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Risk Factors Associated With Community-Onset Sepsis in Latino/ Hispanic Adults

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This is to certify that the doctoral study by

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Walden University
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Abstract

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MPH, University of Northern Colorado, 2002

BS, Pacific University, 1997

Doctoral Study Submitted in Fulfillment

of the Requirements for the Degree of

Doctor of Public Health

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Abstract

Sepsis results in a significant public health burden globally, causing 20% of adult mortality worldwide and accounting for more than one third of deaths in hospitalized adults in the United States, making it one of the top 15 leading causes of death in the United States. Community-onset sepsis (COS) comprises nearly 80% of all sepsis cases occurring in the United States each year. Despite the widespread prevalence of COS, significant gaps in knowledge exist regarding the risk factors that lead to COS and sepsis mortality in Latino/Hispanic adults in the United States. The purpose of this secondary data study was to examine the relationship between diabetes, obesity, age, gender, and socioeconomic status with COS in 1,794 Latino/Hispanic adult patients aged 50 years and older presenting to the emergency departments of a large, multistate, health care system in Arizona and Colorado. Whether these variables predict mortality related to COS in the study population was also evaluated in the study. The Andersen behavioral and access to health care model comprised the theoretical framework for this quantitative, descriptive, correlational study utilizing a secondary data set. Using bivariate logistic regression for analysis, no significant association between COS and diabetes, obesity, age, gender, and socioeconomic status were found. However, multiple logistic regression showed that diabetes and gender were predictive of mortality risk. Use of the study results may help develop positive social change by understanding the actual burden of sepsis in Hispanics in the US, how the risk factors may differ, and the relationship of these risk factors with mortality, and may be used to inform prevention strategies for this specific population that comprises nearly one fifth of the United States population.

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Section 1: Foundation of the Study and Literature Review

Sepsis results in a significant public health burden globally, with treatment costs of $17 billion per year in the United States alone (Tsertsvadze et al., 2016). Additionally, one third of affected adults die (Centers for Disease Control and Prevention [CDC], 2016), making sepsis one of the leading causes of death in the United States (Rhee et al., 2017). While sepsis mortality has declined due to the focus on early identification and treatments in recent years (Rhee et al., 2017), sepsis incidence continues to increase 8%–13% annually (Tsertsvadze et al., 2016).

Sepsis occurs when an infection is accompanied by at least one systemic inflammatory response, including fever, increased heart rate, hyperventilation, or an elevated white blood cell count and, when severe, may result in the dysfunction or failure of one or more organ systems and death (Tsertsvadze et al., 2016). Sepsis can develop during a patient's hospital care, referred to as hospital-onset sepsis, or present when the patient arrives for care, referred to as community-onset sepsis (COS; Tsertsvadze et al., 2016). The definition of COS is somewhat inconsistent in the literature; however, it is generally accepted that infection, or in this case sepsis, is considered community-onset when symptoms are present within 72 hours of arrival to the hospital (Rhee et al., 2019).

Many infections have been associated with an increased risk of developing sepsis, including respiratory infection, intraabdominal infection, urinary tract infection, and skin and soft tissue infection (Novosad et al., 2016). Novosad et al. (2016) found that 97% of adult patients with sepsis had at least one comorbidity putting them at an increased risk of infection, with diabetes being the most common comorbid condition at 35%. Other risk

factors that may contribute to the development of sepsis include age, gender, obesity, and socioeconomic status (Santos et al., 2020).

As with many diseases, the disparity in sepsis outcomes exists for different racial groups (Dimeglio et al., 2018) and based on socioeconomic status (SES), specifically being uninsured (Kahn, 2018). According to Dimeglio et al. (2018), sepsis-related morbidity and mortality are higher in non-White racial groups due to patient factors, such as a higher incidence of comorbidities and SES; community factors, such as access to health care, including preventive services; and hospital factors, including quality of care.

In this section, I provide the background of and the need for this study, the research questions and hypotheses that were addressed, a review of the theoretical framework, a synthesis of relevant literature, and study limitations.

Background

The recognition of sepsis as a public health concern began nearly 20 years ago with effective campaigns developed that targeted early recognition and standardized treatment protocols within hospitals (CDC, 2016). Yet, the actual public health burden of sepsis globally is still likely underestimated. Reinhart et al. (2017) found that the global incidence of more than 30 million cases of sepsis per year is significantly undercounted given the lack of data from low- and middle-income countries that account for a majority of the world's population. While approximately one third of patients who die within the hospital have a sepsis diagnosis, the vast majority of these patients had the onset of their sepsis in the community (Fay et al., 2020). With estimates of COS ranging from 70%–90% of total sepsis cases (Fay et al., 2019; Novosad et al., 2016; Reinhart et al., 2017),

the criticality of identifying the risk factors for COS to inform targeted prevention strategies is apparent.

The morbidity and mortality associated with sepsis are significant, with patients who develop sepsis experiencing prolonged hospitalizations, approximately 20% requiring skilled nursing or long-term care following their acute hospitalization, and another 25% of septic patients dying (Novosad et al., 2016). Morbidity associated with sepsis can be relatively short-term or very long-term, including prolonged hospitalizations, deconditioning resulting in the need for skilled nursing or long-term care following the acute hospitalization, longer-term organ dysfunction, and even lasting cognitive decline (Tsertsvadze et al., 2016).

In addition to the morbidity and mortality burden, sepsis has a high financial burden. According to Novosad et al. (2016), sepsis care cost a staggering $23.7 billion in the United States in 2013, and Dimeglio et al. (2018) found the inpatient costs were even higher at nearly $38 billion annually. Sepsis care is the costliest of all conditions in the United States, with an average cost twice that of the next highest condition, averaging $18,244, and a high of more than $51,000 per hospitalization (Paoli et al., 2018). Roughly 47% of these septic patients were Medicare insured, translating to an annual treatment cost of more than $11 billion to Medicare (Paoli et al., 2018).

Problem Statement

Nearly 80%, or 1.36 million, of sepsis cases occurring in the United States each year had onset in the community before presenting to the emergency department or hospital (Novosad et al., 2016). Despite the widespread existence of COS, significant

gaps in knowledge regarding the risk factors that lead to sepsis are complicated by the lack of a national reporting requirement, standardized definitions, and the variance in data capture methods and clinical documentation (Reinhart et al., 2017; Tsertsvadze et al., 2016).

Various studies have demonstrated an increased risk of sepsis based on age, gender, race/ethnicity, and various comorbid conditions (Tsertsvadze et al., 2016); however, the study of these associations specifically with COS in Latino/Hispanic adults is lacking. Corl et al. (2019) found that race/ethnicity was associated with the degree of improvement with implementing groups of sepsis care and prevention strategies or "bundles" for COS at hospitals in New York, with White patients demonstrating higher rates of improvement than Black patients. While the study included Hispanic patients as well as White and Black patients, the relatively low percentage of Hispanic patients resulted in the researchers' inability to characterize sepsis trends in this population (Corl et al., 2019).

Socioeconomic factors are well known to play a contributing role in many public health problems; however, they only partially explain the variability seen in sepsis (Moore et al., 2017). Walkey et al. (2015) found that 11% of all adult hospitalizations due to infection occurred among Hispanics. According to the Pew Research Center (2017), the United States Latino/Hispanic population reached 58 million and accounted for more than half of the population growth since 2000. Nationally, Latinos/Hispanics account for roughly 18% of the population; however, within Arizona and Colorado, they comprise 31% and 21% of the population, respectively (Pew Research Center, n.d.). Despite

Latinos/Hispanics comprising such a large percentage of the U.S. population, there appear to be no studies to date that have evaluated COS risk factors in this population. I filled this gap with the current study by determining the risk factors for COS in Latino/Hispanic adults age 50 years and older presenting to the emergency department in a large, multistate, health system.

Purpose of the Study

The purpose of this study was to examine the relationship, if any, of diabetes, obesity, age, gender, and SES with COS in Latino/Hispanic adult patients aged 50 years and older who presented to the emergency departments of a large, multistate, health care system in Arizona and Colorado. Additionally, I evaluated whether diabetes, obesity, age, gender, and SES predicted mortality related to COS among the same population. Novosad et al. (2016) found that 97% of patients with sepsis had at least one underlying health condition, such as diabetes, with slightly higher rates of sepsis in males and a median age of 69 years. Similarly, Tsertsvadze et al. (2016) found that age, waist circumference, and underlying chronic conditions were risk factors for COS; however, the availability of quality studies specific to risk factors for COS versus sepsis, in general, are scarce.

Research Questions and Hypotheses

This study was guided by the following research questions and hypotheses:

RQ1: To what extent are diabetes, obesity, age, gender, and SES associated with COS in Latino/Hispanic adult patients aged 50 years and older presenting to the

emergency departments of a large, multistate, health care system in Arizona and Colorado between 2017 and 2019?

$H_0$1: There are no statistically significant associations between diabetes, obesity, age, gender, and SES with COS in Latino/Hispanic adult patients aged 50 years and older in Arizona and Colorado.

$H_1$1: There are statistically significant associations between diabetes, obesity, age, gender, and SES with COS in Latino/Hispanic adult patients aged 50 years and older in Arizona and Colorado.

RQ2: Do diabetes, obesity, age, gender, and SES predict mortality in Latino/Hispanic adult patients aged 50 years and older with COS presenting to the emergency departments of a large, multistate, health care system in Arizona and Colorado between 2017 and 2019?

$H_0$2: Diabetes, obesity, age, gender, and SES do not predict mortality in adult Latino/Hispanic patients aged 50 years and older with COS in Arizona and Colorado.

$H_1$2: Diabetes, obesity, age, gender, and SES predict mortality in adult Latino/Hispanic patients aged 50 years and older with COS in Arizona and Colorado.

Theoretical Framework

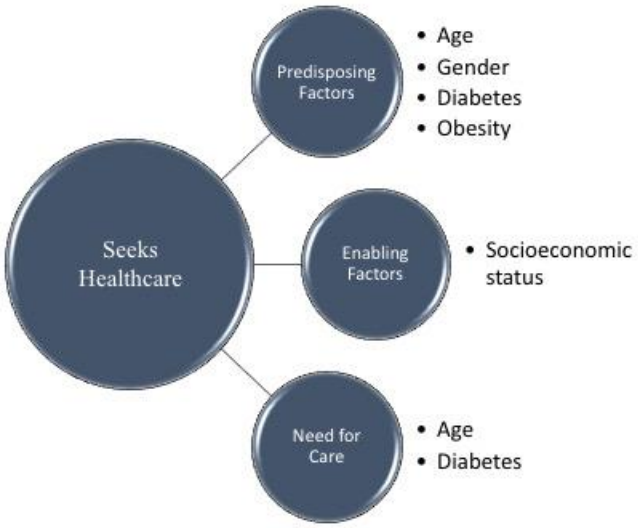
This study was guided by the Andersen (1995) behavioral and access to health care model that originated in 1968 and has gone through some revisions. In the model, Andersen stated that predisposing, need, and enabling factors not only influence if a

person seeks health care but are useful in understanding the association of predictive risk factors with outcomes. Predisposing conditions were defined as having an existing health condition that causes an individual to seek care, enabling conditions as those that either prevent or result in the individual seeking care, and need conditions as those circumstances that most individuals see as requiring medical care.

