**Results:** Average age was 45.65 years (*SD* = 17.17), 67.1% male, 75% Hispanic origin,

60.4% of the patients presented with a heart rate greater than 90 beats per minute (bpm), and less than one percent (0.8%, $n = 7$) had a temperature equal to or higher than 37.7 degrees Celsius. Final diagnosis: 56.9% cellulitis, 40.1% abscess, 2.2% both cellulitis and abscess, 0.7% other SSTI, i.e. abrasion, blister. The most common treatment modality was the administration of an oral medication (56.7%), followed by incision and drainage plus an oral medication (30.8%), and oral medication plus intravenous medication (7.5%, $n = 64$); 97.7% discharged home; 2.3% admitted; 8.8% returned within 24 hours of discharge. Age was significantly different for patients final diagnosis, *Welch's* $F(3, 20) = 24.30$, $p < .001$; younger age for abscess ($M = 40.69$, SD = 13.61) compared to cellulitis ($M = 49.60$, $SD = 18.55$); abscess and cellulitis ($M = 35.00$, $SD = 11.00$) compared to cellulitis ($M = 49.60$, $SD = 18.55$) and final disposition $F(1, 855) = 6.78$, $p = .009$; older age significantly increased for those admitted to the hospital ($M = 55.50$, SD = 13.95) compared to discharged home ($M = 45.42$, $SD = 17.17$). Firth logistic analysis identified age (*Adj. OR* = 1.06, 95% CI 1.00 - 1.12, $p < .001$), and a heart rate greater than 90 bpm (*Adj. OR* = 10.94, 95% CI 2.42 - 71.46, $p = .001$) significantly increased the risk of being admitted to the hospital. Prescription for oral medication (*Adj. OR* = 0.004, 95% CI 0.00 – 0.15, $p < .001$), and an incision and drainage treatment plus an oral medication (*Adj. OR* = 0.02, 95% CI 0.00 – 0.15, $p < .001$) decreased the risk for hospitalization.

**Conclusions and Implications:** Skin and soft tissue infections are commonly treated and managed in the ED. A comprehensive understanding of the patient, including his/ her demographic information, outpatient follow- up access, physical examination findings, and past medical history, is imperative to optimal treatment and management. Age, heart

rate, and management should be included when evaluating and treating a patient with SSTIs. Study findings within this rural community support the current literature, including the identified risk factors and current clinical practice guidelines, thus supporting the incorporation and consideration of sociodemographic factors and social determinents of health as central for standardized care within all communities.

DEDICATION

ACKNOWLEDGEMENTS

TABLE OF CONTENTS

LIST OF TABLES



LIST OF FIGURES



List of Appendices

# CHAPTER I

# INTRODUCTION

Skin and soft tissue infections (SSTI) represent a diverse group of infections that vary in clinical presentation and degree of severity. SSTIs are one of the most common infections in both the community and hospital setting and account for nearly 4.8 million emergency department (ED) visits annually (Amin et al., 2014; Pallin et al., 2008; Pollack et al., 2015; Rui, Kang, & Ashman, 2016). There is a range of SSTIs and distinguishing one infection from another leads to appropriate treatment and management. Clinical practice guidelines for the diagnosis and management of skin and soft tissues infections have been established by the Infectious Disease Society of America (IDSA); however, the lack of adherence to these guidelines is unacceptable and exemplifies the gap in best practice (Pallin, Camargo, & Schuur, 2014; Peterson, McLeod, Woolfrey, & McRae, 2014). Thus, further investigation is warranted to explain this gap in guideline adherence. In particular, the relationships among patient presentation, demographics, clinical examination findings, treatment, and management need further delineation and criteria to provide best practice guidelines.

## Definitions

According to the Food and Drug Administration Center for Drug Evaluation and Research (U.S. Department of Health and Human Services [HHS], 2013), cellulitis is a serious skin and soft tissue infection that has a propensity to spread to the blood stream and lymphatic systems. It is characterized by erythematous areas of skin that are

edematous and/ or indurated. Wound infections are characterized by purulent drainage from an erythematous wound that is indurated and/ or edematous. Abscesses are characterized by a collection of pus within the dermis or deeper accompanied by redness, edema, and/or induration. This subtle variance in presentation compounds the complexity of treatment and management of these infections. Although it is not possible to standardize the practice of every emergency department provider who treats patients with skin and soft tissue infections, it is essential to inform standardized guidelines that consider a comprehensive perspective of a patient, including his or her clinical presentation, demographic information, and physical examination findings.

## Background and Significance

The International Classification of Diseases (ICD) code for patients presenting with cellulitis or abscess account for $5.5 billion in annual health care costs and 1.4% of all hospital admissions in the United States (Gunderson, Cherry, & Fisher, 2018). In the emergency department (ED) specifically, 2.83 million visits per year are for cellulitis, abscesses, or acute skin and soft tissue infection (Rui, Kang, & Ashman, 2016). Because of the tremendous impact on national health care utilization and cost, robust outcome data is needed to inform admission and management decisions, as well as to establish ED disposition guidelines around SSTIs. This lack of current evidence regarding on non-purulent SSTI management and admission criteria results in unnecessarily expensive hospitalizations, inconsistent hospital admission clinical characteristics, and overuse of antibiotics (Gunderson et al., 2018; Housman, Livings, Knee, & Schimmel, 2017; Talan

et al., 2015; Walsh et al., 2016; Wang et al., 2018). Compounding this problem is the lack of clear criteria for ED disposition and follow-up management, which results in less-than-optimal patient outcomes.

**Classification**

SSTIs can be classified as non-purulent or purulent. Purulent lesions are defined as lesions that contain or express pus which is considered a purulent discharge. Cases can range from a straightforward, one-time visit to those involving surgical debridement and intravenous antibiotics (Ramakrishnan, Salinas, & Higuita, 2015). As providers of frontline clinical care for patients with potentially life-threatening infections, ED clinicians have to prioritize care delivery efficiently and timely; however, there have been no systematic evaluations of prescribing patterns, admission criteria, and management of SSTIs (Almarzoky Abuhussain et al., 2018; Guterman et al., 2016; Jenkins et al., 2016; Kamath et al., 2018; Murray H, Stiell I, & Wells G, 2005; Peterson et al., 2014; Sabbaj, Jensen, Browning, Ma, & Newgard, 2009; Talan et al., 2015). Fundamental information may help to establish admission criteria for infection severity that would help to direct care, while decreasing mortality and unnecessary health care costs. The major gaps this study endeavors to capture include the characterization of admission criteria associated with SSTIs, evaluation of the prescribing practices, and management for non-purulent SSTIs in the ED.

**Nonadherence to National Guidelines**

Although the Infectious Disease Society of America (IDSA) established guidelines for the management of SSTI, it is unclear how closely these guidelines are followed in practice (Daly et al., 2011; Ezebuenyi et al., 2018; Kamath et al., 2018; Pallin et al., 2014). Recent evidence suggested a high incidence of antibiotic overuse, exemplifying the importance of antibiotic stewardship, prescriber pattern-recognition, and evaluation (Daly et al., 2011; Ezebuenyi et al., 2018; Kamath et al., 2018; Pallin et al., 2014). This overuse of antibiotics is serious as antibiotic resistance and adverse events, including *Clostridium difficile* colitis, pose potential public health concerns. Research studies have estimated nearly 87% of discharged patients with an STTI were prescribed unnecessary antibiotics (Kamath et al., 2018; Pallin et al., 2014). Adherence to the guidelines may direct patient management and potentially reduce the current overuse of antibiotics, thereby improving patient outcomes with targeted therapy to address and to treat the underlying issue. Furthermore, limited information exists regarding criteria for patients needing hospital admission compared to those who are appropriate for outpatient management (Almarzoky Abuhussain et al., 2018; Sabbaj et al., 2009; Talan et al., 2015). Consequently, establishing well-defined criteria for diagnosis, treatment, and hospital admission are necessary to improve patient outcomes and decrease mortality.

The range of presentation of SSTIs and the need for ED personnel to make skilled decisions on patients may contribute to the over prescribing of antibiotics and variability in discharge disposition. Limited information exists regarding criteria for patients needing hospital admission compared to those who are appropriate for outpatient

management (Almarzoky Abuhussain et al., 2018; Sabbaj et al., 2009; Talan et al., 2015). Establishing well-defined criteria for diagnosis and treatment, in addition to hospital admission and/ or discharge is necessary to improve patient outcomes and decrease mortality. This study aims to identify the common, presenting characteristics associated with SSTIs, management strategies, antibiotic use, and disposition practices. Understanding these characteristics may provide insight to develop potential clinical decision aids by SSTI type.

## Significance to Nursing

Numerous studies have evaluated the relationship between management and treatment modalities for patients with non- purulent or purulent SSTI; however, adherence to clinical practice guidelines is inconsistent and inadequate. Emergency department clinicians have the ability to lead clinical care for these patients by delivering efficient and timely care with the establishment of a systematic evaluation of prescribing patterns, admission criteria, and management of SSTIs. This proposed research endeavors to improve the identification, treatment, and management of SSTI. Establishing clear diagnostic criteria may direct the clinical course, decrease the overuse of antibiotics, and improve patient outcomes, while decreasing unnecessary hospitalizations. With this research and the establishment of clear management criteria, the potential to provide outpatient care with parenteral antibiotics as a safe alternative to costly inpatient care could dramatically transform the standard for SSTI treatment.

## Purpose and Specific Aims

The purpose of this study is to examine relationships among sociodemographics, physical examination findings, and treatment modality and management in patients with SSTIs. The specific aims of this study include the following:

Aim 1. Describe sociodemographics, physical examination findings, treatment modality, patient disposition (i.e. hospital admission or ED discharge at initial presentation), and reason for return visit to the ED among patients with non-purulent and purulent SSTI who presented for treatment in a high-volume rural ED.

Aim 1a. Sociodemographics, Clinical Characteristics, and Treatment Modality by Final Diagnosis

Aim 1b. Sociodemographics, Clinical Characteristics, and Treatment Modality by Disposition Status

Aim 2. Examine the relationships among sociodemographics (age, gender, established PCP, race/ethnicity, education level) physical examination findings (i.e. HR> 90 bpm, temperature > 37.7 C, treatment modality (i.e. incision and drainage, oral medication, or parenteral medication), patient disposition (i.e. hospital admission or ED discharge at initial presentation) and reason for return visit to the ED among patients with non-purulent and purulent SSTI who presented for treatment in a high-volume rural ED.

Aim 2a. Relationships among Sociodemographics, Clinical Characteristics, and Treatment Modality by Final Diagnosis

Aim 2b. Relationships among Sociodemographics, Clinical Characteristics, and Treatment Modality by Final Disposition

Aim 3. Identify factors that increase the odds of hospital admission at initial presentation for patients with specific sociodemographics, physical examination findings, and treatment modality among patients with non-purulent and purulent SSTI who presented for treatment in a high-volume rural ED.

## Theoretical Models and Conceptual Framework

**Web of Causation.** The web of causation theoretical framework underpins the association between events, the cause, and the impacted unit (Krieger, 1994). This approach provides a non-linear and comprehensive view of a system and its causal criteria (Kaufman & Poole, 2000). In order to understand causative factors of disease, illness, or treatment, a large number of cases must be identified and evaluated in order to identify commonalities and differences (Ventriglio, Bellomo, & Bhugra, 2016). This comprehensive methodology explores multiple causative factors, while allowing each to have equal prominence, which ultimately creates a non- linear approach to evaluation. This intricate stance allows for a useful understanding of the etiology and patient specific characteristics as influential factors to any process disease and its management.

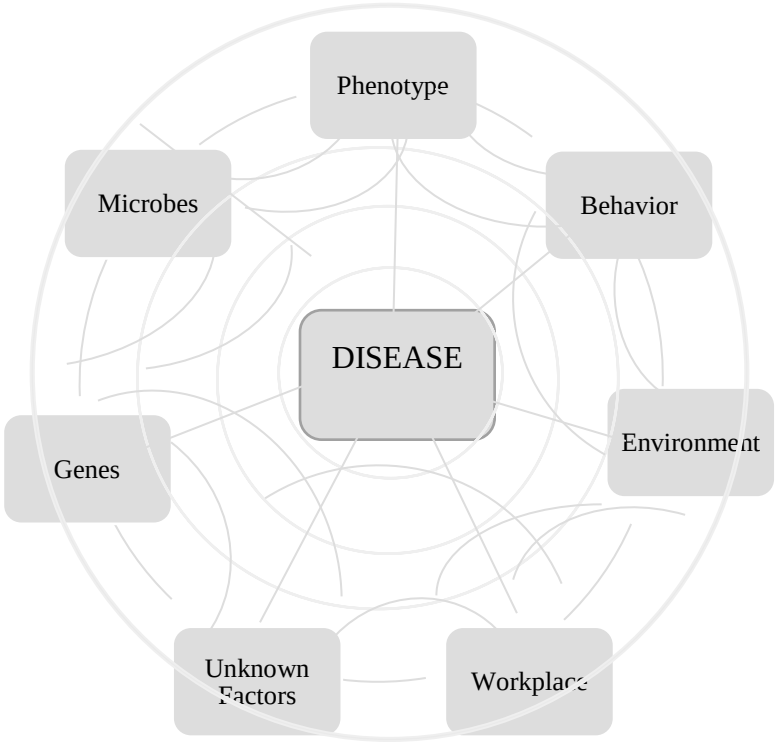
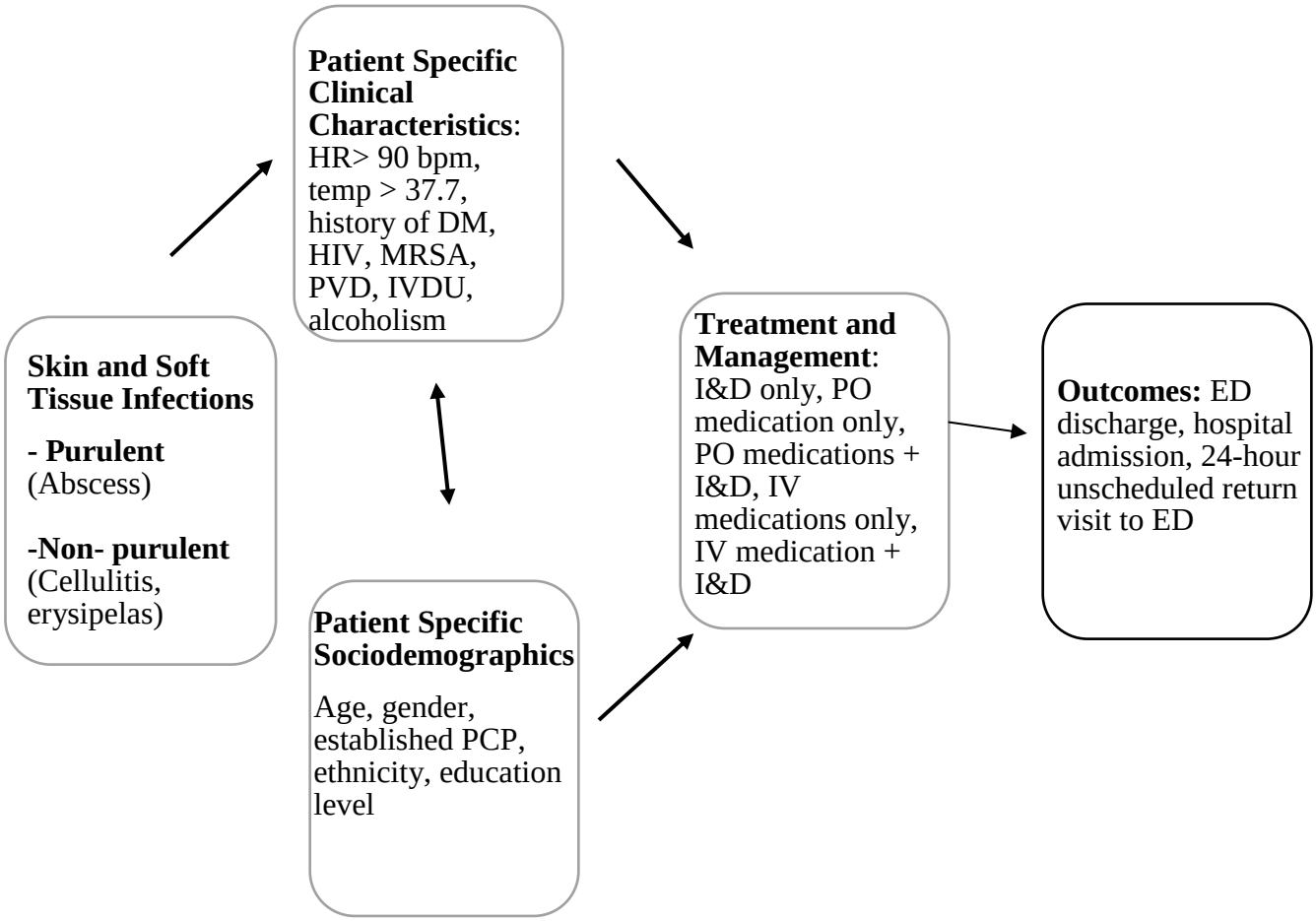



