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Population Level Impact of Self-Immolation on Burn Unit Resources: A Retrospective Case-Matched Study

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Appendix D

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We hereby certify that this dissertation, submitted by Kristina Rosa Bolling, conforms to acceptable standards and is fully adequate in scope and quality to fulfill the dissertation requirement for the degree of Doctor of Philosophy (Ph.D.) in Health Science.

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Abstract

***Background*:** This investigator sought to enhance medical knowledge and clinical care by distinguishing the population level characteristics of patients who attempted self-immolation within the burn population and determine the impact these patients have on health-care related resource utilization. ***Methods*:** Patients who met the inclusion criteria and were admitted for a documented attempt of self-immolation were case-matched based on age, gender, total body surface area burn, inhalation injury, and burn mechanism to individuals who experienced accidental burn injuries and were admitted to the burn unit during the same time-period. To compare patients, this investigator matched patient groups using a propensity score method. ***Results*:** Seventy-two total patients, including matched pairs, were selected after propensity scoring. Self-immolation patients had a significant difference in preexisting history of depression ($p = .008$), psychiatric disease ($p = .028$) and previous psychiatric treatment ($p < .001$) as compared to accidental burn injury patients. They were also more likely to present with a history of anxiety (OR = 1.8), drug abuse (OR = 2.5) and alcohol abuse (OR = 2.8). Longer length of stay and the need for more specialty consult services visits ($p = .002$), and higher rates of complications ($p = .013$) were also found among self-immolation patients. Self-immolation patients were twice as likely to experience greater burn depth with differences in full thickness burn admissions (OR = 2.2). Self-immolation patients required more concomitant surgical procedures than accidental burn injury patients (p = .024) and were nearly three times as likely to be readmitted (OR = 2.82) to the hospital with longer hospital stays during readmission in comparison with accidental burn patients (15 days vs. 9 days). ***Conclusion*:** Self-immolation patients had distinguishable differences in patient level characteristics and utilized more burn unit health-related resources as compared to matched accidental burn injury patients.

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Chapter 1: Introduction

Introduction to the Chapter

The use of fire by individuals as a means of attempting or committing suicide is relatively rare in the United States (US). Although these patients constitute a small percent of burn unit admissions, they pose a significant challenge to clinical care. This investigator sought to enhance medical knowledge and clinical care by distinguishing the population level characteristics of patients who attempted self-immolation within the burn population of the burn unit of Tampa General Hospital-University of South Florida (USF) Health and determine the impact these patients have on health-care related resource utilization.

Background to the Problem

Suicide is a major global public health problem that affects individuals of all ages. In the United States from 1999 through 2018, the suicide rate increased from 35% from a rate of 10.5 per 100,000 to 14.2 per 100,000 (Hedegaard et al., 2020). In 2017, there were an estimated 1.3 million suicide attempts, resulting in 47,173 reported suicide deaths, making suicide the 10th leading cause of death in the United States (CDC, 2018). Since 2009, the U.S. age-adjusted suicide death rate has increased for all races and ethnicities (Suicide Prevention Resource Center [SPRC], 2020) with rates of suicide highest among American Indian/Alaska Native, non-Hispanic males (33.6 per 100,000) and females (11.0 per 100,000), followed by White, non-Hispanic males (28.2 per 100,000) and females (7.9 per 100,000; CDC, 2020).

In the state of Florida where this research was conducted, the suicide rate is high compared to the national average (13.4 per 100,00 in Florida vs. 15.9 per 100,000 nationally (CDC, 2021a), making suicide the 11th leading cause of death in Florida (Florida Department of Children and Families [FDCF], 2018). Over twice as many people die by suicide in Florida

annually than by homicide with the total deaths to suicide reflecting 49,282 years of potential life lost (YPLL) before the age of 65 (American Foundation for Suicide Prevention [AFSP], 2016). In 2010, suicide cost the state of Florida a total of $2.8 billion dollars of combined lifetime medical and work loss cost or an average of $1million per suicide death (AFSP, 2016). Demographically, suicide rates in Florida increased significantly for minority groups with minority suicide rates increasing by 33% among African Americans and 65% among Hispanics in 2016 (FDCF, 2018; Florida Health, 2017).

With suicide by fire, unlike firearms, suffocation and poisoning is an uncommon method of self-destruction in the western world, which is evident in the paucity of literature available for historic review in the United States. Self-inflicted burns are defined as occurring in the context of deliberate self-harm and/or attempted suicide (Greenbaum et al., 2004). Although self-inflicted burns account for only about 1% of all burn injuries in the United States, self-inflicted burn patients are a highly complex group that pose significant challenges to clinical care (C. H. Rietschel et al., 2015) including large burn sizes, higher mortality (Forster et al., 2012) and greater presentation of psychiatric disorders, such as depression and schizophrenia (Laloë, 2004; Pham et al., 2003; Stoddard et al., 1985), which can affect recovery and rehabilitation efforts.

Due to the complex nature of the injuries that occur with suicide and the psychological factors that influence treatment, research for suicide can be limited by understanding and methodology. Definitions lack uniformity, proximal measures are not always predictive of suicide, reporting is inaccurate, and its low frequency exacerbates all of these problems (Goldsmith et al., 2002). Given its unique nature, research on suicide faces a series of obstacles that limit progress in the understanding, prevention, and treatment of the problem (Goldsmith et al., 2002). Because the field is a conglomeration of several disciplines that grew up

independently, issues of interdisciplinary research pose problems of communication, jargon, and interdisciplinary rivalries (NiakanKalhori et al., 2018).

National data show a perspective on the scale of the problem of suicide and permit the evaluation of the impact of federal laws (Goldsmith et al., 2002). Given the low-base rate of completed suicide, national level data is necessary to aggregate enough cases to identify patterns of suicide across populations (Goldsmith et al., 2002, p. 1). Though previous studies about self-inflicted burn patients have yielded results of higher total body surface area (TBSA), complications, and mortality, these studies have no comparison for self-inflicted burn suicide patients directly with accidental burn injuries within the parameters of the dissertation study within the Greater Tampa Bay area. The data this investigator analyzed is intended to be the foundation for better understanding at the population level of patients who attempt self-immolation in order to influence clinical care practitioners and strengthen medical knowledge.

Statement of the Problem

Deliberately inflicted burn injuries are associated with worse outcomes than accidental injuries, both relating to length of stay in hospital (Wood, 2014) and an increased risk of mortality when compared with accidental burn injuries of similar severity (Ali et al., 2006). Unlike patients with accidental burn injuries, self-inflicted injuries incite negative countertransference reactions in staff caring for these patients, and it has been shown that patients with self-inflicted burn injuries report a significantly lower perception of care compared with other burn patients (Wood, 2014). Identifying the unique characteristics of self-inflicted burn patients is necessary to develop appropriate and effective interventions for this difficult burn subgroup (C. H. Rietschel et al., 2015).

Although it is a global public health problem, suicide is highly preventable with appropriate education and access to care. Since 1958, national suicide awareness and prevention programs have been implemented to educate and support individuals, families, and communities suffering from the effects of suicide. The foundations for these programs are rooted in the development and dissemination of evidence-based research. This investigator sought to further enhance the literature about this patient population by highlighting the patient level differences among self-immolation injuries and to determine the impact these differences have on health-related resource utilization as compared to accidental burn injuries.

To achieve these aims, a retrospective case-matched study was conducted to compare patients in the burn unit of Tampa General Hospital (TGH) who sustained burn injuries through attempted self-immolation with patients who sustained accidental burn injuries. With this comprehensive comparison study, the investigator intends to provide a better understanding of self-immolation from a population level and determine its impact on health-related resources in the burn unit. As the population in the Greater Tampa Bay area similarly reflects that of the general U.S. population (76.5% White vs. 23.5% minority and Greater Tampa Bay, 84.6% White vs.15.3% minority, respectively; U.S. Census Bureau, 2020), the results of this dissertation study could be generalized beyond the Greater Tampa Bay area. Ultimately, this study will show evidence-based research to key clinical stakeholders about the differing characteristics of those who attempt self-immolation in order to enhance standards of care practices and to better care for these patients by having a better understanding of the resources needed to support their healing.

Relevance

Burn injuries are the fourth most common type of trauma worldwide, following motor vehicle accidents, falls, and interpersonal violence with an estimate of 11 million people

requiring medical attention annually (World Health Organization [WHO], 2019). Suicide by burning is among the most dramatic of all forms of suicide (Thombs et al., 2007). Perhaps more than any other form of self-destruction, the act of suicide by burning has a long-documented history of powerful cultural meaning and political impact across much of the world (Crosby et al., 1977).

Intentional self-burning injuries occur rarely in most critical care units, accounting for a fraction of all burn related admissions (Nisavic et al., 2017). Although rare in western civilization, these types of self-burning injuries have considerable global distribution with the US and Europe typically accounting for as little as 1% to 6% of all burn unit admissions while intentional self-burn injuries are considerably more prevalent in developing countries where they may account for as many as 25% to 30% of all burn unit admissions (Ahmadi, 2007; Laloë, 2004). These differences may be occurring due to the significance and interpretation of self-burning as a method of self-harm or suicide, which varies according to the country or part of the world, and can be accounted for by the cultural, religious, and psychosocial differences (Laloë, 2004). Nonetheless, these injuries are often severe, and generate considerable challenges for acute medical management of the patient as well as the management of underlying psychiatric or substance use needs (Nisavic et al., 2017).

Bolling et al. (2017) performed a descriptive analysis of the burn unit of Tampa General Hospital and sought to discover cultural level patterns by analyzing the risk factors and frequency of self-inflicted burn suicide within minority populations. Among 34 patients that were admitted to the unit from 2012 to 2016 for attempted self-inflicted burn suicide, 50% identified themselves as White while the other 50% identified themselves as minorities. Within the minority patient population, rates of common risk factors, such as history of mental health

disorders, psychiatric illness and substance abuse history, were reported at lower rates than their White counterparts.

Amid self-reported history of mental illness, minority patients reported lower rates of depression (47.1% vs. 64.7%), anxiety (11.8% vs. 41.2%), and psychiatric disease (29.4% vs. 52.9%), respectively (Bolling et al., 2017). Among substance abuse history, minorities also reported lower rates of drug abuse (23.5% vs. 58.8%) as compared with White patients (Bolling et al., 2017). Overall, within the self-inflicted burn suicide population, Whites were twice as likely as minorities to report a history of depression and five times more likely as minorities to report a history of anxiety and drug abuse. Bolling et al. concluded that minorities were at greater risk for attempting self-inflicted burn suicide within the burn unit population and less likely to report a history of common risk factors for suicide (Bolling et al., 2017).

In order to validate these study findings and confirm the risk of self-inflicted burn suicide among the minority populations as well as confirm the rate of under-reporting of common risk factors, a comparison of self-inflicted burn suicide patients with patients who attempted suicide by other means was conducted. With this six-year (2012 to 2017) retrospective analysis of charts, Bolling et al. (2018) found at TGH that among 169 suicide patients, including 34 self-inflicted burn suicide patients and 135 non-burn suicide patients (suicide by other means), there was a significant difference in minority admission for self-inflicted burn suicide, and trends showing that minorities within this group were less likely to report common risk factors for suicide.

The investigator found that the non-burn suicide group was comprised of 25% minority and 74% White, which was comparable with the population rates in Florida (United States Census Bureau, 2018) while the self-inflicted burn suicide group was comprised of 50% minority

and 50% White ($p <$ 0.0026; Bolling et al., 2018). Although not statistically significant, minorities in the self-inflicted burn suicide group reported lower rates of common risk factors, such as depressions (47% vs. 65%), anxiety (12% vs. 41%), and drug abuse (24% vs. 59%), respectively (Bolling et al., 2018). Within Hillsborough County (74.3% White and 25.7% minority; U.S. Census Bureau, 2020), in the Greater Tampa Bay area, minorities also accounted for a higher percentage of burn suicide as compared with non-burn suicide (55.6% vs. 29.2%, [$p < .0283$]) with higher odds of reporting unemployment than Whites (OR: 31.185, $p < .0233$) while other risk factors were reported at a lower rate.

Bolling et al. (2017, 2018) have established a relevant self-immolation patient population within the Greater Tampa Bay area. These researchers have reported on the racial differences among self-immolation patients, the low risk factor reporting rates among minorities, and the differences in the context of demographics and risk factor reporting, of self-immolation patients, and patients who attempted suicide by other means. The place this dissertation study differentiates itself from those previous studies is in the aim to determine the population level impact of self-immolation patients on health-related resource utilization through the comparison of self-immolation patients directly to those who experience accidental burn injuries. Although similar demographic and mental health information has been collected independently for previous studies on self-immolation patients within the burn unit, it has not yet been assessed in comparison to accidental burn patients or in the context of health-related resource utilization.