In the revised model, Andersen (1995) also considered the equitable or inequitable access to health care and its influence on health outcomes. This model aligned particularly well with this study in that the risk factors being evaluated included age, gender, obesity, and diabetes as predisposing factors and SES as an enabling factor. Additionally, this model was relevant to this study because it addressed health disparities in ethnic minorities, such as Hispanics/Latinos, and the impact on their health outcomes. Figure 1 demonstrates how the variables in this study align with the constructs of the Andersen model. Age and diabetes may serve as both predisposing and need for care factors, depending on whether the individual's diabetes is well controlled and what other age-related comorbid conditions exist that were not considered in this study but may drive an individual to seek health care.

Figure 1

Application of the Andersen Model to Community Onset Sepsis Risk Factors in Hispanic/Latino Adults



Note. Adapted from "Revisiting the Behavioral Model and Access to Medical Care: Does it Matter?," by R. M. Andersen, 1995, *Journal of Health and Social Behavior, 36*(1), 1–10 (https://doi.org/10.2307/2137284).

Nature of the Study

In this quantitative, descriptive, correlational study, I analyzed secondary data to determine if there is an association between diabetes, obesity, age, gender, and SES with COS in Latino/Hispanic adults aged 50 years and older in Arizona and Colorado. I also ascertained if these risk factors could predict mortality in the study population.

I obtained the secondary data set from a large, nonprofit health system's electronic medical record (EMR) data warehouse in a de-identified format. Access to the

data set for this study was secured because I was employed by the health system at the time of the study. The data set included data elements for Latino/Hispanic adult patients who presented to the health system's emergency departments in Arizona and Colorado with sepsis between 2017 and 2019. Data elements included demographics, diabetes status, weight, height, body mass index (BMI), age, gender, payor source as a proxy for SES, and discharge disposition to determine mortality.

Literature Review

Introduction

In this section, I present findings from recent studies on sepsis, risk factors for COS, and sepsis mortality, with a specific focus on differences amongst racial and ethnic minority groups and, in particular, the Hispanic/Latino population. The literature is synthesized regarding the relationships between COS and demographic factors (i.e., age and gender), comorbidities (i.e., obesity and diabetes), and SES among Hispanic/Latino adult patients 50 years of age and older. Previous studies have focused more on the early identification and treatment of sepsis in hospitals, with the goal of reducing mortality (Novosad et al., 2016). Similarly, most studies that have evaluated the risk factors for sepsis have also been focused on risk factors associated with hospital-onset sepsis, with relatively few studies addressing prehospital risk factors or risk factors in Hispanics/Latinos. This has resulted in a gap in the literature relative to the possible risk factors examined in this study. My aim in this study was to identify the risk factors for COS in Hispanic/Latino adult patients in the United States. Additionally, I evaluated

whether these potential risk factors predicted mortality relative to COS in the study population. The Andersen model was utilized as the theoretical framework for this study.

Literature Search Strategy

I searched for relevant literature via the Walden University Library in the Thoreau Multi-Database search tool, the Cinhal and Medline combined search tool, Sage Journals, ProQuest Nursing & Allied Health database, and Embase. Additionally, Google Scholar was used to ensure a complete search of the literature. Keyword search terms used included *sepsis, community-onset sepsis, septic shock, severe sepsis, risk factors, predisposing factors, Hispanics, Latino,* and *Latina*. I further limited the searches by excluding all results related to COVID-19, coronavirus, 2019-ncov, sars-cov-2, cov-19, pediatric, child, children, infant, or adolescent. Additionally, searches were limited to peer-reviewed, scholarly articles published from 2016 through 2021. Several seminal articles that were published before 2016 were also included to ensure an exhaustive review of the literature.

Theoretical Framework

The Andersen (1968) healthcare utilization model (i.e., Andersen model) originated in the 1960s, aiming to provide factors believed to predict health care utilization. Having been through a number of revisions over the years, the 1995 Andersen model is described in this section along with a review of research utilizing the Andersen model that points to the relevance of the model as a framework for determining risk factors for sepsis in the Hispanic/Latino population. The 1995 iteration of the Andersen model is the most cited in the literature (Babitsch et al., 2012), and while there is no

available literature utilizing the Andersen model in sepsis or COS specifically, justification of the model is provided herein.

Andersen purported that health care utilization is determined by three factors occurring at the individual or contextual level (Babitsch et al., 2012). The three factors are predisposing, enabling, and needs-based factors (Andersen, 1995). When these factors occur at the contextual level, they are more at the community level and include social norms and environmental influences (Andersen, 1995). This study focused on the individual-level factors that determine sepsis care.

Predisposing factors include largely demographic indicators, such as age, gender, race/ethnicity, education, occupation, and even existing health beliefs (Andersen, 1995). These predisposing factors are believed to shape an individual's beliefs and attitudes toward seeking health care services (Babitsch et al., 2012). Enabling factors are those conditions that either facilitate the use of health care services or are a barrier to their use and may include things such as income, health insurance, transportation, and even time available to travel to and from said services (Andersen, 1995; Babitsch et al., 2012). Lastly, needs-based factors are those individual perceptions regarding the need for medical care and treatment, both as perceived in the patient or as an evaluated need by their health care provider (Andersen, 1995). This study included variables identified in the Andersen model and shown to be relevant through the literature review, including predisposing variables (i.e., age, gender, and race/ethnicity), an enabling variable (i.e., SES), and needs-based variables (i.e., diabetes, obesity, and sepsis mortality).

A number of studies have employed the Anderson healthcare utilization model. Hirshfield et al. (2018) utilized the Andersen model to explore the predisposing, needs, and enabling factors that were associated with U.S. men who have sex with men reporting hypertension as well as the risk or protective factors associated with hypertension that could be explained by the Andersen model. Hirshfield et al. also evaluated if there were racial differences in hypertension and risk factors amongst men who have sex with men, finding that Hispanic/Latino men were significantly less likely than other ethnicities to report hypertension. Additionally, the authors found that the predisposing factors of gender, age, and ethnicity were associated with reporting hypertension, with those of lower education level and younger age being less likely to report hypertension. Hirshfield et al.'s study is pertinent to the current study in that it demonstrates the relevance of the Andersen model conditions with predicting health care-seeking behaviors, especially in those who are known to have health disparities, such as ethnic minorities. Given the importance of not only early recognition and treatment of sepsis but also the importance of seeking treatment for infections prior to developing sepsis, the Andersen model is particularly useful.

Travers et al. (2020) used the Andersen model to measure not only the intent to use long-term services and support (LTSS) but also the actual uptake of LTSS in older adults with an evaluation of ethnic/racial differences. The need condition was most associated with the actual use of LTSS based on the older person's perception of their physical ability to remain independent (Travers et al., 2020). Racial differences were most prominent in the decision-making process to utilize LTSS because often

racial/ethnic minorities had a lack of trust in the health care system secondary to a history of disparities. This finding was particularly relevant to the current study in that the lack of trust as a predisposing condition could result in delays in care for infections, leading to sepsis, or even delays in care for sepsis, leading to a higher risk of mortality.

Katan and Abduljawad (2019) used the Andersen model to evaluate health care utilization in diabetic patients with hypoglycemic events. The authors evaluated factors under all three Andersen conditions (i.e., predisposing, enabling, and needs-based factors), finding that all three were correlated with health care utilization; however, the condition of the need had the strongest association with the hospital length of stay and the predisposing conditions and needs conditions were strongly interdependent. Their study held particular relevance to the current study in that not only was diabetes evaluated as a risk factor for sepsis, but the behaviors and beliefs that lead diabetic patients to seek health care services were likely similar to those that would lead a patient with an infection and at risk of sepsis to seek health care services. Additionally, Katan and Abduljawad evaluated many of the same variables under the Andersen model as were evaluated in the current study.

Literature Related to Key Variables

Age and Sepsis

While sepsis can and does occur at any age, older age has been demonstrated to be a significant risk factor in the development of sepsis (Ljungström et al., 2019), with the mean age of those adults with sepsis being reported as 66–69 years in the United States (Novosad et al., 2016; Rhee et al., 2017) and a median age of 78 years in Sweden

(Ljungström et al., 2019). In Sweden, Ljungström et al. (2019) conducted a prospective, population-based study over a 9-month period of all patients admitted to a community hospital who had antibiotics started for possible bacterial infection within 48 hours of hospital admission. The authors evaluated each admission for community-onset severe sepsis or septic shock during the first 48 hours of admission. A total of 2,196 patients were included, with a median age of 78 years, and finding a 40-fold increase in sepsis incidence as the age group increased.

A number of studies have evaluated the relationship of age to sepsis incidence and outcomes. In 2017, Rhee et al. (2017) conducted a retrospective cohort study of adult patients admitted from 2009–2014 to 409 U.S. hospitals who subsequently died in the hospital with the goal of describing the incidence of sepsis in the United States as well as the current trends. The study cohort was really large, accounting for about 10% of all hospitalizations in the United States, and of those patients identified with sepsis, more than 70% occurred in those 60 years of age and older. Fay et al. (2020) completed a retrospective cohort study of more than 1,000 patients with sepsis across the United States to understand their risk factors and outcomes, but unlike Rhee et al., they found a similar distribution of disease in those 46 to 64 years old and 65 to 84 years old. While the incidence of sepsis in the age categories was similar, the odds ratio of mortality increased with each age category (Fay et al., 2020). The age groups that may have a higher risk of sepsis did vary between the Swedish and United States studies, which may be attributable to general population differences. Of particular note is the difference in the access to health care, with Sweden having a national health system that may lead to

better, more timely preventive care and outpatient treatment of infections, thereby reducing the risk of sepsis and increasing the median age of those who develop sepsis. Whether age is a risk factor for sepsis in the United States is an unresolved issue; however, increased age has been demonstrated to contribute to higher sepsis-related mortality (Fay et al., 2020).

Diabetes and Sepsis

Diabetes has been associated with an increased risk for a number of infections that may go on to develop into sepsis. Santos et al. (2020) conducted a retrospective observational study of 308 patients admitted to an internal medicine ward with a sepsis diagnosis in 2015 and found that 33.4% of patients who were treated for sepsis had diabetes mellitus ($p = 0.0037$), with a higher incidence of diabetes observed in female sepsis patients, at 58.3% compared with 41.7% in male patients. Fay et al. (2020) completed a retrospective cohort study of more than 1,000 patients with sepsis across the United States to understand their risk factors and outcomes, finding that 35.9% of patients with sepsis had diabetes. This risk factor is important because diabetics are also more susceptible to developing infections and having frequent encounters with the health care system, both of which also increase the risk of developing sepsis and sepsis mortality (Fay et al., 2020). Similarly, Santos et al. (2020) found that more than half of the patients with sepsis had been on a course of antibiotics for infection, with nearly one third having a drug-resistant infection, and that both these factors were associated with increased risk of sepsis and sepsis mortality. Specific to the current study, Hispanics/Latinos experience a higher prevalence of diabetes than non-Hispanic groups

(Mendola et al., 2018). This fact, combined with the fact that diabetes can lead to an increased risk of sepsis and infections that can result in sepsis, further supports the importance of understanding diabetes as a risk for sepsis in Hispanic/Latino adults.

