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Housing status, patient characteristics, and ED utilization associated with medication prescribing at ED discharge among homeless and nonhomeless adults in urban hospitals in the United States

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

by

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Dedication

To my loving husband, Brendan, to Snickers, and to “Yahooti”

Acknowledgments

I would like to thank my advisor, Dr. Leticia R. Moczygemba, for her support and guidance throughout graduate school. From the beginning, I believe she was aware of my potential and capabilities much more than I ever was, and I am grateful for the opportunity she provided to me in becoming a life-long scholar. She has taught me that much more important than talent and genius is persistence and grit. Without fail, every time I thought I had hit a wall and reached the limit of my mental capacity, she encouraged me to always press on, confident in her logic that an answer is out there and eventually I will find it. Through this process I have made achievements that at one point I was certain were impossible. I am grateful for the time we have worked together, and I am proud to call her my advisor and mentor.

To Dr. Patricia W. Slattum, I extend my sincere gratitude for "adopting" me as one of her graduate students. Her commitment allowed me to continue the work in which so much time and hard work had already been invested, and I infinitely appreciate her dedication in making my graduate school experience work for me within the context of everything else life throws one's way. I admire her quiet assuredness that things tend to work out in the end, and I feel fortunate to be a recipient of the wisdom she has imparted during our work together.

I would also like to thank the members of my committee for their dedication, guidance, and wisdom. Their expertise in their respective fields contributed greatly to my research. To Dr. Pramit Nadpara, I thank for his mentorship and research expertise; to Dr. Tiffany Green, I thank for her mentorship and research expertise; and to Dr. Dace Svikis, I thank for her mentorship and

research expertise. I also extend a special thank you to the exceptional faculty and staff at Virginia Commonwealth University School of Pharmacy who have facilitated an excellent learning experience and supported and guided me through my coursework. To Dr. Norman Carroll, Dr. David Holdford, and Dr. Spencer Harpe, I am grateful to have acquired the foundational knowledge of our field under your teaching and expertise. To Ms. Sha-kim Craft, thank you for always patiently helping me dot my i's and cross my t's. I am also grateful for the support and guidance from my older "grad school sister," Dr. Toni Coe.

I express my deepest gratitude to my husband, Brendan. He has supported me, cheered me on, and laughed and cried with me through every single second of my graduate school journey. Six weeks before defending my dissertation, we found out we are expecting a baby, and his dedication in caring for me to support a healthy pregnancy throughout the preparation of my dissertation defense was unrivaled. I would like to thank my parents, Scott and Evelyn Cox, for their unwavering support throughout my graduate education. Their steadfast belief that I can achieve anything was a constant and infectious reminder, and without their love and support, I would not be where I am today.

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Abbreviations

ACA	Affordable Care Act
AHAR	Annual Homeless Assessment Report to Congress
AMA	Against Medical Advice
AOR	Adjusted Odds Ratio
APAP	Acetaminophen
ART	Antiretroviral Therapy
ASA	Aspirin
AUDIT	Alcohol Use Disorders Identification Test
CHF	Congestive Heart Failure
CI	Confidence Interval
COPD	Chronic Obstructive Pulmonary Disease
DEA	Drug Enforcement Administration
DOA	Dead on Arrival
ED	Emergency Department
ESI	Emergency Severity Index
HBV	Hepatitis B Virus
HCH	Health Care for the Homeless
HCUP	Healthcare Cost and Utilization Project
HCV	Hepatitis C Virus

HHS	Department of Health and Human Services
HUD	Department of Housing and Urban Development
IBU	Ibuprofen
IV	Intravenous
MRP	Medication-Related Problem
MSA	Metropolitan Statistical Area
NHAMCS-ED	National Hospital Ambulatory Care Survey-Emergency Department
NOMCAR	Not Missing Completely at Random
NSAID	Nonsteroidal Anti-Inflammatory Drugs
OR	Unadjusted Odds Ratio
OTC	Over-the-Counter
PCP	Primary Care Physician
PSU	Primary Sampling Units
SAMHSA	Substance Abuse and Mental Health Services Administration
TB	Tuberculosis
VIF	Variance Inflation Factors

Abstract

HOUSING STATUS, PATIENT CHARACTERISTICS, AND ED UTILIZATION ASSOCIATED WITH MEDICATION PRESCRIBING AT ED DISCHARGE AMONG HOMELESS AND NONHOMELESS ADULTS IN URBAN HOSPITALS IN THE UNITED STATES

By Lauren Scott Cox, Pharm.D., Ph.D.

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

Virginia Commonwealth University, 2018

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Patricia W. Slattum, Pharm.D., Ph.D.

This cross-sectional study used a weighted sample of ED visits contained in the 2010-2015 years of the National Hospital Ambulatory Care Survey-Emergency Department (NHAMCS-ED) dataset. The purpose of this study was to: 1) identify differences in predisposing, enabling, and need characteristics, and ED use and medication prescribing characteristics between homeless and nonhomeless ED users; 2) assess the association between housing status and medication prescribing at ED discharge, and identify variables contributing to the disparity in medication prescribing between homeless and nonhomeless ED users; and 3) assess the predisposing, enabling, need, and ED use characteristics that predict medication prescribing at ED discharge among homeless ED users. This research is guided by the Andersen-Gelberg Behavioral Model

for Vulnerable Populations. There were a total of 502,614,359 visits to EDs located within a MSA made by homeless and nonhomeless adults 18 years of age and older. About 0.9% of these visits were made by homeless individuals. Age, mental health diagnosis, substance use diagnosis, primary payer, and patient-reported pain differed significantly between homeless and nonhomeless ED users. A significantly greater proportion of homeless ED users arrived to the ED via ambulance, and was seen in the last 72 hours. Homeless ED users tended to have longer ED visits, and ED disposition differed significantly between homeless and nonhomeless ED users. A significantly smaller proportion of homeless ED users were prescribed a medication at ED discharge, and an opioid medication at ED discharge. There was no difference in the likelihood of medication prescribing at ED discharge between homeless and nonhomeless ED users after controlling for predisposing, enabling, need, and ED use characteristics. ED diagnosis was the greatest contributor to the disparity in medication prescribing at ED discharge between homeless and nonhomeless ED users. Among homeless ED users, visits covered by Medicare and other payers were significantly more likely to result in medication prescribing at ED discharge compared to nonhomeless ED users covered by private insurance. Homeless ED users with no substance use condition diagnosis were significantly more likely to be prescribed a medication at ED discharge compared to those with a substance use condition diagnosis.

Chapter 1: Background and Significance

1.1 Homelessness in the United States

1.1.1 Defining Homelessness

In the United States, there is no official definition for homelessness. The definition varies across government agencies and often reflects the eligibility for participation in programs targeting homelessness. (National Health Care for the Homeless Council)[1] The most comprehensive definition, put forth by the Department of Housing and Urban Development (HUD), recognizes four housing situations that qualify individuals and families for housing assistance: 1) literally homeless; 2) at imminent risk of losing housing; 3) homeless under any other federal statues; and 4) fleeing domestic violence.[2]

Individuals and families lacking a fixed and regular nighttime residence are classified as literally homeless, which includes those who are sheltered and unsheltered.[3] Sheltered homeless people reside in private or public shelters designed for temporary housing arrangements.[3] Unsheltered homeless, or "street homeless," live in places not designated for human habitation, such as a car, an abandoned building, a park or a bus or train station.[3] To be considered at imminent risk of losing housing, individuals or families must be facing housing loss within 14 days of applying for housing assistance, have no subsequent residence identified, and lack the resources to obtain permanent housing.[3] The individual or families fleeing domestic violence are considered homeless if they do not have any other residence, and lack the resources or support

networks to obtain permanent housing. HUD also grants eligibility for program participation to individuals and families who qualify as homeless under any other federal statute.[3]

According to the Department of Health and Human Services (HHS), a homeless person is an individual or family without permanent housing who may live on the streets; stay in a shelter, mission, single room occupancy facilities, abandoned building or vehicle; or in any other unstable or non-permanent situation.[1] The HHS also considers individuals and families to be homeless if they are forced to stay with a series of friends or extended family members, a situation coined, doubling up.[1]

1.1.2 Homelessness by the Numbers

According to the 2017 Annual Homeless Assessment Report to Congress (AHAR), 553,742 people were homeless on a given night in January 2017.[4] Sixty-five percent of those experiencing homelessness were staying in sheltered locations.[4] Seventy percent of homeless people were over the age of 24, but nearly one-fifth of the population were children less than 18 years old.[4] Sixty-one percent of the homeless population were men[4]. A higher number of homeless people were White (47%), but a disproportionate number of homeless were Black (41%), given that Blacks make up only 13% of the U.S. population.[4] These demographics shift when the population was grouped by shelter status.[4] The sheltered homeless were slightly younger than the general homeless population, with children under 18 comprising 28% and 6% of sheltered and unsheltered homeless, respectively.[4] There was also a higher proportion of women in the sheltered population (45%) compared to the unsheltered population (28.9%).[4] Men made up 71% of the unsheltered population.[4] A higher proportion of sheltered individuals were White (43%), and a smaller number were Black (30%), and Hispanics made up around 22% of the homeless population regardless of shelter status.[4]

The point-in-time count conducted by HUD in 2015 found that half of all homeless persons resided in five states: California (25%), New York (16%), Florida (6%), Texas (4%), and Washington (4%).[4] The AHAR reports that since 2007, the U.S. has experienced a 14% decline in homelessness, which was driven by decreasing numbers of the unsheltered homeless.[4] The number of unsheltered homeless individuals declined 25%, while those staying in shelters declined by eight percent between 2007 and 2017.[4] The decline in homelessness was not a consistent trend at the state level. While South Carolina, Georgia, and Louisiana experienced decreases ranging from -17% to 23%, North Dakota, California, New Mexico, and Vermont experienced increases ranging from 10 to 18%.[4]

1.1.3 A Closer Look: Subsets of Homeless

Homeless experiences differ by demographic characteristics (family status, age), shelter status, and length of homelessness.[5] Social and community support, available resources, needs, and outcomes vary across subsets of homeless.[5] Sheltered homeless tend to have shorter episodes of homelessness compared to the unsheltered homeless, and unsheltered homeless are more likely to be chronically homeless.[6,7] The average length of stay in an emergency shelter before securing housing was 69 days for men, and 51 days for women, according to a 2007 survey of the U.S. Conference of mayors in 23 US cities with populations greater than 3,000.[8] Unsheltered homeless have been found to have current episodes of homelessness lasting an average of 2.28 (+/-4.37) to 6.34 (+/-6.91) years.[7] The definition of chronic homelessness varies across states and localities, but in general, an individual must be continuously homeless for several months to a year, or have a certain number of episodes of homelessness in a given time frame.[7] Operational definitions for chronic homelessness in the literature have included episodes of homelessness for 9 of the past 24 months; or a single episode of at least 12 months, or 3 or more episodes of

homelessness in the last 4 years.[7,9,10] The unsheltered chronically homeless subpopulation is the subset least likely to transition out of homelessness, has the least community and social supports, and the worst health outcomes.[7]

The typical homeless family is from a minority background and consists of two or more children headed by a younger single mother with no high school diploma or GED.[11] Half of families who enter into homelessness experience a single episode lasting just under two months[11]. Another large segment experiences a single episode averaging 211 days, and the remaining five percent experience homelessness lasting an average of 345 days over three separate episodes.[11] Sixty percent of the sheltered homeless population is comprised of families, and families make up 52% of the unsheltered homeless population.[4] People in families are among the most vulnerable groups among homeless people.[12] Family separations occur frequently as parents often send children to live with friends or relatives in order to protect them from street or shelter life.[13,14] Half of the birth parents of foster children had experienced homelessness.[15] Although only about 5% of families with children experience multiple episodes of homelessness, long-term consequences following rehousing are often experienced.[16] Formerly homeless families require more social and public services, and have worse physical and mental health outcomes and behavioral problems compared to never-homeless, low-income families.[17]

1.2 Homelessness and Health

Since the early 2000s, and particularly in the last decade, fewer studies with recent data on homelessness and health have been available, but current research findings continue to support those reported in older literature. In 2008, a national study of 1,017 users of Health Care for the Homeless (HCH) clinics found that 44% percent of HCH clinic users self-rated their health as poor, compared to 12% of the US population, and the number of individuals in the

general population who rated their health as either excellent or very good (61.6%) was double that of the HCH clinic users (28.2%).[18]

1.2.1 Chronic Physical Conditions

Homeless individuals are more likely to be diagnosed with certain chronic conditions compared to the general population. HCH clinic users had slightly higher prevalence rates of chronic conditions such as diabetes (9.0 versus 7.5%), hypertension (29.3 versus 22.4%), and cerebral vascular accident (2.9 versus 2.4%), and even greater differences in prevalence was found for asthma, with 28% of the homeless reporting a diagnosis compared to 11.7% of the US general population.[18] Only in the cases of cancer and heart disease did the US population display a higher prevalence compared to homeless.[18] Less than half a percent of HCH clinic users had cancer and 4.0% had heart disease or a heart attack compared to 7.4% and 6.5% of the general population, respectively.[18]

A considerable infectious disease disparity exists between the homeless and general population. Tuberculosis, for example, has been nearly eradicated in the U.S. population, while remaining a significant problem in the homeless.[19] Four percent of a national sample of HCH clinic users were diagnosed with tuberculosis, compared to 0.006% of the US population.[18] Additionally, homeless groups have higher rates of infection and transmission of HIV/AIDS, as well as the hepatitis B (HBV) and C viruses (HCV), compared to the general population. It is these communicable diseases among which the greatest disparities are currently observed.[20] Among 387 participants of a national study of HCH clinic users, 31% were found to have HCV antibodies present in their blood.[21] Of the participants who reported using intravenous (IV) drugs, 70% contained HCV antibodies in their blood, compared to only 15.5% of non-IV drug users.[21] Fifty-three percent of participants who presented to HCH clinics with HCV antibodies

were unaware of their status. Among 534 homeless adults sampled from the Skid Row area of Los Angeles, 26.7% and 4% of participants tested positive for HCV and HIV respectively.[22] A similar percentage of homeless diagnosed with HIV was observed in national study of HCH users.[20] In contrast, 0.0004% of the general population in the US is diagnosed with HIV. Almost half of homeless individuals diagnosed with HCV and HIV were unaware of their infection.[23] Forty-three percent of the homeless participants sampled from the Skid Row area seropositive for either HBV or HCV, and of those, 72% were unaware of their status.[23]

1.2.2 Acute Physical Conditions

Trauma and injury were two of the earliest factors identified in the literature as contributing to poor health in the homeless, and these conditions continue to affect the mental and physical health of homeless individuals. NHAMCS-ED data from 2007-2010 indicates that 55% of homeless individuals present to the emergency department (ED) for injury, and have higher odds of presenting with intentional injury, self-inflicted injury, and assault.[24] A smaller study of 904 homeless sheltered and unsheltered women and men found that traumatic brain injury is disproportionately common among the homeless.[25] Around half of homeless individuals have a lifetime prevalence of TBI, compared to 12% in the general population, and TBI is significantly associated with an increased likelihood of seizure disorders, mental health problems, drug abuse, and poorer physical and mental health status.[25]

