TRAUMATIC INJURIES IN PATIENTS WITH PRE-EXISTING MENTAL ALTERING CO-MORBIDITIES

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ABSTRACT

Objective: Studies that describe the characteristics of injuries in patients with multiple pre-existing mental altering comorbidities are limited. Therefore, the main objective of this research is to study a full spectrum of the patterns of traumatic injuries in patients who were pre-disposed to have mental alteration as a result of selected pre-existing co-morbidities.

Materials and Methods: This is a retrospective study of trauma patients ≥10 years old based on the data from the NTDB. Patients with the diagnosis of pre-existing mental altering co-morbidities were identified using ICD-10 diagnosis codes. Descriptive and multivariate logistic regression analyses were employed using demographic variables and injury characteristics to identify the associations between MOI, PMAC and the intents of injuries in the patients who visited the trauma centers of participating hospitals in the United States.

Results: A total of 1,032,919 patients with the diagnosis of traumatic injuries age between 10 to 89 years old were analyzed. Of this number 200,700(17.6%) were patients with PMAC (targets) and the rest 832,219(73.0%) were patients without documented PMAC (controls), Male=677,943(59.43%) and female=462,570(40.55%). The average age of all injured patients was 47 (SD± 24.66) years old. Overall more geriatric female patients [19,628(9.780%)] with PMAC (age 80-89) suffered from traumatic injuries mainly fall (69.0%) and this was prominent in white (Not Latino) racial group. Self-harm was more prevalent in male target patients (31%). Major psychiatric illness was slightly more prevalent in female targets (20.02%) while substance use disorders in male targets (drug=18.78%, alcohol=14.21%), more than three times higher than the females. There were more common statistically significant ($P<0.001$) MOI (W01.0XXA the most common) that caused injuries in the target patients. Female patients with substance use disorder (alcohol) major psychiatric illness and CVA had a more predicted probability for fall injury of W01.0XXA (P<0.0001 for all). Male target patients with drug use disorder had the highest probability of getting an assault injury (X93.XXXA) followed by male patients with alcohol use disorder and female patients with drug use disorder. Self-inflicted intents were more prevalent (3.7%) in the target patients and the comparison of the proportion to controls was statistically significant (p<0.0001).

Conclusion: Over all female target patients were found to have higher predicted probabilities for fall and exposure, transport accidents, and assault injuries. But we still need more structured prospective studies to be done to substantiate this finding. The fact that traumatic injuries were more prevalent in female older target patients will remain an important point of future investigation.

Key words: MOI: Mechanism of injuries.

PMACs: Pre-existing mental altering co-morbidities.

W01.0XXA: ICD-10 diagnosis code for fall on same level from slipping, tripping and stumbling without subsequent striking against object, initial encounter.

X93.XXXA: ICD-10 diagnosis code for assault by handgun discharge, initial encounter.

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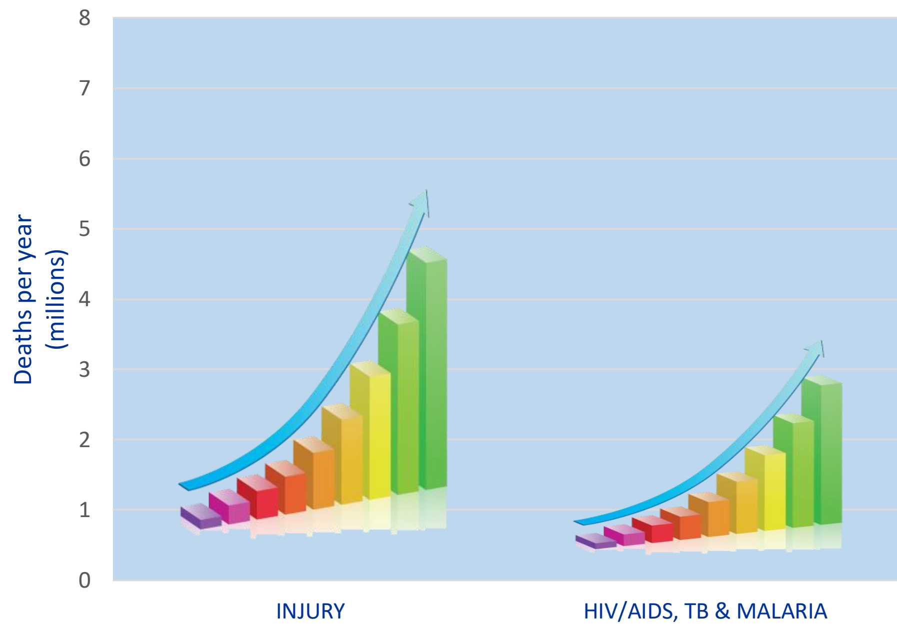
CHAPTER I

INTRODUCTION

Trauma is one of the leading causes of death and disability in the world[1]. Globally more than 5 million people die each year as a result of an injury. This accounts for 9% of deaths worldwide, nearly 1.7 times the number of lives lost as a result of HIV/AIDS, tuberculosis and malaria combined. Approximately 25% of the 5 million deaths from injuries are caused by suicide and homicide, while road traffic injuries result in closely another quarter of the fatalities. Falls, drowning, burns, poisoning, and war are regarded as the other causes of death from injuries[2]. The families and communities affected by the deaths resulting from injuries have an incalculable impact as their lives are often changed irreversibly by these tragedies. It is possible to predict injuries and prevent them by large but has been ignored from the global health program for several years. There is an indication of dramatic successes of preventing injuries by many countries through concerted efforts that encompass, but are not limited to, the health sector. By learning from those success stories, the international community needs to work with governments and civil society around the globe to implement the proven processes and decrease a preventable number of fatalities caused by injuries each year[1,2].

Fig.1. Injury deaths compared to other leading causes of mortality, world, 2012.

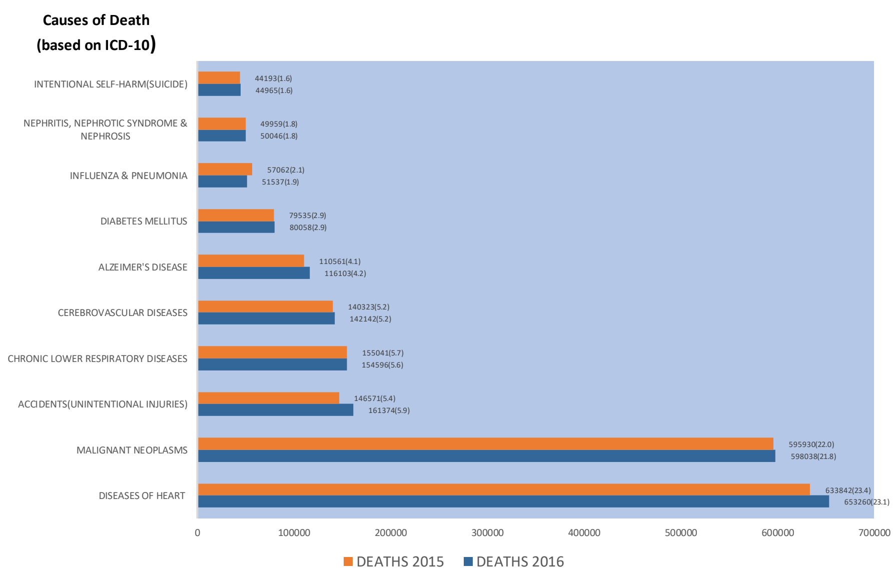


Source: WHO Global Health Estimates, 2014.

Injuries are an important public health concern and remain a growing problem in some countries. For example, road traffic injuries and falls that were regarded as two of the three leading causes of injury deaths, are forecasted to increase in rank compared to other causes of death. By 2030, road traffic injuries are predicted to become the 7th and falls the 17th leading causes of death. Suicide is remaining in the top 20[2].

In the United States, injuries and violence affect everyone, regardless of age, race, or economic status. Injuries and violence such as motor vehicle crashes, falls or homicides kill more Americans in their first half of life than any other causes of death, including cancer, HIV, or the flu. This makes injury the leading cause of death among Americans age 1-44. Every year millions of Americans get injured, some of them die (could be a premature death) and others survive. Each year 214,000 Americans die from an injury which means 1 person every 3 minutes. The Americans who survive the injuries may be faced with life-long mental, physical disability, loss of potential and productivity to social and financial problems with an alarming economic toll[3, 10, 12]. AS in some parts of the world, preventable injury-related fatalities are an increasing problem in the United States. The following reports best explain such rising concern. Since 2012, preventable injuries have increased from the fifth leading cause of death to the third, only preceded by heart disease and cancer. In 2015, 27.6 million people were treated in an emergency department and 2.8 million people were hospitalized, for injuries[3,4]. In 2016, the 10 leading causes of death accounted for 74.1% of all deaths occurring in the United States. The rank order of the 10 leading causes of death in 2015 and 2016 remained the same with two exceptions that accidents (unintentional injuries) and chronic lower respiratory diseases (CLRD) advanced from their lower rank in 2015 to become the third and fourth leading causes of death, respectively in 2016[5].

Fig.2. Deaths and percentage of total deaths for the 10 leading causes of death: United States,2015and2016.



Source: NCHS, National Vital Statistics System, mortality.

Worldwide data on the extent of Altered Mental Status (AMS) itself and its relation to traumatic injuries is very limited. Even the prehospital care setting prevalence of AMS in the United States is not well studied. But few smaller projects, for example, a study in one county in California reported AMS at a prevalence between 1-10% of the emergency department visits. The Local EMS Agencies (LEMSA) who involved in the study at this county of California reported, in their encounter of evaluating the prehospital AMS management they found the highest percentage of patients with traumatic injuries. Depending on this evidence the majority of LEMSAs (79%) recommended evaluating the patients with AMS for signs of trauma[6]. In the United States AMS is a common chief complaint in the emergency department (ED), as well as a frequent concurrent issue in patients presenting with other medical disorders. In general, AMS may be found in 4% to 10% of ED patients. Of course, certain patient subgroups even have higher rates of altered mentation, such as the elderly; dementias and other delirious states. The prevalence of AMS could reach up to 30% of the elderly patients in ED[7].

1.1. Background

An injury is defined as the physical damage that results when a human body is suddenly or briefly exposed to unbearable levels of energy. Injury can be a bodily lesion resulting from acute exposure to energy in amounts that surpass the threshold of physiological tolerance, or it can be an impairment of function resulting from a lack of one or more vital elements (i.e., air, water, or warmth), as in strangulation, drowning, or freezing[8]. Traumatic injuries may result in wounds, broken bones or internal organ damage[9]. The energy causing an injury could be one of the following: Mechanical as in an impact with a moving or stationary object, such as a surface, knife, bullet or vehicle, radiant as in a shock wave from an explosion, thermal as in air or water that is too hot or too cold, electrical and Chemical as in a poison or an intoxicating or mind-altering substance such as alcohol or a drug[8].

The mechanism (MOI) or cause of injury is defined as the way in which the person sustained the injury; how the person was injured; or the process by which the injury occurred[18]. Mechanisms of injury include motor vehicle crashes, firearms, falls (especially in the elderly), fires, burns, drownings, and poisonings. Some injuries, such as poisonings and drownings, are regularly not treated by trauma services or included in trauma registries[19]. According to the National Vital Statistics Reports (NVSS) of 2016, in the United States, four major mechanisms of injury—poisoning, motor-vehicle traffic accidents, firearm, and fall—accounted for 78.6% of all injury-related fatalities. Accidents (unintentional Injuries) were the third and Intentional Self-harm usually called suicide were the tenth leading causes of death in 2016[21]. The death of teens and young adults is mainly due to motor vehicle crashes. Poisoning was the leading cause of preventable death for all ages for the fifth consecutive year. This is mostly due to the opioid epidemic affecting millions of Americans. Preventable poisonings resulting from opioid drugs kill 103 Americans daily and this was accounting for 37,814 deaths in 2016[22].

Traumatic injuries can be relatively minor which can be painful or uncomfortable. Such minor injuries will usually be treated, and the victim will be able to remain at home. However, traumatic injury can be more serious, requiring admission to the hospital for assessment, treatment, and rehabilitation. The full magnitude of injuries is not always apparent when a patient first arrives at the hospital, and they may require in-depth examination and multiple tests including different radiological procedures or operations in the first few days. The severity of an injury can be calculated using a scoring system called the injury severity score (known as ISS). This score is calculated retrospectively once all injuries have been identified. Some patients with severe injuries may require admissions to a higher level of care or specialist treatments[9].

Injuries adversely affect the health and welfare of people, regardless of country of origin or economic status[10,12] but for the sake of prioritization, we may want to know better about persons at more risk. In an attempt to learn the vulnerability, researchers tried to study the injury proneness of individuals and several investigators have shown how psychological states and traits are related to an increased probability of persons becoming a victim of physical injury. Empirical evidence shows that emotional dissatisfaction, impulsiveness, extraversion, external locus of control, hostility, and antisocial attitudes are all connected with injury-prone behavior. Three basic personality dimensions (extraversion, neuroticism, and psychoticism) could be referred to as the most general traits contributing to injury proneness[13]. In addition to the behavioral and personality dimensions, the impact of pre-existing co-morbidities on injury has to be investigated. A study reported a supporting concern that the current burden of injury estimates may be inaccurate if the impact of pre-existing ill-health is not taken into account. It farther stated, compared to the non-injured group, injured people had higher co-morbidity index scores, 1.9 times higher rates of hospital admission and 1.7 times higher rates of physician claims. A study revealed that injured people had a higher rate of admissions to hospital and physician claims for a mental health disorder than the other pre-existing co-morbidities[57] but there is a paucity of general information on the relationship of altered mental status (AMS) itself[14], multiple pre-existing mental altering comorbidities and injuries.

Population aging is a growing issue affecting societies around the world. The effect has been reflected in increased average age of the trauma patients, though younger patients still comprise the majority of the victims. Given this trend toward population aging, trauma care systems are now being challenged with issues related to the pre-existing comorbidities and impaired physiological reserves of elderly patients[15]. In addition to the increased risk of trauma, comorbid diseases such as diabetes mellitus, coronary artery disease, arthritis, renal disease, and pulmonary disease are also common in this population. Preexisting comorbidities affect the patients' physiological functions and are associated with increased mortality rates. In addition to the comorbidities mentioned above, geriatric trauma patients frequently present with altered mental status. AMS is becoming a common chief complaint in the emergency department (ED), as well as a frequent concurrent issue in patients presenting with other primary presentations.

Therefore, understanding of potential etiologies of altered mental status is important to effectively diagnose and manage patients visiting the emergency department[7, 16].

Altered mental status (AMS) refers to disorders of mentation, including impaired cognition, diminished attention, reduced awareness, and/or altered level of consciousness[7]. AMS often known as delirium could exist in 10% to 20% of the general patients admitted to hospitals with increased rates among the elderly[17]. Patients with AMS may present with several vague symptoms such as confusion, not acting right, altered behavior, generalized weakness, lethargy, agitation, psychosis, disorientation, inappropriate behavior, inattention, and hallucination[27]. The differential diagnosis of AMS is lengthy and complex[17]. Often, if the history does not clarify the etiology of AMS, the physical examination and environment will provide the needed clues. But if the history and physical examination do not immediately elucidate the cause of AMS, the acronym AEIOUTIPS-[(Alcohol, Epilepsy/Electrolytes, Insulin/Inborn Errors of Metabolism, Overdose/Oxygen, Uremia, Trauma, Infection, Psychiatric/Poisoning, Stroke/Subarachnoid Hemorrhage (SAH)/Shock)] can be used to consider a broader differentials[6]. There are multiple causes of AMS: drug toxicity/overdose, metabolic derangement, structural abnormality (e.g. Hydrocephalus), infectious disease, psychiatric illness, trauma, neoplasm, stroke, autoimmune, endocrine, temperature and convulsion/seizure are considered among common etiologies[16,17, 25, 26,47]. Studies on how injuries affect patients with multiple PMCs is limited but reports on related diagnosis such as patients with mental illness (major mental illnesses) indicate 80% higher incidence of injury. The risk for fatal injury was also more than four and a half times higher among the cohort with serious mental illness compared to the general population. A related report on psychoactive substances uses stated that alcohol and drug use disorders were associated with both risks of injury and risk of injury-related death with hazard ratios of 1.87 and 4.76 respectively[23, 24].

1.2. Statement of the Problem

Altered mental status (AMS) is a common reason for emergency department visits, hospital admissions, and neurology consultation in the United States[16]. As mentioned earlier since 1980 the elderly population has been increasing worldwide including the United States and geriatric trauma patients frequently present with altered mental status. This implies an increase in the rate of injuries in patients with AMS. Geriatric patients age 65 years and older represent a large, growing segment of the American population and, according to the US Census Bureau data, currently, geriatrics represent an estimated 14% of the population. Moreover, this population accounts for 36% of all ambulance transports, 25% of hospital admissions, and 25% of total trauma costs. This rapidly growing aging population will therefore, impose a high burden on our healthcare system in the upcoming decades, as they are at an increased risk for receiving more medical care[16,28]. The prevalence of drug use in the U.S. and elsewhere are increasingly and the disorder is mainly common in heavy drinkers[31]. In the United States, an increased prescription of opioid drugs led to widespread ill use of both prescription and non-prescription opioids and in 2017 the U.S. Department of Health and Human Services declared a public health emergency of Opioid Crisis[29]. People with addiction often have one or more accompanying health issues which include lung or heart disease, stroke, cancer, or mental health conditions and either the addicted drug or the associated health issue could be the etiology of AMS. Some drugs, such as inhalants, may impair or destroy nerve cells, either in the brain or the peripheral nervous system and that implies drug use and mental illness often co-exist. In some cases, mental disorders such as anxiety, depression, or schizophrenia may come before addiction; in other cases, drug use may trigger or worsen those mental health conditions, especially in patients with specific vulnerabilities[31]. Generally, persons with mental illness have between 40 and 60 percent of co-morbid substance use disorder and this is an established risk factor for injury.

All other factors associated with serious mental illness and its consequences may increase the risk of injury. For instance, changes in perceptions and awareness, such as decreased sensitivity to pain, may contribute to a heightened risk of injury among persons with serious mental illness. In addition to this, problems with social relationships are more prevalent in patients with serious mental illness, and many persons with serious mental illness live in marginal housing and some are homeless. These conditions could lead directly to injuries or to incidents of minor violence or victimization that cause injury[16,23].

The knowledge of the mechanisms of injury is useful in designing effective prevention programs to reduce injuries or to lessen their severity. It can also provide information on the behaviors and events that preceded the injury occurrences [8]. Studies are also indicating criteria using physiological, injury components, and mechanism of injury are more likely to better detect possible major trauma patients even though it results in a high over triage rate[20].

Over the past 20 years, great progress has been made in the United States to reduce the burden of injuries, but more will need to be done for the science and practice of injury and violence prevention to grow. Enhancement of injury and violence surveillance systems is needed to allow more timely and accurate data to monitor trends and evaluate the effects of prevention initiatives. Important gaps remain in areas like the research of the mechanisms that serve as the basis for the development of novel prevention strategies. One important area is the need to understand the modifiable factors that assist young people to overcome personal, relationship, and environmental challenges and to safeguard against injury risks. This type of research can help the understanding of why individuals are injured and the factors within self, families, communities, and schools that serve to protect individuals from injuries[39].

Most studies that have utilized large databases have focused on specific injuries such as vascular trauma to the extremities, spinal cord injuries, traumatic brain injuries (TBI) and penetrating abdominal injuries. Other studies have either used smaller databases or concentrated on specific populations, such as the elderly, adolescents, mentally ill and substance and/or alcohol use disorders. Some more studies again have used these databases to evaluate specific treatment protocols or policy changes. Those studies that have taken a broader view of the epidemiology of trauma in the US have generally concentrated on mortality, and have been either largely based on single institutions, small patient populations or have been based on literature reviews. While informative in their way, so far these studies fail to capture the full spectrum of the patterns of traumatic injuries in patients with multiple pre-existing mental altering co-morbidities all at once using the same large U.S national data and our research is intended to bridge this gap.

1.3. Significance of the Research

This study is based on one of the recently available registries of the National Trauma Data Bank (NTDB) of 2016. The NTDB is preferably used to carry out this research because it is the largest aggregation of the U.S. trauma registry data ever assembled [49]. NTDB is established and owned by the American College of Surgeons (ACS) and the NTDB 2016 contains detailed data on more than six million cases from over 900 registered U.S. trauma centers[50]. It offers information pertinent to the intended investigation and is representative of a typical trauma center population [43].

The scientific evidence that supports the prevention of injury and violence is strong. Public health strategies for prevention such as education, behavior change, policy, engineering, and environmental support are guided by the social-ecological model that informs how strategies should be implemented across individual, relationship, community, and society levels. Interventions that address the social and economic determinants of health and change the context to make individuals' default decisions healthy can have a greater public health effect than interventions that require intensive, one-on-one, counselling[39].

To my knowledge, this is the first study on traumatic injuries in patients with multiple pre-existing mental altering co-morbidities in the United States using such a large data of NTDB and it is expected to yield the most reliable and comprehensive results that represent larger population and will be a very important addition to the available scientific information in the field. AMS and injury are increasing in the U.S for reasons such as the aging population, high alcohol consumption, opioid epidemic, and concurrent mental disorders. Recommendations made based on the results of this study will help in creating preventive measures by public health officers, policymakers, and health personnel working in hospitals and other care facilities.

1.4. Objectives of the Study

There exists a limited nationwide study data on patients with AMS and injury but research findings on related differential diagnoses such as mental illness, alcohol, and drug users indicate a higher percentage of incidence of injury compared to the general population. The purpose of this dissertation is to analyze the NTDB data related to patients with multiple pre-existing mental altering co-morbidities and injury and come up with a result representing a larger patient population that can enrich the baseline data that could be utilized in formulating policies and crafting preventive measures. Therefore, the general objective of this research is to study a full spectrum of the patterns of traumatic injuries in patients who are pre-disposed to have mental alteration as result of selected pre-existing co-morbidities reported by NTDB and the specific objectives are:

- Identify the mechanisms of injuries (MOI) that are more common for injuries in patients with pre-existing mental altering co-morbidities (PMAC).
- Calculate the prevalence of injuries in patients with PMAC.
- Identify more common pre-existing mental altering co-morbid diagnoses in the injured patients.
- Verify the influence of the measure of the patient's level of consciousness (Glasgow Coma Scale) on the probability of getting a traumatic injury in patients with PMAC.
- Find out the prevalence of the intents of injuries among patients with PMAC.

1.5. Research Hypotheses

The following are the research hypotheses to prove:

Hypothesis 1

H10: There is no specific mechanism of injury (MOI) that is more common in patients with PMAC.

H1a: There is a specific mechanism of injury (MOI) that is more common in patients with PMAC.

Hypothesis 2

H20: There is no statistically significant difference in the prevalence of traumatic injuries among patients with PMAC as compared to patients without PMAC.

H2a: There is a statistically significant difference in the prevalence of traumatic injuries in patients with PMAC as compared to patients without PMAC.

Hypothesis 3

H30: There is/are no statistically significant pre-existing mental altering co-morbidities that often associated to sustain traumatic injuries.

H3a: There is/are statistically significant pre-existing mental altering co-morbidities that often associated to sustain traumatic injuries.

Hypothesis 4

H40: Glasgow coma scale (GCS) doesn't have statistically significant effects on traumatic injuries in patients with PMAC.

H4a: Glasgow coma scale (GCS) has statistically significant effects on traumatic injuries in patients with PMAC.

Hypothesis 5

H50: There is no statistically significant difference in the intents of injuries in patients with PMAC and patients without PMAC.

H5a: There is a statistically significant difference in the intents of injuries in patients with PMAC and patients without PMAC.

CHAPTER II

REVIEW OF RELATED LITERATURE

As conducting a thorough literature search is important in structuring a new study and identifying gaps in the knowledge base of the scientific community, the study question for this research was well-formulated using the (Patient /the problem, intervention/Exposure to be considered, Control/comparison and outcome of interest) PICO method for short. Keywords, phrases, and alternatives were entered into the main search databases to extract comprehensive resources (systems), high-quality studies and abstracts (synopses), systematic reviews and original research studies, collectively called 4Ss. PubMed, Medline, CINAHL, OVID, Web of Science, Cochrane Library, Google Scholar and some more search engines[34, 35] were used to retrieve the information as outlined below.

2.1. The Burden of Traumatic Injuries

Injury is responsible for large global health and economic burden. Millions die from trauma each year which makes it a serious international health problem. Moreover, trauma incurs 180 million disability-adjusted life years annually. Ninety percent of this burden takes place in low- or middle-income countries (LMICs). In 2005, countries lost an estimated USD 167.8 billion from road traffic injuries alone[36, 42]. Injuries accounted for 10.1% of the global burden of disease in 2013. Years of Life Lost (YLLs) were responsible for 85.2% of injury Disability-Adjusted Life Year (DALYs). In 2013, they estimated that 973 million people sustained injuries and 4.8 million injury fatalities were recorded. In all regions of the world injury rates are considerably higher in men than in women except for with the 80 years and older age group where the gender differences largely wane[37].

In younger adults aged 15 -49 years old, DALY rates in men vary from a low of 2651 per 100 000 population in western Europe to a high of 10 780 in eastern Europe. In women, rates range from a low of 798 in Australasia to a high of 3268 in South Asia. Rates in developed countries such as North America are around 70% higher than in Western Europe, Australasia, and the high-income Asia Pacific with generally higher rates for most injuries. Patterns of injury DALY rates in the age group 50–79 years follow similar patterns as those in the younger adult age group but the differences between regions and between men and women are less marked i.e. DALY rates in high-income regions are higher and those in other regions are lower. Falls are the dominant cause of injury DALY rates in the geriatric population. Andean Latin America, South-East Asia, North Africa, and the Middle East and sub-Saharan African regions harbor a quite prominent aging cohort of people with long-term disabilities from past wars and disasters[37].

Injury-related morbidity and mortality is a public health burden in the United States in terms of fatalities, cost of care, and lost productivity. Unintentional traumatic injuries killed 136,053 people in the United States in 2014, surpassed only by heart disease (614,348), cancer (591,699), and chronic lower respiratory diseases (147,101). For children and adults younger than age 45, traumatic injuries account for an estimated 79,000 deaths per year, whereas deaths from non-communicable diseases are 49,000 and deaths from infectious diseases is 15,000. It accounts for closely 60% of all deaths among Americans 1–44 years of age. In the U.S alone, approximately 27 million people are treated for injuries in emergency departments each year. In the United States, trauma is the only most important cause of potential years of life lost for persons under age 65. The impact of traumatic injury in the United States extends beyond lives lost[38,41,42]. A total of 31,038,072 nonfatal injury-related hospitalizations and ED visits were identified in 2013. This represents 9.8 per 100 people. Hospital-treated nonfatal injuries in 2013 cost an estimated $1.853 trillion, including $168 billion in medical spending, $223 billion in work losses, and quality of life losses valued at $1.461 trillion. The total estimated cost per injury was roughly $59,700, including approximately $5,400 in medical spending, $7,200 in lost future work and $47,100 in quality of life losses. The total costs per injury were highest for the oldest and youngest age groups; individuals < 1-year-old ($97,623) and 65 years and older ($71,493). Total cost per injury was slightly higher for those with Medicare and Medicaid versus those with commercial insurance or other payer types. 91.5% of patients with injuries were discharged, this represented only 8.8% of costs and 8.5% of patients admitted representing 91.2% of costs[39]. Falls and struck by/against injuries contributed to 35% of nonfatal injury costs and were the leading causes in all age groups. The most severe and debilitating injuries will result in higher costs. Among hospital-treated nonfatal injuries, near-drownings, self-harm, and firearm-related violence are the most costly. The external cause of injury was not coded for cases accounting for 9% of total injury costs[41].

People of all ages, races, and levels of education and income are affected by injuries and violence-no one is immuned. In U.S. clinical settings, patients are more familiar with the prevention of other major fatal conditions such as heart disease, stroke, and cancer than they with injuries. Screening programs for injury risks have not yet incorporated into routine standards of care by Physicians and other healthcare workers[39]. CDC reported in its 2016 ten leading causes of death that from age 1 year to age 30 years, more individuals in the USA die from unintentional injuries than from any other cause. It is the number one leading cause of death followed by malignant neoplasms and heart disease[40]. The health consequences of injuries and violence are not limited to physical and mental problems, but it can affect sexual, and reproductive health where the results extend beyond injury affliction and can become chronic and result in substantial health burden and costs[39].