*Figure 1*: Web of Causation Theoretical Framework underpins the study.

**Study Conceptual Framework**

The utilization of this theoretical model helped to underpin this study's conceptual framework. Sociodemographics of age, gender, ethnicity, educational level, and establishment of primary care provider (PCP) will be descriptively analyzed to examine whether they are related to study outcomes (Andersen & Davis, 2016; Edelsberg et al., 2009). Patient specific clinical characteristics for those with SSTIs include initial heart rate, initial temperature, and history of diabetes mellitus (DM), human immunodeficiency virus (HIV), methicillin resistant staphylococcus aureus (MRSA), intravenous drug use (IVDU), and/ or alcoholism will be described (Abrahamian, Talan, & Moran, 2008; Bookstaver et al., 2018; Dryden, 2009; Figtree et al., 2010; Jenkins et

al., 2010). The treatment and management of the SSTI, specifically whether the patient received an incision and drainage (I&D) only, oral (po) medications only, I&D and oral medication, intravenous (IV)/ parenteral medication only, or I&D and IV/ parenteral medications will be noted. Differences in patient disposition, particularly whether the patient was admitted to the hospital or discharge home from the emergency department, may exist between the patients with purulent and non- purulent SSTIs of the extremity when their patient specific characteristics, sociodemographics, and treatment/ management modalities are considered (See Figure 2). This conceptual framework guides this research study (Ravitch & Riggan, 2012).



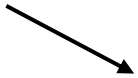


*Figure 2*: Study conceptual framework. Note PCP= primary care provider; HR= heart rate; temp= temperature in Celsius; I&D= incision and drainage; po= by mouth; Rx= prescription; DM= diabetes mellitus; HIV= human immunodeficiency virus; PVD= peripheral vascular disease; MRSA= methicillin resistant staph aureus; IVDU= intravenous drug use.

## CHAPTER II

## LITERATURE REVIEW

Infections of the skin and soft tissue are encountered in community and health care settings and may commonly result in emergency department visits. The overall incidence of SSTIs has steadily increased over the last few decades. In fact, according to the National Hospital Ambulatory Medical Care Survey (NHAMCS) (Rui, Kang, & Ashman, 2015), U.S. emergency department visits for SSTIs increased from 1.2 million in 1993 to 3.4 million in 2005; hospitalizations for SSTIs has increased similarly (Edelsberg et al., 2009; Pallin et al., 2008; David A. Talan et al., 2015). This dramatic increase coincides with the emergence of community- associated methicillin resistant *Staphylococcus aureus* (MRSA) and can be attributed to the increase in incidence of skin and soft tissue infections, in particular cellulitis and abscesses. These common clinical

infections can have mild to potentially life- threatening clinical outcomes and complications. Therefore, it is prudent to understand the intricacies of disease recognition, treatment, and management.

The challenges surrounding SSTI treatment and management echo the multifaceted approach to care, which include concerns for lack of clinical practice guidelines compliance, antibiotic stewardship, and recognition of how social determinants add to the risk stratification of each patient. There has been a lack of consensus among optimal pharmacologic treatment and management despite the recognition of IDSA guidelines. Strikingly, the literature supports a 20-40% compliance rate with IDSA guidelines (Ezebuenyi et al., 2018; Kamath et al., 2018). Often, empiric antibiotic combination therapy was initiated when it was not indicated, which exacerbates the concern for antibiotic stewardship. Furthermore, unnecessary hospitalizations can be expensive and are associated with adverse events (Hauck & Zhao, 2011; Keyloun et al., 2018). A standard and multidisciplinary approach to the management of skin and soft tissue infections can streamline care, reduce hospitalizations, support antimicrobial stewardship, and overall improve patient outcomes. In this chapter, a literature appraisal, key variables, and study concepts will be reviewed.

## Skin and Soft Tissue Infections

The National Hospital Ambulatory Medical Care Survey (Rui, Kang, Ashman, 2016) indicate 3.5% of all emergency department visits are for skin and soft tissue infections. The vast majority of skin and soft tissue infections are commonly managed on

an outpatient basis; however, some cases require hospitalization for parenteral antibiotic coverage and surgical management. Furthermore, the Agency for Healthcare Research and Quality (Moore, Stocks, & Owen, 2017) assert SSTIs are the 5th most common medical complaint for emergency department patients in the U.S. These infections represent a collection of diagnoses reflective of an inflammatory microbial invasion of the epidermis, dermis, and subcutaneous tissues (Dryden, 2009). When the skin barrier is compromised, pathogens can cause infections as they gain access from a break in the skin, ulcer, burn, or trauma/ surgical wounds (Dryden, 2009).

The Food and Drug Administration Center for Drug Evaluation and Research (HHS, 2013) have defined each specific diagnosis. Cellulitis, erysipelas, and abscess are further delineated herein.

**Cellulitis**

Cellulitis is a potentially serious skin and soft tissue infection that may spread to the blood and lymphatic systems causing a potentially life- threatening situation. It is characterized by erythematous areas of skin that are edematous and/ or indurated and poorly demarcated.

**Erysipelas**

Erysipelas is a form of cellulitis described as a rapidly progressing erythematous, indurated, well- demarcated skin infection commonly seen on the face and legs (Celestin, Brown, Kihiczak, & Schwartz, 2007).

**Abscesses**

Wound infections, including abscesses, are characterized by purulent drainage from an erythematous wound that is indurated and/ or edematous. This collection of pus is within the dermis or deeper and is accompanied by redness, edema, and/or induration (HHS, 2013). Common bacterial pathogens causing skin and soft tissue infections are *Streptococcus pyogenes* and *Staphylococcus aureus* including *methicillin-resistant Staphylococcus aureus*. Less common causes include other *Streptococcus species, Enterococcus faecalis, Klebsiella pneumoniae*, or Gram negative bacteria (HHS, 2013; Daly et al., 2011; Rod & Hoyt, 2007; Talan et al., 2011; Yadav, Gatien, Corrales-Medina, & Stiell, 2017). Cellulitis and abscesses are the most common skin and soft tissue infections in the community and hospital settings. Ray, Suaya, and Baxter (2013) examined the incidence, microbiology, and patient characteristics of SSTIs from patients enrolled in the Kaiser Permanente program in Northern California and noted 376,262 individuals experienced 471,550 SSTIs over a two-year time period. Of those who had a culture performed, staphylococcus aureus was isolated in 81% of the specimens of which 46% were methicillin resistant *Staphylococcus aureus* (MRSA).

## Clinical Practice Guidelines

The Infectious Disease Society of America (IDSA) established practice guidelines for the diagnosis and management of skin and soft tissue infections. These recommendations focus on the diagnosis and subsequent treatment of all SSTIs from minor infections,  for example impetigo, to life threatening infections, such as necrotizing

fasciitis (Liu et al., 2011; Stevens et al., 2014). The guidelines aid the clinician with prompt diagnosis, identification of pathogen, and efficient treatment.

According to the IDSA guidelines, the recommended treatment for inflamed epidermoid cysts, carbuncles, abscesses, and large furuncles is an incision and drainage. Gram stain and culture of pus from carbuncles and abscesses is recommended, but treatment without obtaining these studies is reasonable. It is not recommended to have these studies for an inflamed epidermoid cyst (Stevens et al., 2014). The utilization of antibiotics in addition to the incision and drainage is recommended with the presence of systemic inflammatory response syndrome (SIRS), including a temperature > 38 degrees Celsius or < 36 degrees Celsius, tachypnea, tachycardia, or a white blood cell count > 12,000 or < 400 cells/⌈L (Miller, Daum, & Chambers, 2015; Stevens et al., 2014).

Cellulitis and erysipelas without signs of systemic illness should be treated with an antimicrobial agent that is active against streptococci. Parenteral antibiotics are indicated in patients who do present with systemic symptoms. For patients who present with a history of MRSA, penetrating trauma, including intravenous drug use, or SIRS, antimicrobial treatment against MRSA is recommended in addition to the coverage for streptococci (Hurley et al., 2013; Stevens et al., 2014). Broad spectrum coverage may be considered in patients who are immunocompromised. Cultures are not routinely recommended unless the patient is neutropenic, has severe cell mediated immunodeficiency, has a malignancy and is on chemotherapy, or has sustained an animal

bite (Stevens et al., 2014). In addition to pharmacological management, elevation of the recommended area is indicated.

Outpatient therapy for SSTI is recommended for all patients who do not have SIRS, hemodynamic instability, or an altered mental state. In contrast, hospitalization is recommended if the infection is severe, if there is concern for a deeper infection and/ or necrotizing fasciitis, if the patient is failing outpatient treatment, or if there is a concern for poor adherence to therapy (Cranendonk, Lavrijsen, Prins, & Wiersinga, 2017; Gunderson, Cherry, & Fisher, 2018; Kamath et al., 2018; Stevens et al., 2014).

**Community Associated, Methicillin Resistant *Staphylococcus Aureus (CA-MRSA)***

*Staphylococcus aureus* is a major cause of both purulent and non- purulent skin and soft tissue infections (Moran, Gorwitz, & McDougal, 2006; Stevens et al., 2014). Methicillin resistant *S. aureus* (MRSA) is associated with healthcare infections, as well as community associated. Since the early 1900s, there has been a steady increase in incidence of the disease from 1.2 million visits to 3.4 million visits in just 10 years (Pallin et al., 2008; Rui, Kang, & Ashman, 2016). This rampant influx of disease has contributed to a notable public health problem and has resulted in an increase in invasive infections nationwide among patients seeking treatment in the emergency department (Edelsberg et al., 2009; Pollack et al., 2015). For patients with cutaneous abscess, the primary treatment is an incision and drainage alone. Per the clinical practice guidelines for the treatment of MRSA from the IDSA, antibiotic therapy is indicated for patients with:

- Signs and symptoms of systemic illness;

- Severe or extensive disease, including infections with multiple sites;
- History suggestive of a rapid progression with associated cellulitis;
- Abscess in a high risk and complicated area to drain, including the face, genitalia, and hands/ feet;
- Associated septic phlebitis;
- Comorbidities or immunosuppression;
- Extremes of age from the very young to the very old;
- Failure to respond to incision and drainage alone (Liu et al., 2011).

Patients who have purulent cellulitis should receive empirical coverage for CA-MRSA. In contrast, those who have non-purulent cellulitis should receive empirical therapy for infection due to ®-hemolytic streptococci. Only patients who do not respond to treatment for non-purulent cellulitis with a ®- lactam should be covered for empirical coverage for CA- MRSA (Liu et al., 2011). Hospitalized patients with complicated SSTI, including those that involve major abscesses, infected burns or ulcers, deeper soft tissue, and surgical/ traumatic wounds, should be treated with surgical debridement and broad-spectrum antibiotics with consideration for empirical therapy for MRSA. Wound cultures should be obtained from patients who present with systemic illness, patients who have failed initial treatment, or patients with severe infection (Liu et al., 2011; Moran et al., 2006; Singer & Talan, 2014).

## Antibiotic Stewardship

The Society for Healthcare Epidemiology of America (SHEA), Infectious Diseases Society of America (IDSA), and the Pediatric Infectious Diseases Society (PIDS) have collaborated to define a consensus statement for antibiotic stewardship, which refers to "coordinated interventions designed to improve and measure the appropriate use of [antibiotic] agents by promoting the selection of the optimal [antibiotic] drug regimen including dosing, duration of therapy, and route of administration" (Fishman, SHEA, IDSA, & PIDS, 2012, p. 323). The primary goal of antibiotic stewardship is to achieve optimal clinical outcomes while minimizing complications, including toxicity and other adverse events. This fastidious approach improves the rate of antibiotic susceptibility in targeted antibiotics and ultimately enhances resources utilization while maintaining a consciously selective approach and recognition of bacterial populations that have contributed to the emergence of resistant strains (Barlam et al., 2016). This comprehensive approach to care may also address concerns for costs associated with these infections (Fishman et al., 2012).