Elements

Research Questions and Hypotheses

Research Question 1

What are the differences between the self-immolation and accidental burn patient populations with regards to sociodemographic and socioeconomic information, substance abuse history, and mental illness?

- Sociodemographic: age, gender, and race/ethnicity.
- Socioeconomic: insurance coverage and employment status.
- Substance abuse: drug abuse and alcohol abuse
- Mental illness: history of anxiety, history of depression, and psychiatric history.

Hypothesis 1

Hypothesis

Self-immolation patients have unique patient level characteristics differentiating them from accidental burn injuries.

Null Hypothesis

Self-immolation patients have no unique patient level characteristics differentiating them from accidental burn patients.

Research Question 2

Do self-immolation patients experience higher rates of mortality compared to accidental burn patients?

Hypothesis 2

Self-immolation patients experience higher rates of mortality as compared with accidental burn patients.

Null Hypothesis 2

Self-immolation patients do not experience higher rates of mortality as compared with accidental burn patients.

Research Question 3

What are the differences in burn unit health-related resource utilization among self-immolation and accidental burn patients with regards to hospital stay, surgical interventions, burn-related complications, and utilization of specialty services?

- Hospital stay: ICU days and burn floor days.
- Surgical interventions: number and type.
- Inpatient specialty consults services: number and specialty type.
- Burn related complications: diagnosed complications after admission.

Hypothesis 3

Self-immolation patients utilize more burn unit health-related resources than accidental burn patients with regard to hospital stay, surgical interventions, burn-related complications, and utilization of specialty services.

Null Hypothesis 3

Self-immolation patients do not utilize more burn unit health-related resources than accidental burn patients with regard to hospital stay, surgical interventions, burn-related complications, and utilization of specialty services.

Research Question 4:

Do self-immolation patients experience higher rates of re-admissions (hospital admissions via emergency department, burn unit admission via emergency department or direct inpatient admissions, or inpatient rehab facility) after discharge compared to accidental burn patients?

- Re-admission rates: reason for re-admission and number of days in the hospital.

Hypothesis 4

Self-immolation patients utilize more inpatient unit resources as compared with accidental burn injury patients.

Null Hypothesis 4

Self-immolation patients do not utilize more inpatient burn unit resources as compared with accidental burn injury patients.

Definition of Terms

For the purpose of clarification, the important terms used in this study have been identified:

Self-Inflicted Burn

Terms for self-inflicted burn include self-harm, self-mutilation, or deliberately infected and is defined as occurring in the context of deliberate self-harm and/or attempted suicide.

Self-Immolation

Self-immolation is also termed self-destruction and self-inflicted burn suicides that are defined occurring in the context of deliberate self-harm and/or attempted suicide with the intention of death.

Risk Factors

Risk factors are any attribute, characteristic or exposure of an individual that increases the likelihood of deploying a disease or injury. Common risk factors for suicide within the dissertation study include history of mental illness, psychiatric disease, substance abuse history, and employment status.

Greater Tampa Bay Area

The Greater Tampa Bay area has over four million residents. The United States Census Bureau defines the Greater Tampa Bay areas as the Tampa-St. Petersburg-Clearwater

Metropolitan Statistical Area (MSA), including Hillsborough and Pinellas Counties along with Hernando and Pasco Counties to the north.

Thermal/Flash Flame Burn

Thermal burns result from tissue exposure to an external heat source. Flash and flame burns occur due to direct or indirect exposure of a patient to a flame source.

Electrical Burn

An electrical burn is a skin burn that happens when electricity comes in contact with the body.

Chemical Burn

A chemical burn occurs when the skin comes in contact with an irritant, such as an acid or a base.

First-Degree Burns

First-degree burns are also called a superficial burn is an injury that affects the first layer of skin.

Second-Degree Burn

Second-degree burns are also called partial thickness burns and are more severe than first degree burns. They affect the outer layer of skin called the epidermis and part of the second layer of skin, called the dermis.

Third-Degree Burn

Third-degree burns are also called a full-thickness burn and destroys the outer layer of skin (epidermis) and the entire layer beneath (the dermis).

Sociodemographic Information

Factors include age, gender, race, and ethnicity. They are used to characterize populations and estimate population need.

Socioeconomic Status

Factors of socioeconomic status include employment status and insurance coverage. They are used to show inequalities in access to resources plus issues related to privilege power and control.

Substance Abuse History

Substance abuse history refers to harmful or hazardous self-reported use of psychoactive substances, including alcohol and illicit drugs.

Mental Illness

Also called mental health disorders, mental illness refers to a wide range of mental health conditions or disorders that affect mood, thinking and behavior, which includes anxiety and depression and psychiatric disorders, such as schizophrenia.

Inhalation Injury

Inhalation injuries are acute injuries to the respiratory system and lungs. They occur when an individual's breathe in toxic substances, such as smoke (from fires), chemicals, particle pollution, and gases.

Surgical Debridement

Surgical debridement involves using surgical instruments to thoroughly cut away and remove all hyperkeratotic (thickened skin or callus), infected and nonviable (necrotic or dead) tissue, foreign debris, and residual material from the burn wounds..

Allograft

An allograft is tissue that is transplanted from one person to another, typically from a donor or cadaver. Allograft is considered as a temporary wound coverage.

Xenograft

A xenografic dressing (often pig skin) is used to provide temporary cover and pain control for superficial burn wounds and donor sites.

Autograft

An autograft is taken from person burned persons, which is used to cover their own wounds permanently.

Burn-Related Complications

Burn-related complications include systemic complications and burn wound specific complications. Examples include bacterial infection, bloodstream infection (sepsis) fluid loss, low blood volume, low body temperature, and impaired mobility and scar formation.

Inpatient Specialty Services

Specialty care services include referrals to departments outside of Burns/Plastic Surgery. Examples include specialty consults to the department of psychiatry, department of psychology, vascular surgery, general surgery, and so forth.

Summary of Chapter

Although suicide is a difficult topic to address, additional information about self-immolation patients and their use of hospital resources can serve as a foundation for tailored prevention and care planning. Previous researchers have established a relevant cohort of self-immolation patients in the burn unit of TGH-USF Health in Hillsborough County within the Greater Tampa Bay area. However, no data currently exists about the comparison of self-immolation patients to accidental burn patients within this population.

Determining how self-immolation patients differ from accidental burn patients is used for a better understanding at the population level, including the similarities and differences in sociodemographic and socioeconomic background, history of substance abuse and mental illness, and burn unit health-related resource utilization. This retrospective review of secondary de-identified data had information at a population level as well as information on the constraints these injuries placed on health-related resources to better understand the patient population and provide insight into clinical care practices.

Chapter 2: Review of Literature

Introduction to the Chapter

Suicide is a complex public health problem that effects individuals of all ages, genders races, and ethnicities. A review of the literature has produced information both nationally and internationally about the impact of self-inflicted burns and self-immolation on individuals, communities, and health-related resource utilization. Understanding the existing research, identifying potential gaps, and exploring the need for future research can help to create the foundation for further evaluation of this patient population.

Historical Overview

Humans have been perplexed with the phenomenon of suicide since the dawn of human civilization (Greydanus, 2017). Accounts of culturally sanctioned ritualistic self-burning go back as far as the first century B.C. Greece (Crosby et al., 1977), and intentional self-burning continues today to be a major cause of serious burn injury and death in many parts of the world (Laloë, 2004). Although attempted suicide by burning is relatively rare in North America and Europe, (Laloë, 2004), deliberate self-harm carries a significant risk of death with over 800,000 deaths in association with self-immolation worldwide (Saadati et al., 2019).

Previous researchers have noted that there are no readily identifiable cultural patterns or practice reflected in profiles of individuals who attempt suicide by burning in western cultures (Thombs et al., 2007). In developing countries, however, family dynamics that include intimate partner violence, forced marriages, and interpersonal family conflicts have implications for self-immolation. Poor access to mental health services, war-related events, poverty, forced migration, and ethnic conflicts are also important factors contributing to suicide by self-immolation in low- and middle-income countries (Alfonso & Prabha, 2021). The deliberate action of self-

immolation is mostly reported in mid- and low-income countries, such as Asia and Africa (Mohammadi et al., 2020). Additionally, the risk factors for self-immolation vary among countries. Most victims in developed countries tend to be older men while in low- and middle-income countries, it tends to be among younger women (Mohammadi et al., 2020). Moreover, the most frequent predisposing factor for self-immolation in non-western population has been reported to be adjustment disorders while psychoses, addictions, and major depression were reported among western countries (Ahmadi et al., 2009).

Self-inflicted burns are often associated with a larger surface area burns, increasing burn depth, subsequent increased length of stay in the hospital, and a higher morbidity and mortality (Horner et al., 2005; Seoighe et al., 2011; Thombs et al., 2007). There is a suggestion that these findings present the need for further evaluation of this patient population to better understand the patient-level characteristics among the diverse populations it effects and the impact it has on the health care system.

Although self-immolation patients account for only about 2% to 6% of burn unit admissions (Castana et al., 2013), they are a complex group that constitute considerable morbidity and mortality in more economically developed counties, and there is substantial debate regarding the pathophysiological relevance between self-inflected burns and unfavorable outcomes (Ryo et al., 2019). Castaneda et al. (2013) evaluated a six-year retrospective chart review and determined that despite the low incidence of suicide attempts by self-immolation, they were associated with a much higher mortality, higher total body surface area burn, higher frequency of complications, and prolonged hospital stay. Castana et al. (2013) found that among nine patients, the average TBSA was 40.4%. The surviving patients were taken to the operating theatre under general anesthesia at least twice during their hospital stay, and nearly all returned

for more surgery after their discharge (Castana et al., 2013). Although the sample size was small (n = 9), Castaneda et al. (2013) showed a trend of high TBSA and frequency of complications among self-immolation patients.

Mushin et al. (2019) performed a retrospective analysis of patients through the Department of Surgery at the University of Rochester and determined that patients with self-inflicted burns had higher rate of previous self-harm behavior, psychiatric comorbidities, and substance abuse. In a cohort of 34 patients, 53% of patients presented with altered mental status secondary to either psychiatric illness or intoxication, and when compared with a control group of 166 patients with non-intentional burns, patient with self-inflicted burns had higher rates of substance abuse (35% vs. 13%), longer hospital stays (11.3 vs. 5.3 days), and longer stay (1.8 vs. 0.2 days) in the intensive care units (Mushin et al., 2019). Like Castana et al. (2013), Mushin et al. (2019) found that self-immolation patients were more likely to require surgical procedures and expanded individual resources compared with those with non-intentional burns affirming that although rare, self-immolation has an impact on health-care related resource utilization.

Pham et al. (2003) retrospectively reviewed the charts of 32 diagnosed self-inflicted burn patients in the regional burn unit at the University of California, Davis, and found that 91% of patients had an active psychiatric diagnosis with 47% having had a previous suicide attempt. The researchers found that two thirds had a chronic stressor, such as a chronic mental illness and/or long-term disability (Pham et al., 2003). In addition to well-described psychiatric factors, Pham et al. (2003) also found common characteristics predisposing to self-inflicted burns included chronic medical illness, long-term disability, and a lack of access to adequate mental health care.

While the link between suicide and mental disorders (in particular, depression and alcohol use disorders) is well established, many suicides happen impulsively in moments of

crisis with a breakdown in the ability to deal with life stress, such as financial problems, relationship break-up, or chronic pain and illness (WHO, 2018). In addition, experiencing conflict, disaster, violence, abuse, or loss and a sense of isolation are strongly associated with suicidal behavior (WHO, 2018). These underlying risk factors and stressors have significant challenges to recovery for self-immolation patients, which significantly affects standard of care practices throughout burn units.

However, it is important to note that studies among accidental burn injuries have also shown that patients with an existing diagnosis of psychosis or depression who were admitted to a burn service had longer hospital stays and longer wound healing times when compared with controls matched for burn injury, but without a pre-existing diagnosed psychiatric condition (Wisely et al.,2010). When comparing self-inflicted burns with nonintentional burns C. Rietschel et al. (2015) found that among 16 self-infected burn patients and 178 noninternal burns, self-inflicted burn patients were characterized by significantly more psychiatric features and worse mental health relative to a group of nonintentional burn patients. These findings show the need for further evaluation of mental health disorders and psychiatric illness in the context of both diagnosis and treatment history when comparing self-immolation patients with accidental burn injury patients.

