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Healthcare Utilization for Behavioral Health Disorders: Policy Implications on Nationwide Readmissions, and Outcomes in the States of Nebraska and New York

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HEALTHCARE UTILIZATION FOR BEHAVIORAL HEALTH DISORDERS: POLICY IMPLICATIONS ON NATIONWIDE READMISSIONS, AND OUTCOMES IN THE STATES OF NEBRASKA AND NEW YORK

By

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ABSTRACT

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The main goal of this dissertation was to estimate national-level inpatient readmissions and state-level hospital-based emergency department (ED) visits with behavioral health (BH) conditions in the states of Nebraska and New York. The dissertation aims to assess the impact of the policy mandates under the Patient Protection and Affordable Care Act on these state and national estimates. The Nationwide Readmissions Database and the State Emergency Department databases maintained by the Healthcare Cost and Utilization Project were used for this dissertation. US Adult population with high-risk of readmissions in the inpatient departments for alcohol-related disorders (ARD) and of visiting ED for BH conditions were identified. Prediction of economic burden due to 30-day readmissions, specifically for recurrences of ARD, patient and hospital-level rates, costs, and predictors of 30-day readmissions were derived at the national-level. Region-level data on ED facilities and BH workforce in Nebraska were obtained from the Health Professionals Tracking Services. In addition, the location of substance abuse treatment centers and ED facilities in New York were procured from the National Survey of Substance Abuse Treatment Services and the National Emergency Department Inventory, respectively. To identify BH conditions, International Classification of Diseases, Ninth Revision, Clinical Modification codes were used. Estimates of total charges for ED visits in Nebraska and New York were performed along with an assessment of the availability of substance abuse treatment centers, BH workforce, and EDs. The dissertation underlines the need for integrated behavioral health services at primary level and development of preventative health programs tailored specifically for high-risk populations.

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LIST OF ABBREVIATIONS

2PM – Two-part model

ACA – Patient Protection and Affordable Care Act

AHRQ – Agency for Healthcare Research and Quality

AMA – Discharge against medical advice

ARD – Alcohol-related disorders

BH – Behavioral health

CCR – Cost-to-Charge Ratio

CCS – Clinical Classification Software

CMS – Centers for Medicare and Medicaid Services

ECI – Elixhauser Comorbidity Index

ED – Emergency department

EMNet – Emergency Medicine Network

GLM – Generalized linear model

HCUP – Healthcare Cost and Utilization Project

HEDIS – Healthcare Effectiveness Data and Information Set

HPTS – Health Professionals Tracking Services

HRPP – Hospital Readmissions Reduction Program

ICD – 9-CM - International Classification of Diseases, Ninth Revision, Clinical Modification

LOS – Length of stay

MHPAEA – Mental Health Parity and Addiction Equity Act of 2008

NCQA – National Committee for Quality Assurance

NE – State of Nebraska

NEDI – National Emergency Department Inventory

NRD – Nationwide Readmissions Database

N-SSATS – National Survey of Substance Abuse Treatment Services

NY – State of New York

SAMHSA – Substance Abuse and Mental Health Services Administration

SEDD – State Emergency Department Database

SID – State Inpatient Databases

SUDs – Substance Use disorders

CHAPTER I: BACKGROUND

Burden of behavioral health-related problems

Behavioral Health disorder are comprised of mental illnesses and substance use disorders. American Psychiatric Association defined mental illnesses as health conditions involving changes in thinking, emotion or behavior (or a combination of these) (American Psychiatric Association, 2015). Also, mental illnesses are related with distress and/or problems functioning in social, work or family activities (Substance Abuse and Mental Health Services., 2015). The Substance Abuse and Mental Health Services Administration defined substance use disorders as conditions that occur when the recurrent use of alcohol and/or drugs causes clinically and functionally significant impairment, such as health problems, disability, and failure to meet major responsibilities at work, school, or home. Behavioral health (BH) disorders are health conditions that are characterized by alterations in thinking, mood, and behavior that are associated with impaired functioning (Centers for Disease Control and Prevention, 2013; Substance Abuse and Mental Health Services., 2015; World Health Organization, 2014a).

BH is an important public health issue globally and in the US. Worldwide, the number of years lived with disability due to BH problems has been greater than any other medical conditions in the past two decades (World Health Organization, 2004). In the US, one in every four adults and one in ten children experience BH illnesses (Centers for Disease Control and Prevention, 2013; Leong, Ph, & Kalibatseva, 2011; Nayar et al., 2016; Nguyen, Trout, Chen, Madison, & Watkins, 2016). The National Comorbidity Survey estimated that overall 57.4 percent of US adults have experienced some form of diagnosable mental illness in their lifetime (Leong et al., 2011).

Approximately 75 percent of those who suffer from BH disorders-related disabilities are unemployed and 15 percent of those BH conditions patients who are diagnosed with schizophrenia, bipolar disorder, or depression are homeless (World Health Organization, 2010).

In addition, unmet BH care needs can create social problems (e.g., unemployment, poverty, disruption of family relations and social life) that may increase crime and political instability (Ngui, Khasakhala, Ndetei, & Weiss, 2011). Unfortunately, only a third of those who suffer from mental illnesses and substance abuse actually receive community-based behavioral health treatment such as outpatient pharmacological and psychotherapeutic treatments (Doren, Grimsley, Noone, & Neese, 2016).

Previous literature suggests that undiagnosed, untreated and delayed diagnoses of BH conditions can lead to emergency department (ED) (Doren et al., 2016; Grupp-Phelan, Harman, & Kelleher, 2007). Many of these ED visits could have been prevented if the patient had an adequate access to the community-based BH care. Because state and federal laws mandate EDs to screen, diagnose and treat patients 24 hours daily, EDs have become de-facto BH care facilities at a high cost (Grupp-Phelan et al., 2007). The Kaiser Family Foundation found that 18% of frequent ED users (i.e., those who use the ED four or more times in a two-year duration) had a BH condition compared to only 6% of the total study population (Peppe, Mays, & Chang, 2007).

Because of the state and federal laws, ED physicians and staff are required to care for people with BH conditions with their limited experience in detecting and treating BH conditions, which leaves them ill-prepared for the responsibility (Bernstein & Onofrio, 2013; Doren, Grimsley, Noone, & Neese, 2016; Johnson et al., 2015; Little, Clasen, Hendricks, & Walker, 2011; Owens, Mutter, & Stocks, 2010; Rhodes, 2008; Rn, Nurse, Dip, & Icu, 2007). Also, BH diagnoses are not usually meant to be conducted in the ED, and hence, they may conduct an incomplete and/or inaccurate assessment prognosis and may not direct the patient to the right psychotherapy services (Doren et al., 2016). Also, there are no standardized protocols to follow up with patients after the discharge from the ED (Doren et al., 2016).

The economic and social costs associated with BH are substantial, which underscores the importance of treating these conditions (American Hospital Association, 2012). In the US, the indirect costs of BH conditions is estimated to be over $79 billion (Ngui, Khasakhala, Ndetei, &

Weiss, 2011). In addition, the national expenditures for BH services and substance use disorder treatment from all public and private sources was estimated at $172 billion in 2009 (Smith, Stocks, & Santora, 2015; Substance Abuse and Mental Health Services., 2013). A study by Stranges et al. suggests that the cost for 1.8 million inpatient stays for mental health and substance abuse conditions was $9.7 billion in 2009 (Smith et al., 2015; Stranges, Levit, Stocks, & Santora, 2011).

The total costs for hospitalizations reflect on the aggregate use of services, resources, and time invested by the healthcare workforce in providing BH services. Findings from studies that estimate the total cost allow hospital administrators to make decisions about planning, prioritizing and funding new programs (Stensland, Watson, & Grazier, 2012). Also, hospital charges are set within the context of the hospitals' competitors, payers, and customers (Dobson, DaVanzo, Doherty, & Tanamor, 2005). Furthermore, uninsurance and under-insurance for treatment of BH conditions may lead to a substantial difference between charges and received reimbursements and cost shifting between payers (Anderson, 2007; Stensland, Watson, & Grazier, 2012).

Length of stay (LOS), a quantitative performance indicator, is measured as the number of days of hospitalization for selected conditions and procedures. It is a proxy for inpatient resource usage and roughly relates to efficiency of inpatient hospital services (Kroch, Duan, Silow-carroll, & Meyer, 2007; Ormel et al., 2007). However, some researchers have been using LOS as a qualitative outcome measure to grade performance in improvement programs (Brasel, Lim, Nirula, & Weigelt, 2007). LOS is a significant marker to observe reduction in risk-adjusted LOS. Risk-adjusted LOS is defined as actual LOS rate divided by the mean expected LOS (expected rate) which is then multiplied by the national observed LOS (Agency for Healthcare Research and Quality, 2012). LOS also reflect the financial pressures on hospitals to reduce costs, discharge patients quickly or treat them in outpatient departments (Kroch et al., 2007). The availability of BH prescribers and professionals can prevent delayed-diagnoses of psychiatric illnesses and thereby avoid sudden ED visits and reduce the average LOS due to BH disorders. In a study by

Saba, Levit, and Elixhauser, the average LOS for hospitalizations principally for mental health was greater than for all other stays (8.2 days versus 4.6 days, respectively) (Saba, Levit, & Elixhauser, 2008). Hence, it is not only important to study the clinical, demographic, county, and patient-level factors that regulate the LOS of inpatient hospitalizations, but also understand the extent to which the supply of BH workforce affects LOS. Efficiency of hospital services and LOS are essential parameters that help policymakers design effective BH-related policies, such as the expansion of benefits for BH conditions under the Patient Protection and Affordable Care Act (ACA). Therefore, it is important to assess the economic implications of admitting BH patients in EDs and inpatient departments.

Undiagnosed, untreated and delayed diagnoses of BH conditions can lead patients to ED visits. Although EDs were designed to treat life-threatening conditions, over the years, EDs have been used to treat chronically ill patients, including psychiatric patients. Also, because state and federal laws mandate EDs to screen, diagnose and treat patients 24 hours daily, EDs have become an important unit for treating BH conditions and at a high cost (Grupp-Phelan, Harman, & Kelleher, 2007). The Kaiser Family Foundation found that 18% of frequent ED users (those who use the ED four or more times in the two-year duration) had a BH conditions compared to only 6% of the total study population (Peppe, Mays, & Chang, 2007). Hence, we intend to assess the economic implications of admitting BH patients in the EDs, after accounting for factors such as the supply of BH professionals, existing co-morbidities, and location of the hospital. We anticipate that this project will estimate the expenditures of admitting BH patients in EDs and provide estimates for extended LOS in areas with a shortage of practicing BH professionals.

The Nebraska Behavioral Health Needs Assessment of 2016 showed that 114,000 (7.6%) individuals 12 older suffer from alcohol abuse or dependence, out of which only 5.3% received treatment (Braun et al., 2016). Further, approximately 32,000 (2.2%) of individuals in Nebraska have shown dependence on illicit drugs and only 9.3% of these individuals received treatment. Statistically, based on poverty rates, the ratio of youth to adult population, and/or the ratio of

elderly to the adult population, 78 of the 93 counties in Nebraska are facing shortages of BH professionals. More importantly, 32 counties in Nebraska have no BH providers of any kind. Further, 71 counties do not have a psychiatric prescriber (psychiatrist, psychiatric nurse practitioner, or psychiatric physician assistant) (Braun et al., 2016). Over the last few years, Nebraska has made progress in supplying psychologists, nurse practitioners, physician assistants, independent mental health practitioners and addiction counselors, as shown in Table 1. However, the number of licensed mental health practitioners (LMPHs), licensed alcohol and drug abuse counselors (LADACs) was reduced by 21% between 2010 and 2016 (Braun et al., 2016).

There is a concern that the growing BH needs of the US population are not being met by the healthcare system in many parts of the country (Becker & Kleinman, 2013; M. Prince et al., 2007). The former First Lady, Michelle Obama, advocated for changing the conversation around 'Mental Health' and raised the need to expand benefits for BH and substance use disorders under the ACA (Office of the First Lady, 2015). The literature on BH epidemiology and services points towards the rising burden of BH conditions in the US, including adverse effects on social and financial well-being, associated stigma and the impact on education and employment opportunities (Becker & Kleinman, 2013; Centers for Disease Control and Prevention, 2013; World Health Organization, 2014b). Thus, current efforts to reduce the societal costs of BH conditions have been limited (Becker & Kleinman, 2013; Vos, Flaxman, & Naghavi M, 2012).

In general, there is a lack of literature that estimates the current supply of the behavioral workforce at state and county-level. However, one study suggested that the number of active doctoral-level psychologists in the US was about 83,142, or on a per capita basis, 1 per 3,802 people (Olfson, 2016). The number of psychiatrists was 37,296, or 1 per 8,476 people in 2013 (Olfson, 2016). These per-capita rates of psychologists and psychiatrists may not be sufficient to address current and future treatment needs for behavioral health patients. Additionally, the national shortage of psychiatrists and psychologists is further compromised by geographic maldistribution (Olfson, 2016). The designed models of BH service delivery in urban areas are

often unsuitable and challenging to implement in rural settings (Elhai, Baugher, Quevillon, Sauvageot, & Frueh, 2004). For illustration, urban settings are more likely to offer a variety of treatment options that can serve diverse urban population including minorities, HIV positive patients, etc. For successful outcomes, urban health services provide auxiliary services like detoxification. Moreover, the rural areas have fewer primary care settings that are dispersed and located at greater distances. This poses a threat to patients' adherence to treatment and also may mean a lack of anonymity with higher recognition in group-based settings (Pullen & Oser, 2014).

There are studies that suggest that rural residents may have a lower risk of recurrent mental distress than urban residents (Probst et al., 2006; Rohrer, Borders, & Blanton, 2005). However, contradicting these studies was a study by Fontanella et al. that stated that suicide rates for adolescents were higher in rural than in urban areas (Rohrer et al., 2005). Other studies also provided evidence that there are considerable unmet needs for BH services in most rural areas, especially among men (Chou & Cheung, 2013; Gfroerer, Larson, & Colliver, 2007; Hedeker, 2003). Results from Deen and Bridges showed lower rates of utilization of specialty BH services, including psychiatrists, psychologists, counselors, and social workers in rural areas compared to urban areas (Deen, 2011). Similarly, Ziller et al. estimated that BH-related spending was lower among rural residents than those living in urban areas (Ziller, Anderson, & Coburn, 2010). They attribute this finding to the lower cost of psychotherapy in rural versus urban areas (Ziller et al., 2010).

Likewise, many health conditions increase the risk for psychiatric disorders, and the existence of diagnosed or undiagnosed comorbidities complicates the processes of seeking help, screening and diagnosis, treatment, and prognoses (M. Prince et al., 2007; Diefenbach & Goethe, 2006). The current healthcare system does not provide health services equitably to people with a spectrum of BH disorders, and it is important to mention that the quality of care for both mental and physical health conditions for such patients need to be improved (M. Prince et al., 2007). Intervention programs often fail to assess comorbid BH disorders, which is a crucial marker to

manage a multi-drug dosage treatment or to develop specific lines of treatment to cure comorbidities (Chou & Cheung, 2013; Diefenbach & Goethe, 2006; Ormel et al., 2007). The common comorbidities with BH conditions are diabetes, cardiovascular disorder or pulmonary disease (Ormel et al., 2007).

The high prevalence of BH diagnoses among people with chronic medical conditions raises the need for healthcare administrators and policymakers to help in the integration of care for BH and physical health (Druss & Walker, 2011). Treating comorbid conditions is expensive. For example, about 80% of the annual increased costs are due to non-behavioral medical services for comorbid psychological disorders in the US (Melek & Norris, 2011). Also, the average total monthly spending for a person with a chronic disease and a depression diagnosis is $560 more than for a person without depression (Melek & Norris, 2011). Bipolar disorders are associated with high costs of health services and utilization of services due to comorbidities (Melek & Norris, 2011; Rajagopalan et al., 2006).

Financial cost projections estimated that lost earnings and public disability insurance payments associated with behavioral disorders were at least $467 billion in the US (Leong, Ph, & Kalibatseva, 2011). Specifically, $400 billion annually in crime, health, and lost productivity are incurred for substance misuse and substance use disorders, with $249 billion spent on alcohol-related disorders (U.S. Department of Health and Human Services (HHS), 2016). These costs are even higher than other major health problems such as diabetes ($245 billion) (U.S. Department of Health and Human Services (HHS), 2016). In a report by Substance Abuse and Mental Health Services Administration, public payers accounted for 59% of spending on mental health treatment, whereas 41% of this spending was accounted by private payers (Substance Abuse and Mental Health Services Administration., 2016).

In 2002, President Bush initiated the President's New Freedom Commission on Mental Health to endorse policies meant for adoption by federal, state, and local governments to improve existing BH services (Leong, Ph, & Kalibatseva, 2011). The commission decided to focus on six

goals that would transform the existing BH system: (1) accepting that BH is essential to overall health; (2) offering family-driven mental health care; (3) eliminating disparities; (4) focusing interventions for early detection, assessment, and treatment; (5) implementing evidence-based research into practice; and (6) using technology while providing care and access to information. Moreover, the federal government had started making calls for expanding workforce research and workforce development initiatives for better BH delivery. States such as North Carolina, Idaho, Alaska, Hawaii, and Colorado planned workforce development activities (Nayar et al., 2016).

In the State of Nebraska, the legislature passed the Legislative Bill 1083, the Nebraska Behavioral Health Systems Act of 2004. This act assesses the ability of the BH system in Nebraska by analyzing the geographic and demographic availability of the state's BH professionals (including psychiatrists, social workers, community rehabilitation workers, psychologists, substance abuse counselors, licensed mental health practitioners and behavioral analysts) (Nayar et al., 2016). More recently, with the passage of the Patient Protection and Affordable Care Act (ACA), the financing and delivery of behavioral healthcare and addiction care are expected to benefit (Barry & Huskamp, 2011). The ACA requires parity in coverage, thereby making behavioral healthcare equivalent to all other medical and surgical benefits. Also, the ACA's implementation is likely to improve access problems and system fragmentation that will be of assistance to people suffering from BH disorders (Barry & Huskamp, 2011; Leong et al., 2011). Consequently, the ACA will increase the demand for BH services and, hopefully, reduce the ED admissions for BH disorders. In addition, we can expect the inclusion of BH-related benefits and services to be covered by private insurance plans, and also offer protection for insurance access for patients identified with pre-existing BH conditions (Olfson, 2016).

Available evidence gathered from individual health professionals, health agencies and medical associations show that there is a critical shortage of BH professionals and services in inpatient and outpatient departments, causing the patients to seek help from EDs (S. D. Case, Case, Olfson, Linakis, & Laska, 2011; Mulkern, Raab, Potter, Raab, & Potter, 2007; L. Thomas,

2003). For example, in predominantly rural Nebraska, 81 of Nebraska's 93 counties have been state-designated as shortage areas for behavioral health professionals and services (Nayar, Nguyen, Apenteng, & Shaw-Sutherland, 2011). The shortage of psychiatric prescribers and BH professionals in Nebraska can result in missed or late BH diagnoses. This can prove to be detrimental, especially for patients suffering from existing co-morbidities such as diabetes and cardiovascular diseases, leading to an increase in their length of stay and total hospital charges (Galski, Bruno, Zorowitz, & Walker, 1993; Kim, Hwang, Oh, & Kang, 2013; Kwok et al., 2012). A longer LOS also places patients at risk of contracting nosocomial infections (Hoover, Sambamoorthi, Walkup, & Crystal, 2004). However, little is known about the impact of BH disorders on the Nebraskan healthcare system resulting from shortages of BH services, particularly in rural communities. The absence of Medicaid expansion under the ACA in Nebraska also may mean that many individuals with BH disorders will remain uninsured, increasing the likelihood of undiagnosed disorders.

Conversely, in a predominantly urban state of New York (NY), Medicaid expansion was adopted, and Medicaid Managed Care Plans provide some mental health and substance use services to their enrollees. However, even though 1.8 million residents of NY are suffering from substance use disorder, only 15% receive treatment (The New York State Office of Alcoholism and Substance Abuse Services, 2012). Also, among all states, NY spends the most for treating and preventing substance use disorder (The Pew Charitable Trusts and the John D. and Catherine T. MacArthur Foundation, 2015). Thus, for policymakers, hospital administrators, and planners of community outreach, accurate estimates of the frequency of ED visits for substance use disorder, total ED charges, and geographic assessment of available primary and ED-level access to care are crucial but understudied.

At the national-level, it has been found that hospitalizations for BH-related disorders, especially alcohol-related disorders (ARD) are among the top ten principal diagnoses that result

in 30-day readmissions. As of 2013, readmission rates for index hospitalizations for ARD were about 19% (Fingar & Washington, 2015). The ACA introduced two recent programs that focus on reducing readmission rates beginning 2014. One of the two programs mandated in 2013 is called the Hospital Readmissions Reduction Program (HRRP), which requires hospitals with greater rates of readmissions to pay penalties designated under the Medicare reimbursement system (Boccuti & Casillas, 2017; Cutler, 2010). Another program is called the Bundled Payments for Care Improvement Initiative, which ensures that hospitals receive a single payment for a complete episode of care, cumulative of index hospitalizations and all the following readmissions (Cutler, 2010; Medicare Payment Advisory Commission, 2011). Hence, for hospital administrators to monitor spending their budget, especially considering that most hospitals do not budget for readmission encounters, estimates such as readmission rates, costs, and relapses of ARD would be helpful. Additionally, policymakers that revise and amend programs under the ACA must evaluate outcomes of readmissions to understand the sustainability of the programs.

Knowledge gap

The ***objective*** of this study is to address knowledge gaps by evaluating the differences in clinical, demographic and county-level factors, among rural and urban hospitalizations (i.e., ED admission) for BH-related conditions in Nebraska and NY, which impact not only health outcomes but also associated charges. Moreover, plotting county-level availability of BH providers, community-based substance abuse treatment centers, and ED will help us map access to care. By understanding the national-level prevalence of index inpatient hospitalizations for ARD, the resulting 30-day unplanned all-cause readmissions, and corresponding costs, rates, relapses of ARD, hospital administrators and policymakers may improve the allocation of resources for such cases. In addition, our findings will help providers design and adopt better protocols to follow-up with patients at the primary-level after index hospital discharges.

The ***central hypothesis*** is that diagnoses of BH-related conditions, patient-and county-level factors, and the supply of BH providers are associated with healthcare outcomes such as length of stay, total charges TC and rates of index hospitalizations and readmissions. This hypothesis is based on a national level literature review that shows evidence of delayed BH diagnoses in rural areas due to shortage of BH professionals, ED, and treatment centers. Also, it can be anticipated that incidence of hospitalizations and costs may be associated with hospital-level characteristics such as locations, teaching status, and ownership, as well as patient-level socioeconomic factors.

Motivation of the study

The following are the influential factors that drive the findings of this study: (1) access to BH care is a major concern; (2) lack of studies that examine BH-related ED visits using state-specific samples; (3) states vary in their adult Medicaid policy for BH services and rural-urban distribution (NE & NY); and (4) rates of readmissions have been reported to increase, especially post-ACA implementation

Innovation of the study

The proposed study will be the first study to systematically examine the economic impact of treating BH in the EDs in Nebraska and New York. In addition, this study provides national-level estimates of rates and costs of readmissions following index hospitalizations due to ARD. This is an innovative study that could lead to advances in an overall understanding of available BH services and estimate the proportion utilized by rural and urban residents in the US. With the proposed new American Health Care Act of 2017 and the President's Commission on Combating Drug Addiction and the Opioid Crisis established by President Trump, these findings could help identify gaps for BH services and suggest recommendations that could be incorporated in the healthcare system. Hereby, it is anticipated that the results from this study will be able to provide a direction for policymakers to amend, update and/or implement BH policies.

Specific Aims

Descriptive statistics such as the prevalence of BH-related disorders in the US have been reported. However, hospital-based ED visits and the associated charges for BH conditions within the state of Nebraska are not well understood. In addition, with New York State adopting Medicaid expansion and annual increases in public funding to treat substance use disorder, the impact on hospital-based ED visits and associated charges for substance use disorder is unclear. Finally, providers, hospital administrators, and policymakers are struggling to understand the rates and costs of readmissions following index hospitalizations due to ARD. The specific aims of the dissertation are as follows:

Study 1:

Aim 1: Examine the 30-day readmission due to ARD and identify predictors of 30-day readmission for ARD

Hypothesis 1.1: The 30-day readmission rate for ARD would be significantly lower during the post-ACA period compared to pre-ACA period

Hypothesis 1.2: At least one-third of readmissions for ARD occur within 7 days of the discharge.

Aim 2: Examine the costs of hospitalization due to ARD and identify factors related to higher costs of hospitalization due to ARD

Hypothesis 2.1: The average cost of index hospitalization due to ARD would be significantly lower during the post-ACA period compared to pre-ACA period

The goal of the first study of this dissertation is to identify patient- and hospital-level factors that are associated with 30-day readmissions following the index inpatient stays for ARD. The ACA-mandated provisions such as the Hospital Readmissions Reduction Program and the Bundled Payments for Care Improvement Initiative focus on all-cause readmissions but are likely to impact admissions related to ARD. The findings from this study will help us better understand

patient and hospital-level factors that are associated with readmissions, subsequent readmission costs, and the overall economic burden attributed to ARD.

Study 2:

Aim 1: Examine ED admission rates due to BH conditions and identify factors associated with ER admission and discharge against medical advice.

Hypothesis 1.1: Individuals with less access to care (e.g., rural, uninsured, lower SES) are more likely to be admitted to ED than those with more access.

Hypothesis 1.2: Individuals with less access to care (e.g., uninsured, low-income) are more likely to be leave against medical advice

Aim 2: Examine the charge for ED admission due to BH conditions and identify factors associated with higher ED charges

Hypothesis 2.1: Individuals with less access to care (e.g., uninsured, low-income) and with comorbidities (e.g., elderly) are will have higher ED charges.

Aim 3: Investigate a relationship between BH workforce supply and distribution of ED with ED visits.

The goal of the second study of this dissertation is to provide characteristics of BH-related ED visits and charges between the years 2011 to 2013 within Nebraska at the region-level. To understand the reason for ED visits and discharge against medical advice, we linked the availability of BH professionals at the region-level, which will help measure supply of BH workforce in predominantly rural Nebraska. Correspondingly, knowing the distribution of ED at the region-level will help explain the higher proportions of ED visits that may be due to lack of integrated behavioral health services at the primary level. Results from this study will enable

policymakers to improve access to care, introduce incentives for BH professionals to provide care, and identify high-risk groups that have unmet BH needs.

Study 3:

Aim 1: Investigate ED admission for substance use disorders (SUDs) and describe the characteristics of individuals admitted to ED for SUDs in New York.

Hypothesis 1.1: Individuals who are urban poor (e.g., urban, uninsured, low-income) are more likely to be admitted to ED than those with more access.

Aim 2: Investigate the time trend of the ED admission for SUDs and the ED charge for SUDs

Hypothesis 2.1: Post-Medicaid expansion, ED charges and number of visits would reduce.

Aim 3: Identify factors that explain higher ED charges for SUD

Hypothesis 2.1: ED charges will be higher for those with less access to care (e.g., rural, uninsured) and with multiple comorbidities

Aim 4: Investigate a relationship between substance abuse treatment facilities and distribution of ED with ED visits.

The goal of this third aim of this dissertation project is to characterize ED visits and charges for SUD between the years 2011 to 2013 within New York State at the county-level. We mapped the distribution of EDs and substance use treatment centers at the county-level. We then estimated the correlation of these geographical findings to rates of SUD-related ED visits in New York State. We anticipated that the findings from this study would help identify counties with no or few specialty care facilities that have higher rates of ED use for SUD.

Table 1: Trend of behavioral health professionals in Nebraska from 2010 to 2016.

	2010	2012	2014	2016	Diff. 2010-2016	% Diff. 2010-2016
Prescribers						
Psychiatrists	162	156	156	164	2	1%
APRNs Practicing Psychiatry	78	75	98	113	35	45%
PAs Practicing Psychiatry	9	12	16	15	6	67%
Total	***249***	***243***	***270***	***292***	***43***	***17%***
Non-Prescribers						
Psychologists	318	335	366	355	37	12%
LIMHPs	589	703	814	1034	445	76%
LMHPs	991	1028	918	783	-208	-21%
LADACs	132	152	143	105	-27	-21%
Total	***2030***	***2218***	***2241***	***2277***	***247***	***12%***
Grand Total	**2279**	**2461**	**2511**	**2569**	**290**	**13%**

CHAPTER II: CONCEPTUAL FRAMEWORK

To analyze the factors that are associated with service utilization as well as the quality and cost of care for BH conditions, a structured framework that explains an individual's access to and use of health services needs to be considered (Andersen, 1995; Phillips, Morrison, Andersen, & Aday, 1998). This dissertation uses the Aday and Andersen model (Aday & Andersen, 1974). The model incorporates three main domains of determinants that contribute to utilization of health services: predisposing characteristics, enabling resources, and healthcare needs. These domains have patient and hospital-based characteristics and have a linear relationship with each other, as shown in Figure 1.

The structure of the healthcare system includes its organizational structure, resources such as the supply of providers necessary for delivering health services, financial arrangements that impact accessibility and availability, and acceptability (standard) of medical care services (e.g., physician supply) (Phillips et al., 1998). These factors are important to examine because studies have shown that they play a role in healthcare utilization (Phillips et al., 1998). Philips et al. also suggest that utilization patterns differ based on the structure of managed care. Also, the authors state that researchers and policymakers are curious to understand the influence of health policies or organizations on consumption of healthcare services (Phillips et al., 1998). Hence, the conceptual model should not only focus on population-level characteristics but also on hospital-level characteristics. Amendments to policies impact the economic climate and sustainability of hospitals and healthcare stings, which in turn affects financial standing of the system such as politics. As illustrated in Figure 1, it is noteworthy that outcomes such as readmission possibilities, costs, and utilization of health services are interdependent. An individual's health behavior is based on his/her personal health practices, for example, whether they have a regular source of care and go for regular check-ups. Personal health practices and population characteristics, together influence one's use of health services, which include the type of services

(physical, dental or behavioral), purpose, length of stay in inpatient and emergency departments, costs borne and time investment (Andersen, 1995; Fenta, Hyman, & Noh, 2006; Phillips et al., 1998).