1.2.3 Mental Health Conditions

Other discrepancies observed in disease prevalence between homeless and nonhomeless individuals are among mental health conditions. Forty-one percent of homeless individuals have a mental health diagnosis compared to 18.5% of the US population.[18,26] Homeless and low-income housed populations have similar rates of depression and anxiety, but homeless

individuals are more likely to have more severe psychiatric conditions such as bipolar disorder.[19] In 2011, a survey by the Substance Abuse and Mental Health Services Administration (SAMHSA) found that 26.2% of sheltered homeless have severe mental illness.[27] Mental health conditions have been shown to increase the odds of homelessness in individuals with housing insecurity (late mortgage/rent payments, or those facing eviction), but homeless persons are at higher risk than the general population to develop a mental health condition as result of their situation, even if they have never been previously diagnosed.[7] The severity of the homeless condition is associated with mental health. Longer episodes of homelessness and unsheltered status are associated with worse mental health outcomes.[7]

1.2.4 Substance Use Conditions

Substance abuse is high among the homeless population. Eleven percent of a national sample of HCH clinic users reported a substance use problem compared to 7.6% of the US population.[18] Smaller studies observed similar trends. In 2013, a study of 618 homeless and 2,065 non-homeless adults in community health centers was conducted to assess and compare substance use among the two groups.[28] Fifty-nine percent and 30% of homeless and non-homeless individuals, respectively, reported a substance abuse problem.[28] Homeless individuals also reported a higher prevalence of binge drinking (40% vs 20%), alcohol dependence (12% vs 1%), and drug dependence (15% vs 1%) compared to non-homeless individuals.[28] A higher percentage of homeless individuals reported ever injecting drugs (14% vs 3%), and receiving treatment for alcohol and drug use in the past year (31% vs 4%).[28]

More recently, literature has come to identify the complex association between substance abuse and homelessness. The National Coalition for the Homeless recognizes substance abuse as being both a cause and a result of homelessness.[29] For those already struggling with affording

housing, substance use disorders can result in the loss of work and income while disrupting family and social networks leading to homelessness.[29] A 2008 survey by the U.S. Conference of Mayors found that substance abuse was the leading cause of homelessness in all 25 cities with populations over 3,000.[8] In 3 of the 25 cities, it was listed as one of the top three causes. In another study, two-thirds of homeless individuals have reported drugs and/or alcohol as a major contribution to their homelessness.[8] For those whose homelessness precedes substance use, many turn to drugs and/or alcohol as a way to cope with their current situation.[29] Additionally, drugs and alcohol can be a way to self-medicate, and existing mental health conditions for both housed and homeless adults carries an additional risk for substance use.[29]

1.2.5 Homelessness and health across subsets

The heterogeneity of the homeless population has been a more recent emphasis in the literature, as advocates and policy makers have come to realize that there is no one-size-fits-all solution to improving the health of homeless populations, but rather health status and needs differ between groups.[30] Sheltered women are more likely to be accompanied by dependent children, experience shorter-term episodes of homelessness, and rarely have more than one episode of homelessness.[31] Thus, sheltered women have similar health outcomes as low-income housed mothers.[32] However, there are long-term negative health impacts associated with even a single, short episode of homelessness.[33]

Unsheltered single women fair worse than sheltered mothers. A study of 1,051 sheltered and unsheltered homeless women found that unsheltered women have three times greater odds of fair or poor physical health, and 12 times greater odds of poor mental health compared to sheltered women.[32] The unsheltered women were also more likely to use alcohol or non-injection drugs, have multiple sexual partners, and have a history of physical assault.[32] Among unsheltered

women, chronically unsheltered women have even worse mental health status.[32] Within the overall population of homeless in the US, unsheltered women were more likely to be non-chronically homeless.[4] However, a study in Manhattan, New York of 1,093 unsheltered women found that 67% of unsheltered women were chronically homeless, and had a significantly higher rate of mental illness and history of incarceration compared to non-chronically unsheltered women.[7] Understanding the variable demographic and homelessness experiences among groups is key to meeting the health needs of the homeless population.

1.3 Homelessness and Health Care Use

1.3.1 Health Care Utilization Settings

Over the past two decades, the role the ED plays in the health care system has evolved as the capacity for primary care clinics to meet the health care needs of the community has declined.[34] EDs have always evaluated and stabilized seriously ill and injured patients through delivery of acute ambulatory and inpatient care, but the use of EDs for nonurgent care has risen.[35] The ED has become a safety net for uninsured and Medicaid beneficiaries, and, general practitioners have increasingly relied on EDs to care for the evaluation of complex patients with potentially serious problems who traditionally would have been cared for in the primary care setting.[35] Between 2001 to 2008, use of hospital EDs grew at roughly twice the rate of the general population growth.[35] This, coupled with the closing of roughly 198,000 hospital beds nationwide during this same period has many experts concerned that emergency care has reached unsustainable levels.[35]

ED overcrowding is largely driven by an insufficient number of hospital beds, and ED wait times increase with higher hospital occupancy rates, but the contribution of nonurgent ED use to overcrowding is uncertain.[34] Many clinicians report that nonurgent ED use is common and

growing, and many attribute an increase in psychiatric ED visits as a major stressor on limited ED resources, but studies have documented inconsistent rates of nonurgent use.[34] Nonurgent use occurs disproportionately among low-income and uninsured patients. Homeless persons in the US are more likely to present to the ED with a nonurgent problem, as EDs are the only place in the health care system where patients must be cared for regardless of their ability to pay.[34]

Homeless persons are more likely to use the ED compared to those in the general population.[36] In 2005, a national study found that homeless individuals made 550,000 ED visits annually which is equivalent to 72 ED visits per 100 homeless individuals. They are all also more likely to repeatedly use the ED.[37] The majority of ED visits made by homeless are those who had been seen in the ED within the previous 72 hours.[37] According to a national survey of ED users, homeless people are four times as likely to have visited the ED in the previous three days.[37] Similarly, 10% of homeless veterans are classified as high intensity users (>3 visits per year) versus only 1% of housed veterans.[38] A study of 2,578 homeless and marginally housed adults found that 7.9% accounted for 54.5% of visits.[39] While homeless individuals were only found to spend a slightly higher amount of time in the ED compared to nonhomeless, 4 hours versus 3.8 hours, respectively, homeless individuals are more likely to arrive by ED in an ambulance and be seen by a resident or intern compared to nonhomeless groups.[40] Therefore, differences in care and treatment provided in ED visits may differ based on housing status.

Perceived bad health by homeless adults has been positively associated with greater odds of ED use. In a study of 2,532 homeless and marginally housed adults, those who reported being in fair or poor health or who had medical comorbidities were more likely to have at least one ED visit in the prior year.[39] Among 300 homeless and unstably housed women in San Francisco, those reporting moderate or high levels of bodily pain had significantly higher odds of ED

visits.[41] Although some studies have found that homeless adults with mental illness have an increased likelihood of high ED use (>3 visits per year), mental health conditions have not been shown to consistently impact ED use.[39]

Homeless adults who abuse substances have greater ED use than those who do not, and substance abuse is significantly associated with high ED use.[36,39] Alcohol use in particular is associated with greater likelihood of having an ED visit in the year prior among homeless, as well as victimization, a history of child abuse, experiences of intimate partner violence, and incarceration history.[36,39] The severity of alcohol problems is positively associated with frequency of ED use.[36]

Homeless individuals with complex needs exhibited even greater ED use. Among 190 HIV positive adults with a substance use disorder, homeless individuals had 92% more ED visits and significantly higher rates of hospital admission than their nonhomeless counterparts.[42] HIV positive homeless and unstably housed adults were 1.7 times more likely to use the ED if they reported being food insecure.[42] Food insecurity was also significantly associated with ED use.[43] Among users of HCH clinics across the U.S., 68% reported going at least one full day without food and 25% reported food insufficiency, both of which were independently associated with higher ED use.[43] Among homeless and housed veterans, 45% of homeless persons used the ED in the past year compared to 16% of those that were housed.[38] Homeless mothers comprise a subset of the homeless population with complex health care needs, and experience more frequent ED use than low-income housed mothers.[44] Homeless mothers are also significantly more likely to have a resulting hospital admission compared to low-income housed mothers who use the ED.[44] This suggests that homeless mothers are presenting to the ED with more severe or urgent conditions.

The rates of ED-to-hospital admission among the homeless population is unclear. A study in New York City found that 72% of homeless individuals visiting the ED were admitted to the hospital from the compared to 66% of the general population, but a study in a single urban hospital found that homeless individuals are less likely to have an ED visit result in a hospital admission.[40,45] Therefore, the rate of ED-to-hospital admissions of homeless compared to non-homeless individuals may depend on a variety of factors. Health and demographic characteristics are associated with ED-to-hospital admission. Homeless individuals with a higher number of medical conditions and greater level of bodily pain are more likely to having a hospitalization.[46] Homeless adults who are older, black, or less educated were more likely to have a hospitalization during the prior year, as well as those who reported a lack of community support.[46-48] Odds of hospitalization increased with length of time spent homeless.[48] Hospitalizations were not associated with mental health and substance use characteristics.[48] Homeless adults with fewer alcohol-related problems were more likely to use the outpatient, ambulatory, and office-based care, as well as homeless adults involved in case management and those who reported having community support.[48]

1.3.2 Unmet Health Care Needs

Unmet health care needs, which are reported more frequently in the homeless, may be affecting the disproportionately higher rate of ED use and ED-to-hospital admission.[28] Seventy-three percent of a national sample of 966 HCH users reported an unmet health care need.[49] These unmet needs included optometry care (e.g., eye glasses) (41%), dental care (41%), prescription medications (36%) and medical or surgical care (32%). Among 974 homeless women, 37% reported an unmet need for medical care.[49] Factors predicting an unmet need were food insufficiency, out-of-home placement as a minor, and vision impairment.[49] Among homeless

women, those reporting drug abuse, victimization, and depression were most in need of care.[50] White women were more likely than Black and Latina women to report an unmet need.[50] Odds of having an unmet need were lower if a regular source of care was reported.[49]

1.3.3 Barriers to Health Care Access

Unmet needs are more likely to occur if barriers to health care access are experienced. Common barriers for not seeking health care for a chronic physical or mental health condition include not knowing where to go, long office waiting times, and being too sick to seek care.[49] Among homeless adults with severe mental health conditions, the most frequently reported reason for not seeking care for either a physical (53%) or mental (56%) health condition was wanting to solve the problem on their own.[51] Half of study participants reported thinking that their physical or emotional health condition would get better on its own and 40% reported that care they would receive for their physical or mental health condition would not do any good.[51] Those who did not seek care for a mental health condition were significantly more likely to cite perceived stigma from health care providers and friends and family as the principle reason for not seeking care.[51]

Lack of health insurance is a frequently reported barrier to accessing health care, but its role in impacting homeless health care use is uncertain.[49] Studies have shown that having health insurance increases the likelihood for homeless persons to be treated in primary care settings such as doctor's offices and community health clinics.[49] Conversely, previous year lack of health insurance was the greatest predictor of ED use for primary care.[52] However, health insurance has also been shown to increase the odds of a hospitalization. Similar findings have been found in other countries with universal health care coverage.[52]

There are several ways that homeless individuals may acquire private or public insurance despite the barriers that coverage acquisition imposes on homeless individuals, such as the requirement of a permanent address, and considerable documentation that may not be readily available. Very few homeless individuals have private insurance and those that do were most likely enrolled prior to becoming homeless.[53] Federal policy permits the assistance of a third party, usually homeless care providers in the community, to help homeless individuals navigate the application process for Medicaid and coverage under the Affordable Care Act.[54,55] Ninety-one percent of uninsured homeless adults in an urban ED reported an income less than 138% of the federal poverty level, which would likely qualify them for Medicaid coverage.[56]

Disproportionately high ED use in the homeless population may be contributing to the health disparity between homeless and housed.[57] Despite the wide range of health services provided in EDs, they are unable to serve as primary care providers.[52] Adequate primary care includes the provision of preventative services, careful monitoring and management of chronic disease, and frequent follow-up appointments.[57] Most conditions treated in institutionalized care setting require care to be continued in outpatient, ambulatory, and doctors' office settings.[57] Because homeless individuals lack a regular source of care, their conditions are never fully treated, but only acutely managed.[57] Further, the high rate of ED utilization may be overestimated in the homeless population as the proportion of ED visits by homeless is inflated by repeat high utilizers.[37] That is, a small percentage of individuals are accounting for a majority of ED visits by homeless individuals. Therefore, the majority of homeless people aren't accessing care in an institutional setting as often as the numbers suggest. With cross-sectional national data, it is difficult to tell which visits are repeat visits by the same individuals.