The correlation between gender and suicide attempt or ideation is also variable within the literature. Researchers who conducted studies in developing counties have often found that suicide and self-immolation in particular are more common among females (Masoomi et al., 2020), whereas studies conducted in developed parts of the world, such as Australia, Europe and the United States, have shown that men are at higher risk for attempting self-immolation (Cameron et al., 1990). Although no clinical link has been presented to determine these

differences, higher rates of self-immolation in females in developing countries may be attributed to the social standing of women within these countries (Shojaei et al., 2014). In some Asian countries the disfiguring of women with acid or by burning is a frequent form of violence against women (WHO, n.d.), and the use of fire for self-immolation as a form of self-harm can be linked to acts of defiance among oppressed women within these countries (Suhrabi et al., 2012).

Researchers have also suggested that socioeconomic status is an important factor that contributes to self-immolation in less developed countries. Masoomi et al. (2020) found that most female self-immolators were from low socioeconomic classes, which presented as a potential driver for self-immolation. Researchers in the United States have also highlighted the socioeconomic differences among self-immolation patients. Although differentiations in socioeconomic status among men and women are not often explicitly identified within U.S. literature, socioeconomic status and occupation have been found to be significant factors affecting the mode of suicide attempt (Nazeer et al., 2019). Both Kalist et al. (1999) and Smith and Kawachi (2014) found that suicide attempts and suicidal ideation were negatively related to personal income and found that higher incomes were associated with fewer suicide rates. These significant findings, both and in the US and abroad, show the need for further evaluation of the gender and socioeconomic differences of self-immolation and accidental burn injury patients.

Relevant Theory

Although suicide is a major global public health problem, there is little empirical evidence about theories related to suicidal behavior. Research thus far about suicide has been mostly conducted in in a theoretical context with theories of suicide spanning diverse perspectives, including biological, psychodynamic, cognitive behavioral, and developmental/systems etiologies (Van Orden et al., 2010). The lack of empirical attention,

however, may be due to a lack of theories about suicidal behaviors. Van Orden et al. (2010) wrote the "Interpersonal Theory of Suicidal Behavior" and proposed that the most dangerous form of suicidal desire is caused by the simultaneous presence of two interpersonal constructs: thwarted belongingness and perceived burdensomeness (and hopelessness about these states). According to the theory, the capability for suicidal behavior emerges via habituation and opponent processes in the presence of repeated exposure to physically painful and/or fear-inducing experiences (Van Orden et al., 2010, p. 575).

Van Orden et al. (2010) examined the literature for empirically demonstrated risk factors for suicidal behavior and demonstrated how the interpersonal theory is able to account for these facts about suicidal behavior and how the theory involves the assumption to a large extent the same mental processes underlie all forms of suicidal behavior (Sullivan, 1953). Thus, theories of suicide, such as the interpersonal theory, should be able to account for the diverse array of factors associated with lethal suicide and present how these factors are related to suicidal behavior (Van Orden et al., 2010, pp. 559-560). Van Orden et al. (2010) reviewed the risk factors and indicated the most robust support for association with suicide included mental disorders, previous suicide attempts, social isolation, family conflict, unemployment, and physical illness.

Although the dissertation retrospective case-matched study was not able to determine suicidal desire or have suggestions for prevention programs from its findings, the interpersonal theory was still be used to create the foundation for determining specific characteristics of self-immolation patients. The interpersonal theory involves the assumption that mental processes are similar across all forms of suicidal behavior, thus, when looking to the literature on suicidal behavior, available data should be consistent with the role of all constructs in the development of suicidal desire (Sullivan, 1953; Van Orden et al., 2010). As with the dissertation study,

continuity among data points was key to answering the research question of the differences between self-immolation and accidental burn patient populations with regard to sociodemographic and socioeconomic information, substance abuse history, and mental illness.

In the context of health-related resource utilization, identifying the appropriate resources needed to effectively treat self-immolation patients and using this knowledge to enhance future treatments can benefit clinical practice and potentially lead to improved outcomes within the burn unit. This investigator sought to answer the research question of the differences in burn unit health-related resource utilization among self-immolation and accidental burn patients with regard to hospital stay, surgical interventions, burn related complications, utilization of specialty services, and the differences in readmission rates among these patient populations. Understanding the factors that influence health care utilization is helpful in identifying reasons for differences in utilization; customer satisfaction; outcomes; and formulating policies and programs that encourage appropriate utilization, discourage inappropriate utilization, and promote cost-effective care (Aday, 1993).

At this time, models for reducing overuse and de-implementation of non-beneficial health practices have been challenging (Morgan et al., 2015; Prasad & Loannidis, 2014; Ubel & Asch, 2015). Gaps still remain in the basic understanding of its scope and drivers and potential for harming patients physically, mentally, and financially (Morgan et al., 2017). Although a model of utilization, developed by Aday (1993), which is focused on equality, accessibility and ethical issues, is one of the most frequently used frameworks for analyzing the factors that are associated with patient utilization of health services. The use or modification of this model for examining the context within which utilization occurs in relation to the role of environment and provider-related factors has largely been neglected (Phillips et al., 1998). Understanding the

relationship among patients, providers, and environmental factors that influence utilization is particularly important because these relationships are often of great interest from a programmatic and policy perspective (Phillips et al., 1998).

Morgan et al. (2017) developed a recent framework and theorized principles and evidence for patient-centered definitions of overuse, centrality of patient-clinician interactions, and drivers to facilitate understanding, which helped to conceptualize change and prioritize research goals within the framework of this dissertation case-matched study. The principle of patient-centered definitions of overuse is used to reinforce the importance of meeting patients' needs while standardizing treatments to reduce overuse with the goal of assisting professional societies and advocacy groups in developing actionable campaigns and may uncover evidence gaps (Morgan et al., 2017). Incorporating drivers of overuse, including the culture of health care consumption, patient factors, and the practice environment (Morgan et al. (2017), can affect understanding of health care utilization and overuse. This framework was applied in this dissertation case-matched study in the context of determining data points for burn unit health-related resource utilization with the goal of identifying and addressing the needs of self-immolation patients.

The complexity of self-immolation presents challenges for clinical care that requires collaboration between researchers and clinicians to identify the unique characteristics of this patient population. The focus should not only be to assess the risk the individual poses to themselves or society but to identify the window of opportunity to potentially intervene in a positive way that may improve outcomes for self-immolation patients in the longer term (Joory et al., 2015). The maintenance of behavior, and not just initiation of behavior is the true goal of public health (LaMorte, 2019).

Therefore, determining how self-immolation patients differ from accidental burn patients is used for a better understanding at the population level, including the differences in sociodemographic and socioeconomic background, history of substance abuse and mental illness, and burn unit health-related resource utilization. This retrospective review of secondary de-identified data from the dissertation presents information at a population level and presents information about the constraints these injuries place on health-related resources in order to better understand the patient population and ultimately present insight into clinical care practices.

Relevant Concepts

Throughout the literature, researchers have suggested that rates of self-harm vary by ethnic group; however, racial and ethnic differences among self-inflicted burn and self-immolation patients is not extensively documented in the literature, and the evidence for variation in risk has not be synthesized to inform predative initiatives (Bhui et al., 2007). Some researchers have suggested that non-Hispanic Whites have significant higher risk for suicide attempts than any other ethnic groups while other researchers have suggested that Black and Hispanics have divergent suicide rates in the United States (Kessler et al., 1999; Moscicki et al., 1988; Oquendo et al., 2004; Sorenson et al., 1988). Whether these inconsistencies are due to the fact that ethnic groups as usually conceptualized are rather heterogenous remains a point of debate (Perez-Rodriquez et al., 2008). There are also some questions as to whether risk factors for suicidal ideation and attempts among the general population may not apply to specific ethic groups, such as African Americans, American Indians, or Hispanics (Willis et al., 2003). Bhui et al. (2007) suggested that literature among minority population, such as those of the Caribbean, African, and other minority decent, have not been found in the literature, and even fewer researchers have investigated self-harm among prisoners, asylum seekers, and refugees.

These gaps may exist because there is no racial/ethnic difference in individuals who attempt self-immolation in the United States. Bolling et al. (2017, 2018) suggested that there is a significance among minorities attempting self-immolation in the Greater Tampa Bay area. Due to the lack of literature in the United States that confirms racial/ethnicity as a risk factor for self-immolation, it is imperative to validate these findings and determine if these findings are consistent when comparing self-immolation and accidental burn injuries.

Summary of Chapter

As documented in the literature, suicide is a major global public health problem that does not discriminate and effects individuals of all ages, genders, and backgrounds. Suicide has universal risk factors, extensively documented among all forms of suicide by major health institutions, such as the National Institutes of Health, the Centers for Disease Control and Prevention, and the World Health Organization. Although self-immolation is considered rare in the US, these patients are unique, and they pose a significant challenge to clinical care and recovery.

That which is not evident in the literature is a documented exposure or relative patient population outside of Bolling et al. (2017, 2018) in the Greater Tampa Bay area. These factors make a contribution to the need for focused research about the identified at risk population within the burn unit of TGH-USF Health in order to produce the highest quality literature necessary to guide clinical care and standard of care practice for self-immolation injuries.

Chapter 3: Methodology

Introduction to the Chapter

This investigator determined the population-level impact of self-immolation patients on health-related resource utilization through the comparison of self-immolation patients directly to those who experience accidental burn injuries. To answer the study research questions, this investigator retrospectively reviewed and case-match de-identified data of patients who were admitted to the burn unit of TGH-USF Health. By reviewing past patient records, this investigator was able to obtain the variables needed to determine the population-level impact of self-immolation on health-related resource utilization in the Greater Tampa Bay area.

Study Design

This retrospective case-match study was designed to determine the population-level impact of self-immolation among burn unit admissions though the analysis of patient-level data on sociodemographic and socioeconomic status, medical history, and health-related resource utilization. This investigator utilized secondary de-identified data of patients who attempted self-immolation and were admitted to the burn unit of TGH-USF Health between January 1, 2012, to December 31, 2018. Patients who met the inclusion criteria (18 years of age or older) and were admitted to the TGH-USF burn unit for a documented attempt of self-immolation were case-matched based on age, gender, total body surface area burn, inhalation injury, and burn mechanism to individuals who experienced accidental burn injuries and were admitted to the burn unit of TGH-USF Health during the same time period.

Rationale

In previous studies in the burn unit of TGH-USF Health, Bolling et al. (2017, 2018), identified a relevant self-immolation patient population within Hillsborough County and the

Greater Tampa Bay area. No data, however, currently exist within the literature on the patient-level differences of those who attempt self-immolation and those who experience accidental burn injuries in the Greater Tampa Bay Area. The aim of this study was to determine how self-immolation patients differ from accidental burn patients to allow for a better understanding of the patient population and their impact on health-related resource utilization.

Specific Procedures

After Institutional Review Board (IRB) approval was granted by Nova Southeastern University (NSU) and from TGH-USF Health, secondary de-identified data was obtained related to the study criteria from January 1, 2012, to December 31, 2018 from TGH-USF Health. Medical record numbers and patient names were not accessed as the data was secondary de-identified data collected from previous IRB approved research conducted in the Burn Unit of Tampa General Hospital. All electronic secondary de-identified data collected was stored in a password-protected Microsoft Excel spreadsheet on a password protected laptop computer. Data was analyzed using SPSS statistical software Version 25.

The following secondary de-identified data was collected for this study:

Sociodemographic Data

- Age
- Gender
- Race/Ethnicity

Socioeconomic Data

- Insurance Coverage
    - Private Insurance
    - Public Insurance

        - Medicare
        - Medicaid
    - No Insurance
- **Employment Status**
    - Employed
    - Non-employed
    - Retired
    - Disabled
    - Student

Comorbidities

Comorbidities were documented though pre-existing history or self-reported diagnosis.

- Diabetes
- Heart Disease
- Cancer

Substance Abuse History

- Drug Abuse
    - Prescription drug abuse
    - Illicit drug abuse (including marijuana/hashish, cocaine, heroin, hallucinogens, and inhalants)
- Alcohol Abuse

Mental Illness History

Mental illness history was documented through pre-existing history or self-reported diagnosis.

- History of Anxiety

- History of Depression
- Psychiatric History

Burn Unit/Health Related Resource Utilization

Data collected from inpatient hospital admission.

- Days in the Burn Unit
    - ICU days
    - Burn Floor days
- Burn Mechanism
    - Thermal/flash flame
    - Electrical
    - Chemical
- Total Body Surface Area of the Burn
    - Second Degree
    - Third Degree
- Intubation
    - Confirmed Inhalation Injury
- Type Surgical Intervention
    - Surgical Debridement
    - Allograft
    - Xenograft
    - Autograft
- Number of Surgical Interventions
- Type and Number of Specialty Consult Services

- Complications Due to the Burn Injury

Re-Admissions Rates

- Reason for Re-Admission
- Number of days in the hospital

Patient Mortality

- Alive
- Deceased

Sample Size and Medical Record Selection Criteria

Using the inclusion/exclusion criteria, de-identified secondary records were obtained. These consecutive de-identified records were systemically reviewed for all patients meeting the inclusion criteria. The sample size was directly dependent on the number of patients who attempted self-immolation who can be case matched to patients who sustained accidental burn injuries, using the case matching criteria. For this study, the records of 2,207 de-identified patients who were admitted from 2012 to 2018 to the burn unit were reviewed and case matched.