Based on the retrospective descriptive and analytic epidemiologic study of an inpatient database representing 20,659,684 traumatic injury discharges from US hospitals between 2000 and 2011, in the US, trauma is the single most important cause of potential years of life lost for persons under age 65. The epidemiology of the inpatient traumatic injury caseload in the US is changing in important and challenging ways. Inpatient trauma cases are increasingly older, approaching 60 years, more severely injured, and have an increased burden of co-morbid conditions compared to 10 years ago. The increased number of old age inpatient trauma population reflects the aging of the nation, with a 21.1% increase in the population over the age of 62 during the study period. The increasing burden of elderly trauma has been recognized for some time. More recent data, including the results of the study mentioned above, continue to emphasize the importance of the geriatric population. Elderly trauma patients, compared with a younger cohort, suffer more significant injuries for a given mechanism of injury and have higher mortality rates for given injury severity. The increased comorbidities observed in this population often contribute to both the reason for injury and the poor post-injury outcomes. The average length of stay for all trauma discharges during the study period was 5.1 days, with a median length of stay of 3 days. For severely injured discharges, the average length of stay was 7.5 days, with a median stay of 6 days. The total cost of trauma-related inpatient care between 2001 and 2011 in the US reported in 2010 was $240.7 billion, accounting for approximately 6.3% of the total $3.8 Trillion inpatient hospital costs in the US during that period. Annual total costs related to trauma in the US inpatient increased each year from 2001 to 2011, more than doubling from $12.0 billion in 2001 to $29.1 billion in 2011. The number of comorbidities associated with trauma patients also increased during this study period. Older patients experienced the largest increase in comorbidities. Patients who died after being admitted to hospitals had significantly more comorbid disease than patients who survived[43].

2.2. Causes of Traumatic Injuries and Persons at Risk

Per the 2013 report of the global burden of injury, the major mechanisms or causes of injury death were road injury (29.1%), self-harm (17.6%), falls (11.6%) and interpersonal violence (8.5%). Of the people who sustained injuries that obtained some type of healthcare, 5.8% (56.2 million) warranted inpatient care, of whom 38.5% (21.7 million) sustained fractures. Of the patients that given outpatient care 75.2% (689 million) sustained minor injuries (689 million)[37].

According to a report in the Journal of lancet 2014 on prevention of violence and injury in the United States, from age 1 year to age 30 years, more individuals in the USA die from injuries and violence than from any other cause which is almost similar to the report in 2016 but note the difference in upper age range. In 2010, the order of the ten leading causes of death in the age group 1-30 years old were unintentional injury, suicide, homicide, cancer, heart disease, congenital anomalies, cerebrovascular disease, influenza and pneumonia, diabetes, and chronic low respiratory disease. Of injury deaths, 59·6% were caused by unintentional injuries, 20·5% by suicide, and 19·9% by homicide. In 2010, almost 121,000 people of all ages died from unintentional injuries in the USA (age-adjusted rate of 37·9 deaths per 100, 000). The most frequent causes were motor-vehicle crashes (33,687), poisoning (33,041), falls (26,009), suffocation (6,165), drowning (3,782), and fires (2,845). In that same year, more than 55, 000 violence-related deaths occurred in the USA (17·5 per 100,000). In 2011, about 2·3 million people were treated in US emergency departments for an assault or act of self-harm, and about one in ten people had a nonfatal unintentional injury that was serious enough for them to need to visit an emergency department. Beyond these injuries, millions of Americans every year are victims of intimate partner violence, sexual violence, and child abuse. More than 31·2 million unintentional and violence-related injuries occurred in 2010, resulting in an estimated annual cost of more than US$513 billion in medical care and lost productivity across the lifespan of victims. This figure does not include the costs associated with nonmedically treated injuries, legal costs, or indirect costs from other health problems associated with or exacerbated by violence and injuries[39].

A more summarized report of the National Vital Statistics (NVSS) of 2016 stated, in the United States, four major mechanisms of injury—poisoning, motor-vehicle traffic, firearm, and fall—accounted for 78.6% of all injury deaths. A total of 68,995 deaths occurred as a result of poisonings accounting for 29.7% of all injury deaths. Motor vehicle traffic-related injuries resulted in 38,748 fatalities, accounting for 16.7% of all lives lost to injury. Persons died from firearm injuries were 38,658, accounting for 16.7% of all injury deaths that year. The two major component causes of firearm injury deaths were suicide (59.3%) and homicide (37.3%). A total of 35,862 persons died as the result of falls, accounting for 15.5% of all injury deaths. The age-adjusted death rate showed an increasing trend from the previous year and even significantly increased for poisoning. Accidents (unintentional Injuries) were the third and Intentional Self-harm (suicide) were the tenth leading causes of death in 2016[21]. The death of teens and young adults is driven largely by motor vehicle accidents. Poisoning was the leading cause of preventable death for all ages, combined, for the fifth consecutive year and was the leading cause of preventable death for every age from 23 to 64. This is largely due to the opioid epidemic affecting millions of people in the U.S. One hundred three people die daily from preventable poisonings due to opioid drugs, accounting for 37,814 deaths in 2016. An additional 4,435 people died in 2016 from intentional opioid overdoses or overdoses where the intent was undetermined[22]. Opioid turned to be a public health issue after pharmaceutical companies reassured the medical community in the late 1990s that patients would not become addicted to opioid pain relievers and then healthcare providers began to prescribe them at greater rates before it became clear that these medications could indeed be highly addictive resulting in the opioid epidemic. The epidemic kept increasing and since 1999 opioid overdoses have quadrupled, with more than 15,000 people dying from prescription opioid overdoses in 2015[3,29]. The 2008

National Survey on Drug Use and Health found among heavy drinkers, 29% reported current illicit drug use (compared to only 3% of those not reporting current alcohol use). Much of the research on the association of psychoactive drugs and injury have focused on motor vehicle crashes, and these studies have shown that many drugs, in addition to alcohol, impair psychomotor skills and other critical dimensions of performance and may, therefore, place users at increased risk of injury. More studies have also shown that the association of both alcohol and other drugs may be stronger for intentional injuries than for other types of injury. Intentional injuries are more likely to be positive for alcohol in combination with other drugs[30]. High frequency of alcohol was found in victims of road traffic accidents: 29.5–48.7% of their blood measured ethanol. It is set in 21.0–77.0% of road fatalities exceeding the controls by 3–10 times[33]. Deaths dip below the average between ages 66 and 81 before briefly spiking again, driven by older adult falls[22].

Trauma, which has traditionally been viewed as a problem of the young, is becoming increasingly a condition of the old. For geriatrics, a seemingly minor mechanism of injury such as a fall from standing height may result in disproportionately severe injury when compared to younger patients[43]. Studies related to mechanisms of injuries are reporting that falls were more common in geriatric patients but there is limited information regarding injury patterns in this patient population stratified by the mechanism of injury[32]. More recent data, including the reports above, continue to emphasize the importance of this population. The comparison of elderly with younger trauma patients is important because geriatric patients suffer more significant injuries for a given mechanism of injury and have higher mortality rates for a given injury severity than the younger cohort. Falls in the elderly are a particular challenge and analyses indicate that this mechanism persists as an increasingly important cause of injury. Unsteady gait, vision and hearing alterations, and polypharmacy put the elderly at increased risk of falling and the widespread use of anticoagulation medications increases the risk of intracranial hemorrhage. Head, chest and extremity injuries are also more apt to occur in this vulnerable population[43]. Each year, 2.8 million older people are treated in emergency departments for fall injuries[3].

A study in 2017 on specific ethnic groups of 74 participants where all the participants were Black males indicated the median age of the study population to be 33.5 years (range 18–84 years); 49 (66%) men had a high school education or less and 40 (54.1%) reported total annual household incomes less than $20,000. Prior to the injury, 38 (51%) participants were employed, 30 (41%) were unemployed, two (2.7%) were retired, and four participants did not provide employment information. Approximately 40% (n=29) of the sample sustained unintentional injuries, of which almost half (48.3%) were injured in a fall and one-third (34.4%) were injured in a motor vehicle crash, with the remainder from other injury mechanisms. Of the 45 survivors of intentional injuries, 57.8% were injured by firearms and one-third (33.3%) were injured in stabbings. Survivors of intentional injuries (e.g., gun violence and assault) may have an increased risk of adverse mental health outcomes compared to survivors of unintentional injuries (e.g., falls and motor vehicle accidents). Contributing factors to stronger emotional responses among intentionally injured people may include increased perceptions of helplessness and lack of control, greater likelihood of knowing the person who perpetrated the assault which makes the traumatic event more personal, and greater exposure to violence and traumatic events in neighborhoods with concentrated disadvantage. Survivors of unintentional and intentional traumatic injuries described depressive feelings related to their perceived inability to return to their normal activities and perceived loss of independence. The participants described the negative impact on their ability to work, play with their children, and take care of themselves. The primary finding of this study was that emotional responses to traumatic injuries can differ by injury intentionality among urban Black men. The experiences of these men demonstrate that neighborhood exposure to violence is a chronic stressor in their lives with profound implications for mental health and recovery after intentional injury. Living in neighborhoods with concentrated disadvantage and persistent violence offers no reprieve from stressors that may increase the risk of re-traumatization or future assaultive events. Furthermore, for intentionally injured men, the violent nature of their injuries presents an additional set of challenges including interactions with the perpetrators of their injuries and the criminal justice system which may contribute to their feelings of anger and worry. Survivors of intentional injuries reported fearing and distrusting the intentions of others and, as a result, they distanced themselves from people in their lives. Survivors of unintentional injuries experienced negative emotional responses but did not describe distrusting people[42]. Mentally ill persons were more likely to have incurred an unintentional injury from fall or being hit by a car and less likely to have been injured in a motor vehicle crash. Also, several studies investigated falls among persons with schizophrenia or other specific diagnoses of mental illness[23].

2.3. Traumatic Injuries in Patients with Altered Mental Health

There are limited Pieces literature and information related to traumatic injuries and pre-existing co-morbidities particularly mental altering co-morbidities. The studies found have either used smaller databases from a single organization or concentrated on specific populations.

An altered mental status may be classified using three broad clinical areas: psychiatric, encephalopathic, or disease processes confined to the intracranial contents. Psychiatric mental disorders that may cause altered mental status include schizophrenia and other psychoses, mania primarily due to bipolar disorders, severely decompensated major depression, and rapid progression of dementia. Acute encephalopathy causes altered mental status due to generalized brain dysfunction resulting from reversible systemic metabolic or toxic processes. Intracranial processes such as stroke, hemorrhage, or neoplasm may cause altered mental status due to their local or generalized effects on the brain [58]. Many individuals who develop substance use disorders (SUD) such as drugs, alcohol, and tobacco are also diagnosed with mental disorders, and vice versa. The overlap between SUD and mental disorders is especially pronounced with serious mental illness (SMI). Serious mental illnesses include major depression, schizophrenia, and bipolar disorder, and other mental disorders that cause serious impairment[59].

A study carried out in Manitoba, Canada in 2005 reported, based on hospitalizations and physician claims, overall a greater percentage of injured people had comorbidities, and they had more comorbidities per person than the members of the non-injured cohort. Injured people had an average of 2.2 different conditions in the pre-injury year whereas in the non-injured people this figure was 1.5. Of the different co-morbidities listed more injured people than the non-injured cohort had a moderate or severe pre-existing mental health condition, as indicated by health services use in the pre-injury period. Injured people had a rate of admissions to hospital for mental health disorder 9.3 times higher, and physician claims for mental health disorder 3.5 times higher, than that of non-injured people. Alcoholic psychoses, affective psychoses, and schizophrenic disorders contributed to more than half of the mental health admissions. Over 80% of all mental health physician claims for the injured cohort were for personality disorders, more specifically panic, anxiety or depressive conditions[57]. However, this research was aimed at studying all pre-existing co-morbidities and failed to more characterize specific mental altering comorbidities.

Mental illness affects 18% of adults in the United States. Mental illness is one of the pre-existing mental altering co-morbidities. Psychiatric patients undergoing medical care require multiple additional considerations and are at greater risk for all-cause mortality. These disparities are also apparent in the context of traumatic injury. Mental illness is associated with a twofold increased risk of traumatic injury compared to the general population. Once injured, those with psychiatric comorbidity have a longer hospital length of stay (LOS), increased complication rates, and higher rates of discharge to rehabilitation and nursing facilities. These studies have shown that patients with psychiatric illness are less likely to undergo elective surgery and experience higher rates of postoperative complications. After elective surgery, patients with the psychiatric illness also have longer hospital lengths of stay. Studies targeting all characteristics of traumatic injuries including independent risk factors and surgical outcomes in patients with mental illness are limited[56].

A prospective, unblinded, consecutive series study performed at Vanderbilt University Medical Center Adult Trauma Service between December 1, 1998, and November 30, 1999, on AMS patients age older than 14 who sustained blunt traumatic injury reported that of the 2,690 consecutive admissions to their adult trauma center during the 12-month study period, 1,356 patients met entry criteria and were entered into the study. Seventy patients (5.2%) had a total of 95 injuries of Co-C3. Twelve patients of this group (17%) had neurologic deficits attributable to injuries of the upper cervical spine. They found the cause of altered mental status to be multifactorial and includes concomitant brain injury, substance abuse, and hemodynamic instability. Those patients were unable to cooperate or provide reliable responses and, consequently, subtle motor or sensory deficits are missed. The consequences of such a missed diagnosis are catastrophic for both the patient and the physician. Additionally, trauma patients with alterations of the mental status usually have sustained a more severe mechanism of injury. The subgroup of brain-injured patients is particularly noteworthy. The presence of a brain injury appears to be an independent risk factor for cervical spine injury and may increase the incidence to nearly 7%. In their study of patients with altered mental status, the incidence of upper cervical spine injury was 5.2%; 41.4% of this group were obtunded or intubated. The mechanism of injury was a motor vehicle crash 62 (89%), fall injury 7 (10%), and pedestrian versus automobile 1 (1%). Of those patients with injuries to the upper cervical spine, the mean age was 39.5 years (range, 16–91 years), the mean Injury Severity Score was 23.5 (range, 5–75), and the mean Glasgow Coma Scale score was

11 (range, 3–15). Male patients (n = 42) outnumbered female patients (n = 28). Twenty-nine of 70 patients (41.4%) with upper cervical spine injuries arrived obtunded or intubated and were therefore unable to provide even rudimentary information regarding the presence of neck pain or tenderness[44]. Another investigation took place in the same center (Vanderbilt University Medical Center Adult Trauma Service) from January 1, 2001, to July 31, 2001. The inclusion criteria for this study were age 16 years or older, had blunt trauma, and had altered mental status or distracting injuries. One thousand six patients met the study criteria and underwent both CTS and CSX that were entered into the study. Of these, 116 patients had 172 acute CSIs (Cervical spine injuries). The mean age was 38 years; men outnumbered women, 86(72.9%) to 32(27.1%). More whites 99(85%) involved followed by African American 11(9.5%). This was a severely injured group of patients with an average Injury Severity Score of 25 and an average Glasgow Coma Scale score of 12. The most common mechanism of injury was motor vehicle crash 86(74.1%), followed by motorcycle crash 11(9.5%), fall 10(8.6%), assault 3(2.6%), pedestrian struck 2(1.7%) and other 4 (3.4%). There were four (3.4%) deaths in the study; none were caused by their CSI[45].

An older but quite similar study to above performed in 1995. This study was conducted at Metro Health Medical Center, an urban level I trauma/referral center with a busy aeromedical transport service and an emergency department census of 68,000 visits per year. They performed a retrospective chart review of patients diagnosed with TLF from January 1989 to December 1992. ICD-9 coding and the hospital mainframe computer were used and cross-referenced with patient databases located in the departments of orthopedic surgery and neurosurgery. For the purposes of the study, they defined altered sensorium as a Glasgow Coma Scale (GCS) score of 14 or less, or intoxication with ethanol or other drugs as noted by clinical evidence or by blood or urine toxicologic assays. An ethanol level of greater than 0.10 mg/dL was considered intoxicated. One hundred forty-five patients with TLFs were identified. Mean patient age was 36.5 +/- 17.5 years, with a range from 15 to 91 years of age. One hundred and one (69.7%) patients were male. Motor vehicle crashes (MVCs) (40%) and falls (37%) were the major mechanisms of injury, with MVC-pedestrian injuries (6%), motorcycle crashes (4%), sports injuries (2%), and others (11%) accounting for TLFs. Forty-eight patients (33%) had an altered sensorium on presentation, which we defined as a GCS score of 14 or less or evidence of intoxication. Included in this group was one patient with severe dementia and one patient with mental retardation. Our study probably underestimates the percentage of patients with alcohol intoxication, because alcohol levels were often, but not routinely, obtained. Sixteen (11.0%) patients had a delay in diagnosis. Nine (56.3%) of these patients had BPT on presentation. All seven of the patients with a negative finding of BPT had an altered sensorium or concomitant major injury. The T/L fractures were missed (diagnosed after patient discharge) in 8 (5.5%) patients. Seven (87.5%) of these patients complained of BPT. The remaining patient had other major injuries. The presence of back pain, altered sensorium, and the concomitant major injury were compared in patients with a delay/missed diagnosis and those without delay[46].

Another research performed in 2008 at Cukurova University, Turkey. The annual number of admissions to Cukurova University Faculty of Medicine Emergency Department (ED) was 35,000. The number of cases with AMS were 790 annually (0.57% of total patients). Out of 790 patients, 414 (52.3%) were male, 376 (47.7%) were female. Mean age was 45.65 ± 15.5 years. Etiologic factors were neurological (n = 566; 71.6%), head trauma (n = 82; 10.4%), endocrine/metabolic (n = 48; 6.1%), cardiovascular/pulmonary (n = 49; 6.2%), infectious (n = 30; 3.8%), gynecologic and obstetric (n = 2; 0. 4%), toxicologic (n = 12; 1.5%)[47].

An altered mental state can have a detrimental impact on patient outcomes and delivery of care such as postoperative mobilization, increased length of stay and safety risks. A change in the patient's mental state can occur after some procedures. For instance, AMS after surgery can have many causes including; physiological, environmental factors, side effects of medications and pre-existing cognitive impairment that may predispose or create a change in their mental status. The risk of postoperative delirium is higher in the elderly population undergoing orthopedic surgery. Delirium significantly impacts patient outcomes and health economics in terms of resources, length of stay, mortality, morbidity, and cost of hospitalization[48].

2.4. Altered level of consciousness, Glasgow Coma Scale and Traumatic Injuries

It was explained that AMS could be as a result of a structural lesion or primary CNS dysfunction, metabolic or autoregulatory, pharmacologic/toxic, infectious insults or other. Many medical conditions also manifest as AMS when decompensated. Medication effects are very common causes of AMS in the elderly. If encountered a patient with AMS, a detailed review of pre-existing conditions including the medications (including nonprescription, health supplements, home remedies) is critical. Three common broad classifications of AMS include delirium, dementia, and psychosis. Patients with AMS could have altered levels of consciousness (ALOC) and visual hallucination (related to external stimuli) as in delirium or variable level of consciousness and auditory hallucination (related to internal stimuli) as in psychosis. It is difficult to obtain a comprehensive history from patients with AMS. In addition to reviewing the history, family, friends, caretakers, nursing home workers, witnesses are all invaluable sources of information. Make the effort to contact them to determine the nature of the change in mental status. A detailed head to toe physical exam will often yield clues as to the cause and one should pay attention to Glasgow Coma Scale (GCS) as it is a quick useful way to communicate the overall level of arousal[65]. Field triage by EMS is a critical aspect of trauma systems, as it helps to identify potentially seriously injured patients and make transportation decisions. Proper decisions regarding transportation are crucial because the management of severely injured patients in a Level I or a Level II trauma center is associated with improved clinical outcomes. A key component of field triage for patients with a suspected serious injury is level of consciousness assessment. The Glasgow Coma Scale (GCS) was originally created to assess patients with TBI but now it is an instrument widely used for assessment of consciousness at the site of injury, in EDs, and hospitals, as well as to monitor progress or deterioration during treatment. Lower scores on the tGCS indicate lower levels of consciousness, generally correlating with more severe injury associated with poorer prognosis and requiring more intensive care. GCS scores of 3 to 8 are generally considered to denote severe head injury, 9 to 12 moderate, and 13 to 15 mild. The 2011 field triage guidelines from the Centers for Disease Control and Prevention (CDC) National Expert Panel recommend transporting patients with tGCS scores of 13 or less to facilities providing the highest level of trauma care. In some circumstances (e.g., trauma victims who are intoxicated, intubated, or whose other injuries influence response) it may not be possible to accurately assess the verbal and eye components of the tGCS. In these cases, assessments may be primarily based on the motor component of the Glasgow Coma Scale (mGCS) alone[66,67].

Studies were indicating a possible mechanisms for the increased risk of injuries for some specific mental altering disorders such as dementia and comorbid diseases which include DM, hypertension, obesity, CAD, CKD, CHF, depression, and stroke as they might be associated with weaker limb strength, impaired vision, unstable gait and balance, poor judgment, and poor impulse control and thus these could be the factors contributing to the increased risk of injury[67]. A study stated that acute care patients may be at increased risk of falling due to newly altered mobility, medication side effects, history of previous falls, frequent toileting and altered mental status all in an unfamiliar environment[69]. Data showed that age distribution of AMS patients had two peak segments (the first peak was for patients aged 33 years, and the second peak was for those aged 72 years) as a result of the distinct etiology of AMS among the two age groups. Subsequent analysis revealed that the causative disease of AMS in the elderly group differed from that in the non-elderly group, i.e., metabolic diseases, trauma, and poisoning were often found in young people, whereas cerebral vascular disease and organ/system failure were frequently seen in the elderly[70]. A study on postoperative orthopedic patients with AMS revealed that patients' altered mental status increases safety risk to themselves and the staff and has the potential to affect mobilization goals. Challenges such as environment, staffing and time limitation, safety risk, prioritization, and chaos and frustration. Giving instructions to patients with altered mental status and getting them to participate in mobilization can be difficult and was described by the participants as frustrating. Changes in patients' cognition, awareness, concentration, and behavior may hinder the achievement of mobilization goals[71].

CHAPTER III

RESEARCH METHODS

3.1. Data Source

Data used for this study was obtained from the National Trauma Data Bank (NTDB) trauma registry. Particularly, the NTDB 2016 dataset was analyzed and used for this purpose. The American College of Surgeons established the National Trauma Data Bank (NTDB) as a public service to be a repository of trauma-related data voluntarily reported by participating trauma centers. It contains detailed data on more than six million cases from over 900 registered U.S. trauma centers. The American College of Surgeons (ACS) Committee on Trauma collects and maintains the National Trauma Data Bank® (NTDB). The use of NTDB dataset for research purposes and scientific analysis requires completion of an application, approval from the committee and agreement to their terms and conditions[49,50]. Therefore, prior to the purchase of data, a short proposal was written, and approval obtained from the NTDB Committee. The trauma registry in NTDB is the largest database aggregate ever created and consists of a lot of important variables including all the main variables to be incorporated in this study.

The NTDB data in general and the cohorts used in this dissertation are submitted voluntarily from hospitals that have shown a commitment to monitoring and improving the care of injured patients. As a "convenience sample," the NTDB may not be representative of all hospitals and have not been systematically selected to represent any population base but specific inclusion criteria are created for the analysis in order to generate a homogenous population[50]. The NTDB dataset is a standardized and quality data because the organization has already established National Trauma Data Standard (NTDS) as the basis for its data collection and is continually cleaning and standardizing the data to improve data quality. The NTDS standardizes trauma registry data collection to improve patient care and trauma training as well as define a standard on which to measure care. Hospitals across the United States can share the key elements of their data collection nationally. The NTDB is the national repository used to store trauma data from potentially every state in the U.S. This specific dataset was developed to help hospitals and states collect more comparable elements and aid them in submitting their data to the NTDB and Trauma Quality Improvement Program (TQIP). Per the organization's description, the NTDB Data Standard is useful in developing nationwide trauma benchmarks, evaluating hospital and trauma systems patient outcomes, facilitating research efforts, determining national trends in trauma care, addressing resources for disaster and domestic preparedness and providing valuable information on other issues or areas of need related to trauma care[51]. The inclusion and exclusion criteria for the target population are listed below:

3.1.A. NTDB Inclusion Criteria

The NTDB data standard included the diagnostic code in the range of ICD-9-CM: 800-959.9 or no ICD-10-CM: S00-S99, T07, T14, T20-T28, T30-T32 and T79.A1-T79.A9. This excludes injuries like poisoning. The NTDB inclusion in national trauma data registry consists of patients who sustained the traumatic injury and must meet one of the following criteria in injury diagnostic codes defined by International Classification of Diseases, Tenth Revision (ICD-10-CM):

1. Injuries to specific body parts: initial encounter (S00-S99) with 7th character modifiers of A, B, or C only.
2. Unspecified multiple injuries (T07).
3. Injury of unspecified body region (T14).

4. Burns by specific body parts: initial encounter (T20-T28) with 7th character modifier A only.
5. Burn by TBSA percentages (T30-T32).
6. Traumatic compartment syndrome: initial encounter (T79.A1-T79.A9) with 7th character modifier A only.

And must include one of the following in addition to the codes above:

1. Admitted to the hospital, based on the participating hospital trauma registry inclusion criteria, OR
2. Patient transferred to (or from) participating hospital via another hospital using EMS or air ambulance, OR
3. Death resulted from a traumatic injury.

3.1.B. NTDB Exclusion Criteria

The National Data Standard of NTDB excludes the following ICD-10-CM CODES: S00 (Superficial injuries of the head), S10 (Superficial injuries of the neck), S20 (Superficial injuries of the thorax), S30 (Superficial injuries of the abdomen, pelvis, lower back and external genitals), S40 (Superficial injuries of shoulder and upper arm), S50 (Superficial injuries of elbow and forearm), S60 (Superficial injuries of wrist, hand, and fingers), S70 (Superficial injuries of hip and thigh), S80 (Superficial injuries of knee and lower leg), S90 (Superficial injuries of ankle, foot and, toes). Late effect codes, which are represented using the same range of injury diagnosis codes (S00-S99) but with the 7th digit modifier code of D through S, are also excluded[51].

3.1.C. Target Population

1. Male and female patients aged between 10 to 89 years (inclusive) who sustained a traumatic injury and meets the NTDB inclusion criteria stated above, AND

2. Patients with pre-existing mental altering comorbidities (PMAC):

-Alcohol Use Disorder

- Cerebrovascular Accident (CVA)

- Dementia, Major Psychiatric Illness and

-Drug Use Disorder.

3.1.D. Control Population

1. Male and female patients aged between 10 to 89 years (inclusive) who sustained a traumatic injury and meeting the NTDB inclusion criteria stated above, AND
2. Patients without pre-existing mental altering comorbidities (PMAC) listed above.

* Patient Incidence Keys with missing diagnosis (-1 and -2 entries in the NTDB dataset ICD-10-CM diagnosis code) were excluded both from the target population and control population categorization and analysis.

3.2. Study Design

This is a retrospective study based on trauma registry data of the NTDB 2016. The Data obtained contains admissions that occurred in the same year of 2016 to participating hospitals from trauma centers in the United States. Patients amounting to 1,140,668 with the diagnosis of trauma visited the emergency departments of those participating hospitals were considered for this study. Then cases with pre-existing mental altering co-morbidities were retrieved from this pool of patients which were the target population of the study and the rest of the patients were regarded as a control population. The target patients were 220,883 and the control 919,785. Using ICD-10-CM diagnosis code patients with a missing diagnosis for trauma (represented by -1 and -2 in the ICD-10-Diagnosis

Code) in the NTDB dataset were excluded. Finally, 200,700 target patients and 832, 219 control patients included in the analysis. The table below elaborates this process including the percentages of the patients who included and excluded from the study.

Table 1. Study target and control patients, NTDB 2016.

TOTAL ED VISIT WITH DIAGNOSIS OF TRAUMA =1,140,668		
	No.	%
Patients with PMAC (Target)		
Male	124,641	10.927
Female	96,223	8.436
Gender not recorded	19	0.002
Total	220,883	19.364
Patients included (Target)	200,700	17.595
Patients excluded*	20,183	1.769
Patients without PMAC (Control)		
Male	553,302	48.507
Female	366,347	32.117
Gender not recorded	136	0.012
Total	919,785	80.636
Patients included (Control)	832,219	72.959
Patients excluded*	87,566	7.677
TOTAL	1,140,668	100

*patients with missing ICD-10-CM diagnosis code in the NTDB 2016 dataset were excluded from both target and control population.

3.3. Data Elements

The NTDB research dataset (RDS) is a set of relational tables and consists of 18-20 data files. These files are provided in ASCII-CSV (comma-separated value) format, standard SAS (*. sas7bdat) data tables and DBF format (DBASE version 2.0), which can be easily imported to most statistical software. The relational tables are too large to be analyzed in Microsoft Excel but have been used in Microsoft Access and SAS. Microsoft excel used after the large data was simplified. Most of the data files include a unique incident identifier (inc_key) for merging the data files. One data file (RDS_FACILITY) includes the facility information for participating hospitals and these data can be merged to RDS_ ED, RDS_DEMO, and RDS_DISCHARGE, by using the unique facility identifier (fac_key). The remaining data files are lookup tables with a description of The International Classification of Disease, 10th edition, clinical modification (ICD-10-CM) depending on the years of admission[50]. The ICD-10-CM R 41.82 is a code for Altered Mental Status, unspecified for billing purposes. Practically Altered Mental Status is not a diagnosis but rather a group of variables, nonspecific neurologic symptoms requiring further specification of the etiology[53]. The NTDB 2016 has listed the pre-existing comorbidities of the trauma patients in their trauma database registry and five of those comorbidities are known to be mental altering. Those are: Alcohol Use Disorder, Cerebrovascular Accident (CVA), Dementia, Major Psychiatric Illness, and Drug Use Disorder. After retrieving patients with these pre-existing comorbidities more detailed identification and analysis of the diagnosis codes of the comorbidities was done to know the most common mental altering disorders among trauma patients.