## Previous Studies Evaluating Skin and Soft Tissue Infections

Since the increase in CA-MRSA, several studies have been conducted to evaluate the treatment and management, including prescribing practices, admission rates, and health outcomes, of patients with SSTIs. Utilizing 11 university- affiliated emergency departments (EMERGEncy ID Net Study Group), Moran et al. (2006) conducted a prospective prevalence study to examine the incidence of MRSA infections for patients who presented with purulent SSTIs in the ED. The sample included 422 individuals with

a median age of 39 years. Sixty two percent were male, and approximately half (49%) reported to be non- Hispanic blacks (Moran et al., 2006). Of the 422 patients enrolled in the study, *S. aureus* was isolated in 320 cultures (76%). MRSA was isolated from 59% of the patients. MRSA was the most common identifiable cause of SSTI in 10 out of 11 EDs, and abscesses were the most common type of infection noted in 81% of the patients (Moran et al., 2006). Other isolated organisms included methicillin susceptible *S. aureus* (MSSA) (17%) and streptococcus species (7%). Of the 218 MRSA isolates sent to the CDC for genetic and phenotype characterization, 99% were characteristic of CA-MRSA (Moran et al., 2006). Potential risk factors for MRSA infections identified by the investigators included homelessness, intravenous drug use (IVDU), underlying illnesses (though not clearly defined), prior history of MRSA, recent hospitalization, being a resident of a long-term care facility and/ or prison/ jail, and household contact with at risk persons (Moran et al., 2006). According to Moran et al. (2006), Black race and presence of a skin abscess were associated with MRSA SSTI. Though this study characterized the most common pathogen for purulent SSTIs in the ED, social determinants, treatment and management, and disposition for each of these patients were not examined. This information may provide greater insight into the care needed for these patients.

Utilizing a similar approach with the EMERGEncy ID NET population (now 12 university affiliated hospitals), Talan et al. (2014) conducted a prospective study to identify the factors associated with the decision to hospitalize emergency department patients with SSTIs. Providers received a survey regarding their reason for admission,

and patient clinical characteristics were identified and noted to have a correlation with hospitalization (Talan et al., 2015). A total of 619 patients were enrolled. The median age of the patients was 38.7 years, and more than half (57%) were male. A comorbidity was documented in 32% of the patients with diabetes being the highest at 12% (Talan et al., 2015). Hospitalization was significantly associated with history of fever, maximal length of erythema > 10 cm, age > 65 years, history of failed treatment, and any comorbidity (Talan et al., 2015). The need for intravenous antibiotics was the most common reason (85%) for admission per the surveyed providers. The next most common reason for admission was a need for surgical intervention (24%), a significant underlying disease (11%), and complex wound care (9%) (Talan et al., 2015). This study presented a comprehensive evaluation of the need for identifying which factors contribute to the decision-making process for hospital admission or discharge for patients with SSTI and considered patient clinical findings and provider decision making. However, social determinants and adherence to IDSA guidelines were not considered.

In a prospective study across six EDs in the U.S., an anonymous survey was administered to 130 providers (Almarzoky Abuhussain et al., 2018). Each participant was queried on their decision for admission or discharge, as well as their choice of antibiotic therapy for four cases: simple SSTI, recurrent SSTI, controlled diabetes, and septic patient (Almarzoky Abuhussain et al., 2018). They were also asked to rank the factors that may have influenced their decision making process for medical management, including severity of infection, presence of comorbidities, patient adherence, antibiotic

cost and schedule, and microbiological spectrum of activity (Almarzoky Abuhussain et al., 2018). Increased variability in treatment and disposition of the diabetic, recurrent SSTI, and septic cases was noted; the least variability in practice was observed for the simple SSTI case (93% treated with oral antibiotic) (Almarzoky Abuhussain et al., 2018). Septic patients were more commonly treated with a full intravenous course (65%) and hospital admission. Patients with recurrent infections were most commonly treated with an oral antibiotic (48%) and discharged home (51%). Finally, diabetic patients with a SSTI were most commonly treated with an oral antibiotic (53%) and discharged home (62%) (Almarzoky Abuhussain et al., 2018). Although this study did not look at the provider's compliance with the guidelines, the findings suggest a significant variance in provider practice for SSTI, and they further substantiate the need to understand the gap in adherence to the guidelines and actual practice. The investigators suggest the need for the development of an educational pathway that specifically addresses patients with comorbidities, infections recurrence, or sepsis to supplement the decision making process for treatment and management in the ED (Almarzoky Abuhussain et al., 2018).

Kamath et al. (2018) conducted a retrospective review of 240 consecutive ED patients with SSTIs who were discharged from a Texas Veterans Affairs Medical Center. They examined IDSA guideline compliance in four areas: antimicrobial administration, the decision for hospital admission, incision and drainage (I&D) of abscess, and culture submission (Kamath et al., 2018). Non-recommended antibiotics were administered in 71% of the patients with non- purulent infections and in 68.4% of patients with purulent

infections (Kamath et al., 2018). The decision to hospitalize did not comply with guidelines in 19.6% of the cases. For patients who were classified to have an abscess, 43.8% received therapy (I&D) in accordance to the guidelines (Kamath et al., 2006). Blood cultures were drawn for patients with non- purulent infections in most severe cases 28.6% of the time, and only 5% were positive for MSSA; 57.7% of patients had blood cultured obtained from patients with moderate to severe cellulitis with only 2.4% positive to *Streptococcus pyogenes*. The investigators used univariate analysis to identify predictive factors of hospitalization, which included moderate or severe infection, age > 50 years, alcohol abuse, fever, tachycardia, peripheral vascular disease, and diabetes mellitus (Kamath et al., 2018). A multivariate regression noted alcohol abuse, redness, systemic inflammatory response syndrome (SIRS), and moderate- severity infections were identified to be significantly associated with hospitalization ($P< 0.05$ for each). The total number management was in accordance with the IDSA guidelines in all four categories was 20.1% (Kamath et al., 2018). This study presents a striking lack of adherence to published guidelines and offers an opportunity to improve treatment and management. Social determinants, including accessibility to follow- up care and environmental constraints, were not considered.

## Emergency Department Management

Skin and soft tissue infections are one of the most common chief complaints in the emergency department (Rui, Kang, & Ashman, 2015). In fact, > 3 million people annually present to the ED and receive treatment for SSTIs. Although most patients are

managed as outpatient, severe cases require hospitalization. The most common implication for hospital admission from the ED is for the administration of intravenous antibiotics (Talan et al., 2015). The more complicated cases are defined by patients who have an acute bacterial skin and soft structure infection (ABSSSIs) with fever, leukocytosis, multiple co-morbidities, and/ or larger lesions. ABSSSI is also known as a complicated SSTI (cSSTI) (Bookstaver et al., 2018). These patients, in contrast to those with SSTIs, most often require parenteral medication and thus tend to be hospitalized for more aggressive treatment and management (Pollack et al., 2015; Talan et al., 2015). Distinguishing between each diagnosis while taking into account the specific risk of each patient contributes to the dynamic practice of the emergency clinician.

Because of the nature of their practice, emergency department clinicians encounter patients on a daily basis who present with SSTIs. The management of SSTIs is primarily determined by the severity of the infection as defined by the provider, the location of the infection, and the associated risk factors, including patient co- morbidities (Ramakrishnan, Salinas, & Higuita, 2015). Over the last two decades the associated risk has also echoed concerns for CA-MRSA. With the emergence of CA- MRSA, the U.S. incidence for ED visits for patients with SSTIs increased markedly. Consequently, the prescription rate for antibiotics active against CA- MRSA, both oral and parenteral, increased (Pallin, Camargo, & Schuur, 2014; Pallin et al., 2008; Pollack et al., 2015). In fact, outpatient parenteral antibiotic treatment for SSTI has been documented to be an effective treatment modality as a means of avoiding hospital admission (Chan, Ooi,

Wong, Zhong, & Lye, 2017). Unfortunately, the literature supports adherence to the national guidelines and standards of care only 20- 40% of the time even though these guidelines take into account the MRSA as a potential pathogen (Ezebuenyi et al., 2018; Kamath et al., 2018).

**Comorbidities and Complications Related to Skin and Soft Tissue Infections**

As previously discussed, patients with SSTIs can develop complications that may require parenteral antibiotics, hospital admission, and potential surgical debridement. These patients typically have multiple comorbidities and risk factors, including diabetes mellitus, intravenous drug use, immunodeficiency, peripheral vascular disease, and/ or history of prior MRSA infection (Marwick, Rae, Irvine, & Davey, 2012; Talan et al., 2015). These disease processes increase the patient's susceptibility to SSTI complications due to the changes in physiology subsequent to the primary disease state, such as vascular changes, immunologic deficiencies, and infection susceptibility, and classify the patient as having a complicated SSTI.

Though aging in general is not a disease, it can lead to an increase in comorbidities, as well as reduction in physiological reserves and capabilities. This higher incidence in comorbidities results in more vulnerability to infectious diseases (Lin, Tsai, Hsu, & Chen, 2016). Furthermore, with increasing age, the immune system is not as efficient, lymphatic drainage may be compromised, and mobility may decrease (Bickley, 2017; Weiskopf, Weinberger, & Grubeck-Loebenstein, 2009). Consequently, increased

age presents an increased risk for SSTI complications (Bookstaver et al., 2018; Lin et al., 2016; Marwick et al., 2012).

Complications from SSTIs encompass a range of disorders including bone and joint infections, such as osteomyelitis, gangrene, amputation, bloodstream infections, and necrotizing infections that require extensive surgery (Dryden, 2009; Edelsberg et al., 2009; Lipsky et al., 2012). These complications typically arise in patients who have the before mentioned co-morbidities and/ or risk factors and are classified as having a cSSTI. Lipsky et al. (2012) evaluated cSSTI in hospitalized patients, including diabetic patients. This large prospective observational study conducted from 2008- 2009 looked at the treatment, management, and outcomes of patients with diabetic foot infections, surgical site infections, deep soft tissue abscesses, and cellulitis. Of the 1,033 patients enrolled, 44% of the patients underwent surgical debridement and/ or incision and drainage, and the mean length of hospital stay was 7 days (Lipsky et al., 2012). At ED presentation, 89% of patients had received empiric treatment with parenteral antibiotics.

On the other hand, Gonzalez et al. (2005) evaluated previously healthy adolescents without predisposing risk factors who presented with a SSTI in the setting of systemic compromise. All 14 patients in this study were admitted to the Pediatric Intensive Care Unit (PICU) with sepsis and coagulopathy. Twelve patients had CA-MRSA infections emphasizing the incredible risk for complications with CA-MRSA; only two had methicillin- susceptible *S. aureus* (Gonzalez, 2005).

**Social Determinents of Health**

Individuals are ulitmately responsible for their own health, nonetheless, the social determinents of health (SDOH) play a vital role in the individual's health outcomes (Centers for Disease Control and Prevention [CDC], 2018). As with any disease process, the conditions in which people live, learn, work, and play (defined as SDOH) directly influence the range of health risks and outcomes (CDC, 2018). For example, the environment in which a person resides can have both direct and indirect impact on his or her health if the health concerns arose from injuries related to crime, environmental hazards/ exposure to toxins, lack of educational opportunities, and chronic stressors such as poverty and unemployment (Khabbaz, Moseley, Steiner, Levitt, & Bell, 2014; Lantz & Pritchard, 2010). The socioecomnomic environment shapes the resources and opportunities available to the patient and can positively or negatively impact the health outcome (Lantz & Pritchard, 2010). Unfortunately, the degree to which the health outcome is impacted is not well understood; however, research findings suggest the socioeconomic environment has a substantial effect on health risk behaviors (i.e. lack of self care, poor diet, physical inactivity), healthcare use (i.e. preventative and wellness care), and ultimately health outcomes (i.e. chronic disease mortality, birth weight) (Diez Roux, 2004; Larson, Story, & Nelson, 2009; Pickett, 2001; Yen, Michael, & Perdue, 2009). One population in which all these influencers have particular weight is with the Latino population within rural areas. Not only is this population vulnerable to environmental limitations ,but also by cultural, linguistic, and health related challenges.

**Population of Interest**

The Latino population is one of the most rapidly increasing populations in the United States. Not only does the rapidly increasing population present challenges, but the fact the Latino population is more likely to be underinsured and living in poverty exacerbates an already difficult situation (Flores, Abreau, Olivar, & Kastner, 1998; Mueller, Ortega, Parker, Patil, & Askenazi, 1999). Health care in this population is encumbered by lower access to healthcare services, less utilization of preventative services, limited financial resources, and higher prevalence of risk factors, including cardiovascular disease, diabetes mellitus, obesity, and hyperlipidemia (Bassford, 1995; Blewett, Casey, & Call, 2004). Furthermore, cultural and linguistic barriers exert an effect on the already challenging climate.

To further delineate the Latino population, those who live in rural areas are subjected to additional barriers and obstacles as a direct result of the environment and its constraints. The United States (U.S.) Census Bureau (2019) delineates rural areas comprise open country and settlements with fewer than 50,000 residents. Urban areas, on the other hand, comprise larger places densely populated with a population density of 1,000 persons per square mile. The south eastern part of Southern California reflects this rural description according to the U.S. Department of Agriculture (USDA, 2019) and U.S. Census Bureau (USDA, 2019) by metro- nonmetro status. Within this geographic region, it is estimated by the United States Census Bureau (2018) 85.8% of the residents identify with Hispanic or Latino origin, and 69.% percent report a high school degree or higher. Nearly 25% of people report living in poverty, 32% report being foreign born

persons, 17% report a bachelor's degree or higher, and 12% report being without health insurance (United States Census Bureau, 2018).

All are significant factors that contribute to the overall health and wellbeing of the individual, and due to their complexity may render a person vulnerable. This vulnerability is defined by a lack of resources and accessibility reflective of the physical environment, as well as the limited education, health insurance coverage, and incidence of poverty. The lack of resources in particular include a limited number of primary care providers, mental health providers, and acute care facilities. According to the California Health Care Foundation (2017 and 2013), this area of southern California reports 21 primary care providers per 100,000 individuals, 44 specialists per 100,000 individuals, and 4 mental health providers per 100,000 individuals. There are also only two acute care, level IV trauma centers for the 4,482 square miles (Imperial County Emergency Medical Services Agency, 2019). Higher level educational opportunities are also constrained to one community college and a satellite state school that offers 11 bachelor's degrees and two master's degrees (San Diego State University/ Imperial Valley, 2019).