Inclusion Criteria

1. Patients 18 years of age or older.
2. Patients who were admitted to TGH-USF Health Burn Unit from January 1, 2012, to December 31, 2018.

Exclusion Criteria

1. Patients who are not contained within TGH-USF Health electronic medical records from January 1, 2012, to December 31, 2018.

Case-Matching

Once eligible patients were identified, patients who attempted self-immolation were matched to patients who sustained accidental burn injuries. These patients were matched based on age (within 5 years), gender, total body surface area of the burn (± 5%), inhalation injury, comorbid illness, and burn mechanism (thermal/flash flame, electrical, & chemical).

Recruiting Procedures

Given this study was a retrospective review of secondary de-identified data and that no patients were contacted or approached in person, this investigator requested a waiver of consent and of HIPPA authorization. Further, this investigator retrospectively reviewed de-identified existing clinical, sociodemographic, and socioeconomic information for each patient identified for inclusion into this dissertation study.

Data Storage

The secondary de-identified data for this dissertation study was kept on a password-protected Microsoft Excel spreadsheet on a password-protected laptop computer, and all data were analyzed using SPSS Statistical Software V25.

Ethical Considerations and Review

Approval was required from the Institutional Review Board of both TGH-USF Health and NSU. The secondary de-identified data for the purpose of this dissertation study was originally collected through an approved IRB protocol with a waiver of consent at TGH-USF Health. The protocol presented the collection of patient data though the EPIC electronic medical record (EMR) system. As a sub-investigator on this study, this investigator had access to the secondary de-identified data. In order to use these data, an IRB approval was obtained from

Nova Southeastern University, and a data use agreement was put in place between TGH-USF Health and NSU.

Written informed consent and the process of consent to participate was not necessary as the dissertation study was a retrospective review of de-identified data and a waiver of consent, and HIPAA authorization was requested to the IRB. This study involved no more than minimal risk to subjects. Although personal health information (PHI) had all been removed from the secondary de-identified data, anytime such data are accessed and stored by handlers outside the domain of clinical routine, the risk of breached data security is increased. All means necessary were inputted to secure the information. Only the investigator analyzed data. All electronic data were recorded on a secured laptop computer in the investigator's office and was locked. After 36 months, electronic documents containing the de-identified data will be deleted/destroyed.

Funding

This dissertation study was not funded.

Study Setting

This research was conducted using secondary de-identified data from TGH-USF Health, and included IRB review from both TGH-USF Health and NSU. The secondary de-identified patient population was retrospectively reviewed from the burn unit Trauma 1 data collection system. As a co-investigator on the IRB approved data collection from the TGH burn unit, this investigator had access to the secondary deidentified Trauma 1 data. After IRB approval from NSU, this investigator used the inclusion/exclusion criteria to review the secondary de-identified patient list and case match the patients who meet the criteria from the data set. There was no PHI included as this was a secondary de-identified data set.

Data Collection Procedures

This investigator reviewed secondary de-identified data of patients who were admitted to the burn unit of TGH-USF Health. There was no interaction with subject patients. The investigator reviewed existing secondary de-identified clinical, sociodemographic, and socioeconomic data for each patient meeting the criteria for the study. The existing secondary de-identified data that were housed in a password-protected Excel spreadsheet on a password-protected desktop computer came from the patients' medical record that had already been collected as part of the patient's medical diagnosis and treatment and was available in the institutional database (EPIC).

Data Analyses

To directly compare patients, this investigator used a matched design using a propensity score method. Binary logistic regression was used to find propensity sores to predict the probability of being assigned to the self-immolation group compared with the accidental burn injury group. Relevant covariates described in the matching criteria were used in the propensity model to ensure accuracy of the propensity scores. The precision of calibration and discrimination were analyzed using Hosmer-Lemshow goodness-of-fit and equal variances.

All demographic and clinical characteristics of the subjects were reported as means, medians, standard deviation (*SD*) and minimum, maximum, and interquartile ranges (IQR) for continuous measures and frequency distributions for categorical variables for the overall population and patients in each case. For categorical variables, chi-square test of proportionality was used and for continuous variables, unpaired *t* test and analysis of variance (ANOVA) was used. In addition, *p* values and absolute, standardized differences were calculated to assess imbalances in baseline variables between cohorts after matching.

Outcomes were evaluated in the matched cohorts. The statistical significance of descriptive unadjusted differences between cases and controls was measured using appropriate statistical test to account for matching (i.e., McNemar's chi-squared test of proportionality was used for continuous variables) with the significance of differences in results reported with *p* values. All statistical tests were based on a two-sided hypothesis of no difference between cohorts at a significance level of .05. All analysis was conducted using SPSS Statistical Software V25.

Summary of Chapter

With this de-identified retrospective case-matched study, the investigator determined the population-level impact of self-immolation on burn unit resources. As this investigator used the de-identified patient data set from the EMR of TGH-USF Health, an approval from the IRB of TGH-USF Health and a written data use agreement were required for the initiation of this study. For this dissertation study, the IRB of NSU reviewed and approved the study prior to data analysis. The patient-level data consisted of patients admitted to the burn unit of TGH-USF Health who met the inclusion criteria and whose data was collected from January 1, 2012, to December 31, 2018. The secondary de-identified patient records were systemically reviewed, and the relevant data within the parameters of this study were recorded on an Excel spread sheet. All precautions necessary to protect the secondary de-identified data of subjects was taken throughout the data collection and analysis process. The secondary de-identified data reviewed were statistically analyzed using SPSS Statistical Software V25 and disseminated in manuscript form.

Chapter 4: Results

Introduction to Chapter

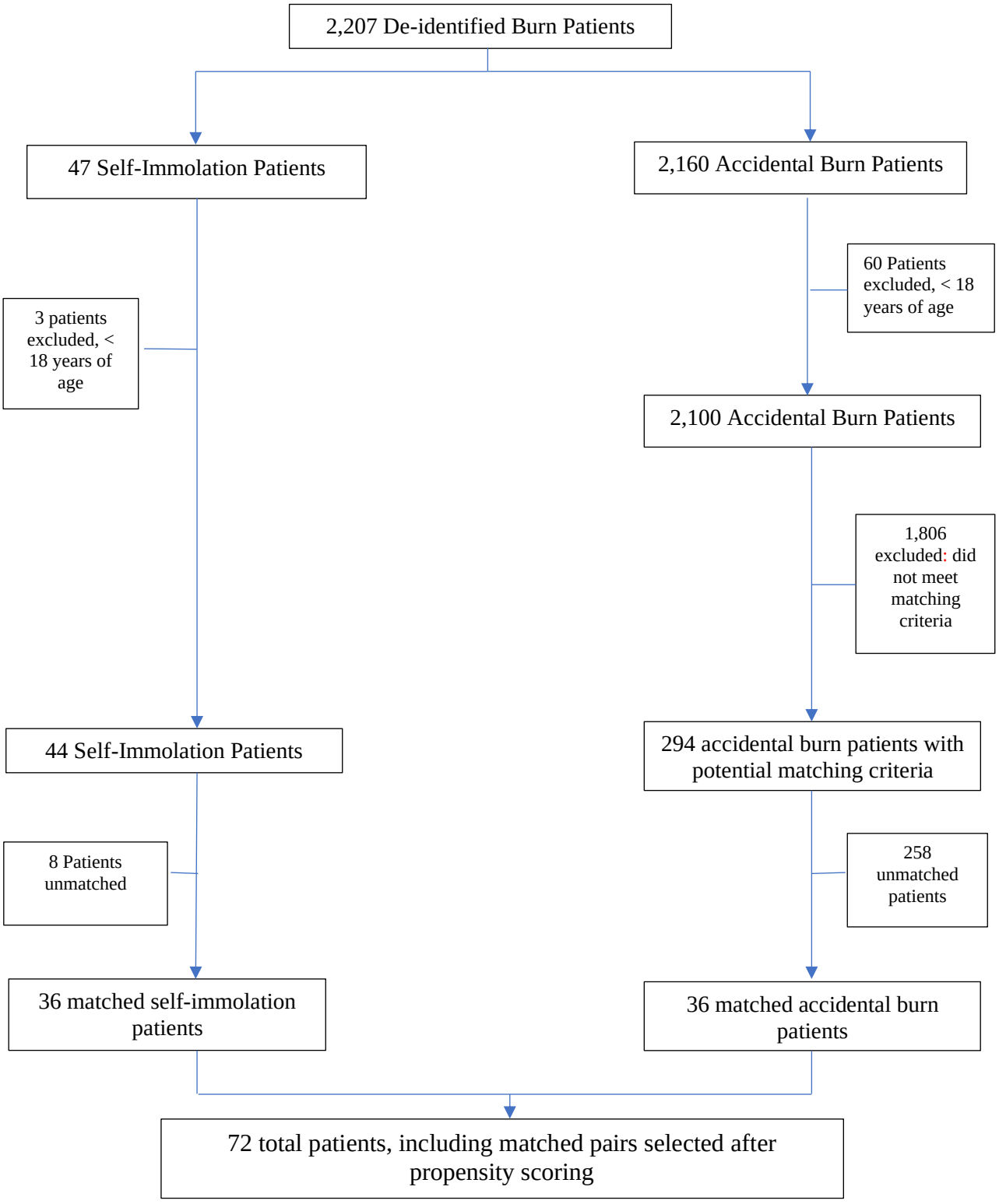
Through means of logistic regression, separate propensity scores were calculated to estimate the probability of matching self-immolation and accidental burn patients (1:1). Specific criteria used to estimate the propensity score can found in Table 1. Matched patients were analyzed to determine the differences in patient level characteristics and burn unit health related resource utilization, *p* values, absolute, and standardized differences were calculated to assess imbalances in variables between self-immolation and accidental burn patients after matching. Outcomes were evaluated in the matched cohorts and statistical significance of descriptive unadjusted differences between self-immolation and accidental burn patients was measured using appropriate statistical test to account for matching with the significance of differences in results reported as *p* values. The analysis was conducted using SPSS Statistical Software V25.

Data Analysis Results

The de-identified records of 2,207 burn patients admitted to the burn unit of TGH from January 1, 2012, to December 31, 2018 were reviewed. Among these patients, 47 were admitted to the burn unit for self-immolation. Upon evaluation of inclusion/exclusion criteria, three patients were excluded due to age range (<18 years of age), leaving 44 self-immolation patients eligible to be matched to accidental burn patients. Among accidental burn patients the de-identified records of 2,160 patients were reviewed. Upon evaluation of inclusion/exclusion criteria, 60 patients were excluded due to age range (<18 years of age), leaving 2,100 accidental burn patients. One thousand eight hundred and six patients were excluded on inability to match to self-immolation patients based on matching criteria. Figure 1. depicts the study selection criteria.

Figure 1

Flow Diagram of Study Selection Criteria



The final propensity model predicting allocation to the self-immolation group included covariates of age (±5 years), gender, TBSA (±5%), inhalation injury, comorbid illness (cancer, heart disease or diabetes) and burn mechanism (thermal/flash flame, chemical, or electrical). This model was validated to have calibration and discrimination for the probability of being a match 1:1 to the self-immolation group (Hosmer-Lemeshow goodness of fit $p = .598$ and equal variances $p = .879$).

Among 338 patients, 72 total patients, including matched pairs, were selected after propensity scoring. The characteristics of these patients are included in Table 1. Burn patients in this study were on average 42 years of age with 40 patients identifying as male and 32 identifying as female. All patients were admitted for flash flame or thermal burns with an average TBSA of 20%, including six patients with a confirmed inhalation injury.

Table 1

Self-Immolation and Accidental Burn Patients' Characteristics after Matching

	Before matching			After matching	
	Self-immolation (n= 44)	Accidental burn (n=294)	*p* values	Self-immolation (*n* = 36)	Accidental burn (*n* = 36)
Age	41 ± 23	41 ± 23	.014*	42 ± 22	42 ± 24
Age Range (*n*)					
<20	0	5		-	1
20-29	9	67		8	6
30-39	8	53		8	8
40-49	13	66		10	8
50-59	7	61		6	9
60-69	4	35		3	4
70+	2	1		1	-
Gender (*n*)			.133		
Male	28	223		20	20
Female	16	71		16	16
Burn mechanism (*n*)			.578		
Flash flame or thermal	45	286		36	36
Chemical	-	1		-	-
Electrical	-	6		-	-
TBSA	13.5	13	.001*	20 ± 20	20 ± 20
TBSA Range (*n*)					
0-9%	17	174		12	15
10-19%	10	75		10	9
20-29%	6	13		5	3
30-39%	2	10		3	3
40-49%	3	1		2	2
50-59%	3	8		2	2
60-69%	3	2		2	1
70-79%	-	1		-	1
80-89%	1	1		-	-
90-99%	-	2		-	-
Inhalation Injury (*n*)			.054		
Yes	9	29		6	6
No	37	263		30	30

Sociodemographic, Socioeconomic, and Medical History

Propensity score matching analysis showed the similarities and differences among sociodemographic and socioeconomic status as well as medical history. Table 2 shows the impact of sociodemographic and socioeconomic status. Race/ethnicity, employment status, and medical insurance coverage was self-reported by the patient or the patient's legally authorized representative and collected from the intake form. There was no significant difference among self-immolation and accidental burn injury patients based on race/ethnicity, employment history, and medical insurance.