An adaptation of the Aday and Andersen framework suggests an association between population and hospital characteristics and health behavior with health outcomes. Studies have suggested using a complex correlation between perceived health status and health care utilization with consuming medical care. This method may indicate that individuals perceive their health status 'worse' if they have been visiting facilities numerous times. (Fenta, Hyman, & Noh, 2006; Jahangir, Irazola, & Rubinstein, 2012; Maguen et al., 2007; Rebhan, 2011). Conversely, individuals who have a poor perception of their own health may also seek medical care more frequently. Thus, it is challenging to assess causation, but one cannot infer causality between perception and utilization. Likewise, evaluated health status by physicians is also relative, for example, those who visit the physician more frequently either are sick and being treated or utilizing the insurance coverage to stay healthy (Andersen, 1995; Fenta et al., 2006). However, we cannot make conclusions about those who do not visit the physicians as they may be healthy, in denial of help or without insurance. Additionally, another health outcome parameter that measures for ED inpatient department-related charges, costs of index hospitalizations and the probable readmissions. This comprehensive factor can be measured by evaluating the access, cost, and quality of the behavioral health services provided while controlling for patient and hospital characteristics.

Predisposing characteristics

These are socio-cultural factors of individuals that exist before the individual develops a specific health condition. The major predisposing factors include demographics (e.g., age and sex) that represent the biological imperatives that indicate the probability that people will need health services and, thereby, help in identifying the 'high-risk' population.

Enabling factors

Enabling factors include income, location, and insurance status. Individuals with more financial resources, have health insurance and live in an area with sufficient access to health care are more likely to seek and use health care services. These variables play an important role in estimating the consumption of BH services because of the associated stigma towards such conditions (Fenta et al., 2006).

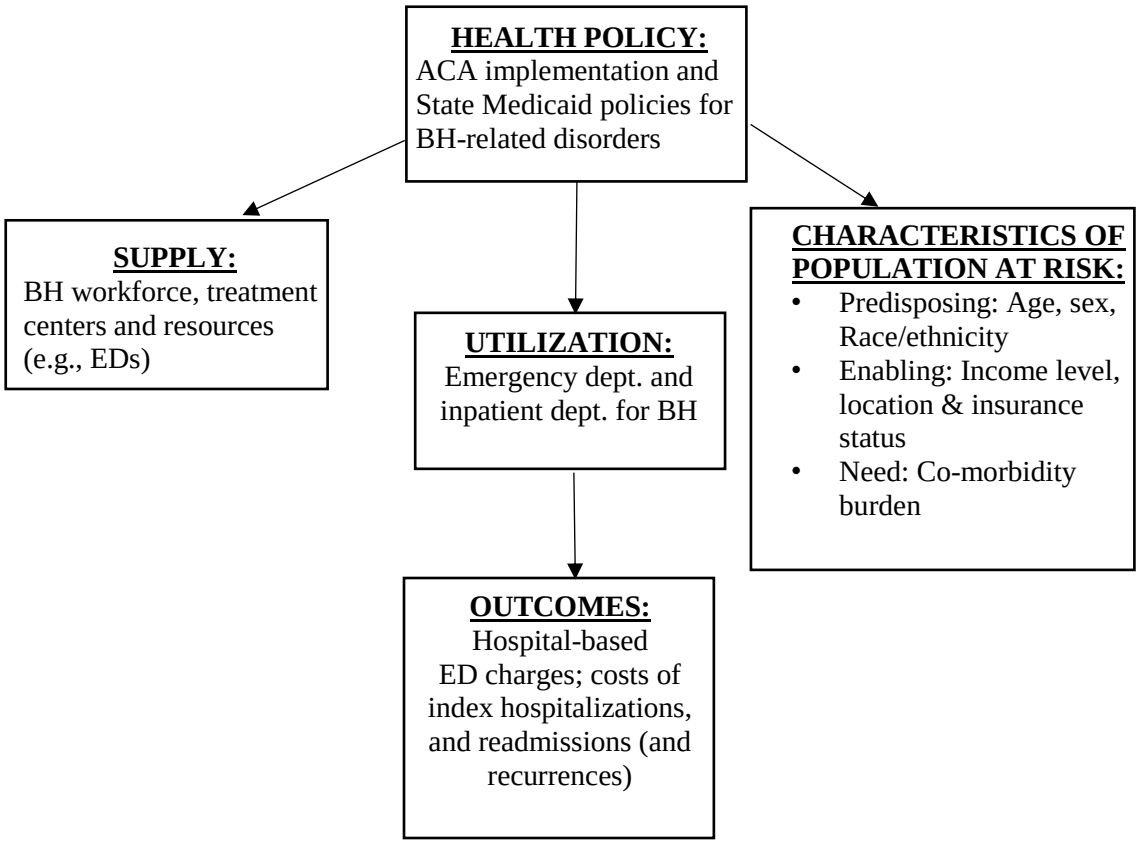
Need

Individuals who have multiple health conditions are in greater need for health care services. Patients that have greater needs for BH services if they also suffer from comorbidities because various physical conditions are treated using prescriptions containing antidepressants, sedatives, hypnotics, opioids, and laxatives. Improper, prolonged and overuse of such drugs can result in such patients seeking care for BH conditions including non-dependent type substance use disorders. About 68% of adults with serious mental disorders have medical conditions such as diabetes, cardiovascular diseases, pulmonary diseases (Druss & Walker, 2011; Lagisetty, Maust, Heisler, & Bohnert, 2017). Hyperlipidemia, HIV, Hepatitis C, and hypertension were found to be common comorbidities with SUDs. Also, patients with SUD had a significantly higher percentage of psychiatric comorbidities of depression, bipolar disease, and anxiety. Recently, an increased level of attention has been paid on an opioid epidemic stemming from the over-use of prescription medications. This is one example of the need for BH care driven by providing integrated behavioral health services. Patients suffering from BH diseases might benefit from novel care models to co-manage BH and common chronic medical conditions. Also, in the presence of more comorbidities, individuals are likely to seek help in various healthcare settings including EDs.

In general, the above conceptual framework controls for probable confounding factors such as income and insurance status, presence of comorbid conditions including chronic illnesses that could affect the correlation between inpatient and emergency admissions due to behavioral

health disorders. Age and sex also tend to act as confounding factors and hence, the research methods should include multivariate analyses.

Figure 1: Framework for the dissertation based on the Aday and Anderson model of 1974.



CHAPTER III: PREDICTORS AND COSTS OF THIRTY-DAY READMISSIONS AFTER HOSPITALIZATIONS FOR ALCOHOL-RELATED DIRORDERS IN US ADULTS

Introduction

Thirty-day readmissions have been accepted as a gold standard indicator to measure the quality of care delivered in US hospitals (Axon & Williams, 2011) mainly because of the high prevalence, costs (McCarthy, Johnson, & Audet, 2013), and preventability of some readmissions. Two health policies introduced under the Patient Protection and Affordable Care Act (ACA) of 2010 are meant to strengthen the US healthcare system by incentivizing hospitals to reduce readmission rates and their corresponding costs. First, starting the fiscal year 2015, the Hospital Readmissions Reduction Program of 2013 mandates financial penalties to hospitals with greater rates of readmissions for certain conditions (e.g., heart attack, heart failure, pneumonia). These penalties are implemented as part of the Medicare reimbursement system (Boccuti & Casillas, 2017; Centers of Medicare & Medicaid Services, 2014; Cutler, 2010). Implementation of this program compelled healthcare administrators to emphasize effective post-discharge case management in order to reduce unnecessary and preventable readmissions. Another program initiated by the ACA is the Bundled Payments for Care Improvement Initiative to regulate the payment method. With this program, hospitals receive a single payment for an entire episode of care, including both index hospitalizations and subsequent readmissions (Cutler, 2010; Medicare Payment Advisory Commission, 2011). Hence, understanding the excess costs of care incurred by hospitals for readmissions becomes essential and a driving factor for hospital strategic management. The salaried providers receive no additional incentive to readmit patients and certain hospitals functioning within an annual budget (e.g., Veterans Health Administration-based hospitals) do not allocate additional budget to treat readmissions (Carey & Stefos, 2016). These

ACA programs have motivated the health care systems to more accurately forecast rates and costs of readmissions, especially for the preventable readmissions.

Nationally, among all other medical conditions, hospitalization due to alcohol-related disorders (ARD) resulted in the highest 7-day (the second rank) and 30-day (the fourth rank) readmissions (Fingar & Washington, 2015). Alcohol-induced disorders, acute alcohol intoxication, unspecified alcohol dependence, alcohol abuse, alcoholic polyneuropathy, alcoholic cardiomyopathy, alcoholic gastritis, liver damage due to alcohol abuse, alcohol affecting fetus or newborn via placenta or breast milk, and toxic effects of ethyl alcohol are some types of ARD. Readmissions due to ARDs are potentially preventable (Patterson, Lindsey, & Roohan, 2009; Viggiano, Pincus, & Crystal, 2012). While overall economic costs and hospital (index stay) costs for excessive alcohol consumption (Bouchery, Harwood, Sacks, Simon, & Brewer, 2011; Gryczynski et al., 2016; Mukamal et al., 2006; Shepard, Daley, Ritter, Hodgkin, & Beinecke, 2002) and their association with clinical factors including comorbidities, and patient-level characteristics have been examined, these studies to do not provide comprehensive data on ARDs. Other studies estimated the hospital spending for primary diagnosis of mental illnesses (e.g., schizophrenia, depression) with ARD as a comorbidity (Bouchery et al., 2011; Gryczynski et al., 2016; Mukamal et al., 2006; J. D. Prince et al., 2008; Sacco, Unick, Zanjani, & Camlin, 2015; Shepard et al., 2002; G. Singh, Zhang, Kuo, & Sharma, 2016; Slaughter, Farris, Singer, Smyth, & Singer, 2017). Hinde *et al* measured hospital costs and proportion of readmissions in Arizona after the state started to mandate screening for ARD in trauma centers (Hinde, Bray, Aldridge, & Zarkin, 2015). Fingar and Washington studied readmission costs for ARD in US between 2009-2013 and reported an aggregate spending of $366 million (Fingar & Washington, 2015).

Importantly, all of these studies were conducted before the implementation of the ACA. Because the two mandates under the ACA can have a large impact on the readmission rate and

the associated cost, it is necessary to use more recent data to understand the potential impact of the ACA. Finally, few studies have fully explored the combined impact of patient and hospital-level characteristics on probabilities of 30-day unplanned all-cause readmissions following index hospitalizations primarily for ARD. The analysis of readmission rates and costs post-ACA is essential for policymakers, hospital administrators, insurance analysts, patients, and providers.

To our knowledge, nationally representative 30-day readmission rates and their corresponding costs following index hospitalizations with ARD as the primary diagnosis have not been studied. Moreover, besides clinical factors and patients' socio-economic characteristics, non-clinical factors and other factors such as hospitals' location, teaching status, bed-size, and ownership could be important in impacting readmission rates and costs. The aims of this study were to expand the existing literature by using post-ACA data for a nationally representative sample of patients with primary diagnosis of ARDs. Five aims of the study are to: (a) determine the incidence of index hospitalizations for patients with principal diagnosis of ARD, (b) estimate the distribution of the proportion of 30-day unplanned all-cause readmissions across the number of days after the index discharge, (c) identify patient and hospital-level predictors of 30-day unplanned all-cause readmissions, (d) predict incremental cost of 30-day readmissions, and (e) evaluate costs due to repeated diagnosis of ARD at the first immediate 30-day readmission.

Methods

Data source

Nationwide Readmissions Database

The Healthcare Cost and Utilization Project (HCUP), sponsored by the Agency for Healthcare Research and Quality (AHRQ), has drawn the 2014 Nationwide Readmissions Database (NRD) from the same sample of discharges as the HCUP State Inpatient Databases (SID). This study utilizes information from the NRD that contains reliable data from 22 states and hospital

readmissions for all types of payers and the uninsured (Healthcare Cost and Utilization Project, 2017). These states are geographically dispersed and account for 51.2 percent of the total US resident population and 49.3 percent of all the US. A verified patient linkage number helps track a patient across hospitals within a state. AHRQ has computed encrypted identifiers that helps flag discharges per patient throughout the year 2014 (Healthcare Cost and Utilization Project, 2017). The 2014 NRD is comprised of 14,894,613 unweighted discharges collected from 2,048 hospitals that amount to 35,306,427 discharges with weighting. We used the visit linkage variable to query the number and days to readmission by patients (Healthcare Cost and Utilization Project, 2017). The NRD also provides a hospital identifier that traces patients across hospitals within a state. Moreover, hospital discharges in the NRD database are stratified and a single stage cluster sample with variables for weights that help quantify nationally representative estimates of index hospitalizations and readmissions.

Study sample

Recommendations made by CMS, the National Committee for Quality Assurance (NCQA), Healthcare Effectiveness Data and Information Set (HEDIS), and National Quality Strategy Annual Reports, were followed to design the inclusion and exclusion criteria for the study (Horwitz et al., 2014; National Committee for Quality Assurance, 2015; National Quality Strategy, 2012). The study population included those discharges in which the patient were adults (over 18 years of age), did not die in the hospital, with one or more days in length of stay (LOS), and discharges between January and November. The study excluded those discharges for the month of December; patients admitted in an out-of-residency state at index stay; transferred to acute care facilities, left against medical advice, discharged to unknown location; and/or had primary diagnoses for (1) cancer, (2) rehabilitation, (3) pregnancy, (4) condition originating in the perinatal period. Only the first readmission is counted within the 30-day period because the outcome measure assessed in this study is percentage of admissions with a readmission.

The following steps that were taken to create the sample. As shown in Row 1 of Table 1, a total of 14,894,613 discharges among 10,203,006 patients were identified. For the calculation of 30-day readmission counts, discharges made after November were excluded because their 30-day follow-ups cannot be observed in the NRD. Row 2 shows that based on CMS and HCUP recommendations, those discharges where the patients were transferred to acute-care facilities (n=131,761), left against medical advice (n=189,690) or had missing information on disposition status (n=15,186) were omitted from the study cohort. Similarly, we excluded from index hospitalizations any discharges for cancer (n=572,679) and rehabilitation (n=21,332) from index hospitalizations (Rows 3 and 4) because they would likely be deemed as 'planned readmissions'. In addition, we excluded admissions that took place in a state that was not the patient's state of residency (n=569,766). This is because these patients would most likely be readmitted in their state of residence, which would not be captured in the NRD (Row 5). Individuals who died during their initial hospitalization and those with missing LOS (n=16) and with zero LOS (n=198,287) (Row 6) were excluded so as to be able to calculate the number of days to a subsequent readmission. Lastly, following NCQA and HEDIS guidelines, the analyses excluded hospital stays for acute inpatient discharge with a principal diagnosis of pregnancy (n=1,846,607) (Row 7) or of a condition originating in the perinatal period (n=731,439) (Row 8). Moreover, a principal diagnosis of organ transplant (Kidney Transplant, Bone Marrow Transplant Organ Transplant Other Than Kidney) and potentially planned procedures without principal acute diagnosis were also queried for deletion but no such cases were found in the study sample. Because disease development and comorbidities vary between children/adolescents and adults, and both these groups have different risk factors; this study excluded patients under the age of 18 years (n=414,844).

The 2014 NRD was queried for ARD using the International Classification of Diseases (ICD) Clinical Classification Software (CCS) Code 660 (Appendix 1). The ICD-9-CM

(International Classification of Diseases, Ninth Revision, Clinical Modification) was used to identify hospitalizations with primary diagnoses for alcohol-induced disorders (291.00-291.90), acute alcohol intoxication (303.00-303.03), unspecified alcohol dependence (303.90–303.93), alcohol abuse (305.00-305.03), alcoholic polyneuropathy (357.5), alcoholic cardiomyopathy (425.5), alcoholic gastritis (535.30, 535.31), liver damage due to alcohol abuse (571.00-571.30), alcohol affecting fetus or newborn via placenta or breast milk (760.71) and toxic effects of ethyl alcohol (980.00) (Healthcare Cost and Utilization Project (HCUP), 2015). Although the study includes those discharges for patients with primary diagnoses of ARD, the readmissions to these hospitalizations were all-cause and unplanned. Because NRD is built on information mentioned on the discharge form, index hospitalizations were classified according to primary diagnoses on discharge. A hospitalization with primary diagnoses for ICD code of 660 as per CCS was considered as an index hospitalization and each qualifying hospital stay was counted as a separate index admission. Therefore, a patient can have multiple index stays during the January to November observation period.

Measures

Independent variables

Patient-level characteristics included age, sex, length of stay, median household income national quartile for patient's home ZIP code, payer, disposition status, patient location, utilization of emergency services, and number of chronic and comorbid conditions at discharge. Age was stratified into five categories (18-24, 25-44, 45-64 and > 65 years old). NRD includes insurance status as the primary payer listed for the index hospital discharge without listing information on the secondary payer. It is important to note that for patients over the age of 65 years, Medicare was coded as their primary payer, given their eligibility to enroll in Medicare. Also, NRD presents all Medicare beneficiaries, whether they use the fee-for-service or Medicare Advantage, into one common category called Medicare. Categories including Worker's Compensation,

TRICARE/CHAMPUS, CHAMPVA, Title V, and other government programs are grouped as 'other' insurance (Healthcare Cost and Utilization Project (HCUP), 2017c). NRD does not provide information on patients' race, ethnicity, and state of residency.

The variable 'utilization of services' indicates records that have evidence of ED services reported on the HCUP record. Some of the ED services included were ED revenue (ICD-9-CM code of 450-459) or any positive ED charge, Current Procedural Terminology (CPT) code of 99281-99285, condition code of P7 (point of origin in emergency room), and admission source of ED. A non-negative value specifies that there is evidence of ED services, whereas a value of zero means that no ED services has been used.

We used a variety of hospital-level characteristics including the ownership, location, teaching status, hospital volume, the number of beds, and the length of hospital stays. The ownership or hospital control is based on mission, vision and values of the organization and include categories like government nonfederal (public), private not-for-profit (voluntary) and private investor-owned (proprietary). NRD also entails hospital location variable that is based on urban-rural designation of the hospital depending on the county of the hospital; and information on teaching status of hospital defined based on approval of the American Medical Association for their residency program. The hospital volume was measured by the annual admissions and divided into equal thirds based on the number of admissions for ARD through 2014 (< 41, 42-98, and > 99). The hospital bed size variable was categorized specific to the hospital's location and teaching status. Moreover, the length of inpatient hospital stays (LOS) in days was used in the analysis.

To capture the overall health of the patients, this study constructed variables measuring their comorbid conditions using HCUP Comorbidity Software Version 3.7 (Healthcare Cost and Utilization Project (HCUP)., 2017). All comorbid conditions used the ICD-9-CM codes. This comorbidity software utilizes 29 binary indicators for calculating the Elixhauser Comorbidity

Index (ECI) (Elixhauser A, Steiner C, Harris DR, 1998). To avoid collinearity and to follow the norms of constructing the ECI measure, we removed alcohol-related comorbidity and categorized the remaining 28 conditions into two groups. Drug-related conditions, depression, and psychoses were categorized as "related" comorbid conditions. The remaining conditions were categorized as "unrelated" comorbid conditions. An ECI measure of 0, for both related and unrelated comorbid conditions, indicates an absence of any comorbid condition.

Outcomes

Index hospitalizations for ARD and 30-day all-cause unplanned readmissions are the units of analysis. It is difficult to determine which readmissions are preventable and which are not. Additionally, from the hospitals' perspective, an all-cause readmission is an important quality improvement metric that drives their strategies to contain high healthcare expenditures. Hence, we included all-cause and unplanned 30-day readmissions (Horwitz et al., 2014). Also, we used the nearest in time or the immediate 30-day readmission, measured as a binary indicator (0/1), that occurred following an index hospitalization between January 1, 2014 to November 31, 2014 for ARD, which is the commonly used method by the CMS (Krumholz et al., 2000; Strom et al., 2017). All subsequent re-hospitalizations that occur after the first readmission and beyond 30-days from the first index hospitalization is considered as a new index hospitalization for the same patient. Because the average rate of readmissions through 2014 per patient following an index hospitalization due to ARD is 1.11, patient-level clustering of readmissions would not have a statistically significant impact on the resulting estimates (Strom et al., 2017).

The incurred inpatient hospital costs in dollars for index hospitalizations and first readmissions in 2014 are the desired primary outcomes. The NRD contains data on inpatient hospital charges. HCUP's Cost-to-Charge Ratio (CCR) files were used to convert the charges into actual costs, which provides the cost in dollars of resources used for providing inpatient care for all hospitals and conditions ("HCUP Cost-to-Charge Ratio Files (CCR).," 2017). The CCR files

include neither any information on who ultimately paid for inpatient services nor how much of these costs were covered by the insurance provider. However, estimates of inpatient costs by all payers are validated by HCUP. Moreover, NRD is sampled such that using the weights, strata and cluster variables, nationally representative estimates of hospital costs and readmission costs can be derived (Healthcare Cost and Utilization Project (HCUP), 2015).

Analytical approach

Index hospitalizations for ARD and all-cause and unplanned first 30-day readmissions were the units of analysis. Descriptive statistics were calculated for the number of inpatient index hospitalizations for ARD and the proportion of them that led to immediate 30-day readmissions, stratified by various patient and hospital-level characteristics. The categorical variables were expressed as frequencies and percentages while the continuous variables were expressed as means (with standard deviations) and medians. Univariate analyses were performed using the Student t-test for continuous data. Chi-square tests at significance level of 0.05 were used to determine differences in grouping variables to estimate the proportions of index hospitalizations for ARD that were and were not followed up by 30-day readmissions. By definition, each patient can have multiple index hospitalizations. Therefore, descriptive statistics are performed at the discharge-level with ARD.

The distribution of the proportion of 30-day readmissions across the number of days after index hospitalization for ARD was estimated. To identify the predictors for an all-cause 30-day readmission, this study performed multivariate logistic regression while adjusting for patient demographics, hospital characteristics, and comorbidities. Simultaneously, a forest plot demonstrating adjusted odds ratios for readmission for key patient and hospital-level characteristics was drawn.

A two-part model (2PM) was used to link the probability of readmission to the corresponding readmission cost to determine patient- and hospital-level estimates for the expected readmissions for overall index hospitalizations with ARD. In short, the 2PM linked the readmission probability model to a readmission cost model. This two-part model based on mixed-discrete-continuous variable regressions was used to not only account for zero costs of readmission visits but to also estimate incremental costs of inpatient readmissions (Manning & Mullahy, 2001). Because this model evaluates individual cost data that typically includes a substantial proportion of zero value costs and, consequently, have skewed distribution (heavy right-side tail) of non-zero values of costs, (Mullahy, 1998) it is an appropriate choice for the analyses.

The first part of 2PM helps evaluate the probability of non-zero costs of readmissions distinctly different from level of costs which are conditional on non-zero readmission costs using a logit link function. This method has been used for hospital-cost analyses in previous studies (Carey & Stefos, 2016; Kang & Barner, 2017; Li, Cairns, Fotheringham, & Ravanan, 2016; Ruhl et al., 2017). This part applies a logistic regression for the binary distribution of the cost variable. The second part of the model uses the generalized linear model with a log-link to estimate conditional costs only for those discharges that had positive costs of readmissions (Belotti, Deb, & Norton, 2015). The expected cost of readmission following an index hospitalization with ARD was calculated as a product of the predictions obtained from estimating each part of the model, i.e., the probability that any given readmission had an inpatient cost and their mean cost. This study adjusted for all the predisposing, enabling and need factors of the Anderson model (Aday & Andersen, 1974). Post-regression estimation of the 2PM enabled us to predict readmission costs, estimate average and incremental costs in readmission for ARD. Additionally, analyses to estimate readmission costs for readmissions that had primary diagnoses of ARD for the index stay as well as 30-day readmission (called recurrence of ARD diagnoses at readmission, for this

study). The estimates of readmission costs for recurrence of ARD at readmission were compared to those that had primary diagnoses of ARD for that index stay but not the immediate 30-day readmissions.

SAS version 9.4 was used for all the descriptive analyses, multivariate logistic regression and plotting the forest plots (SAS Institute Inc, Cary, NC). However, analyses for the 2PM were performed using the user-built 'twopm' command in Stata (Stata Corp, College Station, TX). Also, post-regression estimates for the average and incremental costs were computed using the 'margins' command. To account for the complex survey design, we used sampling weights, clustering and stratification of all patient and hospital-level analyses to produce national estimates of readmission costs for index hospitalizations due to ARD.

Results

Readmission rates of patient- and hospital-level characteristics

Out of 10,203,006 discharges recorded from 2,048 hospitals in the NRD 2014, 285,767 index hospitalizations occurred for ARD. About 18.9% (54,083) of these index hospitalizations for ARD were readmitted within 30-days. Patient- and hospital-level characteristics of ARD index hospitalizations (weighted) are shown in Table 2. The mean age of patients who had 30-day readmissions was 49.8 years. Patients who were 45-64 years old had the majority (57.90%) of index hospitalizations for ARD, followed by those aged between 25-44 years (31.17%). Males contributed the majority (71.9%) of index hospitalizations. Medicaid (34.9%), private insurers (23.9%), and Medicare (19.4%) were the top three payers for index hospitalizations for ARD. The majority of hospitalizations resulted in routine discharges (overall (86.6%). Also, most hospitalizations were for urban residents (87.1%). About half (41.7%) of hospitalized individuals had at least one related comorbid conditions and 82% had at least one unrelated comorbid conditions. The majority (90.8%) of hospitalized individuals had non-elective admission and

78.48% used emergency services. The mean LOS was 5.3 days and the mean cost of the index hospitalization was $8,188. The majority (74.1%) of individuals were admitted to non-profit private hospitals. Over half of the individuals were admitted to large hospitals. The majority (66.7%) of them were admitted to metropolitan teaching hospitals.

All of the patient- and hospital-level variables were significantly associated with the re-admission status mainly due to the large sample size. The notable associations include age, primary payer, unrelated comorbid conditions, and teaching status. For example, 62.3% of re-admitted individuals were between 45 and 64 years of age while 56.7% of individual without readmission were in that age group (<.0001). The proportion of Medicare (23.3% vs. 19.2%) and Medicaid (41.4% vs. 33.7%) coverage was higher among individuals with at least one readmission compared to those without readmissions. Patient who were readmitted had higher proportion patients lived in low-income areas (the first quartile: 32.6% vs. 29.4%) than those that were not readmitted. A higher proportion of hospitalizations with 4 or more comorbidities (20.5% vs.16.4%) resulted in readmissions in contrast to those that did not have 30-day readmissions. Among those who were readmitted, 70.7% of hospitalizations were at metropolitan teaching hospitals while 65.8% of the hospitalizations without readmissions were admitted at such hospitals.

The distribution of the proportion of readmissions was plotted across the number of days (within 30-days) after the index discharges for ARD. As shown in the Figure 1, a higher proportion (3.5-4.5%) of the readmissions occurred during the first 8 days.

The multivariable logistic regression, adjusted for comorbidities as well as patient and hospital characteristics, was performed to identify predictors for all-cause 30-day readmission occurring on index hospitalizations for ARD (Table 3) and Figure 2 visually illustrates the results. Males were slightly less likely to be readmitted than females (OR=0.94; 95% CI: 0.90-0.98). Compared to patients between 18-24 years, those aged between 25-44 years (OR=1.93; 95% CI:

1.62-2.29), and 65 years and older (OR=1.48; 95% CI: 1.22-1.80), were much more likely to be readmitted but the odds of readmission were highest among those 45-64 years old (OR=2.14; 95% CI: 1.80-2.54). Hospitalizations in rural areas were less likely to result in readmissions than those in urban areas (OR=0.83; 95% CI: 0.75-0.91). Individuals living in higher-income areas (the third quartile: OR=0.92; CI: 0.86-0.98; and the fourth quartile: OR=0.92; CI: 0.86-0.98) were less likely to be readmitted when compared to those living in low-income areas (the first quartile). The likelihood of being readmitted increased with increase in the index measure for unrelated comorbidity. In contrast to individuals with no unrelated comorbidity, those with one (OR=1.09; CI: 1.03-1.5), two (OR=1.19; CI: 1.12-1.27), and three (OR=1.29; CI: 1.20-1.38) had higher readmissions, but the odds of readmissions were highest among those with four or more (OR=0.91; CI: 0.85-0.98) unrelated comorbidities. Small metropolitan areas (OR: 0.89; CI: 0.83-0.96), micropolitan (OR: 0.76; CI: 0.65-0.89), areas classified as neither metropolitan nor micropolitan areas (OR: 0.72; CI: 0.60-0.87) had lower odds of readmissions due to ARD when compared to the large metropolitan areas. Individuals admitted to hospitals with medium (OR: 1.10; CI: 1.02-1.20) and large number of beds (OR: 1.19; CI: 1.10-1.29) had a higher likelihood of readmissions due to ARD when compared to those admitted in hospitals with small bed size.

Costs of readmissions for ARD

The estimated coefficients for patients who revisited the hospital for ARD diagnosis; those with one or more unrelated comorbidities as per ECI measure; and hospitals with large bed-size are positively associated with the increased costs of readmissions in the 2PM model and statistically found to be significant at the 1% level (Appendix 2). Individuals admitted for ARD as a primary diagnosis at readmissions are likely to cost more than those whose primary cause of readmission is other than ARD, which is conditional on spending any amount. The probability of readmissions costs following an index hospitalization for ARD increases with the number of unrelated comorbidities. Also, the probability of readmissions costs for patients admitted at hospitals with a

large number of short-term acute care beds set up and staffed in a hospital (bed-size) will likely be more than hospitalizations at hospitals with smaller number of short-term acute care beds.

Similarly, the estimated coefficients for females; those hospitalizations that were uninsured and not charged; and admitted in hospitals built in small metropolitan, micropolitan and not metro or micropolitan areas; are negative in both parts and statistically found to be significant at the 1% level (Appendix 2). This indicates that those patients who paid for self and not charged will have lower readmission costs than those who are covered by Medicare. Also, hospitalizations not in metropolitan areas are likely to have less readmissions costs than those in metropolitan areas.