Obesity and Sepsis

Obesity, as measured by a BMI over 30, is known to increase the risk for a multitude of diseases; however, it appears to have a protective effect with regard to sepsis outcomes and mortality specifically (Jawaid et al., 2018). Jawaid et al. (2018) conducted a retrospective cohort study in 293 patients admitted to a New Jersey hospital over a 3-year period with diagnostic codes for sepsis to determine if obesity was an independent risk factor for sepsis mortality. The authors found that patients with a normal or elevated BMI (i.e., overweight) actually had an increased length of stay and mortality rate compared to those with low or high BMI (i.e., underweight and obese), although the results were not statistically significant. Pepper et al. (2018) conducted a systematic review and meta-analysis of more than 10,000 articles on sepsis, with a full-text review of 652 articles and ultimately six articles meeting inclusion criteria. The authors aimed to evaluate the effect of increased BMI on adjusted sepsis mortality, finding that having an overweight or obese BMI status reduced the odds ratio of sepsis mortality. Similarly, Li et al. (2019) conducted a retrospective cohort study of adult patients admitted with sepsis to an intensive care unit in a U.S. hospital from 2001 to 2012. Li et al. completed logistic regression to examine the “obesity paradox” and the relationship between 30-day and 1-year sepsis mortality rates and BMI. Their study included 5,563 patients and showed that while overweight and obese patients had a more severe course of illness, including

prolonged mechanical ventilation and intensive care unit lengths of stay, they had a lower risk of both 30-day and 1-year mortality than those patients with normal BMI. The mechanisms by which obesity may provide a protective factor for certain diseases, including sepsis, require further research. In addition, none of the studies found evaluated whether there was a difference in this obesity paradox across different races/ethnicities.

SES and Sepsis

The influence of SES in the United States on a person's health outcomes and sepsis has been well established in the literature (Kahn, 2018). According to Dimeglio et al. (2018), those with lower SES are more likely to lack health insurance and experience increased severity of disease and higher mortality rates when diagnosed with infection and sepsis. In addition to delaying medical care, patients who are uninsured or on a federally subsidized program such as Medicaid often receive less intense levels of care and are cared for at lower-quality hospitals that are less likely to be following current, evidence-based treatment guidelines, resulting in worse outcomes (Dimeglio et al., 2018).

Galiatsatos et al. (2018) completed a cross-sectional study of 55 communities across Baltimore City in 2017 to evaluate the relationship community SES had on sepsis mortality. The authors found that uninsured patients had higher sepsis-associated mortality than insured patients when adjusted for other socioeconomic factors. One limitation of their study was that it did not delineate mortality differences between hospital-onset and COS, which are known to be different.

Similarly, Baghdadi et al. (2018) conducted an observational, retrospective, cohort study evaluating whether having insurance was predictive of organ dysfunction in

those with COS presenting to 313 California hospitals in 2010. The authors found that in adult patients aged 15–64 presenting with COS, mortality was significantly higher in the uninsured and that organ dysfunction on admission explained 22.3% of the association of lack of insurance and sepsis mortality. According to Baghdadi et al. (2018), these findings provide evidence that uninsured patients with COS delay seeking care, resulting in worse sepsis outcomes than the insured. Sepsis mortality may also be lower in those with insurance due to their access to preventive care, such as vaccinations and earlier treatment of infections, thereby preventing organ dysfunction and sepsis, and ongoing management of chronic conditions that are known to contribute to infections such as diabetes (Dimeglio et al., 2018; Galiatsatos et al., 2018).

Moore et al. (2017) completed a retrospective analysis study utilizing the Reasons for Geographic and Racial Differences in Stroke stroke cohort comprised of nearly 30,000 patients to evaluate whether the regional differences in sepsis incidence and mortality were mediated by community factors such as poverty or SES. The authors defined the regional variance in sepsis as the sepsis belt and non belt, and while there were regional differences in both sepsis incidence and mortality, neither were mediated at a significant level by community factors after adjusting for individual factors such as age, gender, race, diabetes, obesity, income level, and education (Moore et al., 2017). The authors concluded that while poverty influences personal health choices alone, it does not account for the regional differences seen in sepsis and sepsis mortality. This study demonstrates the interdependency of individual risk factors and the influence that SES and other community factors have on those individual factors. While this study included a

large sample with a significant percentage being of a minority (38-45%), it did not include any Hispanic/Latino population or analysis, further demonstrating the need for studies focused on this population.

Sepsis Mortality

Mortality associated with sepsis ranges from 17 to 35%, with higher mortality rates seen in those who develop hospital-onset sepsis over those with community-onset sepsis (Fay et al., 2020; Novosad et al., 2016; Rhee et al., 2019;). However, given that the vast majority of patients had sepsis onset in the community, the opportunity to identify the risk factors for developing sepsis and develop prevention strategies is critical. Fay et al. (2020) completed a retrospective cohort study of more than 1,000 patients with sepsis across the United States to understand their risk factors and outcomes, finding that more than 60% of sepsis patients had contact with a healthcare setting in the days prior to their sepsis hospitalization, most had comorbid conditions, and that having a comorbid condition was associated with increased 30-day mortality. The authors also found that sepsis is most commonly a result of vaccine-preventable or treatable infections such as pneumonia and urinary tract infection and that those who had not received their influenza or pneumococcal vaccines were at higher risk of dying than those who had been immunized, and that those with comorbidities were also at increased risk of mortality (Fay et al., 2020). This finding suggests that further attention is needed on sepsis risk recognition by inpatient and outpatient medical providers, as well as improved treatment and management of both infections and comorbid conditions (Fay et al., 2020). While the authors did identify that racial minorities comprised approximately 36% of the sepsis

cases, and Hispanics/Latinos contributed nearly 12%, there was no analysis performed on the role that race/ethnicity played in sepsis mortality.

Kemper et al. (2018) completed a longitudinal cohort study of U.S. adults greater than 18 years of age to identify population-level risk factors associated with sepsis and the health disparities among these individuals in the community. Based on the constructs of the theory of fundamental causes, the author's utilized survey data from the 1999-2005 National Health Interview Survey with data linked to the 1999-2011 National Death Index in their study. Study goals included describing the health conditions, health behaviors, and socioeconomic factors associated with increased risk of sepsis mortality and describing which of these factors are associated with race/ethnicity sepsis death disparities. The authors found that significant risk factors for sepsis death were similar to those for other causes of death and included the self-reported need for help with activities of daily living, self-reported "poor" general health, lower education level, lower poverty index ratio, and self-reported chronic health conditions (emphysema, liver and kidney conditions, stroke). The authors also concluded that there was a two-fold Black-White disparity in sepsis deaths that were strongly mediated across the SES domains; however, no analysis was provided for the Hispanic/Latino community. While this study was very robust, demonstrating risk factors for sepsis death as similar to other diseases and disproportionately affecting racial-ethnic minorities, the authors also called out discordant results in the literature related to these risk factors and sepsis mortality, further indicating the need for additional studies in racial-ethnic minorities (Kemper et al. (2018).

Similar to what is seen with obesity, being of Hispanic/Latino ethnicity appears to have a protective effect when it comes to overall mortality. Lariscy et al. (2015) conducted a cross-sectional study utilizing data from the National Health Interview Survey Linked Mortality Files aimed at comparing Hispanic/Latino older adult (65 years and older) mortality to their counterparts who are Black or non-Hispanic White. Additionally, the authors evaluated the relationship of SES and smoking with the differences seen in racial mortality rates (Lariscy et al., 2015). Despite their socioeconomic disadvantage, Latinos/Hispanics in the United States have lower adult mortality rates than Blacks and Whites (Lariscy et al., 2015), potentially attributable to the strong family support structures allowing for better recovery in Hispanics compared to other races (Dimeglio et al., 2018).

While overall mortality in Hispanics/Latinos is lower than other ethnic groups, very little data exists on the differences in sepsis-related mortality, with only one such study found. Melamed and Sorvillo (2009) conducted a retrospective cohort study using data from The National Center for Health Statistics' multiple-cause-of-death dataset that analyzed sepsis mortality rates for different ethnicities, finding Blacks had the highest sepsis mortality rates, followed by American Indian/Alaskan Native, Hispanics/Latinos, Whites, and Asians respectively. The significant gap in knowledge regarding sepsis mortality in Hispanics/Latinos, combined with the discordant findings with overall mortality, further justified the need for this study.

Race/Ethnicity and Sepsis

Variability in health care and health outcomes across a spectrum of diseases is well documented in the literature, with sepsis being no exception. According to Dimeglio et al. (2018), the risk-adjusted incidence of sepsis, as well as the morbidity associated with prolonged hospitalizations and complications, are higher in racial-ethnic minority groups, including Blacks and Hispanic/Latinos, than in Whites. Despite these health disparities, reports on mortality rates are discordant, pointing to the need to evaluate other factors that may contribute to the racial differences seen in sepsis incidence, care, and outcomes (Dimeglio et al., 2018). In their focused review, the authors found that Blacks have higher numbers of comorbid conditions such as diabetes and obesity than their White counterparts, which results in an increased risk of severe sepsis that includes organ failure and ultimately higher mortality. The authors go on to state that disparities in emergency department management of racial-ethnic minority patients exist, specifically, with Black patients experiencing longer wait times and lower ratings of clinical acuity, resulting in delayed identification and treatment of sepsis; however, the authors also point out that there are currently no studies available that examine systemic racism in sepsis management as exists for other diseases. While this study provides evidence regarding racial disparities in healthcare that may contribute to disparities seen in sepsis, the study is limited in that it only specifically provides evidence in Blacks compared to Whites, further demonstrating the need for this study focused on the Hispanic/Latino population.

Definitions

BMI: Is calculated as weight (kg) over height (meters squared) and is commonly used to determine an individual's weight category (CDC, 2020a).

COS: Symptoms consistent with the definition of sepsis are present within 72 hours of arrival to the hospital (Rhee et al., 2019).

Comorbidity: Multiple (more than one) acute or chronic diseases or conditions occurring in an individual concurrently (Valderas et al., 2009).

Diabetes: A chronic disease that results in high blood glucose levels due to the inability of the body to produce or use insulin properly (CDC, 2020b).

Obesity: Condition of excess body fat as measured by a BMI greater than or equal to 30 in adults (World Health Organization, 2020).