**Social and Cultural Factors**

Each year, thousands of people of Hispanic origin settle in the rural borderlands between Mexico and the U.S. Some have entered the U.S. legally, and others may have entered as undocumented foreigners (Cheney, Newkirk, Rodriguez, & Montez, 2018). Regardless of how they have entered, the population is typically largely uninsured and unfamiliar with U.S. health care. Most do not speak English, and as previously

mentioned, numerous have settled in rural areas. Unfortunately, the ability of rural communities to provide efficient and comprehensive care may be limited due to the absence of a local infrastructure and lack of funding that provides linguistically and culturally competent services (Blewett, Casey, & Call, 2004). The ability to provide the essential linguistically and culturally sensitive care to this population is essential because rural communities characteristically have worse health outcomes and are less racially and ethnically diverse than urban areas (Housing Assistance Council, 2012; Rural Health Research and Policy Centers, 2014). This fact further perpetuates the disparity of health outcomes.

In one qualitative study completed by Blewett, Smaida, Fuentes, and Zuehlke (2003), a focus group of rural Latinos were recruited to be asked various questions related to their employment, health, and knowledge regarding the U.S. health care system. They were asked to explain their views and were queried for specific insurance coverage information (Blewett et al.). Overall, most individuals were frustrated with and misunderstood the U.S. health care system. The concept of insurance, copayments, and deductibles was described as challenging, and most individuals were dissatisfied with the convoluted process of accessing public health insurance and care. To further complicate matters, the information provided regarding insurance and health was not linguistically nor culturally competent. This study provided insight in the experiences of Latinos living in rural communities who have accessed U.S. health systems, and it further exemplifies the difficult and challenging climate.

## Summary

Skin and soft tissue infections are one of the most common complaints in the emergency department, and they present a challenge to ED providers when determining the disposition of the patient because a multifactorial approach, including recognition of comorbidities, patient clinical characteristics, and social determinants, must be taken for each case. In this chapter, pertinent literature regarding SSTIs, including pathogens responsible for causing infection, national guidelines, and ED management, was reviewed. CA- MRSA is a highly virulent organism that has resulted in a marked increase in incidence of SSTIs. Due to its potentially devasting outcomes, a number of studies have been conducted to evaluate and identify risk factors for disease, treatment, and patient disposition practices (Almarzoky Abuhussain et al., 2018; Kamath et al., 2018; Moran et al., 2006; Talan et al., 2015). Further research is needed to synthesize this information to evaluate the patient presentation and risk, treatment and management, and disposition of patients with SSTIs.

# CHAPTER III

# METHODOLOGY

The purpose of this study was to examine relationships among sociodemographics, physical examination findings, and treatment modality and management in patients with SSTIs. This chapter includes a description of the study design, setting and population, data collection, and analytic procedures. The protection of human subjects and potential limitations are also discussed. The specific aims of this study include the following:

Aim 1. Describe sociodemographics, physical examination findings, treatment modality, patient disposition (i.e. hospital admission or ED discharge at initial presentation), and reason for return visit to the ED among patients with non-purulent and purulent SSTI who presented for treatment in a high-volume rural ED.

Aim 1a. Sociodemographics, Clinical Characteristics, and Treatment Modality by Final Diagnosis

Aim 1b. Sociodemographics, Clinical Characteristics, and Treatment Modality by Disposition Status

Aim 2. Examine the relationships among sociodemographics (age, gender, established PCP, race/ethnicity, education level) physical examination findings (i.e. HR> 90 bpm, temperature > 37.7 C, treatment modality (i.e. incision and drainage, oral medication, or parenteral medication), patient disposition (i.e. hospital admission or ED discharge at initial presentation) and reason for return visit to the ED among patients with non-purulent and purulent SSTI who presented for treatment in a high-volume rural ED.

Aim 2a. Relationships among Sociodemographics, Clinical Characteristics, and Treatment Modality by Final Diagnosis

Aim 2b. Relationships among Sociodemographics, Clinical Characteristics, and Treatment Modality by Final Disposition

Aim 3. Identify factors that increase the odds of hospital admission at initial presentation for patients with specific sociodemographics, physical examination findings, and treatment modality among patients with non-purulent and purulent SSTI who presented for treatment in a high-volume rural ED.

**Study Design**

This research study was a retrospective, cohort study of ED patients diagnosed with a SSTI to an upper or lower extremity. This cost-effective design provided an appropriate setting to analyze existing data.

**Setting Location and Population**

The study was implemented at a 161-bed facility with approximately 48,000 emergency room visits annually located in a rural agricultural community located within the Imperial County of California. According to estimates from the United States Census Bureau (2018), 85.8% of the residents identify with Hispanic or Latino origin, and 69.% percent report a high school degree or higher. Nearly 25% of people report living in poverty (United States Census Bureau, 2018). The 20-bed emergency department is managed by a large urban academic health care network of emergency physicians. This study examined data collected for ED visits of patients with SSTIs from January 1, 2016 through December 31, 2018.

**Subject inclusion criteria.** Subjects were 18 years of age and older and had been diagnosed at their initial visit with a SSTI to an extremity. ICD-10 codes for cellulitis, erysipelas, and abscess were included (See Table 1).

**Subject exclusion criteria.** Excluded subjects were those less than 18 years of age, patients diagnosed with SSTI, but not on an extremity, patients who died in the ED, patients who left without being seen or against medical advice, and those who were seen for a subsequent visit for the SSTI that was diagnosed outside of the predetermined study time.

**Study Variables**

All variables were captured utilizing the secondary data set. Variables included social determinants, history and physical exam findings, and treatment/ management, including disposition (See Table 2). Patients were grouped by non-purulent and purulent SSTI.

**Independent variables.** Independent variables included social demographic information (e.g., age, gender, race/ ethnicity, educational level, identified primary care provider), physical examination findings (e.g., heart rate > 90, temperature > 37.7), treatment decisions (e.g., incision and drainage (I&D) only, prescription for oral medications only, I&D and prescription for oral medications, I&D with intravenous medications, or intravenous medications only), and comorbidities (e.g., diabetes mellitus, HIV, peripheral vascular disease, history of methicillin resistant staphylococcus aureus, history of intravenous drug use, and alcoholism). The sociodemographics are extraneous to the biological disease process, but have been suggested as influential to the course and

outcomes of this disorder (Almarzoky Abuhussain et al., 2018; Gunderson et al., 2018; Kamath et al., 2018; Pallin et al., 2014)**.** All variables were consistent with variables identified in the literature to impact the care provided to patients with SSTI in the ED (Guterman et al., 2016; Pallin et al., 2014; Sabbaj et al., 2009; Talan et al., 2015; Yadav, Gatien, Corrales-Medina, & Stiell, 2017).

**Dependent variables.** Dependent variables included the disposition status (i.e., hospital admission, emergency department discharge, and 24-hour unscheduled return visit to the ED).

**Sample Size/Power Analyses**

There is no consensus on the approach to compute the power and sample size with logistic regression; although as pointed out by Katz (2013), ten outcomes for each independent variable is appropriate, however a minimum of 20 cases per variable should be used to overcome variability in frequencies.

The calculation of a minimum sample size was performed using G*Power (Faul, 2015). Standard underlying assumptions for this logistic regression were incorporated ($\alpha = .05$, $\beta = .20$/power = .80, OR = 1.3, Pr[Y=1|X=1]H0 = .20) yielding a total sample size of at least 568. 3.5% of all emergency department patient visits are related to skin and subcutaneous complaints (Rui & Kang, 2015). Therefore, accessing data from a 2-year period from an emergency department that sees greater than 100 patient visits per day should sufficiently provide ample cases to achieve an adequate sample size and power.

**Data Collection Plan**

Retrospective data extracted from the ED dataset were examined for cases with the beforementioned ICD- 10 codes from January 1, 2016 to December 31, 2018. Trained hospital abstractors collected data by identifying all patient encounters from the beforementioned time period with a primary diagnosis of the SSTI using the ICD- 10 coding data (See Table 1). All patients with one of these primary ICD-10 codes were identified and data were electronically extracted via the Quality Intelligence (QI) Department. Inclusion and exclusion criteria was utilized by the study investigator to identify cases for this study. For patients with multiple infections during the study period, only the initial episode was included. Patients were grouped by non-purulent and purulent SSTI. Patients with the diagnoses of cellulitis and abscess were included as a separate group. Patients were only included once in the study, and duplicate medical record number information was not recorded after the initial entry. Patients who died in the ED, left without being seen, or against medical advice were excluded. If the ED visit was not the first one for the index condition, the visit was excluded from analysis.

Only initial visits as detailed in the ICD-10 code were included when retrieving data on demographic information, past medical history, physical examination findings, treatment, management, and disposition. This information was extracted by the study investigator. Subsequent visits in the medical record for the SSTI after the initial diagnosis were recorded if the visit occurred less than 24 hours after ED discharge. The subsequent visit information, including demographic information, past medical history,

physical examination findings, treatment, management, and disposition was not included in the data, but rather a notation was made that the patient had returned to the ED.

**Analytic Approach**

Descriptive and inferential statistics were used for this study. All study variables were examined for normality, missing values, and outliers. Summary statistics were calculated including frequencies for categorical variables and means (SD) for continuous variables. Bivariate associations were examined with x-tabs for categorical variables and correlations for continuous variables. Variables significant at $p < .05$ in the bivariate analysis were considered for entry into a logistic regression model to identify factors that increase the likelihood of hospital admission and/ or discharge at initial presentation among patients with non-purulent and purulent SSTI.

In logistic regression, an estimate of the probability of a certain event occurring is made rather than detecting the difference or relationship that may be present, such as in linear regression (Mertler & Vannatta 2017). No assumptions are made about the dependent variable (Munro, 2005). Some authors use the likelihood ratio test; some use a test of proportions; some suggest various approximations to handle the multivariate case. Some advocate the use of the Wald test since the Z-score is routinely used for statistical significance testing of regression coefficients (Demidenko, 2007). Since this is a descriptive study and not focused on hypothesis testing, the Final Logistic Regression Model, which includes significance defined by $p \leq 0.05$, uses the overall chi-squared as the significance test.

Descriptive statistics were used to address Aim 1 and to report characteristics of the nominal, ordinal, and continuous variables. To address Aim 2, bivariate analysis utilizing the Fisher's exact, |2 tests, and correlational statistics were used as appropriate to detect significant differences in frequencies for categorical variables. Binomial logistic regression was then performed to address Aim 3 by using those predictors with a p-value <0.05 on the bivariate analysis. Binomial logistic regression used the entry method to indicate the most relevant associated predictors for disposition. Odds ratios and CIs were used to describe the effect of independent variables on the dependent variable. Odds ratios with 95% confidence intervals were calculated and used to describe associations between treatment modality and disposition, treatment modality, and return visit to the ED, history and physical exam findings, and patient disposition for patients with purulent or non-purulent SSTI. Linearity of the continuous variables with respect to the logit of the dependent variable was assessed via the Box-Tidwell procedure. Quality of the regression model was assessed with an Omnibus test, as well as Cox and Snell and Nagelkerke test for how well the model predicts the dependent variable.

**Protection of Human Subjects and Ethical Considerations**

The primary investigator completed human subjects training, received hospital admission approval for study, and obtained IRB oversight from the University of San Diego. This study was a retrospective analysis of secondary date, and all data were extracted from the hospital's electronic health record. Patient records were scrubbed of all personal health identifiers and assigned an identification number. De- identified data were utilized for statistical analysis.

## Limitations

The setting location and population may present limitations to this study. According to the United States Census Bureau (2018), 85.8% of the population in El Centro, California report being of Hispanic or Latino decent. The cross-sectional design does not allow for cause and effect, and the social demographics may prove to be confounders to this research. Additionally, electronic health record documentation completed by multiple providers (physicians, nurse practitioners, and physician assistants), nursing staff, and administrative personnel was obtained and may present a limitation. Though electronic health records provided opportunities to document detailed patient care, treatment, and management, concerns arise regarding the data quality and validity when multiple individuals are involved initially in the documentation of each patient encounter. Nursing and or nursing assistant staff document patient vital signs, the provider likely document the past medical history, treatment, and disposition, and administrative staff likely document the demographic information. Having multiple individuals involved in the documentation of each case poses the increased potential for inconsistencies and incomplete data capture (Cowie et al., 2017).

## Summary

Diseases of skin and subcutaneous tissues account for 3.5% of all emergency department visits annually in the United States (Rui & Kang, 2015). Though the Infectious Disease Society of America has established and evidence based guidelines, unfortunately studies have shown  those guidelines are only adhered to 20% of the time (Kamath et al., 2018). This retrospective, cohort study in an emergency department in El

Centro, California aimed to describe relationships between patient demographics, physical examination findings, and treatment modality and management in patients with purulent and non- purulent skin and soft tissue infections to the extremities. Data were extracted from an electronic health record, and statistical analysis was conducted to address each research aim. Understanding the common, presenting characteristics associated with SSTIs, management strategies, antibiotic use, and disposition practices provides valuable insight to develop potential clinical decision aids by SSTI type.

Table 1.

International Classification of Diseases Codes for SSTIs

| Type of SSTI | | SSTI Diagnosis | ICD-10 Classification Group | ICD-10 Description | ICD-10 Code |
|---|---|---|---|---|---|
| Non- purulent | | Cellulitis | Infections of the skin and subcutaneous tissues | Cellulitis and acute lymphangitis<br><br>Cellulitis and acute lymphangitis of other parts of the limb<br><br>Cellulitis and acute lymphangitis, unspecified<br><br>Cellulitis, unspecified | L03<br><br>L03.1, L03.111, L03.112, L03.113, L03.114, L03.115, L03.116, L03.119<br><br>L03.9<br><br>L03.90 |
| Non- purulent | | Erysipelas | Infections of the skin and subcutaneous tissues | Erysipelas | A46 |

| | | | | | |
|---|---|---|---|---|---|
| Purulent | | Cutaneous abscess | Infections of the skin and subcutaneous tissues | Cutaneous abscess, furuncle, and carbuncle of the limb<br><br>Cutaneous abscess of the limb<br><br>Cutaneous abscess, furuncle, and carbuncle, unspecified | L02.4<br><br>L02.41, L02.411, L02.412, L02.413, L02.414, L02.415, L02.416, L02.419<br><br>L02.9, L02.91 |

*Note*: Table 1 provides a comprehensive list of the International Classification of Diseases Codes for SSTIs utilized in this study. Retrieved from https://www.icd10data.com/ICD10CM/Codes/L00-L99.

Table 2.