If patients present with altered mental status as a result of those pre-existing mental altering conditions described in this study or many other etiologies, they can be classified as hyperactive or hypoactive and both would affect patients' vulnerability to trauma and care after the injury. Manifestations of the hyperactive state may include increased psychomotor activity, agitation, labile mood, and behavioral disturbances. Hypoactive changes may include decreased psychomotor activity, altered level of consciousness, depressive affect, or withdrawal. An altered level of consciousness (including changes in both arousal and responsiveness) is a very important clinical and documentation consideration that requires careful assessment and precise, specific terminology. It can range from lethargy to stupor and obtundation to deep coma, sometimes with a complete absence of responsiveness. These changes are assessed using the Glasgow Coma Scale

(GCS). The GCS be calculated whenever a patient has an altered level of consciousness, regardless of its cause. In several studies, patients with an abnormal GCS were found to be more likely to have a history of conditions known to be associated with their current altered state[6,16,17,46,52]. Hence the GCS score of patients with the pre-existing mental altering comorbidities was included in the data elements and analyzed to see the variations as the score increased or decreased.

The mechanism of injury (MOI) in the target patient population was also identified and analyzed. In the NTDB 2016, the mechanism of injury is indicated in ICD-10-CM-E-Codes which means ICD-10-CM External Cause Codes. In ICD-10-CM, external cause codes are found in chapter 20, which includes codes that start with the letters V, W, X, and Y. They range from V00 to Y99 and are secondary codes that capture specific details about an injury or health event. Codes V00-V99 are for External Causes of Injury for Transport Accidents. Codes W00-W99 are for Injuries Due to Falls and Exposure. Codes X00-X99 and Y00-Y34.99 are for Injuries Due to Self-Harm, Assault, or Undetermined Intent. Codes Y35-Y99 are for Legal, Military, and Medical Causes and Supplementary Factors[54, 55]. ICD-10-CM codes for pre-existing co-morbidities, the severity of injuries, indentations to injuries, patient hospital stay, and cost of hospital care were retrieved from the database and analyzed.

3.4. Study Variables

Below are the variables used in the study and their level of measurements:

Table 2. Study variables and their level of measurements.

Variables	Level of Measurement
Age	Continuous
Gender	Categorical
Race	Nominal
Ethnicity	Nominal
Mechanisms of Injury (MOI)	Nominal
Prevalence Rate	Continuous
Intention of Injury	Categorical
Severity of Injury	Ordinal
Comorbidity/Etiology	Nominal
Hospital Length of Stay	Continuous
Cost of Hospital Care	Continuous
Glasgow Coma Scale (GCS)	Ordinal

3.5. Data Management

Data from the NTDB obtained as compressed and zipped. It was downloaded from a secured online link with limited license to use from the American College of Surgeons, Committee on Trauma. The data files were unzipped and saved to a private computer as RDS AY 2016 secured with a passcode. It consists of the RDS User Manual, RDS Data Dictionary and the RDS Research Dataset. Care was taken to comply with the Committee on Trauma agreement of terms and conditions, and the Health Insurance Portability and Accountability (HIPPA) Act of 1996 and federal guidance on Public Welfare and the

Protection of Human Subjects. No patient was identified directly or through any identifiers linked to the participants.

3.6. Statistical Analysis

The NTDB data needed for the study was unzipped and imported to Microsoft Access. Data were checked for completeness, missing data and duplicates were cleaned. In order to analyze the study assumptions, first, the descriptive statistics were performed to report the study cohort characteristics of the main variables including demographics (age, race, and sex), independent, and dependent variables. Categorical variables were described by proportions and percentages. Histograms and pie charts were made using Microsoft Excel. Continuous variables were described by the mean and standard deviation. The univariate analysis was made to describe the central tendency of the variables and report the cohort's distribution. Multivariate analysis was performed to find the differences in the independent risk factors. The normality of data was checked by drawing a histogram as a pilot but eventually, Quantile-Quantile plots run using the SAS analysis system. A parametric test was used to do all the analysis in this report, but the non-parametric analysis was employed to countercheck for any discrepancies. Chi-square test was used because variables involved in the hypothesis analysis were binomial categorical variables. The logistic regression model was carried out for the study exposures variables, to determine the adjusted odds ratios (ORs) in predicting the risk of injury. Crosstabulation, donut charts, frequency tables, and Likert plots were used to present categorical data.

The inferential statistics procedures using SAS 9.4 software were employed for research hypothesis and significance testing. Chi-square and regression analysis were among the statistical procedures used for this purpose. The Chi-square test was meant to measure the presence of the systematic relationship between dependent and independent variables. The regression analysis is employed to calculate the relationship between a dependent variable and one or more independent variable/s or predictors. Both cumulative and binary logistic regressions are used. Unless specified a 95% confidence interval is used in this research and therefore, a p-value of < 0.05 for a 95% confidence is significant.

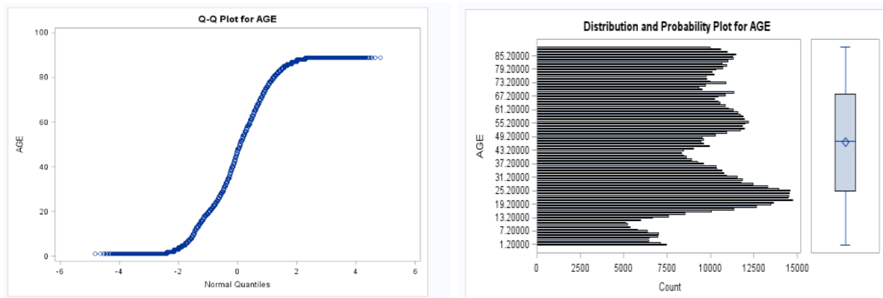
CHAPTER IV

RESULTS

4.1.A. Study Patients Data and Demographic Characteristics

A total of 1,032,919 patients with the diagnosis of trauma were analyzed, male=677,943(59.44%) and female=462,570(40.6%). Of this number 220,833(19.3%), male=124,641(10.9%) and female=96,223(8.4%) were patients with PMAC (targets) and the rest 919,785 (80.6%), male= 553,302(48.5%) and female=366,347(32.1%) were patients without documented PMAC (controls). Patients in the age group 10 years and beyond included in the analysis together with the younger and older adults to learn the characteristics of traumatic injuries in younger patients especially teenagers with PMAC. The average age of all injured patients was 47 (SD± 24.66) years old and their median age was 47 as well. The average age of the target patients was 55 (SD± 21.24) years old and the median age was 56. See fig.3 and fig.4 below. The probability plot of age distribution in the study population indicated the data was not normally distributed but the central limit theorem applies as the study utilizes large data both in the target and control (total) patient population. The central limit theorem indicates that if the sample size is sufficiently large, the means of samples obtained using random sampling with replacement are distributed normally with the mean, regardless of the population distribution [63]. Therefore, parametric models were used in the analysis of inferential statistics.

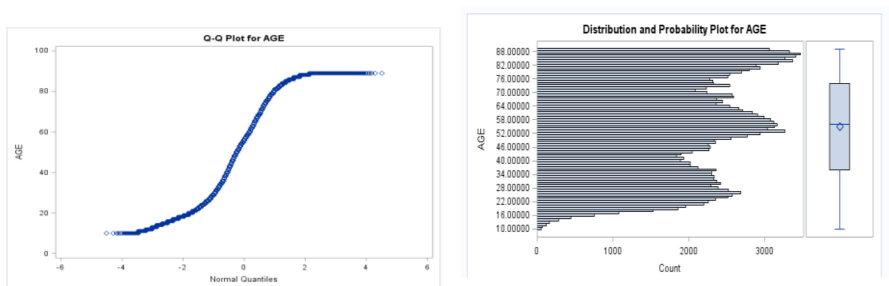
Fig. 3. Age distribution in all injured patients, NTDB 2016.



Basic Statistical Measures			
Location		Variability	
Mean	46.69192	Std Deviation	24.66377
Median	47.00000	Variance	608.30141
Mode	21.00000	Range	88.00000
		Interquartile Range	43.00000

Tests for Normality				
Test	Statistic		p Value	
Kolmogorov-Smirnov	D	0.074474	Pr > D	<0.0100
Cramer-von Mises	W-Sq	1506.352	Pr > W-Sq	<0.0050
Anderson-Darling	A-Sq	9906.229	Pr > A-Sq	<0.0050

Fig. 4. Age distribution in target patients, NTDB 2016.



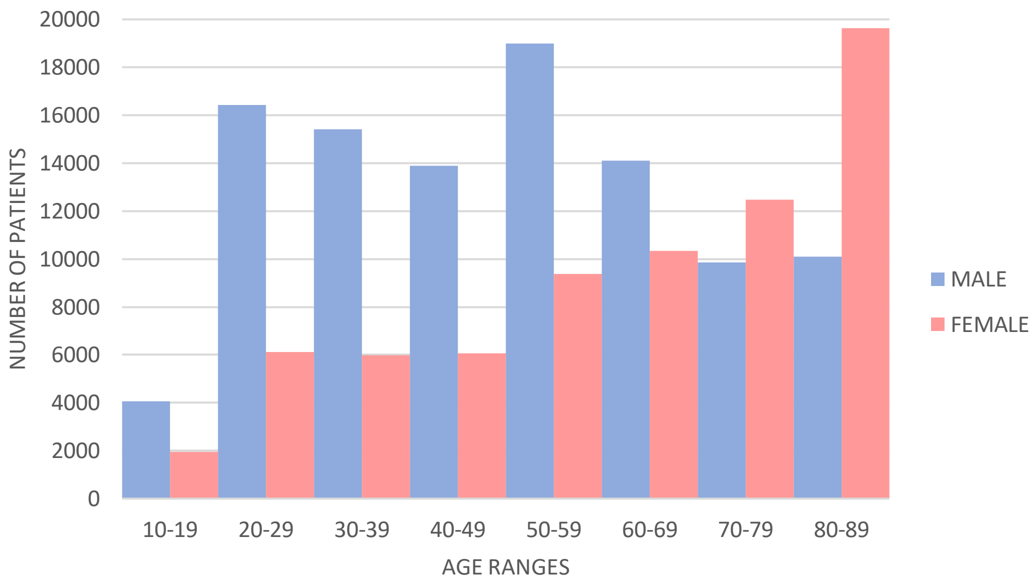
Basic Statistical Measures			
Location		Variability	
Mean	54.98020	Std Deviation	21.24358
Median	56.00000	Variance	451.28962
Mode	87.00000	Range	79.00000
		Interquartile Range	38.00000

Tests for Normality				
Test	Statistic		p Value	
Kolmogorov-Smirnov	D	0.074474	Pr > D	<0.0100
Cramer-von Mises	W-Sq	1506.352	Pr > W-Sq	<0.0050
Anderson-Darling	A-Sq	9906.229	Pr > A-Sq	<0.0050

4.1.B. Age and Gender Distribution of Traumatic Injuries in Target Patients

As illustrated in figure 5 below, male younger patients age 10-19 suffered more traumatic injuries 4,070(2.028%) than their female counterparts 1,941(0.967%). Compared to females, younger male patients with PMAC showed an increasing trend of traumatic injury during their younger ages in their life span and the peak was at age 50-59. After age 60-69 the level of injury started trending down for male patients. But female patients were having a lower rate of injury at a younger age in contrast to the male patients. Trauma in female patients was trending up as their age increased and reached its peak in older female patients age 80-89. Overall older female patients with PMAC (age 80-89) suffered the most 19,628(9.780%) traumatic injuries.

Fig.5. Age and gender distribution of injured patients with PMAC, NTDB 2016. * **



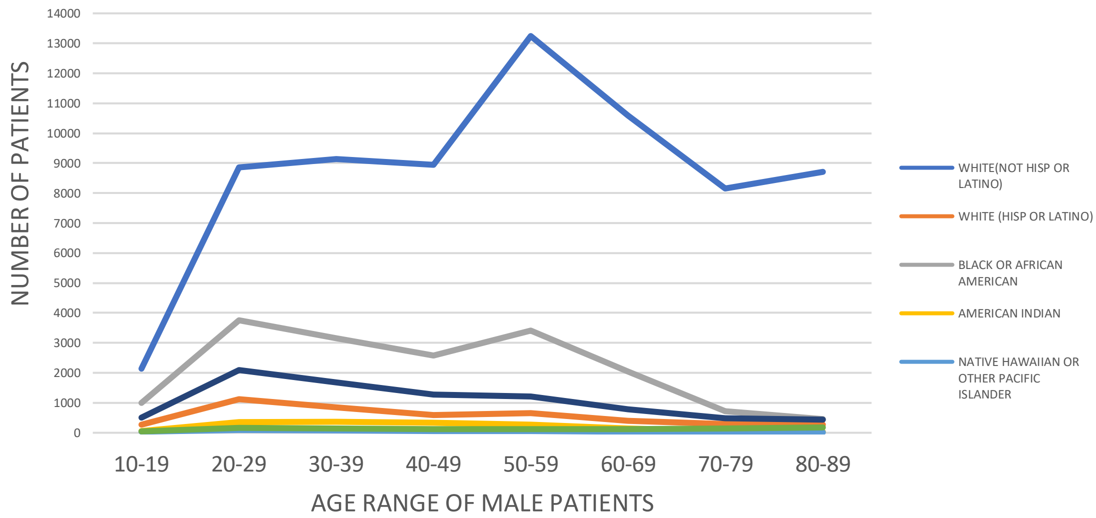
* Age values less than 1 and greater than 89 are censored to '-99' in the NTDB 2016 database. The date of birth of those patients are also not obtained and therefore, patients age greater than 89 are omitted from the analysis.

** The gender of 19 patients was not known/not recorded.

4.1.C. Racial Distribution of Traumatic Injuries in Target Patients.

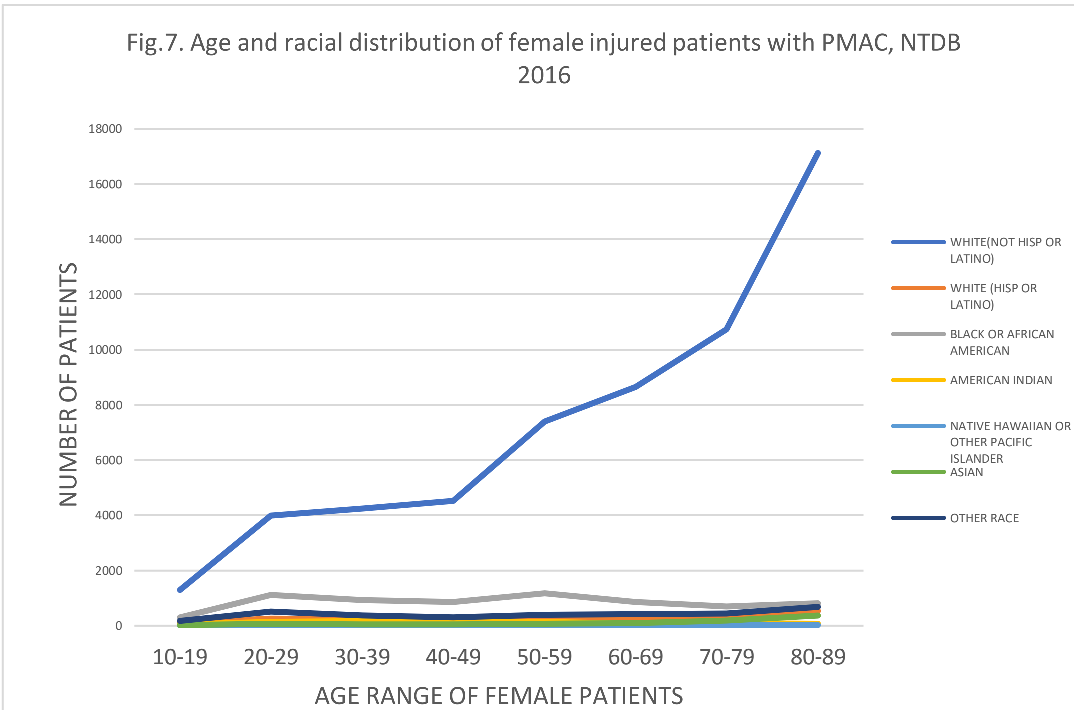
White (Not Hispanic or Latino) patients comprise the largest racial group of patients with PMAC [127,720 (63.637%)]. The White (Not Hispanic or Latino) male patients were [69,756 (34.756%)] of this total patient population whereas the white (Not Hispanic or Latino) female patients were [57,954 (28.876%)]. See Fig.6. The traumatic injury in white (Not Hispanic or Latino) male racial group increases sharply as age increases until age 20-29 and reaches its peak at age 50-59 [13,242(6.598%)]. After age 50-59 the rate of traumatic injury declines in white (Not Hispanic or Latino) male patients. Compared to the other racial groups more white (Not Hispanic or Latino) male patients with PMAC were found to sustain traumatic injuries. The Black or African American patients with PMAC [23,871 (11.894%)] were the largest patient population next to the White (Not Hispanic or Latino). The Black or African American male patients were [17,133 (8.537%)]. In all other races more male patients with PMAC in the age group 20-29 were getting injured but in the age group greater than 29 the number of patients injured decreased as age increased.

Fig.6. Age and racial distribution of male injured patients with PMAC, NTDB 2016.



Injury in white (Not Hispanic or Latino) female patients with PMAC indicated an increasing fashion as age increased and reached the highest at an older age of 80-89 [19,625(9.778%)]. This was a very contrasting occurrence to their male counterparts. The white (Not Hispanic or Latino) female patients with PMAC also sustained more traumatic injuries compared to the female patients in all other racial groups. Black or African female patients with PMAC were the second-largest patient population [6,738(3.357%)] next to the White (Not Hispanic or Latino) female patients with PMAC. Except for White

(Not Hispanic or Latino) female patients roughly all female patients of other racial groups sustained more injury at a younger age (20-29) and the trend decreased as age increased. See fig.7.



4.2. The Distribution of PMACs in the Target Patients

Major psychiatric illness was the most frequent (37.2%) disorder that was affecting the target patients followed by substance use disorders (drug and alcohol, 24.6% and 17.7% respectively). CVA was the least frequent (7.1%) disorder in the list and dementia was 13.4%. See fig.8 below.

Fig. 8.

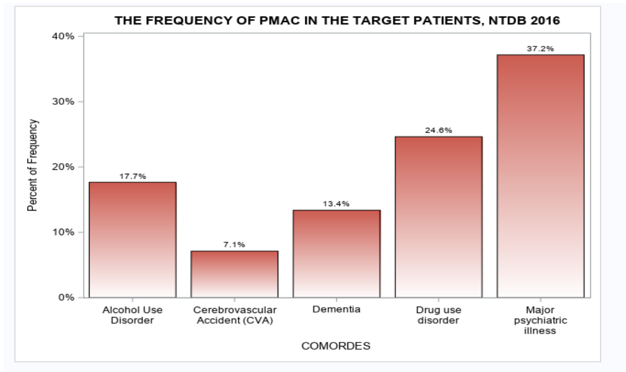


Table 3 below indicates overall more white race target patients (both Latino and not Latino) were affected by PMCs (75.98%) followed by Black or African American (12.87%) and other races (6.33%). All the rest racial groups in the list of the target patients had less than 2% distribution of the PMACs.

Table 3. Racial distribution of the PMCs in the target patients, NTDB 2016

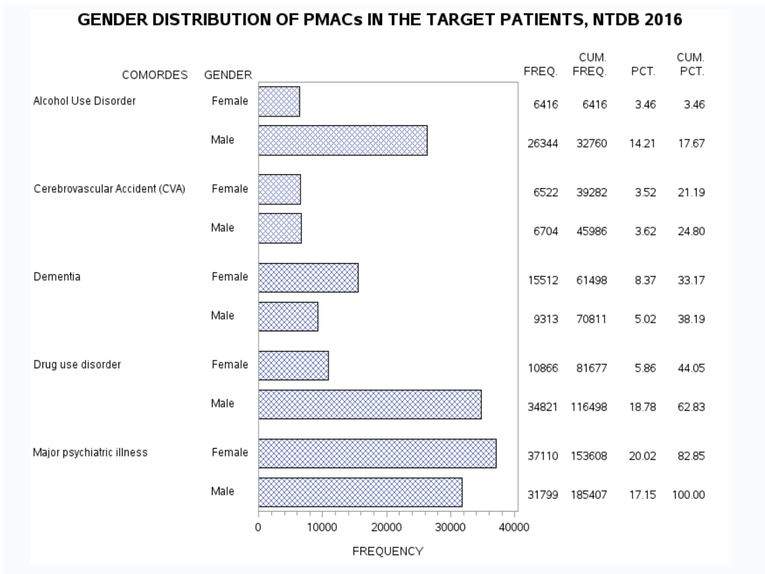
Frequency
Percent
Row Pct
Col Pct

Table of COMORDES by RACE1	RACE1(RACE1)								
COMORDES(COMORDES)	White	Black or African American	Other Race	Not Known/Not Recorded BIU 2	American Indian	Asian	Not Applicable BIU 1	Native Hawaiian or Other Pacific Islander	Total
Major psychiatric illness	57422 30.97 83.33 40.76	6087 3.28 8.83 25.50	2963 1.60 4.30 25.26	1035 0.56 1.50 32.23	458 0.25 0.66 18.48	572 0.31 0.83 29.05	268 0.14 0.39 36.17	104 0.06 0.15 19.66	68909 37.17
Drug use disorder	28698 15.48 62.81 20.37	10563 5.70 23.12 44.25	4030 2.17 8.82 34.36	901 0.49 1.97 28.06	713 0.38 1.56 28.76	337 0.18 0.74 17.12	191 0.10 0.42 25.78	254 0.14 0.56 48.02	45687 24.64
Alcohol Use Disorder	22882 12.34 69.85 16.24	4369 2.36 13.34 18.30	3059 1.65 9.34 26.08	789 0.43 2.41 24.57	1119 0.60 3.42 45.14	260 0.14 0.79 13.20	196 0.11 0.60 26.45	86 0.05 0.26 16.26	32760 17.67
Dementia	21262 11.47 85.65 15.09	1520 0.82 6.12 6.37	1033 0.56 4.16 8.81	289 0.16 1.16 9.00	112 0.06 0.45 4.52	500 0.27 2.01 25.39	66 0.04 0.27 8.91	43 0.02 0.17 8.13	24825 13.39
Cerebrovascular Accident (CVA)	10614 5.72 80.25 7.53	1332 0.72 10.07 5.58	644 0.35 4.87 5.49	197 0.11 1.49 6.14	77 0.04 0.58 3.11	300 0.16 2.27 15.24	20 0.01 0.15 2.70	42 0.02 0.32 7.94	13226 7.13
Total	140878 75.98	23871 12.87	11729 6.33	3211 1.73	2479 1.34	1969 1.06	741 0.40	529 0.29	185407 100.00

ETHNIC				
ETHNIC	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not Hispanic or Latino	159414	85.98	159414	85.98
Hispanic or Latino	15040	8.11	174454	94.09
Not Known/Not Recorded BIU 2	8017	4.32	182471	98.42
Not Applicable BIU 1	2936	1.58	185407	100.00

As described above (fig.8) major psychiatric illness comprised the highest percentage in the target patients and compared to the male patients (17.15%) more female patients (20.02%) were affected by psychiatric disorders. The major difference in the gender distribution was noticed in substance use disorders (drug and alcohol) where male target patients were more affected than their female counterparts. Drug use disorder: male (18.78%), female (5.86%), alcohol use disorder: male (14.21%), female (3.46%). See fig.9 below.

Fig.9.



4.3.A. Mechanisms and the Prevalence of Traumatic Injuries in the Target and Control Patients.

The comparison of the prevalence of traumatic injuries between patients with and without PMAC regardless of their age and gender indicated a higher prevalence of injuries as a result of injuries due to falls and exposure (9.263%) in patients with PMAC followed by injuries for transport accidents (4.512%). Patients without PMAC had similar prevalence of injuries due to fall and exposure and transport accidents as patients with PMAC but the prevalence rate differed between injuries due to fall and exposure (34.304%), and transport accidents (25.791%) in patients without PMAC was higher than the prevalence rate in patients with PMAC. Overall, patients with PMAC sustained most traumatic injuries due to falls and exposure, and transport accidents. See table 4 below. The mechanisms: transport accidents; falls and exposure; self-harm, assault or undetermined intents; and legal military, and medical causes and supplementary factors are general terms. The specific and more common external causes of injuries that are parts of these general terms would be described in detail later in separate subtopics.

Table 4. Mechanisms and the prevalence of Traumatic Injuries in the Target and Control Patients, NTDB 2016.

Target Patients
(at least one PMAC)

Mechanisms	N0.	Prevalence **(per 100)**
External Causes of Injury for Transport Accidents	46,601	4.512
Injuries Due to Falls and Exposure	95,676	9.263
Injuries Due to Self-Harm, Assault, or Undetermined Intent	26,182	2.535
Legal Military, and Medical Causes and Supplementary Factors	438	0.042
TOTAL	168,897	16.351

Control Patients

Mechanisms	N0.	Prevalence (per 100)
External Causes of Injury for Transport Accidents	266,399	25.791
Injuries Due to Falls and Exposure	354,330	34.304
Injuries Due to Self-Harm, Assault, or Undetermined Intent	83,985	8.131
Legal Military, and Medical Causes and Supplementary Factors	1,406	0.136
TOTAL	706,120	68.362

The gender comparison of patients with PMAC indicated female patients (69%) had more injuries due to falls and exposure than their male counterparts (48%). But male patients with PMAC had more injuries from transport accidents (31%) and injuries due to self-harm, assault, or undetermined intent (21%) than the female patients with PMAC. The female patients, of course, had 23% of injuries from transport accidents and much less (8%) injuries from self-harm, assault, or undetermined intent. Similar to patients with PMAC, injuries from fall and exposure, and transport accounted for most traumatic injuries in patients without PMAC, but the difference lies in the percentages of patients affected in both groups. As illustrated in the figures below more male patients with PMAC (48%) sustained an injury due to falls and exposure than male patients without PMAC (44%). Also, more female patients with PMAC (69%) had injuries from fall and exposure than female patients without PMAC (60%). A Higher percentage of injuries due to self-harm, assault and undetermined intent noticed in both male and female patients with PMAC than their counterparts without PMAC. See figures 10 and 11 below.

Fig. 10. Percentage of male and female patients with PMAC affected by different mechanisms of injuries, NTDB 2016.

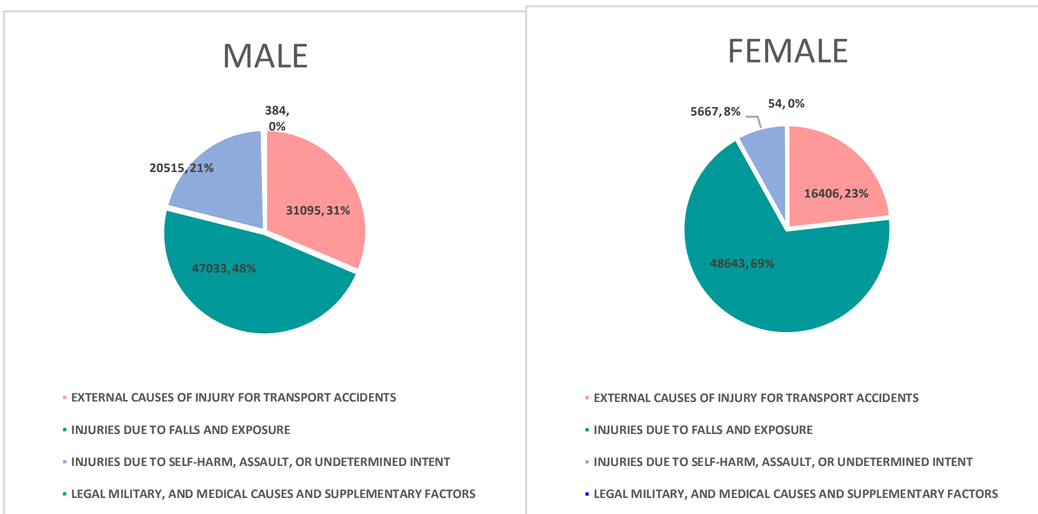
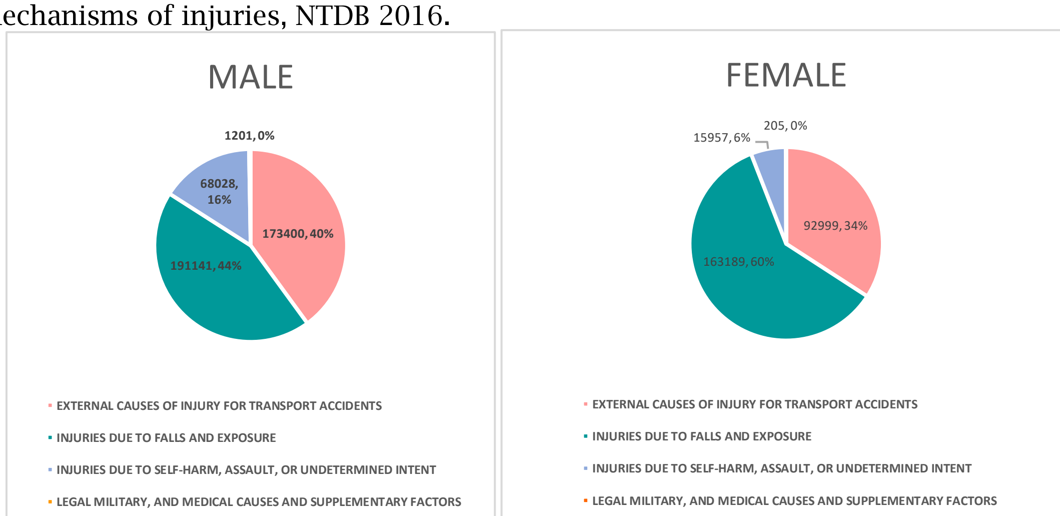


Fig.11. Percentage of male and female patients without PMAC affected by different mechanisms of injuries, NTDB 2016.