Differences were observed independently within the self-immolation and accidental burn injury patient groups. Patients in both groups were primarily White (53% and 72%, respectively), however, minorities in the self-immolation group outnumbered those in the accidental burn group (47% vs. 28%, respectively). Both self-immolation and accidental burn injury patients experienced high rates of unemployment with self-immolation patients having a 61% ($p = .003$) unemployment rate while accidental burn patients had an unemployment rate of 41% ($p = .019$). Self-immolation patients were more likely to be on a form of public insurance, such as Medicare or Medicaid (53% [$p = .014$]), while accidental burn patients were more evenly dispersed with 42% private insurance and 42% public insurance, respectively.

Table 2

Sociodemographic and Socioeconomic Information

	Self-immolation (*n* = 36)			Accidental burn (*n* = 36)		
	N	*%*	*p value*	*N*	*%*	*p value*
Race/Ethnicity						
White	19	52	.003*	26	72	.000*
Black or African American	8	22	.147	4	11	1.00
Hispanic or Latino	5	14	.483	1	3	.215
Asian	1	3	.341	1	3	.215
Other	3	8	-	4	11	-
Employment Status						
Employed	8	22	.050	14	39	.027
Unemployed	22	61	.003*	15	41	.019*
Disability	5	14	.142	-	-	-
Retired	1	3	-	1	3	0.215
Student	-	-	-	2	6	0.423
Unknown	-	-	-	4	11	-
Medical insurance						
Private insurance	11	31	.232	15	42	.058
Public insurance (i.e., Medicare, Medicaid)	19	53	.014*	15	42	.058
Uninsured	6	17	-	6	17	-

Note: Variables that are significant are marked with an *; percent is rounded and may not add to 100%

As per the matching criteria, patients within this study were identified based on comorbid illness. Of the 72 patients included within this analysis, no patients had a pre-existing history or self-reported history of diabetes, heart disease, or cancer. As seen in the medical history table (Table 3) self-immolation patients were more likely to have a preexisting self-reported or documented history of depression (20 vs. 9 [p = .008]), psychiatric disease (18 vs. 9 [p = .028]), and previous psychiatric treatment (19 vs. 5 [p = < .001]) as compared with accidental burn patients. Although not statistically significant, self-immolation patients were also more likely to have a history of anxiety, drug abuse, and alcohol abuse as compared with accidental burn patients.

Table 3

Differences in Medical History among Self-Immolation and Accidental Burn Patients

	Self-immolation patients (n = 36)	Accidental burn patients (n = 36)	OR	95% CI	p value
History of depression					
Yes	20	9	3.750	1.379-10.20	.008*
No	16	27			
History of anxiety					
Yes	10	7	1.801	.594-5.466	.222
No	23	29			
History of psychiatric disease					
Yes	18	9	3.00	1.106-8.138	.028*
No	18	27			
History of psychiatric treatment					
Yes	19	5	6.929	2.196-21.864	.000*
No	17	31			
Drug abuse history					
Yes	12	6	2.500	.818-7.642	.086
No	24	30			
Alcohol abuse history					
Yes	11	5	2.788	.837-8.888	.078
No	25	31			

Note: Variables that are significant are marked with an *

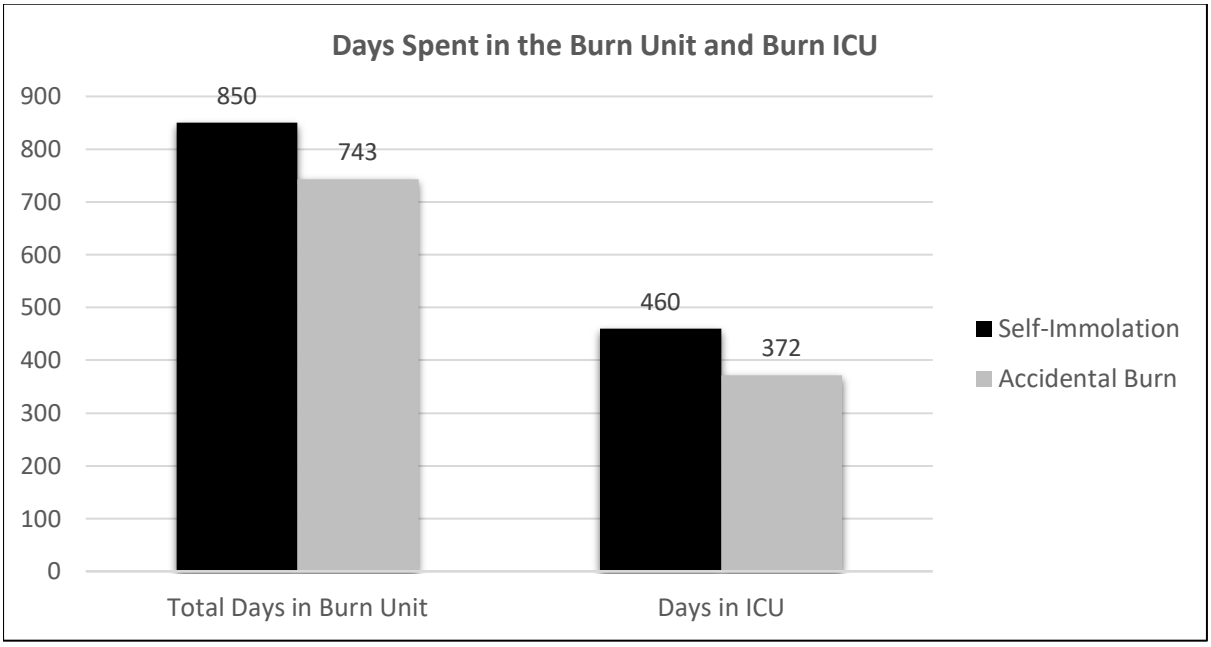
Burn Unit Health-Related Resource Utilization

As with sociodemographic, socioeconomic, and medical history data, propensity score matching was used for an evaluation of burn unit health-related resource utilization among patients with self-immolation and accidental burn injuries. Days in the burn unit were evaluated

based on the time of admission to either the burn floor or burn ICU until time of discharge from the unit. As seen in Figure 2, self-immolation patients spent significantly more total time (+107 days) admitted to the burn unit than accidental burn patients for the treatment of their burn injuries. During that time, self-immolation patients also required a greater total length of stay in the ICU (+88 days) as compared with accidental burn injury patients.

Figure 2

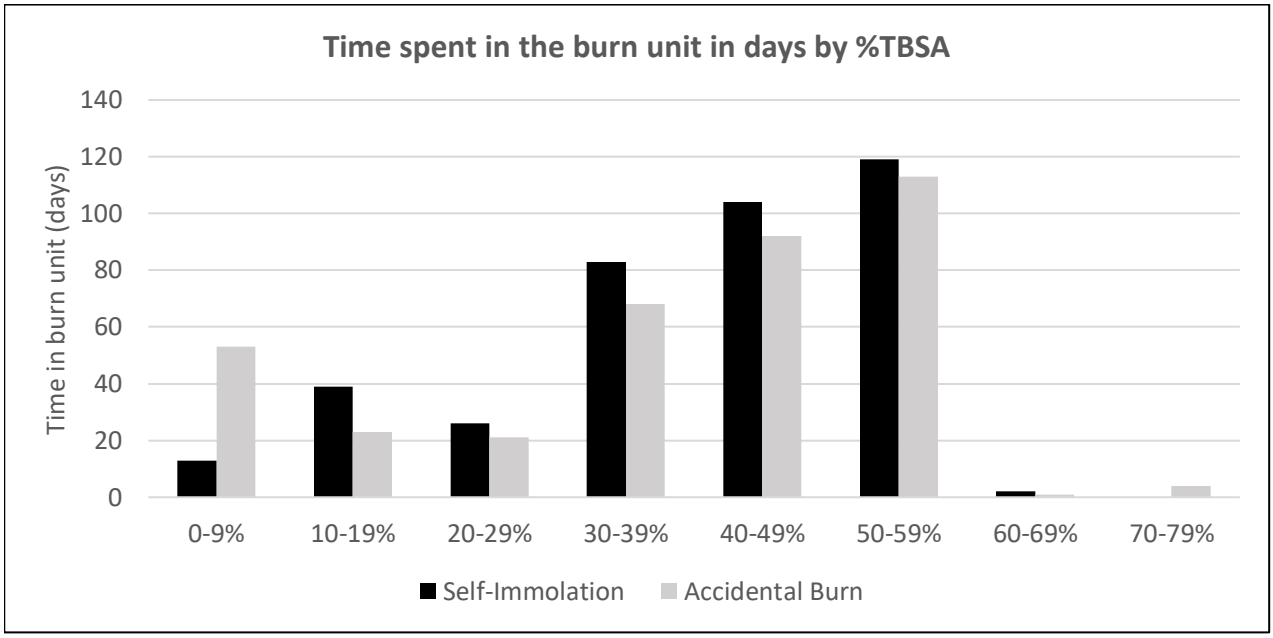
Total Days Spent in The Burn Unit and Burn ICU



When accounting for TBSA, self-immolation patients had a significant correlation with TBSA and sum total days in the burn unit (Pearson chi-square $p = .004$). As the percent TBSA increased, self-immolation patients required more time in the hospital as compared with accidental burn patients. These differences can be seen in Figure 3. It can also be noted that regardless of TBSA, self-immolation patients were twice as likely (OR = 2.2) to be admitted with a full-thickness burns as compared with accidental burn patients.

Figure 3

Number of days spent in the burn unit by % TBSA



For the purpose of this analysis, surgical procedures were defined by number of trips to the operating room and the type of procedure that was conducted. In total, both self-immolation and accidental burn injury patients required multiple surgical procedures for treatment of their burn injuries (96 vs. 86, respectively). There was no statistical difference in the average number of operating rooms visits among self-immolation (2.66) and accidental burn injury patients (2.46). However, when analyzing the type of procedures conducted in the operating room, self-immolation patients required more concomitant procedures, (i.e., excision and allograft plus excision and autograft) in comparison with accidental burn patients (7 vs. 1 [p = .024]). Table 4 shows the results of this analysis.

Table 4

Types of Procedures Conducted in the Operating Room

	Self-immolation (n = 36)	Accidental burn (n = 36)	p value
Debridement	-	1	-
Excision & allograft	-	-	-
Excision & xenograft	2	6	-
Excision & autograft	16	15	-
Excision, allograft & autograft	7	1	.024*
Excision, xenograft & autograft	1	0	-

Note: Variables that are significant are marked with an *.

Specialty consult service utilization was measured by the number of consult services requested by the plastic surgery clinician (attending, resident, or nurse practitioner) and the number of specialty consult visits that occurred in the burn unit (burn floor or burn IUC). A list of specialty consults groups that were requested can be seen in Appendix A. In total, self-immolation patients required more specialty consult services than accidental burn patients. On average, self-immolation patients required specialty consult visits from six different specialty groups while accidental burn patients on average required specialty consults from three specialty groups (p = .002).

Self-immolation and accidental burn injury patients experienced high levels of complications while in the burn unit. Complications were listed within the patients' medical record under their burn unit admission. Only complications from the burn injury or accident from which the injury occurred were used in this analysis. On average, self-immolation patients experienced a greater number of complications as compared with accidental burn patients. Table

5 shows the results of this analysis. A full list of complications and the rate of occurrence of each event can be found in Appendix B.