Variable Table

| Name of Variable | Operational Definition | Instrument | Level of Measurement | Descriptive Statistics |
|---|---|---|---|---|
| Demographics (age, gender, race/ ethnicity, educational level, identified PCP) | Age (# years)<br>Gender (M/F)<br>Race/ ethnicity (Black/AA, white, Hispanic, Asian)Education (# years) Identified PCP (Y/N) | N/A | Nominal and ordinal | Frequency distribution, percentages. |
| Vital signs (HR > 90, temp > 37.7) | HR > 90 (Y/N))<br>Temp > 37.7 (Y/N) | N/A | Nominal | Frequency distribution, percentages. |
| | | | | |
| Comorbidities (DM, HIV, PVD, h/o MRSA, h/o IVDU, alcoholism) | DM (Y/N)<br>HIV (Y/N)<br>PVD (Y/N)<br>h/o MRSA (Y/N)<br>h/o IVDU (Y/N)<br>alcoholism (Y/N) | N/A | Nominal | Frequency distribution, percentages. |

| | | | | |
|---|---|---|---|---|
| Treatment modality (Incision and drainage, po medication, incision and drainage and po medication, parenteral med, parenteral med and incision and drainage) | I&D (Y/N)<br>po med Rx x 1 (Y/N)<br>I&D and po med Rx (Y/N)<br>Parenteral med (Y/N)<br>Parenteral med and I&D (Y/N) | N/A | Ordinal | Frequency distribution, percentages. |
| Disposition status (admission, discharged) unplanned return visit to the ED within less than 72 hours | Admit (Y/N)<br>Discharge (Y/N)<br>Visit within 72 hours of d/c from ED (Y/N) | N/A | Nominal | Frequency distribution, percentages. |

*Note*: Table 2 provides a comprehensive list of all variables. PCP= primary care provider; HR= heart rate; AA= African American; temp= temperature in Celsius; I&D= incision and drainage; po= by mouth; Rx= prescription; DM= diabetes mellitus; HIV= human immunodeficiency virus; PVD= peripheral vascular disease; MRSA= methicillin resistant staph aureus; IVDU= intravenous drug use.

# Chapter IV

## RESULTS

The purpose of this study was to examine relationships among sociodemographic factors, clinical characteristics, treatment and management, and the final disposition of emergency department (ED) patients who have skin and soft tissue infections (SSTI). In this chapter, the results are presented.

*Aim 1.* Describe sociodemographic factors (i.e., age, gender, race/ethnicity, and established primary care provider), physical examination findings (i.e., heart rate, temperature, comorbidities, and chief complaint), treatment modality (i.e., incision and drainage, oral medication, and/or parenteral medication), final diagnosis (i.e., hospital admission or ED discharge at initial presentation), patient

disposition (i.e., hospital admission or ED discharge at initial presentation), and return visit to the ED among patients with non-purulent and/or purulent SSTIs who presented for treatment in a high-volume rural ED.

Sociodemographic factors, physical examination findings, treatment modality, and disposition of the study population ($N$ = 857) overall and by final diagnosis are presented in Table 3. The study included data from all patients evaluated and treated in one rural ED in Southern California between January 1, 2016 and December 31, 2018. In this sample, the most frequent final diagnosis was cellulitis (56.9%, $n$ = 488), followed by abscess (40.1%, $n$ = 344). Only 2.2% ($n$ = 19) of the patients were diagnosed with both cellulitis and abscess, and less than one percent (0.7%, $n$ = 6) with other SSTI (i.e. abrasion, blister, folliculitis, thrombophlebitis, and disorder of the muscle). Most patients (97.7%, $n$ = 837) were discharged home from the ED, and only 2.3% ($n$ = 20) were admitted to the hospital. A recorded 18.8% ($n$ = 161) of all patients seen at the ED returned within 24 hours of discharge.

Average age for the sample was 45.65 years ($SD$ = 17.17, range = 18 - 95), males represented 67.1% ($n$ = 575) of the overall sample, about three quarters (75%, $n$ = 644) were of Hispanic origin, and 58.8% ($n$ = 504) were able to identify a primary care provider. The most common chief complaint was abscess (39.8%, $n$ = 341), followed by pain and/or swelling to any extremity at 29.6% ($n$ = 254), and wound infection/wound check (11.4%, $n$ = 98). A little over half of the patients (51.9%, $n$ = 445) had no comorbidities, 22.2% ($n$ = 191) were intravenous drug users, closely followed by those with diabetes mellitus (19.1%, $n$ = 164). All other comorbidities, including MRSA, PVD,

ETOH, and HIV, were infrequent (less than 2%) in this sample. Regarding the physical examination patients received in the ED, 60.4% of the patients presented with a heart rate greater than 90 beats per minute (bpm), and less than one percent (0.8%, $n = 7$) had a temperature equal to or higher than 37.7 degrees Celsius. Overall, the most common treatment modality was the administration of an oral medication (56.7%, $n = 486$), followed by incision and drainage plus an oral medication (30.8%, $n = 264$), and oral medication plus intravenous medication (7.5%, $n = 64$).

*Aim 2.* Examine the relationships among sociodemographic factors, physical examination findings, treatment modality, final diagnosis, patient disposition, and return visit to the ED among patients with non-purulent and/or purulent SSTIs who presented for treatment in a high-volume rural ED.

**Final Diagnosis**

A chi-square test of independence was conducted examining relationships between patients' final diagnosis and: sociodemographic factors, physical examination findings, treatment modality, patient disposition, and return visit to the ED (see Table 3). Not all expected cell frequencies were greater than five; Fisher's Exact Tests were reported for variables with expected cell frequencies less than five. There was a significant association between patient's final diagnosis and: identified primary care provider, Fisher's $\chi^2 = 13.32$, $p = .003$, *Cramer's V* = .125; chief complaint, Fisher's $\chi^2 = 405.40$, $p < .001$, *Cramer's V* = .381; diabetes mellitus, Fisher's $\chi^2 = 32.45$, $p < .001$,

*Cramer's V* = .190; peripheral vascular disease, Fisher's $\chi^2$ = 10.65, $p$ = .015, *Cramer's V* = .107; MRSA, Fisher's $\chi^2$ = 12.15, $p$ = .006, *Cramer's V* = .123; intravenous drug users, Fisher's $\chi^2$ = 31.17, $p$ < .001, *Cramer's V* = .194; comorbidities combined, *Fisher's* $\chi^2$ = 102.32, $p$ < .001, *Cramer's V* = .173; comorbidities and abnormal vital signs combined, Fisher's $\chi^2$ = 167.15, $p$ < .001, *Cramer's V* = .202; treatment modality: oral medication, Fisher's $\chi^2$ = 490.07, $p$ < .001, *Cramer's V* = .720; treatment modality: incision and drainage plus oral medication, Fisher's $\chi^2$ = 578.03, $p$ < .001, *Cramer's V* = .764; treatment modality: intravenous medication, Fisher's $\chi^2$ = 33.35, $p$ < .001, *Cramer's V* = .190; treatment modality: combined, Fisher's $\chi^2$ = 633.24, $p$ < .001, *Cramer's V* = .483; number of treatment modalities used, Fisher's $\chi^2$ = 44.90, $p$ < .001, *Cramer's V* = .194; and return visit to ED, Fisher's $\chi^2$ = 72.54, $p$ < .001, *Cramer's V* = .296. The largest significant associations in terms of effect sizes were between final diagnosis and the treatment modality oral medication (*Cramer's V* = .720), and final diagnosis and incision and drainage plus oral medication (*Cramer's V* = .764); with the largest adjusted residuals for the cellulitis (non-purulent) group for both treatment modalities (*Adj. residuals* = 20.8 and 21.9 respectively; see Figures 3 and 4).

A one-way between subjects analysis of variance (ANOVA) was conducted to identify if patients' age was significantly different for patients based on final diagnosis (see Table 3). Patients were classified into four groups: abscess (purulent), cellulitis (non-purulent), abscess and cellulitis, and other SSTI (i.e., abrasion, blister, folliculitis, thrombophlebitis, and disorder of the muscle). Homogeneity of variances was assessed by Levene's test of homogeneity of variances. Welch robust test for equality of means are

reported for those ANOVA results that do not meet the homogeneity of variance assumption. Age was significantly different for patients in term of their final diagnosis, *Welch's F*(3, 20) = 24.30, $p < .001$. Age significantly decreased for those diagnosed with abscess ($M = 40.69$, SD = 13.61) when compared to those with cellulitis ($M = 49.60$, $SD = 18.55$), and for those with abscess and cellulitis ($M = 35.00$, $SD = 11.00$) when compared to those with cellulitis ($M = 49.60$, $SD = 18.55$). Games-Howell post-hoc analysis indicated the decrease in age from the cellulitis to the abscess group (*M diff.* = 8.92, 95% CI 6.05 to 11.79, $p < .001$) and from the cellulitis to the abscess and cellulitis group (*M diff.* = 14.61, 95% CI 7.22 to 21.98, $p < .001$) were significant.

Table 3.

Sociodemographic and Clinical Characteristics of Study Population Overall and by Final Diagnosis (N = 857)

| Characteristic | Total | | Abscess | | Cellulitis | | Abscess & Cellulitis | | Other |
|---|---|---|---|---|---|---|---|---|---|
| | ***M*** | ***SD*** | ***M*** | ***SD*** | ***M*** | ***SD*** | ***M*** | ***SD*** | ***M*** |
| Age | 45.65 | 17.17 | 40.69 | 13.61 | 49.60 | 18.55 | 35.00 | 11.00 | 42.83 |
| | ***n*** | ***%*** | ***n*** | ***%*** | ***n*** | ***%*** | ***n*** | ***%*** | ***n*** |
| Gender | | | | | | | | | |
| Female | 282 | 32.9 | 103 | 36.5 | 172 | 61.0 | 7 | 2.5 | 0 |
| Male | 575 | 67.1 | 241 | 41.9 | 316 | 55.0 | 12 | 2.1 | 6 |
| Race | | | | | | | | | |
| White | 129 | 15.1 | 44 | 34.1 | 83 | 64.3 | 1 | 0.8 | 1 |
| Hispanic | 644 | 75.1 | 261 | 40.5 | 360 | 55.9 | 18 | 2.8 | 5 |
| Black, African American | 16 | 1.9 | 10 | 62.5 | 6 | 37.5 | 0 | 0.0 | 0 |
| Asian | 4 | 0.5 | 2 | 50.0 | 2 | 50.0 | 0 | 0.0 | 0 |
| Other Race | 64 | 7.5 | 27 | 42.2 | 37 | 57.8 | 0 | 0.0 | 0 |
| Identified PCP | | | | | | | | | |
| Yes | 353 | 41.2 | 226 | 44.8 | 261 | 51.8 | 13 | 2.6 | 4 |
| No | 504 | 58.8 | 118 | 33.4 | 227 | 64.3 | 6 | 1.7 | 2 |
| Chief Complaint | | | | | | | | | |
| Rash, skin problem[a] | 42 | 4.9 | 13 | 31.0 | 28 | 66.7 | 0 | 0.0 | 1 |
| Insect bite | 53 | 6.2 | 16 | 30.2 | 37 | 69.8 | 0 | 0.0 | 0 |
| Abscess | 341 | 39.8 | 261 | 76.5 | 62 | 18.2 | 14 | 4.1 | 4 |
| Wound infection, wound check | 98 | 11.4 | 17 | 17.3 | 80 | 81.6 | 1 | 1.0 | 0 |
| Pain, swelling to any extremity | 254 | 29.6 | 18 | 7.1 | 231 | 90.9 | 4 | 1.6 | 1 |
| Animal bite, cat bite, dog bite | 8 | 0.9 | 1 | 12.5 | 7 | 87.5 | 0 | 0.0 | 0 |
| Medical clearance | 28 | 3.3 | 9 | 32.1 | 19 | 67.9 | 0 | 0.0 | 0 |
| Other chief complaint[b] | 33 | 3.9 | 9 | 27.3 | 24 | 72.7 | 0 | 0.0 | 0 |

| Characteristic | Total | | Abscess | | Cellulitis | | Abscess & Cellulitis | | Other |
|---|---|---|---|---|---|---|---|---|---|
| | ***n*** | ***%*** | ***n*** | ***%*** | ***n*** | ***%*** | ***n*** | ***%*** | ***n*** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Combined Comorbidities | | | | | | | | | |
| None | 445 | 51.9 | 181 | 40.7 | 255 | 57.3 | 6 | 1.3 | 3 |
| IVDU | 191 | 22.3 | 102 | 53.4 | 78 | 40.8 | 10 | 5.2 | 1 |
| DM | 164 | 19.1 | 36 | 22.0 | 123 | 75.0 | 3 | 1.8 | 2 |
| MRSA | 15 | 1.8 | 12 | 80.0 | 3 | 20.0 | 0 | 0.0 | 0 |
| PVD | 9 | 1.1 | 1 | 11.1 | 8 | 88.9 | 0 | 0.0 | 0 |
| DM + IVDU | 8 | 0.9 | 5 | 62.5 | 3 | 37.5 | 0 | 0.0 | 0 |
| DM + PVD | 7 | 0.8 | 0 | 0.0 | 1 | 100.0 | 0 | 0.0 | 0 |
| MRSA + IVDU | 7 | 0.8 | 0 | 0.0 | 1 | 100.0 | 0 | 0.0 | 0 |
| IVDU + ETOH | 4 | 0.5 | 0 | 0.0 | 1 | 100.0 | 0 | 0.0 | 0 |
| ETOH | 4 | 0.5 | 1 | 25.0 | 3 | 75.0 | 0 | 0.0 | 0 |
| DM + PVD + IVDU | 1 | 0.1 | 0 | 0.0 | 1 | 100.0 | 0 | 0.0 | 0 |
| DM + IVDU + ETOH | 1 | 0.1 | 0 | 0.0 | 1 | 100.0 | 0 | 0.0 | 0 |
| HIV | 1 | 0.1 | 0 | 0.0 | 1 | 100.0 | 0 | 0.0 | 0 |
| Combined Comorbidities & Abnormal Vital Signs[c] | | | | | | | | | |
| None | 285 | 33.3 | 113 | 39.6 | 166 | 58.2 | 3 | 1.1 | 3 |
| HR > 90 bpm | 157 | 18.3 | 68 | 43.3 | 86 | 54.8 | 3 | 1.9 | 0 |
| DM | 105 | 12.3 | 25 | 23.8 | 79 | 75.2 | 1 | 1.1 | 0 |
| IVDU | 98 | 11.4 | 56 | 57.1 | 38 | 38.8 | 3 | 3.1 | 1 |
| IVDU + HR > 90 bpm | 91 | 10.6 | 45 | 49.5 | 39 | 42.9 | 7 | 7.7 | 0 |
| DM + HR > 90 bpm | 58 | 6.8 | 11 | 19.0 | 43 | 74.1 | 2 | 3.4 | 2 |
| MRSA + HR > 90 bpm | 9 | 1.1 | 6 | 66.7 | 3 | 33.3 | 0 | 0.0 | 0 |
| PVD | 8 | 0.9 | 1 | 12.5 | 7 | 87.5 | 0 | 0.0 | 0 |
| DM + IVDU + HR > 90 bpm | 7 | 0.8 | 5 | 71.4 | 2 | 28.6 | 0 | 0.0 | 0 |
| MRSA | 6 | 0.7 | 6 | 100.0 | 0 | 0.0 | 0 | 0.0 | 0 |