Sepsis: Occurs when an infection is accompanied by at least one systemic inflammatory response, including fever, increased heart rate, hyperventilation, or an elevated white blood cell count (Tsertsvadze et al., 2016).

Sepsis care bundle: A group of interventions that, when performed together, improve outcomes in patients with sepsis. These commonly include early diagnostic tools and treatment such as measuring serum lactate levels, an early collection of blood cultures, treatment with a broad-spectrum intravenous antibiotic, and use of intravenous fluid treatment (Baghdadi et al., 2020).

SES: A composite measurement of one's social position based on their level of education, income, and occupation (American Psychological Association, n.d.).

Assumptions

Secondary data from the EMR was used for this study. Assumptions regarding this data include that coding for sepsis, comorbidities, height, weight, discharge disposition, and payor, as well as other demographic data, were accurately reflected in the EMR. It is recognized that the discharge disposition may not capture mortality that occurred post discharge to home, another acute care facility, or a skilled nursing facility. Additionally, the accuracy of race/ethnicity is assumed as this was voluntarily self-reported by the patient at the time of admission to the acute care facility.

Scope and Delimitations

This study focused on the risk factors for COS in adult Hispanic/Latino patients and included data collected in a large health system in Arizona and Colorado. This study also assessed mortality rates associated with COS in this population. Pediatric patients (those under 18 years of age) were excluded from this study as the risk factors for COS in children are significantly different than in adults. Additionally, patients with sepsis-associated with the 2019 SARS-CoV2 coronavirus (COVID) were excluded secondary to a lack of knowledge, literature, and secondary data available for this population.

Limitations

A limitation of this study was the use of secondary data collected via the electronic medical record. Incomplete data points via missing documentation, in addition to data entry errors, may have contributed to a decrease in external validity and the ability to generalize the findings across the population. Also, the use of a convenience sample in

a single health system may not fully represent the Hispanic/Latino population across the rest of the United States, thereby further limiting the study's generalizability.

Significance

Determining the true burden of sepsis disease and the associated mortality has been elusive. The lack of data and reports on sepsis from low- and middle-income countries that hold the vast majority of the world's population, coupled with the lack of standard definitions and reporting across high-income countries, points to the reported 30 million cases and 6 million deaths annually as being woefully underestimated (Reinhart et al., 2017; Tsertsvadze et al., 2016). Nationally, Latinos/Hispanics account for roughly 18% of the population; however, within Arizona and Colorado, they comprise 31% and 21% of the population, respectively (Pew Research Center, n.d.). Despite Latinos/Hispanics comprising such a large percentage of the U.S. population, there appear to be no studies to date that have evaluated COS's risk factors in this population.

McGrath et al. (2019) evaluated 10 health conditions by race in older adults in the United States, finding that certain health conditions such as diabetes, stroke, and myocardial infarction are more prevalent in Blacks and Hispanics when compared to Whites. However, as previously discussed, there appears to be a “Hispanic paradox” whereby despite having higher rates of comorbid conditions such as diabetes than their White counterparts, Hispanics have lower overall adult mortality rates (Lariscy et al., 2015). Understanding the true burden of sepsis in Hispanics in the United States, how the risk factors for COS may differ in Hispanics, and the relationship of these risk factors with mortality will inform prevention strategies for this specific population.

Summary and Conclusions

Hispanics/Latinos are a unique group in that their population in the United States is rapidly growing; however, there is little to no research available on the risk factors for sepsis and sepsis-related mortality in this population. Despite being at increased risk for severe outcomes due to lower SES and higher rates of comorbid conditions such as diabetes and obesity, Hispanics potentially have lower than expected overall mortality rates (Dimeglio et al., 2018; Kahn, 2018; Lariscy et al., 2015). While significant literature exists on the risk factors for sepsis, less is known about the risk factors for COS despite the vast majority of sepsis having onset in the community, and even less is known about sepsis in the Hispanic population, despite their comprising nearly one fourth of the U.S. population (Pew Research Center, n.d.).

In this section, the foundation was laid as to the importance of sepsis as a public health problem, the gap in understanding and knowledge regarding sepsis in the Hispanic population, and the need for this study. I provide a detailed review of the research design, data collection, and data analysis plan for this study in section 2.

Section 2: Research Design and Data Collection

The purpose of this study was to examine the risk factors associated with COS in Hispanic/Latino adults aged 50 years and older and determine if these risk factors can predict mortality. In this section, I discuss the research design and rationale; methodology, including population, sampling, and data collection; and the data analysis plan. Potential threats to validity and reliability and ethical considerations are also presented. I collected data for this study through electronic extraction from EMRs after receiving appropriate Institutional Review Board (IRB) approvals.

Research Design and Rationale

I conducted this research study using the quantitative method with a descriptive, correlational design. Quantitative researchers utilize numeric data to describe variables and their relationships with one another as well as examine causal relationships (Bloomfield & Fisher, 2019). The statistical output from the analyses guides decisions regarding retaining or rejecting the null hypotheses and subsequent conclusions and generalizations of the results. According to Bloomfield and Fisher (2019), descriptive and correlational designs are used to describe the characteristics of a population and examine relationships between the dependent and independent variables but cannot determine causal relationships. A quantitative approach was most appropriate for the current study due to the use of secondary data as predefined and unmanipulated variables to determine if associations between variables existed. Independent variables that were collected and analyzed in this study included age, gender, diabetes, obesity, and SES. Dependent

variables included COS and mortality. I did not choose the qualitative or mixed-methods approaches because they were incompatible with the data type and goals of this study.

Methodology

Population, Sampling, and Data Collection

The target population for this study was Hispanic/Latino adult patients aged 50 years and older who were diagnosed with COS upon presenting to the emergency department or within 72 hours prior to hospital admission at a large health system in Arizona and Colorado between 2017 and 2019. Patients diagnosed with COS who were not Hispanic/Latino, were younger than 50 years of age, or who lacked a sepsis diagnosis were not included in the sample.

I used a nonprobability convenience sample to obtain the study population. Jager et al. (2017) stated that nonprobability convenience samples are widely used due to their ease of use, lower costs, and efficiency of data collection when compared to random probability samples. While a clear disadvantage to the use of a nonprobability convenience sample is sample bias and loss of generalizability, using a homogenous, nonprobability, convenience sample can result in more narrow and clear generalizability, thus reducing this risk (Jager et al., 2017). This strategy aligned well with the target population for this study being limited to Hispanic/Latino adult patients.

Data collection commenced upon receiving approval of this study from the IRBs of Walden University, 09-03-21-1003982, and the study site health care system. I obtained discharge data on Hispanic/Latino adult patients aged 50 years and older with sepsis from the EMRs via the health systems' internal data mining and storage systems.

Data were requested for all adult Hispanic/Latino patients aged 50 years and older with a discharge diagnosis of sepsis between 2017 and 2019. Data were further categorized by those with COS defined as sepsis present on or within 72 hours after admission. I maintained the data for patients that met the study criteria in a Microsoft Excel spreadsheet. Patient data was de-identified following confirmation of meeting inclusion criteria and prior to data analysis.

All variables were coded into either a binary or categorical format prior to data analysis, as shown in Table 1. Operational definitions of variables were as follows:

- Diabetes was defined as having a diagnosis of Type 2 diabetes in the medical record.
- Obesity was defined as having a BMI greater than or equal to 30 in adults (World Health Organization, 2020).
- Age was defined in years at the time of hospitalization and based on the patient's date of birth.
- Gender was defined as male or female, as reflected in the medical record.
- SES was measured with payor source as a proxy measure.
- COS was defined as sepsis present on or within 72 hours after admission to the hospital or emergency department.
- Mortality was defined as the discharge disposition in the medical record as alive or deceased.

Utilizing G*Power 3.1 (Faul et al., 2009), I performed a power analysis to determine the necessary sample size for this study. A minimum sample size of 81 was

calculated based on the inputs of five predictors, a 0.95 power, a small effect size of 0.20, and an alpha level of 0.05; however, a larger sample size of 180 was targeted secondary to having a large data set and increasing the rigor of the study for future publication. The power, effect size, and alpha levels were determined based on alignment with common assumptions and practices and aimed at preventing the premature rejection of the null hypothesis (i.e., Type I error) and also ensuring the null hypothesis was not erroneously accepted (i.e., Type II error; Cohen, 1992).

Data Analysis Plan

I performed data analysis for this study using IBM SPSS Version 27. Descriptive statistics were utilized to describe, compare, and contrast the study population characteristics and variables with those found in the literature review. Data were cleaned to ensure completeness. Missing data were imputed through medical record review when possible. I excluded patients with missing data in the medical record from the analysis for that specific variable but included them in the analysis for complete variables.

The following research questions and hypotheses guided this study:

RQ1: To what extent are diabetes, obesity, age, gender, and SES associated with COS in Latino/Hispanic adult patients aged 50 years and older presenting to the emergency departments of a large, multistate, health care system in Arizona and Colorado between 2017 and 2019?

$H_0$1: There are no statistically significant associations between diabetes, obesity, age, gender, and SES with COS in Latino/Hispanic adult patients aged 50 years and older in Arizona and Colorado.

$H_1$1: There are statistically significant associations between diabetes, obesity, age, gender, and SES with COS in Latino/Hispanic adult patients aged 50 years and older in Arizona and Colorado.

RQ2: Do diabetes, obesity, age, gender, and SES predict mortality in Latino/Hispanic adult patients aged 50 years and older with COS presenting to the emergency departments of a large, multistate, health care system in Arizona and Colorado between 2017 and 2019?

$H_0$2: Diabetes, obesity, age, gender, and SES do not predict mortality in adult Latino/Hispanic patients aged 50 years and older with COS in Arizona and Colorado.

$H_1$2: Diabetes, obesity, age, gender, and SES predict mortality in adult Latino/Hispanic patients aged 50 years and older with COS in Arizona and Colorado.

I used multiple logistic regression to determine if the independent variables predicted the outcome of mortality (i.e., the dependent variable). Additionally, bivariate logistic regression was used to determine if the independent variables were associated with COS (i.e., the dependent variable). Logistic regression assumes the dependent variable(s) are dichotomous or ordinal, independent observations, and low multicollinearity; however, it does not require a linear relationship between the independent and dependent variables (Schreiber-Gregory et al., 2018). In the event assumption violations were identified, I explored the variable transformation to correct

the data. Table 1 provides an overview of the variables for each research question and the statistical analysis method.