1.4 Homelessness and Medication Use

Homelessness is frequently identified in the literature as a barrier to appropriate medication use.[58—66] Homeless individuals encounter a wide range of medication-related problems, such as adherence and medication misuse, experience differences in prescribing patterns compared to non-homeless individuals, and are confronted by barriers to obtaining medications that ultimately decrease access, such as inability to afford prescriptions and frequent absence at follow-up appointments.[67—79] In recent years, medication use among homeless individuals has been studied almost exclusively within the health conditions disproportionately effecting the homeless population. These are the communicable diseases, tuberculosis (TB) and HIV/AIDS, mental health conditions, notably depression and schizophrenia, and substance abuse.[,62 ,,61,69,74,79—82]

Homeless housing status has been found to be associated with decreased access and adherence to antiretroviral medications for the treatment of HIV/AIDS compared to non-homeless housing status.[59,65] Among 503 HIV positive substance users, those with housing insecurity were significantly less likely to be adherent to antiretroviral therapy (ART).[61] Homelessness is also associated with decreased access to ART among HIV positive individuals.[63] In a study of 295 HIV positive opioid dependent adults across 10 clinic sites, those who were homeless were less likely to be on any therapy for HIV/AIDS.[66] For the treatment of tuberculosis, housing status has a significant impact on therapy completion.[64] A national study of the 270,948 cases of TB in the U.S. from 1994 to 2010, found that 6% (16,527) were homeless. These homeless individuals had over twice the odds of incomplete treatment compared to non-homeless individuals.[62]

The proportion of individuals who have been found to be nonadherent to any class of medications among homeless groups ranges from 26% in a study of 716 homeless individuals across three Canadian cities, and 62% among 288 patients/clients of a HCH.[70,71] Among homeless individuals in multiple shelters across one U.S. city, 30% reported medication nonadherence.[72] Studies measuring adherence in specific disease states among the homeless tend to have proportions of nonadherent individuals on the upper end of the aforementioned range. Among 421 homeless HIV+ individuals, 57% reported less than 100% ART adherence, which indicates a significant risk for HIV transmission and acquisition.[69] Among a cohort of homeless individuals diagnosed with schizophrenia, 46% of their prescribed oral medications were found to be missing at baseline.[73] Within the context of substance abuse, studies examine adherence to medications used for addiction treatment. In a small trial of 15 study participants, examining the adherence to an extended release naltrexone injectable for the treatment of alcoholism among homeless veterans, only one out of seven returned to receive the second injection.[74] A trial studying 171 homeless and non-homeless participants in treatment for substance use found that homeless participants were less likely to be retained in treatment with injectable naltrexone.[82]

Reasons for medication nonadherence are multifactorial, and can be due to patient-related factors, therapy-related factors, social/economic-related factors, and health care-related factors.[77] In a study of 426 patients in an HCH setting, three quarters of the 238 reported reasons for nonadherence were patient-related factors. These were self-management of medication, such as purposefully adjusting dose, frequency, and duration, running out medications, low attendance at follow-up appointments, and lack of perceived effect of the medication.[77] Forgetting to take medications and to attend appointments, and not obtaining refills on time were other patient-related factors reported in the literature.[68] Therapy-related factors that reportedly attribute to

medication nonadherence among the homeless are side effects, regimen complexity, and difficulty swallowing.[70,77] Communication issues, care transitions, and lack of access to a PCP are reported health care-related factors contributing to nonadherence, and social/economic-related factors are cost, lack of transportation, and unstable living conditions.[70,77]

Factors that are associated with good adherence to medication among homeless individuals are greater than 40 years of age, and having a regular primary care physician (PCP).[70] A positive screening on the Alcohol Use Disorders Identification Test (AUDIT), is associated with increased likelihood of nonadherence.[70] Greater use of residential/in-patient mental health services was the single most important factor associated with filling any psychotropic medication by veterans with a severe mental health condition.[60] Among homeless and unstably housed individuals with a severe mental health condition, factors associated with medication adherence to antipsychotics is having no history of psychiatric hospitalization, and receipt of a greater number of non-psychiatric medical services.[79] Duration of homelessness is also associated with antipsychotic nonadherence. Individuals homeless for less than three years had higher medication possession ratios on average, a common measure of medication adherence that divides the number of pills on hand by the days that the study participant is observed.[79] Single tablet regimens for ART have also been shown to result in greater adherence and viral suppression compared to regimens that require more than one pill a day.[83] A prospective study examined the impact of a long-acting antipsychotic injectable on adherence by homeless individuals diagnosed with schizophrenia. Long acting injectables were developed to improve adherence to antipsychotics, as one dose can last about 14 to 28 days. Adherence to the long-acting injectable at the end of the study period was 76%, which was a significant improvement in adherence compared to that of the oral medications taken by the participants at baseline.[73]

Apart from nonadherence, little is known about medication-related problems (MRPs) frequently encountered by homeless individuals. A study conducted in an HCH setting described the MRPs reported during a collaborative medication therapy management program. Among the 209 clients who received medication management in the mental health clinic, 425 MRPs were identified (2.0/patient). Among the 40 patients who received CMTM in the medical clinic, 205 MRPs were identified (5.1/patient).[67] MRPs identified included ineffective drug therapy, additional drug therapy needed, unnecessary drug therapy, adverse events, and drug-drug and drug-disease interactions.[67]

Prescribing patterns among homeless individuals differ from those among non-homeless individuals. Despite high rates of HIV risk behavior observed among homeless populations, less than 1% of the 421 study participants who were HIV- were prescribed antiretroviral pre-exposure prophylaxis.[69] Preexposure prophylaxis is recommended by the CDC as an effective method to reduce the risk of HIV infection by 92% when taken consistently every day.[84] Candidates for preexposure prophylaxis must commit to taking the medication every day and seeing a provider for follow-up every 3 months. Discrepancies in prescribing medications for homeless individuals have also been observed for the treatment of mental health conditions. A study examining the use of antidepressants for the management of depression and/or negative symptoms in schizophrenic VA patients, found that the receipt of an antidepressant was significantly less for homeless patients. Further, providers have reported hesitancy in prescribing certain medications for homeless patients and clients. A survey of safety net clinics serving the homeless on Los Angeles' Skid Row reported being uncomfortable in providing psychiatric medication follow-up beyond uncomplicated depression and anxiety.[78]

Studies examining the effects of housing status on prescription medication misuse have found that homeless individuals are more likely to misuse medications compared to non-homeless individuals. A study in Baltimore, MD found that homelessness was associated with street-obtained buprenorphine, a medication prescribed for the treatment of pain and addiction to narcotic pain relievers.[76] Self-management of pain is also associated with housing status. Among 483 study participants reporting injection drug use and moderate to extreme pain, 97.5% reported self-medication to manage their pain. Homelessness and having ever been refused a pain medication were associated with increased likelihood of pain self-management. To self-manage pain, participants reported injecting heroin or obtaining diverted pain medications.[75] Homeless individuals are at an increased risk for acute and chronic pain due to higher incidence of injury and number of comorbidities.[75,85,86] Self-management of pain may indicate inadequate pain prescribing in a clinical setting. Perceived barriers to pain medication among the homeless are unstable/stressful living environments, poor sleeping conditions, inability to afford prescription medications, only being offered OTC medications, and perceived inadequate pain assessment by physicians.[75,87,88]

Two studies have examined disease-related outcomes of antidepressant use among homeless HIV+ adults. In the first study, it was found that among 158 study participants, those who were taking an antidepressant had 2.0 times greater odds of achieving viral suppression compared to participants not taking an antidepressant.[81] In the second study, it was found that fluoxetine treatment was efficacious in HIV+ homeless individuals with depression and substance use disorders regardless of alcohol consumption. For individuals who reported substance use, fluoxetine treatment was only efficacious in those not using drugs.[80]

Multiple factors associated with housing status appear to contribute to the differences in medication use by homeless individuals. It is well-established in the literature that homeless individuals are more likely to be nonadherent to medications compared to nonhomeless individuals due to factors inherent to the homeless situation, barriers disproportionately experienced by homeless individuals, and a health care system especially difficult to navigate for individuals who lack stable housing. There is little else known about disease-related outcomes of medication treatment outside the realm of adherence and antidepressant efficacy on mental health outcomes. The role of single tablet regimens for the treatment of HIV/AIDS, and long-acting injectables for the treatment of schizophrenia for the improvement of medication adherence may be a promising solution in some cases. However, long-acting injectable naltrexone for the treatment of opioid and alcohol addiction was shown to have worse adherence outcomes compared to oral naltrexone. Further studies are needed in different subsets of homeless for the treatment of a variety of disease states to establish the efficacy of these interventions.

1.6 Summary

For decades, the link between homelessness and poorer health has been consistently reported in the literature. Compared to nonhomeless individuals, those who are homeless are more likely to report their health as fair, are commonly diagnosed with diseases rarely found in the general population, experience worse health outcomes from chronic diseases such as heart disease and diabetes and experience a disproportionate amount of trauma and injury. Homeless individuals have higher rates of mental health conditions compared to the general populations and are more likely to be diagnosed with severe mental health conditions, such as schizophrenia and bipolar disorder, compared to their low-income housed counterparts. Homeless individuals

experience higher rates of substance abuse and drug dependence compared to nonhomeless individuals.

Homeless individuals are more likely to visit the ED and have a repeat visit to the ED compared to nonhomeless individuals. A national survey of ED users found that homeless adults are four times as likely to have visited the ED in the previous three days.[37] This disproportionately higher use is associated with perceived poor health, higher number of comorbidities, substance use, and having more complex needs, such as those homeless individuals with HIV/AIDS, those experiencing food insecurity, homeless veterans, and homeless mothers.

Unmet health care needs and barriers to health care access are more frequently reported by homeless than nonhomeless individuals. Findings in the literature suggest that unmet needs are a result of increased ED use and a greater number of reported barriers. Common barriers reported by homeless individuals include not knowing where to go for care, long office wait times, and being too sick to seek care.[49] Homeless individuals also have poorer adherence and access to medications compared to nonhomeless, encounter a high number of MRPs, and experience differences in prescribing patterns.

Chapter 2: Study Purpose, Specific Aims, and Hypotheses

2.1 Study Purpose

To date, little is known about medication use among homeless adults, especially for the treatment of chronic diseases. Prescribing patterns among homeless individuals within the ED setting have not been studied. This research will contribute to the health care utilization and medication use literature by assessing the differences in ED use characteristics and describing and comparing medication prescribing patterns in an ED setting, among homeless and nonhomeless adults. This study will also examine the association between housing status and the receipt of a medication prescription at ED discharge, and evaluate the characteristics that predict the receipt of a medication prescription at ED discharge among homeless adults.

2.2 Specific Aims and Hypotheses

2.2.1 Specific Aim 1

1A: Describe the predisposing (age, gender, race/ethnicity), enabling (housing status, primary payer) and need (ED diagnosis, pain assessment, patient-reported pain, triage level, comorbidity diagnosis) characteristics among homeless and non-homeless adults in the U.S.

1B: Compare the predisposing (age, gender, race/ethnicity), enabling (housing status, primary payer), and need (ED diagnosis, pain assessment, patient-reported pain, triage level, comorbidity diagnosis) characteristics between homeless and nonhomeless adults in the U.S.

HA1: Age differs significantly between homeless and nonhomeless ED users.

HA2: Gender differs significantly between homeless and nonhomeless ED users.

HA3: Race/ethnicity differs significantly between homeless and nonhomeless ED users.

HA4: Primary payer differs significantly between homeless and nonhomeless ED users.

HA5: The rate of diagnosis of a chronic physical condition does not differ significantly between homeless and nonhomeless ED users.

HA6: The rate of diagnosis of an acute physical condition differs significantly between homeless and nonhomeless ED users.

HA7: The rate of diagnosis of a mental health condition differs significantly between homeless and nonhomeless ED users.

HA8: The rate of diagnosis of a substance use condition differs significantly between homeless and nonhomeless ED users.

H09: There is no difference between other need characteristics (pain assessment, patient-reported pain, triage level, comorbidity diagnosis) between homeless and nonhomeless ED users.

1C: Describe the ED use characteristics (arrival by ambulance, ED visit in last 72 hours, provider seen, ED disposition, geographic region, wait time, length of visit, number of diagnostic tests/procedures) among homeless and nonhomeless adults in the U.S.

1D: Compare the ED use characteristics (arrival by ambulance, ED visit in the last 72 hours, provider seen, ED disposition, geographic region, wait time, length of visit, number of procedures/tests) between homeless and nonhomeless adults in the U.S.

HA10: The rate of ambulance arrival to the ED differs significantly between homeless and nonhomeless ED users

HA11: Being seen by a medical doctor, as opposed to another health care provider, differs significantly between homeless and nonhomeless ED users.

H012: There is no difference in other ED use characteristics (ED visit in last 72 hours, ED wait time, ED disposition, number of diagnostic tests/procedures, length of ED visit, geographic region) between homeless and nonhomeless ED users.

1E: Describe the medication prescribing characteristics at ED discharge (receipt of medication prescription, number of medications prescribed, controlled medication prescription, schedule of controlled medication prescribed, opioid medication prescription, five most frequently prescribed class of medication prescribed, medications prescribed by class) among homeless and nonhomeless adults in the U.S.

1F: Compare the medication prescribing characteristics at ED discharge (receipt of medication prescription, number of medications prescribed, controlled medication prescription, schedule of controlled medication prescribed, opioid medication prescription) between homeless and nonhomeless adults in the U.S.

H013: There is no difference between characteristics of medication prescribing at ED discharge (receipt of medication prescription, number of medications prescribed, controlled medication prescription, schedule of controlled medication prescribed, opioid medication prescription) between homeless and non-homeless ED users.

2.2.2 Specific Aim 2

2A: Examine the relationship between the receipt of a medication prescription at ED discharge and housing status, controlling for the predisposing (age, gender, race/ethnicity), enabling (primary payer), and need (ED diagnosis, comorbidity diagnosis) characteristics as well as the ED use characteristics (provider seen, geographic region) among homeless and nonhomeless adults in the U.S.

2B: Quantify the individual contribution of the predisposing (age, gender, race/ethnicity), enabling (primary source of payment), and need (ED diagnosis, comorbidity diagnosis) characteristics as well as the ED use characteristics (provider seen, geographic region) to explain the disparity in receipt of medication prescription at ED discharge between homeless and nonhomeless adults in the U.S.

HA14: Controlling for predisposing (age, gender, race/ethnicity), enabling (primary payer), need (ED diagnosis, comorbidity diagnosis), and ED use characteristics (provider seen, geographic region), homeless ED users are less likely to be prescribed a medication at ED discharge compared to nonhomeless ED users.

2.2.3 Specific Aim 3

Examine the predisposing (age, gender, race/ethnicity), enabling (primary payer), and need characteristics (ED diagnosis, comorbidity diagnosis), as well as the ED use characteristics (provider seen, geographic region) that predict the receipt of a prescription medication at ED discharge among homeless adults in the U.S.

HA15: Non-Hispanic White homeless ED users are more likely to be prescribed a medication at discharge compared to homeless ED users of all other races, ethnicities.

HA16: Homeless ED users who are self-pay are less likely to be prescribed a medication at discharge compared to homeless ED users with private insurance.

HA17: Homeless ED users with no diagnosis of a substance use condition are more likely to receive a medication prescription at ED discharge compared to homeless ED users with a diagnosis of a substance use condition.

HA18: Homeless ED users who are seen by a medical doctor are more likely to be prescribed a medication at discharge compared to homeless ED users seen by other types of providers.

H019: There is no association between other predisposing (age, gender), need (pain assessment, patient-reported pain, comorbidity diagnosis), and ED use characteristics (comorbidity diagnosis, region) and medication prescribing at ED discharge among homeless ED users.

Chapter 3: Proposed Research Design and Methods

3.1 Overview

This is a cross-sectional study which used a weighted sample of ED visits made by homeless and nonhomeless adults contained in the publicly available National Hospital Ambulatory Care Survey-Emergency Department (NHAMCS-ED) database. Data from years 2010, 2011, 2012, 2013, 2014, and 2015 were pooled together and analyzed to examine the association between housing status and the receipt of a medication prescription at ED discharge. Specific aim 1 used descriptive statistics to describe predisposing, enabling, and need characteristics, as well as ED use characteristics and characteristics of medications prescribed at discharge among homeless and nonhomeless adults. Bivariate analyses were then used to compare these characteristics between homeless and non-homeless individuals to assess statistically significant differences between the two groups. A multivariable logistic regression analysis was used in specific aim 2 to examine the association between housing status and the receipt of a medication prescription at ED discharge while controlling for the predisposing, enabling, and need characteristics, as well as ED use characteristics. Variables analyzed in the bivariate analysis were excluded from the multivariable analysis if greater than 5% of the data was missing for that variable. A decomposition analysis was used to explain the individual contributions to the disparity in medication prescribing at ED discharge between homeless and nonhomeless ED users on the part of the explanatory variables leading to a difference in a particular outcome. The Fairlie decomposition model for nonlinear binary models was used to

estimate a multivariable model that quantifies the contributions of the predisposing, enabling, need characteristics, as well as the ED use characteristics, to any difference observed in the receipt of a prescription medication at ED discharge. Specific aim 3 further assessed the predisposing, enabling, and need characteristics as well as the ED use characteristics associated with the prescription of at least one medication at ED discharge among homeless adults using multivariable logistic regression. The study methodology is described by each aim, and all analyses used weighted data. This research is guided by the Andersen-Gelberg Behavioral Model for Vulnerable Populations which is described in section 3.2.