Younger male patients with PMAC in the age group 20-29 were more affected by transport and accident injuries than their female counterparts. See fig.12. But injuries due to fall and exposure in female patients with PMAC age 80-89 was by far worse than all MOI in the target patient population. In patients without PMAC overall, older female patients age 80-89 sustained more traumatic injuries from falls and exposure than male patients. But at younger age 20-29 male patients sustained more traumatic injuries than female patients. See fig.13 below.

Fig.12. Mechanisms of injuries by age and gender for patients with PMAC, NTDB 2016.

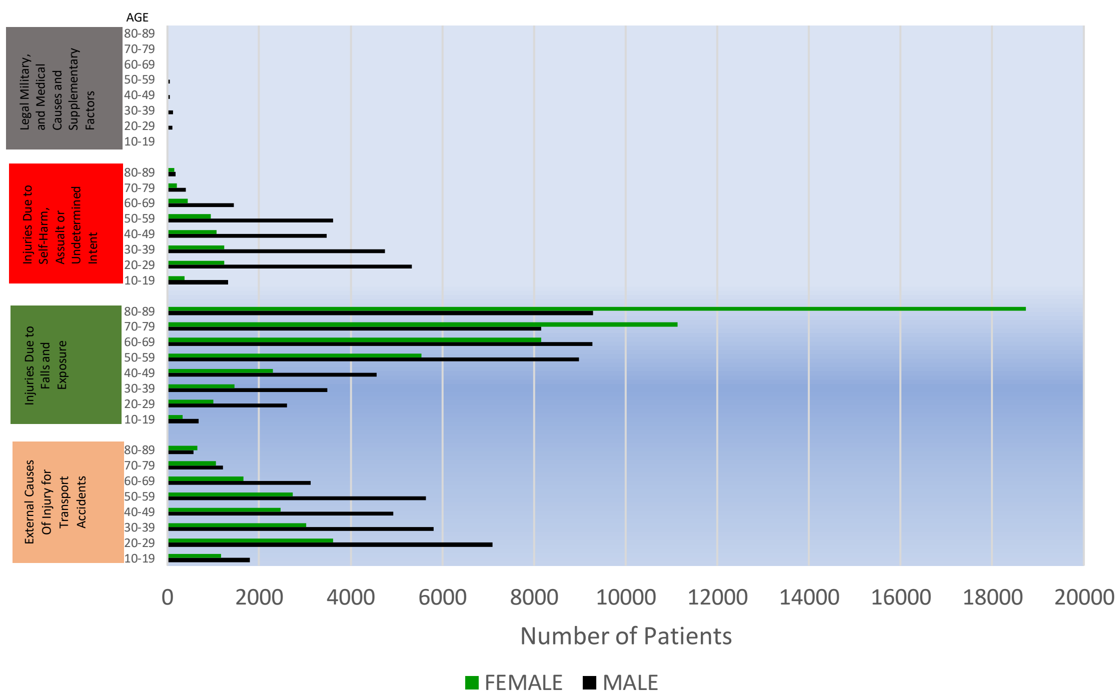
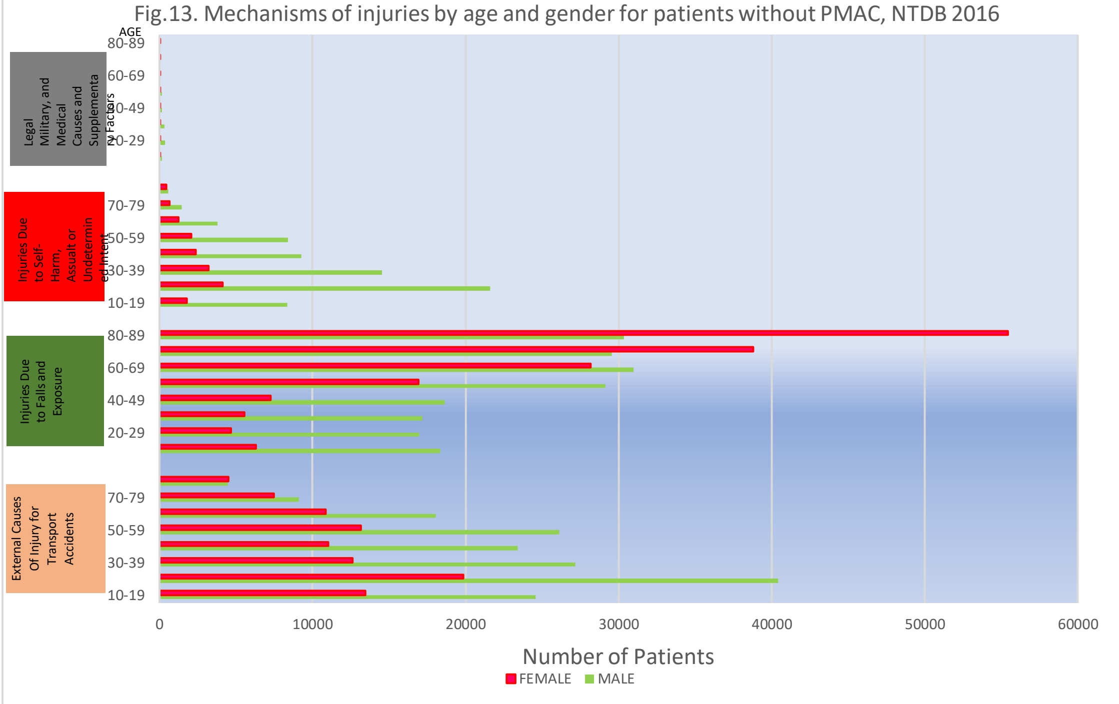


Fig.13. Mechanisms of injuries by age and gender for patients without PMAC, NTDB 2016



4.3. B. Mechanisms and the prevalence of Traumatic Injuries in Target Patients.

As White (Not Hispanic or Latino) comprises the largest proportion of the U.S. general population so were the injured patients with PMAC compared to the other racial groups. Hence, the higher prevalence of traumatic injuries as a result of all external causes of injury was documented in the White (Not Hispanic or Latino) patient population. Accordingly, the highest prevalence (7.497%) of injuries due to falls and exposure involved more White (Not Hispanic or Latino) patients with PMAC. Black or African American patients with PMAC had the second-higher prevalence (0.797%) next to the White (Not Hispanic or Latino) patients. The lowest prevalence (0.019%) for injuries due to falls and exposure was in Native Hawaiian or Other Pacific Islander patients with PMAC. Next to fall and exposure, injuries due to transport accidents affected more patients with PMAC and White (Not Hispanic or Latino) patients still had the highest prevalence of 3.204% compared to the other racial groups. See table 5 below.

Table 5. Mechanisms and the prevalence of injuries among different races by age and gender in Target patients, NTDB 2016.

		AGE AND GENDER																			
		10-19		20-29		30-39		40-49		50-59		60-69		70-79		80-89					
MECHANISMS OF IJURIES	RACE	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	TOTAL(M)	TOTAL(F)	TOTAL	PREVALENCE (PER 100)
EXTERNAL CAUSES OF INJURY FOR TRANSPORT ACCIDENTS	WHITE (NOT HISP. OR LATINO)	1097	833	4424	2483	3861	2212	3457	1905	4056	2120	2326	1361	984	917	493	567	20698	12398	33096	3.204
	WHITE (HISP. OR LATINO)	119	55	459	160	289	108	159	79	188	66	79	30	26	25	12	16	1331	539	1870	0.181
	BLACK OR AFRICAN AMERICAN	307	146	1134	544	963	427	781	307	959	378	490	156	118	66	35	32	4787	2056	6843	0.662
	AMERICAN INDIAN	22	23	121	75	93	72	79	34	63	26	32	16	13	10	2	2	425	258	683	0.066
	NATIVE HAWAIIAN OR OTHER PACIFIC ISLANDER	16	3	32	18	20	13	25	6	21	6	9	5	3	3	0	0	126	54	180	0.017
	ASIAN	24	5	58	39	38	17	41	20	32	21	26	25	7	13	10	9	236	149	385	0.037
	OTHER RACE	216	105	864	301	550	186	383	122	328	118	168	73	61	23	22	24	2592	952	3544	0.343
INJURIES DUE TO FALLS AND EXPOSURE	WHITE (NOT HISP. OR LATINO)	432	224	1689	727	2335	1114	3127	1789	6600	4508	7225	6904	6795	9590	8028	16352	36231	41208	77439	7.497
	WHITE (HISP. OR LATINO)	41	21	154	37	172	55	202	58	290	118	252	160	242	281	253	511	1606	1241	2847	0.276
	BLACK OR AFRICAN AMERICAN	108	49	411	137	484	165	618	270	1303	586	1128	646	550	603	402	773	5004	3229	8233	0.797
	AMERICAN INDIAN	7	2	2	1	48	37	94	49	118	80	83	55	42	72	28	75	422	371	793	0.077
	NATIVE HAWAIIAN OR OTHER PACIFIC ISLANDER	2	1	14	6	15	6	16	7	18	6	15	14	19	15	14	25	113	80	193	0.019
	ASIAN	10	6	27	12	35	17	42	20	73	31	83	66	126	178	161	345	557	675	1232	0.119
	OTHER RACE	79	25	306	80	402	68	461	103	583	212	485	308	383	396	401	647	3100	1839	4939	0.478
INJURIES DUE TO SELF-HARM, ASSAULT, OR UNDETERMINED INTENT	WHITE (NOT HISP. OR LATINO)	511	210	2194	659	2348	768	1923	724	2190	685	886	336	300	165	133	111	10485	3658	14143	1.36
	WHITE (HISP. OR LATINO)	94	22	394	54	289	51	173	30	154	21	56	15	15	6	5	4	1180	203	1383	0.134
	BLACK OR AFRICAN AMERICAN	504	83	1796	339	1317	265	875	212	902	160	347	59	48	23	16	13	5805	1154	6959	0.674
	AMERICAN INDIAN	23	12	152	50	172	42	125	31	77	31	19	3	1	1	3	0	572	170	742	0.0712
	NATIVE HAWAIIAN OR OTHER PACIFIC ISLANDER	5	1	40	7	22	7	12	2	11	2	3	0	2	0	1	1	96	20	116	0.011
	ASIAN	13	8	56	16	60	15	35	14	24	9	19	5	8	1	4	8	219	76	295	0.028
	OTHER RACE	168	38	706	110	539	91	332	61	255	44	118	23	28	10	12	9	2158	386	2544	0.246
LEGAL MILITARY, AND MEDICAL CAUSES AND SUPPLEMENTARY FACTORS	WHITE (NOT HISP. OR LATINO)	8	0	45	7	72	6	30	8	37	4	11	4	5	2	1	4	209	35	244	0.024
	WHITE (HISP. OR LATINO)	0	1	16	0	10	0	5	0	5	0	0	0	0	1	0	0	36	2	38	0.004
	BLACK OR AFRICAN AMERICAN	8	3	29	0	22	2	14	2	10	2	0	1	0	0	0	0	83	10	93	0.009
	AMERICAN INDIAN	1	0	2	0	4	0	1	0	1	0	0	0	1	0	0	0	10	0	10	0.0009
	NATIVE HAWAIIAN OR OTHER PACIFIC ISLANDER	0	0	2	0	2	0	1	0	0	1	0	0	0	0	0	0	5	1	6	0.0005
	ASIAN	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	3	1	4	0.0003
	OTHER RACE	0	0	11	3	15	2	6	0	3	0	3	0	0	0	0	0	38	5	43	0.0042

4.4.A. Specific Mechanisms of Injuries That were More Common and Their Prevalence.

The frequency and prevalence of the mechanisms of injuries both in the target and control population analyzed using the SAS system indicated that ICD10 diagnosis code for external cause of injury W01.0XXA (fall on the same level from slipping, tripping and stumbling without subsequent striking against object, initial encounter) was the most prevalent mechanism (cause) of injury in both the target and control patient population (16.49% and13.06% respectively). But the difference laid in the mechanisms of injuries that came at the next consecutive levels. The target patient population suffered more from a series of fall injuries at a relatively higher prevalence rate compared to the control population. Unspecified fall, initial encounter (W19.XXXA) was the second (7.42%) and fall on the same level, unspecified, initial encounter (W18.30XA) was the third (4.45%) prevalent mechanism of injury in the target patients. The chi-square test for equal proportions in target patients was statistically significant (P<0.0001) and we reject the null hypothesis (H10) and take the alternate hypothesis that there exists a specific mechanism of injury (MOI) that is more common in patients with pre-existing mental altering co-morbidities (PMAC). The diagnosis, car driver injured in collision with other type cars in a traffic accident, initial encounter (V43.52XA) was the second mechanism of injury(4.31%) and unspecified fall, initial encounter (W19.XXXA) was the third (4.05%) prevalent mechanism of injury in control patients. See tables 6 and 7 below.

Table 6. Frequency of major specific mechanisms of injury and their prevalence in target patients, NTDB 2016.

ICD10_PRIM	Frequency	Percent	Cumulative Frequency	Cumulative Percent
W01.0XXA	33039	16.49	33039	16.49
W19.XXXA	14870	7.42	47909	23.91
W18.30XA	8916	4.45	56825	28.36
W10.8XXA	7885	3.94	64710	32.30
W18.39XA	6095	3.04	70805	35.34
W06.XXXA	5890	2.94	76695	38.28
Y04.0XXA	5677	2.83	82372	41.11
V43.52XA	5670	2.83	88042	43.94
W01.198A	4799	2.40	92841	46.34
V03.10XA	3817	1.91	96658	48.24
V47.52XA	3645	1.82	100303	50.06
W01.10XA	3053	1.52	103356	51.59
X99.1XXA	2956	1.48	106312	53.06
V48.5XXA	2930	1.46	109242	54.53
W17.89XA	2787	1.39	112029	55.92
W10.9XXA	2744	1.37	114773	57.29
Y00.XXXA	2739	1.37	117512	58.65
W05.0XXA	2717	1.36	120229	60.01
W11.XXXA	2364	1.18	122593	61.19
W07.XXXA	2304	1.15	124897	62.34
X95.9XXA	2247	1.12	127144	63.46
W01.190A	2126	1.06	129270	64.52
X93.XXXA	2030	1.01	131300	65.53

Chi-Square Test for Equal Proportions	
Chi-Square	10569616.0390
DF	1222
Pr > ChiSq	<.0001

Table 7. Frequency of major specific mechanisms of injury and prevalence in control patients, NTDB 2016.

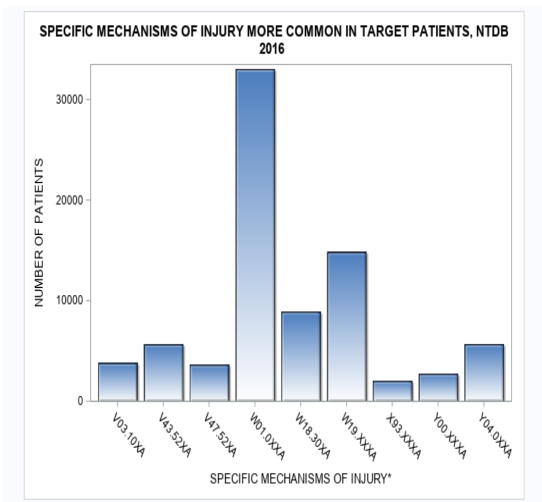
ICD10_PRIM	Frequency	Percent	Cumulative Frequency	Cumulative Percent
W01.0XXA	105469	13.06	105469	13.06
V43.52XA	34779	4.31	140248	17.36
W19.XXXA	32676	4.05	172924	21.41
W10.8XXA	26779	3.32	199703	24.73
W18.30XA	22382	2.77	222085	27.50
W18.39XA	18617	2.31	240702	29.80
W17.89XA	18533	2.29	259235	32.10
W11.XXXA	16990	2.10	276225	34.20
W01.198A	15953	1.98	292178	36.18
Y04.0XXA	15665	1.94	307843	38.12
V43.62XA	15353	1.90	323196	40.02
W06.XXXA	15208	1.88	338404	41.90
V03.10XA	15094	1.87	353498	43.77
V47.52XA	13610	1.69	367108	45.45
X95.9XXA	13453	1.67	380561	47.12
V23.4XXA	12264	1.52	392825	48.64
V48.5XXA	11473	1.42	404298	50.06
X93.XXXA	10300	1.28	414598	51.33
W01.10XA	9506	1.18	424104	52.51
W10.9XXA	8955	1.11	433059	53.62
V28.4XXA	8445	1.05	441504	54.67

Chi-Square Test for Equal Proportions	
Chi-Square	40810245.2570
DF	1789
Pr > ChiSq	<.0001

4.4.B. The Specific Mechanisms of Injuries in Target Patients.

The mechanisms of injury classified as legal/military, and medical causes and supplementary factors had the lowest prevalence of all the mechanisms and due emphasis was given to the mechanisms with relatively higher prevalence. Accordingly, the external cause of injury for transport accidents (V43.52XA, V03.10XA, V47.52XA), mechanisms for falls and exposure (W01.0XXA, W19.XXXA, W18.30XA), and mechanisms for self-harm, assault or undetermined intent were taken into consideration (Y04.0XXA, Y00.XXXA, X93.XXXA). The three mechanisms in the parenthesis listed in respective of their rank (first to third) in the classification of the mechanisms of injury were selected for further analysis and graphed as shown in fig.14. below. It is possible to look up the prevalence of these selected mechanisms in table.5. above.

Fig. 14.



*** ICD10 DESCRIPTION OF DIGNOSIS:**

-**W01.0XXA**= Fall on same level from slipping, tripping and stumbling without subsequent striking against object, initial encounter.
-**W19.XXXA**= Unspecified fall, initial encounter.
-**W18.30XA**= Fall on same level, unspecified, initial encounter.
-**V43.52XA**= Car driver injured in collision with other type car in traffic accident, initial encounter.
-**V03.10XA**= Pedestrian on foot injured in collision with car, pick-up truck or van in traffic accident, initial encounter
-**V47.52XA**= Driver of other type car injured in collision with fixed or stationary object in traffic accident, initial encounter.
-**Y04.0XXA**= Assault by unarmed brawl or fight, initial encounter.
-**Y00.XXXA**= Assault by blunt object, initial encounter.

4.5. Comparison of the Prevalence of Traumatic Injuries in the Target and Control Patients.

As a prevalence is a proportion of a population with a condition, in this case, traumatic injuries, it is possible to test the equality of the proportion of traumatic injuries in patients with and without PMAC using the Pearson Chi-square test. The test was done selecting the most prevalent specific mechanisms of injuries (W01.0XXA, V43.52XA, and Y04.0XXA) from each classification of both the target and control patients. The small P-value in each of the three tests (P<0.0001) in tables: a, b & c indicated the null hypothesis (H20) can be rejected that the proportions were unequal, hence there exists a significant difference in the prevalence of traumatic injuries in patients with PMAC (target) as compared to patients without PMAC (control).

Table 8. Comparison of the proportion of traumatic injuries in the target and control patients, NTDB 2016.

a. W01.0XXA

Frequency Percent Row Pct Col Pct	Table of PATIENTS by W010XXA		
PATIENTS	W010XXA: Y	N	Total
PMAC	33039 3.20 16.46 23.85	167661 16.23 83.54 18.75	200700 19.43
WOPMAC	105469 10.21 12.67 76.15	726750 70.36 87.33 81.25	832219 80.57
Total	138508 13.41	894411 86.59	1032919 100.00

Statistics for Table of PATIENTS by W010XXA

Statistic	DF	Value	Prob
Chi-Square	1	1998.9862	<.0001
Likelihood Ratio Chi-Square	1	1912.5439	<.0001
Continuity Adj. Chi-Square	1	1998.6599	<.0001
Mantel-Haenszel Chi-Square	1	1998.9843	<.0001
Phi Coefficient		0.0440	
Contingency Coefficient		0.0439	
Cramer's V		0.0440	

Fisher's Exact Test	
Cell (1,1) Frequency (F)	33039
Left-sided Pr <= F	1.0000
Right-sided Pr >= F	<.0001
Table Probability (P)	<.0001
Two-sided Pr <= P	<.0001

b. V43.52XA

Frequency Percent Row Pct Col Pct	Table of PATIENTS by V4352XA		
PATIENTS	V4352XA: Y	N	Total
PMAC	5670 0.55 2.83 14.02	195030 18.88 97.17 19.65	200700 19.43
WOPMAC	34779 3.37 4.18 85.98	797440 77.20 95.82 80.35	832219 80.57
Total	40449 3.92	992470 96.08	1032919 100.00

Statistics for Table of PATIENTS by V4352XA

Statistic	DF	Value	Prob
Chi-Square	1	787.8350	<.0001
Likelihood Ratio Chi-Square	1	850.7059	<.0001
Continuity Adj. Chi-Square	1	787.4752	<.0001
Mantel-Haenszel Chi-Square	1	787.8343	<.0001
Phi Coefficient		-0.0276	
Contingency Coefficient		0.0276	
Cramer's V		-0.0276	

Fisher's Exact Test	
Cell (1,1) Frequency (F)	5670
Left-sided Pr <= F	<.0001
Right-sided Pr >= F	1.0000
Table Probability (P)	<.0001
Two-sided Pr <= P	<.0001

C. Y04.0XXA

Frequency Percent Row Pct Col Pct	Table of PATIENTS by Y040XXA		
PATIENTS	Y040XXA: Y	N	Total
PMAC	5677 0.55 2.83 26.60	195023 18.88 97.17 19.28	200700 19.43
WOPMAC	15665 1.52 1.88 73.40	816554 79.05 98.12 80.72	832219 80.57
Total	21342 2.07	1011577 97.93	1032919 100.00

Statistics for Table of PATIENTS by Y040XXA

Statistic	DF	Value	Prob
Chi-Square	1	715.5816	<.0001
Likelihood Ratio Chi-Square	1	660.9209	<.0001
Continuity Adj. Chi-Square	1	715.1140	<.0001
Mantel-Haenszel Chi-Square	1	715.5809	<.0001
Phi Coefficient		0.0263	
Contingency Coefficient		0.0263	
Cramer's V		0.0263	

Fisher's Exact Test	
Cell (1,1) Frequency (F)	5677
Left-sided Pr <= F	1.0000
Right-sided Pr >= F	<.0001
Table Probability (P)	<.0001
Two-sided Pr <= P	<.0001

4.6.A. The Association of PMACs and Traumatic Injuries.

After cleaning the target patient population's data for missing values of the diagnosis of specific traumatic injuries, the frequency analysis of the co-morbidities and ICD10-primary causes of injury indicated (table 9) the pre-existing mental altering co-morbidities were significantly associated to traumatic injuries (P<0.0001). Based on the statistics we fail to accept the null hypothesis (H30) and accept the fact that there is/are significant pre-existing mental altering co-morbidities often associated to sustain traumatic injuries.

Table 9. Frequency and significance of pre-existing co-morbidities and specific traumatic injuries, NTDB 2016.

Frequency
Percent
Row Pct
Col Pct

Table of COMORDES by ICD10_PRIM

ICD10_PRIM (ICD10_PRIM)

COMORDES(COMORDES)	W01.0XXA	W19.XXXA	W18.30XA	W10.8XXA	W18.39XA	W06.XXXA	Y04.0XXA	V43.52XA	W01.198A	V03.10XA	V47.52XA	W01.10XA
Major psychiatric illness	12715	4258	2862	3245	2331	1894	1574	2553	1912	1251	1216	1067
	6.37	2.13	1.43	1.62	1.17	0.95	0.79	1.28	0.96	0.63	0.61	0.53
	17.57	5.88	3.96	4.48	3.22	2.62	2.18	3.53	2.64	1.73	1.68	1.47
	38.48	28.63	32.10	41.15	38.24	32.16	27.73	45.03	39.84	32.77	33.36	34.95
Drug use disorder	1694	1040	467	822	466	214	2518	1953	323	1492	1540	191
	0.85	0.52	0.23	0.41	0.23	0.11	1.26	0.98	0.16	0.75	0.77	0.10
	3.72	2.29	1.03	1.81	1.02	0.47	5.54	4.29	0.71	3.28	3.39	0.42
	5.13	6.99	5.24	10.42	7.65	3.63	44.35	34.44	6.73	39.09	42.25	6.26
Dementia	10690	5755	3288	1252	1671	2840	49	145	1189	77	55	878
	5.35	2.88	1.65	0.63	0.84	1.42	0.02	0.07	0.60	0.04	0.03	0.44
	30.89	16.63	9.50	3.62	4.83	8.21	0.14	0.42	3.44	0.22	0.16	2.54
	32.36	38.70	36.88	15.88	27.42	48.22	0.86	2.56	24.78	2.02	1.51	28.76
Alcohol Use Disorder	3952	2440	1213	1876	901	277	1454	737	710	905	745	494
	1.98	1.22	0.61	0.94	0.45	0.14	0.73	0.37	0.36	0.45	0.37	0.25
	12.12	7.48	3.72	5.75	2.76	0.85	4.46	2.26	2.18	2.78	2.29	1.52
	11.96	16.41	13.60	23.79	14.78	4.70	25.61	13.00	14.79	23.71	20.44	16.18
Cerebrovascular Accident (CVA)	3988	1377	1086	690	726	665	82	282	665	92	89	423
	2.00	0.69	0.54	0.35	0.36	0.33	0.04	0.14	0.33	0.05	0.04	0.21
	27.14	9.37	7.39	4.70	4.94	4.53	0.56	1.92	4.53	0.63	0.61	2.88
	12.07	9.26	12.18	8.75	11.91	11.29	1.44	4.97	13.86	2.41	2.44	13.86
Total	33039	14870	8916	7885	6095	5890	5677	5670	4799	3817	3645	3053
	16.54	7.44	4.46	3.95	3.05	2.95	2.84	2.84	2.40	1.91	1.82	1.53

COMORDES(COMORDES)	X99.1XXA	V48.5XXA	W17.89XA	W10.9XXA	Y00.XXXA	W05.0XXA	W11.XXXA	W07.XXXA	X95.9XXA	W01.190A	X93.XXXA	Total
Major psychiatric illness	712	1006	1122	1136	615	862	1125	779	393	846	259	72360
	0.36	0.50	0.56	0.57	0.31	0.43	0.56	0.39	0.20	0.42	0.13	36.22
	0.98	1.39	1.55	1.57	0.85	1.19	1.55	1.08	0.54	1.17	0.36	
	24.09	34.33	40.26	41.40	22.45	31.73	47.59	33.81	17.49	39.79	12.76	
Drug use disorder	1665	1211	608	295	1339	63	490	112	1625	106	1542	45492
	0.83	0.61	0.30	0.15	0.67	0.03	0.25	0.06	0.81	0.05	0.77	22.77
	3.66	2.66	1.34	0.65	2.94	0.14	1.08	0.25	3.57	0.23	3.39	
	56.33	41.33	21.82	10.75	48.89	2.32	20.73	4.86	72.32	4.99	75.96	
Dementia	4	39	292	389	13	1255	64	831	6	575	1	34608
	0.00	0.02	0.15	0.19	0.01	0.63	0.03	0.42	0.00	0.29	0.00	17.33
	0.01	0.11	0.84	1.12	0.04	3.63	0.18	2.40	0.02	1.66	0.00	
	0.14	1.33	10.48	14.18	0.47	46.19	2.71	36.07	0.27	27.05	0.05	
Alcohol Use Disorder	557	613	560	699	732	80	550	263	213	292	216	32600
	0.28	0.31	0.28	0.35	0.37	0.04	0.28	0.13	0.11	0.15	0.11	16.32
	1.71	1.88	1.72	2.14	2.25	0.25	1.69	0.81	0.65	0.90	0.66	
	18.84	20.92	20.09	25.47	26.73	2.94	23.27	11.41	9.48	13.73	10.64	
Cerebrovascular Accident (CVA)	18	61	205	225	40	457	135	319	10	307	12	14692
	0.01	0.03	0.10	0.11	0.02	0.23	0.07	0.16	0.01	0.15	0.01	7.36
	0.12	0.42	1.40	1.53	0.27	3.11	0.92	2.17	0.07	2.09	0.08	
	0.61	2.08	7.36	8.20	1.46	16.82	5.71	13.85	0.45	14.44	0.59	
Total	2956	2930	2787	2744	2739	2717	2364	2304	2247	2126	2030	199752
	1.48	1.47	1.40	1.37	1.37	1.36	1.18	1.15	1.12	1.06	1.02	100.00

Statistics for Table of COMORDES by ICD10_PRIM

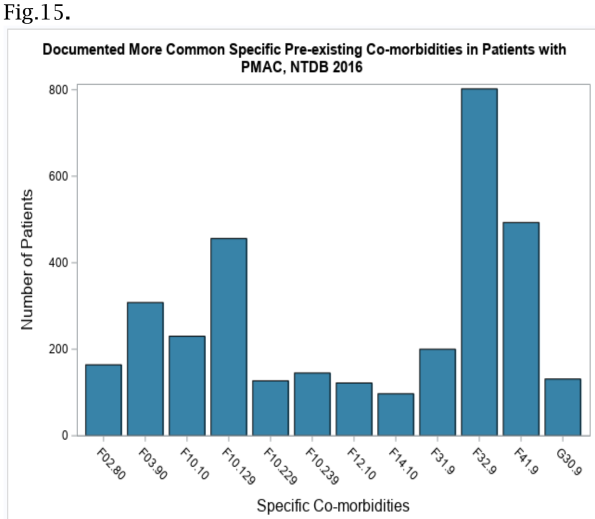
Statistic	DF	Value	Prob
Chi-Square	4884	81152.7085	<.0001
Likelihood Ratio Chi-Square	4884	87905.0576	<.0001
Mantel-Haenszel Chi-Square	1	805.0103	<.0001
Phi Coefficient		0.6374	
Contingency Coefficient		0.5375	
Cramer's V		0.3187	
WARNING: 75% of the cells have expected counts less than 5. Chi-Square may not be a valid test.			