Table 1

Research Questions, Variables, and Statistical Analysis Plan

Research Question	Variable	Type of Variable	Coding of Variable	Statistical Test
RQ1: To what extent are diabetes, obesity, age, gender, and socioeconomic status associated with community-onset sepsis in Latino/Hispanic adult patients age 50 years and older presenting to the emergency departments of a large multi-state healthcare system in Arizona and Colorado between 2017 and 2019?	Diabetes	Independent	0 = No, 1 = Yes	Bivariate logistic regression
	Obesity	Independent	0 = No, 1 = Yes	
	Age	Independent	1 = 50–59 years 2 = 60–69 years 3 = 70–79 years 4 = 80–89 years 5 = ≥ 90 years	
	Gender	Independent	0 = Female 1 = Male	
	Socioeconomic status	Independent	1 = Uninsured 2 = Medicaid 3 = Medicare 4 = Other payor	
	Community-onset sepsis	Dependent	0 = No 1 = Yes	
RQ2: Do diabetes, obesity, age, gender, and socioeconomic status, predict mortality in Latino/Hispanic adult patients age 50 years and older with community-onset sepsis presenting to the emergency departments of a large multi-state healthcare system in Arizona and Colorado between 2017 and 2019?	Diabetes	Independent	0 = No, 1 = Yes	Multiple logistic regression
	Obesity	Independent	0 = No, 1 = Yes	
	Age	Independent	1 = 50–59 years 2 = 60–69 years 3 = 70–79 years 4 = 80–89 years 5 = ≥ 90 years	
	Gender	Independent	0 = Female 1 = Male	
	Socioeconomic status	Independent	1 = Uninsured 2 = Medicaid 3 = Medicare 4 = Other payor	
	Mortality	Dependent	0 = No 1 = Yes	

Threats to Validity and Reliability

Threats to the validity of the data included those common to secondary data and specifically to data obtained from EMRs. Internal threats included missing or incomplete information in the medical record, incorrect documentation, and incorrect coding of diagnosis codes. While these risks do exist, the study site health system does have a

quality control process in place with routine validation of the completeness and accuracy of the medical record and coding, minimizing the impact of this threat. An additional threat to external validity was the use of data from a single health system and that generalizing these results to the broader population may result in erroneous conclusions. This risk was mitigated by collecting data from multiple hospitals in the system in different markets to provide a broader study population. Finally, there was some threat to statistical validity and, therefore, generalizability by using a nonprobability, convenience sample with dichotomous dependent variables. This risk was mitigated by using a homogenous study population of an adequate sample size. Even with these risks, this study provides useful information that is currently lacking on the risks for COS in the Hispanic/Latino population.

Electronic capture of data from the medical record provided more reliability than manual abstraction or data gathering techniques. While there are the risks discussed above, the quality control measures in place to review coding and medical record accuracy helped to ensure the reliability of the data source.

Ethical Procedures

I did not undertake data collection until receiving approval of the study from the Walden University IRB and the health system's IRB. Data were extracted from the health system's data warehouse by the data analytics team and provided to me in a secure location. Once the data had been confirmed to be complete and in alignment with the study design, the data were de-identified for data analysis. All data stored on my personal computer for analysis was expunged of patient identifiers and stored in a password-

protected folder. I will maintain the data collected for this study for a period of 7 years or as required by the IRBs and then destroyed. As an employee of the study site health care system, I complete annual training on health information privacy and confidentiality. Patient consent was not required because all data were secondary data from EMRs and collected for analysis after discharge.

Summary

In this chapter, I outlined the methods used to examine the risk factors for COS and its related mortality in Hispanic/Latino adults in Arizona and Colorado. This included a review of sampling strategies; a description of the population and variables, data collection procedures, and data analysis plan; and the rationale for the approach. In Section 3, I will provide the results of the data collection and analyses.

Section 3: Presentation of the Results and Findings

The purpose of this quantitative study was to examine the risk factors associated with COS in Hispanic/Latino adults aged 50 years and older and determine if these risk factors can predict mortality. Using a descriptive, correlational design, I examined the relationships between the independent variables of age, gender, diabetes, obesity, and SES with the dependent variables of COS and mortality. In Section 2, I provided an in-depth description of the data collection process and data analysis plan. This section includes the descriptive and demographic characteristics of the sample, followed by a presentation of the statistical analysis findings organized by the research question with the corresponding hypotheses. I conclude the section with a summary of the results.

Descriptive Analysis and Demographic Characteristics

The initial sample population included all patients in Arizona and Colorado aged 50 years and older with a diagnosis code including sepsis between January 1, 2017, and December 31, 2019. The total sample size was 9,076 patients, with 8,568 patients in Arizona (94.4%) and 508 patients in Colorado (5.6%). Most of the hospitals in the health system are in Arizona, so this distribution was expected. Because this study was focused on COS in Hispanic/Latino adults, I created a subpopulation sample including only patients who self-identified as Hispanic/Latino. A total of 1,794 (19.8%) patients self-identified as Hispanic/Latino, with the remaining 7,268 (80.1%) identifying as other ethnicities. Nine patients (0.1%) were unable to answer questions regarding their ethnicity upon admission or during their hospital stay. Table 2 provides the descriptive analysis for the sample population.

Table 2

*Population Characteristics (*N= *9,076)*

Variable		*n*	%
Hispanic/Latino		1,794	19.8
	Gender		
	Female	841	46.9
	Male	953	53.1
	Age		
	50–59 years	546	30.4
	60–69 years	584	32.6
	70–79 years	422	23.5
	80–89 years	209	11.6
	≥ 90 years	33	1.8
	Diabetes		
	No	496	27.6
	Yes	1,298	72.4
	Obesity		
	BMI < 30	1,056	59.6
	BMI ≥ 30	716	40.4
	Socioeconomic status		
	Uninsured	49	2.7
	Medicare	1,091	60.8
	Medicaid	470	26.2
	Other payor	184	10.3
	COS		
	Not COS	178	9.9
	COS	1,616	90.1
	Mortality		
	Live	1,451	80.9
	Expired	343	19.1
Other ethnicities		7,268	80.1
	Gender		
	Female	3,311	45.6
	Male	3,957	54.4
	Age		
	50–59 years	1,419	19.5
	60–69 years	1,910	26.3
	70–79 years	2,191	30.1
	80–89 years	1,407	19.4
	≥ 90 years	341	4.7
	Diabetes		
	No	3,303	45.4
	Yes	3,965	54.6
	Obesity		
	BMI < 30	4,697	64.6
	BMI ≥ 30	2,571	35.4
	Socioeconomic status		
	Uninsured	75	1.0
	Medicare	5,412	74.5
	Medicaid	843	11.6
	Other payor	938	12.9
	COS		
	Not COS	709	9.8
	COS	6,559	90.2
	Mortality		
	Live	5,857	80.6
	Expired	1,411	19.4

Research Question 1

RQ1: To what extent are diabetes, obesity, age, gender, and SES associated with COS in Latino/Hispanic adult patients aged 50 years and older presenting to the emergency departments of a large, multistate, health care system in Arizona and Colorado between 2017 and 2019?

$H_0$1: There are no statistically significant associations between diabetes, obesity, age, gender, and SES with COS in Latino/Hispanic adult patients aged 50 years and older in Arizona and Colorado.

$H_1$1: There are statistically significant associations between diabetes, obesity, age, gender, and SES with COS in Latino/Hispanic adult patients aged 50 years and older in Arizona and Colorado.

To answer this question, I conducted bivariate logistic regressions that utilized the independent variables (i.e., diabetes, obesity, age, gender, and SES). The dependent variable was COS (0 = not COS, 1 = COS). When examined individually, the independent variables were not significantly associated with COS.

Diabetes

The model was not significant, $\chi 2$ (2, n = 1794) = 0.563, p = 0.453 as shown in Table 3. Due to the model not being significant, the p values for the coefficients were not examined. When controlling for COS, I did not find diabetes status to be associated with the development of COS, so the null hypothesis failed to be rejected.

Table 3

Logistic Regression Analysis for COS Regressed on Diabetes

								95% C.I.for EXP(B)	
		B	S.E.	Wald	*df*	Sig.	Exp(*B*)	Lower	Upper
Step 1[a]	Diabetes	.135	.181	.553	1	.457	1.144	.802	1.632
	Constant	2.170	.092	562.177	1	.000	8.759		

[a.] Variable(s) entered on Step 1: reference category diabetes = no.

Obesity

The model was not significant, $\chi 2$ (2, n = 1772) = 0.998, p = 0.338 as shown in Table 4. Twenty-two cases were excluded in the obesity analysis due to the inability to calculate the BMI due to missing weight or height in the electronic medical record. Due to the model not being significant, the *p* values for the coefficients were not examined. When controlling for COS, I did not find obesity status to be associated with the development of COS, so the null hypothesis failed to be rejected.

Table 4

Logistic Regression Analysis for COS Regressed on Obesity

								95% C.I.for EXP(B)	
		B	S.E.	Wald	*df*	Sig.	Exp(*B*)	Lower	Upper
Step 1[a]	Obesity	.156	.163	.909	1	.340	1.168	.848	1.609
	Constant	2.132	.100	454.934	1	.000	8.429		

[a.] Variable(s) entered on Step 1: reference category obesity = no.

Age

The model was not significant, $\chi 2$ (5, n = 1794) = 3.121, p = 0.538 as shown in Table 5. Due to the model not being significant, the *p* values for the coefficients were not

examined. When controlling for COS, I did not find the age group to be associated with the development of COS, so the null hypothesis failed to be rejected.

Table 5

Logistic Regression Analysis for COS Regressed on Age Group

								95% C.I.for EXP(B)	
		B	S.E.	Wald	*df*	Sig.	Exp(*B*)	Lower	Upper
Step 1[a]	Age groups			2.290	4	.683			
	60–69 years	-.001	.195	.000	1	.998	.999	.682	1.464
	70–79 years	.080	.216	.137	1	.711	1.083	.709	1.654
	80–89 years	.213	.284	.562	1	.453	1.237	.710	2.156
	90 and older	1.316	1.025	1.649	1	.199	3.730	.500	27.815
	Constant	2.149	.140	235.825	1	.000	8.579		

[a]. Variable(s) entered on Step 1: reference category Age Group = 1 (50–59 years).

Gender

The model was not significant, $\chi 2$ (2, n = 1794) = 1.794, p = 0.180 as shown in Table 6. Due to the model not being significant, the p values for the coefficients were not examined. When controlling for COS, I did not find gender to be associated with the development of COS, so the null hypothesis failed to be rejected.

Table 6

Logistic Regression Analysis for COS Regressed on Gender

								95% C.I.for EXP(B)	
		B	S.E.	Wald	*df*	Sig.	Exp(*B*)	Lower	Upper
Step 1[a]	Gender	-.213	.160	1.781	1	.182	.808	.591	1.105
	Constant	2.324	.121	368.852	1	.000	10.213		

[a.] Variable(s) entered on Step 1: reference category gender = female.

SES

The model was not significant, $\chi 2$ (4, n = 1794) = 4.540, p = 0.209 as shown in Table 7. Due to the model not being significant, the p values for the coefficients were not

examined. When controlling for COS, I did not find SES to be associated with the development of COS, so the null hypothesis failed to be rejected.