3.2 Theoretical Framework

3.2.1 The Andersen-Gelberg Behavioral Model for Vulnerable Populations

The Andersen Behavioral Model of Health Services Use describes predisposing, enabling, and need characteristics that predict patients' use of health services.[88] To address additional factors that influence health outcomes and health service use in vulnerable populations, the Andersen-Gelberg Behavioral Model for Vulnerable Populations was developed.[89] It retains the traditional domain of characteristics of the Andersen Model, and incorporates characteristics unique to vulnerable populations (Appendix 1).

Predisposing characteristics are demographic characteristics that an individual is born with or exposed to in early life. These characteristics remain constant over time and include date of birth, gender, and race in the traditional domain, and immigration status, sexual orientation, and criminal history in the vulnerable domain.[89] Enabling characteristics such as insurance, income, and community-level health services resources are included in the traditional domain, and the enabling characteristics of the vulnerable domain include hunger, availability of case management and community-level crime rates.[88,89] These are characteristics that encourage or

discourage appropriate health care use and positive health outcomes. These characteristics may vary over time. Need characteristics are perceived and evaluated health for general population health conditions, such as the diagnosis of diabetes and hypertension, in the traditional domain and vulnerable population health conditions in the vulnerable domain.[88,89] Vulnerable population health conditions occur with higher prevalence in vulnerable populations and include tuberculosis, sexually transmitted diseases, and HIV/AIDS.[88] Mental health conditions and substance abuse and dependency are also included in this domain.[88]

Predisposing, enabling, and need characteristics predict health behavior, which consists of personal health practices, such as diet and exercise in the traditional domain, and hygiene and unsafe sexual behaviors in the vulnerable domain. Use of health services is also a component of health behavior and includes ambulatory care, inpatient care, alternative health care, and long-term care utilization for both traditional and vulnerable domains. In turn, health behavior predicts health outcomes which are comprised of perceived and evaluated health status, and satisfaction with care.

The Andersen-Gelberg Behavioral Model for Vulnerable Populations was validated in homeless adults in the Skid Row area of Los Angeles, CA.[89] The study hypothesized that homeless individuals would be more likely to seek health care services for conditions with more immediate impact (skin/leg/foot problems, vision impairment), and less likely to seek health care services for conditions with less immediate impact, but more serious, long-term consequences (high blood pressure, TB exposure).[89] Investigators found that vulnerable populations were likely to obtain care for conditions with immediate impact or if they had greater salience in the mind of the general public, such as high blood pressure.[89] Predisposing, enabling, and need characteristics of the vulnerable domain were significant factors in the prediction of health care

use and health outcomes in vulnerable populations.[89] This model has been used in a number of vulnerable groups, including homeless individuals, poor and impoverished adults and adolescents, residents of rural areas, racial/ethnic minorities, and adults and adolescents with mental health conditions.[41,91—99] The Anderson-Gelberg Behavioral Model for Vulnerable Populations was used to guide the analysis of this study using a modified model that fits the study objective (Figure 3.1). The modified model uses predisposing, enabling, and need characteristics, as well as ED use characteristics, to determine factors associated with the receipt of a prescription medication at ED discharge, using housing status as the main covariate.

3.2.2 Advantages of the Andersen-Gelberg Behavioral Model for Vulnerable Populations

The advantages of the use of the Andersen-Gelberg Behavioral Model for Vulnerable Populations in this study are two-fold: 1) It emphasizes the population characteristics specific to vulnerable groups, allowing for the development of rigorous and well-informed studies of health behavior and outcomes in populations to which conventional models do not apply; and 2) it supports the study of specific health behaviors and health outcomes experienced by homeless individuals.

The Andersen-Gelberg Behavioral Model for Vulnerable Populations contains a comprehensive list of variables to be considered when studying the health behavior and health outcomes of vulnerable populations and is designed to be modified based on the variables that are appropriate to the population of interest. Because the model must be tailored to fit the study population, researchers can modify the Andersen-Gelberg Behavioral Model for Vulnerable Populations to include vulnerable characteristics specific to the population being studied. The Andersen-Gelberg Behavioral Model for Vulnerable Populations can also be modified to study a diverse set of health behavior and health outcomes specific to the study population. For example,

ED use characteristics have been included in the modified model being used for this study. Although medication prescribing at ED discharge is not listed on the original Andersen-Gelberg Behavioral Model for Vulnerable Populations, it is an important health-related factor to study among homeless populations. Homelessness is frequently identified in the literature as a barrier to appropriate medication use as homeless individuals encounter a wide range of medication-related problems and are confronted by barriers to obtaining medications that ultimately decrease access, such as inability to afford prescriptions and frequent absence at follow-up appointments.[58—79] Poor adherence and access to medication regimens accounts for substantial worsening of health outcomes, mortality, and increased health care costs in the United States.[99]

3.2.3 Limitations of the Modified Andersen-Gelberg Behavioral Model for Vulnerable Populations

The limitation of the modified model used in my study is the lack of information in the NHAMCS-ED data to describe the population characteristic variables in both the traditional and vulnerable domains that are pertinent to the homeless population. Thus, the advantage of the Andersen-Gelberg Behavioral Model for Vulnerable Populations's ability for application to homeless persons is mitigated by the data source used in this study, and the modified model is not exhaustive in its consideration of pertinent factors specific to the homeless.

3.2.3.1 Homelessness characteristics

Because the health status and health needs across distinct subgroups of homeless differ markedly, being able to include variables describing length of time homeless, shelter status, and family status as independent variables would have added to the literature.[4,5,6,7] The inclusion of these characteristics into the analysis would provide important insight into the ED utilization of the different subsets of homeless, which could help the intervention efforts of homeless service

providers. The NHAMCS-ED data does not include information on homeless subgroups, such as length of time homeless, shelter status, or family status. The analysis conducted for this study will be grouping homeless individuals together, which leaves out important distinctions that may exist between subgroups and their respective ED utilization characteristics.

3.2.3.2 Predisposing characteristics

Within the predisposing subcategory of the Andersen-Gelberg Behavioral Model for Vulnerable Populations, the modified model contains only three of the demographic variables (age, gender, and race/ethnicity). The NHAMCS-ED database does not contain data on marital status, a particularly important demographic characteristic to consider because homeless individuals are significantly less likely to be married than those in the general population. In the homeless, marital status is associated with increased levels of perceived social support, a factor known to impact health-related factors in both the homeless and general populations.[102]

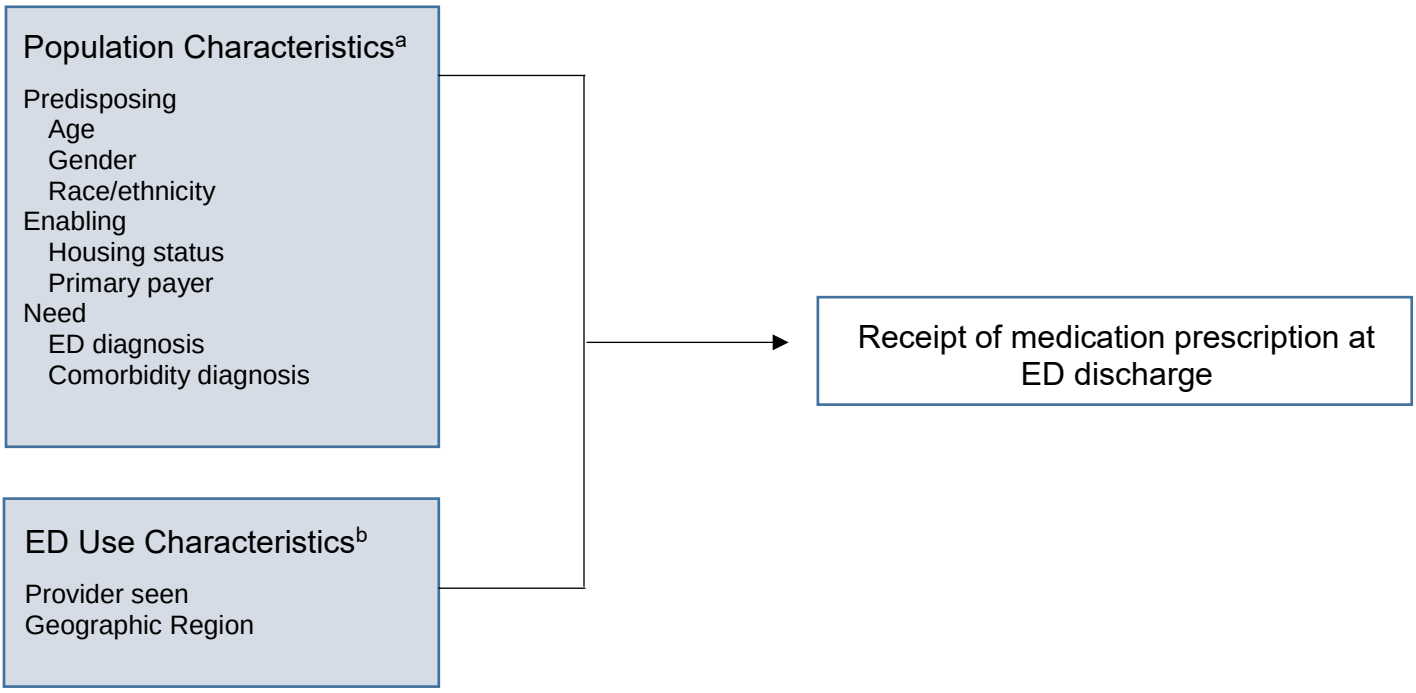
The predisposing characteristics, education, employment, and occupation, and the enabling characteristics, income and insurance, are variables of the Andersen-Gelberg Behavioral Model for Vulnerable Populations inextricably associated with each other within the context of homelessness in a manner perhaps not seen in the general population. These variables have also been shown to impact health and health care use in the homeless population.

3.2.3.3 Enabling characteristics

Within the enabling subcategory of the Andersen-Gelberg Behavioral Model for Vulnerable Populations, the modified model contains only the primary expected source of payment. Other variables pertaining to homeless populations in the Andersen-Gelberg Behavioral Model for Vulnerable Populations are barriers to health care well-established in the literature, such as having unreliable transportation, and poor health literacy.[103,104,105] Homeless

individuals also have to contend with competing priorities between healthcare and basic needs, such as food and shelter, and many lack confidence in navigating the fragmented healthcare system often characterized by poor continuity of care.[105,108,109]

Other issues include embarrassment about physical appearance, perceived judgment, and lack of knowledge and understanding from providers.[106,110] Poor social functioning and an inadequate social network and social support may also contribute to the physical and mental health disparities among homeless individuals.[111] This information would provide further understanding to specific barriers medication prescribing at ED discharge, but because the NHAMCS-ED data does not include this information, these variables are not contained in the modified model, and the analysis will have no way to account for many of the enabling characteristics in the vulnerable domain.



[a]Pain assessment, patient-reported pain, and triage level were excluded from the model due to missing data.
[b]Arrival by ambulance, ED visit in the last 72 hours, ED disposition, wait time, length of visit, and number of procedures/tests were excluded from the model due to missing data.

Figure 3.1. Modified Andersen-Gelberg Behavioral Model for Vulnerable Populations

3.3 Data Source

The NHAMCS-ED is a retrospective database of visits to the EDs of noninstitutional, general, and short stay hospitals in the 50 states and the District of Columbia.[112—117] The survey sample design is a four-stage probability design beginning first with primary sampling units (PSUs), hospitals within PSUs, emergency services areas within hospitals, and finally, patient visits within the emergency services areas. PSUs are geographic segments composed of counties, groups of counties, county equivalents or towns, townships, and other minor civil divisions.[112—117] Alternatively, a PSU could consist solely of a metropolitan statistical area (MSA). There were 112 PSUs included in the sample.

Within PSUs, eligible hospitals were identified. Short stay hospitals are defined as hospitals with an average length of stay for all patients of less than 30 days and were included in the sample. Also included were hospitals whose specialty was general (medical or surgical), and children's general.[112—117] Excluded were federal hospitals, hospital units of institutions, and hospitals with less than six beds staffed for patient use. Five hundred and fifty hospitals with EDs were included in the sample.[112—117]

The patient visit or encounter is the basic sampling unit for NHAMCS-ED, and is defined as a direct, personal exchange between a physician or a staff member operating under a physician's direction, for the purpose of seeking care and rendering health services.[112—117] Patient visits are systematically selected over a randomly assigned 4-week reporting period for each ED. Visits were excluded if they were solely for administrative purposes or had no medical care provided.[112—117] The U.S. Bureau of the Census was the data collection agency responsible for overseeing the data collection process, and trained hospital staff on visit sampling and completion of the Patient Record Forms.[112—117] The target number of Patient Record Forms to be completed for each ED was 100.[112—117]

3.4 Inclusion and Exclusion Criteria

Patient ED visits were included in this study if the patient residence was homeless or private residence, and the encounter took place with the ED of an urban hospital. Hospitals located within a MSA were considered urban. This study pools six years of data from 2010, 2011, 2012, 2013, 2014, and 2015. To analyze this subpopulation, a domain analysis using the DOMAIN option in SAS survey procedures was used. This allowed for the analysis of the subpopulation and the analysis of the entire study population which incorporates the variability

of the variance estimation and results in nonrandom sample sizes for the subpopulation of interest.[112—117]

Patient ED visits were excluded if they took place in a hospital located outside of a MSA, if the ED visit resulted in a hospital admission, or if a patient's residence was designated as nursing home, other, unknown, or blank. The exclusion of hospitals located outside of a MSA is due to the inherent differences in health determining characteristics between the urban and rural homeless individuals that can't be accounted for in this study. Rural homeless individuals are referred to as the "hidden homeless," often residing in unsheltered, remote areas such as the woods or abandoned farm buildings, and this shelter status is associated with poorer health.[107,108] Rural homeless individuals also have fewer available resources for health care and housing access. Communities in rural areas have a lower capacity for homeless service provider infrastructure, and criteria for federal programs generally favor urban areas.[107]

3.5 Missing Data

To address missing data, the NOMCAR (not missing completely at random) option was used in the PROC SURVEYLOGISTIC SAS procedure which includes observations with missing values in the dependent variable and the independent variables in the variance estimation. The NOMCAR option preserves the NHAMCS sampling structure and allows for accurate parameter estimation. It has been used in other studies of the NHAMCS-ED dataset, and is a recommended procedure by the National Center for Health Statistics.[118]

3.6 Specific Aim 1

3.6.1 Specific Aim 1A

1A: Describe the predisposing (age, gender, race/ethnicity), enabling (housing status, primary payer) and need (ED diagnosis, pain assessment, patient-reported pain, triage level, comorbidity diagnosis) characteristics among homeless and non-homeless adults in the U.S.