Table 5

Burn-Related Complication Rates

		Self-immolation (*n* = 36)	Accidental burn (*n* = 36)	OR	CI	*p* value
Documented Complication from Burn Injury						
	Yes	28	18	3.50	1.26-9.724	.013*
	No	8	18			

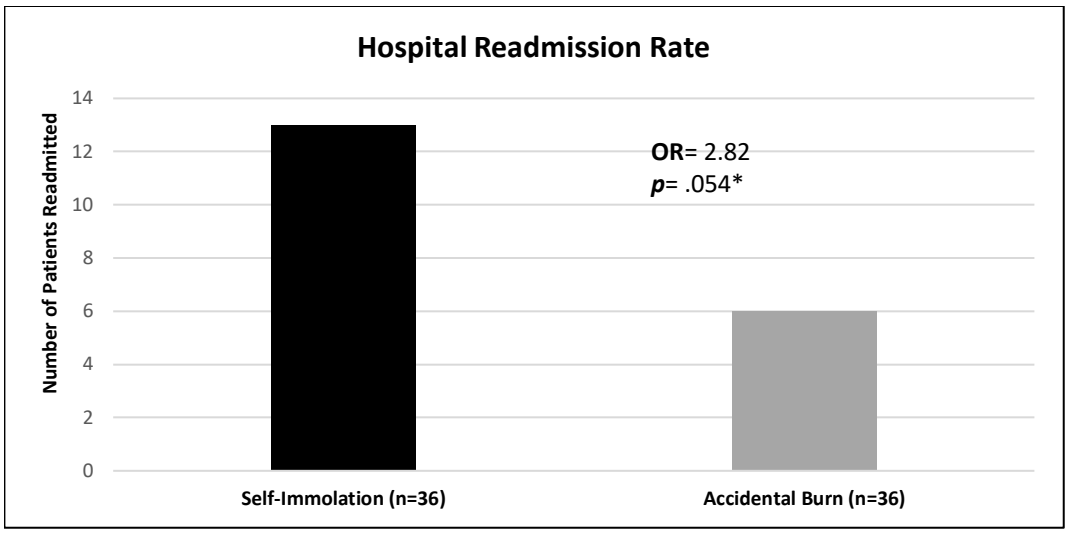
Note: Variables that are significant are marked with an *.

Readmissions Rate

The rate of readmission was calculated for self-immolation patients and accidental burn patients. Readmission could transpire any time after discharge from the initial hospitalization and could occur though the emergency department, through direct inpatient readmission, or through inpatient rehab. Self-immolation patients were almost three times as likely to be readmitted as compared with accidental burn patients. This finding can be seen in Figure 4. Also, self-immolation patients who were readmitted on average had a longer length of stay in the hospital as compared with accidental burn patients (15 days vs. 9 days, respectively). The causes for readmission are displayed in Table 6.

Figure 4

Rates of Hospital Readmission



Note: Variables that are significant are marked with an *.

Table 6

Reasons for Readmission

Self-immolation (n = 36)	Accidental burn (n = 36)
Uncontrolled Pain	Uncontrolled Pain
Inpatient Rehab	Inpatient Rehab
Non-Healing Wound	Wound Check

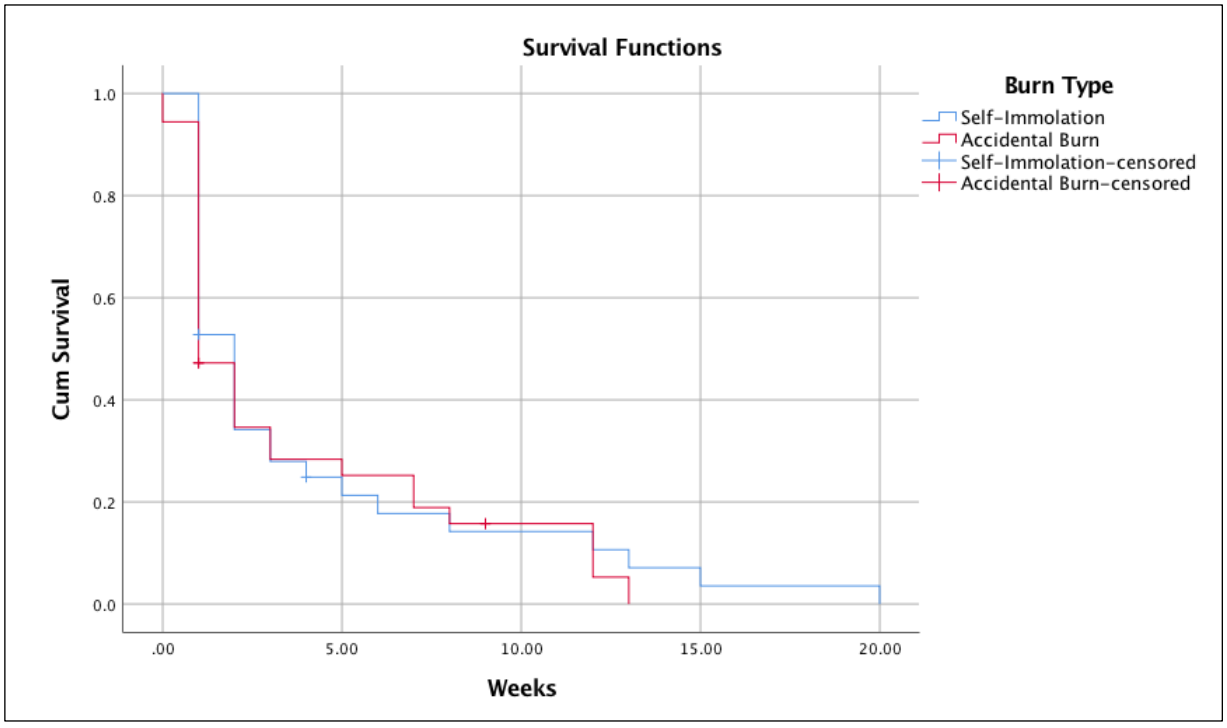
Survival Status

This investigator compared survival status among self-immolation and accidental burn injury patients. Survival status was evaluated from admission to discharge from the burn unit. After discharge survival status was unable to be obtained. There was no statistical difference in survival status among self-immolation and accidental burn injury patients. Overall, the survival status for both self-immolation and accidental burn patients was very high (92% and 89%,

respectively). Figure 5 Shows the Kaplan-Meier survival curves for self-immolation and accidental burn patients in weeks based on hospital admission time. Deceased patients on average spent 3.3 days in the unit before death occurred. Among these patients, the average TBSA was 43.3% for self-immolation patients and 53.5% for accidental burn patients.

Figure 5

Kaplan-Meier Survival Curves for Self-Immolation and Accidental Burn Injury Patients



Summary of Chapter

In this analysis, 72 total patients, including matched pairs, selected after propensity scoring were used to determine the similarities and differences in patient level characteristics and burn unit health related resource utilization among self-immolation and accidental burn injury patients. The final propensity model predicting allocation to the self-immolation group included covariates of age (±5 years), gender, TBSA (±5%), inhalation injury, comorbid illness (cancer, heart disease or diabetes), and burn mechanism (thermal/flash flame, chemical, or electrical).

Propensity score matching was used for an evaluation of the differences among self-immolation and accidental burn injury patients with little to no differences in variation among the specified covariates.

The final analysis showed that self-immolation patients had significant differences in preexisting or self-reported medical history in terms of mental illness and substance abuse history as compared with accidental burn injury patients. Self-immolation patients spent more time spent in the burn unit and the burn ICU, and during that time, they required more concomitant surgical procedures, specialty consult services, and reported higher rates of burn-related complications. Self-immolation patients also were more likely to be readmitted after initial hospitalization and required a greater length of stay upon readmission in comparison with accidental burn patients.

Chapter 5: Summary

Introduction to the Chapter

The use of fire by individuals as a means of attempting or committing suicide is relatively rare in the United States. Although these patients constitute a small percentage of burn unit admissions, they pose a significant challenge to clinical care. Given the limited size of many studies reporting on self-inflicted burns, it is important to continue generating data to further characterize the nature of these injuries and the patients who suffer from them (Mushin et al., 2017). This investigator sought to determine the population-level impact of self-immolation on health-related resource utilization through the comparison of self-immolation patients with those who experienced accidental burn injuries. To answer the study research questions, this investigator retrospectively reviewed and case-matched de-identified data of patients who were admitted to the burn unit of TGH-USF Health from January 1, 2012, to December 31, 2018.

Among 338 eligible patients who met the inclusion criteria for the study, 72 total patients including matched pairs were selected after propensity scoring. Through means of logistic regression, separate propensity scores were calculated to estimate the probability of matching self-immolation and accidental burn patients one-to-one. Propensity score matching allowed for an evaluation of patient level characteristics and the patient-level impact on burn unit health-related resource utilization among patients with self-immolation and accidental burn injuries. The analysis showed that self-immolation patients had significant differences in medical history and time spent in the burn unit and the burn ICU. Self-immolation patients similarly had significant differences in the number of concomitant surgical procedures, specialty consult services, and rates of burn related complications. Self-immolation patients also had higher rates

of readmissions and required a greater length of stay upon readmission in comparison to accidental burn patients.

Discussion and Interpretation of Results

This investigator sought to enhance medical knowledge and clinical care by distinguishing the population level characteristics of patients who attempted self-immolation and determine the impact these patients have on health-care related resource utilization. In order to accurately report on the differences among self-immolation and accidental burn injury patients, this study had to achieve consistency among data points that could be translatable to existing literature and research on both suicide and health-care resource utilization. The interpersonal theory and principles and evidence of patient-centered definitions of overuse presented this consistency and guided the framework for the collection and analysis of data points involving patient level characteristics, which reflected constructs and risk factors for suicide and burn unit health-related resource utilization, which considered patient need and standardize treatment to translate overuse. This investigator used a collimation of these data points to identify significant differences among self-immolation and accidental burn injury populations within this study.

Sociodemographic and Socioeconomic Status

Among sociodemographic and socioeconomic status, no statistically significant differences were found between self-immolation and accidental burn injury patients. However, differences were observed independently with self-immolation patients having higher rates of unemployment and higher utilization of public insurance, including Medicare and Medicaid. Historically, high rates of unemployment have been identified as a common risk factor for suicide in general (CDC, 2021b), and the high utilization of public insurance shown in this study

has the potential to be attributed to unemployment and preexisting medical history (McAlpine & Mechanic, 2000).

Differences were also observed independently with self-immolation patients having a higher representation of minority patients within the study. As reported by Bolling et al. (2017, 2018), a large proportion of minority self-immolation patients had already been identified in the population of the burn unit of TGH-USF Health. In the Bolling et al. showed there were 47 patients, of which 24 identified as minority, including Black or African Americans (59%), Hispanics or Latinos (24%), Asians (6%), Native Hawaiian/Pacific Islanders (6%) and two or more races (6%) while the other 23 patients identified as White, which aligns with the statistics seen in this study in which minorities made up 48% of the self-immolation population that was much higher than that of the accidental burn injury population (28%). The minorities found within this patient population included Black or African Americans (22%), Hispanic or Latino (14%), Asians (3%) and two or more races (8%). Although these rates were different from the Bolling et al. 2017 and 2018 studies, due to matching criteria still showed a substantial minority patient population in comparison with accidental burn injury patients.

Previous researchers have suggested that rates of self-harm vary by ethnic background (Bhui et al., 2007); however, the literature is limited for the identification of racial/ethnic background as a risk factor for self-harm. Although this investigator did not seek to identify racial/ethnic background as a risk factor for self-immolation, a relevant concept as part of this study was to confirm the racial/ethnic findings from the Bolling et al. studies. As the population census of Florida is 77% White and 23% Minority, including 16.9% Back or African American, 3% Asian, 2.2% two or more races and 26% non-white Hispanic Latinos (U.S. Census Bureau, 2019), it would be anticipated that patients admitted to the burn unit would follow these trends.

However, unlike patients in the accidental burn group (72% White and 28% minority, respectively), patients in the self-immolation group did not follow these trends (52% White and 48% minority) and had a higher representation of minorities.

Although it is unclear why minorities within the Tampa Bay Area are attempting self-immolation, the evidence presented in this study was used to confirm the findings from previous research that minorities are at high risk for self-immolation. These results have suggested the need for awareness of the potential impact race/ethnicity has on self-immolation and the need for future research within this area.

Medical History

Self-immolation patients had a statistically significant difference in pre-existing history of depression ($p = .008$), psychiatric disease ($p = .028$) and previous psychiatric treatment ($p \leq .001$) as compared with accidental burn injury patients. Though not statistically significant, they were also more likely to present with a history of anxiety (OR = 1.8), drug abuse (OR = 2.5), and alcohol abuse (OR = 2.8) as compared with accidental burn injury patients. With a larger sample size, future research might find these data to be statistically significant. However, as it is difficult to capture a large self-immolation patient population, these findings have a substantial impact on the identification of patient level characteristics for self-immolation patient populations.

As expected with individuals who attempt suicide, common risk factors, such as history of mental disorders and history of alcohol and substance abuse, are often present (CDC, 2020c). However, it is important to note that studies among accidental burn injuries have also shown high rates of pre-existing diagnosis of psychosis or depression, which can have effects on hospital stay and wound healing times (Wisely et al., 2010). Wisely et al. (2010) showed that for self-immolation patients, the rates of mental illness were significantly higher as compared with

accidental burn patients; these high rates of mental illness may have contributed to greater length of stay in the burn unit.