Table 7

Logistic Regression Analysis for COS Regressed on SES

							95% C.I.for EXP(B)	
		B	S.E.	Wald	*df*	Sig.	Exp(*B*)	Lower	Upper
Step 1[a]	Payor			4.566	3	.206			
	Uninsured	.880	.634	1.929	1	.165	2.411	.696	8.345
	Medicaid	.525	.271	3.742	1	.053	1.690	.993	2.877
	Medicare	.338	.237	2.026	1	.155	1.402	.880	2.233
	Constant	1.850	.215	73.939	1	.000	6.360		

[a]. Variable(s) entered on Step 1: reference category payor = other payor (4).

Combined Demographics

To examine the impact of all the demographic characteristics when considered as a group, I looked at the omnibus. The full model was not significant, $\chi 2$ (10, n = 1772) = 11.087, p = .351. The independent variables and covariate taken as a group did not significantly predict COS (see Table 8), so the null hypothesis failed to be rejected.

Table 8

Logistic Regression Analysis for COS Regressed on Combined Demographics

								95% C.I.for EXP(B)	
		B	S.E.	Wald	*df*	Sig.	Exp(*B*)	Lower	Upper
Step 1[a]	Diabetes	-.139	.185	.566	1	.452	.870	.605	1.251
	Obesity	.200	.168	1.423	1	.233	1.222	.879	1.698
	Age groups			2.775	4	.596			
	Age 60–69	.088	.208	.179	1	.672	1.092	.727	1.640
	Age 70–79	.197	.249	.628	1	.428	1.218	.748	1.985
	Age 80–89	.324	.311	1.084	1	.298	1.382	.751	2.543
	Age 90 and above	1.401	1.034	1.837	1	.175	4.059	.535	30.782
	Gender	-.177	.161	1.205	1	.272	.838	.610	1.149
	Payor			4.785	3	.188			
	Uninsured	.834	.635	1.726	1	.189	2.303	.663	7.997
	Medicaid	.529	.273	3.753	1	.053	1.697	.994	2.898
	Medicare	.241	.259	.867	1	.352	1.272	.766	2.112
	Constant	1.892	.292	42.003	1	.000	6.635		

[a.] Variable(s) entered on Step 1: reference categories, diabetes = no, obesity = no, age group 1 (50–59), gender = female, payor = other payor.

Research Question 2

RQ2: Do diabetes, obesity, age, gender, and SES predict mortality in Latino/Hispanic adult patients aged 50 years and older with COS presenting to the emergency departments of a large, multistate, health care system in Arizona and Colorado between 2017 and 2019?

$H_0$2: Diabetes, obesity, age, gender, and SES do not predict mortality in adult Latino/Hispanic patients aged 50 years and older with COS in Arizona and Colorado.

$H_1$2: Diabetes, obesity, age, gender, and SES predict mortality in adult Latino/Hispanic patients aged 50 years and older with COS in Arizona and Colorado.

To answer this question, I performed multivariate logistic regression on cases of COS that utilized the independent variables (i.e., diabetes, obesity, age, gender, and SES). The dependent variable was mortality (0 = live, 1 = expired). Table 9 provides the descriptive analysis of the population.

Table 9

Population Description

		n	Marginal Percentage
Mortality	Live	1,290	80.9%
	Expired	304	19.1%
Diabetes or not	Not diabetic	441	27.7%
	Diabetic	1,153	72.3%
Obesity	BMI < 30	944	59.2%
	BMI >= 30	650	40.8%
Age group	60–69	517	32.4%
	All other ages	1,077	67.6%
Gender	Female	752	47.2%
	Male	842	52.8%
SES	Medicare or insured	1,128	70.8%
	Medicaid or uninsured	466	29.2%
Valid		1,594	100.0%
Missing		22	
Total		1,616	
Subpopulation		32	

The model was significant, $\chi 2$ (5, n = 1,594) = 42.817, p =< 0.001 suggesting that diabetes, obesity, age, gender, and SES are predictive of mortality for this sample (see Table 10). Based on this significance, I rejected the null hypothesis. The p value for

diabetes (p = <0.001) was significant, with an odds ratio of 2.026. This indicated diabetics had 2.026 higher odds of dying with COS than nondiabetics. The p value for gender (p = 0.002) was also significant; however, the OR was below 1, indicating that being of the male gender was predictive of lower mortality in patients with COS. When examined individually, the independent variables of obesity (p = 0.301), age group (p = 0.526), and socioeconomic status (p = 0.824) were not significant predictors of mortality in patients with COS. Given the model was significant and only two of the independent variables were significant, I performed a collinearity analysis with each of the independent variables. All variance inflation factors (VIF) were near 1, indicating no multicollinearity between the independent variables. Additionally, a Hosmer-Lemeshow test was performed for goodness of fit for the model, with a *Chi*-square of 12.67 and p value 0.124. Given the p value is greater than 0.05, the model was determined to be a good fit.

Table 10

Logistic Regression Analysis for Mortality Regressed on Combined Demographics

								95% Confidence Interval for Exp(B)	
Mortality[a]		*B*	Std. Error	Wald	*df*	Sig.	Exp(B)	Lower Bound	Upper Bound
Expired	Intercept	-1.585	.170	86.672	1	<0.001*			
	Diabetes[a]	.706	.136	26.861	1	<0.001*	2.026	1.551	2.647
	Obesity[a]	.141	.136	1.071	1	.301	1.151	.882	1.503
	Age group[a]	.088	.138	.402	1	.526	1.092	.832	1.431
	Gender[a]	-.417	.133	9.880	1	.002*	.659	.508	.855
	SES[a]	-.031	.142	.049	1	.824	.969	.734	1.279

[a.] The reference categories are: mortality = live, diabetes = no, obesity = BMI < 30, age group = 60–69 years, gender = female, SES = Medicare or insured. *p = ≤0.05

Summary

In summary, Table 11 shows the final results and decisions regarding each research question and their associated hypotheses.

Table 11

Hypothesis Testing Results

Hypotheses	Variable	*p* value	Decision
$H_0$1: There are no statistically significant associations between diabetes, obesity, age, gender, and socioeconomic status with community-onset sepsis in Latino/Hispanic adult patients age 50 years and older in Arizona and Colorado.	Model	0.351	Retain
	Diabetes	0.453	Retain
	Obesity	0.338	Retain
	Age	0.538	Retain
	Gender	0.180	Retain
	Socioeconomic status	0.209	Retain
$H_0$2: Diabetes, obesity, age, gender, and socioeconomic status do not predict mortality in adult Latino/Hispanic patients age 50 years and older with community-onset sepsis in Arizona and Colorado.	Model	< 0.001	Reject
	Diabetes	< 0.001	Reject
	Obesity	0.301	Retain
	Age	0.526	Retain
	Gender	0.002	Reject
	Socioeconomic status	0.824	Retain

In Section 3, I presented the findings regarding the two research questions and corresponding hypotheses. There was no significant association between COS and the independent variables (i.e., diabetes, obesity, age, gender, and SES). However, diabetes and gender were found to be predictive of mortality risk. In Section 4, I will discuss the significance of the results and social change implications.

Section 4: Application to Professional Practice and Implications for Social Change

In this quantitative study, I analyzed secondary, cross-sectional data for 1,794 participants. The purpose of this study was to examine the relationship, if any, of diabetes, obesity, age, gender, and SES with COS in Latino/Hispanic adult patients age 50 years and older and evaluate whether diabetes, obesity, age, gender, and SES predicted mortality related to COS in this population group. Two research questions were tested using logistic regression. Through the use of bivariate logistic regression, I assessed the relationship between COS and the demographic variables (i.e., diabetes, obesity, age, gender, and SES). Finally, multiple logistic regression was used to determine if these risk factors were predictive of mortality in the study population.

In this section, I provide a summary of the study findings, a discussion of the limitations associated with this study, and a comparison of the study findings with the current body of literature. The section also includes recommendations for professional practice and future research as well as a discussion of the implications for social change.

Interpretation of the Findings

To date, the only literature available on the risk factors for COS was in either the general population or non-Hispanic populations. In this study, I focused on Hispanic/Latino adults aged 50 years and older with COS as well as determining their risk factors for COS and whether these risk factors predicted mortality.

Research Question 1

This study was guided by the Andersen model in which Andersen (1995) stated that predisposing (i.e., age, gender, obesity, and diabetes), need (i.e., age and diabetes),

and enabling factors (i.e., SES) not only influence if a person seeks health care but are useful in understanding the association of predictive risk factors with outcomes. This model was relevant to this study because it addressed health disparities that exist in ethnic minorities, such as Hispanics/Latinos, and the impact on their health outcomes.

In this study, no relationship was demonstrated between COS in Hispanic/Latino adults over 50 years of age and the demographic variables of diabetes, obesity, age, gender, and SES. While this finding does contrast with those of previous studies in the literature, previous literature did not include the analysis of these risk factors specifically in Hispanic/Latino adults. For example, Tsertsvadze et al. (2016) found age and diabetes associated with COS; however, no analysis for differences amongst minority groups/ethnicities was performed. As noted by Tsertsvadze et al., there is a lack of quality studies available on the risk factors and outcomes associated with COS specifically.

Research Question 2

In keeping with the Andersen model, I examined whether diabetes, obesity, age, gender, and SES predicted mortality in Latino/Hispanic adult patients aged 50 years and older with COS in this study. The findings demonstrated that these risk factors, when considered together, were predictive of mortality and that diabetes and being of female gender independently were also predictive of COS-related mortality. These findings are partially consistent with previous findings in the literature.

Fay et al. (2020) completed a retrospective cohort study of more than 1,078 patients with sepsis across the United States, of which 973 had COS, to understand their

risk factors and outcomes, finding that most had comorbid conditions and that having a comorbid condition was associated with increased 30-day mortality. Diabetes was included in the comorbid conditions used in their mortality analysis; however, it was not analyzed separately for its impact. Fay et al.'s findings vary from those in the current study in that the Fay et al. did not perform an analysis for diabetes as an independent comorbidity or was there analysis of the role, if any, the comorbidity risk factors played in sepsis mortality by race/ethnicity.

Kemper et al. (2018) found that significant risk factors for sepsis death were similar to those for other causes of death and included the self-reported need for help with activities of daily living, self-reported "poor" general health, lower education level, lower poverty index ratio, and self-reported chronic health conditions (i.e., emphysema, liver and kidney conditions, and stroke). The authors also concluded that there was a two-fold Black-White disparity in sepsis deaths that were strongly mediated across the SES domains. The findings of the current study differ from those of Kemper et al. (2018) because those authors did not provide any analysis for Hispanic/Latinos but only analyzed disparities in Blacks and Whites.

Similarly, Dimeglio et al. (2018) found a disparity in sepsis outcomes existed for different racial groups and based on SES and, specifically, being uninsured (Kahn, 2018). According to Dimeglio et al., sepsis-related morbidity and mortality are higher in non-White racial groups due to patient factors, such as a higher incidence of comorbidities and SES; community factors, such as access to health care including preventive services; and hospital factors, including quality of care. Dimeglio et al.'s findings differ from those

in the current study in that the analysis did not include a breakdown of mortality for Hispanic/Latinos and was for overall sepsis mortality versus only COS. Additionally, in the current study, I used payor source as a proxy measure for SES, with 74.5% of the study population having Medicare coverage. These participants were grouped with those with other insurances for analysis, and the percentage of those with Medicare coverage that were at or below the federal poverty level is unknown, potentially confounding the association of SES and COS mortality.