3.6.1.1 Variables

Below is a description of variables used in Specific Aim 1A.

Age.

Patient age is a continuous variable that was collapsed into the following five categories: 18—24; 25—34; 35—44; 45—54; 55—64; and 65+.

Gender.

Gender was a dichotomous variable, defined as male or female.

Race/Ethnicity.

Race and ethnicity are two separate items in the Patient Record Form. Ethnicity is a dichotomous variable, defined as Hispanic or Latino; or not Hispanic or Latino. The imputed race/ethnicity variable was a nominal categorical variable with the following four categories: Non-Hispanic White, Non-Hispanic Black, Hispanic, and Other.

Housing status.

Housing status is measured by the variable, patient residence, in the Patient Record Form which is a nominal categorical variable with five categories: Private residence, Nursing home, Homeless, Other, and Unknown. Housing status is constructed in this study as a dichotomous variable, homeless or non-homeless. Patients were considered homeless if they reported having no address or said they were homeless. Patients were considered non-homeless if they reported

having a private residence.[112—117] Patients with the responses of Nursing home, Other, or Unknown was excluded from this study.

Primary payer.

Primary payer is a variable derived from the *Expected source of payment* section on the NHAMCS patient record form. *Expected source of payment* is comprised of seven binary (Y/N) categorical variables for which each payer is marked "Yes" if the ED visit in question was covered by that respective payer, or "No" if the ED visit was not covered by that payer. The payers listed in the patient record form are Private insurance, Medicare, Medicaid or CHIP, Worker's Compensation, Self-pay, No charge/charity, and Other. To create mutually exclusive categories, the variable, Primary payer, was created and follows the hierarchy: Private insurance, Medicare, Medicaid, Self-pay, and No charge/charity. Visits covered by Worker's Compensation or by Other payer were categorized as Other. First, any ED visits covered by Private insurance, regardless of additional coverage by any other payer, were categorized as having a Primary payer of Private insurance. Of the remaining visits, those covered by Medicare, regardless of additional coverage by any other payer, were categorized as have a Primary expected source of payment of Medicare. Of the remaining visits, those covered by Medicaid, regardless of additional coverage by any other payer, were categorized as having a Primary expected source of payment of Medicaid. This method was continued per the hierarchy until visits that only had either Worker's compensation or Other listed as an expected source of payment were remaining, and these visits were categorized as having a Primary payer of Other.

ED diagnosis.

Up to three ED discharge diagnoses can be listed on the patient record form for the years 2010, 2011, 2012, and 2013. In 2014 and 2015 up to five ED discharge diagnoses were able to be

listed. ED discharge diagnoses are listed using the ICD-9-CM diagnosis codes. In a study of homeless veterans enrolled in a Veterans Affairs Supported Housing Program, investigators categorized their primary hospital diagnosis into four categories using ICD-9 codes. Chronic physical illness, Acute physical illness, Mental illness, and Substance use disorders.[119] This study adopted the same method to categorize the ED diagnoses of each visit (Table 3.1). Four categorical, binary variables were listed in the model, chronic physical illness, acute physical illness, mental illness, and substance use disorders, with either a Yes or No response option. Each variable was marked Yes if any one of the primary, secondary, and tertiary ICD-9 diagnoses was categorized as such for the years 2010, 2011, 2012, and 2013. For the year 2014 and 2015, each diagnoses variable was marked Yes if any one of the five ICD-9-CM codes was categorized as such. The frequencies of each category listed in Table 3.1 were reported by housing status and compared between homeless and nonhomeless groups.

Table 3.1 Diagnoses and Associated ICD-9 Codes[119]	
Diagnosis	ICD-9 Codes
Chronic physical illness	
Arthropathies	710.xx-719.xx
Asthma	493.xx
Benign neoplasms	229—229, 235—239
Cancer	140.xx-208.xx
Coronary atherosclerosis	84, 202, 203, 204, 308.89, 720.0—724.9, 729.1, 737—737.9, 738.4—738.5, 739.3—739.4, 756.1—756.19, 805.00, 805.1—806.9, 839—839.5, 846.0—847.9, 996.4
Coronary atherosclerosis and other heart disease	411.0—414.01, 414.2, 414.3, 414.4, 414.8, 414.9, V4581, V4582, 78650, 78651, 78659
Chronic obstructive pulmonary disease (COPD) and bronchiectasis	490.xx-492.xx, 494, 494.x, 496
Congestive heart failure (CHF)	428.xx, 398.91
Diabetes	250.xx, 648.0x, 775.1x
Glaucoma	365.00
Hepatitis C	070.20, 070.22, 070.30, 070.32
HIV/AIDS	042.xx, 079.53, V08
Hypertension	401.xx-405.xx
Tuberculosis	401.xx-405.xx Tuberculosis 010.xx-018.xx
Acute physical illness	
Acute upper respiratory infections	460.xx-461.xx, 463.xx-466.xx
Fractures/open wounds/sprains/other injuries	800.xx-829.xx, 840.xx-844.xx, 845.1, 846.xx-848.xx, 870.xx- 897.xx, 920.xx-924.xx
Skin/subcutaneous infections	680.xx-686.xx, 692.xx
Mental illness	
Anxiety disorders excluding posttraumatic stress disorder	300.0x, 300.2x, 300.3, 308.3
Bipolar disorder	296.00–296.16, 296.40–296.99
Depression	293.83, 296.20–296.36, 300.4, 301.13, 311.xx
Posttraumatic stress disorder	309.81
Schizophrenia and other psychotic disorders	293.81, 293.82, 295.xx, 297.x-298.x
Substance use disorders	
Alcohol-related disorders	291.xx, 303.xx, 305.0x, 357.5x
Drug-related disorders	292.1x-292.8x, 304.xx, 305.2x-305.9x, 357.6x, 648.3x
Tobacco use disorders	305.10

Pain assessment.

An ED visit was reported to have a pain assessment if the *Pain scale* section on the patient record form was filled out from 0 to 10. If this section was marked Unknown, then the patient was indicated as not having had a pain assessment at that ED visit.

Patient-reported pain.

Pain scale is a continuous variable on a 10-point scale on the patient record form with 0 indicating no pain and a 10 indicating the most pain. In this study, Patient-reported pain was collapsed to a nominal categorical variable with the following categories: None (0), Mild (1-3), Moderate (4-6), and Severe (7-10).[112—117]

Triage level.

Triage acuity is defined by the immediacy with which a patient should be seen. It is assessed using the patient's physical and mental status as well as initial vital signs. Triage level is an ordinal categorical variable on a 5-point scale ranging from one to five.[112—117] Table 3.2 indicates the urgency that corresponds to each score and the time in which patients with that respective score must receive care:

Table 3.2 Triage level and corresponding urgency and time to be seen

Triage Level	Urgency	Time to be Seen
1	Immediate	Immediately
2	Emergent	1 to 14 minutes
3	Urgent	15 to 60 minutes
4	Semi-urgent	> 1 to 2 hours
5	Nonurgent	> 2 to 24 hours

Triage acuity level will serve as a proxy for disease severity at the time of the ED visit. There are different types of triage systems used by EDs in the United States that are on three, four, and five levels. The Emergency Severity Index (ESI) is a 5-level triage system, and is the system used

most frequently in hospitals in the United States.[120] It is considered the gold-standard for triage acuity and studies have shown that ESI triage levels were strongly associated with resources used in the ED and outcomes such as hospitalization.[121] Within the NHAMCS-ED data, a rescaling method determined in consultation with subject matter experts was used to rescale triage responses that used a three- or four-level system to a five-level system. For three-level systems, responses of 1, 2, and 3 were recoded to 2, 3, and 4. For 4-level systems, responses were recoded from 1-4 to 2-5. Rescaling was required for about 12% of records in 2010 and 2011, 7% in 2012, 4 % for 2013, 3% for 2014 and 7% for 2015.[112—117]Figure 3.2 is the ESI algorithm used by triage nurses to assign acuity levels.[122]

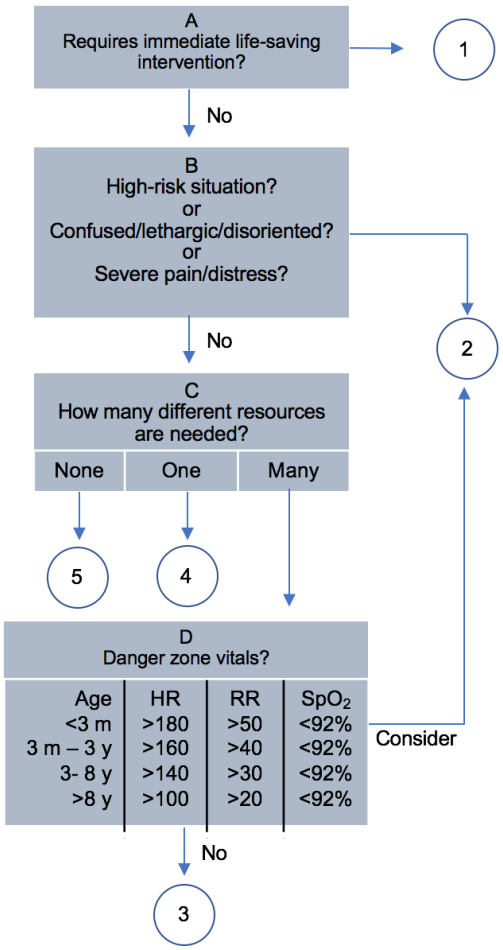


Figure 3.2. Emergency Severity Index Algorithm[122]

Due to cell sizes less than 30 among ED visits by homeless, this variable was collapsed into a binary variable indicating whether a visit is triaged as urgent or nonurgent. Visits triaged as Immediate, Emergent, or Urgent were classified as Urgent, and visits triaged as Semi-urgent or Non-urgent are classified as Non-urgent.

Comorbidity diagnosis.

Within the Patient Record Form, there is a list of comorbid diseases that are marked either Yes if the patient has a past diagnosis of that disease, or No. The number and specific disease states listed varies on the Patient Record Form by year, but the following five disease states are listed for 2010, 2011, 2012, 2013, 2014, and 2015: cerebrovascular disease, congestive heart failure, condition requiring dialysis, HIV, and diabetes. The 2014 and 2015 Patient Record Form also contains these disease states, with the exception of condition requiring dialysis, and has instead included both chronic kidney disease and end stage renal disease to assess the presence of renal disease.[112—117] End stage renal disease on the 2014 and 2015 patient record form will be used as the disease state that corresponds with condition requiring dialysis on the 2010, 2011, 2012, and 2013 patient record forms. ED users were classified as having a diagnosis of a comorbid disease if they had a diagnosis of at least one of these five chronic diseases.

3.6.1.2 Summary of variables

A summary of the variables is presented in Table 3.3.

Table 3.3 Predisposing, enabling, and need variables contained in the Patient Record Form of the NHAMCS-ED Survey	
Variable	**Definition**
Predisposing	
Gender	Male / Female
Race/Ethnicity	Non-Hispanic White / Non-Hispanic Black / Hispanic / Other
Age	18—24 / 25—34 / 35—44 / 45—54 / 55—64 / 65+
Enabling	
Housing Status	Nonhomeless / Homeless
Primary payer	Private insurance / Medicare / Medicaid or CHIP / Self-pay / No charge or charity / Other[a]
Need	
ED visit diagnosis	
Chronic physical illness	Yes / No
Acute physical illness	Yes / No
Mental illness	Yes / No
Substance Abuse	Yes / No
Pain Assessment	Yes / No
Patient-reported pain	None / Mild / Moderate / Severe
Triage Level	Urgent / Nonurgent
Comorbidity diagnosis[b]	Yes / No

[a]"Other" includes payers not meeting definitions for any other primary payer, and visits covered by worker's compensation

[b]Defined as having at least one of the five following comorbid disease states: cerebrovascular disease, congestive heart failure, condition requiring dialysis, HIV infection/AIDS, diabetes

3.6.1.2 Data Analysis

Descriptive statistics (mean and standard deviation (SD) for continuous variables, and frequency and percentage for categorical variables) were used to report the predisposing (age, gender, race/ethnicity), enabling (housing status, primary source of payment), and need (pain score, triage level, number of comorbidities) characteristics of the total sample as well as by housing status (homeless and-non-homeless).

3.6.2 Specific Aim 1B

1B: Compare the predisposing (age, gender, race/ethnicity), enabling (housing status, primary source of payment), and need (ED diagnosis, pain score, triage level, diagnosis of comorbidity) characteristics between homeless and non-homeless adults in the U.S.

3.6.2.1 Data Analysis

Bivariate statistics (t-tests for continuous variables, chi-square for categorical variables) were used assess the difference between predisposing (age, gender, race/ethnicity), enabling (private insurance, public benefits, housing status), and need (pain score, triage level, number of comorbidities) characteristics between homeless and non-homeless adults.

3.6.3 Specific Aim 1C

1C: Describe the ED use characteristics (arrival by ambulance, ED visit in last 72 hours, ED wait time, provider seen, number of diagnostic tests, ED disposition, total time spent in ED, and geographic region of the ED) among homeless and non-homeless adults in the U.S.

3.6.3.1 Variables

Below is a description of variables used in Specific Aim 1C.

Arrival by ambulance.

Arrival by ambulance is a dichotomous variable defined as either Yes or No.

ED visit in last 72 hours.

ED visit in the last 72 hours is a dichotomous variable defined as either Yes or No.

Provider seen during ED visit.

This is a categorical variable in the patient record form which indicates all the providers seen during the ED visit. The providers listed on the patient record form are ED attending physician, ED resident/intern, Consulting physician, RN/LPN, Nurse practitioner, Physician assistant, EMT, Other mental health provider, and Other. Due to cell sizes below 30 among ED visits made by homeless, this variable was collapsed into a binary categorical variable. Patients who were seen by either an ED attending physician or a consulting physician, were designated as

having seen a physician. Patients seen by any other provider were classified as having not seen an ED attending or consulting physician.

ED disposition.

Disposition from the ED is a follow-up list of services and treatments to be provided to the patient. Patients could have multiple dispositions marked for this variable. These include No follow-up, Return to ED, Return/Refer to physician's clinic for follow-up, left before triage, left after triage, left AMA, DOA, Died in ED, Return/transfer to nursing home, Transfer to psychiatric hospital, Transfer to other hospital, Admit to this hospital, Admit to observation unit then hospitalized, Admit to observation unit, then discharged, or other. To create mutually exclusive categories, this variable was collapsed into the following 4 categories: Discharge, Admit to hospital, Transferred, Other. The definition of each disposition category is reported in Table 3.4. To begin categorizing patients into one of the four categories, dispositions for patients who were dead on arrival (DOA) or who died in the ED, left against medical advice, or who left before or after triage were categorized as "Other." Then, any patients who were Returned/Transferred to a nursing home, Transferred to a psychiatric hospital, or Transferred to another hospital were considered "Transferred." Patients who were Admitted to the hospital or Admitted to observation and then hospitalized were considered "Admitted to Hospital." Any patients who were marked as No follow-up planned, Return if needed, Refer to MD or clinic for follow-up, or who were Admitted to observation and then discharged were categorized as "Discharged."