Burn Unit Health-Related Resource Utilization

A framework developed by Morgan et al. (2017) on the principles and evidence of patient-centered definitions of overuse was used to construct the framework for the collection and analysis of data involving burn unit health-related resource utilization. Morgan et al. (2017) showed that self-immolation patients spent more time in the burn unit in comparison with accidental burn injury patients (850 days vs. 743 days) and required more days in the burn ICU during their admission (460 days vs. 372 days). According to the 2016 health care cost and utilization project (HCUP) statistical report, which is a nationally represented report, including data from state and federal government organization, hospital associations and private data organizations, on average, burn-related inpatient stays with a mean length of hospital stay of 8.1 days cost $24,000 (McDermott et al., 2016). As the data for this study included patients from 2012 to 2018, the 2016-dollar amounts projected by the HCUP statistical report can be applied to these data.

If self-immolation patients within the Morgan et al. (2017) study on average spent 23.6 days in the burn unit and accidental burn patients spent 20.6 days in the burn unit, the cost for a self-immolation injury could be estimated to be $69,925 (23.6/8.1 = 2.91 x 24,000) while the cost for an accidental burn patient could be estimated to be $61,037 (20.6/8.1 = 2.54 x 24,000). Considering the $8,888 per patient cost difference, self-immolation patients as a group within the Morgan et al. (2017) study had the potential to cost 12.7% more ($320,000) in hospital-related cost as compared with accidental burn injury patients. Longer length of stay along with the need for more specialty consult services visits (p = .002), and higher rates of complications (p = .013)

among self-immolation patients were used to draw the conclusion that self-immolation patients within this study required the utilization of more burn unit health-related resources as compared with accidental burn injury patients.

Self-immolation patients were also twice as likely to experienced greater burn depth with differences in full-thickness burn admissions (OR = 2.2). Although no differences were found in the number of surgical procedures performed, self-immolation patients required more concomitant surgical procedures (i.e., excision and autograft plus allograft) than accidental burn injury patients (p = .024). Allograft or temporary skin substitute is used to close the wound remaining after all available autologous (autograft) skin has been harvested and grafted (Calota et al., 2012). Although a causation cannot be made between high rates of full-thickness burns and concomitant procedures, these data have shown that self-immolation patients required more surgical-related burn resources than accidental burn injury patients.

Readmission Rate

Within the dissertation study, readmission could occur any time after discharge from the burn unit and could take place through the emergency room as a direct inpatient admission or through the inpatient rehab facility. The readmission rate for both self-immolation and accidental burn injury patients was based solely on return to the hospital after discharge for complications or the need for inpatient rehab, but did not consider the original discharge disposition or discharge location (home, home with health, skilled nursing facility (SNF), long-term acute care hospital (LTACH), or inpatient psychiatry) and, therefore, can only be interpreted in that context. Among the self-immolation and accidental burn injury patients, self-immolation patients were nearly three times as likely to be readmitted (OR = 2.82) to the hospital with longer hospital stays during readmission in comparison with accidental burn patients (15 days vs. 9 days).

Considering the previous model using the HCUP data in 2016-dollor amounts, it can be estimated that for readmissions self-immolation patients on average cost $44,000 in health care spending per patient while accidental burn patients cost $26,666 per patient in 2016-dollar amounts. In total, when accounting for the number of patients (13 self-immolation and 6 accidental) and the average cost for readmission based on hospital length of stay, self-immolation patients costed 38.8% ($412,004) more for readmissions in comparison with accidental burn injury patients. This investigator found that self-immolation patients not only utilized a significant number of resources during their initial hospitalization, but they also contributed to greater utilization and health care associated cost during readmission for burn related complications.

Mortality

There was no significant difference in mortality rates among self-immolation and accidental burn injury patients. Overall, the survival status for both self-immolation and accidental burn patients was positive (92% and 89%, respectively). With an average TBSA of 20% among both self-immolation and accidental burn injury patients (ranging from 0%-70% TBSA) this investigator found high survival rates and no significant differences within the patient populations.

Literature Review

Although self-inflicted burns have accounted for only about 1% of all burn injuries in the United States (C. Rietschel et al., 2015) as observed in the dissertation study, these injuries are often complex and present as difficult challenges to clinical care. From January 1, 2012, to December 31, 2018, self-immolation patients made up roughly 2% of the burn unit population

each year at TGH-USF Health. Although this percentage is a small percentage of the total, it is still important to note the increase in the burn unit population seen in the dissertation study.

Prior to matching and propensity scoring, this investigator evaluated the baseline patient level characteristics of self-immolation and accidental burn injury patients. Although the comparison of these baseline characteristics was not part of the study design, the dissertation study still presented information on the differences among self-immolation and accidental burn injury patients who met the inclusion criteria for the study. Among these characteristics, gender was a point of interest as literature from developing countries has shown that females are at high risk for self-immolation in comparison with developed countries where males have been identified as high risk (Masoomi et al., 2020).

This study like others in developed countries, researchers found that males made up the majority (64%) of the self-immolation patient population. Similarly, in the US, males are more likely to experience accidental burn injuries in comparison to females (American Burn Association [ABA], 2017). This investigator found that males in the accidental burn injury patient population made up 75% of the population, following the trends suggested by the American Burn Association. Although the dissertation study only represented a small portion of burn unit admissions, the patients included in this study accurately represented the population trends seen within the literature.

Low socioeconomic status (SES) like gender has been widely acknowledged as a risk factor for burns in both developed and developing countries around the world (WHO, n.d.). This investigator sought to determine if there were identifiable differences in socioeconomic status among self-immolation and accidental burn injury patients. Although no statistically significant differences were found among self-immolation and accidental burn injury patients within this

study, a large majority of patients did suffer from low SES. Both self-immolation and accidental burn injury patients experienced high rates of unemployment (61% and 41%, respectively) and more often required the support of public insurance (53% and 42%, respectively), suggesting that even within a small patient population, low SES can often be found among burn patients.

Self-immolation patients differ from other burn patients because of their frequent association with larger surface area burns, subsequent increased length of stay, high morbidity, and greater presentation of mental health disorders (Ahmadi, 2007; Ahmadi et al., 2009; Castana et al., 2013; Forster et al., 2012; Horner et al., 2005; Laloë, 2004; Mushin et al., 2019; Nisavic et al., 2017; Pham et al., 2003; Seoighe et al., 2011; Thombs et al., 2007). This analysis was used to confirm many of these findings within the burn unit population contained in the dissertation study. Although larger surface area burns could not be confirmed due to matching criteria, this investigator established that even with similar TBSA self-immolation patients had a greater total length of stay in the burn unit and the IUC, required more specialty consult services, and reported higher rates of burn related complications. Self-immolation patients also presented with significantly higher rates of pre-existing or self-reported medical history in terms of mental illness and substance abuse history as compared with accidental burn patients.

Self-immolation patients have also been associated with the need for more surgical procedures (Castana et al., 2013) and higher rates of mortality (Ahmadi, 2007; Horner et al., 2005; Peck, 2012; Ryo et al., 2019; Seoighe et al., 2011; Thombs et al., 2007). This investigator, however, found that there was no significant difference in the average number of procedures among self-immolation and accidental burn injury patients. However, it was found that self-immolation patients required a significant number of concomitant procedures (i.e., excision and autografting plus allografting) as compared with accidental burn injury patients.

Similarly, there was no significant difference in mortality rates among self-immolation and accidental burn injury patients. Despite the low incidence of self-immolation studies, it has been suggested that self-immolation burns are associated with higher mortality (Castana et al., 2013; Thombs et al., 2007; Yamamoto et al., 2019). The survival rates in the burn unit of TGH-USF Health were also noted to be positive for both self-immolation and accidental burn injury patients even though there were over 20 patients with a TBSA greater than 30%.

Implications

Self-immolation patients had significant patient-level characteristics differentiating them from accidental burn injury patients. These characteristics, which were denoted by the interpersonal theory for being common risk factors for suicide, presented the foundation for the identification of differences among sociodemographic, socioeconomic, and medical history data. Although no differences were found in race/ethnicity, employment status, and medical insurance coverage, self-immolation patients could be distinguished from accidental burn injury patient by their history of mental illness and substance abuse. It is important to note that one of the greatest differences among self-immolation and accidental burn injury patients presented in this study was their history of psychiatric treatment. Fifty-three percent of patients in the self-immolation group had a previous history of psychiatric treatment prior to attempting self-immolation.

Often, a culmination of multiple risk factors has been shown to trigger the identification of suicidal ideation (Fleischmann et al., 2016). However, even with high rates of psychiatric treatment, self-immolation patients still progressed to suicide without the identification of common risk factors. As the aim of this study was to highlight the patient level differences among self-immolation injuries in order to influence clinical care and strengthen medical

knowledge, this information is very important in terms of early detection, intervention and prevention for the future.

Self-immolation patients also had significant differences in burn unit health related resource utilization. The data points used to determine these differences were derived from the patient centered principles of overuse, which were centered around differences in utilization, satisfaction and outcomes. Self-immolation patients with matched TBSA's in total spent more time in the burn unit and the burn ICU, required the use of more specialty consult services and experienced higher rates of complications. This information validates what has previously been seen in literature on self-immolation and self-inflicted burns, and informs the level of care and resources necessary to manage this patient population.

Annually nearly 500,000 patients in the United State require medical treatment for burn injuries, and of those patients, 40,000 require acute inpatient hospitalizations (Delaplain & Joe, 2018). Applying the annual frequency of self-immolation hospitalizations at TGH-USF Health (2%) to the national average produces roughly 800 self-immolations patients requiring acute inpatient care annually throughout the country. These rates suggest the need to translate evidence into clinical management in order to impact quality of care and improve patient and staff experiences.

The information generated from this study allows for a better foundation of understanding at the patient level and informs on the differences among self-immolation and accidental burn injury patients. Population health management through the identification and development of risk stratifications enable providers to identify the right level of care and services for distinct subgroups of patients (National Association of Community Health Centers, 2019). Though this study did not seek to develop a risk stratification for self-immolation, the results

have the potential to inform clinical care and provide insight into potential time spent in the hospital, complication rates, utilization of surgical resources and specially consult services for self-immolation patients. Proactive and informed care management based on evidence-based research has the potential to lower-cost of care and improved health outcomes for self-immolation patients in the future.

Historically, cost-of-care of self-immolation injuries and readmission rates among this patient population have not been highlighted in the literature. The costs of care estimates included in this study suggest a significant increase in cost of care between self-immolation and accidental burn injury patients in 2016-dollar amounts. It is important to consider, however, how inflation has changed the cost of care over the last four years. The US Health Care Inflation Rate reflects the year over year change in the health care component of the US Consumer Price Index. The inflation rate changed from 4.6% in 2016, to 6.2% at the beginning of 2020 prior to the COVID-19 Pandemic (Kamal et al., 2020). Considering the increase in inflation, self-immolation patients on average would have cost $9,021 more per patient than accidental burn injury patients. In total, based on 2020-dollar amounts, self-immolation patients in this study on average would have cost $324,756 more for burn unit admissions than accidental burn patients, an increase of ~ $,5000 from 2016, and self-immolation patients who were readmitted on average would have cost $418,696 more than accidental burn injury patients, an increase of ~$6,000 from 2016. It can also be noted that this is a conservative estimation and $9,021/patient is likely the lower bound of the differential, as this estimation is based on burn unit days and did not include other health care resource utilization.

The patient level impact on cost of care and healthcare resource utilization is also evident in readmission rates among self-immolation patients. The transition from inpatient to outpatient

behavioral health care is a critical time for patients with a history of suicide risk and for the health care system and providers who serve them (National Alliance for Suicide Prevention [NAFSP], 2019). Recently discharged patients often lack social support and can feel isolated once they leave care (Fleischmann et al., 2016). In the month after patients leave inpatient psychiatric care, their suicide death rate is 300 times higher (in first week) and 200 times higher (in the first month) than the general populations (Chung et al., 2019). Due to the retrospective nature of the dissertation study and its limitations as previously collected de-identified data, original discharge disposition and long-term outcomes of self-immolation patients could not be assessed. However, the implications for continued self-harm and the need for readmissions due to complications among this patient population have suggested the need for patient-centered outpatient care focused on both burn care and behavioral health.