Predicted and incremental readmission costs following index stays for ARD

The mean cost was predicted to be $2,520 per recurrence of ARD diagnoses, $918 more than the cost of readmission without recurring ARD. Readmissions by males were predicted to cost an average of $1,754, about $44 more than that for females. The highest average cost of $1,908 was predicted to be incurred by those between the ages of 45-64 years, which is $1,018 more than the readmissions costs for young adults (18-24 years). The cost of readmissions was the highest for those covered by Medicare ($2,133). Readmission costs increase with the number of unrelated comorbidities increases. For example, the mean cost was $2,414 among patients with 4 or more conditions, which is $1,170 more than those with no unrelated comorbidities. Because the average length of stay for index and revisit hospitalizations for ARD is about 5 days, predicted marginal effects were measured at 5 days and found to be $1,966, which would increase by $295 for every additional day.

The predicted mean readmission cost for hospitals located in large metropolitan areas is $2,032, which is $485, $930 and $1,002 more than readmissions occurring in hospitals located in small metropolitan, micropolitan, and neither metro nor micropolitan areas, respectively. The

readmission cost in hospitals with large number of bed in short-term acute care hospitals is predicted to be an average of $1,964, which is $413 more than hospitals with smaller number of beds. Readmissions in non-federal government hospitals (predicted mean costs: $2,109) costs more by $337 and $567 than readmissions in private not-for-profit (voluntary) and private investor-owned hospitals, respectively. Hospitals experiencing lower volumes of cases for ARD are predicted to cost more to patients for their rehospitalizations. For example, readmission costs are predicted to be the least ($1,666) in hospitals that experience high volume of ARD cases by $488 than those experiencing low volume of ARD cases.

Incremental costs of readmissions with and without recurrence of ARD

Table 5 represents an estimation of incremental costs for readmissions with and without recurrence of ARD (primary diagnoses of ARD at index discharge and readmission). The initial analyses found that 25.7% of readmissions to index hospitalizations for ARD also had primary diagnosis of ARD. This is a huge population of 'frequent users' who get hospitalized in inpatient departments within 30-days for the same diagnoses. We estimated that average marginal costs of readmissions were statistically and significantly greater through all age groups of adults in the group of patients that were readmitted for ARD as recurring diagnoses versus those that were readmitted for other primary diagnoses. For illustration, as compared to young adults, the costs for the elderly with recurrence of ARD was $1,003 ($P<0.0001$) higher while that for the elderly with no recurrence for ARD was higher by $641 ($P<0.0001$). Compared to individuals covered by Medicare and readmitted for recurrence of ARD; the privately insured (-$1,040 vs.-$718), not charged (-$1,176 vs. -$784) and using other insurances compared to Medicare (-$939 vs. $570) incurred lesser costs when compared to those who were not readmitted for recurrence of ARD. However, individuals who were uninsured and had a recurrence for ARD (-$1,154 vs. -$779) paid the least readmission costs compared to those covered by Medicare and without recurrence of ARD. Incremental readmission costs for recurrences of ARD increase significantly with increase

in the number unrelated comorbidities than those readmissions without recurrence of ARD. However, the incremental readmission costs for recurrence of ARD was significantly higher by $419 for every extra day of stay while that for readmissions without recurrence of ARD was increased by $264 only. Compared to readmission costs without recurrence of ARD, costs for treating recurrence of ARD at hospitals in smaller areas was much higher. For example, costs of treating recurrence of ARD in hospitals located in neither metropolitan nor micropolitan areas than those located in large metropolitan areas is less by $1,389 (-$905 less for readmissions without recurrence of ARD at hospitals in neither metropolitan nor micropolitan areas). Similarly, rehospitalizations with higher number of beds incurred more incremental readmissions costs than those with small number of beds for readmissions with recurrence of ARD versus those without recurrence of ARD ($564 vs.$375). Readmissions at non-federal government hospitals incurred more incremental readmissions costs than private not-for-profit (voluntary) (incremental cost: -$473 with recurrence of ARD vs. -$302 without recurrence of ARD) and private investor-owned hospitals (-$804 vs. -$498 without recurrence of ARD) for readmissions due to ARD versus those without ARD. Lastly, readmissions at hospitals experiencing medium (-$424 vs. -$272) and high (incremental cost: -$693 vs. -$441) volume of cases for recurrence of ARD cost significantly less than readmissions at hospitals that experience low volume of cases, especially for readmissions with ARD versus without ARD at primary diagnosis.

Estimated burden of ARD in the US

Based on the weighted number of index hospitalizations for ARD (N=285,767), the estimated total costs of hospitalizations among patients with primary diagnosis of ARD is $2.3 billion (Table 1) per year in the US. Moreover, $512 million (Table 1) is spent on the first 30-day unplanned and all-cause readmissions following these index hospitalizations to ARD, of which it is predicted that $136 million (Table 4) is spent on those readmissions whose primary diagnoses is ARD.

Discussion

To our knowledge, this study is the first to provide nationally representative estimates of the rates of unplanned all-cause 30-day readmissions to index hospitalizations for patients with primary diagnoses of ARD. Previous studies have looked at predictors of readmissions following index hospitalizations where ARD and other psychiatric disorders were comorbidities (Baumeister, Haschke, Munzinger, Hutter, & Tully, 2015; Sacco, Unick, Zanjani, & Camlin, 2015; G. Singh, Zhang, Kuo, & Sharma, 2016; Slaughter, Farris, Singer, Smyth, & Singer, 2017) and not as the primary cause of hospitalizations. Despite the fact that readmissions for ARD are potentially preventable (Patterson et al., 2009; Viggiano et al., 2012), we found that even after the ACA implementation about 19% of index hospitalizations with ARD resulted in 30-day readmissions. The difference in readmission rate maybe because the number of Americans that received access to care increased post-ACA while quality of care and discharge protocols remained mostly unchanged. Also, consistent with pre-ACA findings by Fingar and Washington (2015) for the period 2009-2013 (Fingar & Washington, 2015), our study shows that readmissions following the index discharge due to ARD occur within the first 8 days. Suicidality and social problems have been regarded as the commonest immediate reason behind readmission (N. Chakraborty & Aryiku, 2008). These preventable readmissions may be due to untimely discharge without adequately stabilizing patients and poor transition; failure to continue care after discharge; or insufficient communication among hospital staff, patients, caregivers and community-based clinicians (Viggiano et al., 2012). Furthermore, consistent with previous studies, our study identified high-risk patients that included those who were males, between the age of 45-64 years (B. J. Clark et al., 2013; Weiss, Barrett, Heslin, & Stocks, 2016), covered by Medicaid (Hines, Barrett, Jiang, & Steiner, 2014), residing in urban but low-income areas (Weiss et al., 2016), had utilized emergency departments before inpatient admissions, and having 3 or more chronic conditions and up to 2 unrelated comorbidities (H. Chakraborty et al., 2017; Smith, Stocks, &

Santora, 2015; Walley et al., 2012), were more likely to be hospitalized for ARD which can result in 30-day unplanned readmissions. Additionally, patients who were males, 25 years old and above, with Medicare coverage, 2 or more unrelated comorbidities (Barker et al., 2017; Campbell, Bahorik, Kline-simon, & Satre, 2017; J. D. Prince et al., 2008), residents of urban, and low-income areas have higher odds of readmission. Our results also show that patients were more likely to be readmitted within 30-days than those without unrelated comorbidities, which is consistent with existing literature.

To the best of our understanding, this is the first published study that incorporated patient- as well as hospital-level characteristics to estimate the rates, probability and costs of 30-day readmissions. Our study shows that readmission rates were higher for those hospitalizations that occurred in those hospitals that were not-for-profit private, with large numbers of beds, located in metropolitan areas, had a metropolitan teaching status, and experienced high volume of cases for ARD. This is comparable to results found in the literature (J. D. Prince et al., 2008; Sacco et al., 2015). Patients admitted at hospitals with medium and large bed-size also had higher odds of 30-day readmissions, thereby, indicating that such facilities must improve delivery of integrated treatment and ensure consistent communication across the care team. Like previous literature, we found that readmissions occurring in hospitals located in large metropolitan areas cost higher than those in rural areas. Higher wages for providers, provision of graduate medical education, payer and case mix, higher probability of competition, and treatment of poor, uninsured and Medicaid patients were the reported reasons for the differences in costs of treatment between rural and urban hospitals (iVantage Health Analytics, 2016; Thorpe, 1988). This issue indicates that urban hospitals need to offer less fragmented care, emphasize on continuity of care together with home follow-up visits, and increase education to patients including teaching them self-management of care. These strategies may also be applied by those hospitals where patients incur higher costs of hospitalizations and had large bed-size, were non-

federal public/government hospitals, and had experienced lower volume of ARD cases. Reports which evaluated treatment costs for other diseases also had similar associations between costs of hospitalizations and hospital-level factors (Brinjikji, Rabinstein, & Cloft, 2012; Chen, Jha, Ridgway, Orav, & Epstein, 2010; Walkey & Wiener, 2014). However, this study shows that hospitals that were non-federal government, located in large metropolitan areas and have a larger number of beds, may offer comparatively lower hospitalizations costs to those who had recurrences of ARD at readmissions than without recurrence of ARD. Hence, this indicates that rehospitalizations for the same diagnoses may be treated at lower costs than for different diagnoses at these hospitals. Because there is paucity of similar studies to compare findings on recurrences of ARD, future research needs to be conducted on estimating differences in costs of readmissions with and without recurrences of ARD by patient and hospital-level characteristics.

It is noteworthy that the average cost of index inpatient stays for ARD we found was $8,188, which was almost twice that from findings on all substance abuse-related inpatient hospital stays ($4,600) in 2008 (Stranges et al., 2011). With the absence of recent statistics and comparable studies performed on a national-level on readmissions following index discharge with ARD, our results provide useful, detailed information on possible cost drivers among patient and hospital characteristics. After the implementation of the ACA and other health policies that increase access and coverage for mental health and substance use-related disorders, outpatient services offering follow-ups for ARD should render reduction of readmission rates and costs. Also, we anticipated reduced readmission costs for treating recurrence of ARD because certain elements of treatment such as costs for diagnostics and pathology tests would not be repeated within 30 days. Compared to results of pre-ACA estimated aggregate costs of readmissions ($366 million between 2009-2013) (Fingar & Washington, 2015), our study shows that post-ACA in 2014 alone, a cost of $512 million was incurred for immediate 30-day readmissions. There are only two other studies in our understanding that have attempted to provide similar estimates but

at state-level. The first study used Ontario, Canada's population to derive and validate sex-specific models to predict 30-day psychiatric readmissions (Barker et al., 2017). The second used inpatient data from the San Francisco General Hospital to measure 30-day readmission rates for alcohol dependence to evaluate the discharge protocol (Wei et al., 2015) without estimating costs of readmissions. In the advent of healthcare policy reform, such a comprehensive analysis of rates, costs, and predictors of 30-day readmissions following index stay for ARD provides evidence to the US healthcare policymakers indicating high healthcare utilization for preventable conditions.

Because recurrence of ARD as primary diagnoses was seen frequently (among one in every four 30-day readmissions), cost analyses for readmissions is important. This study is exclusive in evaluating the incremental costs of readmissions with and without recurrence of ARD. Our study showed that the cost of treating recurrence of ARD ($2,520 vs. $1,601) was higher than treating other diagnoses. This result emphasizes the need to provide integrated behavioral health services which can reduce the costs of recurring hospitalizations for ARD. Our findings show that readmissions costs increased with an increase in age and ECI for unrelated comorbidities for those with and without recurrences of ARD at readmissions. However, incremental differences in readmission costs with and without recurrences of ARD were not found to be significantly associated with sex, patient location, and income status for those patients. Therefore, our study highlights that hospital administrators and providers have an opportunity to reduce costs of readmissions by regulating factors that have higher incremental costs for readmissions with recurrence of ARD.

Using health information technology; increasing patient outreach via telephone reminders for outpatient follow-ups; introducing protocols for best practices in discharge planning; and proactively scheduling the first outpatient session after discharge may help reduce readmission rates (Kripalani, Theobald, Anctil, & Vasilevskis, 2014). In a randomized study by Jack et al.,

reports that medication reconciliation, reviewing test results and pending tests, discussion related to action plans of future treatments, and sharing post-discharge plans in both written (patient education) and verbal (instructions in plain language) formats have helped reduce readmissions at inpatient and emergency departments (Jack et al., 2009). Author Coleman et al. conducted 'Care Transitions Intervention' by utilizing nurses to be coaches of transitions to offer home visits within 48-72 hours of discharge to significantly reduced 30-day readmissions (Coleman, Parry, Chalmers, & Min, 2006). A few recommendations and interventions are specifically suggested to reduce readmission rates among these patients with multiple comorbid and chronic conditions. Patients who are not provided holistically managed care must be referred to suitable intensive services. Also, by offering peer coaching for transitioning from ARD and managing other comorbidities; and implementing clinical interventions to encourage adherence to treatment, readmission rates may be reduced (Hudali, Robinson, & Bhattarai, 2017; Kripalani, Theobald, Anctil, & Vasilevskis, 2014; Pincus, 2014)

In summary, this national-level study contributes to the knowledgebase on economic burden of primary diagnoses by using sophisticated analysis of several types of patient and hospital-level characteristics that are predictors of readmissions, the cost of index stays and readmissions. Also, our study provides robust estimates on readmission costs by simultaneously addressing the problem of zero costs of readmissions and thus skewed (to the right) distribution of hospital and readmission costs, which is novel for studies with ARD as a primary or even secondary diagnosis. Policymakers and hospital administrators can benefit from the findings and may implement protocols for hospitals that monitor and bridge care after index hospitalizations to outpatient settings. Local and state public health departments must contrive for community-based outreach programs to educate high-risk patients to curb readmission rates for ARD which are comparatively top ten in volume but also preventable.

Conclusions

One in five index hospitalizations for ARD in the US results in unplanned all-cause 30-day readmission, with a major proportion occurring within the first 8 days. One in 4 of these readmissions chances to be for a principal diagnosis for ARD. Readmissions rates, an international indicator of healthcare quality, are fund to be more likely among those patients who are 45-64 years old and suffer from multiple comorbidities. Overall, readmissions costs are found to be higher in hospitals located in large metropolitan areas, with high number of beds, of not-for-profit government status, and treat low volume of ARD cases per year. However, in contrast, these hospital characteristics render lower costs for treating readmissions for recurrence of ARD. The estimated burden of ARD-driven index hospitalization in the US in 2014 was $2.3 billion of which approximately $474 million were costs on the hospital stays that led to readmissions. Nationally, $512 million were spent on treating the first readmissions following the index hospitalizations for ARD of which $136 million is predicted to be spent on relapse visits for principal diagnosis for ARD. These exorbitant costs on index stays and readmissions indicate the fragmented behavioral care offered currently, despite the advent of value-based care, and highlight the need for integrated behavioral health services, which can curb these preventable readmissions for ARD. An ecological, multifaceted, and combined effort by patients and hospitals can together reduce factors that propel preventable readmissions and steep costs for ARD. Future studies must analyze patient-level predictors and costs of treating patients with ARD in the outpatient departments or other healthcare settings after index discharge and before being readmitted within 30 days. Such analysis will help in understanding the extent to which patients are utilizing follow-up care before being readmitted.

Table 1: Flow chart of exclusion criteria for numbers of observed hospital discharges per unique patients applicable to index admissions and readmissions from the NRD, 2014.

Observed discharges (n) & unique patients (N)	Excluded discharges (n) & unique patients (N)	Explanations
n = 14,894,613 N = 10,943,999		All discharges in NRD
n=14,557,976 N= 10,727,851	n=336,637 N=216,148	Excluded if discharge status is: a) Transfer to acute (n=131,761; N= 90,467) b) Left against medical advice (n=189,690; N= 116,738) c) Unknown (n=15,186; N= 8,943) [a]
n=13,985,297 N=10,178,040	N=572,679 N=549,811	Excluded if discharges for primary diagnoses of Cancer [b]
n=13,963,965 N=10,162,858	n=21,332 N=15,182	Excluded if discharges primary diagnoses of Rehabilitation [b]
n=13,394,199 N=10,031,591	n=569,766 N=131,267	Exclude who were not residents of the state in which the initial hospitalization took place were excluded since they would most likely be readmitted in their state of residence and this would not be captured in the NRD.
n=13,195,896 N=9,894,825	n=198,303 N=136,766	Excluded if LOS is:[c] a) LOS is missing (n= 16; N= 16) b) LOS=0 (n=198,287 and N=136,750)
n=11,349,289 N=8,153,943	n=1,846,607 N=1,740,882	Acute inpatient discharge with a principal diagnosis of pregnancy.[d]
n=10,617,850 N=7,441,110	n=731,439 N=712,833	Acute inpatient discharge with a principal diagnosis of a condition originating in the perinatal period.
n=10,203,006 N= 7,108,419	n= 414844 N=332691	Excluded children and adolescents from the study

NRD, Nationwide Readmissions Database; n, number of observed discharges; N= unique number of patients; LOS, length of stay.

[a] Healthcare Cost and Utilization Project (HCUP). (2017). Nationwide readmissions database description of data elements. Retrieved from https://www.hcup-us.ahrq.gov/db/vars/nrd_visitlink/nrdnote.jsp

[b] Horwitz, L., Grady, J., Lin, Z., Nwosu, C., Keenan, M., Bhat, K. R., … Drye, E. (2014). *2014 Measure Updates and Specifications Report : Hospital-Wide All-Cause Unplanned Readmission*. *Centers for Medicare & Medicaid Services (CMS)*.

[c] Yoon, F., Sheng, M., Jiang, H., Steiner, C., & Barrett, M. (2017). *Calculating Nationwide Readmissions Database (NRD) Variances*. *HCUP Methods Series Report # 2017-01*. ONLINE. January 24, 2017. U.S. Agency for Healthcare Research and Quality. Available: http://www.hcupus.ahrq.gov/reports/methods/methods.jsp

[d] National Committee for Quality Assurance. (2015). *Proposed Changes to Existing Measure for HEDIS ® 2015: Plan All-Cause Readmissions (PCR)*.

Table 2: Characteristics of patients and hospitals registered in the NRD 2014 with an index hospitalization for alcohol-related disorders based on 30-day all-cause readmissions.

Characteristics	Overall N=285,767 (100%)		Readmissions N= 54,083 (18.93%)		No Readmissions N= 231,684 (81.07%)		P value
	Number	Percent	Number	Percent	Number	Percent	
PATIENT-LEVEL CHARACTERISTICS							
Age in years							
18 to 24	6,124	2.1	503	0.9	5,622	2.4	<.0001
25 to 44	89,087	31.2	15,357	28.4	73,730	31.8	
45 to 64	165,458	57.9	33,723	62.4	131,736	56.9	
65 and over	25,097	8.8	4,500	8.3	20,597	8.9	
Mean age ± SD	48.9 ± 0.11		49.8 ± 0.15		48.7 ± 0.11		
Sex							<.0001
Male	205,366	71.9	39,811	73.6	165,554	71.5	
Female	80,401	28.1	14,271	26.4	66,130	28.5	
Primary payer*							<.0001
Medicare	57,164	19.9	12,580	23.3	44,584	19.2	
Medicaid	100,181	34.9	22,374	41.4	77,807	33.5	
Private Insurance	68,582	23.2	9,475	17.5	59,107	25.4	
Uninsured	39,763	13.8	6,320	11.7	33,443	14.4	
No charge	6,870	2.4	1,267	2.3	5,603	2.4	
Other	12,786	4.5	1,989	3.7	10,797	4.6	
Admission Day							0.0014
Weekday	219,108	76.7	40,973	75.8	178,135	76.9	
Weekend	66,658	23.3	13,109	24.2	53,549	23.1	
Disposition status							<.0001
Routine	247,328	86.6	46,813	86.6	200,516	86.6	

Transfer to Nursing, intermediate or other facility	26,299	9.2	4,371	8.1	21,927	9.5	
Home Health Care (HHC)	12,140	4.2	2,899	5.4	9,241	4.0	
Median household income national quartile for patient ZIP code**							<.0001
First quartile	85,736	30	17,615	32.6	68,121	29.4	
Second quartile	71,798	25.1	13,541	25.0	58,257	25.2	
Third quartile	63,405	22.2	11,347	21.0	52,058	22.5	
Fourth quartile	60,454	21.15	10,791	20.0	49,663	21.4	
Patient location*							<.0001
Urban	249,709	87.11	48,384	89.5	201,325	86.6	
Rural	32,893	11.47	4,870	9.0	28,023	12.1	
Number of chronic conditions							<.0001
0	16	0.01	0	0.0	16	0.0	
1	10,274	3.6	1,311	2.4	8,963	3.9	
2	27,853	9.75	4,220	7.8	23,633	10.2	
3 or more	247,624	86.65	48,552	89.8	199,072	85.9	
Elixhauser Comorbidity Index measure							
Related comorbid conditions [a]							<.0001
0	160,174	56.05	28,620	52.9	131,554	56.8	
1	119,179	41.7	23,927	44.2	95,252	41.1	
2	6,332	2.22	1,506	2.8	4,826	2.1	
Unrelated comorbid conditions [b]							<.0001
0	53,551	18.74	8,357	15.5	45,194	19.5	
1	69,762	24.41	12,190	22.5	57,572	24.9	

2	65,630	22.97	12,623	23.3	53,007	22.9	
3	47,846	16.74	9,828	18.2	38,018	16.4	
4 or more	48,977	17.14	11,084	20.5	37,893	16.4	
Elective							<.0001
Non-elective admission	258,955	90.78	50,275	93.2	208,680	90.2	
Elective admission	26,312	9.22	3,679	6.8	22,633	9.8	
Utilization of emergency services							NA
Yes	224,357	78.48	44,159	81.6	180,198	77.5	
No	61,410	21.52	9,924	18.4	51,486	22.5	
Length of stay in days, mean ± SD (median)	5.3±0.11 (3.01)		5.3 ±0.10 (3.18)		5.3 ±0.12 (2.98)		NA
Total cost of index hospitalizations	$2,316,239,719.00		$473,917,432.00		$1,842,322,287.00		
Cost of index hospitalization in dollars, mean + SD (median)	$8,188.28 ± 204.78 ($5,012.08)		$8,839.60 ± 344.91 ($5,271.74)		$8,035.97 ± 182.51 ($4950.55)		NA
Total cost of immediate readmission			$512,763,105.00				
HOSPITAL-LEVEL CHARACTERISTICS							
Hospital control/ ownership							0.3893
Government, nonfederal	36,468	12.76	7,253	13.4	29,215	12.6	
Private, non-profit	211,842	74.13	39,637	73.3	172,206	74.3	

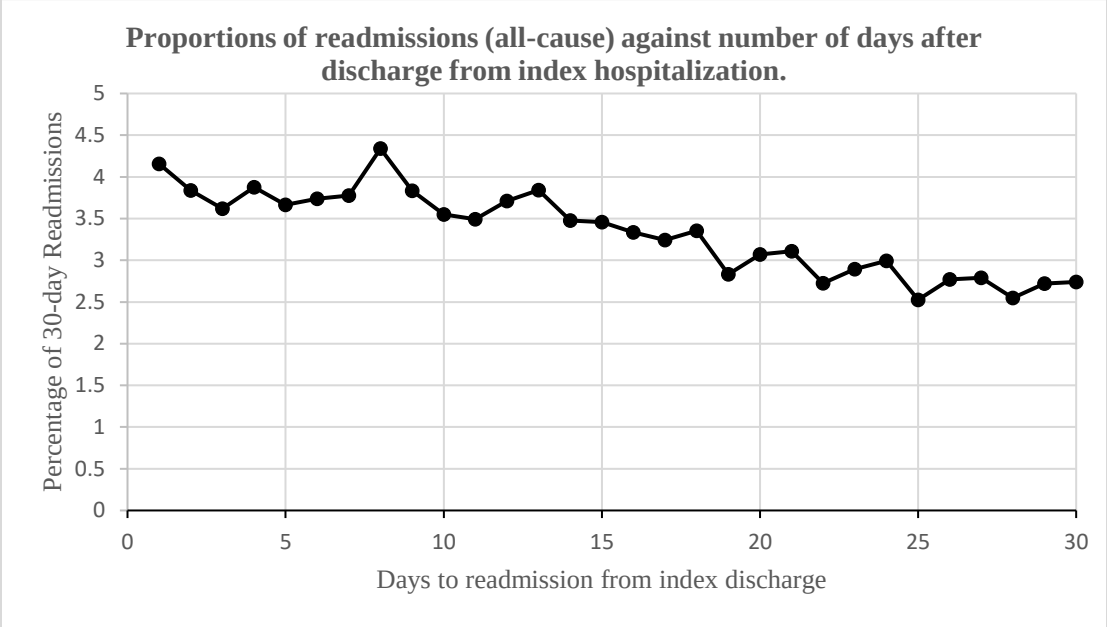
Private, invest-own	37,456	13.11	7,193	13.3	30,263	13.1	
Bed-size of hospital							0.0006
Small	47,737	16.7	8,191	15.2	39,546	17.1	
Medium	87,472	30.61	16,189	29.9	71,282	30.8	
Large	150,557	52.69	29,702	54.9	120,855	52.2	
Hospital location							
Large metropolitan areas	165,264	57.83	33,320	61.6	131,944	57.0	<.0001
Small metropolitan areas	98,560	34.49	17,665	32.7	80,895	34.9	
Micropolitan areas	16,680	5.84	2,443	4.5	14,236	6.1	
Not metropolitan or micropolitan	5,263	1.84	654	1.2	4,609	2.0	
Teaching status							<.0001
Metropolitan non-teaching	73,209	25.62	12,726	23.5	60,483	26.1	
Metropolitan teaching	190,615	66.7	38,259	70.7	152,356	65.8	
Non-metropolitan hospital	21,942	7.68	3,097	5.7	18,845	8.1	
Hospital volume [c]							0.0041
Low	50,055	17.52	8,667	16.0	41,388	17.9	
Medium	70,117	24.54	13,328	24.7	56,789	24.5	
High	165,496	57.93	32,064	59.3	133,432	57.6	

NRD, Nationwide Readmissions Database.

P-value in the last column represents the significance of difference of characteristics between index hospitalizations without readmission group and index hospitalizations with at least one readmission group.

*The sum of individual counts may not add up to the total number of visits because of missing information for certain variables.
**Median household income quartiles of residents in the patient's ZIP code for 2014 are defined as: (1) $1 - $39,999; (2) $40,000 - $50,999; (3) $51,000 - $65,999; and (4) $66,000 or more.
[a] Count of related comorbid conditions including drug-related, depression, and psychoses.
[b] Count of non-related comorbid conditions which comprises of a count of one for congestive heart failure, valvular disease, pulmonary circulation disease, peripheral vascular disease, paralysis, other neurological disorders, chronic pulmonary disease, diabetes without chronic complications, diabetes with chronic complications, hypothyroidism, renal failure, liver disease, peptic ulcer bleeding, acquired immune efficiency syndrome, lymphoma, metastatic cancer, solid tumor without metastasis, rheumatoid arthritis, coagulopathy, obesity, weight loss, fluid and electrolyte disorders, chronic blood loss anemia, and deficiency anemia.
[c] Computed based on the tertile cutoff values of (1) up to 41, (2) 42-97, and (3) 98 and over index admissions at each facility for ARD.

Figure 1: Proportions of 30-day readmissions (all-cause) against number of days after discharge from index hospitalization for alcohol-related disorders using NRD, 2014.



NRD, Nationwide Readmissions Database

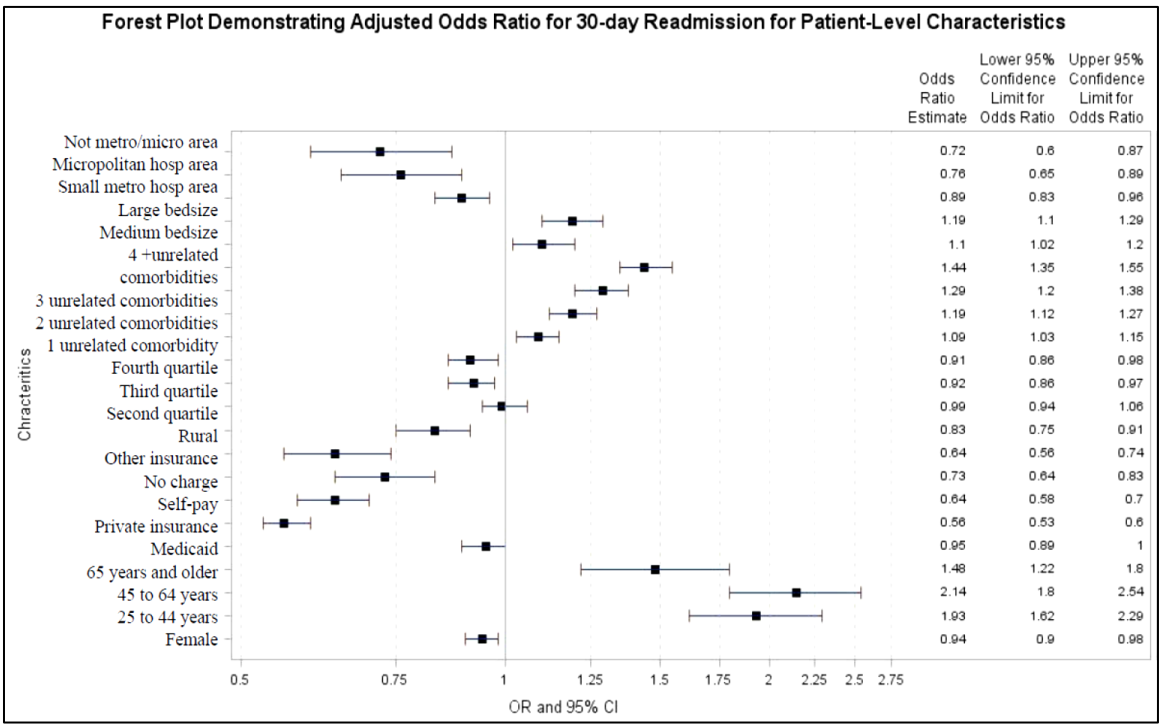
Table 3: Logistic regression for 30-day readmissions on index hospitalizations for alcohol-related disorders, NRD 2014.