Sample Size = 199752

4.6.B. Specific PMAC Sustaining Traumatic Injuries in the target Patients.

As we can see in the table.8 above the percentage of each PMAC disorders in the target patients read major psychiatric illness(36.22%), drug use disorder(22.77%), dementia (17.33%), alcohol use disorder (16.32%) and cerebrovascular accident (CVA) (7.36%). These disorders were more generalized classifications of the pre-existing mental altering co-morbidities (PMAC). The detailed specific diagnosis that were part of each of these classifications were retrieved using the ICD10 diagnosis except for the Cerebrovascular Accident (CVA) which had a relatively least percentage in the classification. Of these specific diagnoses, major depressive disorders, single episode (F32.9) in the classification of major psychiatric illness comprised the highest number of patients followed by anxiety disorder (F41.9) from the same classification of major psychiatric illness and then comes alcohol abuse with intoxication (F10.129) and dementia (F03.90). The figure (fig.15) below illustrates the specific diagnosis of pre-existing mental altering co-morbidities from each of the classifications. A detailed analysis of how these specific diagnoses related to the covariates and their solitary or synergetic effects on traumatic injuries would be made in the subsequent studies.

Fig.15.



ICD10 KEY:

F02.80= Dementia in other diseases classified elsewhere without behavioral disturbance.

F03.90= Unspecified dementia without behavioral disturbance.

F10.10= Alcohol abuse, uncomplicated.

F10.129= Alcohol abuse with intoxication, NOS.

F10.229= Alcohol dependence with intoxication NOS.,

F10.239= alcohol dependence with withdrawal, N OS.

F12.10= Cannabis abuse, uncomplicated.

F14.10= Cocaine abuse, uncomplicated.

F31.9= Bipolar disorder, NOS.

F32.9= Major depressive disorder, single episode NOS.,

F41.9= Anxiety disorder, NOS.

G30.9= Alzheimer's disease, NOS.

4.6.C. Analysis of the Variation of the Effects of PMAC and Covariates on Traumatic Injuries.

The result of the multivariate analysis of variance to compare the effects of PMAC in addition to the other covariates on traumatic injuries in the target patients showed a small p-value (<0.0001) in type I and P<0.0045 in type III for the interaction of comorbidities, age, gender, and race. Both are statistically significant that there exists a variation of the effects of PMAC and other covariates on traumatic injuries. The box and whisker plot indicated the group of patients had a varying extent of the diagnosis of traumatic injuries. The analysis for the control patients was similar to the target patients except for the p-value for all tests was <0.0001 in the results of control patients. case. See tables 10 and 11.

Table 10. Analysis of variance results in the target patients, NTDB 2016.

The GLM Procedure

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3159	2.7403441E14	86747200599	1.13	<.0001
Error	77243	5.9146918E15	76572528006		
Corrected Total	80402	6.1887262E15			

Source	DF	Type I SS	Mean Square	F Value	Pr > F
COMO*AGE*GENDE*RACE1	3151	2.6622334E14	84488523900	1.10	<.0001
ICD10_PRIM	8	7.8110679E12	976383485453	12.75	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
COMO*AGE*GENDE*RACE1	3151	2.5779664E14	81814231779	1.07	0.0045
ICD10_PRIM	8	7.8110679E12	976383485453	12.75	<.0001

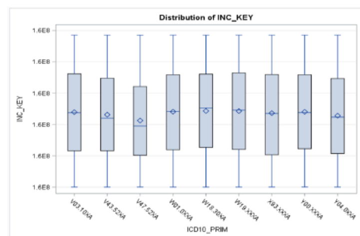


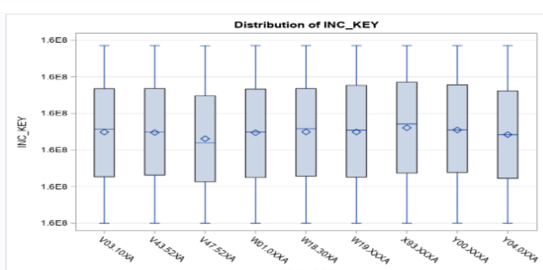
Table. 11. Analysis of variance results in the control patients, NTDB 2016.

The GLM Procedure

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	106	6.4314561E13	606741143174	7.75	<.0001
Error	239642	1.8751685E16	78248743682		
Corrected Total	239748	1.8816E16			

Source	DF	Type I SS	Mean Square	F Value	Pr > F
AGE	89	1.1943302E13	134194400960	1.71	<.0001
GENDER	2	1.400164E12	700081992632	8.95	0.0001
RACE1	7	2.8475035E13	4.0678622E12	51.99	<.0001
ICD10_PRIM	8	2.249606E13	2.8120075E12	35.94	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
AGE	89	1.2650488E13	142140318215	1.82	<.0001
GENDER	2	2.3630026E12	1.1815013E12	15.10	<.0001
RACE1	7	2.3425895E13	3.3465565E12	42.77	<.0001
ICD10_PRIM	8	2.249606E13	2.8120075E12	35.94	<.0001



4.6.D. The Effects of PMAC and Other Covariates on the Most Prevalent Mechanisms of Injuries in Target patients (Multiple Logistic Regression).

The analysis in section 4.5.C. signified that there existed a variation in the effects of the PMAC and other covariates. The next step was to examine how far these factors affected the target patients. The cumulative logistic regression result in tables 12 and 13 showed gender (Female vs Male) had the highest predictive effect of getting the odds of traumatic injuries in target patients (OR 1.533; 95% CI 0.99-0.99; P<0.0001). Age was another covariate with higher odds of getting injuries (OR 0.993; 95% CI 0.99-0.99; P<0.0001). In control patients (table 12) Race: American Indian vs White had the highest predictive effect of getting the odds of traumatic injuries (OR 2.066; 95CI 1.90-2.25; P<0.0001). Gender (Female vs Male) had a lower predictive effect of the odds of getting traumatic injuries (OR 0.630; 95% CI 0.62-0.64; P<0.0001) in contrast to the target patients.

Table 12. Multivariate analysis of the effects of PMAC and other co-variates on the most prevalent mechanisms of injuries in target patients, NTDB 2016.

THE EFFECT OF PMAC AND OTHER COVARIATES ON THE MOST PREVALENT MECHANISMS OF INJURIES, NTDB 2016

The LOGISTIC Procedure

Model Information		
Data Set	WORK.TARGET10	
Response Variable	ICD10_PRIM	ICD10_PRIM
Number of Response Levels	9	
Model	cumulative logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	71442
Number of Observations Used	71442

Response Profile		
Ordered Value	ICD10_PRIM	Total Frequency
1	V03.10XA	3800
2	V43.52XA	5629
3	V47.52XA	3637
4	W01.0XXA	20078
5	W18.30XA	7445
6	W19.XXXA	12429
7	X93.XXXA	2027
8	Y00.XXXA	2731
9	Y04.0XXA	5666

Probabilities modeled are cumulated over the lower Ordered Values.

Analysis of Maximum Likelihood Estimates						
Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	V03.10XA	1	-2.7225	0.0476	3271.1574	<.0001
Intercept	V43.52XA	1	-1.7239	0.0459	1407.5921	<.0001
Intercept	V47.52XA	1	-1.3334	0.0456	853.2745	<.0001
Intercept	W01.0XXA	1	0.5093	0.0454	126.0716	<.0001
Intercept	W18.30XA	1	0.9718	0.0455	456.8142	<.0001
Intercept	W19.XXXA	1	2.0217	0.0460	1927.7543	<.0001
Intercept	X93.XXXA	1	2.2793	0.0463	2423.0909	<.0001
Intercept	Y00.XXXA	1	2.7235	0.0469	3368.4161	<.0001
AGE		1	-0.00672	0.000456	216.6073	<.0001
GENDER	Female	1	0.2137	0.00739	835.1482	<.0001
RACE1	American Indian	1	-0.5610	0.0630	79.1907	<.0001
RACE1	Asian	1	0.1432	0.0647	4.8985	0.0269
RACE1	Black or African American	1	-0.2399	0.0398	36.3474	<.0001
RACE1	Native Hawaiian or Other Pacific Islander	1	0.1505	0.1204	1.5621	0.2114
RACE1	Not Applicable BIU 1	1	0.0197	0.2051	0.0092	0.9236
RACE1	Not Known/Not Recorded BIU 2	1	0.0927	0.0608	2.3249	0.1273
RACE1	Other Race	1	0.1292	0.0433	8.9177	0.0028
COMORDES	Alcohol Use Disorder	1	-0.0936	0.0153	37.3089	<.0001
COMORDES	Cerebrovascular Accident (CVA)	1	0.1601	0.0199	64.7942	<.0001
COMORDES	Dementia	1	-0.0829	0.0164	25.4909	<.0001
COMORDES	Drug use disorder	1	-0.1920	0.0174	121.1659	<.0001

Odds Ratio Estimates and Wald Confidence Intervals				
Effect	Unit	Estimate	95% Confidence Limits	
AGE	1.0000	0.993	0.992	0.994
GENDER Female vs Male	1.0000	1.533	1.489	1.578
RACE1 American Indian vs White	1.0000	0.438	0.389	0.492
RACE1 Asian vs White	1.0000	0.885	0.783	1.000
RACE1 Black or African American vs White	1.0000	0.603	0.578	0.629
RACE1 Native Hawaiian or Other Pacific Islander vs White	1.0000	0.891	0.687	1.157
RACE1 Not Applicable BIU 1 vs White	1.0000	0.782	0.495	1.235
RACE1 Not Known/Not Recorded BIU 2 vs White	1.0000	0.841	0.752	0.941
RACE1 Other Race vs White	1.0000	0.872	0.824	0.923
COMORDES Alcohol Use Disorder vs Major psychiatric illness	1.0000	0.739	0.710	0.770
COMORDES Cerebrovascular Accident (CVA) vs Major psychiatric illness	1.0000	0.953	0.905	1.003
COMORDES Dementia vs Major psychiatric illness	1.0000	0.747	0.717	0.778
COMORDES Drug use disorder vs Major psychiatric illness	1.0000	0.670	0.642	0.700

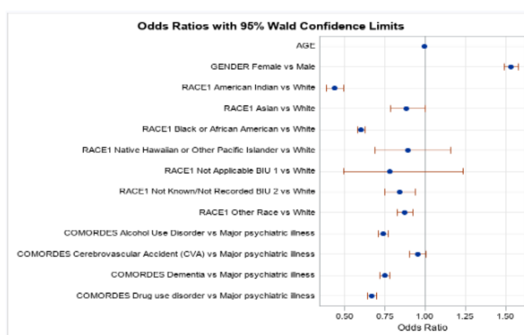


Table 13. Multivariate analysis of the effect of the co-variates on the most prevalent mechanisms of injuries in control patients, NTDB 2016.

THE EFFECT OF COVARIATES ON THE MECHANISMS OF INJURIES REGARDED AS THE MOST PREVALENT IN PATIENTS WITH PMAC COMPARED TO PATIENTS WITHOUT PMAC, NTDB 2016

The LOGISTIC Procedure

Model Information		
Data Set	WORK.CMECHLOGIT	
Response Variable	ICD10_PRIM	ICD10_PRIM
Number of Response Levels	9	
Model	cumulative logit	
Optimization Technique	Fisher's scoring	

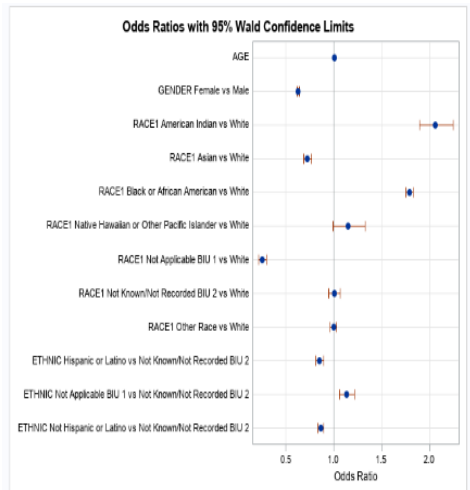
Number of Observations Read	228234
Number of Observations Used	228234

Response Profile		
Ordered Value	ICD10_PRIM	Total Frequency
1	Y04.0XXA	15610
2	Y00.XXXA	7516
3	X93.XXXA	10200
4	W19.XXXA	26814
5	W18.30XA	18474
6	W01.0XXA	87675
7	V47.52XA	13505
8	V43.52XA	34325
9	V03.10XA	14015

Probabilities modeled are cumulated over the lower Ordered Values.

Analysis of Maximum Likelihood Estimates						
Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	Y04.0XXA	1	-3.2781	0.0204	25940.4452	<.0001
Intercept	Y00.XXXA	1	-2.8473	0.0198	20628.2026	<.0001
Intercept	X93.XXXA	1	-2.4255	0.0195	15518.0221	<.0001
Intercept	W19.XXXA	1	-1.6697	0.0191	7655.5365	<.0001
Intercept	W18.30XA	1	-1.2766	0.0190	4534.1898	<.0001
Intercept	W01.0XXA	1	0.4032	0.0188	460.9143	<.0001
Intercept	V47.52XA	1	0.7371	0.0188	1529.8197	<.0001
Intercept	V43.52XA	1	2.1703	0.0200	11781.8262	<.0001
AGE		1	0.01000	0.000183	2973.1210	<.0001
GENDER	Female	1	-0.2307	0.00395	3404.8877	<.0001
RACE1	American Indian	1	0.7557	0.0405	348.8066	<.0001
RACE1	Asian	1	-0.2904	0.0279	108.4648	<.0001
RACE1	Black or African American	1	0.6144	0.0178	1196.0613	<.0001
RACE1	Native Hawaiian or Other Pacific Islander	1	0.1674	0.0667	6.2890	0.0121
RACE1	Not Applicable BIU 1	1	-1.3410	0.0669	401.3673	<.0001
RACE1	Not Known/Not Recorded BIU 2	1	0.0365	0.0315	1.3477	0.2457
RACE1	Other Race	1	0.0273	0.0211	1.6628	0.1972
ETHNIC	Hispanic or Latino	1	-0.1155	0.0140	67.7227	<.0001
ETHNIC	Not Applicable BIU 1	1	0.1717	0.0231	55.4105	<.0001
ETHNIC	Not Hispanic or Latino	1	-0.0985	0.00997	97.5097	<.0001

Odds Ratio Estimates and Wald Confidence Intervals				
Effect	Unit	Estimate	95% Confidence Limits	
AGE	1.0000	1.010	1.010	1.010
GENDER Female vs Male	1.0000	0.630	0.621	0.640
RACE1 American Indian vs White	1.0000	2.066	1.897	2.249
RACE1 Asian vs White	1.0000	0.726	0.688	0.765
RACE1 Black or African American vs White	1.0000	1.794	1.755	1.834
RACE1 Native Hawaiian or Other Pacific Islander vs White	1.0000	1.147	0.990	1.329
RACE1 Not Applicable BIU 1 vs White	1.0000	0.254	0.219	0.294
RACE1 Not Known/Not Recorded BIU 2 vs White	1.0000	1.006	0.945	1.072
RACE1 Other Race vs White	1.0000	0.997	0.964	1.032
ETHNIC Hispanic or Latino vs Not Known/Not Recorded BIU 2	1.0000	0.854	0.817	0.892
ETHNIC Not Applicable BIU 1 vs Not Known/Not Recorded BIU 2	1.0000	1.138	1.064	1.218
ETHNIC Not Hispanic or Latino vs Not Known/Not Recorded BIU 2	1.0000	0.869	0.839	0.900



4.6.E. Study Cohort's Subgroup and Analysis of the Effects of PMAC on Target Patients (Multiple Logistic Regression).

The PMAC cohorts included two different groups of patient population i.e. (I) patients with major psychiatric illness and substance abuse (drug and alcohol) & (II) Patients with cerebrovascular accident (CVA) and dementia. The results of multiple logistic regression analysis below would help to lean the differences in the effects of these subgroups on the most prevalent mechanisms of traumatic injuries.

I. The Effects of Substance Use (drug and alcohol) and Major Psychiatric

Illness on the Most Prevalent Mechanisms of Traumatic Injuries in Target Patients.

In this subgroup gender (Female vs Male) had the highest predictive effect of injury (OR 1.700; 95% CI 1.648-1.754). Both substance abuse and major psychiatric illness had a significant effect on getting traumatic injuries (P<0.001), alcohol use disorder vs major psychiatric illness (OR=0.838) and drug use disorder vs major psychiatric illness (OR=0.842). See table.13.

Table 14. The effects of substance use and major psychiatric illness on the most prevalent mechanisms of traumatic injuries, NTDB 2016.

THE EFFECT OF SUBSTANCE USE (DRUG AND ALCOHOL) ADND MAJOR PSYCHIATRIC ILLNESS ON THE MOST PREVALENT MECHANISMS OF INJURIES, NTDB

The LOGISTIC Procedure

Model Information		
Data Set	WORK.TARGETPSYCLOGIT	
Response Variable	ICD10_PRIM	ICD10_PRIM
Number of Response Levels	9	
Model	cumulative logit	
Optimization Technique	Fisher's scoring	

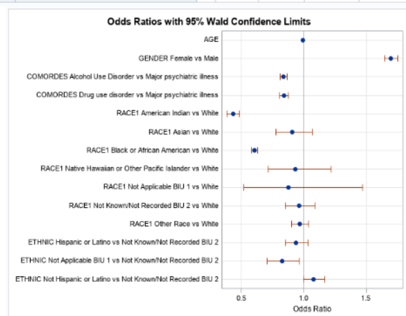
Number of Observations Read	61469
Number of Observations Used	61469

Response Profile		
Ordered Value	ICD10_PRIM	Total Frequency
1	V03.10XA	4678
2	V43.52XA	6203
3	V47.52XA	4300
4	W01.0XXA	19601
5	W18.30XA	5109
6	W19.XXXA	8832
7	X93.XXXA	2338
8	Y00.XXXA	3451
9	Y04.0XXA	7257

Probabilities modeled are cumulated over the lower Ordered Values.

Analysis of Maximum Likelihood Estimates						
Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	V03.10XA	1	-2.4925	0.0494	2550.5598	<.0001
Intercept	V43.52XA	1	-1.5535	0.0481	1041.4460	<.0001
Intercept	V47.52XA	1	-1.1227	0.0479	549.7945	<.0001
Intercept	W01.0XXA	1	0.3001	0.0477	39.6351	<.0001
Intercept	W18.30XA	1	0.6572	0.0477	189.6214	<.0001
Intercept	W19.XXXA	1	1.4133	0.0480	866.2771	<.0001
Intercept	X93.XXXA	1	1.6697	0.0482	1200.5340	<.0001
Intercept	Y00.XXXA	1	2.1371	0.0486	1930.1052	<.0001
AGE		1	-0.00510	0.000428	142.2030	<.0001
GENDER	Female	1	0.2654	0.00799	1101.8815	<.0001
COMORDES	Alcohol Use Disorder	1	-0.0602	0.0108	31.3076	<.0001
COMORDES	Drug use disorder	1	-0.0560	0.0125	19.8776	<.0001
RACE1	American Indian	1	-0.6258	0.0635	97.1913	<.0001
RACE1	Asian	1	0.1186	0.0813	2.1261	0.1448
RACE1	Black or African American	1	-0.2895	0.0435	44.2416	<.0001
RACE1	Native Hawaiian or Other Pacific Islander	1	0.1465	0.1230	1.4193	0.2335
RACE1	Not Applicable BIU 1	1	0.0804	0.2326	0.1194	0.7297
RACE1	Not Known/Not Recorded BIU 2	1	0.1749	0.0666	6.8995	0.0086
RACE1	Other Race	1	0.1820	0.0499	13.3239	0.0003
ETHNIC	Hispanic or Latino	1	-0.0189	0.0303	0.3882	0.5333
ETHNIC	Not Applicable BIU 1	1	-0.1478	0.0543	7.4235	0.0064
ETHNIC	Not Hispanic or Latino	1	0.1219	0.0225	29.3245	<.0001

Odds Ratio Estimates and Wald Confidence Intervals				
Effect	Unit	Estimate	95% Confidence Limits	
AGE	1.0000	0.995	0.994	0.996
GENDER Female vs Male	1.0000	1.700	1.648	1.754
COMORDES Alcohol Use Disorder vs Major psychiatric illness	1.0000	0.838	0.810	0.868
COMORDES Drug use disorder vs Major psychiatric illness	1.0000	0.842	0.808	0.877
RACE1 American Indian vs White	1.0000	0.432	0.386	0.484
RACE1 Asian vs White	1.0000	0.910	0.775	1.068
RACE1 Black or African American vs White	1.0000	0.605	0.581	0.630
RACE1 Native Hawaiian or Other Pacific Islander vs White	1.0000	0.936	0.719	1.218
RACE1 Not Applicable BIU 1 vs White	1.0000	0.876	0.521	1.472
RACE1 Not Known/Not Recorded BIU 2 vs White	1.0000	0.963	0.851	1.088
RACE1 Other Race vs White	1.0000	0.969	0.905	1.039
ETHNIC Hispanic or Latino vs Not Known/Not Recorded BIU 2	1.0000	0.938	0.854	1.031
ETHNIC Not Applicable BIU 1 vs Not Known/Not Recorded BIU 2	1.0000	0.825	0.705	0.965
ETHNIC Not Hispanic or Latino vs Not Known/Not Recorded BIU 2	1.0000	1.080	0.999	1.167



II. The Effects of Cerebrovascular Accidents (CVA) and Dementia on the Most Prevalent Traumatic Injuries in Target Patients.

In this subgroup, age had a comparable effect as in subgroup I and gender influence weren't the highest as in group I. As shown in table……below CVA and dementia themselves had a higher predictive effect on traumatic injuries in this subgroup (CVA vs Dementia OR=1.397; 95% CI 1.35-1.474) and P<0.0001 for CVA.

Table 15. The effects of substance use and major psychiatric illness on the most prevalent mechanisms of traumatic injuries (Multiple logistic regression), NTDB 2016.

THE EFFECT OF DEMENTIA AND CEREBROVASCULAR ACCIDENT ON THE MOST PREVALENT MECHANISMS OF INJURY IN PATIENTS WITH PMAC, NTDB 2016

The LOGISTIC Procedure

Model Information		
Data Set	WORK.TARGETCVAD	
Response Variable	ICD10_PRIM	ICD10_PRIM
Number of Response Levels	9	
Model	cumulative logit	
Optimization Technique	Fisher's scoring	

Number of Observations Read	25150
Number of Observations Used	25150

Response Profile		
Ordered Value	ICD10_PRIM	Total Frequency
1	V03.10XA	209
2	V43.52XA	479
3	V47.52XA	180
4	W01.0XXA	14158
5	W18.30XA	4140
6	W19.XXXA	5599
7	X93.XXXA	13
8	Y00.XXXA	80
9	Y04.0XXA	192

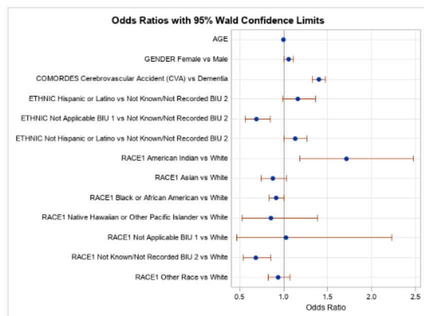
Probabilities modeled are cumulated over the lower Ordered Values.

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	V03.10XA	1	-4.6753	0.1415	1091.7933	<.0001
Intercept	V43.52XA	1	-3.4627	0.1292	718.3058	<.0001
Intercept	V47.52XA	1	-3.2222	0.1280	633.4026	<.0001
Intercept	W01.0XXA	1	0.4724	0.1242	14.4635	0.0001
Intercept	W18.30XA	1	1.1868	0.1244	91.0025	<.0001
Intercept	W19.XXXA	1	4.6929	0.1373	1169.0712	<.0001
Intercept	X93.XXXA	1	4.7400	0.1379	1182.1393	<.0001
Intercept	Y00.XXXA	1	5.0909	0.1433	1261.9602	<.0001
AGE		1	-0.00348	0.00135	6.5974	0.0102
GENDER	Female	1	0.0270	0.0124	4.7245	0.0297
COMORDES	Cerebrovascular Accident (CVA)	1	0.1673	0.0136	150.8828	<.0001
ETHNIC	Hispanic or Latino	1	0.1770	0.0518	11.6744	0.0006
ETHNIC	Not Applicable BIU 1	1	-0.3485	0.0698	24.9287	<.0001
ETHNIC	Not Hispanic or Latino	1	0.1457	0.0319	20.8066	<.0001
RACE1	American Indian	1	0.5735	0.1752	10.7121	0.0011
RACE1	Asian	1	-0.1000	0.0995	1.0102	0.3148
RACE1	Black or African American	1	-0.0559	0.0777	0.5181	0.4717
RACE1	Native Hawaiian or Other Pacific Islander	1	-0.1271	0.2247	0.3197	0.5718
RACE1	Not Applicable BIU 1	1	0.0567	0.3516	0.0260	0.8719
RACE1	Not Known/Not Recorded BIU 2	1	-0.3535	0.1222	8.3700	0.0038
RACE1	Other Race	1	-0.0288	0.0879	0.1072	0.7434

Odds Ratio Estimates and Wald Confidence Intervals

Effect	Unit	Estimate	95% Confidence Limits	
AGE	1.0000	0.997	0.994	0.999
GENDER Female vs Male	1.0000	1.055	1.005	1.108
COMORDES Cerebrovascular Accident (CVA) vs Dementia	1.0000	1.397	1.325	1.474
ETHNIC Hispanic or Latino vs Not Known/Not Recorded BIU 2	1.0000	1.163	0.991	1.365
ETHNIC Not Applicable BIU 1 vs Not Known/Not Recorded BIU 2	1.0000	0.688	0.559	0.846
ETHNIC Not Hispanic or Latino vs Not Known/Not Recorded BIU 2	1.0000	1.127	1.005	1.264
RACE1 American Indian vs White	1.0000	1.713	1.186	2.475
RACE1 Asian vs White	1.0000	0.874	0.738	1.034
RACE1 Black or African American vs White	1.0000	0.913	0.831	1.003
RACE1 Native Hawaiian or Other Pacific Islander vs White	1.0000	0.850	0.523	1.383
RACE1 Not Applicable BIU 1 vs White	1.0000	1.022	0.467	2.233
RACE1 Not Known/Not Recorded BIU 2 vs White	1.0000	0.678	0.537	0.856
RACE1 Other Race vs White	1.0000	0.938	0.821	1.072



4.6.F. Having Multiple PMAC diagnosis and effects on the Most Prevalent Mechanisms of Injuries in the Target Patients.

a. The Effects of Major Psychiatric Illness, Drug and Alcohol Use Disorders on the Most Prevalent Mechanisms of Injuries in the Target Patients.

Regardless of the difference of the PMAC cohorts' group, there was a possibility that the target patients could be diagnosed with a single or multiple PMACs. The analysis below was related to a condition when the individual patient in the target had diagnosed to have three PMAC diagnoses (Major Psychiatric Illness, Drug, and Alcohol Use disorders) at the same time during this admission. The results indicated that the effect of having such multiple comorbidities on the most prevalent MOI was statistically significant (P<0.0001) as per the analysis of the maximum likelihood estimate for MPSYDGAL below. The odds ratio MPSYDGAL vs Major psychiatric illness was 1.919 (95% CI=1.713-2.150) and the predicted cumulative probabilities of the most prevalent MOI showed, patients who were diagnosed with the disorders mentioned above (MPSYDGAL) had almost the highest predictive probabilities for all the injuries. A more pronounced difference in the probabilities was noticed in W19.XXXA (Unspecified fall, initial encounter) and W18.30XA (Fall on the same level, unspecified, initial encounter) where the predictive probabilities for such injuries were higher than all the target patients with the diagnosis of a single PMAC. Moreover, patients with multiple PMACs (MPSYDGAL) had the highest predictive probabilities for injuries related to transport accidents V03.10XA (Pedestrian on foot injured in collision with car, pick-up truck or van in traffic accident, initial encounter) and V43.52XA(Car driver injured in collision with other type car in traffic accident, initial encounter), and fall and exposure injury W01.0XXA (Fall on same level from slipping, tripping and stumbling without subsequent striking against object, initial encounter) as compared to the patients with a single PMAC diagnosis (table 16).