The high readmission rates among self-immolation patients not only affect health care resource utilization, but they also have implications on cost of care, especially for patients primarily insured through public insurance (i.e., Medicaid and Medicare). As the goal of Medicare and Medicaid is to reduce avoidable readmissions and improve outpatient care (Center for Medicare & Medicaid Services [CMS], 2020), hospital leaders seek to intensify their efforts to reduce rehospitalizations due to the alignment of payments with patient outcomes through the Hospital Readmissions Reduction Program (HRRR; Warchol et al., 2019), it is important to disseminate the results of the dissertation study so states and health care organizations are aware of the need for improvements in outpatient care for this patient population not only to reduce readmission rates but also reduce cost as CMS will penalize 2,545 hospitals in fiscal year 2021 for having too many Medicare patients readmitted within 30 days (Rau, 2020).

It is also important to disseminate these findings locally as Florida is a non-expanded Medicaid state. With roughly 47% of the patients included in the dissertation study participating in public insurance and another 16% uninsured, there are implications to cost of care for both those who had public insurance and those who were unable to attain insurance. Medicaid eligibility for adults in states that did not expand their programs is quite limited; the median income limit for patients in these states is just 41% of poverty, or an annual income of $8,905 for families of three in 2020, and in nearly all states not expanded, childless adults remain ineligible (Garfield et al., 2021). Although the association between Medicaid eligibility and the uninsured in the dissertation study cannot be made, it is important to note the financial implications to both public insurance and the state due to the high cost of care and readmission rates for this patient population. Although self-immolation patients make up a small portion of readmissions within the hospital setting, reducing readmissions rates within this patient population could have an impact on health-care-associated cost and outcomes-based reimbursement.

Mortality rates have generally been high for self-immolation and self-inflicted burn patients. However, the investigator found that there was no difference in mortality rates among self-immolation patients and accidental burn patients, which differs from the existing literature, and resulted in failing to reject the null-hypothesis, finding no difference in mortality rates among these groups. Within the dissertation study, there was no significant difference in mortality rates, and in general, survival rates were very high for both self-immolation and accidental burn injury patients.

The strongest risk factor affecting survival of self-immolation attempters was TBSA. After multivariate adaption for each unit increase in burns percentage, death risk ratio (HR) in self-immolation attempters was increased 1.2 times (Moradinazar et al., 2016). In studies

conducted on 952 unintentional burns above 30% in the US, the survival rate and mortality ratio of burns had the highest relation with TBSA (Kraft et al., 2012). Of note, the average TBSA was 20% for both the self-immolation and accidental burn injury patient populations within the dissertation study. Those patients who did expire had a TBSA between 70% and 90%. Although the average TBSA was not very high, nine self-immolation patients included in the dissertation study had a TBSA between 40% to 60%, which adds to the risk of complications and mortality. The results presented in the dissertation study may contradict the literature and the predicted outcomes, but it adds to medical knowledge in that the standard of care at TGH-USF Health may be a contributing factor to survival among this patient population.

Limitations and Delimitations

Retrospective studies are designed to evaluate existing data to examine certain risks factors or events that contributed to the outcome of a certain disease or exposure. In the dissertation study, the retrospective nature was based on a secondary de-identified data set of patients who were admitted to TGH-USF Health for a burn injury. The disadvantage to this type of retrospective review includes selection bias and misclassification bias. The delimitations were the establishment of sufficient data, the establishment of necessary information to fulfill the objectives of this study, and that a sufficient patient population for both self-immolation patients and accidental burn injury patients were available to match and perform the analysis. Steps that were taken to mitigate selection bias and misclassification bias included using specific diagnostic coding (ICD-9 and ICD-10) to identify self-immolation patients within the burn unit population and using the de-identified patient-level data to confirm the diagnosis.

The results of the dissertation study must be interpreted in the context of the study design. The investigator performed this study retrospectively with previously collected de-identified

patient-level data, which has the potential for confounding or misinterpretation of significant data from the medical record. There was also an inability to obtain certain outcomes, such as discharge disposition or long-term data over a significant period-of-time as presented within the dissertation study. However, this investigator engaged methodological considerations to reduce confounding and produce data with minimal variations. Propensity score matching was used to reduce confounding in covariates and produce matched data among self-immolation and accidental burn injury patients.

The dissertation study was also limited in its sample size (36 self-immolation and 36 accidental burn injury patients). As noted previously, these injuries account for a small percentage of burn unit admission, and with only 47 total self-immolation patients being admitted to TGH-USF Health over 6 years, roughly 2% of total burn unit admissions, it would be difficult to anticipate the number of patients that could be used for a research study. To perform a prospective observational or randomized clinical trial and enroll enough patients for significance would be very difficult within this patient population.

Recommendations

Suicide is a major global public health problem that does not discriminate and affects both the physical and mental health of individuals worldwide. For national responses to be effective, a comprehensive multisectoral suicide strategy, including good-quality data, is essential (Vijayakumar, 2005). Research is needed within this patient population to better understand the psychiatric characteristics of self-immolation patients in order to provide recommendations for long-term care and prevention programs. A future study evaluating long-term burn-related outcomes of self-immolation patients might examine matched pairs with accidental burn injury patients with a concomitant psychiatric diagnosis.

Recently, the COVID-19 pandemic has dramatically change life circumstances worldwide, and among the many negative health effects are the concerns about increasing risk of suicide (Schwebel, 2020). During the global quarantines required by COVID-19, family quarrels and domestic violence have increase and the potential for domestic conflict could lead to increased rates of self-immolation given the concurrent emotional, economic and mental health challenges individuals are currently facing (Bradbury-Jones & Isham, 2020; Sacco et al., 2020). Widely reported studies modeling the effect of the COVID-19 pandemic on suicide rates have predicted increases ranging from 1% to 145% (Lob et al., 2020), largely reflecting variation in underlying assumptions (John et al., 2020). Particular emphasis has been placed on the effect of the pandemic on children with numerous surveys showing that their mental health has been disproportionately affected, relative to older adults (Lob et al., 2020; Pierce et al., 2020), and some suggest an increase in suicidal thoughts and self-harm (O'Connor et al., 2020; Zhang et al., 2020). While we are unaware at this time of the direct correlation between COVID-19 and self-immolation, future research should be focusing on the concurrent effects and strategies to identify these patients.

Future research within the burn population of TGH-USF Health should also include an analysis of standard of care practices at TGH-USF Health. The investigator did not seek to evaluate nor report on standard of care practices for self-immolation patients within the burn unit of TGH-USF Health. However, the investigator suggests the results show a positive quality of care as self-immolation patients did not require more surgical procedures or suffer from higher mortality rates than accidental burn injury patients as seen in the literature (Ahmadi, 2007; Ahmadi et al., 2009; Castana et al., 2013; Forster et al., 2012; Horner et al., 2005; Laloë, 2004; Mushin et al., 2019; Nisavic et al., 2017; Pham et al., 2003; Seoighe et al., 2011; Thombs et al.,

2007). As these results may be attributed to the standard of care practices, it is important to determine why these improvements have been apparent within this patient population.

Continued research is needed for discharge disposition and its relation to readmission to affirm rates seen among self-immolation and accidental burn injury patients within the dissertation study. Similarly, continued research is needed to better understand the cost of care of this patient population and their impact on medical spending. A larger sample size among self-immolation patients could have a significant impact on future research. A study that combines many study centers could be more geographically representative and have the numbers needed to better assess this patient population.

Summary of Chapter

The aim of this research was to distinguish the population-level characteristics of patients who attempt self-immolation within the burn unit of Tampa General Hospital-USF Health and determine the impact these patients have on health-related resource utilization to inform clinical care and medical knowledge. Among 338 eligible patients, based upon inclusion criteria, 72 total patients, including matched pairs, were selected after propensity scoring. This investigator found statistically significant differences in characteristics of self-immolation patients with respect to medical history, including mental illness and substance abuse. With regards to health-related resources utilization, this investigator confirmed that self-immolation patients required a greater use of burn unit resources with respect to total hospital length of stay, burn unit surgical supplies, specialty consult services, and treatment for complications.

This investigator also determined that self-immolation patients were more likely to be readmitted to the hospital after discharge and required a greater length of stay in the hospital upon readmission. In summary, self-immolation patients had distinguishable differences in

patient-level characteristics, including mental illness and substance abuse history, and they utilized more burn unit health related resources as related to total length of hospital stay, burn unit surgical supplies, specialty consult services and treatment for complications, and increased readmission rates and stays in the hospital as compared with matched accidental burn injury patients.

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Appendix A

Specialty Consult Service Groups

Specialty Consult Service Groups
Psychology
Psychiatry
Physical Medicine & Rehab
Ophthalmology
Critical Care Anesthesia
Cardiology
Urology
Internal Medicine
Obstetrics and Gynecology
Vascular Surgery
Respiratory Therapy
Recreational Therapy
Orthopedic Surgery
Otolaryngology and Head and Neck Surgery
Nephrology
Interventional Radiology
Infectious Disease
General Surgery
Hospice and Palliative Care
Trauma Surgery
Pulmonary Disease and Critical Care
Speech Pathology
Endocrinology
Dermatology
Family Medicine
Hospital Medicine
Social Work
Hand Surgery
Pain Medicine
Oral Surgery
Skin-ostomy Care

Appendix B

List of Complications

Complication list	**Self-immolation**		**Accidental burn**	
	N	**%**	***N***	**%**
Leukocytosis	10	27.80%	4	11.10%
Normocytic Anemia	5	13.90%	2	5.60%
Hyperglycemia	6	16.70%	4	11.10%
Malnutrition of Serious Illness	7	19.40%	3	8.30%
Hypoalbuminemia	4	11.10%	7	19.40%
Hyponatremia	3	8.30%	3	8.30%
Hyperkalemia	5	13.90%	2	5.60%
Hypermagnesemia	2	5.60%	2	5.60%
Acute Respiratory Failure	13	36.10%	8	22.20%
Inhalation Injury Complication	3	8.30%	2	5.60%
Lactic Acidosis	4	11.10%	1	2.80%
Acute Hypoxic Respiratory Failure	1	2.80%	0	
Encephalopathy	1	2.80%	0	
Systemic Inflammatory Response Syndrome	11	30.60%	4	11.10%
Acute Blood Loss Anemia	2	5.60%	1	2.80%
Hyperchloremia	3	8.30%	2	5.60%
Azotemia	1	2.80%	1	2.80%
Deep Vein Thrombosis	1	2.80%	1	2.80%
Hypophosphatemia	2	5.60%	0	
Anemia	4	11.10%	8	22.20%
Metabolic Acidosis	7	19.40%	3	8.30%
Uncontrolled Pain	0		4	11.10%
Hypertension	3	8.30%	1	2.80%
Hypovolemia	5	13.90%	2	5.60%
Respiratory Acidosis	0		1	2.80%
Hepatic Encephalopathy	1	2.80%	0	
Leukopenia	1	2.80%	0	
NAGMA	0		4	11.10%
Transaminitis	3	8.30%	2	5.60%
Hypercalcemia	2	5.60%	1	2.80%
Tachycardia	4	11.10%	3	8.30%
Acute Kidney Injury	3	8.30%	2	5.60%
Thrombocytopenia	3	8.30%	2	5.60%

Compartment Syndrome	1	2.80%	1	2.80%
Hypotension	5	13.90%	2	5.60%
C. Difficile Infection	0		1	2.80%
Cardiac Arrest	0		2	5.60%
MRSA	1	2.80%	3	8.30%
Thrombocytosis	0		2	5.60%
Tracheobronchitis	0		2	5.60%
Urinary Incontinence	2	5.60%	0	
Hemoconcentration	1	2.80%	0	
Hypocalcemia	1	2.80%	1	2.80%
Acute Psychosis	3	8.30%	0	
Hyperbilirubinemia	1	2.80%	1	2.80%
Rhabdomyolysis	1	2.80%	1	2.80%
Agitation	1	2.80%	0	
Occlusive Superficial Venus Thrombosis	1	2.80%	0	
Septic Shock	2	5.60%	0	
Fungemia	3	8.30%	0	
Acute Renal Failure	2	5.60%	0	
Edema	0		1	2.80%
Dehydration	0		1	2.80%
Hypothermia	1	2.80%	0	
Intraventricular Volume Depletion	2	5.60%	0	
Gait Disturbance	1	2.80%	0	
Hypertrophic Ossification	1	2.80%	0	
Hilar Lymphadenopathy	1	2.80%	0	
Cellulitis	1	2.80%	0	
Sarcoidosis	1	2.80%	0	
Vitamin D Deficiency	1	2.80%	0	
Pulmonary Vascular Congestion	0		1	2.80%
Tracheobronchitis	0		1	2.80%
Non-occlusive Thrombocytopenia	1	2.80%	0	
Dislocation	1	2.80%	0	
Necrosis/Gangrene	1	2.80%	0	
Polymicrobial Bacteria	1	2.80%	0	
Burn Contracture	1	2.80%	0	
Parasitosis	1	2.80%	0	