Variable	Estimate	Odds ratio	95% confidence level		P-value
			Lower limit	Upper limit	
Intercept	-2.076				<.0001
Sex					
Male			Reference		
Female	-0.067	0.935	0.896	0.976	0.002
Age					
18 to 24			Reference		
25 to 44	0.655	1.926	1.620	2.290	<.0001
45 to 64	0.760	2.138	1.803	2.535	<.0001
65 and over	0.394	1.482	1.222	1.797	<.0001
Primary payer					
Medicare			Reference		
Medicaid	-0.053	0.948	0.894	1.005	0.073
Private Insurance	-0.572	0.564	0.529	0.602	<.0001
Uninsured	-0.452	0.636	0.579	0.699	<.0001
No charge	-0.318	0.727	0.641	0.826	<.0001
Other	-0.444	0.641	0.557	0.738	<.0001
Patient location					
Urban			Reference		
Rural	-0.188	0.829	0.754	0.911	<.0001
Median household income national quartile for patient ZIP code**					
First quartile			Reference		
Second quartile	-0.006	0.994	0.936	1.057	0.851
Third quartile	-0.087	0.916	0.861	0.975	0.006
Fourth quartile	-0.089	0.915	0.855	0.979	0.010
Elixhauser Comorbidity Index for unrelated comorbid conditions					
0			Reference		
1	0.085	1.089	1.032	1.149	0.002
2	0.177	1.194	1.124	1.268	<.0001
3	0.252	1.287	1.201	1.379	<.0001
4 or more	0.368	1.445	1.346	1.551	<.0001
Hospital urban-rural designation					
Large metropolitan areas			Reference		
Small metropolitan areas	-0.114	0.893	0.830	0.960	0.002
Micropolitan areas	-0.272	0.762	0.653	0.889	0.001
Not metro or micro	-0.328	0.720	0.596	0.871	0.001
Bedsize of hospital					
Small	Reference				
Medium	0.099	1.104	1.017	1.198	0.018
Large	0.177	1.193	1.104	1.290	<.0001

NRD, Nationwide Readmissions Database; metro, metropolitan; micro, micropolitan.

**Median household income quartiles of residents in the patient's ZIP code for 2014 are defined as: (1) $1 - $39,999; (2) $40,000 - $50,999; (3) $51,000 - $65,999; and (4) $66,000 or more.

Figure 2: Forest plot demonstrating adjusted odds ratio for 30-day readmissions on index hospitalizations due to alcohol-related disorders for comorbidities, key patient and hospital characteristics using NRD, 2014.



NRD, Nationwide Readmissions Database.

Table 4: Post-regression estimates for predicted and incremental costs for readmissions with index hospitalizations for alcohol-related disorders using the NRD 2014.

Characteristics	Predicted marginal costs		Average marginal effects (dy/dx)	SE	P>z	95% confidence interval	
	Mean	SE				Lower limit	Upper limit
Recurrence of ARD diagnoses							
No	$1,601.67	$33.50			Reference		
Yes	$2,519.89	$73.32	$918.22	71.32	<.0001	778.45	1,057.99
Sex							
Male	$1,798.31	$37.04			Reference		
Female	$1,754.46	$49.09	-$43.85	49.822	0.379	-141.50	53.80
Age							
18 to 24	$890.09	$162.38			Reference		
25 to 44	$1,636.67	$46.27	$746.58	168.42	<.0001	416.48	1076.67
45 to 64	$1,908.29	$39.81	$1,018.20	164.15	<.0001	696.47	1339.93
65 and over	$1,603.48	$88.12	$713.38	184.50	<.0001	351.78	1074.99
Primary payer							
Medicare	$2,132.53	$64.47			Reference		
Medicaid	$2,112.33	$51.61	-$20.20	79.09	0.798	-175.20	134.81
Private Insurance	$1,350.67	$50.24	-$781.86	76.28	<.0001	-931.37	-632.36
Uninsured	$1,279.42	$50.99	-$853.11	79.72	<.0001	-1009.36	-696.86
No charge	$1,271.25	$96.98	-$861.28	114.22	<.0001	-1085.14	-637.41
Other	$1,429.62	$127.48	-$702.91	135.54	<.0001	-968.57	-437.25
Patient location							
Urban	$1,781.07	$33.61			Reference		
Rural	$1,841.36	$143.78	$60.29	144.98	0.678	-223.87	344.44
Median household income national quartile for patient ZIP code**							
First quartile	$1,735.07	$49.39					
Second quartile	$1,807.45	$52.29	$72.38	63.73	0.256	-52.53	197.30
Third quartile	$1,745.86	$58.67	$10.79	68.62	0.875	-123.70	145.27
Fourth quartile	$1,876.69	$67.17	$141.62	81.47812	0.082	-18.08	301.31
Elixhauser Comorbidity Index for unrelated comorbid conditions							

0	$1,244.17	$44.37			Reference		
1	$1,478.73	$43.98	$234.57	58.28	<.0001	120.35	348.79
2	$1,733.70	$51.45	$489.53	61.42	<.0001	369.16	609.90
3	$2,075.12	$68.83	$830.96	78.31	<.0001	677.48	984.44
4 or more	$2,414.64	$86.39	$1,170.47	98.46	<.0001	977.50	1363.45
Length of stay [a]	$1,966.15	$49.57	$295.28	41.19	<.0001	214.54	376.015
Hospital urban-rural designation							
Large metropolitan areas	$2,032.20	$53.42			Reference		
Small metropolitan areas	$1,547.50	$51.05	-$484.70	69.64	<.0001	-621.19	-348.22
Micropolitan areas	$1,102.39	$97.64	-$929.81	121.32	<.0001	-1167.59	-692.02
Not metro or micropolitan	$1,030.69	$123.30	-$1,001.51	139.81	<.0001	-1275.54	-727.49
Bed-size of hospital							
Small	$1,551.04	$62.86			Reference		
Medium	$1,627.36	$48.82	$76.32	75.50	0.312	-71.66	224.29
Large	$1,964.03	$53.25	$412.99	82.99	<.0001	250.34	575.64
Hospital control/ ownership							
Government, nonfederal	$2,109.25	$96.71			Reference		
Private, non-profit	$1,772.75	$39.41	-$336.50	103.57	0.001	-539.49	-133.50
Private, invest-own	$1,542.12	$64.50	-$567.13	114.28	<.0001	-791.11	-343.15
Hospital volume [b]							
Low	$2,154.79	$80.36			Reference		
Medium	$1,852.60	$62.58	-$302.19	93.03	0.001	-484.52	-119.85
High	$1,665.99	$44.90	-$488.80	92.80	<.0001	-670.69	-306.91

NRD, Nationwide Readmissions Database; SE, Standard error

** Median household income quartiles of residents in the patient's ZIP code for 2014 are defined as: (1) $1 - $39,999; (2) $40,000 - $50,999; (3) $51,000 - $65,999; and (4) $66,000 or more.

[a] Predicted marginal costs are computed using the mean length of stay of 5 days.

[b] Computed based on the tertile cutoff values of (1) up to 41, (2) 42-97, and (3) 98 and more index admissions at each facility for ARD.

Table 5: Post-regression estimates for average marginal effects among individuals with and without readmissions with recurrence of alcohol-related disorders, NRD 2014.

Characteristics	Readmission with recurrence of ARD N=13,906 (25.71%)					Readmission without recurrence of ARD N=40,177 (74.29%)				
	Average marginal effects (dy/dx)	Std. Err.	P>z	95% Conf. Interval Lower limit	Upper limit	Average marginal effects (dy/dx)	Std. Err.	P>z	95% Conf. Interval Lower limit	Upper limit
PATIENT CHARACTERISTICS										
Sex										
Male			Reference					Reference		
Female	-$53.09	$69.08	0.442	-188.48	82.30	-$41.62	$45.01	0.355	-$129.85	$46.60
Age										
18 to 24			Reference					Reference		
25 to 44	$1,022.29	$245.33	<.0001	541.46	1503.12	$677.89	$149.46	<.0001	384.96	970.82
45 to 64	$1,391.33	$240.81	<.0001	919.36	1863.30	$925.27	$145.57	<.0001	639.96	1210.58
65 and over	$1,002.47	$265.75	<.0001	481.61	1523.34	$641.06	$164.46	<.0001	318.72	963.40
Primary Payer										
Medicare			Reference					Reference		
Medicaid	-$20.76	$107.71	0.847	-231.87	190.36	-$20.09	$72.04	0.780	-161.28	121.10
Private Insurance	-$1,040.37	$107.00	<.0001	-1250.08	-830.66	-$718.12	$69.48	<.0001	-854.30	-581.94
Uninsured	-$1,153.71	$112.04	<.0001	-1373.3	-934.12	-$778.89	$72.67	<.0001	-921.33	-636.45
No charge	-$1,176.13	$160.00	<.0001	-1489.73	-862.53	-$783.48	$103.61	<.0001	-986.56	-580.40
Other	-$939.41	$188.69	<.0001	-1309.24	-569.59	-$644.57	$122.77	<.0001	-885.20	-403.93
Patient location										
Urban			Reference					Reference		
Rural	$108.62	$204.18	0.595	-291.57	508.81	$47.89	$130.15	0.713	-207.19	302.97
Median household income national quartile for patient ZIP code**										
First quartile			Reference					Reference		
Second quartile	$103.31	$87.55	0.238	-68.29	274.90	$64.60	$57.81	0.264	-48.70	177.89
Third quartile	$26.75	$94.49	0.777	-158.45	211.95	$6.66	$62.16	0.915	-115.18	128.49
Fourth quartile	$211.77	$112.68	0.06	-9.08	432.62	$123.86	$73.73	0.093	-20.64	268.36
Elixhauser Comorbidity Index for unrelated comorbid conditions										

0			Reference					Reference		
1	$326.85	$81.63	<.0001	166.85	486.85	$211.73	$52.62	<.0001	108.61	314.86
2	$678.33	$86.09	<.0001	509.59	847.07	$442.84	$55.77	<.0001	333.54	552.15
3	$1,149.65	$116.22	<.0001	921.86	1377.45	$752.16	$69.87	<.0001	615.23	889.10
4 or more	$1,608.78	$139.56	<.0001	1335.25	1882.32	$1,062.19	$89.83	<.0001	886.14	1238.25
Length of stay	$418.59	$57.16	<.0001	306.55	530.63	$264.27	$37.45	<.0001	190.87	337.67
HOSPITAL CHARACTERISTICS										
Hospital urban-rural designation										
Large metropolitan areas			Reference					Reference		
Small metropolitan areas	-$671.17	$94.26	<.0001	-855.91	-486.43	-$438.02	$63.89	0	-563.24	-312.80
Micropolitan areas	-$1,290.99	$175.88	<.0001	-1635.7	-946.276	-$839.34	$108.50	0	-1052.00	-626.69
Not metro or micropolitan	-$1,388.80	$200.82	<.0001	-1782.39	-995.2	-$904.54	$125.38	0	-1150.28	-658.80
Bed-size of hospital										
Small			Reference					Reference		
Medium	$97.94	$104.00	0.346	-105.89	301.78	$70.99	$68.39	0.299	-63.06	205.04
Large	$563.39	$114.55	<.0001	338.87	787.91	$375.40	$75.33	0	227.77	523.04
Hospital control/ ownership										
Government, nonfederal			Reference					Reference		
Private, non-profit	-$473.39	$140.78	0.001	-749.32	-197.45	-302.12	94.49	0.00	-487.31	-116.93
Private, invest-own	-$803.85	$156.14	<.0001	-1109.88	-497.81	-507.62	104.26	0.00	-711.95	-303.28
Hospital volume										
Low			Reference					Reference		
Medium	-$424.10	$128.67	0.001	-676.29	-171.91	-271.56	84.25	0.00	-436.69	-106.44
High	-$693.28	$128.50	<.0001	-945.13	-441.42	-437.36	84.19	0.00	-602.37	-272.35

ARD, Alcohol-related disorders; NRD, Nationwide Readmission Database; SE, Standard error.

**Median household income quartiles of residents' ZIP code for 2014 are: (1) $1 - $39,999; (2) $40,000 - $50,999; (3) $51,000 - $65,999; and (4) $66,000 or more. [a] Predicted marginal effects of length of stay was measured at 5 days (average length of stay) to treat both index hospitalizations and readmissions for ARD.

[b] Computed based on the tertile cutoff values of (1) up to 41, (2) 42-97, and (3) 98 and more index admissions at each facility for ARD.

CHAPTER IV: EMERGENCY DEPARTMENTS UTILIZATION FOR BEHAVIORAL HEALTH CONDITIONS AND DISTRIBUTION OF BEHAVIORAL HEALTH WORKFORCE AND EMERGENCY DEPARTMENTS IN NEBRASKA, 2011-2013

Introduction

Previous literature has shown that patients suffering from behavioral health (BH) and comorbid conditions frequently visit the emergency departments (EDs), which often become an entry point for treating such conditions (Crane, Collins, Hall, & Rochester, 2012; Curran et al., 2003; Doupe, Palatnick, Day, Chateau, & Soodeen, 2012; Mulkern et al., 2007; Owens et al., 2010; Pines et al., 2011; Smith, Stocks, & Santora, 2015). Reports suggest that patients seeking psychiatric care account for between 6 to 9% of all ED visits (Hazlett, McCarthy, Londner, & Onyike, 2004; Larkin, Claassen, Emond, Pelletier, & Camargo, 2005; Owens et al., 2010; Zeller, Calma, & Stone, 2014) and that 18% of frequent ED users had BH conditions compared to only 6% of the total study population (Peppe et al., 2007). Hence, it has become necessary to evaluate the reasons for patients to utilize the ED for BH-related conditions. Some communities lack access to general health services and specialty care. Under such circumstances, patients tend to visit and treat the ED as an ‘open door' for uncomplicated and routine BH care (Clarke, Dusome, & Hughes, 2007; Doren et al., 2016). It should be noted that many EDs have few BH services to offer, which compels patients to wait or “board” while the ED staff searches for an open inpatient psychiatric bed. This results in two issues: (i) the patient’s condition might worsen, eventually requiring more psychiatric care, and (ii) an ED visit incurs a high cost ($2,264 per visit) (Korn, Currier, & Henderson, 2000; Nicks & Manthey, 2012; Zeller et al., 2014).

In 2014, the Kaiser Family Foundation reported that about 30.2% of Nebraska’s residents suffer from some form of BH condition, (Kaiser Family Foundation, 2014) leading to $167 million in expenditures (Insel, 2008). But in Nebraska, 88 out of 93 counties have been designated as Mental Health Professions Shortage Areas and 32 counties have no BH provider of

any kind (Liu & Khan, 2017). It has been well-documented that there exists a health disparity between rural and urban areas, which is associated with residents' ability to access BH specialists (Edelstein, Pater, Sharma, & Albert, 2014). BH service delivery models in urban areas might often be unsuitable and challenging to implement in rural settings (Elhai et al., 2004). It is widely thought that rural residents experience severe living circumstances, such as low income, lack of employment, and scarcity of health services, which result in a higher prevalence of BH disorders (Probst et al., 2006; Rohrer, Borders, & Blanton, 2005; Ziller, Anderson, & Coburn, 2010). In addition, because of the long distances between rural homes and primary care clinics, EDs in rural hospitals have become the closest point of health services (Greenwood-Ericksen, Tipirneni, & Abir, 2017). Previous literature has shown increased mortality among adults living in rural areas due to suicide and substance use disorders (A. Case & Deaton, 2015; Joynt, Nguyen, Samson, & Snyder, 2016). However, there is limited research at the state-level to investigate the economic impact due to a shortage of BH workforce and existing rural-urban disparities on hospital-based EDs. Nebraska is in the unique position to conduct this type of study because it implements an active surveillance of health professionals, which provides county-level data on BH professionals.

ED outcomes include routine release upon treatment, transfer to short-term hospitals/skilled nursing facility (SNF), discharge with commencement of home health services (HHC), and discharge against medical advice. Those patients who leave against medical advice have a higher likelihood of not adhering to treatment, participating in follow-up care at rehabilitation centers or outpatient clinics with specialty care for BH disorders. Also, such patients may not use preventative services for existing BH disorders and may not monitor the severity of the BH condition for which they were admitted in the ED. Previous studies analyzed impact of BH disorders on the ED outcome of discharge against medical advice among specific classes of patients. For example, one study examined impact of discharge against medical advice among those suffering from HIV (B. Choi, DiNitto, Marti, & Choi, 2016), while another focused

on older adults (Choi, Dinitto, Marti, & Choi, 2015). O'Toole and group studied the impact of leaving against medical advice in a hospital's outpatient substance abuse treatment unit. However, to our knowledge, little information is available on the association of patient-related factors such as age, sex, insurance and income statuses, and existing comorbidities with being discharged against medical advice following an ED visit for primary diagnosis of BH disorders. With an increase in prevalence of BH disorders in both rural and urban areas across all age groups (Reynolds, Pietrzak, El-Gabalawy, Mackenzie, & Sareen, 2015; Robinson et al., 2017), these disorders are an important public health issue that affect the well-being of individuals and the healthcare system in terms of use of services and the corresponding costs. Hence, identification of the high-risk groups who leave ED against medical advice following primary diagnoses for BH can help public health practitioners, hospital administrators, and BH clinicians to create unique programs, especially for patients in rural areas with less access to care and find ways to encourage such patients to comply with treatments.

This study aims to estimate hospital-based ED visits, ED outcomes, and associated charges for BH conditions within the state of Nebraska. The objectives of this study were four-fold. First, we characterized ED visits for BH conditions from 2011 to 2013 within Nebraska at the regional-level. Second, we mapped the distribution of BH workforce, availability of EDs, and patient BH-related ED visits at the region-level. Third, we determined patient-related characteristics associated with ED visits for BH. Finally, we estimated the association of patient-level factors with being discharged against medical advice. We anticipate that findings from this study will help to guide policy recommendations for predominantly rural states such as Nebraska to address specific BH-related treatment needs by increasing workforce and access in such areas. We expect that such health policies will improve patient outcomes and reduce rates of costly revisits and ED visits.

Methods

Data Sources

State Emergency Department Database

This study utilizes the Nebraska State Emergency Department Database (SEDD) from the Healthcare Cost and Utilization Project (HCUP) for the years 2011 to 2013, which contains de-identified patient information. SEDD belongs to the family of databases sponsored by the Agency for Healthcare Research and Quality (AHRQ). SEDD provides census data on treat-and-release emergency department visits, which include more than 80% of all emergency department visits. (Healthcare Cost and Utilization Project, 2015) It must be noted that SEDD contains information on only those emergency visits that did not eventually result in hospitalizations. Important patient and hospital-related variables available in SEDD include age, sex, the presence of co-morbid conditions, charges, disposition status, patient location, the number of ED visits, and insurance and median household income.

Health Professions Tracking Service annual survey database

We used data obtained from the University of Nebraska Medical Center's College of Public Health, Health Professions Tracking Service (HPTS) annual survey database for 2013 to calculate the number of EDs and BH professionals available in Nebraska at county-level (Appendix 3). HPTS builds a database from licensure data of Nebraska's healthcare professionals, which is continuously updated through extensive data collection and data exchange activities.

BH professionals are categorized as psychiatric prescribers, independent BH professionals, and other BH professionals. Based on the ability of these professionals to prescribe within the state of Nebraska, psychiatric prescribers consist of three licensed professionals: psychiatrists, advanced practice registered nurses, and physician assistants. Similarly, those professionals who held board-certified licenses and were actively practicing within the state, such as psychologists and independent mental health practitioners, were classified as independent BH professionals. Additionally, alcohol and drug counselors, as well as other BH professionals that practiced as a mental health practitioner in the state of Nebraska and held a license, were included

in the group as other BH professionals. For this study, we included all seven sub-types of BH professionals. All patients within Nebraska who had visited the ED for BH disorders comprised the study population.

Measures

All hospital-based ED visits for patients with BH conditions in the State of Nebraska in 2011 to 2013 were selected. Appendix 4 presents the list of all primary diagnoses and surgical codes for each patient that has been used in this study. The codes 290–294 for psychotic conditions; 295–299 for other neurotic disorders; 300–316 for neurotic disorders, personality disorders, substance-use-related and other nonpsychotic mental disorders; and 317–319 for intellectual disabilities have been identified by the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM).

The independent variables included in the study were patient-related demographic characteristics such as age and sex. Patient location includes categories such as urban, large rural, small rural, and isolated rural towns defined upon by the ZIP codes using population, primary destination of commuting information from the Census. Based on the patients' disposition at discharge (routine, transfer to another hospital, died, etc.), a variable called the disposition status was classified and used. Income status was defined using a quartile classification of the estimated median household income of residents in the patient's ZIP Code. The variable "insurance status" in our study indicated the primary payer who was expected to cover charges for the ED visit, for example, Medicaid, Medicare, private insurance. SEDD also included information on those patients who paid for themselves, were uninsured, or not charged.

The comorbid burden was estimated using the Elixhauser Comorbidity Index (ECI) measure, which was computed by summing up the 29 binary Elixhauser comorbidity variables available in the current HCUP Elixhauser Comorbidity Software, Version 3.7 (HCUP Comorbidity Software, Version 3.7.," 2017). An ECI measure of 0 indicates the absence of co-morbid conditions. All comorbidity variables were determined by the ICD-9-CM codes. Clinical

conditions primarily responsible for the emergency visits such as depression, psychoses, alcohol and drug-related abuse were not considered comorbidities, as per the standard norms of computing ECI measure using the Elixhauser Comorbidity Software (Elixhauser A, Steiner C, Harris DR, 1998; H. B. Mehta et al., 2017; Moore, White, Washington, Coenen, & Elixhauser, 2017; Sarfati, 2016; Strom et al., 2017). The remaining conditions called 'unrelated comorbid conditions' comprise of congestive heart failure, valvular disease, pulmonary circulation disease, peripheral vascular disease, paralysis, other neurological disorders, chronic pulmonary disease, diabetes without chronic complications, diabetes with chronic complications, hypothyroidism, renal failure, liver disease, peptic ulcer bleeding, acquired immune deficiency syndrome, lymphoma, metastatic cancer, solid tumor without metastasis, rheumatoid arthritis, coagulopathy, obesity, weight loss, fluid and electrolyte disorders, chronic blood loss anemia, and deficiency anemia.

Outcomes

One of the primary outcome variables for this study was the incurred hospital ED charges (in dollars). Here, total charges represent the amount billed for each hospitalization reported by the facilities. Data on cost of care provided to patients or the amount of reimbursement for services rendered were not available. These charges were adjusted for inflation to the value of 2013 US dollars, using the Bureau of Labor Statistics Consumer Price Index.

The outcome variable of discharge against medical advice was coded as a binary variable (0/1). Disposition statuses such as routine discharge, transfer to a short-term hospital; transfer to other facilities (e.g., SNF); and initiation of HHC were categorized as those ED visits which were not discharged against medical advice.

Behavioral Health Regions in Nebraska

Nebraska has been divided into six behavioral health regions and have a total of 13 major cities (Appendix 4). They are combined local units of the governments that plans and implements services by partnering with the state. The regions also purchase services from the providers that

serve the areas and if needed, also from other service providers across the state. Hence, for our study, we conducted descriptive and geographical analyses of ED visits for BH disorders in Nebraska by region.

Analytical Approach

An individual ED visit was the unit of analysis. Descriptive statistics included the number of BH-related ED visits per 10,000 population in Nebraska, number of ED visits stratified by clinically diagnosed for BH conditions, and patient characteristics. The population-based incidence rates of BH conditions per 10,000 people were calculated using the 2013 US Census population estimates for each county. ED visits in Nebraska were stratified at the county-level using the five-digit Federal Information Processing Standard code.

The main interest of our study was to identify important patient-related factors associated with ED charges. In this study, charges have non-negative values (> 10% have zero values), a distribution with a longer right tail, and outliers when compared to a normal distribution. Using ordinary least square regression might provide biased estimates of means and marginal/incremental effects (Manning, 2006; Partha, Manning, & Norton, 2010). Therefore, we estimated total charges using a generalized linear model (GLM) with a gamma distribution and log-link function, which best fits this particular data structure and is a common method in cases where the log-transformed dependent variables do not have heavy tails (N. G. Choi, Dinitto, Marti, & Choi, 2015; J. A. Singh & Yu, 2016; Thompson & Nixon, 2005). The log-link function accounts for the non-normal distributional characteristics of the total charges data (Kazley, Simpson, Simpson, & Teufel, 2014; Malehi, Pourmotahari, & Angali, 2015; Manning, Basu, & Mullahy, 2005). To examine the distributional characteristics of the residuals, we selected the gamma distribution ($\lambda = 2$) based on the Modified Park Test, a diagnostic test recommended for the GLM family (S. D. Case et al., 2011; Malehi, Pourmotahari, & Angali, 2015; Manning et al., 2005). For interpretability, we converted coefficients to average marginal effects (AME), which is measured as the difference in adjusted predicted outcome between the reference group and the

comparison group after adjusting for other covariates. Statistical significance was assessed at a level of 0.05.

By categorizing disposition status into those ED visits that were discharged against medical advice and those that were discharged otherwise, a multivariate logistic regression analysis was used to estimate association of discharge against medical advice following ED visits for primary diagnoses of BH disorders on patient characteristics.

All descriptive statistical analyses were performed using SAS software, version 9.4 (SAS Institute, Cary, NC). The log-linked gamma distributed GLM analyses were conducted using the Stata (StataCorp, College Station, TX). The average marginal effects of health care charges due to ED visits were calculated using the ‘‘margins’’ post-regression command in Stata software. Geographic information system maps were created using ArcGIS software, Version 10.4 (Esri, Redlands, CA). The University of Nebraska Medical Center’s Institutional Review Board deemed this study exempt.

Results

SEDD reported 52,035 BH-related conditions in Nebraska from 2011 to 2013. Anxiety (23.4%), nondependent use of drugs (17.0%), episodic mood disorders (15.6%), depressive disorders (7.8%), and having a history of mental disorders accompanied by family-based problems and suicidal ideation (6.2%) were the most common BH conditions (Table 1).

Table 2 presents characteristics of patient with primary diagnoses for BH conditions stratified by the State-designated BH regions. There has been almost 5% increase in BH-related ED visits from 15,756 in 2011 to 18,297 in 2013. From 2011 to 2013, all regions had an increasing number of ED visits for BH conditions, except Region II. Overall, males represented over half of ED visits for all the BH disorders. The mean age of patients ranged from 35.5 to 41.2 years with the younger age groups residing in the urban regions V and VI. Across all regions, those between 24 to 44 years old made the highest proportion of ED visits for BH conditions

(35.5%), followed by patients between 45 to 64 years old (23.78%) and younger adults between 18 to 24 years of age (18.1%).

About 40% of patients that visited an ED for BH-related conditions were covered by private insurance, followed by 23.1% of patients that were uninsured. Only 17.9% and 14.9% of the ED visits related to BH were covered by Medicare and Medicaid, respectively. The predominantly rural Regions I to IV (24.0 to 30.4%) had higher proportion of ED visits made by Medicare enrollees when compared to the urban regions V (19.4%) and VI (15.2%). In contrast, the uninsured patients residing in urban regions of V (21.4%) and VI (26.8%) made higher ED visits for BH disorders than most rural regions of I, III and IV (10.0, 15.0, and 17.1%, respectively), except for region II (19.2%) that had comparatively higher visits by the uninsured. Interestingly, a sizeable proportion of the visits for BH-related conditions occurred on weekdays (71.6%), and about 81.2% of the visits were routinely discharged.

Table 2 also presents ED visits by patient location. Overall, approximately 71.0% of the ED visits were in urban areas, followed by large rural towns (15.7%), small rural towns (7.5%) and, finally, isolated rural areas (6%). Specifically, Region I - III being rural areas had no visit made by urban residents and the converse was true for the primarily urban regions V (77.5%) and VI (93.3%). Also, nearly a third of ED visits due to BH conditions were for patients residing in zip codes with low median household incomes. Interestingly, about 95% of the ED visits in region II belonged to the low-income areas with no visits from the high-income population whereas over one-third of ED visits in Regions V and VI were made by high-income populations.

As shown in Table 2, eighty-two percent of the ED visits related to BH conditions were not concurrent with comorbid conditions. ED visits made by patients with 1 or more unrelated comorbidities were higher in the rural regions I (26.3%), II (25.7%) and III (31.6%) whereas the urban regions V (85.0%) and VI (83.7%) had higher proportion of patients without any unrelated comorbidities. After adjusting for inflation, mean hospital ED charges per visit were $1,854 with

a total of approximately $96.4 million in ED charges due to BH-related conditions during the study period. Among the rural regions, region II had higher ED charges of $1,717.25 while the most charges were made by residents from region VI ($2,120.44).

Table 3 shows the number of BH-related ED visits per 10,000 population made by region, and the availability of ED facilities and BH providers by region. The highest number ED visits were made by residents of rural region II (11,805 per 10,000 population), followed by the urban region V (3,015 per 10,000 population) while, conversely, the least visits were made by those residing in region VI (1,394 per 10,000 population). Regions IV (21) and V (22) had the highest number of EDs whereas region I had the least number of EDs (8). Interestingly, comparatively lower ED admission rates were observed in regions III and IV (2,538 and 1,908 per 10,000 population, respectively) which had higher number of BH providers (94 and 89, respectively).

Figure 1 represents the distribution of population estimates of BH-related ED visits and BH professionals in Nebraska by BH regions. This map depicts that ED admission rates could be higher in rural regions (scarcely populated rural regions I, II and IV) where BH workforce supply is low and vice-versa. For illustration, region II had access to 37 BH providers and had the highest ED admission rates of 11,805 per 10,000 population. Also, the converse is also true because region IV had access to higher (89) BH providers which was found to be correlated to reduced ED admission rates (1,908 per 10,000 population) for BH disorders. On the other hand, in the urban region VI, despite the lower supply of BH providers, the ED admission rate is lower which maybe because of sufficient access to primary-level behavioral healthcare services. However, for the other urban Region V, despite the moderate supply of BH providers (83), the ED admission rate was found to high (3,015 per 10,000 population).

Figure 2 represents that the EDs in rural regions of Nebraska had higher ED admission rates. For example, region I had lower number of EDs (8) which accommodated 2,072 visits per 10,00 population for BH disorders. Similarly, region II had only 9 EDs which provided

emergency behavioral services to 11,805 BH-related visits per 10,000 population. Moreover, region III had 2,538 visits per 10,000 population at 18 EDs for BH disorders despite having the highest supply of BH professionals (94) in the state.