| | **Total** | | **Abscess** | | **Cellulitis** | | **Abscess & Cellulitis** | | **Othe** |
|---|---|---|---|---|---|---|---|---|---|
| **Characteristic** | ***N*** | ***%*** | ***n*** | ***%*** | ***n*** | ***%*** | ***n*** | ***%*** | ***n*** |
| IVDU | | | | | | | | | |
| Yes | 212 | 24.7 | 113 | 53.3 | 88 | 41.5 | 10 | 4.7 | 1 |
| No | 645 | 75.3 | 231 | 35.8 | 400 | 62.0 | 9 | 1.4 | 5 |
| DM | | | | | | | | | |
| Yes | 181 | 21.1 | 41 | 22.7 | 135 | 74.6 | 3 | 1.7 | 2 |
| No | 676 | 78.9 | 303 | 44.8 | 353 | 52.2 | 16 | 2.4 | 4 |
| MRSA | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Yes | 22 | 2.6 | 17 | 77.3 | 5 | 22.7 | 0 | 0.0 | 0 |
| No | 835 | 97.4 | 327 | 39.2 | 483 | 57.8 | 19 | 2.3 | 6 |
| PVD | | | | | | | | | |
| Yes | 17 | 2.0 | 1 | 5.9 | 16 | 94.1 | 0 | 0.0 | 0 |
| No | 840 | 98.0 | 343 | 40.8 | 472 | 56.2 | 19 | 2.3 | 6 |
| Heart Rate > 90 bpm | | | | | | | | | |
| Yes | 339 | 39.6 | 140 | 41.3 | 185 | 54.6 | 12 | 3.5 | 2 |
| No | 518 | 60.4 | 204 | 39.4 | 303 | 58.5 | 7 | 1.4 | 4 |
| Temperature > 37.7 | | | | | | | | | |
| Yes | 7 | 0.8 | 1 | 14.3 | 6 | 85.7 | 0 | 0.0 | 0 |
| No | 850 | 99.2 | 343 | 40.4 | 482 | 56.7 | 19 | 2.2 | 6 |
| Combined Treatment | | | | | | | | | |
| PoMed | 486 | 56.7 | 84 | 17.3 | 398 | 81.9 | 0 | 0.0 | 4 |
| IDpoMed | 264 | 30.8 | 241 | 91.3 | 5 | 1.9 | 18 | 6.8 | 9 |
| PoMed + IVmed | 64 | 7.5 | 5 | 7.8 | 59 | 92.2 | 0 | 0.0 | 0 |
| IVmed | 28 | 3.3 | 6 | 21.4 | 21 | 75.0 | 0 | 0.0 | 1 |
| IDpoMed + IVmed | 5 | 0.6 | 5 | 100.0 | 0 | 0.0 | 0 | 0.0 | 0 |
| IDIVmed | 4 | 0.5 | 1 | 25.0 | 2 | 50.0 | 0 | 0.0 | 0 |
| None | 2 | 0.2 | 0 | 0.0 | 1 | 50.0 | 0 | 0.0 | 1 |
| IDonly | 2 | 0.2 | 2 | 100.0 | 0 | 0.0 | 0 | 0.0 | 0 |
| PoMed + IDIVmed | 1 | 0.1 | 0 | 0.0 | 1 | 100.0 | 0 | 0.0 | 0 |
| PoMed + IDpoMed + IVmed + IDIVmed | 1 | 0.1 | 0 | 0.0 | 1 | 100.00 | 0 | 0.0 | 0 |

| | **Total** | | **Abscess** | | **Cellulitis** | | **Abscess & Cellulitis** | | **Othe** |
|---|---|---|---|---|---|---|---|---|---|
| **Characteristic** | ***n*** | ***%*** | ***n*** | ***%*** | ***n*** | ***%*** | ***n*** | ***%*** | ***n*** |
| IDonly | | | | | | | | | |
| Yes | 2 | 0.2 | 2 | 100.0 | 0 | 0.0 | 0 | 0.0 | 0 |
| No | 855 | 99.8 | 342 | 40.0 | 488 | 57.1 | 19 | 2.2 | 6 |
| PoMed | | | | | | | | | |
| Yes | 552 | 64.4 | 89 | 16.1 | 459 | 83.2 | 0 | 0.0 | 4 |
| No | 305 | 35.6 | 255 | 83.6 | 29 | 9.5 | 19 | 6.2 | 2 |
| IDpoMed | | | | | | | | | |
| Yes | 270 | 31.5 | 246 | 91.1 | 6 | 2.2 | 18 | 6.7 | 0 |
| No | 587 | 68.5 | 98 | 16.7 | 482 | 82.1 | 1 | 0.2 | 6 |
| IVMed | | | | | | | | | |
| Yes | 98 | 11.4 | 16 | 16.3 | 81 | 82.7 | 0 | 0.0 | 1 |
| No | 759 | 88.6 | 328 | 43.2 | 407 | 53.6 | 19 | 2.5 | 5 |
| IDIVmed | | | | | | | | | |
| Yes | 6 | 0.7 | 1 | 16.7 | 4 | 66.7 | 1 | 16.7 | 0 |
| No | 851 | 99.3 | 343 | 40.3 | 484 | 56.9 | 18 | 2.1 | 6 |
| Disposition Status | | | | | | | | | |
| Discharged home | 837 | 97.7 | 337 | 40.3 | 476 | 56.9 | 19 | 2.3 | 5 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Admitted to hospital | 20 | 2.3 | 7 | 35.0 | 12 | 60.0 | 0 | 0.0 | 1 |
| Return Visit to ER | | | | | | | | | |
| Yes | 161 | 18.8 | 113 | 70.2 | 46 | 28.6 | 2 | 1.2 | 0 |
| No | 696 | 81.2 | 231 | 33.2 | 442 | 63.5 | 17 | 2.4 | 6 |

*Note.* AVS = Abnormal vital signs; STTI = Skin and soft tissue infection. $\chi^2$ = Pearson's Chi-square unless otherwise specified.

[a] Abrasion, redness, hives, and burn.

[b] Abdominal, chest, or testicular pain, weakness, fever, bleeding, hypertension, high/low blood glucose, and DVT.

[c] Only most frequent unique combination of comorbidities OR comorbidities and abnormal vital signs presented in Table 3, accounting for over 95% of all cases.

[d] Other SSTI includes abrasion, blister, folliculitis, thrombophlebitis, and disorder of the muscle.

[e] Fisher's Exact Test, Monte Carlo Sig. (2-sided).

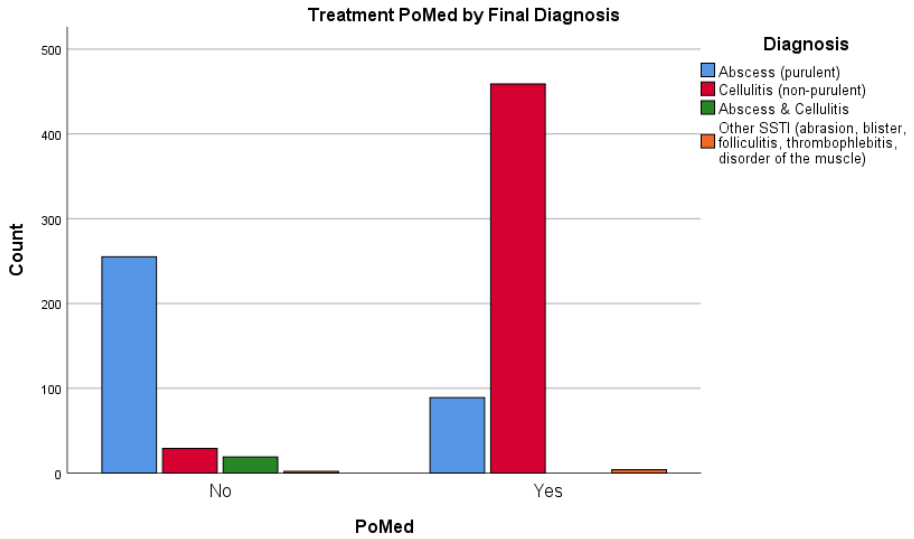



*Figure 3.* Treatment with oral medications to emergency department patients with a skin and soft tissue infection.

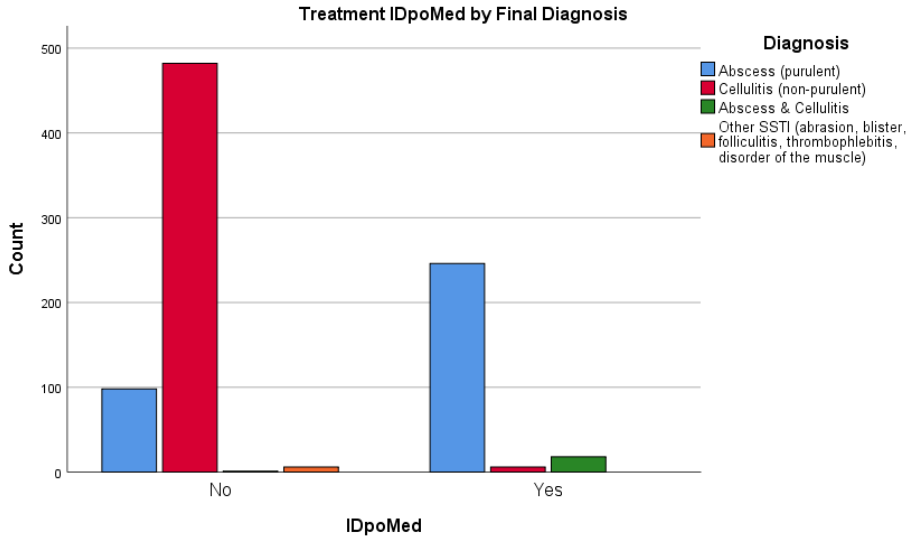



*Figure 4.* Treatment with incision and drainage and oral medications to emergency department patients with a skin and soft tissue infection.

**Patient Disposition**

A chi-square test of independence was conducted examining relationships between patients' disposition and: sociodemographic factors, physical examination findings, treatment modality, final diagnosis, and return visit to the ED (see Table 4). Not all expected cell frequencies were greater than five; Fisher's Exact Tests were reported for variables with expected cell frequencies less than five. There was a significant association between patient's final disposition and: chief complaint, Fisher's $\chi^2 = 13.03$, $p = .036$, *Cramer's V* = .125; diabetes mellitus, Fisher's $\chi^2 = 7.01$, $p = .021$, *Cramer's V* = .090, heart rate greater than 90 bpm, Fisher's $\chi^2 = 10.76$, $p = .002$, *Cramer's V* = .313; comorbidities & abnormal vital signs combined, Fisher's $\chi^2 = 57.20$, $p = .003$, *Cramer's V* = .190; treatment modality: oral medication, Fisher's $\chi^2 = 31.53$, $p < .001$, *Cramer's V* = .192; treatment modality: incision and drainage plus oral medication, Fisher's $\chi^2 = 6.67$, $p = .007$, *Cramer's V* = .088; intravenous medication, Fisher's $\chi^2 = 109.43$, $p < .001$, *Cramer's V* = .357; treatment modality combined, Fisher's $\chi^2 = 125.57$, $p < .001$, *Cramer's V* = .719; and return visit to emergency department, Fisher's $\chi^2 = 4.74$, $p = .021$, *Cramer's V* = .074. The largest significant associations in terms of effect sizes were between disposition status and intravenous medication (*Cramer's V* = .357) and disposition status and oral medication (*Cramer's V* = .192; see Figures 5 and 6).

A one-way ANOVA was conducted to identify if patient's disposition status was different based on age (see Table 4). Patients were classified into two groups: discharged from ED to home and admitted to the hospital. Homogeneity of variances was assessed by Levene's test of homogeneity of variances. Age was significantly different for patients

in term of their disposition status, $F(1, 855) = 6.78$, $p = .009$. Age significantly increased for those admitted to the hospital ($M = 55.50$, SD = 13.95) when compared to those discharged from the ED home ($M = 45.42$, $SD = 17.17$; see Figure 7.

Table 4.