Sepsis is a complex group of organ and biologic dysfunctions in response to an infection, making mortality predictive modeling difficult (CDC, 2016). Wu et al. (2021) discussed the use of a combination of mortality risk scoring systems based on regression models with real-time, machine-based learning models to improve clinical analysis of the severity of disease and the mortality risk in hospitalized sepsis patients. Because sepsis is more of a syndrome than a discrete disease, risk factors for mortality may present with an additive effect; the additive effect of having multiple comorbidities increasing the risk of poor health outcomes has been well documented for decades (Charlson et al., 1987). In this study, the overall model for predicting mortality was significant; however, only the independent risk factors of diabetes and gender were significant. Given the lack of multicollinearity, one explanation is that the independent risk factors of diabetes and gender were so highly predictive of mortality that they resulted in the model being significant overall. Another explanation would include the possibility that when considered as a group, the independent risk factors were predictive of mortality due to an additive effect.

Limitations of the Study

In this study, I used secondary data from EMRs. The results of this study are only applicable to Hispanic/Latino adults diagnosed with COS. The sample included patients presenting to emergency departments at the hospitals of a large health system in Arizona and Colorado. These findings may not be generalizable to other Hispanic/Latino persons with COS in other geographic locations. Additional risk factors that have been associated with sepsis and sepsis mortality, specifically, frequent contact with the health care system, respiratory and urinary tract infections, and infections caused by certain pathogens (Novosad et al., 2016) were not analyzed due to the availability of data in this secondary data set.

Recommendations

The findings of this study indicate that risk factors for COS may differ from those for hospital-onset sepsis as well as amongst Hispanic/Latino adults when compared with other ethnicities, further supporting the recommendation for specific policy revisions and future research in this area. My recommendations include educating patients on how to care for any comorbidities to avoid the complication of sepsis and its associated mortality and, in particular, the prevention and management of diabetes. Specific to this study population of Hispanic and Latino adults, conversations regarding lifestyle changes to manage or prevent diabetes should be had at every encounter with health care providers and be inclusive of family members. Hispanic persons with diabetes are more likely to seek feedback from family members than the outside health care community, so inclusion of the immediate and sometimes even extended family in education is critical to the

successful adoption of lifestyle changes (Amirehsani et al., 2019). Amirehsani et al. (2019) also shared that the cultural foods for Hispanics/Latinos tend to be of lower nutritional value, with high carbohydrate and sugar content, and that to be successful with dietary changes, healthier alternative methods to prepare cultural foods should be integrated into education efforts. Increased access to nutritional consultations with Hispanic dieticians or dieticians who are well versed in the Hispanic cultural foods should be considered in health care facilities that serve higher proportions of the Hispanic/Latino population.

In this study, I focused exclusively on adult Hispanic/Latino patients with COS and found that the relationships present in the literature for sepsis overall and, specifically, for hospital-onset sepsis did not appear to be the same for this patient population. The same could also be true for Hispanic/Latinos when compared with other racial and ethnic subgroups such as Blacks. Additional research is recommended to determine the extent to which previously identified risk factors in other ethnic subgroups are associated with the odds of developing COS in Hispanics/Latinos.

Future researchers should also examine patients in other geographic regions and health systems. I conducted this study with patients in only two states and who were treated at a health system that has had a comprehensive sepsis improvement initiative for nearly a decade; therefore, the lack of an association of risk factors with COS may not be seen in the broader Hispanic/Latino population in the United States and certainly outside of the United States where the health care infrastructure is substantially different.

Conducting the study in other geographic locations may provide additional information on the risk factors for COS in Hispanic/Latino adults.

In this study, diabetes, obesity, age, gender, and SES, when evaluated together, were predictive of higher COS-related mortality in Hispanic/Latino adults. When evaluated individually, patients with diabetes were twice as likely to experience COS-related mortality than patients without diabetes. Future studies might examine whether mortality risk is higher in patients with controlled versus uncontrolled diabetes as well as differences in mortality between those who are insulin dependent and those controlled with oral medications or diet.

Additionally, patients who were of the male gender in this study had a significantly lower risk of COS-related mortality than females. Santos et al. (2020) found that 33.4% of patients who were treated for sepsis had diabetes mellitus ($p = 0.0037$), with a higher incidence of diabetes observed in female sepsis patients, at 58.3% compared with 41.7% in male sepsis patients. Whether being of the male gender truly leads to lower COS mortality versus female individuals potentially having a higher incidence of other risk factors such as diabetes for COS mortality is an area for future research.

Finally, I used a convenience sample in this study and only analyzed mortality based on the patient's documented discharge disposition from their sepsis hospitalization. Mortality that may have occurred post discharge to home, a skilled nursing or rehabilitation facility, or to another acute care facility were not captured. A longitudinal design would be useful for analyzing participants' mortality for at least 30 days and up to

1 year following their acute sepsis episode. Following these patients over time would allow for a more thorough observation of patient characteristics that may serve as risk factors as well as ensuring a higher capture of sepsis-associated mortality in this population.

Based on the findings of this study, educating patients on how to manage each of their health conditions and, in particular, diabetes is a necessary component to prevent COS hospitalization and death. While obesity and diabetes are clearly interdependent, in this study population, unlike diabetes, obesity was not independently predictive of sepsis mortality. Clearly, both diet and exercise need to be included in patient education programs regarding diabetes management; however, focusing on diet first may result in greater success with both important strategies. Mier et al. (2017) stated that older Hispanic adults who were obese and diabetic reported lower success with physical activity interventions due to perceptions of the interventions causing increased pain. Dietary changes will not only improve diabetes management but is likely to result in some degree of weight loss that may make physical activity changes more tolerable. Patient education and discharge planning should also take into consideration the role diet plays in the social norms for Hispanics/Latinos and include strategies for managing their diet and diabetes that are culturally sensitive.

Positive Social Change

The positive social change implications of this study include providing evidence that could be used in all ambulatory and outpatient care settings to help Hispanic/Latino patients decrease their risk of sepsis and its associated mortality. Specifically, educating

Hispanics/Latino populations on strategies to prevent the development of diabetes that are culturally sensitive and achievable is of critical importance. Such strategies should include dietary instruction on how to modify cultural foods to improve their impact on health rather than just instruction on foods to avoid because elimination of these foods is unlikely to be adopted. This study has provided findings and information that can be used to reduce COS-related mortality in Hispanics/Latinos and develop programs targeting the improvement of specific lifestyle choices and comorbidities.

The results of this study provide evidence to suggest that some risk factors for COS and COS-associated mortality may differ for Hispanic/Latino patients. A better understanding of these factors may help health care providers find new approaches to reducing health disparities among this population, thereby providing for a better treatment platform and resulting in improved health and longevity. Specifically, addressing how patients with diabetes manage their condition in a culturally sensitive way can decrease their risk of developing sepsis.

Conclusion

Previous studies indicated that demographics play a significant role in the development of COS and its associated mortality (Novosad et al., 2016). The extant literature covers the risk factors for sepsis and sepsis mortality as well as some information on COS risk factors specifically, but there is almost no information on sepsis, COS, and the risk factors among Hispanics/Latinos. This study contributes to the extremely limited literature on COS and COS-associated mortality. While there was no relationship between the risk factors evaluated in this study and COS, these risk factors

together, and specifically diabetes and gender, were predictive of COS-related mortality in Hispanic/Latino adults over 50 years of age. The fact that certain Hispanic/Latino adults who develop COS are at higher risk of death than others is information that is important and needs to be considered by health care professionals. The findings from this study can aid health care professionals in developing targeted patient education and disease management plans that decrease COS incidence and COS-related mortality as well as lower the cost of health care utilization for this patient population.

References

American Psychological Association. (n.d.). *Socioeconomic status.* https://www.apa.org/topics/socioeconomic-status#:~:text=Socioeconomic%20status%20is%20the%20social,to%20privilege%2C%20power%20and%20control

Amirehsani, K. A., Hu, J., Wallace, D. C., Silva, Z. A., & Dick, S. (2019). Hispanic families' action plans for a healthier lifestyle for diabetes management. *The Diabetes Educator*, *45*(1), 87–95. https://doi.org/10.1177/0145721718812478

Andersen, R. (1968). *Behavioral model of families' use of health services. Research Series No. 25.* Center for Health Administration Studies, University of Chicago.

Andersen, R. M. (1995). Revisiting the behavioral model and access to medical care: Does it matter? *Journal of Health and Social Behavior*, *36*(1), 1–10. https://doi.org/10.2307/2137284

Babitsch, B., Gohl, D., & von Lengerke, T. (2012). Re-revisiting Andersen's behavioral model of health services use: A systematic review of studies from 1998-2011. *Psycho-Social Medicine*, *9*. https://doi.org/10.3205/psm000089

Baghdadi, J. D., Brook, R. H., Uslan, D. Z., Needleman, J., Bell, D. S., Cunningham, W. E., & Wong, M. D. (2020). Association of a care bundle for early sepsis management with mortality among patients with hospital-onset or community-onset sepsis. *JAMA Internal Medicine*, *180*(5), 707–716. https://doi.org/10.1001/jamainternmed.2020.0183

Baghdadi, J. D., Wong, M., Comulada, W. S., & Uslan, D. Z. (2018). Lack of insurance as a barrier to care in sepsis: A retrospective cohort study. *Journal of Critical Care, 46*, 134–138. https://doi.org/10.1016/j.jcrc.2018.02.005

Bloomfield, J., & Fisher, M. J. (2019). Quantitative research design. *Journal of the Australasian Rehabilitation Nurses' Association, 22*(2), 27–30. https://doi.org/10.33235/jarna.22.2.27-30

Centers for Disease Control and Prevention. (2016, August 23). *Sepsis.* https://www.cdc.gov/sepsis/datareports/index.html

Centers for Disease Control and Prevention. (2017, May 17). *Deaths, percent of total deaths, and death rates for the 15 leading causes of death: United States and each State, 1999-2015*. https://www.cdc.gov/nchs/data/dvs/LCWK9_2015.pdf

Centers for Disease Control and Prevention. (2020b, June 11). *What is diabetes?* https://www.cdc.gov/diabetes/basics/diabetes.html

Centers for Disease Control and Prevention. (2020a, September 17). *Body mass index (BMI).* https://www.cdc.gov/healthyweight/assessing/bmi/index.html

Charlson, M. E., Pompei, P., Ales, K. L., & MacKenzie, C. R. (1987). A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. *Journal of Chronic Diseases,* 40, 373-383. http://www.sbcdb.ch/download/HSM_Suppl_8_charlson.pdf