Table 4 shows the results of regression using a multivariate log-linked Gamma Distributed Generalized Linear model that evaluates the effect of patient-related factors on hospital-based ED charges. The AME indicates that the total charges for females was significantly lower compared to for males (by $105 per visit). Older age groups were associated with higher charges than younger age groups. Compared to children and adolescents under the age of 18 years, those aged 18 to 24 years, 25 to 44 years, and 45 to 64 years incurred significantly higher ED charged by $408, $473, and $678, respectively, but the elderly (65 years and older) incurred the highest ED charges by $1,120. Patients who were covered by Medicare had significantly lower ED charges than those who were covered by self, Medicaid, private, and other insurance types by $318, $240, $213, and $205. The patient's location was also significantly associated with ED charges. Patients residing in large rural towns, small rural towns, and isolated rural areas had lower ED charges per visit by $123, $527, and $378, respectively, than patients residing in urban areas. Patients whose median household income at the ZIP code level fell into the fourth quartile had significantly higher ED charges by $314. ED charges were significantly increased with an increase in ECI. In contrast to those with 0 unrelated comorbidities, those with 2 and 3 comorbidities had significantly higher ED charges by $549 and $930. However, ED visits made by those with 3 or more unrelated comorbidities to BH disorders incurred $2,015 more than those with no unrelated comorbidity.

Table 5 displays the results from the multivariate logistic regression that was conducted to evaluate the associations between patient-level factors and discharged against medical advice. Females (OR: 0.63; CI: 0.82-0.98, P<.001) are significantly less likely to be discharged against medical advice than males. Compared to those up to the age of 17 years, those aged 25 to 44 years (OR: 1.83; CI: 1.42-2.36, P<.001), and aged 44 to 64 years (OR: 2.31; CI: 1.78-3.00,

P<.001) were associated with higher odds for discharge against medical advice. Among the payer type, those who were uninsured were associated with higher odds (OR: 1.56; CI: 1.27-1.91, P<.001) of being discharged against medical advice compared to those covered by Medicare. Those residing in living in ZIP codes with median household income belonging to the second (OR: 0.77, CI: 0.66-0.89, P=0.0003), third (OR: 0.59, CI: 0.49-0.75, P<.001), and fourth (OR: 0.67, CI: 0.53-0.85, P<.001), quartile were associated with significantly lower odds for discharge against medical advice than those living in ZIP codes with first quartile median household income.

Discussion

These findings show that the majority of the ED visits were by males of 25- to 44-years-old but that the elderly had the highest ED charges. Consistent with common beliefs, we found that the uninsured incurred higher total ED charges for BH-related conditions. Because one-third of counties in Nebraska have no BH professional and about one-fourth counties have no EDs, it can be concluded that state-wide access to care is minimal, particularly in rural counties. The average charge levied on patients was as high as $1,854 per ED visit. Multivariate logistic regression modeling also suggested that patients discharged against medical advice were more likely to be males, between the age of 18 to 64 years, uninsured, living in low-income areas (first quartile) and with no unrelated comorbidities.

Currently, there is uncertainty for the future of healthcare coverage in the US, and an understanding of the economic implications of providing behavioral health services for states that did not expand Medicaid eligibility under the Affordable Care Act requires state-specific analyses. Few studies have examined the distribution of BH professionals or BH-related ED utilization in largely rural states. One prior study examined only the urban counties of North Carolina (Doren et al., 2016), while Choi *et al.* studied the impact of specific BH illnesses on non-suicidal self-injury and suicide attempts among 50-years and older ED patients (N. G. Choi

et al., 2015). Other studies have focused on specific subpopulations, such as adolescents (Doshi, Glick, & Polsky, 2006) and older adults (Pines et al., 2011).

One of the key findings from this study is that about $96.4 million was spent during 2011–2013 on a total of 52,035 ED visits due to BH-related conditions, across all age groups. Because federal law mandates EDs to screen, diagnose and treat patients, EDs have become an important place for treating BH-related conditions, though at a high cost (Fahimi, Aurrecoechea, Anderson, Herring, & Alter, 2015). Our data show that 12 out of 93 counties in Nebraska have an ED but do not have any practicing BH professionals. Many BH-related conditions can be assessed and treated successfully in outpatient settings through the use of integrated care and telemental services. In addition to the high cost of ED treatment, ED staff members in rural areas have limited experience in detecting and treating BH-related conditions (Rhodes, 2008). This may further increase the costs of treating these conditions in the long run. Undiagnosed, untreated or delayed diagnoses of BH conditions can lead to an increased number of ED visits, require more intensive interventions compared to early diagnosis, or result in societal costs such as increased arrest and incarceration rates (Insel, 2008; Mark et al., 2007).

Young adults in Nebraska are the more likely to be burdened by BH disorders (18% ED visits), as per our study, given that they comprise only 7% of the population (Kaiser Family Foundation, 2017). Even though patients living in non-metropolitan areas make up for 40% of the population in Nebraska (Nebraska Department of Health and Human Services, 2008), urban population make majority of the ED visits for BH disorders. Likewise, patients covered by Medicare, other insurances, and the uninsured are the most burdened by BH disorders, considering that within Nebraska the insurance coverage for this population comprise of only 13, 7, and 9%, respectively (Kaiser Family Foundation, 2016). Our results also suggest that a substantial proportion of ED patients are uninsured (23%), and the charges levied on them are the highest when compared to other payers. Additionally, we found that one-third of BH patients

using the ED are covered under either Medicare or Medicaid, despite that it is often known to be difficult to find a provider accepting Medicaid.

Our data show that urban patients were levied higher ED charges than those living in rural towns. This may be because EDs within urban areas offer more health services and have more comprehensive health insurance coverage than rural residents. However, a study shows that BH services are provided to rural populations at lower reimbursement rates than in urban areas (Ziller et al., 2010). Besides, rural residents often travel long distances to procure health services, are less likely to be insured for BH services, may face greater social stigma, and have less probability to be diagnosed with BH-related illnesses than urban residents (Substance Abuse and Mental Health Services., 2013). This is consistent with our results depicting that there are fewer ED visits and charges for rural patients than those from urban areas for BH disorders.

The findings from our study are consistent with the literature, which reports that the leading causes of BH disorders are anxiety, episodic mood, and depressive disorders, and alcohol dependence (Hazlett et al., 2004; Huynh, Ferland, Blanchette-martin, & Me, 2016; Pines et al., 2011; Richmond et al., 2007). In our study, patients aged 25 to 44 years, residing in low-income or urban areas, and with private insurance, were more likely to utilize ED for BH conditions. These patients are ‘high-risk', and prior studies have found similar results (Huynh et al., 2016; Pines et al., 2011; Smith et al., 2015). Therefore, our findings suggest the need to tailor interventions to address BH issues for high-risk patients.

In the past, one study reported that one in five patients with either primary or secondary diagnoses of substance abuse disorders specifically were discharged against medical advice (Bradley & Zarkin, 1997). Specifically, chronic alcoholism and drug addiction were the common causes which were discharged against medical advice (Jankowski & Drum, 1977). The unwanted consequences of being discharged against medical advice could be high risk of revisits (in inpatient and outpatient departments) or even mortality (Hwang, Li, Gupta, Chien, & Martin, 2003). Consequently, the revisits could be accompanied by greater severity of disorders. This

issue can also potentially increase healthcare expenditures towards what could have been a single episode of care. To our knowledge, in the recent years, no prior work has evaluated the problem of leaving ED against medical advice following primary diagnoses for BH disorders across all age groups, especially in rural states that offer limited healthcare services. Overall, 2.1% of our study population was discharged against medical advice. Our results show these patients are more likely to be males, uninsured, living in low-income areas (first quartile), and with no other unrelated comorbidities. Parents play a vital role in facilitating healthcare needs and more often make decisions as significant as obtaining discharge against medical needs. Hence, this could be the reason why children and adolescents have lower odds of leaving against medical needs. Also, as per expectation, those who are uninsured and have low-income status would be discharged against the advice of providers because financial problems and/or were refused treatment by hospital staff. Because there are limited such studies that have provided evidence-based research, our findings are not comparable and the implication of BH-related discharges against medical advice on policy for revisits (as inpatient stay and/or ED) and associated costs are uncertain. However, our findings are generalizable in similar states which are predominantly rural, and with shortage of BH services. By identifying the high-risk cohort, community-based health programs could be tailored for this group to encourage compliance to treatment and provide screenings for psychiatric disorders. ED-based peer coaching, education for such conditions, and counselling for this cohort can improve ED outcomes as well as likely reduce the discharges against medical advice.

Multiple studies have demonstrated that there are substantial geographic shortages and maldistribution of the BH workforce in the US (Doren et al., 2016; Hoge et al., 2009; K. C. Thomas, Ellis, Konrad, Holzer, & Morrissey, 2009). From Figures 1, it is evident that BH-related ED visits are more in areas where the numbers of BH providers are fewer. One of the reason for this could be that these rural regions had higher proportion of uninsured, low-income population with higher comorbidities. However, it should be noted that not all of these BH professionals are

licensed to prescribe medication. Most prescribers in Nebraska are concentrated near the major medical centers and state hospitals located in Nebraska's three most populated counties (regions V and VI). Among those BH professionals who are board-certified to prescribe in rural areas, many may not be working as full-time professionals. This could be the reason why certain regions have greater ED use for BH services despite having moderate supply of BH professionals.

On the other hand, Figure 2 shows EDs in rural regions of Nebraska maybe overcrowded and a 'failsafe' healthcare setting for BH disorders because ED visits are more common in those regions which have fewer ED facilities (except urban regions V and VI that are home to the largest two big cities in Nebraska). This highlights the consequences of unmet BH needs, shortage of BH services and providers. ED facilities in such counties may also be expected to be crowded. Hence, further research must be conducted to understand the ratios of ED and outpatient facilities to visits for BH-related conditions, impact of the lack of access to full-time BH professionals, and prescribers in rural communities and its impact on preventable ED utilization.

Region II has remarkably high proportion of ED visits for the scare population in the region, despite fewer ED facilities. This may be because this region has the highest proportion of low-income population with comorbidities and a substantial number of uninsured. However, there has been a 4% reduction in the numbers of BH-related ED visits between 2012 and 2013. In future, efforts need to be made to provide adequate services to this population.

The Center for Medicaid and CHIP Services (CMCS), in their 2013 bulletin, recommended that efforts need to be made to expanded primary care access, design and implement programs targeting super-utilizers or high-risk cohort, and address co-morbid mental health and substance abuse issues (US Department of Health and Human Servives, 2013). Using geographic mapping to locate high ED utilizers, the States of Maine, Massachusetts, and New Jersey structured interdisciplinary teams including nurse care managers, social workers, and behavioral health workers and provided visits to patients in their homes and community settings. Such teams also worked with primary care practices to identify referrals and coordinate care for

patients (Center for Health Information and Analysis, 2015; Green, Singh, & Byrne, 2010; US Department of Health and Human Servives, 2013). The findings from our study can be utilized by region-based teams in Nebraska to target the highest utilizers and provide care coordination, supportive therapy, substance abuse treatment, supportive housing, and assertive community outreach to those routinely discharged as well as transferred to home health agencies. These teams can also ensure that rural residents are provided access to community-based organizations, or large community-based primary care practices such as federally-qualified health centers.

Conclusions

Many patients needing BH-related services seek help in EDs instead of more appropriate settings for psychiatric care such as primary clinics, leading to substantial and preventable healthcare expenditures, particularly in rural communities. Community-based interventions should be tailored with a goal of reducing unnecessary and expensive ED visits among high-risk patient groups that include those aged 25-44 years, uninsured, covered by private insurance, residing in low-income areas, and suffer from other comorbid conditions. Being male, between 18 to 64 years of age, uninsured, living in low-income areas had higher odds of patient discharge against medical advice. Innovative rural-centric public health programs can focus on encouraging patients to adhere to ED-treatment and continue follow-up BH care, provide education and counselling, thereby, improving ED outcomes and reducing hospital revisits. Increasing BH workforce, especially in rural areas, can alleviate the problem and reduce the number of frequent ED users for BH conditions. Future studies should work towards identifying challenges to providing and procuring holistic BH services.

Table 1: Number and percent of emergency department visits stratified by diagnoses for behavioral health conditions, NE SEDD, 2011–2013

Types of BH conditions	ED visits (N= 52,035)	
	N	%
Anxiety, dissociative and somatoform disorders	12,154	23.4
Nondependent abuse of drugs	8,827	17.0
Episodic mood disorders	8,115	15.6
Depressive disorders	4,060	7.8
History of mental disorders, family-based problems, and suicidal ideation	3,244	6.2
Alcohol dependence syndrome	3,012	5.8
Other nonorganic psychoses	1,887	3.6
Schizophrenic disorders	1,590	3.1
Other specifically mental health-related conditions	1,498	2.9
Special symptoms or syndromes not elsewhere classified	1,145	2.2
Adjustment reaction	1,057	2.0
Drug-induced mental disorders	971	1.9
Alcohol-induced mental disorders	796	1.5
Specific nonpsychotic mental disorders due to brain damage	752	1.5
Disturbance of conduct not elsewhere classified	696	1.3
Disturbance of emotions specific to childhood and adolescence	662	1.3
Persistent mental disorders due to conditions classified elsewhere	604	1.2
Acute reaction to stress	569	1.1
Drug dependence	396	.8

SEDD, State Emergency Department Database; BH, Behavioral health; ED, Emergency department

Table 2: Descriptive characteristics for emergency department visits related to behavioral health conditions in NE SEDD, 2011–2013 *

Characteristics	Overall ED visits		Region I (n=1,405)		Region II (n=2,534)		Region III (3,739)		Region IV (1,747)		Region V (12,886)		Region VI (25,151)	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Sex														
Male	26,333	50.6	667	47.5	1,206	47.6	1,728	46.2	775	44.4	6,459	50.1	13,079	52.01
Female	25,682	49.4	728	51.8	1,320	52.1	2,011	53.8	972	55.6	6,427	49.9	12,072	47.99
Age group (in years)														
up to 17	7,340	14.1	193	13.7	285	11.2	396	10.6	210	12.0	1,976	15.3	3,819	15.2
18 to 24	9,396	18.1	223	15.9	450	17.8	678	18.1	281	16.1	2,293	17.8	4,434	17.6
25 to 44	18,464	35.5	424	30.2	810	32.0	1,224	32.7	580	33.2	4,432	34.4	9,193	36.6
45 to 64	12,356	23.7	332	23.6	658	26.0	844	22.6	348	19.9	3,027	23.5	6,115	24.3
65 and over	4,479	8.6	233	16.6	331	13.1	597	16.0	328	18.8	1,158	9.0	1,590	6.3
Mean age (in years)	36.6		40.9		39.8		40.7		41.2		36.5		35.5	
Primary payer														
Medicare	9,317	17.9	428	30.5	609	24.0	929	24.8	478	27.4	2,506	19.4	3,953	15.7
Medicaid	7,762	14.9	355	25.3	326	12.9	619	16.6	233	13.3	1,070	8.3	4,741	18.9
Private Insurance	20,872	40.1	462	32.9	1,077	42.5	1,525	40.8	707	40.5	6,088	47.2	8,627	34.3
Uninsured	12,036	23.1	142	10.1	486	19.2	562	15.0	298	17.1	2,756	21.4	6,732	26.8
Other	2,048	3.9	18	1.3	36	1.4	104	2.8	31	1.8	466	3.6	1,098	4.4
Admission day														
Weekday	37,245	71.6	1,019	72.5	1,791	70.7	2,536	67.8	1,202	68.8	9,347	72.5	18,150	72.2
Weekend	14,789	28.4	386	27.5	743	29.3	1,203	32.2	545	31.2	3,539	27.5	7,000	27.8
Disposition status														
Routine	40,746	81.2	1,111	79.1	2,065	81.5	3,096	82.8	1,465	83.9	11,766	91.3	19,054	75.8
Transfer to short-term hospital	4,230	8.4	141	10.0	143	5.6	238	6.4	136	7.8	458	3.6	2,842	11.3

Transfer Other: Includes SNF, ICF, Another Type of Facility	4,139	8.3	124	8.8	239	9.4	344	9.2	126	7.2	358	2.8	2,725	10.8
Home Health Care (HHC)	25	0.1	0	0.0	4	0.2	2	0.1	0	0.0	6	0.0	12	0.0
Against Medical Advice (AMA)	1,054	2.1	29	2.1	83	3.3	59	1.6	20	1.1	298	2.3	518	2.1
Patient location														
Urban	36,177	70.8	0	0.0	0	0.0	0	0.0	27	1.5	9,982	77.5	23,472	93.3
Large rural town	8,014	15.7	459	32.7	1,634	64.5	2,651	70.9	630	36.1	610	4.7	1,106	4.4
Small rural town	3,835	7.5	641	45.6	557.0	22.0	357	9.5	347	19.9	1,380	10.7	238	0.9
Isolated rural	3,093	6.1	288	20.5	286	11.3	678	18.1	725	41.5	650	5.0	143	0.6
Median household income national quartile for patient ZIP code**														
First quartile	16,284	31.8	510	36.3	239	9.4	298	8.0	318	18.2	3,444	26.7	10,358	41.2
Second quartile	18,757	36.6	795	56.6	2,157	85.1	3,100	82.9	1,162	66.5	4,391	34.1	5,724	22.8
Third quartile	9,769	19.1	83	5.9	81	3.2	287	7.7	249	14.3	3,556	27.6	4,275	17.0
Fourth quartile	6,399	12.5	0	0.0	0	0.0	1	0.0	0	0.0	1,230	9.5	4,684	18.6
Elixhauser Unrelated Comorbidity Index measure***														
0	42,691	82.04	1,035	73.7	1,884	74.3	2,558	68.4	1,409	80.7	10,948	85.0	21,052	83.7
1	6,585	12.65	259	18.4	428	16.9	787	21.0	235	13.5	1,361	10.6	2934	11.7
2	2,119	4.07	88	6.3	145	5.7	278	7.4	79	4.5	419	3.3	956	3.8
=> 3	640	1.23	23	1.6	77	3.0	116	3.1	24	1.4	158	1.2	209	0.8
Behavioral health-related ED visits by year														
2011	15,756	30.91	422	30.0	796	31.4	1,188	31.8	566	32.4	4,104	31.8	7,181	28.6
2012	16,924	33.20	426	30.3	915	36.1	1249	33.4	572	32.7	4314	33.5	8,519	33.9
2013	18,297	35.89	557	39.6	823	32.5	1,302	34.8	609	34.9	4,468	34.7	9,451	37.6
Hospital ED charges (inflation adjusted to 2013 US dollar value)														
Mean (median) charges	$1,854.48 (1,352.00)		$1,663.25 (1,240)		$1,717.25 (1,163.25)		$1,693.53 (1,157.74)		$1,486.76 (995.28)		$1,418.44 (701.00)		$2,2120.44 (1,597.82)	
Total charges	$96,353,163.18		$2,330,214.51		$4,347,037.37		$6,330,422.39		$2,597,377.38		$18,273,816.23		$53,210,242.25	

SEDD, State Emergency Department Database; ED, Emergency department; N, Number

*****The sum of individual counts may not add up to the total number of visits because of missing information for certain variables.

** Median household income quartiles of residents in the patient's ZIP code differ every year. The levels were $1 to $38,999 (quartile 1), $39,000 to $47,999 (quartile 2), $48,000 to $63,999 (quartile 3) and $64,000 or higher (quartile 4) in the year 2011. The levels were $1 to $38,999 (quartile 1), $39,000 to $47,999 (quartile 2), $48,000 to $62,999 (quartile 3) and $63,000 or higher (quartile 4) in the year 2012. The levels were $1 to $37,999 (quartile 1), $38,000 to $47,999 (Quartile 2), $48,000 to $63,999 (quartile 3) and $64,000 or higher (quartile 4) in the year 2013.

*** Unrelated comorbid conditions comprise congestive heart failure, valvular disease, pulmonary circulation disease, peripheral vascular disease, paralysis, other neurological disorders, chronic pulmonary disease, diabetes without chronic complications, diabetes with chronic complications, hypothyroidism, renal failure, liver disease, peptic ulcer bleeding, acquired immune deficiency syndrome, lymphoma, metastatic cancer, solid tumor without metastasis, rheumatoid arthritis, coagulopathy, obesity, weight loss, fluid and electrolyte disorders, chronic blood loss anemia, and deficiency anemia.

Table 3: Counties served, emergency department facilities, and emergency visits for behavioral health disorders and providers per 10,000 population by behavioral health region in Nebraska.

Behavioral Health Region	Counties served	ED visits per 10,000 population	Number of ED facilities	Number of providers per 10,000 population
1	Sheridan, Dawes, Sioux, Box Butte, Morrill, Scotts Bluff, Banner, Cheyenne, Deuel, Garden, and Kimball	2,072	8	38
2	Arthur, Chase, Dawson, Dundy, Frontier, Gosper, Grant, Hayes, Hitchcock, Hooker, Keith, Lincoln, Logan, McPherson, Perkins, Red Willow, and Thomas	11,805	9	37
3	Adams, Blaine, Buffalo, Clay, Custer, Franklin, Furnas, Garfield, Greeley, Hall, Hamilton, Harlan, Howard, Kearney, Loup, Merrick, Nuckolls, Phelps, Valley, Sherman, Webster and Wheeler	2,538	18	94
4	Antelope, Boone, Boyd, Brown, Burt, Cedar, Cherry, Colfax, Cuming, Dakota, Dixon, Holt, Keya Paha, Knox, Madison, Nance, Pierce, Platte, Rock, Stanton, Thurston & Wayne	1,908	21	89
5	Butler, Fillmore, Gage, Jefferson, Johnson, Lancaster, Nemaha, Otoe, Pawnee, Polk, Richardson, Saline, Saunders, Seward, Thayer, and York	3,015	22	83
6	Cass, Dodge, Douglas, Sarpy, and Washington	1,394	16	31

The population estimates for behavioral health regions 1 through 6 were (1) 87,839; (2) 101,213; (3) 227,270; (4) 207,646; (5) 448,995; and (6) 769,678, respectively.

Table 4: Multivariable linear regression model for hospital-based emergency department charges (in dollars) due to behavioral health conditions NE SEDD, 2011–2013. [a]

Parameter	AME (dollars) [a]	Standard Error	95% Confidence Intervals		P-value [b]
			Lower	Upper	
Sex					
Male			Reference		
Female	-105.429	14.40826	-133.67	-77.19	<.001
Age group					
0 to 17			Reference		
18 to 24	408.1	21.44	366.09	450.116	<.001
25 to 44	472.75	19.144	435.23	510.27	<.001
45 to 64	678.26	22.81	633.56	722.96	<.001
65 and over	1,119.48	45.22	1030.86	1208.1	<.001
Primary Payer					
Medicare			Reference		
Medicaid	239.64	27.92	184.91	294.36	<.001
Private Insurance	212.94	22.64	168.57	257.3	<.001
Uninsured	317.46	25.38	267.71	367.21	<.001
Other insurance	204.64	41.07	124.13	285.13	<.001
Median household income national quartile for patient ZIP code**					
First quartile	Reference				
Second quartile	-18.76	18.85	-55.71	18.18	0.32
Third quartile	15.91	20.68	-24.62	56.44	0.44
Fourth quartile	313.84	27.43	260.08	367.59	<.001
Patient Location					
Urban			Reference		
Large rural town	-123.44	22.61	-167.75	-79.13	<.001
Small rural town	-527.38	22.67	-571.81	-482.95	<.001
Isolated rural	-377.56	26.83	-430.14	-324.99	<.001
Elixhauser Comorbidity Index measure ***					
0			Reference		
1	594.13	27.33	540.57	647.68	<.001
2	929.73	53.12	825.63	1033.84	<.001
≥3	2,015.1	133.47	1753.52	2276.69	<.001

SEDD, State Emergency Department Database

[a] Average Marginal Effect (AME) is measured as the difference in the adjusted predicted outcome between reference group and comparison group.

[b] P values were calculated using multivariate Log-linked Gamma Distributed Generalized Linear Model.

** Median household income quartiles of residents in the patient's ZIP code vary by year. The levels were $1 to $38,999 (quartile 1), $39,000 to $47,999 (quartile 2), $48,000 to $63,999 (quartile 3) and $64,000 or higher (quartile 4) in the year 2011. The levels were $1 to $38,999 (quartile 1), $39,000 to $47,999 (quartile 2), $48,000 to $62,999 (quartile 3) and $63,000 or higher (quartile 4) in the year 2012. The levels were $1 to $37,999 (quartile 1), $38,000 to $47,999 (Quartile 2), $48,000 to $63,999 (quartile 3) and $64,000 or higher (quartile 4) in the year 2013.

*** Unrelated comorbid conditions comprise of congestive heart failure, valvular disease, pulmonary circulation disease, peripheral vascular disease, paralysis, other neurological disorders, chronic pulmonary disease, diabetes without chronic complications, diabetes with chronic complications, hypothyroidism, renal failure, liver disease, peptic ulcer bleeding, acquired immune deficiency syndrome, lymphoma, metastatic cancer, solid tumor without metastasis, rheumatoid arthritis, coagulopathy, obesity, weight loss, fluid and electrolyte disorders, chronic blood loss anemia, and deficiency anemia.

Table 5: Adjusted odds ratios from multivariate logistic regression analysis of discharge against medical advice by patient-level characteristics, NE SEDD, 2011-2013.

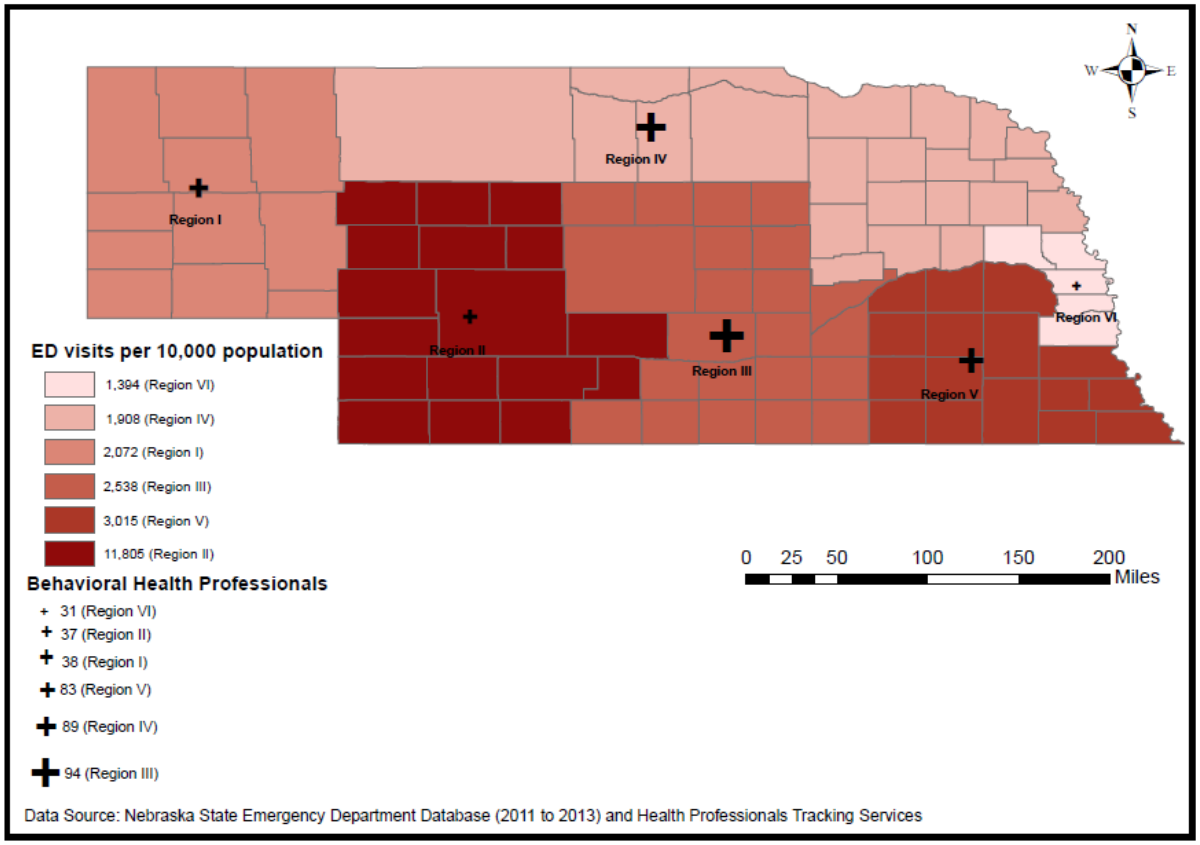
Characteristics	Estimate	Odds ratio (AMA)	95% confidence level OR Lower	OR Upper	P-value
Intercept	-4.02				<.0001
Sex					
Male			Reference		
Female	0.72	0.63	0.82	0.98	<.0001
Age					
up to 17			Reference		
18 to 24	0.19	1.20	0.91	1.60	0.200
25 to 44	0.61	1.83	1.42	2.36	<.0001
45 to 64	0.84	2.31	1.78	3.00	<.0001
65 and over	-0.35	0.704	0.443	1.12	0.139
Primary payer					
Medicare			Reference		
Medicaid	0.03	1.03	0.80	1.33	0.829
Private Insurance	-0.08	0.92	0.74	1.14	0.457
Uninsured	0.44	1.56	1.27	1.91	<.0001
Other	-0.21	0.81	0.53	1.25	0.340
Median household income national quartile for patient ZIP code**					
First quartile			Reference		
Second quartile	-0.27	0.77	0.66	0.89	0.0003
Third quartile	-0.53	0.59	0.49	0.72	<.0001
Fourth quartile	-0.40	0.67	0.53	0.85	0.001
Elixhauser Comorbidity Index for unrelated comorbid conditions***					
0			Reference		
1	-0.42	0.66	0.53	0.82	0.0002
2	-0.26	0.77	0.55	1.10	0.149
3 or more	-0.25	0.78	0.40	1.52	0.464

AMA, Discharge against medical advice; SEDD, State Emergency Department Database

** Median household income quartiles of residents in the patient's ZIP code vary by year. The levels were $1 to $38,999 (quartile 1), $39,000 to $47,999 (quartile 2), $48,000 to $63,999 (quartile 3) and $64,000 or higher (quartile 4) in the year 2011. The levels were $1 to $38,999 (quartile 1), $39,000 to $47,999 (quartile 2), $48,000 to $62,999 (quartile 3) and $63,000 or higher (quartile 4) in the year 2012. The levels were $1 to $37,999 (quartile 1), $38,000 to $47,999 (Quartile 2), $48,000 to $63,999 (quartile 3) and $64,000 or higher (quartile 4) in the year 2013.