Table 16. The effects of major psychiatric illness, drug and alcohol use disorders on the most prevalent mechanisms of injuries in the target patients, results of cumulative logistic regression, NTDB 2016.

THE EFFECT OF MULTIPLE PMACs (MAJOR PSYCHIATRIC ILLNESS,DRUG AND ALCOHOL USE DISORDERS) AND SINGLE PMAC ON THE MOST PREVALENT MOI IN TARGET PATIENTS

The LOGISTIC Procedure

Model Information	
Data Set	WORK.TRGTPSYCHDA2
Response Variable	ICD10_PRIMARY_ECODE
Number of Response Levels	9
Model	cumulative logit
Optimization Technique	Fisher's scoring

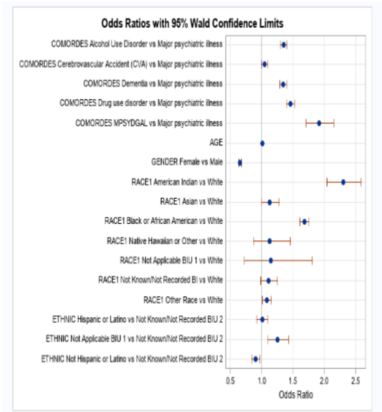
Number of Observations Read	71442
Number of Observations Used	71442

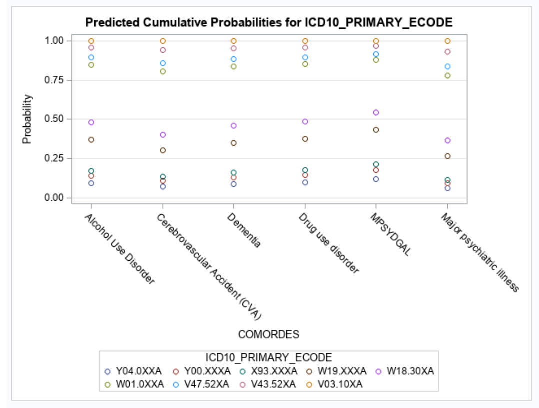
Response Profile		
Ordered Value	ICD10_PRIMARY_ECODE	Total Frequency
1	Y04.0XXA	5666
2	Y00.XXXA	2731
3	X93.XXXA	2027
4	W19.XXXA	12429
5	W18.30XA	7445
6	W01.0XXA	28078
7	V47.52XA	3637
8	V43.52XA	5629
9	V03.10XA	3800

Probabilities modeled are cumulated over the lower Ordered Values.

Analysis of Maximum Likelihood Estimates						
Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	Y04.0XXA	1	-2.5566	0.0488	2742.9048	<.0001
Intercept	Y00.XXXA	1	-2.1122	0.0482	1918.2178	<.0001
Intercept	X93.XXXA	1	-1.8547	0.0480	1493.7229	<.0001
Intercept	W19.XXXA	1	-0.8045	0.0475	287.1292	<.0001
Intercept	W18.30XA	1	-0.3416	0.0474	51.9423	<.0001
Intercept	W01.0XXA	1	1.5029	0.0478	990.2991	<.0001
Intercept	V47.52XA	1	1.8937	0.0481	1552.8154	<.0001
Intercept	V43.52XA	1	2.8925	0.0497	3393.7212	<.0001
COMORDES	Alcohol Use Disorder	1	0.0203	0.0178	1.3056	0.2532
COMORDES	Cerebrovascular Accident (CVA)	1	-0.2310	0.0227	103.2796	<.0001
COMORDES	Dementia	1	0.0137	0.0195	0.4949	0.4818
COMORDES	Drug use disorder	1	0.0981	0.0197	24.8872	<.0001
COMORDES	MPSYDGAL	1	0.3754	0.0476	62.1933	<.0001
AGE		1	0.00668	0.000458	212.4201	<.0001
GENDER	Female	1	-0.2134	0.00740	832.1507	<.0001
RACE1	American Indian	1	0.5952	0.0633	88.3585	<.0001
RACE1	Asian	1	-0.1175	0.0649	3.2786	0.0702
RACE1	Black or African American	1	0.2816	0.0403	48.8689	<.0001
RACE1	Native Hawaiian or Other	1	-0.1231	0.1206	1.0421	0.3073
RACE1	Not Applicable BIU 1	1	-0.1045	0.2058	0.2580	0.6115
RACE1	Not Known/Not Recorded BI	1	-0.1331	0.0635	4.3878	0.0362
RACE1	Other Race	1	-0.1608	0.0463	12.0550	0.0005
ETHNIC	Hispanic or Latino	1	-0.0259	0.0279	0.8607	0.3535
ETHNIC	Not Applicable BIU 1	1	0.1943	0.0452	18.4991	<.0001
ETHNIC	Not Hispanic or Latino	1	-0.1382	0.0195	50.4471	<.0001

Odds Ratio Estimates and Wald Confidence Intervals				
Effect	Unit	Estimate	95% Confidence Limits	
COMORDES Alcohol Use Disorder vs Major psychiatric illness	1.0000	1.346	1.292	1.402
COMORDES Cerebrovascular Accident (CVA) vs Major psychiatric illness	1.0000	1.047	0.994	1.102
COMORDES Dementia vs Major psychiatric illness	1.0000	1.337	1.283	1.393
COMORDES Drug use disorder vs Major psychiatric illness	1.0000	1.454	1.391	1.521
COMORDES MPSYDGAL vs Major psychiatric illness	1.0000	1.919	1.713	2.150
AGE	1.0000	1.007	1.006	1.008
GENDER Female vs Male	1.0000	0.653	0.634	0.672
RACE1 American Indian vs White	1.0000	2.300	2.043	2.589
RACE1 Asian vs White	1.0000	1.128	0.998	1.274
RACE1 Black or African American vs White	1.0000	1.681	1.612	1.753
RACE1 Native Hawaiian or Other vs White	1.0000	1.122	0.864	1.456
RACE1 Not Applicable BIU 1 vs White	1.0000	1.143	0.722	1.808
RACE1 Not Known/Not Recorded BI vs White	1.0000	1.110	0.985	1.251
RACE1 Other Race vs White	1.0000	1.080	1.010	1.156
ETHNIC Hispanic or Latino vs Not Known/Not Recorded BIU 2	1.0000	1.004	0.920	1.097
ETHNIC Not Applicable BIU 1 vs Not Known/Not Recorded BIU 2	1.0000	1.252	1.096	1.429
ETHNIC Not Hispanic or Latino vs Not Known/Not Recorded BIU 2	1.0000	0.898	0.837	0.962

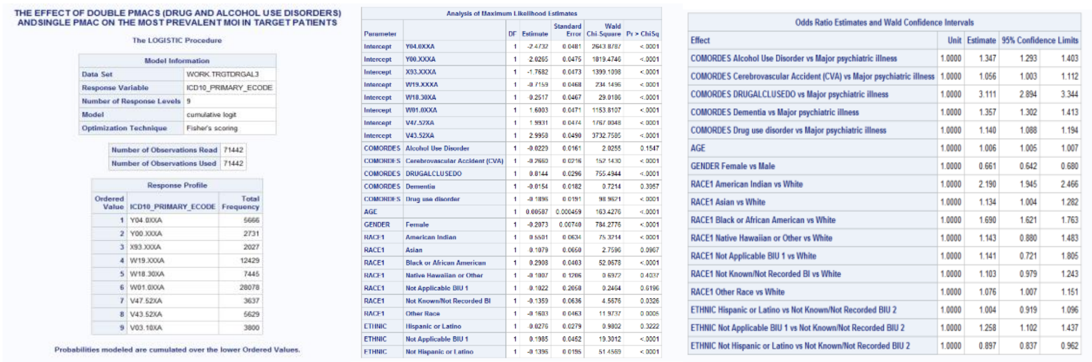




b. The Effects of Drug and Alcohol Use Disorders on the Most Prevalent Mechanisms of Injuries in Target Patients.

The target patients who diagnosed with double disorders (drug and alcohol use) had a statistically significant effect on the prevalent MOI ($P<0.0001$; OR DRUGALCLUSEDO vs Major psychiatric illness=3.111; 95%CI=2.894-3.344). Per the result of the predicted cumulative probabilities patients with these double disorders had a higher probability for fall and exposure injuries W18.30XA (Fall on the same level, unspecified, initial encounter) and W19.XXXA (Unspecified fall, initial encounter) respectively compared to the other target patients with a single PMAC diagnosis. But the highest predicted probabilities were observed in transport accident injuries V03.10XA (Pedestrian on foot injured in collision with car, pick-up truck or van in traffic accident, initial encounter) and V43.52XA(Car driver injured in collision with other type car in traffic accident, initial encounter), V47.52XA (Driver of other type car injured in collision with fixed or stationary object in traffic accident, initial encounter) and fall and exposure injury W01.0XXA (Fall on same level from slipping, tripping and stumbling without subsequent striking against object, initial encounter) with V03.10XA had been having the highest predicted probability in this group of patients (table 17).

Table 17. The effects of drug and alcohol use disorders on the most prevalent mechanisms of injuries in the target patients, results of cumulative logistic regression, NTDB 2016.



THE EFFECT OF DOUBLE PMACS (DRUG AND ALCOHOL USE DISORDERS) ANDSINGLE PMAC ON THE MOST PREVALENT MOI IN TARGET PATIENTS

The LOGISTIC Procedure

Model Information	
Data Set	WORK.TRGTDRGAL3
Response Variable	ICD10_PRIMARY_ECODE
Number of Response Levels	9
Model	cumulative logit
Optimization Technique	Fisher's scoring

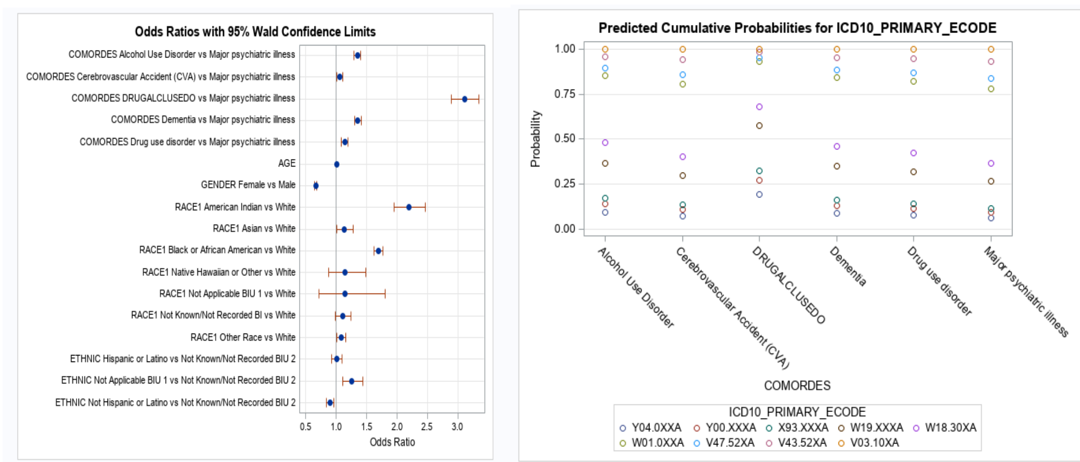
Number of Observations Read	71442
Number of Observations Used	71442

Response Profile		
Ordered Value	ICD10_PRIMARY_ECODE	Total Frequency
1	Y04.0XXA	5666
2	Y00.XXXA	2731
3	X93.XXXA	2027
4	W19.XXXA	12429
5	W18.30XA	7445
6	W01.0XXA	28078
7	V47.52XA	3637
8	V43.52XA	5629
9	V03.10XA	3800

Probabilities modeled are cumulated over the lower Ordered Values.

Analysis of Maximum Likelihood Estimates						
Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	Y04.0XXA	1	-2.4732	0.0481	2643.8787	<.0001
Intercept	Y00.XXXA	1	-2.0265	0.0475	1819.4746	<.0001
Intercept	X93.XXXA	1	-1.7682	0.0473	1399.1098	<.0001
Intercept	W19.XXXA	1	-0.7159	0.0468	234.1496	<.0001
Intercept	W18.30XA	1	-0.2517	0.0467	29.0186	<.0001
Intercept	W01.0XXA	1	1.6003	0.0471	1153.8107	<.0001
Intercept	V47.52XA	1	1.9931	0.0474	1767.0048	<.0001
Intercept	V43.52XA	1	2.9958	0.0490	3732.7585	<.0001
COMORDES	Alcohol Use Disorder	1	-0.0229	0.0161	2.0255	0.1547
COMORDES	Cerebrovascular Accident (CVA)	1	-0.2660	0.0216	152.1430	<.0001
COMORDES	DRUGALCLUSEDO	1	0.8144	0.0296	755.4944	<.0001
COMORDES	Dementia	1	-0.0154	0.0182	0.7214	0.3957
COMORDES	Drug use disorder	1	-0.1896	0.0191	98.9621	<.0001
AGE		1	0.00587	0.000459	163.4276	<.0001
GENDER	Female	1	-0.2073	0.00740	784.2776	<.0001
RACE1	American Indian	1	0.5501	0.0634	75.3214	<.0001
RACE1	Asian	1	0.1079	0.0650	2.7596	0.0967
RACE1	Black or African American	1	0.2908	0.0403	52.0678	<.0001
RACE1	Native Hawaiian or Other	1	-0.1007	0.1206	0.6972	0.4037
RACE1	Not Applicable BIU 1	1	0.1022	0.2058	0.2464	0.6196
RACE1	Not Known/Not Recorded BI	1	-0.1359	0.0636	4.5676	0.0326
RACE1	Other Race	1	-0.1603	0.0463	11.9737	0.0005
ETHNIC	Hispanic or Latino	1	0.0276	0.0279	0.9802	0.3222
ETHNIC	Not Applicable BIU 1	1	0.1985	0.0452	19.3012	<.0001
ETHNIC	Not Hispanic or Latino	1	-0.1396	0.0195	51.4569	<.0001

Odds Ratio Estimates and Wald Confidence Intervals				
Effect	Unit	Estimate	95% Confidence Limits	
COMORDES Alcohol Use Disorder vs Major psychiatric illness	1.0000	1.347	1.293	1.403
COMORDES Cerebrovascular Accident (CVA) vs Major psychiatric illness	1.0000	1.056	1.003	1.112
COMORDES DRUGALCLUSEDO vs Major psychiatric illness	1.0000	3.111	2.894	3.344
COMORDES Dementia vs Major psychiatric illness	1.0000	1.357	1.302	1.413
COMORDES Drug use disorder vs Major psychiatric illness	1.0000	1.140	1.088	1.194
AGE	1.0000	1.006	1.005	1.007
GENDER Female vs Male	1.0000	0.661	0.642	0.680
RACE1 American Indian vs White	1.0000	2.190	1.945	2.466
RACE1 Asian vs White	1.0000	1.134	1.004	1.282
RACE1 Black or African American vs White	1.0000	1.690	1.621	1.763
RACE1 Native Hawaiian or Other vs White	1.0000	1.143	0.880	1.483
RACE1 Not Applicable BIU 1 vs White	1.0000	1.141	0.721	1.805
RACE1 Not Known/Not Recorded BI vs White	1.0000	1.103	0.979	1.243
RACE1 Other Race vs White	1.0000	1.076	1.007	1.151
ETHNIC Hispanic or Latino vs Not Known/Not Recorded BIU 2	1.0000	1.004	0.919	1.096
ETHNIC Not Applicable BIU 1 vs Not Known/Not Recorded BIU 2	1.0000	1.258	1.102	1.437
ETHNIC Not Hispanic or Latino vs Not Known/Not Recorded BIU 2	1.0000	0.897	0.837	0.962



c. The Effects of Alcohol Use Disorder and Cerebrovascular Accident (CVA) on the Most Prevalent Mechanisms of Injuries in the Target Patients.

Alcohol use disorder and CVA didn't have a statistically significant effect on the most prevalent MOI (P=0.5398). According to the result of the predicted cumulative probabilities patient who diagnosed with a single disorder of either alcohol or drug use had a higher predicted probability of fall (W18.30XA) compared to the rest of the patients in the group including those with double disorders i.e. alcohol use and CVA. A transport accident injury, V03.10XA (Pedestrian on foot injured in collision with a car, pick-up truck or van in a traffic accident, initial encounter) had been having the highest predicted probability associated with all PMACs.

Table18. The effects of alcohol use disorder and cerebrovascular accident (CVA) on the most prevalent mechanisms of injuries in the target patients, the results of cumulative logistic regression, NTDB 2016.

THE EFFECT OF DOUBLE PMACs (ALCOHOL USE DISORDER AND CVA) ANDSINGLE PMAC ON THE MOST PREVALENT MOI IN TARGET PATIENTS

The LOGISTIC Procedure

Model Information	
Data Set	WORK.TRGTALCCVA3
Response Variable	ICD10_PRIMARY_ECODE
Number of Response Levels	9
Model	cumulative logit
Optimization Technique	Fisher's scoring

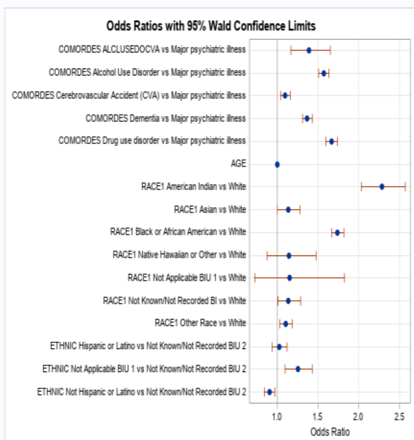
Number of Observations Read	71442
Number of Observations Used	71442

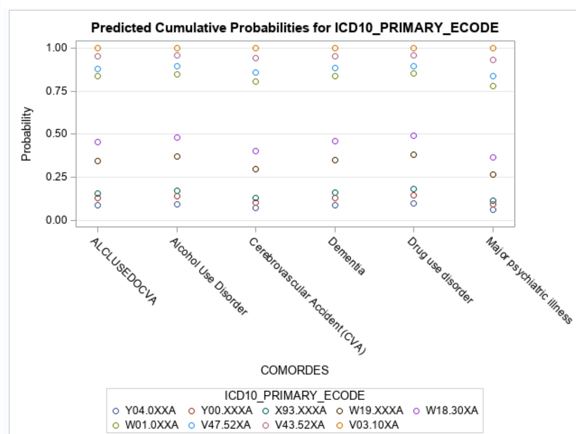
Response Profile		
Ordered Value	ICD10_PRIMARY_ECODE	Total Frequency
1	Y04.0XXA	5666
2	Y00.XXXA	2731
3	X93.XXXA	2027
4	W19.XXXA	12429
5	W18.30XA	7445
6	W01.0XXA	28078
7	V47.52XA	3637
8	V43.52XA	5629
9	V03.10XA	3800

Probabilities modeled are cumulated over the lower Ordered Values.

Analysis of Maximum Likelihood Estimates						
Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	Y04.0XXA	1	-2.4814	0.0504	2424.0463	<.0001
Intercept	Y00.XXXA	1	-2.0397	0.0498	1675.2767	<.0001
Intercept	X93.XXXA	1	-1.7842	0.0496	1293.6888	<.0001
Intercept	W19.XXXA	1	-0.7426	0.0491	228.4957	<.0001
Intercept	W18.30XA	1	-0.2838	0.0491	33.4673	<.0001
Intercept	W01.0XXA	1	1.5468	0.0494	979.1870	<.0001
Intercept	V47.52XA	1	1.9361	0.0497	1516.3315	<.0001
Intercept	V43.52XA	1	2.9336	0.0513	3274.6597	<.0001
COMORDES	ALCLUSEDOCVA	1	0.0449	0.0733	0.3758	0.5398
COMORDES	Alcohol Use Disorder	1	0.1692	0.0210	64.7200	<.0001
COMORDES	Cerebrovascular Accident (CVA)	1	0.1000	0.0254	15.4206	<.0001
COMORDES	Dementia	1	0.0305	0.0219	1.9478	0.1628
COMORDES	Drug use disorder	1	0.2206	0.0220	100.6271	<.0001
AGE		1	0.00509	0.000453	126.1286	<.0001
RACE1	American Indian	1	0.5741	0.0633	82.3150	<.0001
RACE1	Asian	1	-0.1258	0.0649	3.7554	0.0526
RACE1	Black or African American	1	0.3023	0.0403	56.3529	<.0001
RACE1	Native Hawaiian or Other	1	-0.1190	0.1205	0.9758	0.3232
RACE1	Not Applicable BIU 1	1	-0.1093	0.2057	0.2824	0.5952
RACE1	Not Known/Not Recorded BI	1	-0.1198	0.0635	3.5606	0.0592
RACE1	Other Race	1	-0.1505	0.0463	10.5646	0.0012
ETHNIC	Hispanic or Latino	1	-0.0103	0.0279	0.1360	0.7122
ETHNIC	Not Applicable BIU 1	1	0.1872	0.0452	17.1962	<.0001
ETHNIC	Not Hispanic or Latino	1	-0.1379	0.0196	50.2987	<.0001

Odds Ratio Estimates and Wald Confidence Intervals				
Effect	Unit	Estimate	95% Confidence Limits	
COMORDES ALCLUSEDOCVA vs Major psychiatric illness	1.0000	1.390	1.169	1.653
COMORDES Alcohol Use Disorder vs Major psychiatric illness	1.0000	1.574	1.513	1.638
COMORDES Cerebrovascular Accident (CVA) vs Major psychiatric illness	1.0000	1.100	1.044	1.159
COMORDES Dementia vs Major psychiatric illness	1.0000	1.370	1.315	1.427
COMORDES Drug use disorder vs Major psychiatric illness	1.0000	1.670	1.600	1.744
AGE	1.0000	1.005	1.004	1.006
RACE1 American Indian vs White	1.0000	2.284	2.029	2.571
RACE1 Asian vs White	1.0000	1.134	1.004	1.282
RACE1 Black or African American vs White	1.0000	1.741	1.669	1.815
RACE1 Native Hawaiian or Other vs White	1.0000	1.142	0.880	1.482
RACE1 Not Applicable BIU 1 vs White	1.0000	1.153	0.729	1.824
RACE1 Not Known/Not Recorded BI vs White	1.0000	1.141	1.013	1.286
RACE1 Other Race vs White	1.0000	1.107	1.035	1.183
ETHNIC Hispanic or Latino vs Not Known/Not Recorded BIU 2	1.0000	1.029	0.943	1.124
ETHNIC Not Applicable BIU 1 vs Not Known/Not Recorded BIU 2	1.0000	1.254	1.098	1.431
ETHNIC Not Hispanic or Latino vs Not Known/Not Recorded BIU 2	1.0000	0.906	0.845	0.971





4.6.G. The Effects of Specific PMACs on Most Prevalent Mechanisms of Injuries in the Target Patient Population.

The influence of PMAC on most prevalent mechanisms of injuries as shown in the results above was statistically significant in most of the cases but as the data captured only few diagnosis codes (ICD10 diagnosis codes) of the specific illnesses/disorders, the inferences made from the analysis of those specific PMAC were not that meaningful and preferred to carry out inferential statistics based on the general classifications. For example, the multiple logistic regression analysis to see the effects of the common specific pre-existing co-morbidities on the most prevalent mechanisms of injuries below indicated only age and gender had a statistically significant effect as the number of these co-morbidities was so small compared to the total number of patients analyzed.

Table 19. The effects of common specific PMAC on fall and exposure injuries (Multiple logistic regression), NTDB 2016.

THE EFFECTS OF COMMON SPECIFIC PMAC ON FALL AND EXPOSURE INJURIES, NTDB 2016

The LOGISTIC Procedure

Model Information	
Data Set	WORK.TRGCMR2
Response Variable	FALL
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

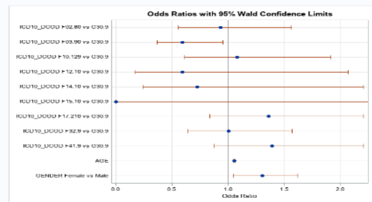
Number of Observations Read	3463
Number of Observations Used	3463

Response Profile		
Ordered Value	FALL	Total Frequency
1	1	477
2	0	2986

Probability modeled is FALL='1'.

Analysis of Maximum Likelihood Estimates						
Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-6.4990	34.1927	0.0361	0.8493
ICD10_DCOD	F02.80	1	1.2904	34.1922	0.0014	0.9699
ICD10_DCOD	F03.90	1	0.8401	34.1921	0.0006	0.9804
ICD10_DCOD	F10.129	1	1.4417	34.1922	0.0018	0.9664
ICD10_DCOD	F12.10	1	0.8374	34.1959	0.0006	0.9805
ICD10_DCOD	F14.10	1	1.0432	34.1949	0.0009	0.9757
ICD10_DCOD	F15.10	1	-11.5416	307.7	0.0014	0.9701
ICD10_DCOD	F17.210	1	1.6695	34.1919	0.0024	0.9611
ICD10_DCOD	F32.9	1	1.3664	34.1919	0.0016	0.9681
ICD10_DCOD	F41.9	1	1.6909	34.1919	0.0024	0.9606
AGE		1	0.0518	0.00402	165.9360	<.0001
GENDER	Female	1	0.1324	0.0560	5.5813	0.0182

Odds Ratio Estimates and Wald Confidence Intervals				
Effect	Unit	Estimate	95% Confidence Limits	
ICD10_DCOD F02.80 vs G30.9	1.0000	0.931	0.556	1.563
ICD10_DCOD F03.90 vs G30.9	1.0000	0.593	0.369	0.955
ICD10_DCOD F10.129 vs G30.9	1.0000	1.083	0.612	1.917
ICD10_DCOD F12.10 vs G30.9	1.0000	0.592	0.169	2.071
ICD10_DCOD F14.10 vs G30.9	1.0000	0.727	0.240	2.206
ICD10_DCOD F15.10 vs G30.9	1.0000	<0.001	<0.001	>999.999
ICD10_DCOD F17.210 vs G30.9	1.0000	1.360	0.838	2.206
ICD10_DCOD F32.9 vs G30.9	1.0000	1.006	0.644	1.568
ICD10_DCOD F41.9 vs G30.9	1.0000	1.390	0.875	2.206
AGE	1.0000	1.053	1.045	1.061
GENDER Female vs Male	1.0000	1.303	1.046	1.623



4.6.H. The Effects of Specific PMACs on Most Prevalent Mechanisms of Injuries in the Target Patient Population.

a). The Effect of PMAC on Selected Fall and Exposure Injury (W01.0XXA).

As shown in table 20 below all the PMACs were significantly affecting the selected fall injury but gender (Female vs Male) had the highest predictive effect (OR=1.522) and P<0.0001 for females, followed by age (OR=1.047; P<0.0001). Alcohol use disorder and CVA vs major psychiatric illness had also affected the selected fall injury significantly with OR greater than 1 for both. The predicted probability graph indicated the risk for fall injury increased as age increased and female patients with substance use disorder (alcohol) and CVA had more predicted probability of fall(W01.0XXA) injury followed by female target patients with major psychiatric illness compared to the rest of the patients in this analysis, fig.16.

Table 20. The effect of PMAC on selected fall and exposure injury, NTDB 2016.

THE EFFECT OF PMAC ON FALL INJURIES, NTDB 2016

The LOGISTIC Procedure

Model Information	
Data Set	WORK.MECHLOGIT2
Response Variable	FALL
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	185078
Number of Observations Used	185078

Response Profile		
Ordered Value	FALL	Total Frequency
1	1	28078
2	0	157000

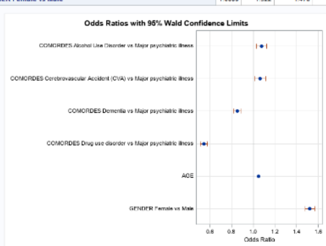
Probability modeled is FALL='1'.

Analysis of Maximum Likelihood Estimates						
Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-4.6251	0.0356	16878.0088	<.0001
COMORDES	Alcohol Use Disorder	1	0.2012	0.0165	147.7627	<.0001
COMORDES	Cerebrovascular Accident (CVA)	1	0.1874	0.0184	103.5524	<.0001
COMORDES	Dementia	1	-0.0330	0.0161	4.2031	0.0403
COMORDES	Drug use disorder	1	-0.4827	0.0234	426.3018	<.0001
AGE		1	0.0461	0.000526	7703.8749	<.0001
GENDER	Female	1	0.2099	0.00741	802.4807	<.0001

Fig.16. The predicted probabilities of the effects of PMACs on selected fall and exposure injury, NTDB 2016.

A.