Cohen, J. (1992). Statistical power analysis. *Current Directions in Psychological Science, 1*(3), 98–101. https://doi.org/10.1111/1467-8721.ep10768783

Corl, K., Levy, M., Phillips, G., Terry, K., Friedrich, M., & Trivedi, A. N. (2019). Racial and ethnic disparities in care following the New York State sepsis initiative. *Health Affairs, 38*(7), 1119–1126. https://doi.org/10.1377/hlthaff.2018.05381

DiMeglio, M., Dubensky, J., Schadt, S., Potdar, R., & Laudanski, K. (2018). Factors underlying racial disparities in sepsis management. *Healthcare, 6*(4), 133. https://doi.org/10.3390%2Fhealthcare6040133

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods, 41*, 1149-1160. https://doi.org/10.3758/BRM.41.4.1149

Fay, K., Sapiano, M. R. P., Gokhale, R., Dantes, R., Thompson, N., Katz, D. E., Ray, S. M., Wilson, L. E., Perlmutter, R., Nadle, J., Godine, D., Frank, L., Brousseau, G., Johnston, H., Bamberg, W., Dumyati, G., Nelson, D., Lynfield, R., DeSilva, M.,… Epstein, L. (2020). Assessment of health care exposures and outcomes in adult patients with sepsis and septic shock. *JAMA Network Open, 3*(7), e206004. https://doi.org/10.1001/jamanetworkopen.2020.6004

Galiatsatos, P., Brigham, E. P., Pietri, J., Littleton, K., Hwang, S., Grant, M. C., Hansel, N. N., & Chen, E. S. (2018). The effect of community socioeconomic status on sepsis-attributable mortality. *Journal of Critical Care, 46*, 129–133. https://doi.org/10.1016/j.jcrc.2018.01.008

Hirshfield, S., Downing, M. J., Jr., Horvath, K. J., Swartz, J. A., & Chiasson, M. A. (2018). Adapting Andersen's behavioral model of health service use to

examine risk factors for hypertension among US MSM. *American Journal of Men's Health, 12*(4), 788–797. https://doi.org/10.1177/1557988316644402

Jager, J., Putnick, D. L., & Bornstein, M. H. (2017). More than just convenient: The scientific merits of homogeneous convenience samples. *Monographs of the Society for Research in Child Development, 82*(2), 13–30. https://doi.org/10.1111/mono.12296

Jawaid, Y., Ahmed, W., Kusmic, D., Ajmeri, A., Mansoor, K., Mannino, C., Judge, T., Carter, L. E., & Ajmera, A. V. (2018). The influence of body mass index on survival and length of stay in patients with septic shock. *Marshall Journal of Medicine, 4*(4), 65-74. https://doi.org/10.18590/mjm.2018.vol4.iss4.11

Kahn, J. M. (2018). Economic disparities in sepsis-New insights with new implications. *Journal of Critical Care, 46*, 127–128. https://doi.org/10.1016/j.jcrc.2018.04.011

Kattan, W. M., & Abduljawad, A. A. (2019). Predicting different factors that affect hospital utilization and outcomes among diabetic patients admitted with hypoglycemia using structural equation modeling. *Diabetes Research and Clinical Practice, 153*, 55–65. https://doi.org/10.1016/j.diabres.2019.05.031

Kempker, J. A., Kramer, M. R., Waller, L. A., & Martin, G. S. (2018). Risk factors for septicemia deaths and disparities in a longitudinal U.S. cohort. *Open Forum Infectious Diseases, 5*(12). https://doi.org/10.1093/ofid/ofy305

Lariscy, J. T., Hummer, R. A., & Hayward, M. D. (2015). Hispanic older adult mortality in the United States: New estimates and an assessment of factors shaping the

Hispanic paradox. *Demography 52*, 1–14. https://doi.org/10.1007/s13524-014-0357-y

Li, S., Hu, X., Xu, J., Huang, F., Guo, Z., Tong, L., Lui, K. Y., Cao, L., Zhu, Y., Yao, J., Lin, X., Guan, X., & Cai, C. (2019). Increased body mass index linked to greater short- and long-term survival in sepsis patients: A retrospective analysis of a large clinical database. *International Journal of Infectious Diseases, 87*, 109–116. https://doi.org/10.1016/j.ijid.2019.07.018

Ljungström, L., Andersson, R., & Jacobsson, G. (2019). Incidences of community-onset severe sepsis, Sepsis-3 sepsis, and bacteremia in Sweden - A prospective population-based study. *PloS One, 14*(12), e0225700. https://doi.org/10.1371/journal.pone.0225700

McGrath, R. P., Snih, S. A., Markides, K. S., Faul, J. D., Vincent, B. M., Hall, O. T., & Peterson, M. D. (2019). The burden of health conditions across race and ethnicity for aging Americans: Disability-adjusted life years. *Medicine, 98*(46), e17964. https://doi.org/10.1097/MD.0000000000017964

Mendola, N. D., Chen, T. C., Gu, Q., Eberhardt, M. S., & Saydah, S. (2018). *Prevalence of total, diagnosed, and undiagnosed diabetes among adults: United States, 2013-2016* (NCHS Data Brief, No. 319). National Center for Health Statistics. https://www.cdc.gov/nchs/data/databriefs/db319.pdf

Mier, N., Smith, M. L., Wang, X., Towne, S. D., Carrillo, G., Garza, N., & Ory, M. G. (2017). Factors associated with diet and exercise among overweight and obese

older Hispanics with diabetes. *SAGE Open*. https://doi.org/10.1177/2158244017710840

Moore, J. X., Donnelly, J. P., Griffin, R., Safford, M. M., Howard, G., Baddley, J., & Wang, H. E. (2017). Community characteristics and regional variations in sepsis. *International Journal of Epidemiology*, *46*(5), 1607–1617. https://doi.org/10.1093/ije/dyx099

Novosad, S. A., Sapiano, M. R. P., Grigg, C., Lake, J., Robyn, M., Dumyati, G., Felsen, C., Blog, D., Dufort, E., Zansky, S., Wiedeman, K., Avery, L., Dantes, R. B., Jernigan, J. A., Magill, S. S., Fiore, A., & Epstein, L. (2016). Vital signs: Epidemiology of sepsis: prevalence of health care factors and opportunities for prevention. *MMWR: Morbidity & Mortality Weekly Report*, *65*(33), 864–869. https://doi.org/10.15585/mmwr.mm6533e1

Paoli, C. J., Reynolds, M. A., Sinha, M., Gitlin, M., & Crouser, E. (2018). Epidemiology and costs of sepsis in the United States-An analysis based on timing of diagnosis and severity level. *Critical Care Medicine*, *46*(12), 1889–1897. https://doi.org/10.1097/CCM.0000000000003342

Pew Research Center. (n.d.). *Demographic and economic profiles of Hispanics by state and county, 2014.* https://www.pewresearch.org/hispanic/states/

Pew Research Center. (2017). *How the U.S. Hispanic population is changing.* https://www.pewresearch.org/fact-tank/2017/09/18/how-the-u-s-hispanic-population-is-changing/

Reinhart, K., Daniels, R., Niranjan, K., Machado, F. R., Schachter, R. D., & Simon, F. (2017). Recognizing sepsis as a global health priority - A WHO resolution. *The New England Journal of Medicine, 377*(5), 414-417. https://doi.org/10.1056/NEJMp1707170

Rhee, C., Dantes, R., Epstein, L., Murphy, D. J., Seymour, C. W., Iwashyna, T. J., Kadri, S. S., Angus, D. C., Danner, R. L., Fiore, A. E., Jernigan, J. A., Martin, G. S., Septimus, E., Warren, D. K., Karcz, A., Chan, C., Menchaca, J. T., Wang, R., Gruber, S., & Klompas, M. (2017). Incidence and trends of sepsis in U.S. hospitals using clinical vs. claims data, 2009-2014. *JAMA, 318*(13), 1241–1249. https://doi.org/10.1001/jama.2017.13836

Rhee, C., Wang, R., Zhang, Z., Fram, D., Kadri, S. S., Klompas, M., & CDC Prevention Epicenters Program (2019). Epidemiology of hospital-onset versus community-onset sepsis in U.S. hospitals and association with mortality: A retrospective analysis using electronic clinical data. *Critical Care Medicine, 47*(9), 1169–1176. https://doi.org/10.1097/CCM.0000000000003817

Rudd, K. E., Johnson, S. C., Agesa, K. M., Shackelford, K. A., Tsoi, D., Kievlan, D. R., Colombara, D. V., Ikuta, K. S., Kissoon, N., Finfer, S., Fleischmann-Struzek, C., Machado, F. R., Reinhart, K. K., Rowan, K., Seymour, C. W., Watson, R. S., West, T. E., Marinho, F., Hay, S. I., … Naghavi, M. (2020). Global, regional, and national sepsis incidence and mortality, 1990–2017: Analysis for the Global Burden of Disease Study. *The Lancet, 395*(10219), 200–211. https://doi.org/10.1016/S0140-6736(19)32989-7

Santos, S., Ponciano, A., Monteiro, J. R., Pinhal, F., Leite, J., & Fernandes, C. (2020). Sepsis - Retrospective observational study of sepsis and septic shock treated in internal medicine wards. *Galicia Clínica, 81*(3), 70-74. https://doi.org/10.22546/57/1977

Schreiber-Gregory, D., Jackson, H.M., & Bader, K. (2018). *Logistic and linear regression assumptions: Violation recognition and control*. SESUG Paper 247 - 2018. https://analytics.ncsu.edu/sesug/2018/SESUG2018_Paper-247_Final_PDF.pdf

Travers, J. L., Hirschman, K. B., & Naylor, M. D. (2020). Adapting Andersen's expanded behavioral model of health services use to include older adults receiving long-term services and supports. *BMC Geriatrics*, *20*(1), 58. https://doi.org/10.1186/s12877-019-1405-7

Tsertsvadze, A., Royle, P., Seedat, F., Cooper, J., Crosby, R., & McCarthy, N. (2016). Community-onset sepsis and its public health burden: a systematic review. *Systematic Reviews, 5*, 1. https://doi.org/10.1186/s13643-016-0243-3

Valderas, J. M., Starfield, B., Sibbald, B., Salisbury, C., & Roland, M. (2009). Defining comorbidity: Implications for understanding health and health services. *Annals of Family Medicine, 7*(4), 357–363. https://doi.org/10.1370/afm.983

Walkey, A. J., Lagu, T., & Lindenauer, P. K. (2015). Trends in sepsis and infection sources in the United States. A population-based study. *Annals of the American Thoracic Society, 12*(2), 216–220. https://doi.org/10.1513/AnnalsATS.201411-498BC

World Health Organization. (2020, April 1). O*besity and overweight*. https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

Wu, Y., Huang, S., & Chang, X. (2021). Understanding the complexity of sepsis mortality prediction via rule discovery and analysis: A pilot study. *BMC Medical Informatics and Decision Making*, 21(1), 334. https://doi.org/10.1186/s12911-021-01690-9