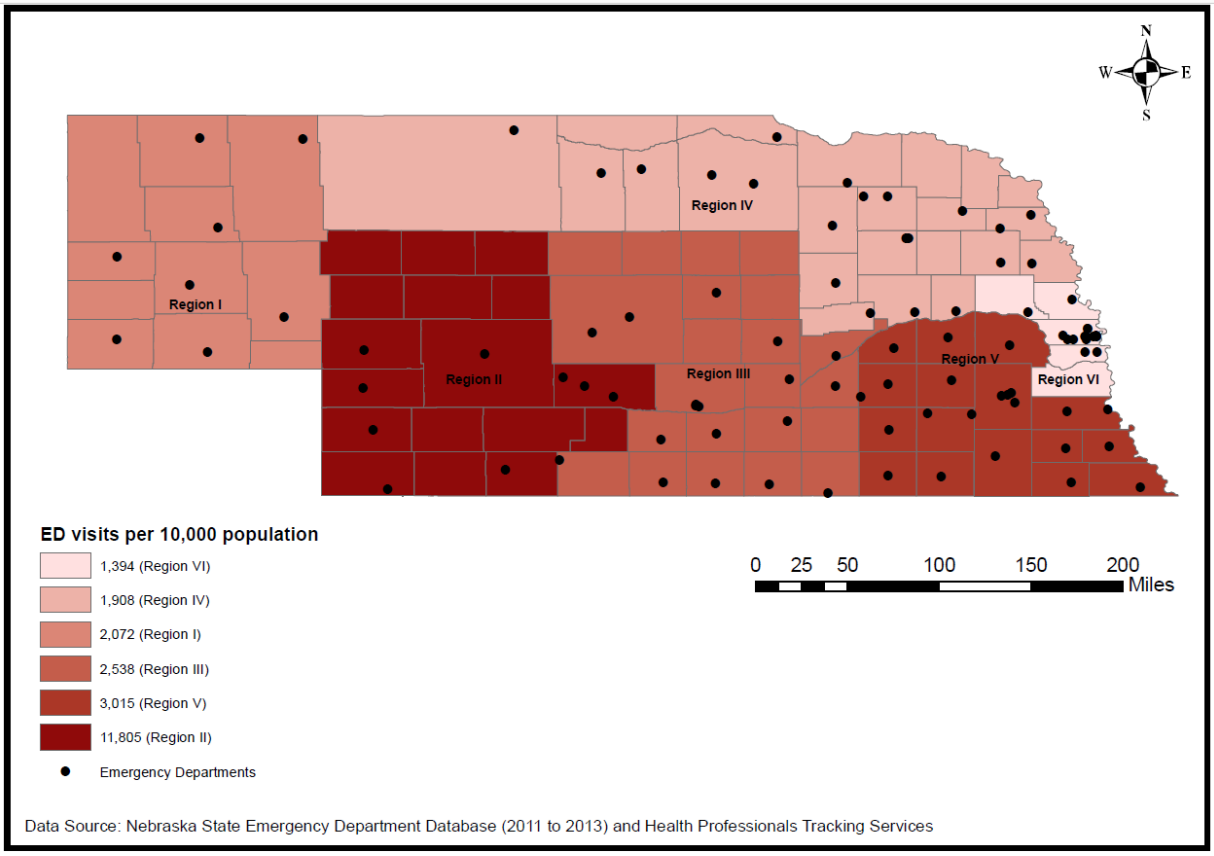
*** Unrelated comorbid conditions comprise of congestive heart failure, valvular disease, pulmonary circulation disease, peripheral vascular disease, paralysis, other neurological disorders, chronic pulmonary disease, diabetes without chronic complications, diabetes with chronic complications, hypothyroidism, renal failure, liver disease, peptic ulcer bleeding, acquired immune deficiency syndrome, lymphoma, metastatic cancer, solid tumor without metastasis, rheumatoid arthritis, coagulopathy, obesity, weight loss, fluid and electrolyte disorders, chronic blood loss anemia, and deficiency anemia.

Figure 1: Emergency Department visits in Nebraska related to behavioral health and supply of behavioral health professionals per 10,000 population by designated behavioral health regions, NE SEDD, 2011-2013.



SEDD, State Emergency Department Database

Figure 2: Emergency Department visits in Nebraska related to behavioral health and number of emergency departments by designated behavioral health regions, NE SEDD, 2011-2013



SEDD, State Emergency Department Database

CHAPTER V: EMERGENCY DEPARTMENT UTILIZATION FOR SUBSTANCE USE-RELATED DISORDERS AND ASSESSMENT OF TREATMENT FACILITIES IN NEW YORK STATE, 2011- 2013

Introduction

Substance use disorders (SUDs), the leading cause of premature illnesses and death (Bernstein & D'Onofrio, 2013; Shroeder, 2007), were experienced by about 21.5 million Americans over the age of 12 years in 2014 (Tice, Hedden, Kennet, Lipari, & Medley, 2014), thereby, attributed as an important public health issue. For 2017 alone, the US Department of Health and Human Services allocated $2.6 billion for substance abuse treatment and $211 million for prevention of SUDs (US Department of Health and Human Servives, 2017). However, the overall social and economic burden to society is compounded not only by the direct consequences of overuse of substances, but also such disorders have an effect on public safety, health, welfare, and socioeconomic status (Han, Sherman, Link, Wang, & Mcneely, 2017; Kosten & O'Connor, 2003; U.S. Department of Health and Human Services (HHS), 2016). On the other hand, from the providers perspective, unmanaged treatment of SUDs impact patient safety because there is a possibility of withdrawal while admitted to the hospital. For example, withdrawal from drugs such as opioid and its conjugates, alcohol, and benzodiazepines are not only lethal but also can result in unwanted interactions between the drug and medications (Han et al., 2017; Kosten & O'Connor, 2003). Thus, these disorders not only contribute to the disease burden but cost heavily to the nation.

Over the last decade, many health policies have been introduced to address parity issues for mental health and SUDs. The latest amendment of 2016 to the Mental Health Parity and Addiction Equity Act of 2008 (MHAEA) mandates both public, including Medicaid non-managed care and benchmark-equivalent plans, and private insurance to provide coverage for behavioral health conditions. To complement these policies, the Patient Protection and Affordable Care Act of 2010 (ACA) along with the National Drug Control Strategy have categorically emphasized early detection of SUDs and embraced integration of behavioral health services in

medical settings (Executive Office of the President, 2011; Wu et al., 2013). The increased number of insured Americans under the ACA present more opportunities to healthcare organizations to treat SUDs at primary-care level and also allows them to acquire more plausible revenue. The profits generated due to implementation of such Acts, help the organizations to adapt themselves with changes in health policies (Aletraris et al., 2017; Pfeffer & Salancik, 1978). For example, an ED equipped with a behavioral health professional and requisite toolkits to treat SUDs, and a primary care integrated with behavioral health services; can take advantage of the changes in the health laws for SUDs to generate pockets of revenue (Aletraris et al., 2017). By Executive Order, President Trump too has assembled the President's Commission on Combating Drug Addiction and the Opioid Crisis, besides asking the Congress to provide funding of additional $500 million for state grants in the fiscal year 2018 stipulated under the 21st Century Cures Act of 2016 (H. W. Clark, 2017). Therefore, it would be interesting to study the effects of such rigorous, timely and frequently updating health policies on the utilization of various healthcare settings for SUDs.

Annually, 11% or 1.8 million residents of New York (NY) over 12 years of age, experience SUDs but only 15% of them receive treatment (The New York State Office of Alcoholism and Substance Abuse Services, 2012). An additional state funding of $25 million was approved for 2016-17 to facilitate development and implementation of prevention and support services, especially for individuals with heroin and opioid use disorders (DiNapoli, 2016). Moreover, the federal government has announced recently that 21 community health centers in NY will receive a total of $7.3 million in Substance Abuse Service Expansion awards to help address opioid abuse and heroin epidemic in the State (DiNapoli, 2016). Overall, the public spending for SUDs treatment has grown faster than private spending. It is noteworthy that of all the spending in 2013 from SUDs state and local agencies across the US, NY State has spent the highest of $413, 750 (The Pew Charitable Trusts and the John D. and Catherine T. MacArthur Foundation, 2015). Therefore, there is a pressing need to evaluate the utilization of healthcare spending on SUDs in NY State.

Previous studies have shown that among those SUD patients who receive treatment, many are likely to not adhere to the therapy (Heaton, Tundia, & Luder, 2013) and lack strong connections to primary care settings (Han, 2017; Hinkin & Barclay, 2010), which explains the fact that hospitalized patients have more sever SUDs in contrast to those examined in outpatient settings (Han et al., 2017; Holt et al., 2012). Moreover, it has been established that misuse of alcohol, drugs and other substances is more likely among users of emergency departments (ED) than non-users (Beaudoin, Baird, Liu, & Merchant, 2015; Bernstein & D'Onofrio, 2013; Blow et al., 2007; Cherpitel & Ye, 2012). Studies have also shown that ED utilization is 50-100% higher for patients with SUD than those without (Bahorik et al., 2017; Cherpitel & Ye, 2012; Frank et al., 2016; John & Wu, 2017). In 2011 alone, over 5 million ED visits were made for SUD, as reported in the Drug Abuse Warning Network (DAWN) (Bernstein & D'Onofrio, 2013; Substance Abuse and Mental Health Services Administration Center forMental Health Services. Rockville, 2001). ED has, therefore, evolved from being a treatment setting for acute illness and injuries to becoming a "failsafe" site of psychiatric services. Additionally, the National Hospital Ambulatory Medical Care Survey revealed that 55% of the nation's EDs "board" or hold the patients in the ED until they can allocate an inpatient bed for psychiatric services (Bernstein & D'Onofrio, 2013). It is also known that most psychiatric facilities are overcrowded and thus may increase reliance on EDs for SUD treatment (Chakravarthy et al., 2013; Honberg, Diehl, & Kimball, 2011). Also, with a rise in the number of individuals who seek care in ED for SUD, it is becoming essential for healthcare leaders to introduce innovative methods to encourage follow-up of care on discharge for SUD patients and to curb healthcare costs (Bernstein & D'Onofrio, 2013; Gau et al., 2005). However, the health professionals who are primarily trained in emergency medicine specialty to treat acute illnesses, trauma and injuries and not psychiatric care; are not conventional choice of professionals to diagnose and treat SUD. Also, the ratio of population to mental health providers for NY state is 420:1 which is much lower than the US median ratio of

1060:1 (Robert Wood Johnson Foundation Program and University of Wisconsin Population Health Institute 2016).

Regardless of the importance of the ED as a key clinical point of care for patients at high-risk, the relationship between ED utilization patterns and SUDs is understudied. ED utilization patterns and frequencies are solid predictors of subsequent death due to an overdose. Thus, it is important to understand the timing of overdose death with respect to ED utilization for identifying at-risk patients that require overdose prevention interventions. With rising cases of ED visits in NY State, clinical practice needs to re-evaluate their need to incorporate brief intervention and referrals to addiction counselors as part of emergency treatment.

The first objective of this study was to provide estimates and rates of hospital-based ED visits between the years 2011 to 2013 within NY at the county-level. Secondly, the study evaluated the effect of patient-level characteristics (age, sex, race, ethnicity, insurance status, patient location, income level, and comorbid conditions) on the associated charges for SUDs within the State over the period of 2011-2013. Finally, the study presents the geographic distribution of substance use treatment centers, ED, and patient SUDs-related ED visits at the county-level.

Methods

Data Sources

State Emergency Department Database

This study utilized the NY State Emergency Department Database (SEDD) data for the years 2011 to 2013 available from the Healthcare Cost and Utilization Project (HCUP). HCUP is sponsored by The Agency for Healthcare Research and Quality (AHRQ) and collects longitudinal hospital care de-identified patient information. SEDD provides census data on treat-and-release emergency department visits, which include more than 80% of all emergency department visits

(Agency for Healthcare Research and Quality. HCUP Databases., 2015). However, SEDD does not contain information on those emergency visits that resulted in hospitalizations. SEDD includes patient- and hospital-related variables such as age, sex, race, ethnicity, the presence of co-morbid conditions, charges, disposition status, patient location, and insurance and income.

Emergency Medicine Network

We used the 2013 data obtained from the Emergency Medicine Network (EMNet) to calculate the number of EDs in NY at county-level. EMNet collects data through the National Emergency Department Inventory (NEDI) that includes ongoing cross-sectional web-based surveys and contains data on all EDs at state, and county-level, including facility location and annual visit volume. NEDI has ED as a primary unit of analysis and has over an 80% response rate (Emergency Medicine Network., 2012).

National Survey of Substance Abuse Treatment Services

We used the substance abuse facilities locator that was generated by the National Survey of Substance Abuse Treatment Services (N-SSATS) to procure the number of substance use treatment centers in NY at the county-level. The annual census data from all the public and privately known substance abuse treatment facilities in the United States comprise N-SSATS. The N-SSATS conducted by the Mathematica Policy Research for the Substance Abuse and Mental Health Services Administration (SAMHSA). Federal, state, and local governments use the N-SSATS to assess treatment resources, update their inventories containing information on behavioral health services, and generate resource for the public to access and estimate trends in available services (Substance Abuse and Mental Health Services., 2017). The treatment centers included in this database offer services such as assessment, counseling, pharmacotherapies used, testing, transitional, and ancillary services (Substance Abuse and Mental Health Services., 2017).

Measures

All hospital-based ED visits for patients with SUDs in the State of NY between the years 2011 to 2013 were selected. Appendix 5 presents the list of all primary diagnoses codes used in this study. Disorders due to alcohol; amphetamines; cannabis; cocaine; drug-induced mental disorders; hallucinogens; opioids; sedatives, hypnotics, anxiolytics, tranquilizers, barbiturates; tobacco; and other combinations drugs were identified by the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM). The independent variables included in the study were patient-related demographic characteristics such as age, race, sex, patient location, disposition status, income and insurance statuses, and co-morbid conditions.

The comorbid burden was measured using the Elixhauser comorbidity index (ECI) measure, a summation of 29 binary Elixhauser comorbidity variables, which is available in the current HCUP Elixhauser Comorbidity Software, Version 3.7 ("Healthcare Cost and Utilization Project (HCUP). HCUP Comorbidity Software, Version 3.7.," 2017). By definition, an ECI measure of 0 indicates the absence of co-morbid conditions. For the premise of this study, we computed two separate variables: related and unrelated ECI measure. Clinical conditions primarily responsible for emergency visits such as depression and psychoses were considered as related comorbidity conditions and measures for alcohol and drug-related abuse were not considered comorbidities. Congestive heart failure, valvular disease, pulmonary circulation disease, peripheral vascular disease, paralysis, other neurological disorders, chronic pulmonary disease, diabetes without chronic complications, diabetes with chronic complications, hypothyroidism, renal failure, liver disease, peptic ulcer bleeding, acquired immune deficiency syndrome, lymphoma, metastatic cancer, solid tumor without metastasis, rheumatoid arthritis, coagulopathy, obesity, weight loss, fluid and electrolyte disorders, chronic blood loss anemia, and deficiency anemia were considered as unrelated ECI measures. All comorbidity variables were determined by the International Classification of Diseases, Clinical Modification, Version 9

(ICD-9-CM) codes (Elixhauser A, Steiner C, Harris DR, 1998; H. Mehta, 2012; Moore et al., 2017).

Outcomes

The key outcome variable for this study was the incurred hospital ED charges (in dollars) for hospital visits in NY State's hospitals. In SEDD, total charges represent the amount billed for each hospitalization reported by the facilities. Data in SEDD on cost of care provided to patients or the amount of reimbursement for services rendered were not available. These charges were adjusted for inflation to the value of 2013 US dollars, using the Bureau of Labor Statistics Consumer Price Index.

Analytical Approach

An individual ED visit was the unit of analysis. Descriptive statistics included the number and rates of SUDs-related ED visits per 10,000 population in NY where the visits stratified by clinically diagnosed SUD conditions and patient characteristics. The population-based incidence rates of SUDs per 10,000 people were calculated using the 2013 US Census population estimates for each county. ED visits in NY were stratified at the county-level using the five-digit Federal Information Processing Standard code.

The main interest of this study was to identify important patient-related factors associated with ED charges. In this study, charges have non-negative values (> 10% have zero values) with a distribution with longer right tail and outliers when compared to normal distribution. In this case, using ordinary least square regression may provide inaccurate estimates of means and marginal/incremental effects (Manning, 2006; Manning et al., 2005; Partha et al., 2010). Therefore, total charges were estimated using a generalized linear model (GLM) with a gamma distribution and log-link function which best fits our data structure and is a common method in cases where the log-transformed dependent variables do not have heavy tails (N. G. Choi et al.,

2015; J. A. Singh & Yu, 2016; Thompson & Nixon, 2005). The log-link function accounts for the non-normal distributional characteristics of the total charges data (Kazley et al., 2014; Malehi et al., 2015; Manning et al., 2005). The gamma distribution was selected based on the recommended diagnostic test ($\lambda = 2$) for the GLM family, called the modified Park Test, to examine the distributional characteristics of the residuals (S. D. Case et al., 2011; Malehi et al., 2015; Manning et al., 2005). For interpretability, coefficients were converted to average marginal effects (AME) which measures the difference in adjusted predicted outcomes between the reference group and the comparison groups after adjusting for other covariates. Statistical significance was assessed at a level of 0.05.

All of the descriptive analyses were carried out using SAS version 9.4 (SAS Institute Inc, Cary, NC), whereas log-linked Gamma distributed Generalized Linear model analyses were conducted using Stata (StataCorp, College Station, TX). Geographic information system (GIS) maps were created using ArcGIS software, version 10.4 (Esri, Redlands, CA). The University of Nebraska Medical Center IRB deemed this study exempt from human subject protocol.

Results

Patient Characteristics

Table 1 is a compilation of SUDs-related ED visits in NY stratified by patient characteristics over the study period. The majority (74.3%) of the ED visits for SUD were made by males. While the mean age of patients admitted in the ED for SUDs was 41 years, over 41% of the visits were made by those aged between 45 to 64 years, followed by adults within the 25 to 44 years age group (38.2%). Young adults belonging to the 17 to 24 years old age group represented 15% of the ED visits for SUD. About 41% of patients who visited the ED for SUDs were White, followed by 23.6% of Black patients and 19.1% were Hispanic. About 77% of these patients had non-Spanish or non-Hispanic ethnicity. The majority were covered by Medicaid (42%) uninsured

(31%). Only 15% of these patients were privately insured and less than 9% were covered by Medicare.

Table 1 also shows that about 95% ED visits were made by patients living in urban areas with about 57% of ED visits occurred in patients living in zip codes with the first (38%) and second (19%) quartile median household income. However, about a quarter of ED visits comprised of those patients living in zip codes within the fourth quartile. Using the ECI measure, the present study found that 93% of the ED visits for SUDs were made by patients who had zero related comorbidities. However about 7% had 1 or 2 related comorbid conditions such as depression and psychoses. The present study categorized ECI measures for unrelated comorbid conditions and found that 86% ED visits for SUDs comprised of patients who did not suffer from any related comorbid condition, but there were 13% of visits made by patients who had 1 to 2 unrelated comorbid conditions.

NY's EDs reported a total of 492,419 ED visits for a primary diagnosis of SUDs during 2011 to 2013, as shown in Table 2. There was an overall reduction in the number of ED visits for SUD (9% from 2011 to 2012 and 6% from 2011 to 2013). In our study, we found that the most common causes of SUDs-related ED visits were made for abuse of alcohol (72.5%), opioids (7.9%), combination of drugs (7.8%), and drugs (5.5%). While rates of ED visits for some types SUDs reduced, rates for drug-induced mental disorders increased. Specifically, the rates of drug-related ED visits increased from 4.0 in 2011 to 5.0 in 2013 per 10,000 population. However, rates of ED visits for alcohol abuse (61.9 in 2011 to 61.8 in 2013 per 10,000 population); amphetamines (0.1 per 10,000 population through 2011-2013); sedatives, hypnotics, anxiolytics, tranquilizers, barbiturates (0.37 per 10,000 population through 2011-2013); and tobacco use (3 per 10,000 population through 2011-2013) have remained steady. Interestingly, rates of ED visits due to abuse of cannabis (4.0 vs. 12.6), cocaine (3.5 vs.1.6 per 10,000 population) opioids (75.8 vs. 61.8 per 10,000 population), and abuse of combination of drugs (6.9 vs. 6.2 per 10,000

population) have decreased from 2011 to 2013. But cases of disorders caused due to drug induced mental disorders (4.0 vs. 4.9) has increased over the three years. (Table 1).

Table 3 shows that SUDs visits caused by alcohol, opioids, combination of drugs, and drugs-induced mental disorders are most prevalent. Over the study period, in NY State, for alcohol abuse-related disorders have had the highest rates of ED visits across all age groups. Among those under the age of 18 years had alcohol as the main cause of ED visits with the rate of 3.2 per 10,000 population. But it is the most common cause among those aged between 45 to 64 years (83.6 per 10,000 population), followed 25 to 44 years (62.5 per 10,000 population), and 18 to 24 years (24.1 per 10,000 population) age groups. Interestingly, among the elderly ED visit rates for alcohol-abuse is the predominant cause as 90 out 100 per 10,000 population are admitted for this type of SUDs.

The second most common type of SUD that had high rates of ED visits was opioid use. Specifically, among all ages, those aged between 25 to 44 years (9.6 per 10,000 population) had higher rates of ED visits for opioid abuse, followed by age groups of 45 to 64 years (6.1 per 10,000 population) and 18 to 24 (3.8 per 10,000) years. Use of drugs as mixtures or in combination was the third leading cause of ED visits in NY State over the study period. Similarly, those between 25 to 44 years (9.7 per 10,000 population) had the highest rates of ED visits, followed by those between 45 to 64 years (5.3 per 10,000 population) and 18 to 24 years (4.0 per 10,000 population) of age for abuse of combination of drugs. Among those patients who are 25 to 44 years old, high rates of ED visits for drug-induced mental disorders (6.9 per 10,000 population) and abuse of cocaine (3.3 per 10,000 population) were the other common causes. It is noteworthy that those between 45 to 64 years (103.1 per 10,000) of age had the most ED visit rates among all age groups for SUDs.

Hospital ED Charges for SUD

After adjusting hospital ED charges for inflation to the value of 2013 US dollars, the aggregated ED charges have increased by 9% from $276 million in 2011 to approximately $300 million in 2013. The total ED charges incurred from SUD in the state of NY was $856 million with an average ED visit charge of $1,764 (Table 1). As seen in Figure 2, the number of ED visits for SUD decreased from 2011 (172,958) to 2012 (153,444) and then increased to 162,522 in 2013. From 2011 to 2013, both total ED charges and average ED charges for SUDs-related visits showed a substantial increase after inflation adjusted to 2013 US dollars. The average hospital ED charges increased from $1,658 in 2011 to $1,845 in 2013.

Table 4 represents the findings of the effect of patient-related factors on hospital-based ED charges for SUDs using a multivariate log-linked gamma distributed GLM. As indicated by average marginal effects (AME), the total charges for females are significantly higher than males by $64. Interestingly, ED visits made by patients below the ages of 17 years were charged higher than all other age groups. Adults between the ages of 45-64 years incurred hospital ED charges of SUD lower than children under the age of 17 years by $278. Race was significantly associated with hospital ED charges for SUDs. White patients incurred higher ED charges than all other races. Asians and Pacific Islanders incurred ED charges $178 lower than Whites for SUDs. Privately insured patients had ED charges higher by $36 than those covered by Medicare. However, those patients covered by other insurance types that includes CHAMPUS/VA were charged $272 less than those covered by Medicare. Patients covered by Medicaid also had $148 less than those covered by Medicare. Patients whose median household income at the ZIP code level fell into the fourth quartile had significantly higher ED charges than those living in the first, second and third quartile by $569, $591 and $368, respectively. The regression model also indicates that patient location is significantly associated with ED charges for SUDs. Patients residing in large, small and isolated rural towns had higher ED charges for SUD by $327, $158 and $297 more than those residing in urban areas. Additionally, ED charges are also significantly

associated with an ECI measure for unrelated comorbid conditions. Hospital ED charges for SUDs increased with an increase in the index measure, with ED charges being $1064 higher for those patients with 3 or more unrelated comorbid conditions than those with no unrelated comorbid conditions.

GIS Analysis Results

Overall, the maps depict geographic patterns of ED admission for SUDs and explore potential reasons for geographic variations by plotting available distribution of EDs and substance abuse treatment centers. Figure 2 presents the distribution of population-based estimates of ED visits for SUDs and the available treatment centers for SUDs in NY by county during 2011-2013. The majority of the substance abuse treatment centers were clustered in the urban five boroughs area (Greater NY City) comprised of the Richmond, Kings, Queens, New York, and Bronx counties which had also experienced high number of ED visits (>over 400 per 10,000 population) for SUDs. In contrast, some rural counties had a moderate proportion of ED visits for SUDs but less than 5 treatment centers (e.g., Schenectady and Broome: 201-400 ED visits per 10,000 population) or zero treatment centers (Chemung, Schuyler and Delaware: 101-200 400 ED visits per 10,000 population). Interestingly, even urban counties (Washington, Herkimer, and Tioga) had 0-1 treatment centers but their residents made <100 ED visits per 10,000 population for SUD.

Figure 3 shows the distribution of population-based estimates of ED visits for SUDs and the distribution of EDs in NY by county between 2011 and 2013. Within the five-borough region, there are most number of EDs. Also, the neighboring urban counties of Suffolk, Nassau, and Westchester have between 11-15 EDs. In contrast, their neighboring urban county of Richmond had fewer EDs (3-5). Even though, the urban counties of Broome, Schenectady, and Rensselaer counties had high rates of ED visits for SUDs, they had only 1-2 ED facilities. Interestingly, counties such as Saratoga and Rensselaer were moderately populated and urban, but had only 1 ED whereas urban county of Tioga had no ED. Moreover, there were 20 other counties that had

only 1-2 EDs. Markedly, rural counties of Greene, and Hamilton had no EDs although their residents had between 80-200 visits per 10,000 population for SUDs.

Discussion

The racially and culturally diverse NY State happens to be predominantly urban (Hevesi, 2004; RLS Demographics, 2011), adopted Medicaid expansion under ACA, and its state substance abuse agency had the highest spending per capita in the US. These facts make NY an important state to evaluate regarding their healthcare utilization for SUDs at both the EDs and treatment centers. To our knowledge, this study is the first to examine hospital-based ED visits for all ten types of SUDs in NY. Researchers have examined ED visits for misuse of cannabis, alcohol, heroin and opioid-related disorders. For example, Schmidt et al. analyzed ED utilization for cannabis abuse in California (Schmidt, Behar, Cordova, & Beckum, 2017), while Campbell and Bahorik examined specifically encounters in ED for alcohol, cannabis, and opioid use disorders (Bahorik et al., 2017; Campbell, Bahorik, Kline-simon, & Satre, 2017). John and Wu (2017) have evaluated nationwide utilization of ED and inpatient hospitalization for only alcohol use among individuals with cannabis use disorders (John & Wu, 2017). However, after implementation of ACA, there are no data published examining the burden of ED visits in NY for all ten SUDs categories.

This study indicated that a total of 492,419 ED visits for SUDs occurred during the study period resulting in total ED charges of close to $856 million. Most ED visits across all age groups were made for alcohol abuse. Nevertheless, it is noteworthy that 90% of the ED visits made by elderly were for alcohol abuse resulting in alcohol-induced delirium, amnesia and sleep disorders which is common among elderly.

Considering that SUDs are conventionally treated at substance abuse treatment centers, rehabilitation centers, and at outpatient clinics; average ED spending of $285 million per year for SUDs is alarming. Moreover, considering that ED staff usually do not have behavioral health

providers on their team for treating SUDs, the approach to treat SUDs may lack definitive diagnoses and is rather symptomatic which may delay the required line of treatment.

Based on the demographic distribution in NY State, males; patients who were between 25-64 years old; of Black, Hispanics and other racial minorities; Medicaid and uninsured; urban residents are the most burdened with SUDs. Consistent with previous literature, this study shows that males (Bohnert, Tracy, & Galea, 2012; Fahimi et al., 2015; Meiman, Tomasallo, & Paulozzi, 2015a), mostly adults who are 25-64 years old, and Whites represent a substantial proportion of ED visits for SUDs (DiNapoli, 2016; Tice et al., 2014; Wu et al., 2013; Xie et al., 2014). A sizeable proportion of ED visits for SUDs were made by those patients covered by Medicaid which has been the case nationally (U.S. Department of Health and Human Services (HHS), 2016; Weiss, Barrett, Heslin, & Stocks, 2016). Additionally, about 57% of the SUDs-related ED visits occurred in patients living in zip codes with the first and second quartile median household income. This finding explains that more SUDs occur among those living urban but low-income areas. However, unlike the national-level studies, the second largest number of ED visits were made by uninsured (31.3%) in NY followed by those privately insured (14.9%). Other studies have also reported that most of the ED visits for SUDs occurred over weekdays (Fahimi et al., 2015) and were routinely discharged (Mark et al., 2010; Schildhaus et al., 2013). Similar to published reports, we that urban or metropolitan population (Meiman, Tomasallo, & Paulozzi, 2015b; Schildhaus et al., 2013; Schroeder & Leigh-peterson, 2017), had a greater proportion of ED visits. EDs are located more in urban and densely populated areas, especially the five boroughs region in NY.

This study was able to identify high-risk cohorts who are likely to visit an ED for SUDs and have higher ED charges in the NY. Specifically, females, $\geq$17 years of age, Whites, those privately insured, and living in low-income areas had higher ED charges. Few studies have reported that behavioral disorders-related ED charges for adolescents, pediatrics, and young adults have been expensive (Akosa Antwi, Moriya, & Simon, 2015; Torio, Encinosa, Berdahl,

McCormick, & Simpson, 2015). However, there are no epidemiologic studies that have presented comparison on ED charges between children, adolescents and adults with which the present findings could be compared, and more research is needed to further explore this area. A high proportion (95%) of ED visits for SUDs were made by urban patients who could be due to an array of parameters including acceptance of risky substance use as 'normal' by the communities (Center on Addiction and Substance Abuse Columbia, 2013). Efforts need to be made by policymakers and healthcare administrators to implement preventative behavioral health programs targeted towards these individuals. Also, because there are unmet behavioral healthcare needs in low-income quartile areas, primary care settings must pursue to be integrated with behavioral health services.