Odds Ratio Estimates and Wald Confidence Intervals				
Effect	Unit	Estimate	95% Confidence Limits	
COMORDES Alcohol Use Disorder vs Major psychiatric illness	1.0000	1.077	1.032	1.124
COMORDES Cerebrovascular Accident (CVA) vs Major psychiatric illness	1.0000	1.062	1.014	1.112
COMORDES Dementia vs Major psychiatric illness	1.0000	0.852	0.820	0.885
COMORDES Drug use disorder vs Major psychiatric illness	1.0000	0.543	0.513	0.576
AGE	1.0000	1.047	1.046	1.048
GENDER Female vs Male	1.0000	1.522	1.478	1.566



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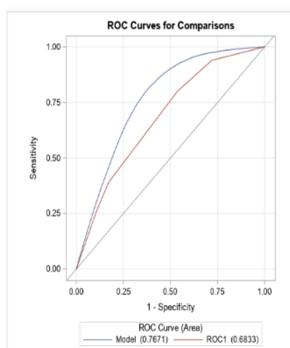

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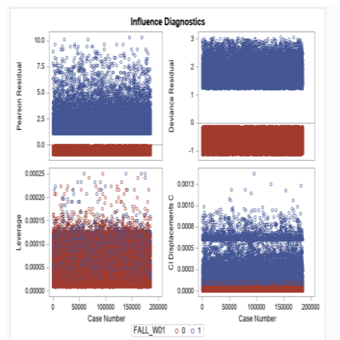

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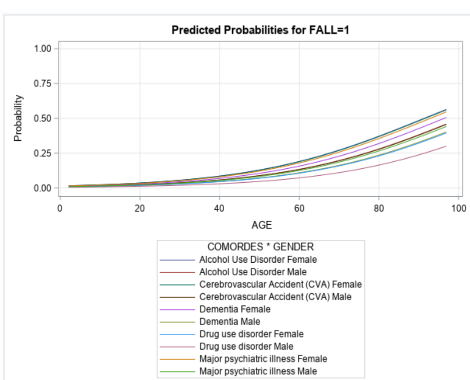

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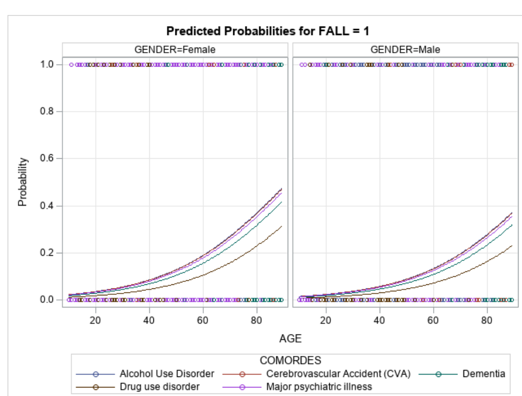


b). The Effect of PMAC on Selected Transport Accident Injury (V43.52XA).

Female vs male patients had a higher predictive effect of transport accident injury coded as V43.52XA (Car driver injured in collision with other type cars in a traffic accident, initial encounter) [OR=1.734; P<0.0001 for female, table 21]. Next to gender, age and drug use disorder vs major psychiatric illness had a higher influence on such accidents (OR=0.979 and 0.970 for age, and drug use disorder vs major psychiatric illness respectively). In contrast to the fall injury, the predicted probability graph showed the probability of injury decreased as age increased in transport accident injury (V43.52XA). Female patients with major psychiatric illness and drug use disorder had the highest and closely equal predicted probability for transport accident injury (V43.52XA) followed by female patients with CVA, fig. 17.

Table 21. The effect of PMAC on selected transport accident injuries, NTDB 2016.

THE EFFECT OF PMAC ON TRANSPORT ACCIDENT INJURIES, NTDB 2016

The LOGISTIC Procedure

Model Information	
Data Set	WORK.MECHLOGIT2
Response Variable	TRAN_ACC_V43
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	185078
Number of Observations Used	185078

Response Profile		
Ordered Value	TRAN_ACC_V43	Total Frequency
1	1	5629
2	0	179449

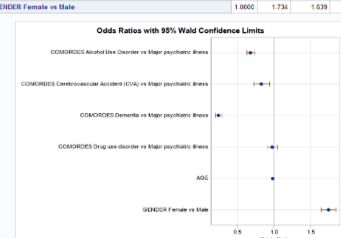
Probability modeled is TRAN_ACC_V43='1'.

Analysis of Maximum Likelihood Estimates						
Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-2.6267	0.0503	2727.7915	<.0001
COMORDES	Alcohol Use Disorder	1	0.0209	0.0384	0.2958	0.5865
COMORDES	Cerebrovascular Accident (CVA)	1	0.2134	0.0540	15.6146	<.0001
COMORDES	Dementia	1	-1.0285	0.0744	191.0975	<.0001
COMORDES	Drug use disorder	1	0.3819	0.0343	123.7963	<.0001
AGE		1	-0.0209	0.000801	679.7500	<.0001
GENDER	Female	1	0.2753	0.0144	363.6207	<.0001

Fig. 17. The predicted probabilities of the effects of PMACs on selected transport accident injuries, NTDB 2016.

A.

Odds Ratio Estimates and Wald Confidence Intervals				
Effect	Unit	Estimate	95% Confidence Limits	
COMORDES Alcohol Use Disorder vs Major psychiatric illness	1.0000	0.676	0.621	0.736
COMORDES Cerebrovascular Accident (CVA) vs Major psychiatric illness	1.0000	0.820	0.719	0.934
COMORDES Dementia vs Major psychiatric illness	1.0000	0.237	0.197	0.284
COMORDES Drug use disorder vs Major psychiatric illness	1.0000	0.970	0.908	1.036
AGE	1.0000	0.979	0.978	0.981
GENDER Female vs Male	1.0000	1.734	1.639	1.835



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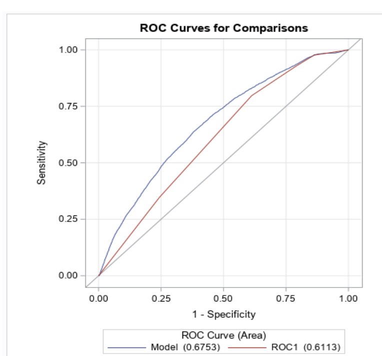

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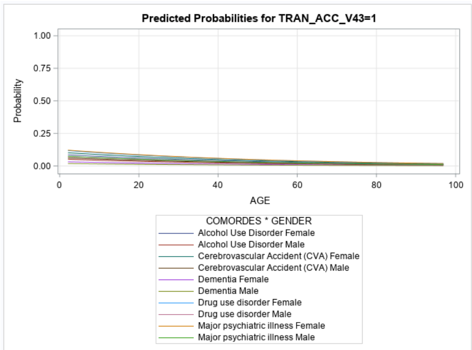

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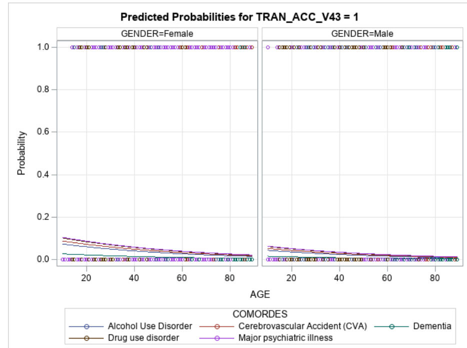


c). The Effect of PMAC on Second Selected Transport Accident Injury (V47.52XA).

In another transport accident injury coded V47.52XA (Driver of other types of car injured in collision with a fixed or stationary object in a traffic accident, initial encounter) PMAC showed a different effect. Alcohol use and drug use disorder vs major psychiatric illness had a higher predictive effect of injury (OR=1.320 and 1.330 respectively; P<0.0001 for both alcohol and drug, table 22) followed by gender (female vs male)[OR=1.308; P<0.0001 for female]. As in transport accident injury (V43.52XA) the probability of injury in transport accident injury (V47.52XA), decreased as age increased. But female patients with substance use disorder (drug and alcohol) had the highest and closely equal predicted probability for transport accident injury (V47.52XA) followed by female patients with major psychiatric illness, fig.18

Table.22. The effect of PMAC on selected transport accident injuries, NTDB 2016.

THE EFFECT OF PMAC ON TRANSPORT ACCIDENT INJURIES, NTDB 2016

The LOGISTIC Procedure

Model Information	
Data Set	WORK.MECHLOGIT2
Response Variable	TRAN_ACC_V47
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	185078
Number of Observations Used	185078

Response Profile		
Ordered Value	TRAN_ACC_V47	Total Frequency
1	1	3637
2	0	181441

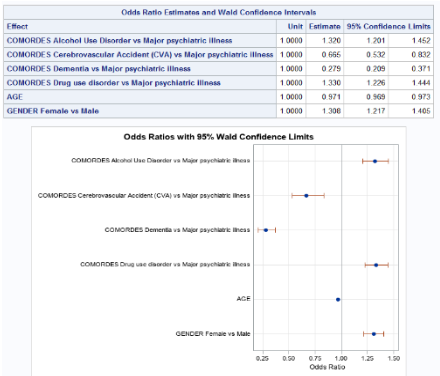
Probability modeled is TRAN_ACC_V47='1'.

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-2.7575	0.0675	1669.1248	<.0001
COMORDES	Alcohol Use Disorder	1	0.5025	0.0482	108.7214	<.0001
COMORDES	Cerebrovascular Accident (CVA)	1	-0.1831	0.0922	3.9422	0.0471
COMORDES	Dementia	1	-1.0538	0.1169	81.2901	<.0001
COMORDES	Drug use disorder	1	0.5099	0.0475	115.3376	<.0001
AGE		1	-0.0299	0.00106	799.8740	<.0001
GENDER	Female	1	0.1341	0.0183	53.7555	<.0001

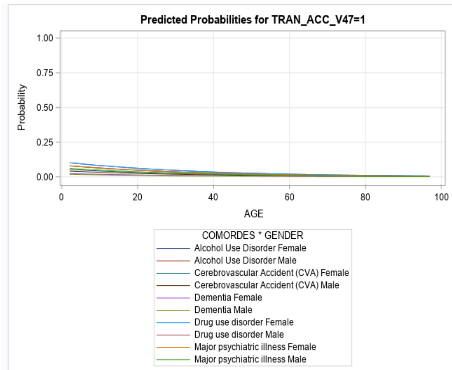
Fig. 18. The predicted probabilities of the effects of PMACs on selected transport accident injuries, NTDB 2016.

A.

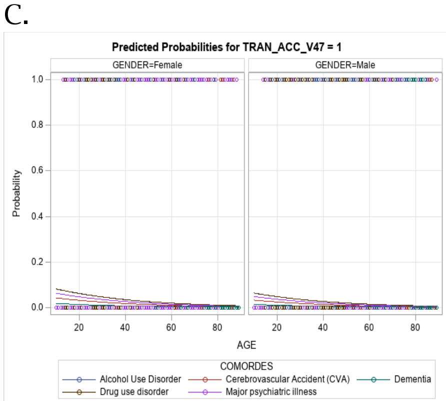


Odds Ratio Estimates and Wald Confidence Intervals				
Effect	Unit	Estimate	95% Confidence Limits	
COMORDES Alcohol Use Disorder vs Major psychiatric illness	1.0000	1.320	1.201	1.452
COMORDES Cerebrovascular Accident (CVA) vs Major psychiatric illness	1.0000	0.665	0.532	0.832
COMORDES Dementia vs Major psychiatric illness	1.0000	0.279	0.209	0.371
COMORDES Drug use disorder vs Major psychiatric illness	1.0000	1.330	1.226	1.444
AGE	1.0000	0.971	0.969	0.973
GENDER Female vs Male	1.0000	1.308	1.217	1.405

B.



C.



d). The Effect of PMAC on Selected Self-harm, Assault and Undetermined Intent Injuries (Y04.0XXA).

Alcohol and drug use disorders vs major psychiatric illness had a higher predictive effect on one selected assault injury coded as Y04.0XXA (assault by a blunt object, initial encounter) [OR=1.52 and 1.441 respectively; P<0.0001 for alcohol and drug use, table 23]. This effect was even higher than the effect on transport accidents described above. Gender (female vs male) had a lower predictive effect, in this case, OR=0.434. Per the predicted probabilities graph, as age increased the probability of getting such injury also decreased. Male patients with substance use disorder, both alcohol and drug (alcohol use slightly more than drug use) had the highest predicted probability for an assault injury (Y04.0XXA) followed by male patients with major psychiatric illness, fig.19.

Table 23. The effect of PMAC on selected self-harm, assault and undetermined intent injuries, NTDB 2016.

THE EFFECT OF PMAC ON SELF-HARM, ASSUALT AND UNDETERMINED INTENT INJURIES, NTDB 2016

The LOGISTIC Procedure

Model Information	
Data Set	WORK.MECHLOGIT2
Response Variable	HARM_Y04
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	185078
Number of Observations Used	185078

Response Profile		
Ordered Value	HARM_Y04	Total Frequency
1	1	5666
2	0	179412

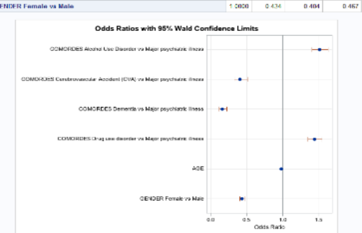
Probability modeled is HARM_Y04='1'.

Analysis of Maximum Likelihood Estimates						
Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-3.0407	0.0623	2383.6019	<.0001
COMORDES	Alcohol Use Disorder	1	0.8033	0.0448	321.5015	<.0001
COMORDES	Cerebrovascular Accident (CVA)	1	-0.5098	0.0949	28.8723	<.0001
COMORDES	Dementia	1	-1.4384	0.1263	129.6809	<.0001
COMORDES	Drug use disorder	1	0.7551	0.0456	274.5944	<.0001
AGE		1	-0.0233	0.000869	715.9279	<.0001
GENDER	Female	1	-0.4169	0.0186	504.2414	<.0001

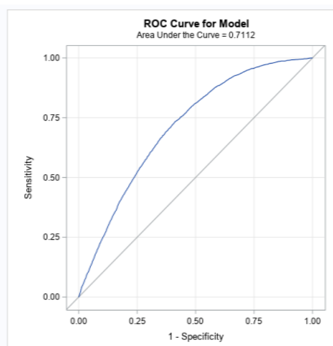
Fig.19. The predicted probabilities of the effects of PMACs on selected self-harm, assault and undetermined intent injuries, NTDB 2016.

A.

Odds Ratio Estimates and Wald Confidence Intervals				
Effect	Unit	Estimate	95% Confidence Limits	
COMORDES Alcohol Use Disorder vs Major psychiatric illness	1.0000	1.512	1.403	1.629
COMORDES Cerebrovascular Accident (CVA) vs Major psychiatric illness	1.0000	0.407	0.324	0.510
COMORDES Dementia vs Major psychiatric illness	1.0000	0.161	0.118	0.219
COMORDES Drug use disorder vs Major psychiatric illness	1.0000	1.441	1.346	1.543
AGE	1.0000	0.977	0.975	0.979
GENDER Female vs Male	1.0000	0.434	0.404	0.467



B.



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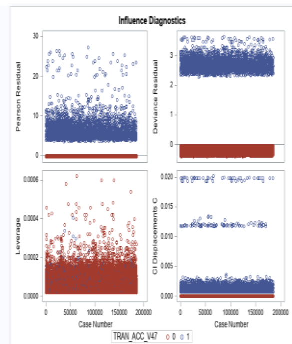

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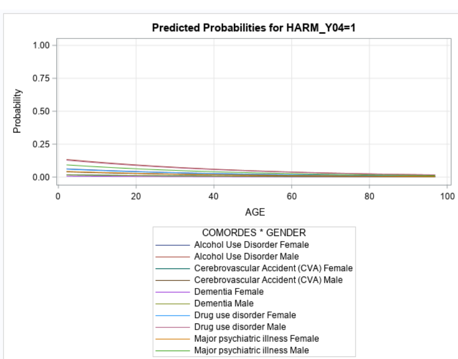
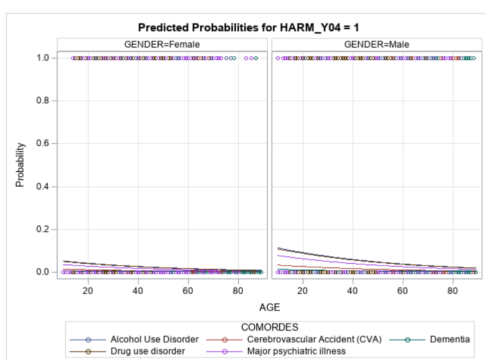


E.



e). The Effect of PMAC on Second Selected Self-harm, Assault and Undetermined Intent Injuries (X93.XXXA).

Drug use disorder vs major psychiatric illness had one of the highest predictive effects on assault injury coded as X93.XXA (assault by handgun discharge, initial encounter) [OR=4.032; p<0.0001 for drug, table 24] followed by alcohol use disorder vs major psychiatric illness (OR=1.410; P<0.0127 for alcohol). Age had also a significant effect on such injury OR= 0.945. The predicted probability indicted that male patients with drug use disorder had the highest probability of getting assault injury by handgun discharge (X93.XXXA) followed by male patients with alcohol use disorder and female patients with drug use disorder, but overall the probability of this kind of injury decreased as age increased for all PMACs, fig.20.

Table.24. The effect of PMAC on selected self-harm, assault and undetermined intent injuries, NTDB 2016.

THE EFFECT OF PMAC ON SELF-HARM, ASSUALT AND UNDETERMINED INTENT INJURIES, NTDB 2016

The LOGISTIC Procedure

Model Information	
Data Set	WORK.MECHLOGIT2
Response Variable	HARM_X93
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	185078
Number of Observations Used	185078

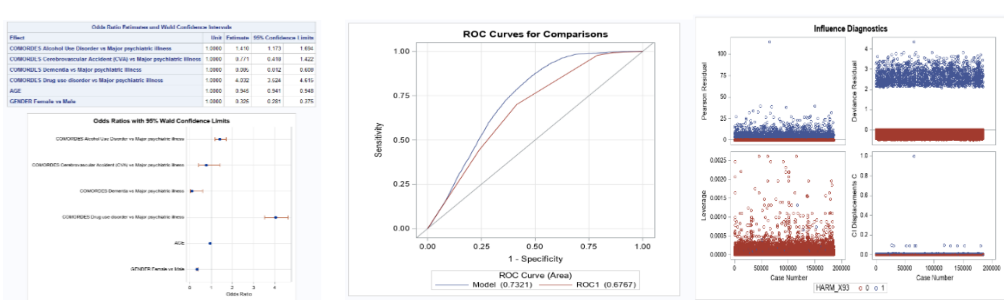
Response Profile		
Ordered Value	HARM_X93	Total Frequency
1	1	2027
2	0	183051

Probability modeled is HARM_X93='1'.

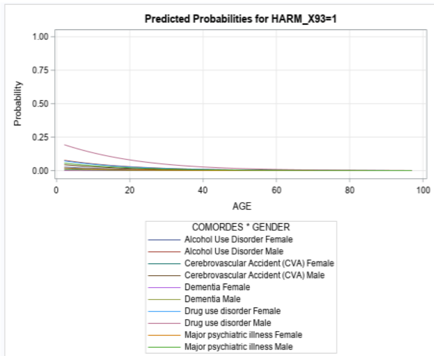
Analysis of Maximum Likelihood Estimates						
Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-3.4653	0.2291	228.8205	<.0001
COMORDES	Alcohol Use Disorder	1	0.5407	0.2170	6.2078	0.0127
COMORDES	Cerebrovascular Accident (CVA)	1	-0.0620	0.3150	0.0388	0.8439
COMORDES	Dementia	1	-2.2679	0.8035	7.9660	0.0048
COMORDES	Drug use disorder	1	1.5918	0.2133	55.7084	<.0001
AGE		1	-0.0567	0.00191	881.6119	<.0001
GENDER	Female	1	-0.5626	0.0368	233.9156	<.0001

Fig.20. The predicted probabilities of the effects of PMACs on selected self-harm, assault and undetermined intent injuries, NTDB 2016.

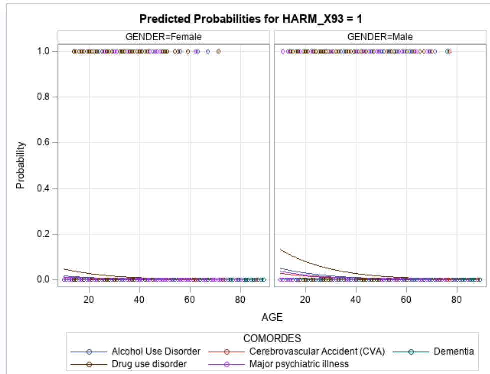
A. B. C.



D.



E.

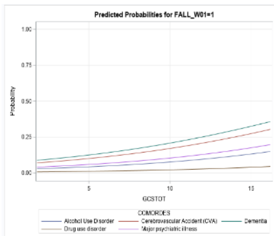


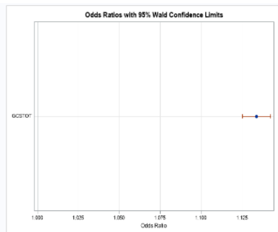
4.6.I. The Effects of GCS and PMAC on Selected Most Prevalent Mechanisms of Injuries in Target Patients.

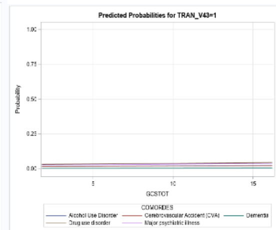
The analysis made to see the effects of PMAC in association with the patients' level of Glasgow coma scale (GCS) in target patients indicated a statically significant result (P<0.001) in all selected most prevalent mechanisms of injuries. The null hypothesis (H40) can be rejected that the Glasgow Coma Scale (GCS) actually has statistically significant effects on traumatic injuries in patients with PMAC. The probability of getting an injury in patients with selected fall and exposure injury (W01.0XXA) increased as total GCS (GCSTOT) score increased except for drug use disorder where the probability seemed almost constant as GCSTOT score increased. Overall GCSTOT had a significant predictive effect (OR=1.129) in association with PMAC on fall injury coded as W01.0XXA. GCS had a significant and wider predictive effect on self-harm, assault and undetermined intent injuries coded Y0.0XXA and X93.XXXA (OR=1.054 and 1.060 respectively, fig.21).

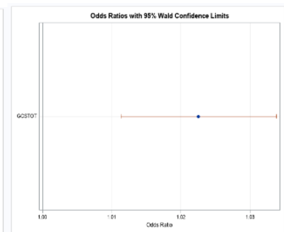
Figure.21. Predicted probability (1.a.) and odds ratio (1.b.) for fall and exposure injuries (W0.0XXA), predicted probability (2.a.) and odds ratio (2.b.) for transport accident injuries (V43.52XA), predicted probability (3.a.) and odds ratio (3.b.) for self-harm, assault and undetermined intent injuries (Y04.0XXA), predicted probability (4.a.) and odds ratio (4.b.) for self-harm, assault and undetermined intent injuries (X93.XXXA).

1.a. 1.b. 2.a. 2.b.

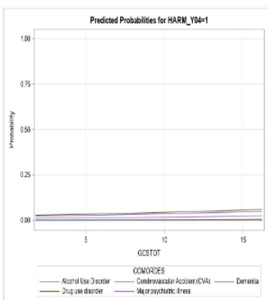


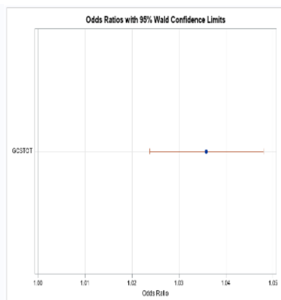


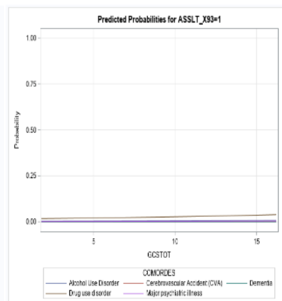


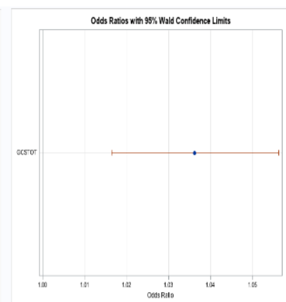


3.a 3.b. 4.a. 4.b.









4.6.J. The Effect of GCS on Selected Most Prevalent Mechanisms of Injuries in Control Patients.

The Total Glasgow Coma Scale (GCSTOT) had a statistically significant effect on the selected most prevalent mechanisms of injuries in control patients (P<0.0001). The difference with target patients was that it had a slightly higher predictive effect in the selected fall and exposure injury (W01.0XXA) (OR=1.163) but had a lower predictive effect in the rest of the traumatic injuries as evidenced by odds ratio less than 1 (OR=0.926) in a traumatic injury coded as X93.XXXA (assault by handgun discharge, initial encounter). See fig. 22 below.

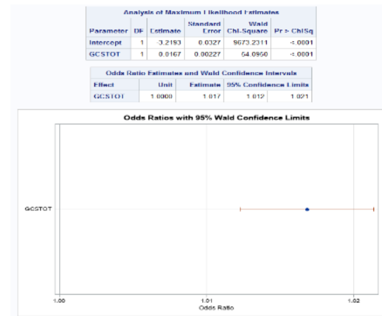
Figure.22. The effect of GCS on selected most prevalent mechanisms of injury in control patients, odds ratio for (a) fall and exposure injury (W01.0XXA), (b) transport accident injury (V43.52XA) (c) self-harm, assault and undetermined intent injury (X93.XXXA).

a.

Analysis of Maximum Likelihood Estimates					
Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-4.1761	0.0376	12306.4476	<.0001
GCSTOT	1	0.1506	0.00256	3467.5468	<.0001

Odds Ratio Estimates and Wald Confidence Intervals				
Effect	Unit	Estimate	95% Confidence Limits	
GCSTOT	1.0000	1.163	1.157	1.168

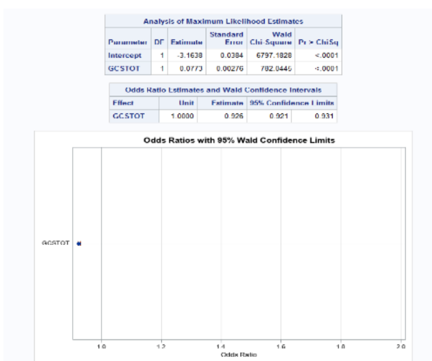
b.



Analysis of Maximum Likelihood Estimates					
Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-3.2193	0.0327	9673.2311	<.0001
GCSTOT	1	0.0167	0.00227	54.0950	<.0001

Odds Ratio Estimates and Wald Confidence Intervals				
Effect	Unit	Estimate	95% Confidence Limits	
GCSTOT	1.0000	1.017	1.012	1.021

c.



Analysis of Maximum Likelihood Estimates					
Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-3.1638	0.0384	6797.1828	<.0001
GCSTOT	1	0.0773	0.00276	782.0445	<.0001

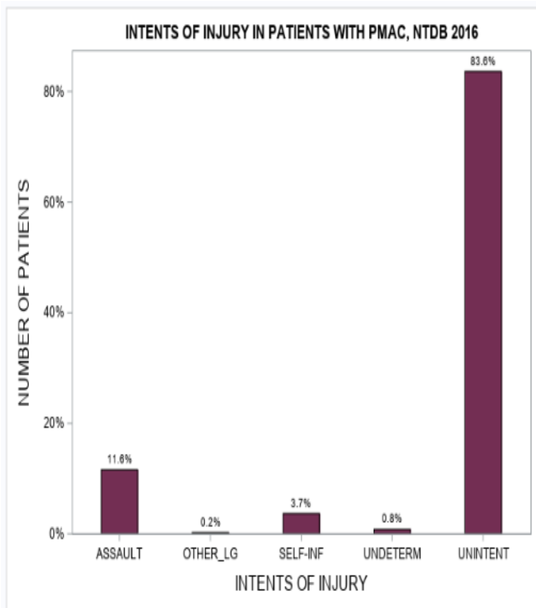
Odds Ratio Estimates and Wald Confidence Intervals				
Effect	Unit	Estimate	95% Confidence Limits	
GCSTOT	1.0000	0.926	0.921	0.931

5. The Intents of Injuries

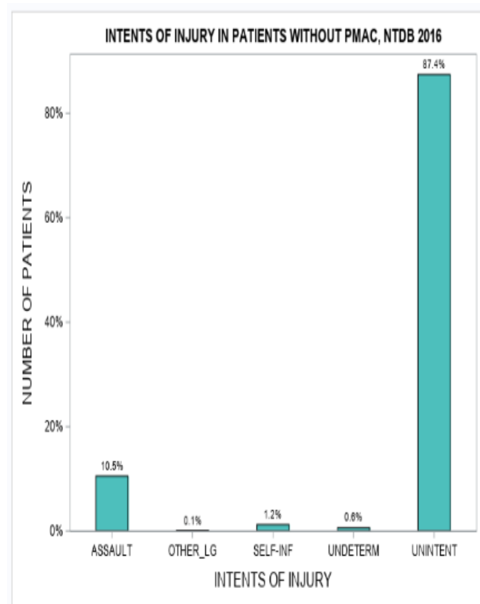
The CDC external causes of injury matrices classified the intents of injuries into five: 1) Unintentional 2) Self-inflicted (Suicidal 3) Assault (homicidal) (4) Undetermined and (5) Other/ Legal Intervention or War[64]. This classification was adopted and applied to the analysis in this section. Unintentional injuries comprised the higher percentage of patients in both target and control patients: target (83.6%) and control (87.4%). Overall, target patients had some higher percentages in all other classifications compared to the control patients. See figure.23.