Table 3.4 ED disposition categories and definitions	
Disposition	Definition
Discharge	No follow-up plan; Return if needed; Refer to MD or clinic for follow-up; or Refer to social services
Hospital admission	Admit to this hospital; Admit to observation unit, then hospitalized
Transfer	Return/transfer to nursing home; Transfer to psychiatric hospital; Transfer to other hospital
Other	Left against medical advice (AMA); Left before triage; Left after Triage; Died in ED; Other; Blank; DOA; Left against medical advice

ED wait time.

This is a continuous variable that was constructed using the date and time of arrival to the ED and the date and time that the patient was seen by a provider. ED wait times were collapsed into eight categories: 15 minutes, 30 minutes, 45 minutes, 60 minutes, 2 hours, 3 hours, 4 hours, and greater than 4 hours.

Number of diagnostic tests or exams ordered or provided during ED visit.

The Patient Record form provides a list of diagnostic tests and procedures that could have been ordered and/or provided during the ED visit, and all that apply for each visit are marked on the form. The total number of tests and exams were reported for this variable. The number and type of diagnostic tests and procedures varies from year-to-year. As little as 29 diagnostic tests and 13 procedures to as many as 37 diagnostic tests and 14 procedures could be marked on the patient record forms for years 2010, 2011, 2012, 2013, 2014, and 2015.[112—117] However, the maximum number of diagnostic tests reported in any year was 23 in 2012. The maximum number of procedures reported in any year was eight in 2011. The number of diagnostic tests and procedures will be added and reported as one continuous variable, ranging from 0 to 29.

Geographic region.

This is a categorical variable in the patient record form with four options to indicate the geographic region in which the ED visit took place. The regions are Northeast, Midwest, South, and West. Table 3.5 provides a list of the states corresponding to each U.S. region.

Table 3.5 The four regions of the United States and their corresponding states

Region	States
Northeast	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, New Jersey, New York, Pennsylvania
Midwest	Indiana, Illinois, Michigan, Ohio, Wisconsin, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota
South	Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia, Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, Texas
West	Arizona, Colorado, Idaho, New Mexico, Montana, Utah, Nevada, Wyoming, Alaska, California, Hawaii, Oregon, Washington

Length of ED visit

This is a continuous variable constructed using the date and time of arrival to the ED and the date and time the patient was discharged from the ED. Lengths of ED visits were collapsed into six categories: 1 hour, 2 hours, 4 hours, 6 hours, 12 hours, and greater than 12 hours. Note that the total length of the ED visit also includes the time measured in the variable, ED wait time described above.

3.6.3.2 Summary of variables

A summary of the variables is presented in Table 3.6.

Table 3.6. ED use variables	
Variable	**Definition**
Arrival by ambulance	Yes / No
ED visit in last 72 hours	Yes / No
Provider seen	Medical doctor / Other
ED disposition	Discharged / Admit to hospital / Transferred / Other[a]
Geographic region	Northeast / Midwest / South / West
Wait time to be seen	The difference between time of presentation to the ED and time patient was seen by the provider 15 minutes / 30 minutes / 45 minutes / 60 minutes / 2 hours / 3 hours / 4 hours / 4+ hours
Length of visit	The difference between time of presentation to the ED and time patient was discharged. (Applies to patient who were not admitted for observation or to the hospital.) 1 hour / 2 hours / 4 hours / 6 hours / 12 hours / 12+ hours
Number of procedures/tests	Number of "blood," "imaging," or "other" tests or exams done at ED visit (ranges from 0 to 29)

[a]"Other" includes visits at which patients were dead on arrival or died in the ED, left against medical advice, or left before or after triage

3.6.3.3 Data Analysis

Descriptive statistics (mean and SD for continuous variables, and frequency and percentage for categorical variables) were used to report the ED use variables (arrival by ambulance, episode of care, ED wait time, providers seen, number of diagnostic tests, ED disposition, total time spent in ED, and geographic region of the ED) of the total sample as well as by housing status (homeless and non-homeless).

3.6.4. Specific Aim 1D

1D: Compare the ED use characteristics (arrival by ambulance, ED visit in last 72 hours, ED wait time, provider seen, number of diagnostic tests, ED disposition, total time spent in the ED, and geographic region) between homeless and non-homeless adults in the U.S.

3.6.4.1 Data Analysis

Bivariate statistics (t-tests for continuous variables, chi-square for categorical variables) were used to assess the difference between the ED use characteristics) between homeless and non-homeless adults.

3.6.5 Specific Aim 1E

1E: Describe the characteristics of medications prescribed at ED discharge (total number prescribed, controlled status, prescription status, classes of medication most frequently prescribed, medications prescribed by class) among homeless and non-homeless adults in the U.S.

3.6.5.1 Variables

Below is a description of variables used in Specific Aim 1E.

Medication prescribing at ED discharge.

An ED visit was coded as having resulted in a medication prescription at ED discharge if: 1) any medication is listed as being prescribed to the patient; and 2) that medication was checked as having been given at discharge. This is a dichotomous, categorical variable with either a Yes or No response.

Number of medications prescribed at ED discharge.

Within the patient record form, up to 8 medications on the 2010 and 2011 patient record form, 12 medications on the 2012 and 2013 forms, and 30 medications on the 2014 and 2015 forms that were given to the patient either during the visit or at discharge can be recorded. Medications indicated as being prescribed at discharge were counted.

Controlled medication prescription at ED discharge.

Medications were considered controlled if they were coded as being either Schedule II, Schedule III, Schedule IV, Schedule V. A non-control medication is coded as having "no control." Medications coded as having multiple schedules were considered controlled medications.

Schedule of controlled medications prescribed at ED discharge.

The five Schedules of controlled medications, and medications coded as having multiple schedules, were collapsed into the following three categories: Schedule II, Schedule III, and Schedule IV, V. Medications coded as a Schedule IV or V were collapsed due to cell sizes less than 30. Medications with multiple schedules were recoded into the same schedule as that of the controlled ingredient. For example, the combination medication, acetaminophen with codeine was coded as having multiple schedules. Because codeine is a Schedule III, this medication was recategorized as a Schedule III.

Opioid medication prescription at ED discharge

Medications were considered an opioid if they were coded as being either a narcotic analgesic, or a narcotic/analgesic combination. "Narcotic" is a term used by the Drug Enforcement Administration (DEA) to mean "opioid."[127] A narcotic/analgesic combination is a medication that contains both an opioid and a non-controlled analgesic such as a nonsteroidal anti-inflammatory drug, or acetaminophen.

Prescription status of medications prescribed at ED discharge.

Medications were categorized as either prescription drug or nonprescription drug. Medications coded as having both a prescription and over-the-counter (OTC) status were considered a prescription.

Five most frequently prescribed classes of medications at ED discharge.

Lexicon Plus, a proprietary database of Cerner Multum, Inc., is a comprehensive database of all prescription and non-prescription drug products available in the U.S. drug market. The Multum Lexicon provides a three-level nested category system that assigns each medication to up to three classification levels[112—1170] For example, for the medication, naproxen, the broadest category (level 1) is central nervous system agents, a more detailed category is analgesics (level 2), and the most detailed category is nonsteroidal anti-inflammatory agents. Not all drugs have three levels of classification; some may have only two. The Level 1 class of medication was reported for this variable.

Medications prescribed by class.

The medications belonging to the five most frequently prescribed medication classes at ED discharge are reported.

3.6.5.2 Summary of variables

A summary of the variables is presented in Table 3.7.

Table 3.7 Characteristics of medications prescribed at ED discharge

Variable	Definition
Medication prescription at discharge	Yes / No
Number of medications prescribed at discharge	Number of medications listed on patient form with "prescribed at discharge" marked (ranges from 0 to 12)
Controlled medication prescription at discharge	Control / Non-control
Schedule of controlled medications prescribed at discharge	Schedule II / Schedule III / Schedule IV / Schedule V / Mixed schedule
Opioid prescribed at discharge	Yes / No
Prescription status of medications prescribed at discharge	Prescription drug / Over-the-counter (OTC) drug
Five most frequently prescribed classes of medications at ED discharge	Detailed category, Level 1
Medications prescribed by class	Medications prescribed at discharge, listed by five most frequently prescribed classes

3.6.5.3 Data Analysis

Descriptive statistics (mean and SD for continuous variables, and frequency and percentage for categorical variables) were used to report the characteristics of medications prescribed at ED discharge (classes of medications prescribed, medications prescribed by class, total number, controlled status, prescription status) of the total sample as well as by housing status (homeless, non-homeless).

3.6.6 Specific Aim 1F

1F: Compare the characteristics of medications prescribed at discharge (total number prescribed, controlled status, prescription status, classes of medication most frequently prescribed, medications prescribed by class) between homeless and non-homeless adults in the U.S.

3.6.6.1 Data Analysis

Bivariate statistics were used (t-tests for continuous variables, chi-square for categorical variables) to assess the difference between the characteristics of medications prescribed at ED discharge between homeless and non-homeless adults in the U.S.

3.7 Specific Aim 2

3.7.1 Specific Aim 2A

2A: Examine the relationship between medication prescribing at ED discharge and housing status, controlling for the predisposing (age, gender, race/ethnicity), enabling (primary source of payment), and need (ED diagnosis, diagnosis of comorbidity) characteristics as well as the ED use characteristics (provider seen, geographic region) among homeless and non-homeless adults in the U.S.

3.7.1.1 Data Analysis

Multivariable logistic regression examined the relationship between medication prescribing at ED discharge and housing status, while controlling for the predisposing (age, gender, race/ethnicity), enabling (housing status, expected source of payment), and need (ED diagnosis, presence of comorbid condition) characteristics as well as the ED use characteristics (provider seen, region). Variables analyzed in the bivariate analysis were excluded from the multivariable analysis if greater than 5% of the data was missing for that variable. The only exception is the variable primary payer, which was missing data for 7.48% of visits. Due to the importance of this variable, and the relative proximity of the rate of missingness to the threshold of 5%, Primary payer was included in the multivariable analysis. Patients with a disposition that did not result in an ED discharge were excluded from this analysis. Multicollinearity was assessed. Unadjusted and adjusted odds ratios and 95% confidence intervals were reported. The *a priori* significance level was $p<.05$.

3.7.2 Specific Aim 2B

2B: Quantify the individual contribution of the predisposing (age, gender, race/ethnicity), enabling (primary source of payment), and need (ED diagnosis, diagnosis of comorbidity) characteristics as well as the ED use characteristics (provider seen, geographic region) in order to explain the disparity observed in medication prescribing at ED discharge between homeless and housed adults in the U.S.

3.7.2.1 Data Analysis

Comparing differences in medication prescribing between homeless and nonhomeless individuals while controlling for potentially confounding factors helps to isolate the effect of housing status on this outcome but does little to explain the individual contributions to an

observed disparity on the part of the explanatory variables. A disparity decomposition was conducted to explain the most relevant factors leading to a difference in outcomes. The Fairlie decomposition model for nonlinear binary models was used to estimate a multivariable model that quantifies the contributions of the predisposing, enabling, need characteristics, as well as the ED use characteristics, and the hospital and ED characteristics to any difference observed in medication prescribing at ED discharge between homeless and nonhomeless individuals.

Predisposing variables included age, gender, and race/ethnicity, enabling characteristics included primary payer, and need characteristics included ED diagnosis and comorbidity diagnosis. ED diagnosis was a set of variables comprised of chronic physical condition diagnosis, acute physical condition diagnosis, mental health condition diagnosis, and substance use condition diagnosis. ED use characteristics included provider seen and geographic region. Means and frequencies of these explanatory variables of one group were substituted one at a time by the means and frequencies of the other group and the difference in outcome was recalculated between the two groups after each substitution. Thus, the magnitude of change in the outcome between the two groups as a result of a substitution for a certain explanatory variable represents the contribution of that variable to the total outcome difference between these two groups. Patients with a disposition that did not result in an ED discharge was excluded from this analysis.

3.8 Specific Aim 3

Examine the predisposing (age, gender, race/ethnicity), enabling (primary source of payment), and need characteristics (ED diagnosis, diagnosis of comorbidity), as well as the ED use characteristics (provider seen, geographic region) that predict the prescription of a medication at discharge among homeless adults in the U.S.

3.8.1 Data Analysis

Multivariable logistic regression examined the predisposing (age, gender, race/ethnicity), enabling (primary payer), and need (ED diagnosis, comorbidity diagnosis) characteristics, and ED use characteristics (providers seen, region) associated with the prescription of a medication at discharge. Patients with a disposition that did not result in an ED discharge was excluded from this analysis. Multicollinearity was assessed. Unadjusted and adjusted odds ratios and 95% confidence intervals was reported. The *a priori* significance level was $p<.05$.

Chapter 4: Results

4.1 Specific Aim 1A, 1B

1A: Describe the predisposing (age, gender, race/ethnicity), enabling (housing status, primary source of payment) and need (ED diagnosis, pain score, triage level, diagnosis of comorbidity) characteristics among homeless and non-homeless adults in the U.S.

1B: Compare the predisposing (age, gender, race/ethnicity), enabling (housing status, primary source of payment), and need (ED diagnosis, pain score, triage level, diagnosis of comorbidity) characteristics between homeless and non-homeless adults in the U.S.

From January 2010 to December 2015, there were a total of 502,614,359 visits to EDs located within a MSA made by adults 18 years of age and older who were either homeless or living in a private residence (nonhomeless). About 0.9% of these visits, or 4,678,630 visits, were made by homeless individuals. Descriptive results (frequencies and percentages), and results of the chi-square tests (categorical variables) and t-tests (continuous variables) for Predisposing, Enabling, and Need characteristics are presented in Table 4.1.

4.1.1 Predisposing Characteristics

Seven percent of homeless visits were made by 18- to 24-year-olds, 19% by 24- to 34-year-olds, 20% by 35- to 44-year-olds, 32% by 45- to 54-year-olds, 17% by 55- to 64-year-olds, and 4% by persons 65 years of age and older. Among nonhomeless ED visits, 16% were made by 18- to 24-year-olds, 21% by 25- to 34-year-olds, 16% by 35- to 44-year-olds, 16% by 45- to

54-year-olds, 12% by 55- to 64-year-olds, and 18% by persons 65 years of age and older. Age differed significantly between homeless and nonhomeless ED users ($p<.001$). The proportion of homeless ED users in the two youngest age categories (18 to 34 years) was smaller, and their proportion in the older age categories (35 to 64 years) was larger, compared to nonhomeless ED users.

Seventy-five percent of homeless ED visits were made by men compared to 42% of nonhomeless ED visits. Fifty-six percent of homeless ED users were White, 24% were Black, and 16% were Hispanic. Fifty-eight percent of nonhomeless ED users were White, 24% were Black, and 14% were Hispanic. While the distribution of homeless ED visits across racial/ethnic groups did not differ significantly between homeless and nonhomeless ED users ($p=0.13$), a statistically significant difference in gender ($p<.001$) was observed between the two groups.