Sociodemographic and Clinical Characteristics of Study Population by Disposition Status (N = 857)

| | **Discharged Home** | | **Admitted to Hospital** | | | |
|---|---|---|---|---|---|---|
| **Characteristic** | ***M*** | ***SD*** | ***M*** | ***SD*** | ***F*** | ***p*** |
| Age | 45.42 | 17.17 | 55.50 | 13.95 | 6.78 | .009 |
| | ***n*** | ***%*** | ***n*** | ***%*** | $\chi^2$ | ***p*** |
| Gender | | | | | 0.08 | .817[e] |
| Female | 276 | 97.9 | 6 | 2.1 | | |
| Male | 561 | 97.6 | 14 | 2.4 | | |
| Race | | | | | 3.18 | .485 |
| White | 126 | 97.7 | 3 | 2.3 | | |
| Hispanic | 630 | 97.8 | 14 | 2.2 | | |
| Black, African American | 15 | 93.8 | 1 | 6.3 | | |
| Asian | 4 | 100.0 | 0 | 0.0 | | |
| Other Race | 62 | 96.9 | 2 | 3.1 | | |
| Identified PCP | | | | | .123 | .819[e] |
| Yes | 344 | 97.5 | 9 | 2.5 | | |
| No | 493 | 97.8 | 11 | 2.2 | | |
| Chief Complaint | | | | | 13.03 | .036 |
| Rash, skin problem[a] | 42 | 100.0 | 0 | 0.0 | | |
| Insect bite | 53 | 100.0 | 0 | 0.0 | | |
| Abscess | 338 | 99.1 | 3 | 0.9 | | |
| Wound infection, wound check | 94 | 95.9 | 4 | 4.1 | | |
| Pain, swelling to any extremity | 245 | 96.5 | 9 | 3.5 | | |
| Animal bite, cat bite, dog bite | 8 | 100.0 | 0 | 0.0 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Medical clearance | 26 | 92.9 | 2 | 7.1 | | |
| Other chief complaint[b] | 31 | 93.9 | 2 | 6.1 | | |
| Combined Comorbidities | | | | | 23.41 | .058 |
| None | 438 | 98.4 | 7 | 1.6 | | |
| IVDU | 188 | 98.4 | 3 | 1.6 | | |
| DM | 156 | 95.1 | 8 | 4.9 | | |
| MRSA | 14 | 93.3 | 1 | 6.7 | | |
| PVD | 9 | 100.0 | 0 | 0.0 | | |
| DM + IVDU | 8 | 100.0 | 0 | 0.0 | | |
| DM + PVD | 7 | 1000 | 0 | 0.0 | | |
| MRSA + IVDU | 7 | 100.0 | 0 | 0.0 | | |
| IVDU + ETOH | 4 | 100.0 | 0 | 0.0 | | |
| ETOH | 4 | 100.0 | 0 | 0.0 | | |

| | **Discharged Home** | | **Admitted to Hospital** | | | |
|---|---|---|---|---|---|---|
| **Characteristic** | ***n*** | ***%*** | ***n*** | ***%*** | $\chi^2$ | ***p*** |
| DM + PVD + IVDU | 0 | 0.0 | 1 | 100.0 | | |
| DM + IVDU + ETOH | 1 | 100.0 | 0 | 0.0 | | |
| HIV | 1 | 100.0 | 0 | 0.0 | | |
| Combined Comorbidities & Abnormal Vital Signs[c] | | | | | 57.20 | .003 |
| None | 284 | 99.6 | 1 | 0.4 | | |
| HR > 90 bpm | 151 | 96.2 | 6 | 3.8 | | |
| DM | 102 | 97.1 | 3 | 2.9 | | |
| IVDU | 97 | 99.0 | 1 | 1.0 | | |
| IVDU + HR > 90 bpm | 90 | 98.9 | 1 | 1.1 | | |
| DM + HR > 90 bpm | 53 | 91.4 | 5 | 8.6 | | |
| MRSA + HR > 90 bpm | 8 | 88.9 | 1 | 11.1 | | |
| PVD | 8 | 100.0 | 0 | 0.0 | | |
| DM + IVDU + HR > 90 bpm | 7 | 100.0 | 0 | 0.0 | | |
| MRSA | 6 | 100.0 | 0 | 0.0 | | |
| IVDU | | | | | 0.25 | .795[e] |
| Yes | 208 | 98.1 | 4 | 1.9 | | |
| No | 629 | 75.1 | 16 | 2.5 | | |
| DM | | | | | 7.01 | .016 |
| Yes | 172 | 95.0 | 9 | 5.0 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| No | 665 | 98.4 | 11 | 1.6 | | |
| MRSA | | | | | 0.49 | .486[e] |
| Yes | 21 | 95.5 | 1 | 4.5 | | |
| No | 816 | 97.7 | 19 | 2.3 | | |
| PVD | | | | | 0.96 | .333 |
| Yes | 16 | 94.1 | 1 | 5.9 | | |
| No | 821 | 97.7 | 19 | 2.3 | | |
| Heart Rate > 90 bpm | | | | | 10.76 | .002 |
| Yes | 324 | 95.6 | 15 | 4.4 | | |
| No | 513 | 99.0 | 5 | 1.0 | | |
| Temperature > 37.7 | | | | | 4.42 | .153 |
| Yes | 6 | 85.7 | 1 | 14.3 | | |
| No | 831 | 99.3 | 19 | 2.2 | | |
| Combined Treatment | | | | | 125.57 | < .001 |
| PoMed | 485 | 99.8 | 1 | 0.2 | | |
| IDpoMed | 263 | 99.6 | 1 | 0.4 | | |
| PoMed + IVmed | 64 | 100.0 | 0 | 0.0 | | |
| IVmed | 11 | 39.3 | 17 | 60.7 | | |
| IDpoMed + IVmed | 5 | 100.0 | 0 | 0.0 | | |
| IDIVmed | 3 | 75.0 | 1 | 25.0 | | |

| | **Discharged Home** | | **Admitted to Hospital** | | | |
|---|---|---|---|---|---|---|
| **Characteristic** | ***n*** | ***%*** | ***n*** | ***%*** | $\chi^2$ | ***p*** |
| None | 2 | 100.0 | 0 | 0.0 | | |
| IDonly | 2 | 100.0 | 0 | 0.0 | | |
| PoMed + IDIVmed | 1 | 100.0 | 0 | 0.0 | | |
| PoMed + IDpoMed + IVmed + IDIVmed | 1 | 100.0 | 0 | 0.0 | | |
| IDonly | | | | | 0.05 | .827[e] |
| Yes | 2 | 100.0 | 0 | 0.0 | | |
| No | 835 | 97.7 | 20 | 2.3 | | |
| PoMed | | | | | 31.53 | < .001[e] |
| Yes | 551 | 99.8 | 1 | 0.2 | | |
| No | 286 | 93.8 | 19 | 6.2 | | |
| IDpoMed | | | | | 6.67 | .007 |
| Yes | 269 | 99.6 | 1 | 0.4 | | |
| No | 568 | 96.8 | 19 | 3.2 | | |
| IVMed | | | | | 109.43 | < .001 |
| Yes | 81 | 82.7 | 17 | 17.3 | | |
| No | 756 | 99.6 | 3 | 0.4 | | |
| IDIVmed | | | | | 5.45 | .132 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Yes | 5 | 83.3 | 1 | 16.7 | | |
| No | 832 | 97.8 | 19 | 2.2 | | |
| Final Diagnosis | | | | | 4.34 | .225 |
| Abscess (purulent) | 337 | 98.0 | 7 | 2.0 | | |
| Cellulitis (non-purulent) | 476 | 97.5 | 12 | 2.5 | | |
| Abscess & Cellulitis | 19 | 100.0 | 0 | 0.0 | | |
| Other SSTI | 5 | 83.3 | 1 | 16.7 | | |
| Return Visit to ER | | | | | 4.74 | .021 |
| Yes | 161 | 100.0 | 0 | 0.0 | | |
| No | 676 | 97.1 | 20 | 2.9 | | |

*Note.* AVS = Abnormal vital signs; STTI = Skin and soft tissue infection. $\chi^2$ = Pearson's Chi-square unless otherwise specified.

[a] Abrasion, redness, hives, and burn. [b] Abdominal, chest, or testicular pain, weakness, fever, bleeding, hypertension, high/low blood glucose, and DVT. [c] Only most frequent unique combination of comorbidities OR comorbidities and abnormal vital signs presented in Table 4, accounting for over 95% of all cases. [d] Other SSTI includes abrasion, blister, folliculitis, thrombophlebitis, and disorder of the muscle. [e] Pearson (2-sided).

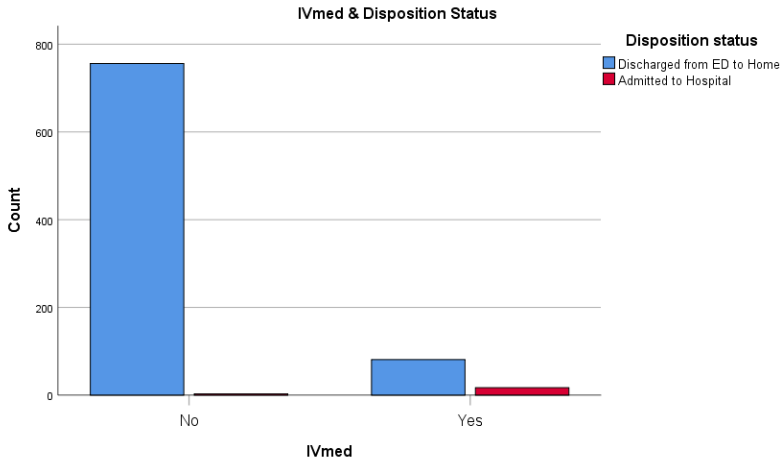



*Figure 5.* Treatment with a parenteral (intravenous) medication for a skin and soft tissue infection and its relationship to patient disposition status.

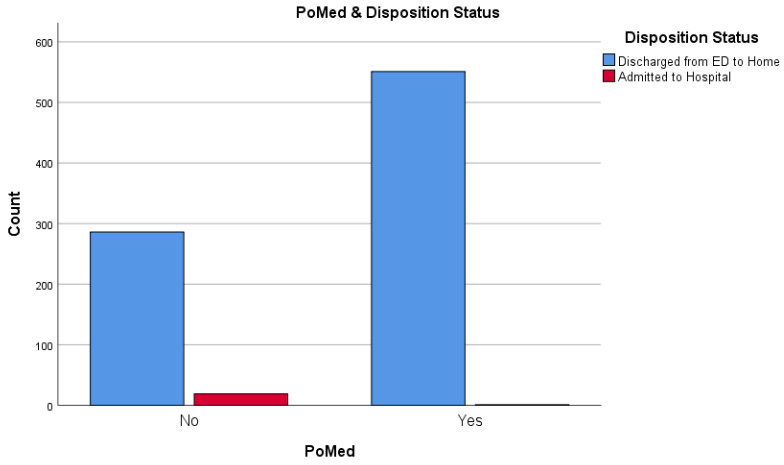



*Figure 6.* Treatment with an oral medication for a skin and soft tissue infection and its relationship to patient disposition status.

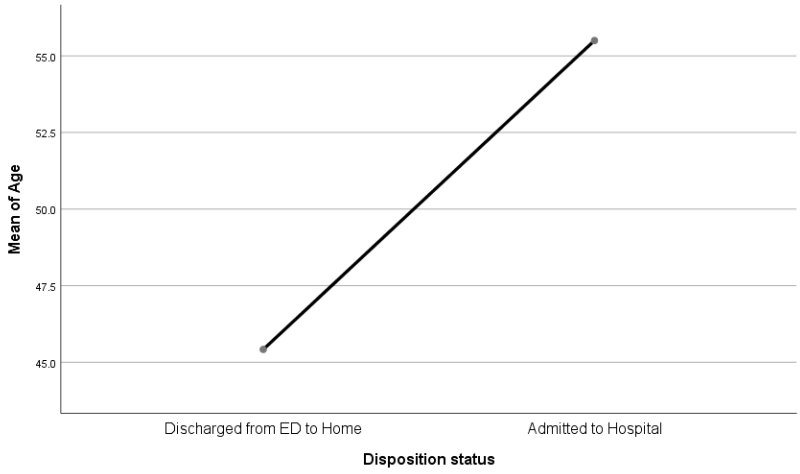



*Figure 7.* Patient's age in years by disposition status.

*Aim 3.* Identify factors that increase the odds of hospital admission at initial presentation for patients with specific sociodemographics, physical examination findings, and treatment modality among patients with non-purulent and purulent SSTI who presented for treatment in a high-volume rural ED.

**Predicting Patient Disposition**

The size of the group admitted to the hospital was small (n=20). As a result, there was insufficient power to conduct a traditional logistic regression.

Exploratory analysis

Firth (penalized likelihood) logistic regression was used to account for the small-sample bias since being admitted to the hospital was a rare event (Cole et al., 2014). . All variables significant at the $p < .05$ in the bivariate analysis were considered for entry into the model. The following variables were entered: age, diabetes mellitus, heart rate greater

than 90 bpm, prescription for oral medication, incision and drainage treatment plus prescription for oral medication, and intravenous medication. The significant factors that increased the risk of being admitted to the hospital included age (*Adj. OR* = 1.06, 95% CI 1.00 - 1.12, $p < .001$), and a heart rate greater than 90 bpm (*Adj. OR* = 10.94, 95% CI 2.42 - 71.46, $p = .001$). Being treated with a prescription for oral medication (*Adj. OR* = 0.004, 95% CI 0.00 – 0.15, $p < .001$), and an incision and drainage treatment plus an oral medication (*Adj. OR* = 0.02, 95% CI 0.00 – 0.15, $p < .001$) decreased the risk for hospitalization (see Table 5).

Table 5.

Summary of Firth (Penalized Likelihood) Logistic Regression Analysis Predicting Disposition Status (N = 857)

| Variable | *B* | *SE* | *OR* | 99% CI | *Chi-Square* | *p* |
|---|---|---|---|---|---|---|
| Age | 0.05 | 0.02 | 1.06 | [1.00, 1.12] | 4.61 | .032 |
| Diabetes Mellitus | 0.49 | 0.75 | 1.63 | [0.33, 8.00] | 0.38 | .540 |
| Heart Rate > 90 bpm | 2.39 | 0.79 | 10.95 | [2.42, 71.46] | 10.52 | .001 |
| PoMed | -5.50 | 1.05 | 0.004 | [0.00, 0.03] | 52.81 | < .001 |
| IDpoMed | -4.10 | 1.11 | 0.02 | [0.00, 0.15] | 14.26 | < .001 |
| IVMed | 1.09 | 0.87 | 2.97 | [0.49, 19.47] | 1.41 | .024 |
| | | | | *RL*(6) = -23.54, $p < .001$ | | |

*Note.* CI = Confidence interval for odds ratio (OR). IDpoMed = Incision and drainage, plus oral medication; IVmed = Intravenous medication; PoMed = Oral medication; RL = Restricted Likelihood Ratio Test

# Chapter V

# DISCUSSION

Skin and soft tissue infections are commonly treated and managed in the emergency department. A comprehensive understanding of the patient, including his/ her demographic information, outpatient follow- up access, physical examination findings, and past medical history, is imperative to optimal treatment and management. The purpose of this study was to examine relationships among sociodemographics, physical examination findings, and treatment modality and management in patients with SSTIs. In this chapter, the results, study limitations, and implications for nursing practice will be presented.

The web of causation theoretical framework informed this study as it posits that associations between events, the cause, and the impacted unit follow a non- linear approach which is exemplified in the conceptual framework of this study. This comprehensive methodology is useful when exploring a large number of cases in a means to identify commonalities and differences, and it provides a vehicle of explanation for the treatment and management of a disease (Ventriglio, Bellomo, & Bhugra, 2016). In this study, the web of causation echoed the intricate balance of multiple factors that influence care for all emergency department patients, including those with skin and soft tissue infections. Understanding these factors is necessary to a comprehensive and thorough approach to care.