Figure.23. The intents of injuries in target patients (a) and control patients (b), NTDB 2016.

a. The intents of injuries in targets



b. The intents of injuries in controls



5.A. **Comparison of the Intents of Injuries Between Target and Control Patients.**

The equality of the proportions of the intents of injuries between the target and control patient was done by statistically testing the proportion of the patients that were listed in each of the five classifications of the intents of injuries from both the target and control patient population. The small p-value (P<0.0001, table 25) in the result of the statistics indicated the null hypothesis (H40) of no significant difference in the intention of injuries in patients with PMAC and patients without PMAC could be rejected and this implies there exists a statistically significant difference in the intention of injuries in patients with PMAC and patients without PMAC.

Table.25. Frequency and statistics for comparison of the proportion of the intents of injuries in target and control patients, NTDB 2016.

Table of INTENTS by RESPONSE

Frequency Percent Row Pct Col Pct	RESPONSE		
INTENTS	YES	NO	Total
PMAC_UNI	15311 0.30 7.63 2.01	185389 3.59 92.37 4.21	200700 3.89
PMAC_SLF	6760 0.13 3.37 0.89	193940 3.76 96.63 4.40	200700 3.89
PMAC_ASS	21258 0.41 10.59 2.79	179442 3.47 89.41 4.08	200700 3.89
PMAC_UND	1515 0.03 0.75 0.20	199185 3.86 99.25 4.52	200700 3.89
PMAC_OLG	420 0.01 0.21 0.06	200280 3.88 99.79 4.55	200700 3.89
WOPMAC_U	630690 12.21 37.89 82.84	1033748 20.02 62.11 23.48	1664438 32.23
WOPMAC_S	8885 0.17 1.07 1.17	823334 15.94 98.93 18.70	832219 16.11
WOPMAC_A	75456 1.46 9.07 9.91	756763 14.65 90.93 17.19	832219 16.11
WOPMAC_O	1025 0.02 0.12 0.13	831194 16.09 99.88 18.88	832219 16.11
Total	761320 14.74	4403275 85.26	5164595 100.00

Statistics for Table of INTENTS by RESPONSE

Statistic	DF	Value	Prob
Chi-Square	8	1092856	<.0001
Likelihood Ratio Chi-Square	8	1163684	<.0001
Mantel-Haenszel Chi-Square	1	32708	<.0001
Phi Coefficient		0.46001	
Contingency Coefficient		0.41791	
Cramer's V		0.46001	

5.B. The Effects of PMAC and Other Covariates on the Intents of Injuries in Target Patients.

I. List of Most Frequent Intents of Injuries in Target Patients.

Table 26 below enlisted the twenty-five most frequent intents of injuries in target patients. Unintentional fall injuries held the first few upper ranks in the list followed by assault (Y04.0XXA) and then another mechanism of unintentional injury (transport accident injury) V43.52XA.

Table.26. The first twenty-five most frequent intents of injuries in target patients, NTDB 2016.

MOST FREQUENT INTENTS OF INJURY IN TARGET PATIENTS, NTDB 2016

The FREQ Procedure

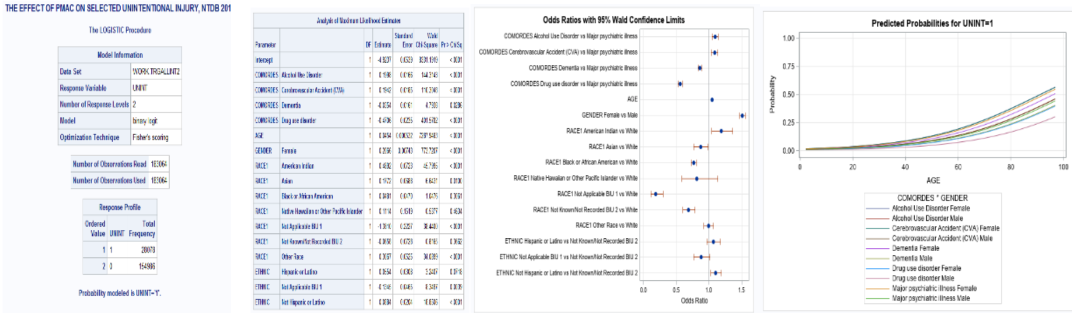
ICD10_PRIM				
ICD10_PRIM	Frequency	Percent	Cumulative Frequency	Cumulative Percent
W01.0XXA	28078	15.34	28078	16.34
W19.XXXA	12429	6.79	40507	22.13
W10.8XXA	7534	4.12	48041	26.24
W18.30XA	7445	4.07	55486	30.31
Y04.0XXA	5666	3.10	61152	33.40
V43.52XA	5629	3.07	66781	36.48
W18.39XA	5283	2.89	72064	39.37
W06.XXXA	4550	2.49	76614	41.85
W01.198A	4231	2.31	80845	44.16
V03.10XA	3800	2.08	84645	46.24
V47.52XA	3637	1.99	88282	48.22
X99.1XXA	2952	1.61	91234	49.84
V48.5XXA	2925	1.60	94159	51.44
Y00.XXXA	2731	1.49	96890	52.93
W01.10XA	2685	1.47	99575	54.39
W17.89XA	2673	1.46	102248	55.85
W10.9XXA	2637	1.44	104885	57.29
W11.XXXA	2355	1.29	107240	58.58
X95.9XXA	2245	1.23	109485	59.81
W05.0XXA	2145	1.17	111630	60.98
X93.XXXA	2027	1.11	113657	62.09
X78.1XXA	1993	1.09	115650	63.17
V43.62XA	1905	1.04	117555	64.22
W07.XXXA	1871	1.02	119426	65.24
W01.190A	1819	0.99	121245	66.23

II. Analysis of the Effects of PMAC and Other Covariates on the Intents of Injuries in Target Patients.

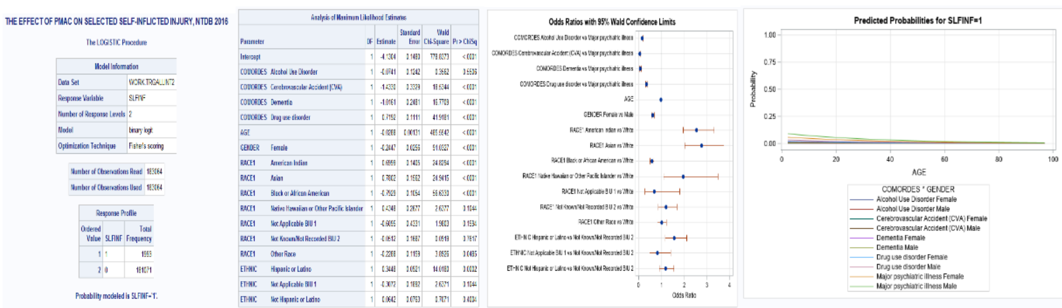
The multiple logistic regression analysis results indicated that gender (female vs male) had a higher predictive effect on unintentional injury coded as W01.0XXA in target patients [OR (female vs male) = 1.512; P<0.0001 for female]. Alcohol use disorder, CVA vs major psychiatric illness and age had a higher predictive effect next to gender with OR= 1.092, 1086 and 1.046 respectively, P<0.0001 for all. The PMACs had odds ratios less than 1 for a single self-inflicted diagnosis (X78.1XXA) analyzed but the figure might be different if more diagnosis of self-inflicted injuries got analyzed. The predicted probability graph shows that the chance of getting the unintentional injury (W01.0XXA) increased as age increased but this trend was the reverse for self-inflicted and assault injuries analyzed, table 27.

Table 27. The effects of PMAC and other covariates on the intents of injury in target patients (a) unintentional (b) self-inflicted (c) assault, NTDB 2016.

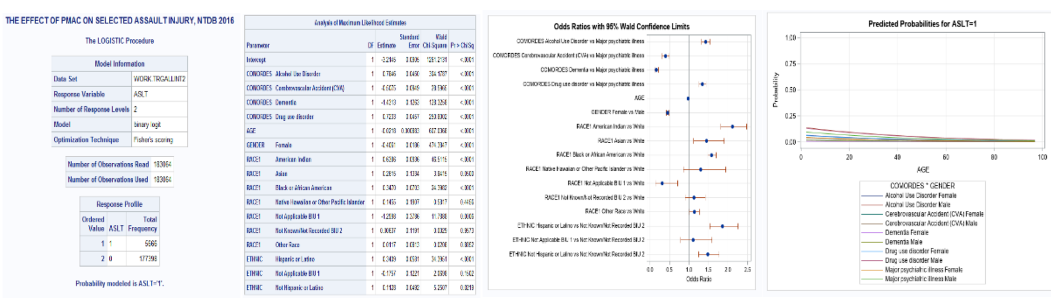
a. Unintentional Injury (W01.0XXA)



b. Self-inflicted Injury (X78.1XXA)



c. Assault Injury (Y04.0XXA)



5.C. The Effects of the Covariates on the Intents of Injuries in Control Patients.

I. List of Most Frequent Intents of Injuries in Control Patients.

Unintentional fall injury (W01.0XXA) was at number one in the list of the first twenty-five most frequent intents of injuries in control patients. But unlike the target patients, the second list was taken by unintentional transport accident injury (V43.52XA) and then followed by some more Unintentional fall injuries and few assault injuries, table 28.

Table 28. The first twenty-five most frequent intents of injuries in target patients, NTDB 2016.

MOST FREQUENT INTENTS OF INJURY IN TARGET PATIENTS, NTDB 2016

The FREQ Procedure

ICD10_PRIM				
ICD10_PRIM	Frequency	Percent	Cumulative Frequency	Cumulative Percent
W01.0XXA	28078	15.34	28078	15.34
W19.XXXA	12429	6.79	40507	22.13
W10.8XXA	7534	4.12	48041	26.24
W18.30XA	7445	4.07	55486	30.31
Y04.0XXA	5666	3.10	61152	33.40
V43.52XA	5629	3.07	66781	36.48
W18.39XA	5283	2.89	72064	39.37
W06.XXXA	4550	2.49	76614	41.85
W01.198A	4231	2.31	80845	44.16
V03.10XA	3800	2.08	84645	46.24
V47.52XA	3637	1.99	88282	48.22
X99.1XXA	2952	1.61	91234	49.84
V48.5XXA	2925	1.60	94159	51.44
Y00.XXXA	2731	1.49	96890	52.93
W01.10XA	2685	1.47	99575	54.39
W17.89XA	2673	1.46	102248	55.85
W10.9XXA	2637	1.44	104885	57.29
W11.XXXA	2355	1.29	107240	58.58
X95.9XXA	2245	1.23	109485	59.81
W05.0XXA	2145	1.17	111630	60.98
X93.XXXA	2027	1.11	113657	62.09
X78.1XXA	1993	1.09	115650	63.17
V43.62XA	1905	1.04	117555	64.22
W07.XXXA	1871	1.02	119426	65.24
W01.190A	1819	0.99	121245	66.23

II. Analysis of the Effects of the Covariates on the Intents of Injuries in Control Patients.

In control patients, gender (female vs male) had the highest predictive effect on unintentional fall injury selected for the analysis (W01.0XXA) OR (female vs male) =1.931, $P<0.0001$ for female, followed by age (OR=1.049). Both gender and age had less than 1 odds ratio in self-inflicted and assault intents and their influence was thought to be minimal. There were some racial and ethnic influences but didn't go into deep analysis in this regard as this could be from the disparity of the proportion of patients from each of these races and ethnics.

Table 29. The effects of PMAC and other covariates on the intents of injury in target patients (a) unintentional (b) self-inflicted (c) assault, NTDB 2016 (multiple logistic regression analysis).

a. Unintentional Injury (W01.0XXA)

THE EFFECTS OF COVARIATES ON UNINTENTIONAL INJURIES IN CONTROL PATIENTS, NTDB 2016

The LOGISTIC Procedure

Model Information	
Data Set	WORK.COTLAINT2
Response Variable	UNINTL
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

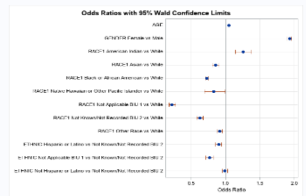
Number of Observations Read	716056
Number of Observations Used	716056

Response Profile		
Ordered Value	UNINTL	Total Frequency
1	1	87675
2	0	628381

Probability modeled is UNINTL='1'.

Analysis of Maximum Likelihood Estimates						
Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-5.1504	0.0243	45037.2764	<.0001
AGE		1	0.0479	0.000229	43843.4776	<.0001
GENDER	Female	1	0.3289	0.00401	6729.1544	<.0001
RACE1	American Indian	1	0.5407	0.0445	147.4392	<.0001
RACE1	Asian	1	0.1591	0.0312	25.9849	<.0001
RACE1	Black or African American	1	-0.00808	0.0230	0.1231	0.7257
RACE1	Native Hawaiian or Other Pacific Islander	1	0.1271	0.0815	2.4306	0.1190
RACE1	Not Applicable BIU 1	1	-1.2017	0.0910	174.3720	<.0001
RACE1	Not Known/Not Recorded BIU 2	1	-0.1574	0.0369	18.1723	<.0001
RACE1	Other Race	1	0.2258	0.0258	76.8106	<.0001
ETHNIC	Hispanic or Latino	1	-0.0115	0.0158	0.5337	0.4651
ETHNIC	Not Applicable BIU 1	1	-0.1703	0.0239	50.7192	<.0001
ETHNIC	Not Hispanic or Latino	1	0.0853	0.0105	65.9674	<.0001

Odds Ratio Estimates and Wald Confidence Intervals				
Effect	Unit	Estimate	95% Confidence Limits	
AGE	1.0000	1.049	1.049	1.050
GENDER Female vs Male	1.0000	1.931	1.901	1.961
RACE1 American Indian vs White	1.0000	1.264	1.144	1.374
RACE1 Asian vs White	1.0000	0.856	0.809	0.905
RACE1 Black or African American vs White	1.0000	0.724	0.703	0.746
RACE1 Native Hawaiian or Other Pacific Islander vs White	1.0000	0.829	0.693	0.992
RACE1 Not Applicable BIU 1 vs White	1.0000	0.220	0.179	0.269
RACE1 Not Known/Not Recorded BIU 2 vs White	1.0000	0.624	0.581	0.670
RACE1 Other Race vs White	1.0000	0.915	0.879	0.952
ETHNIC Hispanic or Latino vs Not Known/Not Recorded BIU 2	1.0000	0.898	0.855	0.943
ETHNIC Not Applicable BIU 1 vs Not Known/Not Recorded BIU 2	1.0000	0.766	0.714	0.821
ETHNIC Not Hispanic or Latino vs Not Known/Not Recorded BIU 2	1.0000	0.989	0.963	1.026



b. Self-inflicted Injury (X78.1XXA)

THE EFFECTS OF COVARIATES ON SELF-INFLICTED INJURIES IN CONTROL PATIENTS, NTDB 2016

The LOGISTIC Procedure

Model Information	
Data Set	WORK.COTLAINT2
Response Variable	SLFINF
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	716056
Number of Observations Used	716056

Response Profile		
Ordered Value	SLFINF	Total Frequency
1	1	2162
2	0	713894

Probability modeled is SLFINF='1'.

Analysis of Maximum Likelihood Estimates						
Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-5.0168	0.0816	3781.0684	<.0001
AGE		1	-0.0167	0.00103	260.0532	<.0001
GENDER	Female	1	-0.1544	0.0245	39.7389	<.0001
RACE1	American Indian	1	1.0994	0.1261	76.0111	<.0001
RACE1	Asian	1	0.3511	0.1306	7.2292	0.0072
RACE1	Black or African American	1	-0.7533	0.0898	70.3071	<.0001
RACE1	Native Hawaiian or Other Pacific Islander	1	0.3996	0.2592	2.3770	0.1231
RACE1	Not Applicable BIU 1	1	-0.7719	0.3102	6.1945	0.0128
RACE1	Not Known/Not Recorded BIU 2	1	-0.1162	0.1573	0.5462	0.4599
RACE1	Other Race	1	-0.1134	0.0977	1.3480	0.2456
ETHNIC	Hispanic or Latino	1	0.1003	0.0742	1.8282	0.1763
ETHNIC	Not Applicable BIU 1	1	-0.0323	0.1362	0.0562	0.8126
ETHNIC	Not Hispanic or Latino	1	0.0932	0.0590	2.4938	0.1143

Odds Ratio Estimates and Wald Confidence Intervals				
Effect	Unit	Estimate	95% Confidence Limits	
AGE	1.0000	0.983	0.981	0.985
GENDER Female vs Male	1.0000	0.734	0.667	0.808
RACE1 American Indian vs White	1.0000	3.302	2.575	4.234
RACE1 Asian vs White	1.0000	1.562	1.206	2.024
RACE1 Black or African American vs White	1.0000	0.518	0.447	0.599
RACE1 Native Hawaiian or Other Pacific Islander vs White	1.0000	1.640	0.927	2.901
RACE1 Not Applicable BIU 1 vs White	1.0000	0.508	0.255	1.012
RACE1 Not Known/Not Recorded BIU 2 vs White	1.0000	0.979	0.706	1.359
RACE1 Other Race vs White	1.0000	0.982	0.828	1.164
ETHNIC Hispanic or Latino vs Not Known/Not Recorded BIU 2	1.0000	1.299	1.003	1.682
ETHNIC Not Applicable BIU 1 vs Not Known/Not Recorded BIU 2	1.0000	1.138	0.754	1.716
ETHNIC Not Hispanic or Latino vs Not Known/Not Recorded BIU 2	1.0000	1.290	1.024	1.624

c. Assault Injury (Y04.0XXA)

THE EFFECTS OF COVARIATES ON ASSAULT INJURIES IN CONTROL PATIENTS, NTDB 2016

The LOGISTIC Procedure

Model Information	
Data Set	WORK.COTLAINT2
Response Variable	ASLT
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

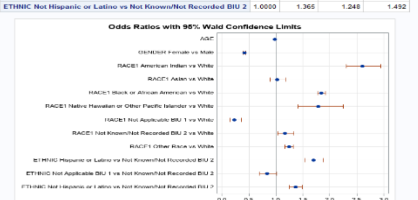
Number of Observations Read	716056
Number of Observations Used	716056

Response Profile		
Ordered Value	ASLT	Total Frequency
1	1	15610
2	0	700446

Probability modeled is ASLT='1'.

Analysis of Maximum Likelihood Estimates						
Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-3.2258	0.0410	6188.2065	<.0001
AGE		1	-0.0223	0.000427	2729.3522	<.0001
GENDER	Female	1	-0.4390	0.0110	1586.9069	<.0001
RACE1	American Indian	1	0.8221	0.0638	166.1953	<.0001
RACE1	Asian	1	-0.1115	0.0703	2.5208	0.1124
RACE1	Black or African American	1	0.4758	0.0382	154.9503	<.0001
RACE1	Native Hawaiian or Other Pacific Islander	1	0.4426	0.1084	16.6650	<.0001
RACE1	Not Applicable BIU 1	1	-1.5992	0.2009	63.3432	<.0001
RACE1	Not Known/Not Recorded BIU 2	1	0.0223	0.0649	0.1186	0.7305
RACE1	Other Race	1	0.0829	0.0439	3.5643	0.0590
ETHNIC	Hispanic or Latino	1	0.3651	0.0307	141.4318	<.0001
ETHNIC	Not Applicable BIU 1	1	-0.3450	0.0646	28.4792	<.0001
ETHNIC	Not Hispanic or Latino	1	0.1454	0.0259	31.4137	<.0001

Odds Ratio Estimates and Wald Confidence Intervals				
Effect	Unit	Estimate	95% Confidence Limits	
AGE	1.0000	0.978	0.977	0.979
GENDER Female vs Male	1.0000	0.416	0.398	0.434
RACE1 American Indian vs White	1.0000	2.604	2.305	2.942
RACE1 Asian vs White	1.0000	1.024	0.891	1.176
RACE1 Black or African American vs White	1.0000	1.842	1.772	1.914
RACE1 Native Hawaiian or Other Pacific Islander vs White	1.0000	1.782	1.411	2.250
RACE1 Not Applicable BIU 1 vs White	1.0000	0.231	0.148	0.362
RACE1 Not Known/Not Recorded BIU 2 vs White	1.0000	1.170	1.033	1.326
RACE1 Other Race vs White	1.0000	1.243	1.168	1.323
ETHNIC Hispanic or Latino vs Not Known/Not Recorded BIU 2	1.0000	1.700	1.540	1.876
ETHNIC Not Applicable BIU 1 vs Not Known/Not Recorded BIU 2	1.0000	0.836	0.693	1.007
ETHNIC Not Hispanic or Latino vs Not Known/Not Recorded BIU 2	1.0000	1.365	1.248	1.492



CHAPTER V

DISCUSSIONS

The age and gender distribution of traumatic injuries in target patients were so different that younger male patients suffered more injuries than their female counterparts. Traumatic injuries in younger male patients trended up until age 50-59 but after this age, the injuries started to trend down. This phenomenon took a different course in female target patients that fewer female patients than their male counterparts had traumatic injuries at their younger age but at age 50-59 the traumatic injuries in female target patients started to trend up oppositely to the male target patients to be ended up being at its highest level at age 80-89. This finding would indicate that a greater number of older female target patients were associated with getting traumatic injuries than older male patients and this difference was very significant.

The studies consulted so far had a mixed stand with the trend of the age distribution of traumatic injuries. There was a report that states elderly trauma patients, compared with a younger cohort, suffer more significant injuries for a given mechanism of injury[3] but it failed to indicate the differences in the trends of gender distribution. Another study explains that in all regions of the world injury rates are much higher in men than in women except for the 80 years and older age group where the sex differential largely disappears[37]. But our finding indicated a major difference in the age distribution of traumatic injuries among the target patients that as age increased more female patients had suffered from traumatic injuries than the male patients.

Fall on the same level from slipping, tripping and stumbling without subsequent striking against an object, initial encounter coded as W01.0XXA was the most prevalent mechanism (cause) of injury in both the target and control patient population (16.49% and13.06% respectively). The higher percentage in the target patients signifies that patients with PMAC could have a balancing issue to stabilize themselves that they could easily fall on the same level without the exertion of much external forces. The mechanisms of injury frequency table indicated that the target patients were suffering from subsequent fall injuries at a higher percentage compared to the control patients and this indicated that PMACs had an impact in predisposing the target patients to fall injuries.

The global burden of injury report in 2013 described fall (11.6%) as the third mechanism of death from injury next to road injury (29.1%) and self-harm (17.6%) in the general population[37]. Some more studies described fall as a more common mechanism of injuries and a particular challenge of the elderly, but they revealed the information on the whole patterns of injuries was limited[32,43]. There existed another general report that states patients with injuries had a higher co-morbidity index than the non-injured and most of those injured patients claimed pre-existing mental illness[57]. Our result strengthens this last statement that the pre-existing mental altering co-morbidities had increased the risk of getting fall injuries in the target patients.

Based on frequency distribution of the PMACs, major psychiatric illness was more prevalent, table 9. The database in use failed to enlist all the ICD10 diagnosis code of the PMACs but the analysis made from the available documentation indicated that patients with major depressive disorder, single episode (F32.9) comprised (24.5%) [the highest percentage], anxiety disorder (F41.9) (15.0%) and alcohol abuse with intoxication (F10.129) (14%) of the PMAC disorders/illnesses. Generally, the data for the target patients came from two different cohorts, substance use (alcohol and drug), major psychiatric illness in one group and CVA, dementia on in the other group. A cumulative logistic analysis for each of these groups indicated that these disorders/illnesses had a significant effect on all mechanisms of injuries but CVA vs Dementia had a higher predictive effect on injuries (OR=1.397; 95%CI=1.325-1.474). Apart from the cohort subgrouping patients could have any sort of multiple PMACs at the same time and in some cases having such disorders resulted in augmenting the risk for traumatic injuries. As already seen in the results target patients who had the major psychiatric illness and substance use disorder (drug and alcohol) experienced an elevated predicted probability (statistically significant, P<0.0001) for injuries related to falls, transport accident and self-harm and assault compared to the rest of the target patients. Patients who had the disorders of substance use at the same time (drug and alcohol) even had a more elevated predicted probability (statistically significant, P<0.0001) for the traumatic injuries said above. This was in line with the studies that reported the association of both alcohol and other drugs may be stronger for intentional injuries and a high frequency of alcohol was found in victims of road traffic accidents[30,33].

Male target patients had more prevalence of substance use disorders (drug and alcohol) Male: drug (18.78), alcohol (14.21%). Female: drug (5.86%), alcohol (3.46%). On the other hand, female target patients had more prevalence of major psychiatric illness than males, females (20.02%) and male (17.15%). But contrary to the differences in prevalence the female target patients with a lower prevalence of substance use disorders (drug and alcohol) than the male target patients had a more predicted probability of fall (W01.0XXA) followed by the female patients with major psychiatric illness. This differs from the report that states psychiatric patients are at greater risk for all-cause mortality and traumatic injury[56]. The predicted probability for transport accident coded as V47.52XA (Driver of other type car injured in collision with fixed or stationary object in traffic accident, initial encounter) was exactly similar to fall (W01.0XXA) that female target patients with substance use disorders (drug and alcohol) were sustaining transport accident (V47.52XA) than male target patients followed by the females with major psychiatric illness. As described above male target patients had a higher prevalence of substance use disorders (drug and alcohol) and male target patients with drug use disorder had a higher predicted probability for assault injury coded as X93.XXA (assault by handgun discharge, initial encounter) followed by male target patients with alcohol use disorder (second place) and female target patients with drug use disorder (third place). It is possible to see that target patients with substance use disorders (drug and alcohol) and major psychiatric illnesses had been having a higher probability of getting injuries.

The specific ICD-10 code that was documented in the NTDB database wasn't exhaustively listed all the specific PMACs documented but based on the data available perhaps target patients with drug use disorder may have specific problems of cannabis abuse, uncomplicated (F12.10)or cocaine abuse, uncomplicated (F14.10), and target patients with alcohol use disorder may have specific problems of alcohol abuse with intoxication (F10.129) or alcohol abuse, uncomplicated (F10.10), and target patients with major psychiatric illness may have specific problems of major depressive disorder (F32.9) or a major anxiety disorder (F41.9). This must be substantiated with a well-designed prospective study listing multiple specific PMACs with the goals of designing injury risk screening programs that will enhance traumatic injury prevention initiatives. The target patients had more percentages of all the matrices of injury intents even though the differences in percentages seemed to be small but statistically significant ($P<0.0001$) except for unintentional intents where the control patients scored higher percentage. The big difference in percentages between the target and control patients regarding the intents of injury noticed in self-inflicted injuries (difference of 2.5%) indicating more target patients were sustaining such injuries compared to the control patients.

CHAPTER VI

LIMITATIONS AND FURTHER SCOPE OF THE RESEARCH

6.1. LIMITATIONS OF THE STUDY

1. The Glasgow coma scale score used in this analysis was just to compare the differences as the scores decrease and increase. Otherwise, it is difficult to know if the lower scores were from some head injuries to the patients or as a result of the pre-existing mental altering co-morbidity.
2. Many other co-morbidities would lead to mental alteration. This study analyzed the limited number of pre-existing mental altering co-morbidities reported in the NTDB dataset. Considering all the co-morbidities that could be the etiology for altered mental status would let us establish a larger baseline data.
3. The NTDB dataset captured only a few specific ICD-10 diagnosis codes of PMCs and it was impossible to analyze the relationship of the specific PMCs to the most common MOIs.

6.2. FUTURE RESEARCH AND RECOMMENDATION

The existing studies are based on either a small number of patients or specific institution data. Therefore, future researches may need to be carried out using patient data representing a larger population and multiple comorbidities that possibly predispose the patients to have traumatic injuries and would be better if done in a prospective design. A plan is underway to carry out a related study to see the effect of PMCs on the severity of injuries, patient's hospital length of stay (LOS) and the costs these disorders incur on the patients' hospital care. The fact that traumatic injuries were more prevalent in female target patients even when they had a lower prevalence of some PMACs would remain an important point of future investigation.

6.3. CONCLUSIONS

To my knowledge, this study is the first to compare multiple causes of AMS in trauma patients all at the same time using a larger national database and created baseline information on which to prioritize care and services at any level. In this study male target patients were found to have a higher percentage of substance use disorders (drug and alcohol), even higher than the national figures reported so far. But the female target patients seemed to have lower percentages of disorders such as substance abuse (drug and alcohol) compared to the male counterparts, however, more old age female patients were affected by traumatic injuries (esp. fall injuries) than their male counterparts and the logistic regression analysis indicated over all the female target patients had a higher predicted probability for fall and exposure and even for other injuries including transport accidents, and assault injuries. The gender difference for females having a higher prevalence of traumatic injuries, in this case, was noticeable that no current literature reported such difference. A more structured prospective study on the most common PMACs [perhaps Major depressive, Anxiety, substance use (drug and alcohol) disorders and age-related comorbidities including CVA and dementia] and MOI needs to be carried out to design an effective preventive mechanism in the community or facilities (e.g. trauma risk screening programs, dedicated specific helplines, change in driving license issuing and weapons ownership policies).

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