4.1.2 Enabling Characteristics

Variables were excluded from the bivariate analysis if they were missing greater than 5% of data. The only exception in the case of primary payer, which was missing data for 7.48% of visits. Due to the importance of this variable, and the relative proximity of the rate of missingness to the threshold of 5%, Primary payer was included in the multivariable analysis. Medicaid covered the greatest proportion of homeless ED visits (35%), and a quarter of homeless ED visits were categorized as Self-pay. Nine percent of visits were considered No charge/charity, and another 9% were categorized as Other. Eight percent of homeless ED visits were covered by Private insurance. Among nonhomeless ED users, Private insurance covered the greatest proportion of visits (40%). Twenty-two percent of nonhomeless ED visits were covered by Medicaid, 17% were Self-pay, 15% were covered by Medicare, 1% were No charge/charity, and 4% were categorized as Other. Primary payer differed significantly between homeless and nonhomeless ED visits ($p<.001$).

4.1.3 Need Characteristics

Twenty-two percent of homeless ED users were diagnosed with at least one chronic physical condition, 16% with an acute physical condition, 17% with a mental health condition, and 27% with a substance use condition. Thirty-two percent of nonhomeless ED users were diagnosed with a chronic physical condition, 20% with an acute physical condition, 4% with a mental health condition, and 3% with a substance use condition. The prevalence of chronic and acute physical condition diagnoses, and mental health and substance use condition diagnoses, differed significantly between homeless and nonhomeless ED users. A smaller proportion of homeless ED users were diagnosed with chronic physical conditions ($p<.001$) and acute physical conditions ($p=.03$), and a greater proportion of homeless ED users were diagnosed with mental health conditions ($p<.001$) and substance use conditions ($p<.001$), compared to nonhomeless ED users.

Pain was assessed at 71% of homeless ED visits. Of those, homeless ED users reported having severe pain at 43% of visits, moderate pain at 15% of visits, mild pain at 6% of visits, and no pain at 36% of visits. Pain was assessed at 76% of nonhomeless ED visits. Of those, nonhomeless ED users reported having severe pain at 48% of visits, moderate pain at 21% of visits, mild pain at 9% of visits, and no pain at 22% of visits. Patient assessment of pain ($p=.04$) and patient reported pain ($p<.001$) differed significantly between homeless and nonhomeless ED users. Fewer homeless ED users received a pain assessment during their visits, but a greater proportion of homeless reported having no pain. The proportion of patients reporting mild, moderate, and severe pain was greater among nonhomeless ED users compared to homeless.

Just over 60% of ED visits for both homeless and nonhomeless ED users were triaged as urgent, and 14% and 16% of homeless and nonhomeless ED visits, respectively, had a diagnosis

of at least one comorbid condition. Triage level and prevalence of diagnosis of at least one of five major comorbid disease states did not differ significantly between homeless and nonhomeless ED visits.

Table 4.1 Predisposing, enabling, and need characteristics among homeless and nonhomeless adults using urban EDs in the United States, 2010-2015 NHAMCS-ED

	Homeless			Nonhomeless			
	Unweighted N[a]	Weighted n[a] *in thousands* (%)	95% CI	Unweighted N[a]	Weighted n[a] *in thousands* (%)	95% CI	*p*
Number of ED visits	1,457	4679 (0.93)	0.81, 1.06	103,501	497,936 (99.07)	98.94, 99.19	
Predisposing							
Age							
18 – 24	102	344 (7.36)	5.02, 9.69	16,413	80,824 (16.23)	15.79, 16.67	**<.0001**
25 – 34	259	897 (19.18)	16.00, 22.35	21,927	106,586 (21.41)	20.92, 21.89	
35 – 44	332	936 (20.00)	16.96, 23.05	17,103	80,739 (16.21)	15.85, 16.57	
45 – 54	453	1,491 (31.87)	28.66, 35.09	16,998	81,264 (16.32)	15.99, 16.65	
55 – 64	253	813 (17.38)	14.42, 20.33	12,611	60,436 (12.14)	11.79, 12.49	
65+	58	197 (4.21)	2.72, 5.70	18,449	88,087 (17.69)	17.08, 18.31	
Gender							
Women	382	1,179 (25.19)	21.68, 28.70	59,673	289,778 (58.20)	57.60, 58.79	**<.0001**
Men	1,075	3,500 (74.81)	71.30, 78.32	43,828	208,158 (41.80)	41.21, 42.40	
Race/Ethnicity							
White	761	2,601 (55.60)	51.56, 59.64	60,193	292,407 (58.72)	56.52, 60.93	.1283
Black	400	1,112 (23.78)	19.95, 27.60	24,085	118,558 (23.81)	21.43, 26.19	
Hispanic	232	760 (16.25)	12.94, 19.55	15,249	71,759 (14.41)	12.93, 15.90	
Other	64	205 (4.38)	2.74, 6.02	3,974	15,212 (3.06)	2.56, 3.55	
Enabling							
Primary source of payment							
Private insurance	62	307 (7.65)	1.33, 13.97	38,343	184,117 (40.18)	38.95, 41.41	**<.0001**
Medicare	189	576 (14.36)	11.41, 17.30	14,550	70,775 (15.44)	14.77, 16.12	
Medicaid	476	1,404 (34.99)	29.70, 40.29	22,041	101,120 (22.07)	21.00, 23.13	

Self-pay	261	1,022 (25.45)	21.30, 29.60	15,697	77,113 (16.83)	15.76. 17.90	
No charge/ charity	99	346 (8.63)	5.50, 11.75	1,111	5,747 (1.25)	0.82, 1.69	
Other	148	358 (8.92)	6.24, 11.60	4,123	19,383 (4.23)	3.68, 4.78	
Need							
ED visit diagnosis							
Chronic physical condition	342	1,028 (21.97)	18.06, 25.86	32,207	158,402 (31.81)	30.99, 32.63	**<.0001**
Acute physical condition	212	760 (16.25)	13.18, 19.33	20,560	99,195 (19.92)	19.46, 20.38	**.0343**
Mental health condition	341	796 (17.01)	13.79, 20.23	4,913	19,324 (3.88)	3.62, 4.15	**<.0001**
Substance use condition	429	1,285 (27.47)	23.99, 30.96	3,347	14,453 (2.90)	2.70, 3.10	**<.0001**
Pain assessment							
Yes	1024	3,328 (71.14)	66.61, 75.66	79765	377,609 (75.84)	73.22, 78.45	**.0369**
No	433	1,350 (28.86)	24.34, 33.39	23736	120,326 (24.17)	21.55, 26.78	
Pain scale for those who had pain assessment							
None	431	1,206 (36.24)	31.18, 41.30	18,656	82,001 (21.72)	20.90, 22.53	**<.0001**
Mild	60	191 (5.73)	3.86, 7.61	7,102	33,296 (8.82)	8.38, 9.25	
Moderate	154	502 (15.09)	11.73, 18.45	16,854	79,398 (21.03)	20.41, 21.64	
Severe	379	1,429 (42.93)	36.60, 49.27	37,153	182,914 (48.44)	47.36, 49.52	
Triage level							
Urgent	782	2,434 (62.53)	56.29, 68.77	52,181	242,324 (61.45)	59.80, 63.10	.7232
Nonurgent	438	1,459 (37.47)	31.23, 43.71	32,660	152,003 (38.55)	36.90, 40.20	
Comorbidity diagnosis	213	631 (13.48)	10.61, 16.35	16,705	80,033 (16.07)	15.38, 16.76	.0907

[a]The unweighted and weighted frequencies of each variable may not add up to the total number of ED visit frequencies due to missing data

[b]Defined as having at least one of the following five major comorbid disease states: cerebrovascular disease, congestive heart failure, condition requiring dialysis, HIV infection/AIDS, diabetes

4.1.4 Summary of Results

In summary, the proposed hypotheses for Specific Aim 1B, the variable tested, and the results are listed in Table 4.2.

Table 4.2 Summary of hypothesis testing the difference in Predisposing, Enabling, and Need characteristics between homeless and nonhomeless ED users

Hypothesis tested		Variable from data	Results
HA1:	Age differs significantly between homeless and nonhomeless ED users.	Age	This hypothesis was accepted. A greater proportion of homeless ED users comprised the 35 to 64 age groups, and a smaller proportion comprised the 65 years and older age group, compared to nonhomeless ED users ($p<.001$).
HA2:	Gender differs significantly between homeless and nonhomeless ED users.	Gender	This hypothesis was accepted. A greater proportion of homeless ED users were male compared to nonhomeless ED users ($p<.001$).
HA3:	Race/ethnicity differs significantly between homeless and nonhomeless ED users.	Race/ethnicity	This hypothesis was rejected. There was no difference in race/ethnicity between homeless and nonhomeless ED users ($p=.13$).
HA4:	Primary payer differs significantly between homeless and nonhomeless ED users.	Primary payer	This hypothesis was accepted. A greater proportion of homeless ED visits were covered by Medicaid, Self-pay, and No charge/charity compared to nonhomeless visits, and a smaller proportion of homeless ED visits were covered by Private insurance, compared to nonhomeless visits ($p<.001$).
HA5:	The rate of diagnosis of a chronic physical condition differs significantly between homeless and nonhomeless ED users.	Chronic physical condition	This hypothesis was accepted. A smaller proportion of homeless ED users were diagnosed with a chronic physical condition compared to nonhomeless ED users ($p<.001$).

HA6:	The rate of diagnosis of an acute physical condition does not differ significantly between homeless and nonhomeless ED users.	Acute physical condition	This hypothesis was rejected. A smaller proportion of homeless ED users were diagnosed with an acute physical condition compared to nonhomeless ED users (p=.03).
HA7:	The rate of diagnosis of a mental health condition differs significantly between homeless and nonhomeless ED users.	Mental health condition	This hypothesis was accepted. A greater proportion of homeless ED users were diagnosed with a mental health condition compared to nonhomeless ED users (p<.001).
HA8:	The rate of diagnosis of a substance use condition differs significantly between homeless and nonhomeless ED users.	Substance use condition	This hypothesis was accepted. A greater proportion of ED users were diagnosed with a substance use condition compared to nonhomeless ED users (p<.001).
H09:	There is no difference between other need characteristics between homeless and non-homeless ED users.	Pain assessment, Patient-reported pain, Triage level, Comorbidity diagnosis	This hypothesis was rejected. A smaller proportion of homeless ED users received a *pain assessment* during their ED visit compared to nonhomeless ED users (p=0.04). *Patient-reported pain* differed significantly between homeless and nonhomeless ED users (p<.001). A greater proportion of homeless reported having no pain compared to nonhomeless ED users. There was no significant difference in *Triage level* (p=.72) and *Comorbidity diagnosis* (p=.09) between homeless and nonhomeless ED users.

4.2 Specific Aim 1C, 1D

1C: Describe the ED use characteristics (arrival by ambulance, ED visit in last 72 hours, ED wait time, provider seen, number of diagnostic tests, ED disposition, total time spent in ED, and geographic region of the ED) among homeless and non-homeless adults in the U.S.

1D: Compare the ED use characteristics (arrival by ambulance, ED visit in last 72 hours, ED wait time, provider seen, number of diagnostic tests, ED disposition, total time spent in the ED, and geographic region) between homeless and non-homeless adults in the U.S.

Descriptive results (frequencies and percentages), and results of the chi-square tests (categorical variables) and t-tests (continuous variables) for ED use characteristics are presented in Table 4.3.

4.2.1 ED Use Characteristics

An arrival by ambulance initiated 43% of homeless ED visits, and 10% of homeless ED visits were preceded by a previous ED visit within the past 72 hours. An arrival by ambulance initiated 17% of nonhomeless ED visits, and 5% of nonhomeless ED visits were preceded by a previous ED visits within the past 72 hours. Homeless and nonhomeless ED users differed significantly by rate of ambulance arrival ($p<.001$) and previous ED visit ($p<.001$).

On average, homeless ED visit wait times lasted 61 minutes (SD=5.60, range 0-1,438), Thirty-five percent of homeless ED users waited 15 minutes to be seen by a provider, 19% waited 30 minutes, 14% waited two hours, 5% waited three hours, 2% waited four hours, and 5% waited for five or more hours. On average, nonhomeless ED visit wait times lasted 47 minutes (SD=1.20, range 3-5,567). Thirty-seven percent of nonhomeless ED users waited 15 minutes to be seen by a provider, 21% waited 30 minutes, 12% waited 45 minutes, 7% waited 60 minutes, 14% waited

two hours, 5% waited three hours, 2% waited four hours, and 2% waited five or more hours. Homeless and nonhomeless ED visits differed significantly by their distribution across wait times ($p<.001$). The proportion of homeless ED visits comprising the four shortest wait time categories (15 to 60 minutes) was smaller, and the proportion of homeless ED visits whose wait times were five or more hours was greater, compared to those of nonhomeless ED visits.

Seventy-five percent of homeless ED visits resulted in discharge from the ED, 12% resulted in a hospital admission, 7% of patients were transferred to another facility, and 7% of homeless ED dispositions were categorized as Other. Eighty-three percent of nonhomeless ED visits resulted in discharge from the ED, 13% resulted in a hospital admission, 2% of patients were transferred to another facility, and 3% of nonhomeless dispositions were categorized as Other. There was a significant difference in ED disposition between homeless and nonhomeless ED users ($p<.001$).

The mean length of homeless ED visits was 357.58 minutes, or about 6.0 hours (SD=17.31, range 3-5,567). This measure includes the time measured by the variable, ED wait time. Seven percent of homeless ED visits lasted one hour, 19% lasted two hours, 26% lasted four hours, 17% lasted six hours, 19% lasted 12 hours, and 12% lasted 13 hours or more. Among nonhomeless ED visits, the average length of stay in the ED was 230.73 minutes, or about 3.8 hours (SD=3.75, range 0-5,760). Ten percent lasted on hour, 22% lasted two hours, 36% lasted four hours, 18% lasted six hours, 10% lasted 12 hours, and 3% lasted 13 hours or more. The length of visits differed significantly between homeless and nonhomeless ED users ($p<.001$). The proportion of homeless ED visits comprising the three shortest time frames (one to four hours) was smaller, and the proportion comprising the two longest time frames (12 and 13 or more hours) was larger, compared to nonhomeless ED users.

Forty-five percent of homeless ED visits took place in the West, 23% took place in the South, and the remaining 32% of homeless ED visits were divided evenly between the Northeast and Midwest. Among nonhomeless ED visits, 36% took place in the South, 19% took place in the Northeast and both the West and the Midwest each saw about 22% of nonhomeless visits Geographic region differed significantly between homeless and nonhomeless ED users ($p<.001$). The Western region saw the greatest proportion of homeless ED visits while the South saw the greatest proportion of nonhomeless ED visits.