**Synthesis of Findings for Research Aims**

This research study addressed the following specific aims to assist in the characterization of patients with skin and soft tissue infections who present to the emergency department:

Aim 1. Describe sociodemographics, physical examination findings, treatment modality, patient disposition (i.e. hospital admission or ED discharge at initial presentation), and reason for return visit to the ED among patients with non-purulent and purulent SSTI who presented for treatment in a high-volume rural ED.

Aim 1a. Sociodemographics, Clinical Characteristics, and Treatment Modality by Final Diagnosis

Aim 1b. Sociodemographics, Clinical Characteristics, and Treatment Modality by Disposition Status

Aim 2. Examine the relationships among sociodemographics (age, gender, established PCP, race/ethnicity, education level) physical examination findings (i.e. HR> 90 bpm, temperature > 37.7 C, treatment modality (i.e. incision and drainage, oral medication, or parenteral medication), patient disposition (i.e. hospital admission or ED discharge at initial presentation) and reason for return visit to the ED among patients with non-purulent and purulent SSTI who presented for treatment in a high-volume rural ED.

Aim 2a. Relationships among Sociodemographics, Clinical Characteristics, and Treatment Modality by Final Diagnosis

Aim 2b. Relationships among Sociodemographics, Clinical Characteristics, and Treatment Modality by Final Disposition

Aim 3. Identify factors that increase the odds of hospital admission at initial presentation for patients with specific sociodemographics, physical examination findings, and treatment modality among patients with non-purulent and purulent SSTI who presented for treatment in a high-volume rural ED.

All aims were met, and the research findings are reviewed below.

## Relationships among Sociodemographic, Clinical Characteristics, and Treatment Modality

The challenges surrounding SSTI treatment and management echo the multifaceted approach to care, which include concerns for lack of clinical practice guidelines compliance, antibiotic stewardship, and recognition of how sociodemographic information adds to the risk stratification of each patient. This study examined the relationships between sociodemographic indicators, clinical characteristics, and treatment modality, and how it may impact the final diagnosis and emergency department disposition.

### Final Diagnosis

The largest significant associations in terms of effect sizes were between final diagnosis and treatment modality of an oral medication and final diagnosis and incision and drainage plus oral medication with the largest adjusted residuals for cellulitis group for both. Consistent with the IDSA guidelines, these findings demonstrate an adherence to the national recommendations (Stevens et al., 2014). Unexpectedly, the treatment of an

abscess with incision and drainage only was not found to be significant despite the proposed management being the first line treatment for abscess (Stevens et al., 2014). Instead, these findings attest to the increased variability and lack of adherence to the national guidelines that has been previously noted (Kamath et al., 2018; Walsh et al., 2016; Yadav et al., 2017). The variability may also account for provider preference and insight that is not reflective in the clinical characteristics of the patient nor in the proposed national guidelines (Jenkins et al., 2014; Wang et al., 2018). Most notably, the importance of sociodemographic information that may or may not have been included in the record can have a more significant impact on the ultimate plan of care of each SSTI patient.

**Patient Disposition**

The relationships between patient's disposition and sociodemographic factors, physical examination findings, treatment modality, final diagnosis, and return visit to the ED were also examined. The largest significant associations in terms of effect sizes were between disposition status and intravenous medication and disposition status and oral medication. Age also significantly increased for those who were admitted compared to those who were discharged from the ED home. These findings are consistent with previous studies reporting similar results (Almarzoky Abuhussain et al., 2018; Jenkins et al., 2010; Talan et al., 2015). The information also echoes practice compliance with the IDSA guidelines (Liu et al., 2011; Stevens et al., 2014). In particular, patients who are considered to be low risk and can reasonably be managed as an outpatient should receive oral medication only, in contrast those who are higher risk and potentially may have

poorer outcomes should be admitted and treated with intravenous antibiotics as the guidelines suggest. Similarly, an increase in age also poses a risk for potential complications and a highly likelihood of comorbidities.

**Predicting Patient Disposition**

In order to identify the effects of patient sociodemographic characteristics, comorbidities, physical examination findings, and treatment modality on the likelihood patients are admitted to the hospital, a Firth (penalized likelihood) logistic regression was conducted. All significant variables- age, diabetes mellitus, heart rate greater than 90 bpm, prescription for oral medication, incision and drainage treatment plus prescription for oral medication, and intravenous medication- were incorporated into the model. Age and heart rate greater than 90 bpm were significant factors that increased the likelihood and risk of being admitted to the hospital. This finding is consistent with the literature (Almarzoky Abuhussain et al., 2018; Guterman et al., 2016; Sabbaj et al., 2009; Talan et al., 2015); however, it should be noted an elevated heart rate without documented fever may be indicative of other etiologies. For example, it was recorded that 22% of the population reported a history of intravenous drug use; however, the specific type of drug use was not noted. If the patient was under the influence of a stimulant at the time of the evaluation, this may have certainly accounted for the increased heart rate. Similarly, some patients with multiple comorbidities may be on medications that have an effect on the individual's heart rate, thus resulting in potentially non- organic findings. The decreased risk of hospitalization was found with patients who received a prescription for

oral medications and those who had an incision and drainage plus oral medication. These findings are not only consistent with the literature (Almarzoky Abuhussain et al., 2018; Jenkins et al., 2010; Talan et al., 2015), but are also reflective of the national guidelines (Stevens et al., 2014).

**Sociodemographics**

Sociodemographic information provided a robust understanding of a study's population, but it also provides insight into social determinents that may play a vital role in the individual's health outcomes. In addition, the socioeconomic environment shapes the resources and opportunities available to the individual which can ultimately drive care and compliance. These qualities and accessibility directly influence a positive or negative impact on the health outcome of the individual. In this study, sociodemographic factors, including age, gender, and race/ ethnicity, were examined. The information provided a detailed analysis of a relatively homogeneous population. Findings were consistent with national census data and adequately reflected the population. The average age of participants in this study was consistent with the average age of individuals with SSTIs in the literature (Ray, Suaya, & Baxter, 2013); however, males were more represented in this population than females. This finding is not supported by the literature as the risk for a SSTI is not influenced by gender.

In addition to the conventional sociodemographic factors, proxy variables were utilized as a measure to assess for patient characteristics that may influence health outcomes. In particular, access to a primary care provider and patient educational level

were identified as proxy variables to represent a patient's ability and accessibility to follow up and to adhere to the plan of care. These factors represented two important contributors to the social determinents of health of this population. Unfortunately, the patient's educational level was never recorded in the electronic health record; therefore, the information could not be analyzed. Only 41% of the total population reported an identified primary care provider. The potential for a lapse in continuity and accessibility to care for the remaining 59% may have resulted in return visits to the ED. This information also may have influenced the ultimate disposition of the patient and played a role in the medical decision making for the provider. For example, if two patients present with similar mild to moderate presentations of a SSTI, yet one patient does not have accessibility to a primary provider and/ or does not have the ability to be adherent to the plan of care, it is logical to assume that this may influence the health care provider's tendency and preference to admit this patient. On the other hand, the same patient who has identified a PCP and demonstrates an ability to adherence may be discharged to home.

## Limitations and Strengths of the Study

This study had several limitations. This retrospective study was susceptible to all potential biases consistent with this type of inquiry, including missing, incomplete, or erroneous data. The use of an electronic health record (EHR) exemplified the opportunity to enhance patient care, facilitate research, and evaluate performance measures in clinical practice (Cowie et al., 2017). However, along with the utilization of an EHR provided the opportunity for multiple individuals to contribute to the same medical record, which

opens the opportunity for human error. Though incomplete and missing data was minimal during this study's data collection, it is possible some data may have been primarily recorded incorrectly. Furthermore, data collected from electronic health records may have inherent error related to the potential for recording errors and lack of interrater reliability. The limitations of retrospectively reviewing a secondary data source did not provide for an opportunity to further investigate the medical record for missed or incomplete data, including educational status.

To potentially further challenge the documentation process, some records included the utilization of scribes who assisted the provider with documentation. Though the implementation of scribes helps to increase the productivity of the provider, it may also create a potential for missed documenation and/ or medical decision making process. The scribe is an unlicensed individual whom may not be able to convey the exact critical thinking and decision making of the provider. The main purpose of a scribe is to decrease provider cognitive load and allow for the provider to spend more time focusing on the patient and develop a personable patient to provider rapport (Heaton et al., 2019; Walker et al., 2019). The potential for missed data may have been demonstrated by the fact that some charts had incomplete information, including pertinent subjective and objective history as well as procedure note documentation. Furthermore, the provider's medical decision making was limited.

One strength of this study was the large sample size and data available from one rural hospital over two years. Though the large sample provided ample information, the numbers of those admitted to the hospital was small (n=20). As a result, there was

insufficient power to conduct a traditional logistic regression. A Firth Logistic Regression designed to analysis rare events was used. Nonetheless results must be interpreted with caution due to the unique characteristics and homogeneity of the sample. In particular, the population was largely represented by one ethnicity and culture; specially 85% were Hispanic. Although the data from the EHR did not consistently note whether or not an interpreter was utilized nor needed, the potential for misinterpration or misrepresentation of data was noted. Cultural barriers and facilitators of health care use, from the perspective of the patient, should be studied further in order to understand a comprehensive perspecitive of the treatment and management of all patients with SSTIs who present to the ED. Despite these limitations new knowledge has been gained in understanding patient presentation in the ED with SSTI, treatment, and health outcomes.

## Implications

### Practice and Education

The Infectious Disease Society of America has established national guidelines for the treatment and management of individuals with skin and soft tissue infections. Although risk factors have been identified, there are limited studies within the rural community as most studies were conducted at large teaching facilities in metropolitan areas (Pallin et al., 2008; Talan et al., 2015; Walsh et al., 2016). It is important to evaluate rural populations for disease risk as often times these communities are of lower socioeconomic status and are at risk of limited access to appropriate medical treatment and care (Khabbaz et al., 2014; Lantz & Pritchard, 2010). Individuals of lower socioeconomic status are also less likely to have an established primary care provider and

thus unable to seek medical attention early and follow up care afterwards. This potential lack of access results in the individual being more likely to be at risk for increased complications, including hospitalization, outpatient treatment failure, and readmission (Ray et al., 2013). The findings from this study within the rural community support the current literature, including the identified risk factors and current clinical practice guidelines, thus supporting the incorporation and consideration of sociodemographic factors and social determinents of health as a mainstay in standardized care within all communities. Although it is impossible to standardize every aspect of care, it is recommended that health care providers consistently incorporate a comprehensive history, including availability of access to follow up care, while establishing their informed clinical decision making. This standardization will optimize patient outcomes.

Emergency department health care providers serving rural populations must define their practice of care in a broad and comprehensive approach that is reflective of the needs of their population. Clinicians should incorporate culturally and linguistically appropriate care, including translation services and teaching materials in the preferred language. In addition, the support and incorporation of case management providers to ensure adequate follow up care should be considered with all patients with SSTIs. This continuity of care creates a strong supportive foundation for the patient to have optimal outcomes.

**Research**

Future research investigating the relationship between patient characteristics, physical examination findings, and treatment and management of patients with SSTIs

should incoporate the utilization of data extracted from an EHR as well as qualitative information from the perspective of the provider and the patient. This information will provide insight into the complexity of the management and disposition of these patients. Furthermore, it will fill a gap in the literature which addresses the patient's needs as well as the provider's medical decision making process outside of the established guidelines. Though utilizing EHR data in clinical research presents several challenges related to a lack of standardization and potential for missing data, the expansion of standardized fields and incoporation of clinical guidelines into the EHR may overcome this barrier. Overall, understanding the relationship between sociodemographic and socioeconomic characteristics, physical examination findings, and treatment and management of patients with SSTIS could lead to more defined and comprehensive national clinical practice guidelines, and emergency department clinicians are well positioned to lead a new approach to care with respect to patients with SSTIs.

**Future Research**

Future research within the rural Latino community may present multiple challenges, including those that are reflective of the basic and fundamental identity of the population. Researchers must explore language barriers, unconscious bias, stereotyping, gender bias, racism, and even bias associated with whether a person is a legal U.S. citizen or not (White & Stubblefield-Tave, 2017). Language, in particular, is a tremendous part of an individual, and understanding the role of language within the culture is paramount to understanding the population as a whole. It is absolutely critical for researchers to be culturally and linguistically knowledgeable about the proposed population in order to

adequately inform their research, establish appropriate protocols, and disseminate the information in a practical and respectful manner (Meuter et al., 2015). This understanding of how to mitigate language barriers is essential for health care providers and researchers worldwide.

Overall, language may affect participant- researcher relationships in a multitude of ways. For example, with a language barrier, the recruitment process may be difficult, the consent process may be hindered, and the dissemination of the study results may be impossible. One study that surveyed the Spanish- speaking caregivers of children with chronic illnesses concluded that language barriers negatively impact the quality of the informed decision making and care experience (Zamora et al., 2016). Another study by Sanchez and Vargas (2016) emphasized that simply translating research materials may not be enough to overcome this barrier; instead, considering a true understanding of the language and context is imperative. The first step to overcoming and addressing this potential barrier is to anticipate and recognize the importance of language within your proposed population, then to develop research methods and a theoretical framework that will guide the research (Meuter et al., 2015). Schwei et al. (2016) further describes the solution by suggesting that researchers should document how language influences patient outcomes, evaluate cost effectiveness of providing linguistically competent care, and provide evidence for interventions that alleviate language barriers (Schwei et al., 2016).

## Conclusion

Skin and soft tissue infections are one of the most common chief complaints for emergency department patients. These infections can vary in presentation, treatment,

management, and potential for complication. Healthcare providers play an important role in mitigating these variances in care through the implementation and adherence to national guidelines that address not only the physical examination findings and treatment of the patient but also the sociodemographic characteristics of the patient that may predispose him/ her to a higher risk of complication and poor health outcomes.

This study found it is important to consider all significant variables- age, past medical history and comorbidities, heart rate, and management- when evaluating and treating a patient with a skin and soft tissue infection. Notably, age and heart rate greater than 90 bpm were significant factors that increased the likelihood and risk of being admitted to the hospital. The findings were consistent with the literature (Almarzoky Abuhussain et al., 2018; Guterman et al., 2016; Sabbaj et al., 2009; Talan et al., 2015) and support a comprehensive approach to skin and soft tissue infection management. Future studies are needed to identify qualitative factors from the patient and provider perspective that may influence adherence to the guidelines and treatment plan. Understanding the many layers of presentation, treatment, and management provides health care clinicians with the confidence to comprehensively address each patient.

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# APPENDIX A

## USD Institutional Review Board Approval


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