SAMHSA reported that the highest spending by payer for SUDs with and without the impact of ACA, is by Medicaid and private insurance companies, followed by the uninsured (U.S. Department of Health and Human Services, 2016). This study shows that, even though there are statistically significant changes in the proportion of charges covered by payers, overall, the population covered by Medicaid, the uninsured, and the privately insured contributed to a substantial proportion of ED visits for SUD. These findings for NY differ from those at the national level (Fahimi et al., 2015; U.S. Department of Health and Human Services, 2016), and those for the states of California (Bahorik et al., 2017; Campbell, Bahorik, Kline-simon, & Satre, 2017b), and North Carolina (Doren et al., 2016) suggesting, that state-specific studies should be performed. In NY, most substance abuse services (including all outpatient services) and mental health services were excluded from its managed care benefit package. These services were only offered on a fee-for-service basis or as an optional Medicaid benefit. However, on expanding Medicaid under the ACA, NY State's Medicaid program offered to include substance abuse services to the benefits package along with comprehensive behavioral health services (Bachrach, Boozang, & Lipson, 2015; Boozang, Bachrach, & Detty, 2014). On identifying high-risk cohorts, this evidence-based research, can help policymakers examine the state reimbursement policies

may negatively impact access to behavioral health services. Furthermore, despite the ACA's expansion of SUDs treatment coverage and reduction in the number of ED visits from 2011 to 2013, the average hospital ED charges for SUDs increased. This proposes that the ED-level spending for SUDs needs to be re-evaluated by introducing cost-effective programs that use screening, intervention, and referral toolkits, and peer-SUDs-afflicted coaches on the ED staff to direct patients with SUDs to appropriate healthcare settings.

Figures 2 and 3 display the ED utilization pattern for SUDs across the geographic regions in NY indicating that visits are higher in areas with more treatment facilities and EDs. This could be because of the greater number of low-income and uninsured population in these urban counties. Also, in our study, ED visits were mainly made by those who are living in low-income areas and covered by Medicaid and the uninsured. This indicates that despite the availability of treatment centers, this population maybe limited in their access to these facilities and ultimately seek help in ED. US DHHS projected a shortage of behavioral health professionals in 2025 (U.S. Department of Health and Human Services, 2016). Subsequently, there is a possibility of insufficient behavioral healthcare with sustained health disparities in NY. In addition, the maps displayed that the ED utilization pattern for SUD across the geographic regions in NY. Counties that form the five boroughs region such as Kings, Queens, New York, Richmond, and Bronx counties had high rates of ED rates and high proportion of the high-risk cohort that belonged to 29-44 years old age group. Contrastingly, even though Suffolk and Westchester counties had high proportion of high-risk age group (29- 44 years) because of the high numbers of treatment centers their rates of ED visits were low (less than 200 ED visits per 10,000 population). Therefore, from the figures, there is clear evidence that the SUD-related ED visits are higher in urban areas with more substance abuse treatment facilities and EDs. This could be because of the greater number of low-income and uninsured population in these counties (mostly urban five boroughs region). Also, in our study, ED visits are majorly made by those who are living in low-income areas and covered by Medicaid and the uninsured. This also reinstates that access of EDs drives their

utilization. Subsequently, dearth of treatment centers compels both urban and urban residents to seek healthcare services for SUDs in EDs, which maybe because his population may be limited in their access to these facilities. Further studies need to be performed to understand the severity of disorders among SUD-related ED visitors.

Health systems need to emphasize educating the population in NY about available provisions for behavioral healthcare and unwanted outcomes of substance abuse. According to a report by the US Department of Health and Human Services, there will be a projected shortage of psychiatrists; clinical, counseling, and school psychologists; and mental health and substance abuse social workers in 2025 (U.S. Department of Health and Human Services, 2016). This indicates that there is a possibility of deteriorating behavioral health care and sustained health disparities in behavioral health care access in NY. Specifically, Broome, Schenectady, Albany, Richmond, Tompkins and Rensselaer and Cortland counties need treatment facilities. Also, policymakers need to design policies that could improve access to integrated or segregated behavioral healthcare and reduce ED visits and deaths due to SUD. For illustration, to avoid readmissions in inpatient or emergency departments, especially among the high-risk cohorts, integrated behavioral health services must be provided by the ED hospital staff. Allocation of a CPT code for follow-ups, reminders, peer-coaching and adherence to therapy for patients with SUDs will encourage the healthcare professionals and hospital staff to participate in supportive community outreach and procure reimbursements for delivering patient-centered and coordinated care with primary care providers. New York State can adopt such Patient-centered approach from predominantly urban states with similar demography such as New Jersey, Massachusetts, and Oregon. These states manage the social, behavioral, and medical needs of those individuals with high charges of ED visits for SUDs by including the hospital administrators and policymakers on their interdisciplinary teams. It could be anticipated that combined efforts from patients, providers and policymakers can break the harmful and costly cycle of inappropriate and costly ED and/or inpatient admissions.

Conclusions

This study provides estimates of characteristics of patients across all ages that make ED visits in the State of NY for ten types of SUD. This study also examined the significant changes in the proportion of charges covered by Medicaid, the uninsured and those privately insured due to the impact of altering health policies in NY. Treatment charges are significantly higher for females, children, privately insured and patients in rural areas. The study identified that males, Whites, those aged 25-64 years, uninsured, covered by Medicaid and private insurance, and residing in low-income areas and belonging to urban areas were at high-risk in the State of NY. Additionally, despite sufficient access to behavioral healthcare services in urban areas, more substance use-related problems exist, especially in the five boroughs areas of NY. On the other hand, there are counties in NY that have no EDs or have insufficient substance abuse treatment centers available implying high numbers of unmet behavioral health needs. In the future, studies should be conducted to better understand the barriers to access for behavioral healthcare at the primary level, especially among high-risk groups. These findings emphasize that it is essential to design state-specific preventive health policies and programs to improve access to care and reduce dependence on ED for treatment of SUD. We anticipate that the findings will provide evidence to psychiatric healthcare providers and policymakers.

Table 1: **Emergency Department visits for substance use disorders stratified by patient characteristics in NY SEDD, 2011 – 2013. ***

Characteristics	Number (Percent)
Sex	
Male	365,693 (74.3)
Female	126,694 (25.7)
Age group (in years)	
up to 17	9,093 (1.9)
17 to 24	73,594 (15.0)
25 to 44	188,233 (38.2)
45 to 64	201,771 (41.0)
65 and over	19,728 (4.0)
Mean Age (years)	41.00
Race	
White	200,656 (41.0)
Black	115,735 (23.6)
Hispanic	93,744 (19.1)
Asian and Pacific Islander	8,247 (1.7)
Other (includes NA)	71,509 (14.6)
Ethnicity*	
Spanish/Hispanic origin	93,744 (19.9)
Non-Spanish/Non-Hispanic	378,502 (76.9)
Primary payer	
Medicare	43,014 (8.7)
Medicaid	209,005 (42.5)
Private Insurance	73,462 (14.9)
Uninsured	153,862 (31.3)
Other (includes No charge)	12,928 (2.6)
Admission Day	
Weekday	336,863 (68.41)
Weekend	155,556 (31.59)
Disposition status	
Routine	459,855 (93.42)
Transfer to short-term hospital	3,926 (0.80)
Transfer Other: Includes SNF, ICF, Another Type of Facility	6,874 (1.40)

Home Health Care (HHC)	1,310 (0.27)
Against Medical Advice (AMA)	20,270 (4.12)
Died in hospital	36 (0.01)
Missing	148
Patient Location	
Urban	451,330 (95.09)
Large rural town	14,093 (2.97)
Small rural town	5,365 (1.13)
Isolated rural	3,850 (0.81)
Median household income national quartile for patient ZIP code**	
First quartile	181,819 (38.20)
Second quartile	89,468 (18.80)
Third quartile	85,610 (17.99)
Fourth quartile	119,047 (25.01)
Elixhauser Comorbidity Index	
Related comorbid conditions [a]	
0	457,219 (92.9)
1	34,025 (6.9)
2	1,175 (0.2)
Unrelated comorbid conditions [b]	
0	423, 338 (86.0)
1	51,930 (10.6)
2	13, 987 (2.8)
3 or more	3, 164 (0.6)
Hospital ED charges (inflation adjusted to 2013 US dollars)	
2011	$276,123,421.00
2012	$280,069,900.00
2013	$299,824,373.00
Total charges	$856,017,694
Mean (median) charges	$1,764.4 ($1,266.7)

ED, emergency department; SEDD, State Emergency Department Database; NA, Native Americans; SNF, Skilled Nursing Facility; ICF, Intermediate Care Facility.

* The sum of individual counts may not add up to the total number of visits because of missing information for certain variables.

** Median household income quartiles of residents in the patient's ZIP code vary by year. The levels were $1 to $38,999 (quartile 1), $39,000 to $47,999 (quartile 2), $48,000 to $63,999 (quartile 3) and $64,000 or higher (quartile 4) in the year 2011.

The levels were $1 to $38,999 (quartile 1), $39,000 to $47,999 (quartile 2), $48,000 to $62,999 (quartile 3) and $63,000 or higher (quartile 4) in the year 2012.
The levels were $1 to $37,999 (quartile 1), $38,000 to $47,999 (Quartile 2), $48,000 to $63,999 (quartile 3) and $64,000 or higher (quartile 4) in the year 2013.

[a] Count of related comorbid conditions from 2011 to 2013 which includes depression and psychoses.

[b] Count of unrelated comorbid conditions from 2011 to 2013 which comprises of a count of one for congestive heart failure, valvular disease, pulmonary circulation disease, peripheral vascular disease, paralysis, other neurological disorders, chronic pulmonary disease, diabetes without chronic complications, diabetes with chronic complications, hypothyroidism, renal failure, liver disease, peptic ulcer bleeding, acquired immune deficiency syndrome, lymphoma, metastatic cancer, solid tumor without metastasis, rheumatoid arthritis, coagulopathy, obesity, weight loss, fluid and electrolyte disorders, chronic blood loss anemia, and deficiency anemias.

Table 2: Number, percent and rates of substance use disorders-related emergency department visits per 10,000 population by year in New York, SEDD 2011 – 2013.

Type of SUD	2011			2012			2013			Total		
	N	%	R	N	%	R	N	%	R	N	%	R
Alcohol	120,591	69.7	61.95	114,844	73.3	58.7	121,413	74.6	61.8	356,848	72.5	182.4
Amphetamines	226	0.1	0.12	237	0.2	0.1	262	0.2	0.1	725	0.1	0.4
Cannabis	7,759	4.5	3.99	2,520	1.6	1.3	2,481	1.5	1.3	12,760	2.6	6.5
Cocaine	6,755	3.9	3.47	3,379	2.2	1.7	3,198	2.0	1.6	13,332	2.7	6.8
Drug-induced mental disorders	7,889	4.6	4.05	9,463	6.0	4.8	9,691	6.0	4.9	27,043	5.5	13.8
Hallucinogens	294	0.2	0.15	166	0.1	0.1	138	0.1	0.1	598	0.1	0.3
Opioids	14,763	8.5	7.58	11,990	7.7	6.1	12,136	7.5	6.2	38,889	7.9	19.9
Sedatives, hypnotics, anxiolytics, tranquilizers, barbiturates	710	0.4	0.36	639	0.4	0.3	730	0.4	0.4	2,079	0.4	1.1
Tobacco	499	0.3	0.26	506	0.3	0.3	568	0.3	0.3	1,573	0.3	0.8
Other	13,472	7.8	6.92	12,980	8.3	6.6	12,120	7.4	6.2	38,572	7.8	19.7
Total	**172,958**	100.0	88.85	**156,724**	100.0	80.1	**162,737**	100.0	82.8	**492,419**	100.0	251.7

ED, emergency department; SEDD, State Emergency Department Database; SUD, Substance Use Disorders; N, Number R, Rate

Note: Rate is calculated using population estimates of New York to be 19,465,197 in 2011; 19,570,261 in 2012; and 19,651,127 in 2013.

Table 3: Number, percent and rates of substance use disorders-related emergency department visits per 10,000 population by age groups in New York, SEDD 2011 – 2013.

Types of SUD	Age in years										Total	
	1 to 17		18 to 24		25 to 44		45 to 64		65 and more			
	N (%)	R	N (%)	R	N (%)	R	N (%)	R	N (%)	R	N (%)	R
Alcohol	6,190 (68.1)	3.2	47,088 (64.0)	24.1	122,193 (64.9)	62.5	163,625 (81.1)	83.6	17,752 (90.0)	9.1	356,848 (72.5)	182.4
Amphetamines	26 (0.3)	0.0	254	0.1	368 (0.02)	0.2	75 (0.0)	0.0	89.98 (0.5)	0.0	725 (0.1)	0.4
Cannabis	1,324 (14.6)	0.7	4,121 (5.6)	2.1	5,790 (3.1)	3.0	1,497 (0.7)	0.8	28 (0.1)	0.0	12,760 (2.6)	6.5
Cocaine	31 (0.3)	0.0	971 (1.3)	0.5	6,447 (3.4)	3.3	5,753 (2.9)	2.9	130 (0.7)	0.1	13,332 (2.7)	6.8
Drug-induced mental disorders	383 (4.2)	0.2	4,921 (6.7)	2.5	13,545 (7.2)	6.9	7,435 (3.7)	3.8	759 (3.8)	0.4	27,043 (5.5)	13.8
Hallucinogens	22 (0.2)	0.0	254 (0.3)	0.1	278 (0.1)	0.1	43 (0.0)	0.0	1 (0.0)	0.0	598 (0.1)	0.3
Opioids	135 (1.5)	0.1	7,413 (10.1)	3.8	18,818 (10.0)	9.6	12,019 (6.0)	6.1	504 (2.6)	0.3	38,889 (7.9)	19.9
Sedatives, hypnotics, anxiolytics, tranquilizers, barbiturates	46 (0.5)	0.0	408 (0.6)	0.2	1,011 (0.5)	0.5	559 (0.3)	0.3	55 (0.3)	0.0	2,079 (0.4)	1.1
Tobacco	18 (0.2)	0.0	315 (0.4)	0.2	725 (0.4)	0.4	459 (0.2)	0.2	56 (0.3)	0.0	1573 (0.3)	0.8
Other combinations	918 (10.1)	0.5	7,849 (10.7)	4.0	19,058 (10.1)	9.7	10,306 (5.1)	5.3	441 (2.2)	0.2	38,572 (7.8)	19.7
Total	9,093	4.6	73,594	37.6	188,233	96.2	201771	103.1	19,728	10.1	492,419	251.7

ED, emergency department; SEDD, State Emergency Department Database; SUD, Substance Use Disorders; N, Number R, Rate

Note: Rate is calculated using average population estimates of New York to be 19,562,195 between 2011 and 2013.

Table 4: Multivariate generalized linear model of hospital-based emergency department charges due to substance use disorders, NY SEDD 2011 – 2013.

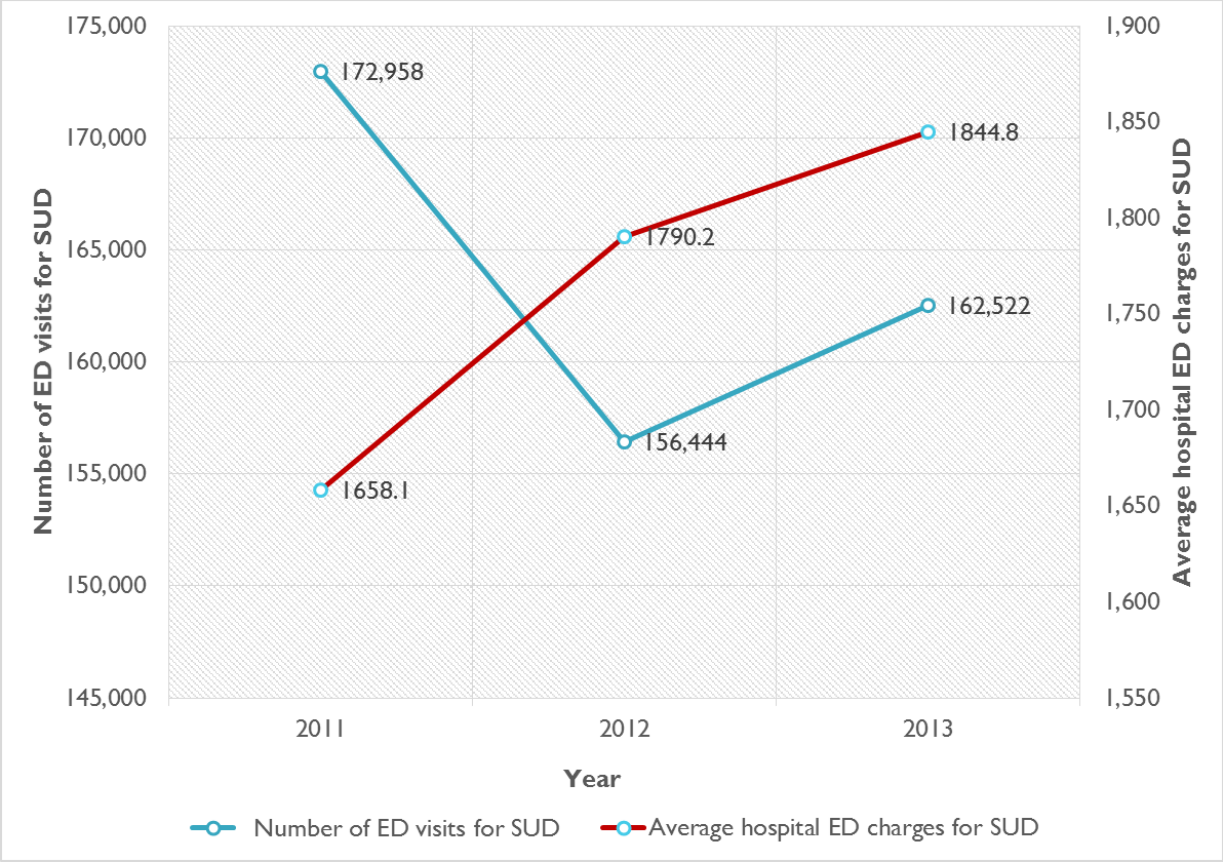
Parameter	AME (dy/dx) in dollars	Standard Error	95% Confidence Intervals		P-value
			Lower	Upper	
Sex					
Male			Reference		
Female	64.41	5.09	54.44	74.39	<.0001
Age group					
0 to 17			Reference		
18 to 24	-250.83	18.48	-287.05	-214.60	<.001
25 to 44	-194.43	18.16	-230.02	-158.83	<.001
45 to 64	-277.87	18.16	-313.47	-242.27	<.001
65 and over	-210.63	21.70	-253.16	-168.10	<.001
Race					
White			Reference		
Black	-169.92	5.91	-181.50	-158.34	<.001
Hispanic	-81.76	6.34	-94.18	-69.34	<.001
Asian and Pacific Islander	-178.29	16.02	-209.68	-146.90	<.001
Other (includes NA)	-155.74	6.67	-168.81	-142.68	<.001
Primary Payer					
Medicare			Reference		
Medicaid	-148.00	9.18	-165.99	-130.01	<.001
Private Insurance	35.91	10.71	14.92	56.90	0.001
Uninsured	-75.09	9.54	-93.78	-56.40	<.001
Other insurance	-271.78	14.67	-300.53	-243.03	<.001
Median household income national quartile for patient ZIP code**					
Fourth quartile			Reference		
First quartile	-568.76	6.54	-581.58	-555.93	<.001
Second quartile	-590.47	7.15	-604.47	-576.46	<.001
Third quartile	-367.66	7.41	-382.19	-353.42	<.001
Patient Location					
Urban			Reference		
Large rural town	327.40	15.36	297.28	357.51	<.001
Small rural town	157.62	22.20	114.11	201.13	<.001
Isolated rural	296.62	27.96	241.83	351.42	<.001
Elixhauser Comorbidity Index Measure for Unrelated Comorbid Conditions***					
0			Reference		
1	476.16	8.52	459.46	492.87	<.001
2	582.23	16.80	549.31	615.15	<.001
=> 3	1063.56	42.43	980.40	1146.73	<.001

NY SEDD, NY State Emergency Department Database; AME, Average marginal effects; NA, Native Americans.

** Median household income quartiles of residents in the patient's ZIP code vary by year. The levels were $1 to $38,999 (quartile 1), $39,000 to $47,999 (quartile 2), $48,000 to $63,999 (quartile 3) and $64,000 or higher (quartile 4) in the year 2011. The levels were $1 to $38,999 (quartile 1), $39,000 to $47,999 (quartile 2), $48,000 to $62,999 (quartile 3) and $63,000 or higher (quartile 4) in the year 2012. The levels were $1 to $37,999 (quartile 1), $38,000 to $47,999 (Quartile 2), $48,000 to $63,999 (quartile 3) and $64,000 or higher (quartile 4) in the year 2013.

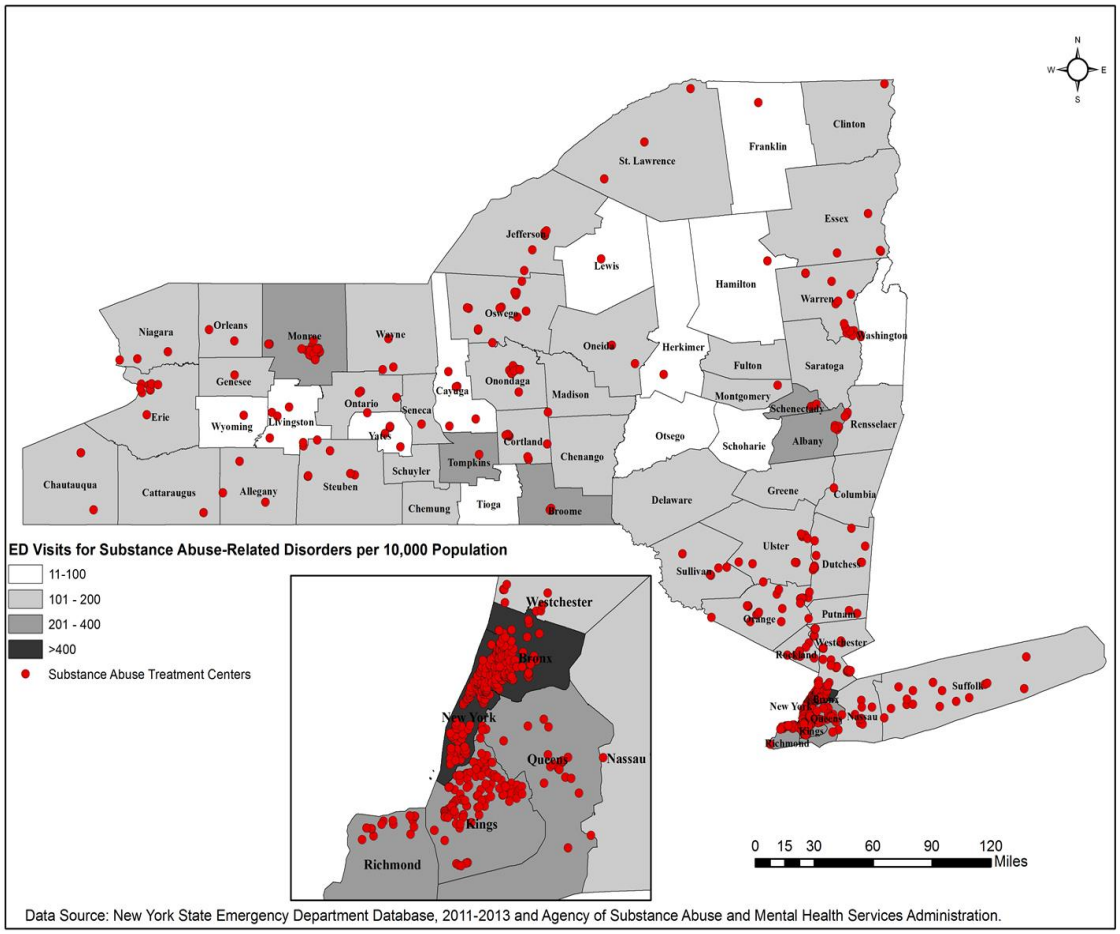
***Count of unrelated comorbid conditions from 2011 to 2013 which comprises of a count of one for congestive heart failure, valvular disease, pulmonary circulation disease, peripheral vascular disease, paralysis, other neurological disorders, chronic pulmonary disease, diabetes without chronic complications, diabetes with chronic complications, hypothyroidism, renal failure, liver disease, peptic ulcer bleeding, acquired immune deficiency syndrome, lymphoma, metastatic cancer, solid tumor without metastasis, rheumatoid arthritis, coagulopathy, obesity, weight loss, fluid and electrolyte disorders, chronic blood loss anemia, and deficiency anemias.

Figure 1: Number of ED visits and average Emergency Department charges* for Substance Use Disorders, NY SEDD 2011–2013.



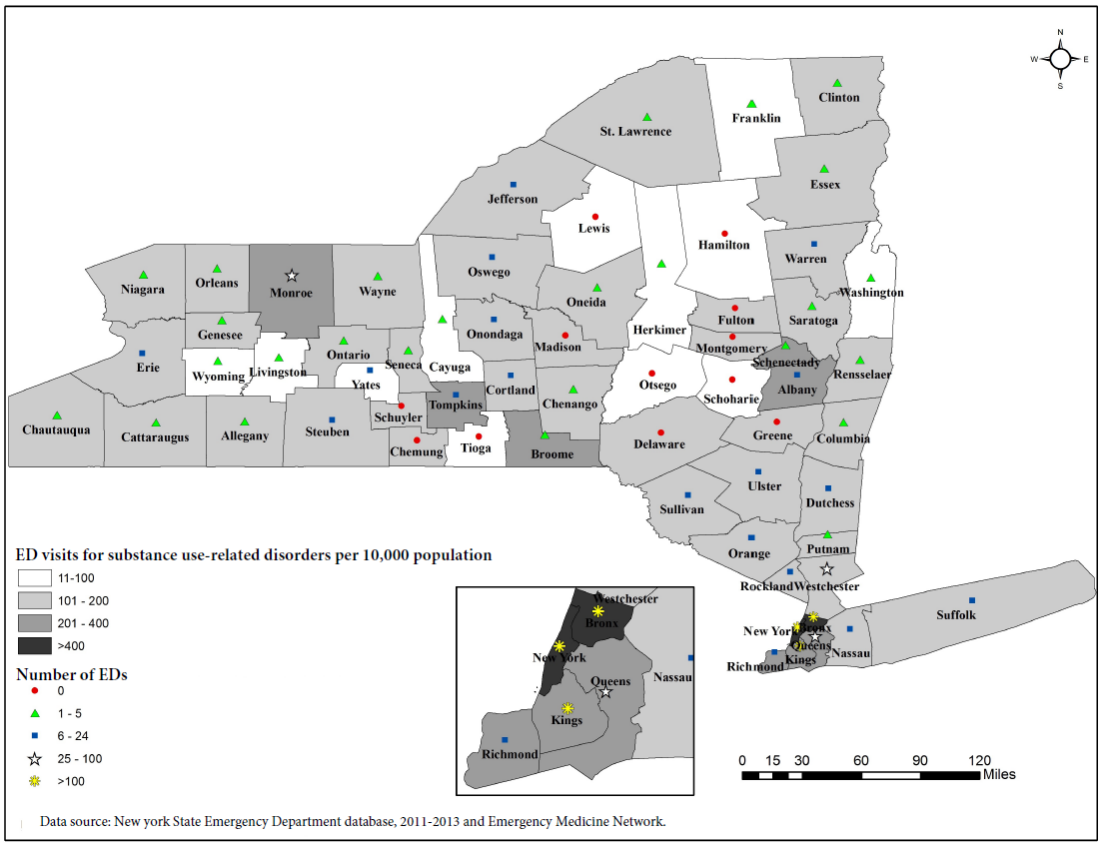
* Hospital ED charges– inflation adjusted to 2013 US dollar value

Figure 2: Emergency department visits per 10,000 population for substance use disorders and their treatment centers in the New York State using NY SEDD, 2011–2013 and SAMHSA 2013.



SAMHSA, Substance Abuse and Mental Health Agency; SEDD, State Emergency Department Database

Figure 3: Emergency department visits per 10,000 population for substance use disorders and the distribution of emergency departments in the State of New York using NY SEDD, 2011– 2013 and EMNet 2013.



SEDD, State Emergency Department Database; EMNet, Emergency Medicine Network

CHAPTER VI: DISCUSSION AND CONCLUSIONS

Studies outlined in this dissertation project examined three different aspects of behavioral health (BH) services in the United States (US). Each of these three independent studies have addressed vital questions based on healthcare utilization for BH services, available access to care, and the implications of healthcare reforms and the mandated policies. The findings of this dissertation will benefit policymakers who are developing the American Health Care Act of 2017 and shaping the President Trump's Commission on Combating Drug Addiction and the Opioid Crisis. In addition, the findings of this dissertation laid down salient features that will enable hospital administrators and providers to recognize high-risk population suffering from BH conditions, and design methods to curb charges and costs of hospitalization as well as rates and costs of readmissions. Subsequently, the actions by policymakers and health administrators will aid public health program developers to design community outreach to address the problem of BH conditions that can eventually be advantageous to patients.

The first study of this dissertation analyzed the rates, costs and relapses of 30-day unplanned all-cause readmissions following index hospitalizations for alcohol-related disorders (ARD) among US adults. The conclusions derived from this study will help policymakers, budget and discharge protocol designers at hospitals, and eventually patients. The second study examined the incidence of emergency department (ED) visits and the corresponding incurred charges for BH disorders as well as predicted cohorts that have higher odds of leaving against medical advice, and correlation BH workforce in Nebraska between 2011 and 2013. The findings from this study will depict ED outcomes among high-risk cohort and also highlight that BH provider shortages are responsible for high number of ED visits and charges for BH disorders, despite limited availability of EDs in rural Nebraska. The third study examined the frequency of ED visits and the hence incurred charges for substance use disorders (SUD) in New York between 2011 and 2013 during the adoption of Medicaid expansion under Patient Protection and

Affordable Care Act (ACA). The results from this study explained that there is a need to develop policies and increase access to primary care clinics or substance abuse treatment centers despite New York being a predominantly urban state. This concluding section of the dissertation will briefly discuss the findings of the three studies, policy implications, and suggest few new ideas for future research.

All three studies used data from the Healthcare Cost and Utilization Project (HCUP) database maintained and curated by the Agency for Healthcare Research and Quality. The first study used 2014 Nationwide Readmissions Database to obtain patient and hospital-level characteristics and discharges (index hospitalizations and readmissions) for ARD. Although NRD contains information from 22 states, national-level estimates that produce nationally representative results. HCUP's 2011-2013 Nebraska State Emergency Department Database (SEDD) was queried for the second study for number of cases for all BH-related disorders, patient-level characteristics, and charges for ED visits, etc at BH regions. Similarly, for the third study, 2011-2013 New York SEDD was retrieved for ED visits on SUD. In addition, for the second study data on BH workforce and availability of EDs at county-level were provided by the Health Professionals Tracking Services (HPTS). National Emergency Department Inventories (NEDI) and National Survey of Substance Abuse Treatment Services (N-SSATS) provided information locations of EDs and substance abuse treatment centers, respectively, for the third study.

Summary of the Study Findings

Hospitalizations principally due to alcohol-related disorders (ARD) are at high-risk of 30-day unplanned all-cause readmissions. However, national estimates of the overall economic burden of index hospitalizations for ARD, factors associated with readmissions and their costs; have not been studied considering the recent policies for readmissions under the Patient Protection and Affordable Care Act. The first study examines the frequency and distribution of

readmissions following index discharges due to ARD; patient and hospital-level predictors of readmissions; and costs for readmissions with and without recurrences of ARD. 2014 NRD representing over 49% of all the US hospitalizations, was used for this study. ARD were identified through ICD-9 Clinical Classification Software Code 660 for inpatient hospital stays. Chi-square test was used for descriptive analysis to calculate frequency of index hospitalizations with ARD and the proportion that had at least one 30-day readmissions. Multivariate logistic regression was used to estimate patient and hospital-level characteristics that are predictors for the 30-day readmissions for index hospitalizations for ARD. Two-part models (2PM) were used to estimate the incremental and predicted costs of the immediate all-cause readmissions among patients with index hospitalizations for ARD after adjusting for predisposing, enabling, need-related factors selected based on the Anderson Healthcare Behavior Model. Additionally, costs of readmissions with and without relapses for ARD from the 2PM were estimated. All analyses were analyzed at significance level of ≤ 0.05. About 286,655 index hospitalizations were made for ARD out of which 54,092 (18.9%) hospitalizations resulted into at least one 30-days unplanned all-cause readmissions. Index hospitalizations with ARD among patients who were males, between 45-64 years old, covered by Medicaid, belonging to urban and low-income areas, with 1-2 unrelated but zero related comorbidities measure using Elixhauser Comorbidity Index were at high-risk to 30-day readmissions. Similarly, patients admitted in hospitals that are privately controlled for not-profit, had high number of beds, located in large metropolitan areas, and with metropolitan teaching status had high proportions of readmissions. Those index stays that resulted in readmissions had a higher average cost of $8,840 versus those without readmissions ($8,036). However, those patients who were between 25-64 years old, with multiple unrelated comorbidities and admitted in hospitals with medium or large number of beds had statistically higher odds of readmissions. Predicted mean costs for readmissions on index stay with ARD was greater among those with recurrence of ARD ($2,520), males ($1,798), between 45-64 years old ($1,908), covered by Medicare ($2,132), rural residents ($1,841), high-income ($1,877), 4 or

more unrelated comorbidities ($2,415), average length of stay of 5 days ($1,966); and admitted in hospitals in large metropolitan areas ($2,032), large number of beds ($1,551), non-federal government owned ($2,109), and with low volume of cases for ARD ($2,154). Patients with recurrences of ARD, 45-64 years old, and 4 or more unrelated comorbidities had greater readmission costs by $919 and $1,608 than those without recurrences for ARD. Similarly, patients readmitted in large metropolitan areas, large number of beds, non-federal government hospitals, and low volume of cases for ARD had readmission costs higher by $1,002, $413, $567, and $489 than admissions in micropolitan areas, small number of beds, private investor-owned hospitals, and with high volume of cases for ARD. However, hospitals that are non-federal government, located in large metropolitan areas and have high number of beds, offer comparatively reduced readmission costs to recurrences with ARD than non-recurrence cases. Overall costs of index hospitalizations primarily for ARD was $2.3 billion in 2014, of which $512 million were spent on those stays that resulted in at least one 30-day readmissions. Also, this study predicts that $136 million were spent on those readmissions that were for recurrences to ARD. Although, readmission rates did not significantly decline after the implementation of ACA, the study estimates that greater readmissions costs were amounted in 2014, especially among those with relapses to ARD. Therefore, there is a need to develop and implement more sustainable policies to reduced readmission rates and costs among individuals with ARD.

Using Aday and Andersen model for healthcare utilization, the second study estimated hospital-based emergency department (ED) visits and the incurred charges for BH conditions, including mental health and substance abuse disorders, within Nebraska between 2011and 2013. The study also focused on correlating behavioral workforce distribution in Nebraska with ED utilization. The 2011-2013 Nebraska SEDD provided information on utilization of services in ED, charges, diagnoses, and demographic variables, such as age, sex, patient location, health insurance, and income status. The 2013 HPTS annual survey database provided the number of EDs and the distribution of BH professionals in Nebraska by region. The study population was

comprised of patients within Nebraska who had visited the ED for BH-related conditions. To examine the effect of patient characteristics on the outcome variable ED charges, multivariate linear regression model was used. $96.4 million was spent on 52,035 ED visits for BH-related conditions over three years. Of these, 35% were between 25- and 44-years-old. Private insurance covered 40% of these patients. ED charges were significantly greater for patients who were male, older, uninsured, and residing in rural areas. Males, those between 18 to 64 years of age, uninsured, living in low-income areas, with no unrelated comorbidity had higher odds of obtained discharge against medical advice following ED visits for primary diagnoses of BH disorders. This explains that a majority of Nebraskan regions have BH provider shortages and limited availability of EDs. Health policies are needed to increase access to BH services in the rural areas of Nebraska.

Using the utilization model, the third study examines hospital-based emergency department (ED) visits due to SUD and the corresponding incurred charges within the state of New York during 2011 to 2013. HCUP's New York SEDD provided information on utilization of services in emergency departments, charges, diagnoses, and discharge, as well as demographic variables such as age, race, sex, patient location, health insurance and income status. All patients within New York who had visited the ED for SUD comprised the study population. The distribution of EDs and Substance Abuse treatment centers at county-level was obtained from NEDI and N-SSATS, respectively. To examine the effect of patient characteristics on the outcome variable ED charges, we used a multivariate log-linked Gamma Distributed Generalized Linear Model. A total of 492,419 SUD ED visits were reported between the years 2011 to 2013. These findings show that a substantial proportion (38%) of patients belonged to the age group of 25 to 44 years. About 74% ED visits were made by males. Whites comprised forty-one percent of ED visits. Medicaid covered forty-two percent of patients, and sixty-eight percent of visits were made on weekdays. Over three years, $856 million was spent in treating SUD in EDs, with an

average charge of $1,764 per case. ED charges spent were significantly greater for those patients who were white, male, less than 18 years of age, covered by private insurance, and residing in urban areas. Patients who are males, aged 25 – 44 years, covered by private insurance and residing in urban areas are identified to be at high-risk. The geographical analyses displayed that access of EDs drives their utilization. Also, paucity of treatment centers compels both urban and urban residents to seek healthcare services for SUDs in EDs, which maybe because his population maybe limited in their access to these facilities. There is a need to develop health policies and programs to improve access to care for substance-use disorders in urban states.

Contribution to Existing Literature

Although some studies have shown the correlation between patient-level factors on readmissions, no other study has shown the combined impact of hospital and patient characteristics on both index stays and readmissions among US adults. Also, the first study is a unique study that has produced nation level estimates for hospitalizations due to primary diagnoses for ARD, whereas previous studies have results with ARD as a comorbidity. Moreover, unlike other studies, the first study has provided readmissions-related rates, costs, predictors, forecast of economic burden and recurrences of ARD, post-ACA mandated programs.

Results from the second study has proven the association between ED charges and patient-level characteristics for BH disorders, in the absence of Medicaid expansion in Nebraska. For predominantly rural and agrarian state of Nebraska, dearth of BH providers compel residents to seek care in the ED. Also, the study is the first to plot the availability of ED and BH workforce by region, thereby weighing the supply of facilities and providers against the demand (proportion of unmet) of treatment for BH conditions. Moreover, this is a unique study that studied the ED outcomes and identified high-risk patients that discharged against medical advice.

In the largely urban State of New York that expanded Medicaid under ACA and has rising number of cases for SUD, the findings from the last study will be the first to identify ED charges accounted for ten types of SUD. Also, findings from the plotted maps showing the

distribution of primary level care available (substance abuse treatment centers) and emergency care (ED) will show access of care with change in health policies. Yet the results show the high proportion of unmet behavioral healthcare needs even in urban states.

Study Limitations

Despite the notable strengths that the first study present, the findings should be interpreted in light of a number of limitations. This study uses administrative database that does not contain information on pathological tests performed during treatment that could describe the severity of ARD and the patients-to-doctor ratios. Also, individuals admitted to the hospital for ARD may suffer from mental health-related conditions that result into excessive alcohol use. Even though, this study carefully excludes the comorbidity index measure for related comorbidities (such as depression, drug-related, and psychoses disorders) from analytical models as they contribute to collinearity, the results do not estimate for predisposing factors such as mental health disorders that may cause ARD and lead to admissions. NRD being an administrative data does not provide information on reasons (diagnostic or causality) that influenced the decision for admission but only the primary and secondary diagnosis on admission. Moreover, the study excludes non-residents of states in this study as the NRD only captures readmissions in a given state and does not provide state identifiers. Hence, the results are likely to be underestimated for those patients whose index admission and readmissions occurred in their out-of-state hospitals which maybe their temporary location of residency. In addition, the NRD does not contain information on the distance traveled by the patients to the hospital to seek medical help. The findings are, hence, underestimated for those living on the state borders and were admitted in nearby hospitals in neighboring state. Because NRD had discharge-level weights, the univariate and bivariate analysis of patient and hospital-level characteristics performed at an individual level cannot be weighted. This applies to all weighted results that are to be interpreted at discharge level (single episodes of care) and not individual patient-level,

thereby, limiting derivation of the results to the overall cost of care per individual at other than inpatient settings. Additionally, NRD does not include race/ethnicity and education status-related results which restricts the interpretation of the findings in the context of health disparities. Finally, the discharge records may not have been assigned proper ICD-9-CM codes- a phenomenon called non-differential misclassification of diagnoses in data. Also, it is possible that there could be differences in coding practices across providers and states. Nevertheless, even if the estimates were biased due to misclassification, it is likely that we underestimated rather than overestimated the number of index hospitalizations for ARD and resulting readmissions.

Findings from the second study must be interpreted in the context of some limitations. Although Nebraska SEDD contains detailed information on healthcare utilization, there is a possibility that the discharge records may not have been assigned proper ICD-9-CM codes. This is a commonly occurring research phenomenon called non-differential misclassification of diagnoses in data. However, even if the estimates were biased due to misclassification, it is still likely that we underestimated rather than overestimated the number of ED visits related to BH disorders. It is also possible that there could be differences in coding practices across providers in Nebraska that cannot be accounted for. The Nebraska data does not include race and ethnicity for patients, which limits the interpretation of the findings regarding disparities. Moreover, SEDD data did not provide information on patient's education level and homelessness, which may be associated with BH utilization. Also, HCUP's SEDD contains information on only those emergency visits that did not eventually result in hospitalizations. Finally, we were unable to establish causality between availability of BH professionals and ED utilization for BH-related care.

The third study also has a retrospective design because it uses secondary datasets presents certain limitations. Firstly, the information in this study is about the use of ED visits for SUD and does not include the resulting inpatient hospitalizations, if any. Consequently, this study underestimates the total amount of ED charges due to primary admission in ED. Secondly, the

HCUP SEDD dataset informs us about the primary diagnoses and not the actual cause of the ED admission. Finally, SEDD does not provide any information on events or health outcomes after discharging the patients. Hence, future studies need to be conducted regarding emergency visits made by patients in substance abuse treatment centers, primary outpatient clinics or rehabilitation and therapy centers.

Future Research Directions

The ACA has introduced policies focusing on reducing readmissions, and so more longitudinal studies must be performed understanding the readmission rates before and after these programs was implemented. Like the study on Nebraska, research must be conducted on other rural states that adopted to expand Medicaid to see the effect of rurality. Similarly, urban states without Medicaid expansion but with higher number of ED visits for all types SUD of must be studied to see the impact of available access to care. Impact of ACA will bring more insurance-covered patients at various healthcare settings. However, to further improvise on the ACA's BH-related policies, the following amendments can be recommended: (1) offering team-based BH services at primary care clinics, (2) providing BH-related training to social workers so that they can participate in BH interventions, and (3) expanding federal education loan repayment initiatives for BH practitioners to work in rural areas.

With upcoming and anticipated changes in health policies under the administration of President Trump, future studies should monitor differential changes in healthcare utilization for BH-related disorders across primary and emergency care. In addition, efforts must be made to understand readmissions-related costs, rates and economic burden for other behavioral disorders other than ARD such as drug-related disorders, depression, and anxiety, which are widely prevalent.

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APPENDIX 1: ICD-9-CM diagnosis codes defining alcohol-related disorders

ICD-9-CM diagnosis codes	Description
291	Alcohol withdrawal delirium
291.1	Alcohol-induced persisting amnestic disorder
291.2	Alcohol-induced persisting dementia
291.3	Alcohol-induced psychotic disorder with hallucinations
291.4	Idiosyncratic alcohol intoxication
291.5	Alcohol-induced psychotic disorder with delusions
291.8	Other specified alcohol-induced mental disorders
291.81	Alcohol withdrawal
291.82	Alcohol-induced sleep disorders
291.89	Other alcohol-induced disorders
291.9	Unspecified alcohol-induced mental disorders
303.00–303.03	Acute alcohol intoxication
303.90–303.93	Other and unspecified alcohol dependence
305.00–305.03	Alcohol abuse
357.5	Alcoholic polyneuropathy
425.5	Alcoholic cardiomyopathy
535.30, 535.31	Alcoholic gastritis
571	Alcoholic fatty liver
571.1	Acute alcoholic hepatitis
571.2	Alcoholic cirrhosis of liver
571.3	Alcoholic liver damage, unspecified
760.71	Alcohol affecting fetus or newborn via placenta or breast milk
980	Toxic effects of ethyl alcohol

APPENDIX 2: Results of two-part model of factors associated with total cost of readmissions for alcohol-related disorders, NRD 2014.

Variable	Logit					GLM with Gamma log-link				
	Coeff	SE	P-value	95% confidence level		Coeff	SE	P-value	95% confidence level	
				Lower	Upper				Lower	Upper
Intercept	-2.144	0.113	<.0001	-2.366	-1.922	8.844	0.176	<.0001	8.499	9.189
Revisit for ARD										
No			Reference					Reference		
Yes	0.425	0.024	<.0001	0.378	0.472	0.124	0.026	<.0001	0.074	0.174
Sex										
Male			Reference					Reference		
Female	-0.070	0.022	0.001	-0.113	-0.027	0.031	0.023	0.192	-0.015	0.076
AGE										
18 to 24			Reference					Reference		
25 to 44	0.638	0.088	<.0001	0.465	0.812	0.074	0.163	0.651	-0.246	0.393
45 to 64	0.748	0.087	<.0001	0.577	0.918	0.141	0.163	0.387	-0.179	0.461
65 and over	0.382	0.099	<.0001	0.187	0.576	0.262	0.169	0.122	-0.070	0.594
Primary Payer										
Medicare			Reference					Reference		
Medicaid	-0.045	0.030	0.132	-0.104	0.014	0.025	0.029	0.395	-0.032	0.082
Private Insurance	-0.577	0.034	<.0001	-0.643	-0.511	0.009	0.034	0.798	-0.059	0.076
Uninsured	-0.439	0.049	<.0001	-0.535	-0.344	-0.161	0.037	<.0001	-0.233	-0.089
No charge	-0.312	0.064	<.0001	-0.437	-0.186	-0.272	0.071	<.0001	-0.411	-0.133
Other	-0.432	0.072	<.0001	-0.573	-0.291	-0.056	0.052	0.281	-0.158	0.046
Patient location										
Urban			Reference					Reference		
Rural	-0.186	0.048	<.0001	-0.279	-0.092	0.186	0.072	0.01	0.044	0.327
Median household income national quartile for patient ZIP code**										
First quartile			Reference					Reference		
Second quartile	-0.011	0.031	0.731	-0.072	0.050	0.049	0.029	0.093	-0.008	0.107
Third quartile	-0.092	0.033	0.005	-0.156	-0.028	0.079	0.032	0.012	0.017	0.141

Fourth quartile		-0.092	0.036	0.01	-0.162	-0.022	0.151	0.034	<.0001	0.084	0.218
Elixhauser Comorbidity Index for unrelated comorbid conditions											
	0			Reference					Reference		
	1	0.078	0.028	0.005	0.0238	0.1331	0.109	0.034	0.001	0.042	0.176
	2	0.168	0.031	<.0001	0.1075	0.2291	0.196	0.032	<.0001	0.132	0.260
	3	0.246	0.037	<.0001	0.1746	0.3180	0.314	0.036	<.0001	0.245	0.384
4 or more		0.352	0.039	<.0001	0.2758	0.4275	0.385	0.039	<.0001	0.309	0.460
Length of stay		-0.016	0.017	0.373	-0.050	0.019	0.178	0.016	<.0001	0.146	0.209
Hospital urban-rural designation											
Large metropolitan areas				Reference					Reference		
Small metropolitan areas		-0.104	0.038	0.007	-0.179	-0.029	-0.190	0.030	<.0001	-0.250	-0.131
Micropolitan areas		-0.244	0.079	0.002	-0.399	-0.090	-0.416	0.076	<.0001	-0.566	-0.266
Not metropolitan or micropolitan		-0.312	0.101	0.002	-0.510	-0.113	-0.428	0.088	<.0001	-0.601	-0.254
Bedsize of hospital											
Small				Reference					Reference		
Medium		0.092	0.043	0.031	0.008	0.176	-0.026	0.037	0.486	-0.097	0.046
Large		0.164	0.042	<.0001	0.082	0.246	0.106	0.038	0.005	0.032	0.180
Hospital control/ ownership											
Government, nonfederal				Reference					Reference		
Private, non-profit		-0.010	0.063	0.87	-0.134	0.114	-0.166	0.047	<.0001	-0.258	-0.073
Private, invest-own		0.034	0.069	0.624	-0.102	0.170	-0.340	0.057	<.0001	-0.451	-0.229
Hospital volume											
Low				Reference					Reference		
Medium		-0.018	0.039	0.637	-0.094	0.057	-0.137	0.038	<.0001	-0.210	-0.063
High		0.028	0.037	0.45	-0.045	0.102	-0.279	0.035	<.0001	-0.349	-0.210

NRD, Nationwide Readmissions Database; Coeff, Coefficient; SE, standard error; GLM, Generalized linear regression model

**Median household income quartiles of residents' ZIP code for 2014 are: (1) $1 - $39,999; (2) $40,000 - $50,999; (3) $51,000 - $65,999; and (4) $66,000 or more.

APPENDIX 3: Diagnoses used in the analysis of behavioral health disorders in Nebraska and their corresponding codes as per International Classification of Diseases, Ninth Revision, Clinical Modification.

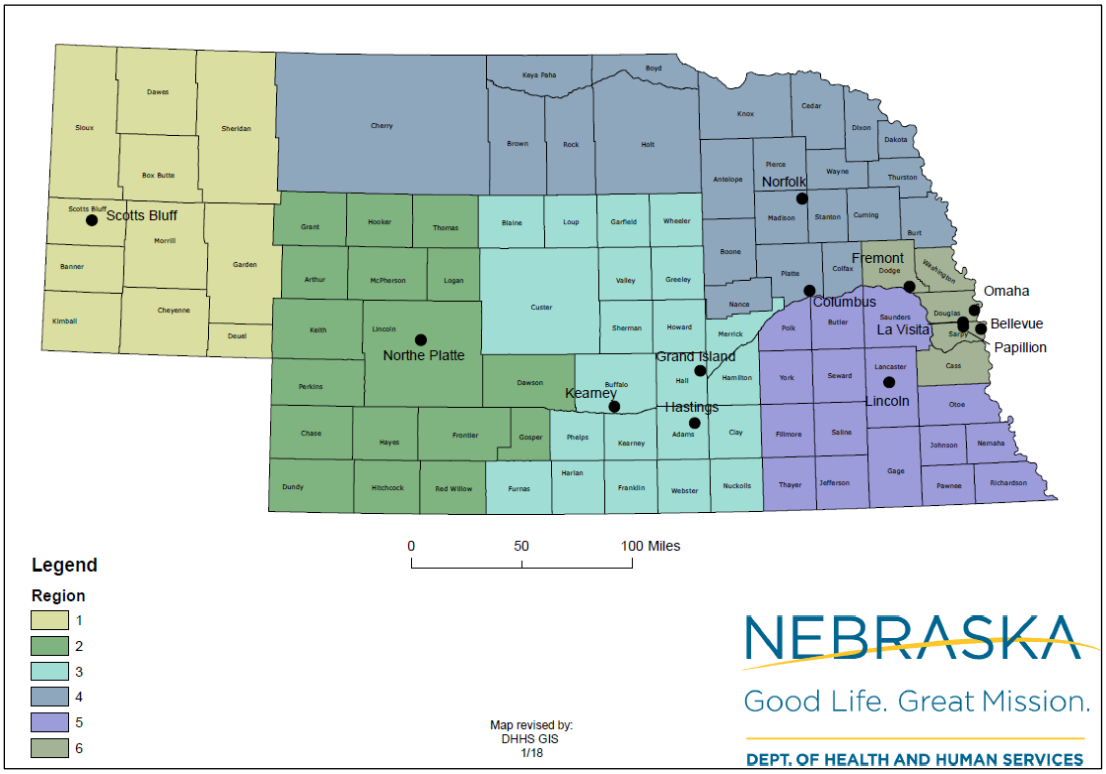
Mental Disorders

Category	Codes
Dementias	290.0, 290.10, 290.11, 290.12, 290.13, 290.20, 290.21, 290.3, 290.40, 290.41, 290.42, 290.43, 290.8, 290.9
Transient mental disorders due to conditions classified elsewhere	293.0, 293.1, 293.82, 293.83, 293.84, 293.89, 293.9
Persistent mental disorders due to conditions classified elsewhere	294.0, 294.10, 294.11, 294.20, 294.21, 294.8, 294.9
Schizophrenic disorders	295.02, 295.04, 295.10, 295.11, 295.12, 295.13, 295.14, 295.20, 295.22, 295.24, 295.30, 295.31, 295.32, 295.33, 295.34, 295.35, 295.40, 295.42, 295.44, 295.50, 295.54, 295.60, 295.62, 295.63, 295.64, 295.65, 295.70, 295.71, 295.72, 295.73, 295.74, 295.75, 295.80, 295.82, 295.83, 295.84, 295.90, 295.92, 295.94
Episodic mood disorders	296.00, 296.01, 296.03, 296.04, 296.10, 296.20, 296.21, 296.22, 296.23, 296.24, 296.25, 296.26, 296.30, 296.31, 296.32, 29633, 296.34, 296.35, 296.36, 296.40, 296.41, 296.42, 296.43, 296.44, 296.45, 296.46, 296.50, 296.51, 296.52, 296.53, 29654, 29655, 296.56, 296.60, 296.61, 296.62, 296.63, 296.64, 296.65, 296.66, 296.7, 296.80, 296.81, 296.82, 296.89, 296.90, 296.99
Delusional disorders	297.0, 297.1, 297.3, 297.8, 297.9
Other nonorganic psychoses	298.0, 298.1, 298.2, 298.3, 298.4, 298.8, 298.9
Pervasive developmental disorders	299.00, 299.01, 299.80, 299.90
Anxiety, dissociative and somatoform disorders	300.00, 300.01, 300.02, 300.09, 300.10, 300.11, 300.12, 300.13, 300.14, 300.15, 300.16, 300.19, 300.20, 300.21, 300.23, 300.29, 300l3, 300.4, 300.5, 300.6, 300.7, 300.81, 300.82, 300.89, 300.9
Personality Disorders	301.0, 301.13, 301.22, 301.3, 301.4, 301.51, 301.6, 301.7, 301.81, 301.83, 301.89, 301.9
Sexual and gender identity disorders	302.2, 302.85, 302.89, 302.9
Physiological malfunctions arising from mental factors	306.0, 306.1, 306.2, 306.4, 306.8, 306.9
Special Symptoms not elsewhere classified	307.0, 307.1, 307.20, 307.23, 307.41, 307.42, 307.47, 307.50, 307.51, 307.54, 307.59, 307.7, 307.80, 307.81, 307.9
Acute reactions to stress	308.0, 308.2, 308.3, 308.9
Adjustment reaction	309.0, 309.1, 309.21, 309.24, 309.28, 309.29, 309.3, 309.4, 309.81, 309.89, 309.9
Specific nonpsychotic mental disorders due to brain damage	310.0, 310.1, 310.2, 310.8, 310.89, 310.9

Depressive disorder, not elsewhere classified	311
Disturbances of conduct	312.00, 312.30, 312.31, 312.32, 312.34, 312.4, 312.81, 312.82, 312.89, 312.9
Disturbances of emotions specific to childhood and adolescents	313.81, 313.89
Hyperkinetic syndrome of childhood	314.00, 314.01
Specific delays in development	315.8, 315.9
Intellectual diabilities and Psychic factors associated with diseases classified elsewhere	317, 318.0, 318.1-318.2, 319
Other ill-defined and unknown causes of morbidity and mortality	799.2, 799.21, 799.22, 799.24, 799.25, 799.29, 799.59
V Codes	
	V11.8, V61.10, V61.20, V62.83, V62.84, V62.85, V70.1, V70.2, V71.01, V71.02, V71.09

Substance Disorders	
Category	**Codes**
Alcohol-Induced mental disorders	
	291.0, 291.1, 291.2, 291.3, 291.5, 291.81, 291.89, 291.9
Drug-Induced mental disorders	292.0, 292.11, 292.12, 292.2, 292.81, 292.82, 292.84, 292.85, 292.89, 292.9
Alcohol Dependence Syndrome	303.00, 303.01, 303.02, 303.03, 303.90, 303.91, 303.92, 303.93
Drug Dependence Syndrome	304.00, 304.01, 304.10, 304.11, 304.20, 304.21, 304.22, 304.30, 304.31, 304.40, 304.41, 304.42, 304.43, 304.60, 304.61, 304.62, 304.70, 304.71, 304.73, 304.80, 304.81, 304.83, 304.90, 304.91
Non-dependent Drug Abuse	305.00, 305.01, 305.02, 305.03, 305.1, 305.20, 305.21, 305.23, 305.30, 305.40, 305.41, 305.50, 305.51, 305.52, 305.53, 305.60, 305.61, 305.62, 305.70, 305.71, 305.72, 305.80, 305.90, 305.91

APPENDIX 4: Behavioral health regions and major cities in Nebraska.



APPENDIX 5: Diagnoses related to substance use disorders used in the analysis and their corresponding codes as per International Classification of Diseases, Ninth Revision, Clinical Modification

Category number	ICD-9-CM diagnosis codes	Description
1	**Alcohol**	
	291	Alcohol withdrawal delirium
	291.1	Alcohol-induced persisting amnestic disorder
	291.2	Alcohol-induced persisting dementia
	291.3	Alcohol-induced psychotic disorder with hallucinations
	291.4	Idiosyncratic alcohol intoxication
	291.5	Alcohol-induced psychotic disorder with delusions
	291.8	Other specified alcohol-induced mental disorders
	291.81	Alcohol withdrawal
	291.82	Alcohol-induced sleep disorders
	291.89	Other alcohol-induced disorders
	291.9	Unspecified alcohol-induced mental disorders
	303.00–303.03	Acute alcohol intoxication
	303.90–303.93	Other and unspecified alcohol dependence
	305.00–305.03	Alcohol abuse
2	**Amphetamines**	
	304.40–304.43	Amphetamines dependence
	305.70–305.73	Nondependent amphetamine abuse
3	**Cannabis**	
	304.30–304.33	Cannabis dependence
	305.20–305.23	Nondependent cannabis abuse
4	**Cocaine**	
	304.20–304.23	Cocaine dependence
	305.60–305.63	Nondependent cocaine abuse
5	**Drug-induced mental disorders**	
	292	Drug withdrawal
	292.11	Drug-induced psychotic disorder with delusions
	292.12	Drug-induced psychotic disorder with hallucinations
	292.2	Pathological drug intoxication
	292.81	Drug-induced delirium
	292.82	Drug-induced persistent dementia
	292.83	Drug-induced persistent amnestic disorder
	292.84	Drug-induced mood disorder
	292.85	Drug-induced sleep disorders

	292.89	Other drug-induced mental disorder
	292.9	Unspecified drug-induced mental disorder
6	**Hallucinogens**	
	304.50–304.53	Hallucinogen dependence
	305.30–305.33	Nondependent hallucinogen abuse
	969.6	Poisoning by hallucinogens (psychodysleptics)
7	**Opioids**	
	304.00–304.03	Opioid type dependence
	304.70–304.73	Combinations of opioids with any other
	305.50–305.53	Nondependent opioid abuse
8	**Sedatives, hypnotics, anxiolytics, tranquilizers, barbituates**	
	304.10–304.13	Sedatives, hypnotics, or anxiolytic dependence
	305.40–305.43	Nondependent sedative, hypnotic, or anxiolytic abuse
9	**Tobocco**	
	305.00–305.13	Nondependent tobacco use disorder
10	**Other**	
	304.60–304.63	Other, specified drug dependence
	304.80–304.83	Combinations excluding opioids
	304.90–304.93	Unspecified drug dependence
	305.90–305.93	Other, mixed or unspecified drug abuse

SUD, substance use disorders.