Homeless ED visits had an average of 3.58 procedures and diagnostic tests (SD=0.18, range 0-18), versus 3.98 (SD=0.08, range 0-26) among nonhomeless ED visits. Patients in 86% and 87% of homeless and nonhomeless ED visits were seen by a medical doctor. There was a significant difference in the number of procedures and diagnostic tests performed between homeless and nonhomeless ED users ($p=.02$), but no significant difference was found between the two groups regarding the proportion of each seen by a medical doctor ($p=0.34$).

Table 4.3 ED use characteristics among homeless and nonhomeless adults using urban EDs in the United States, 2010-2015 NHAMCS-ED

	Homeless			Nonhomeless			*p*
	Unweighted N	Weighted n[a] (%)	95% CI	Unweighted N	Weighted n[a] (%)	95% CI	
Arrival by ambulance							
Yes	583	1,936 (42.71)	37.99, 47.44	17,258	80,824 (16.81)	16.10, 17.52	**<.0001**
No	801	2,596 (57.23)	52.56, 62.01	82,211	399,927 (83.19)	82.48, 83.90	
ED visit in the last 72 hours							
Yes	155	418 (9.88)	7.61, 12.16	4,656	21,346 (4.88)	4.10, 5.67	**<.0001**
No	1,168	3,816 (90.11)	87.84, 92.39	86,295	415,752 (95.12)	94.33, 95.91	
Wait time to be seen							
15 minutes	393	1,397 (34.81)	28.64, 40.97	32,220	155,818 (36.52)	34.29, 38.76	**.0007**
30 minutes	197	750 (18.69)	15.25, 22.13	19,271	90,370 (21.18)	20.41, 21.96	
45 minutes	153	561 (13.97)	10.92, 17.03	10,712	50,786 (11.90)	11.31, 12.50	
60 minutes	82	264 (6.58)	4.55, 8.62	6,678	61,564 (7.40)	6.99, 7.80	
2 hours	195	563 (14.03)	11.16, 16.92	12,481	60,810 (14.25)	13.41, 15.10	
3 hours	76	196 (4.88)	3.37, 6.39	4,149	20,273 (4.75)	4.33, 5.17	
4 hours	44	90 (2.24)	1.27, 3.20	1,753	8,076 (1.89)	1.68, 2.10	
> 4 hours	76	193 (4.80)	3.18, 6.42	2,130	8,930 (2.09)	1.80, 2.38	
Physician seen							
Yes	1,255	4,023 (85.98)	82.74, 89.22	91,389	434,928 (87.35)	85.84, 88.86	0.3898
No	202	656 (14.02)	10.78, 17.26	12,112	63,008 (12.65)	11.14, 14.16	
ED Disposition							
Discharged	986	3,188 (74.52)	70.70, 78.34	79,722	392,078 (82.76)	81.60, 83.92	**<.0001**
Admit to hospital	177	484 (11.32)	8.57, 14.08	13,304	60,415 (12.75)	11.72, 13.78	
Transfer	85	316 (7.38)	4.79, 9.96	1,990	8,325 (1.76)	1.59, 1.93	
Other	75	290 (6.78)	4.58, 8.98	2,767	12,941 (2.73)	2.49, 2.98	
Length of visit							

1 hour	97	317 (7.16)	5.19, 9.13	10,358	48,371 (10.26)	9.66, 10.87	**<.0001**
2 hours	173	823 (18.54)	12.69, 24.39	21,257	102,758 (21.81)	20.96, 22.65	
4 hours	345	1,137 (25.65)	22.26, 29.03	34,865	171,582 (36.41)	35.75, 37.07	
6 hours	224	772 (17.41)	14.30, 20.52	17,157	84,537 (17.94)	17.28, 18.60	
12 hours	270	851 (19.21)	16.09, 22.32	10,665	49,281 (10.46)	9.74, 11.18	
<12 hours	218	533 (12.03)	9.46, 14.61	3,739	14,705 (3.12)	2.80, 3.44	
Geographic region							
Northeast	271	777 (16.60)	11.74, 21.47	22,702	94,588 (19.00)	15.87, 22.13	**<.0001**
Midwest	137	742 (15.86)	8.78, 22.95	22,871	112,012 (22.50)	17.73, 27.26	
South	272	1,057 (22.60)	17.06, 28.13	34,769	179,726 (36.09)	31.22, 40.97	
West	777	2,102 (44.94)	38.26, 51.61	23,159	111,609 (22.41)	18.65, 26.17	

	Mean +/- SD	Range	Mean +/- SD	Range	
Wait time (minutes)[b]	61.43 +/- 5.60	0.00-1438.00	47.09 +/- 1.20	0.00-1439.00	**.0075**
Length of visit (minutes)[c]	357.58 +/- 17.31	3.00-5567.00	230.73 +/- 3.75	0.00-5760.00	**<.0001**
No. procedures/tests	3.58 +/- 0.18	0.00-18.00	3.98 +/- 0.08	0.00-26.00	**<.0212**

[a]The unweighted and weighted frequencies of each variable may not add up to the total number of ED visit frequencies due to missing data

[b]Hypothesis testing of Wait time based on categorical variable

[c]Hypothesis testing of Length of visit based on categorical variable

4.2.2 Summary of Results

In summary, the proposed hypothesis for Specific Aim 1D, the variable tested, and the results are listed in Table 4.4.

Table 4.4 Summary of hypothesis testing the difference in Predisposing, Enabling, and Need characteristics between homeless and nonhomeless ED users

Hypothesis tested		Variable from data	Results
HA10:	The rate of ambulance arrival to the ED differs significantly between homeless and nonhomeless ED users.	Arrival to ED by ambulance	This hypothesis was accepted. A greater proportion of homeless ED users arrived to the ED by ambulance compared to nonhomeless ED users ($p<.001$).
HA11:	Being seen by a medical doctor, as opposed to another health care provider, differs significantly between homeless and nonhomeless ED users.	Provider seen	This hypothesis was rejected. There was no significant difference in the type of provider seen between homeless and nonhomeless ED users ($p=.39$).
H012:	There is no difference in other ED use characteristics between homeless and non-homeless ED users.	ED visit in last 72 hours, ED wait time, ED disposition, Number of diagnostic tests/procedures, Length of ED visit, Geographic region	This hypothesis was rejected. A greater proportion of homeless ED users had an *ED visits in the last 72 hours* compared to nonhomeless ED users ($p<.001$). A greater proportion of homeless ED users tended to have a longer *ED wait time* compared to nonhomeless ED users ($p<.001$). *ED disposition* differed significantly between homeless and nonhomeless ED users ($p<.001$). A greater proportion of homeless were transferred to another facility, and had a disposition categorized as other, compared to nonhomeless ED users.

			Homeless ED users had a greater *Number of diagnostic tests/procedures* during their ED visit compared to nonhomeless ED users (p<.001). A greater proportion of homeless ED users tended to have a longer *Length of ED visit* compared to nonhomeless ED users (p<.001). *Geographic region* differed significantly between homeless and nonhomeless ED users. A greater proportion of homeless ED visits took place, and a smaller proportion took place in all other regions, compared to nonhomeless ED visits (p<.001).

4.3 Specific Aim 1E, 1F

1E: Describe the characteristics of medications prescribed at ED discharge (total number prescribed, controlled status, prescription status, classes of medication most frequently prescribed, medications prescribed by class) among homeless and non-homeless adults in the U.S.

1F: Compare the characteristics of medications prescribed at discharge (total number prescribed, controlled status, prescription status, classes of medication most frequently prescribed, medications prescribed by class) between homeless and non-homeless adults in the U.S.

Descriptive results (frequencies and percentages), and results of the chi-square tests (categorical variables) and t-tests (continuous variables) for Characteristics of medications prescribed at ED discharge are presented in Table 4.5.

4.3.1 Characteristics of medications prescribed at ED discharge

At least one medication was prescribed at the discharge of 1,448,160 visits made by homeless ED users, which comprises 45% of all ED visits by homeless individuals that resulted in a disposition of discharge from the ED. Among nonhomeless ED users, at least one medication was prescribed at the discharge of 235,598,385 visits, which comprises 60% of all ED visits by nonhomeless that resulted in a disposition of discharge from the ED. The rate of medication prescribing at ED discharge differed significantly between homeless and nonhomeless ED users ($p<.001$).

Forty-three percent of homeless ED visits resulted in the prescription of one medication at ED discharge, 37% resulted in the prescription of two medications, 9% resulted in the prescription of three medications, and 10% resulted in the prescription of four or more medications. Forty-six percent of nonhomeless ED visits resulted in the prescription of one medication at ED discharge, 34% resulted in the prescription of two medications, 14% resulted in the prescription of three medications, and 6% resulted in the prescription of four or more medications. There was no significant difference in number of medications prescribed between homeless and nonhomeless ED users.

Thirty-one percent of homeless ED visits resulted in the prescription of at least one opioid medication at discharge. Among nonhomeless ED visits, 41% resulted in the prescription of at least one opioid medication at discharge. The rate of opioid prescription differed significantly between homeless and nonhomeless ED users ($p=.01$). Ninety-seven percent and

98% of homeless and nonhomeless ED users, respectively, were prescribed prescription drugs (as opposed to OTC), and this did not differ significantly between the two groups. The schedule of controlled medication at ED discharge was also not statistically different between the two groups.

Table 4.5 Characteristics of medications prescribed at discharge among homeless and nonhomeless adults using urban EDs in the United States, 2010-2015 NHAMCS-ED

	Homeless			Nonhomeless			*p*
	Unweighted N	Weighted n[a] *in thousands* (%)	95% CI	Unweighted N	Weighted n[a] *in thousands* (%)	95% CI	
Medication prescribed at discharge							
Yes	397	1,448 (45.42)	39.00, 51.84	48,005	235,598 (60.09)	58.51, 61.67	**<.0001**
No	589	1,740 (54.58)	48.16, 61.00	31,717	156,480 (39.91)	38.33, 41.49	
No. prescribed at discharge							
1	179	628 (43.37)	33.44, 53.31	22,268	108,124 (45.89)	44.79, 46.99	.2100
2	125	537 (37.10)	24.15, 50.04	16,221	80,187 (34.04)	33.23, 34.84	
3	51	135 (9.31)	5.70, 12.92	6,449	32,160 (13.65)	13.10, 14.20	
>/=4	42	148 (10.22)	5.39, 15.05	3,067	15,127 (6.42)	5.73, 7.12	
Prescribed controlled medication at discharge							
Yes	144	554 (38.23)	31.54, 44.92	20,839	106,405 (45.16)	44.03, 46.30	.0493
No	253	895 (61.77)	55.08, 68.46	27,166	129,193 (54.84)	53.70, 55.97	
Controlled status of medication prescribed at discharge							
Schedule II	30	67 (12.18)	6.06, 18.29	5,006	25,893 (24.33)	21.80, 26.87	.0612
Schedule III	67	320 (57.78)	43.87, 71.70	10,924	55,744 (52.39)	50.23, 54.55	
Schedule IV, V	47	166 (30.04)	17.37, 42.71	5,970	24,768 (28.52)	21.99, 24.56	
Prescribed opioid at discharge							
Yes	115	448 (30.97)	24.00, 37.93	18,750	96,344 (40.89)	39.73, 42.06	**.0092**
No	282	1,000 (69.03)	62.07, 76.00	29,255	139,254 (59.12)	57.94, 60.27	
Prescription status of medication prescribed at discharge[b]							
Rx	378	1,397 (96.89)	94.81, 98.98	46,735	229,699 (97.91)	97.68, 98.13	.2552
OTC	17	45 (3.11)	1.02, 5.19	1,086	4,913 (2.09)	1.87, 2.32	

[a]The unweighted and weighted frequencies of each variable may not add up to the total number of ED visit frequencies due to missing data

[b]Does not add to up to total number visits resulting in medication at discharge due to missing data within this variable

During the study period, a total of 446,118,711 medications were prescribed at discharge to homeless and nonhomeless ED users. Less than 1% (2,995,955 medications) were prescribed to homeless and users, and 443,122,756 medications were prescribed to nonhomeless ED users. The top five most frequently prescribed drug classes, and the medications comprising those classes, are presented in Table 4.6 and Table 4.7 for homeless and nonhomeless ED users, respectively.

Among homeless ED visits, NSAIDs were the most commonly prescribed medications, comprising 14% of medications prescribed at ED discharge. Ibuprofen and naproxen were the most frequently prescribed medications in this class among nonhomeless ED users, together comprising 90% of all NSAIDs prescribed. Narcotic/analgesic combinations were the second most prescribed class of medications, comprising 13% of all medications prescribed at homeless ED discharge. Hydrocodone/APAP and oxycodone/APAP were the most frequently prescribed medications in this class among homeless ED users, together comprising 96% of all narcotic analgesic combinations prescribed. First-generation cephalosporin antibiotics, comprised entirely of cephalosporin, and miscellaneous analgesics, almost entirely comprised of acetaminophen, each make up 5% of all medications at homeless ED discharge.

Among nonhomeless ED visits, the most frequently prescribed medications at ED discharge were narcotic/analgesic combinations, making up 17% of all medications prescribed at the discharge of nonhomeless ED visits. Hydrocodone/APAP and oxycodone/APAP were the most frequently prescribed medications in this class among nonhomeless ED users, together comprising 92% of all narcotic analgesic combinations prescribed. The second most frequently prescribed class of medications at nonhomeless ED discharge was nonsteroidal anti-

inflammatory drugs (NSAIDs), comprising 12% of all medications prescribed. Ibuprofen and naproxen were the most frequently prescribed medications in this class among nonhomeless ED users, together comprising 88% of all NSAIDs prescribed.

Narcotics and skeletal muscle relaxants comprise 5% and 4% of medications prescribed at nonhomeless ED discharge, respectively. Among the narcotics, tramadol comprised sixty percent of this drug class and oxycodone comprised 17%. Cyclobenzaprine was the most frequently prescribed muscle relaxant among nonhomeless ED visits, comprising 69% of this drug class. Methocarbamol was the second-most frequently prescribed, comprising 18%. 5HT3 receptor agonists comprised 4% of medications prescribed at both nonhomeless and homeless ED visits. Ondansetron was the sole medication in this class.

Table 4.6 Top five most frequently prescribed medication classes at discharge among nonhomeless and homeless ED visits, 2010-2015 NHAMCS-ED (n=2,995,955 medications)

	No. (%) *in thousands*
CNS; analgesics; NSAID	424 (14.14)
Ibuprofen	341 (80.51)
Naproxen	40 (9.40)
Meloxicam	23 (5.48)
Indomethacin	10 (2.36)
Diclofenac	7 (1.64)
Ketoprofen	3 (0.60)
CNS; analgesics; narcotic analgesic combos	375 (12.52)
Hydrocodone / APAP	324 (86.31)
Oxycodone / APAP	37 (9.82)
Propoxyphene / APAP	13 (3.34)
Codeine / APAP	2 (0.53)
Anti-infectives; cephalosporins; first generation cephalosporins	143 (4.76)
Cephalexen	143 (100)

Table 4.7 Top five most frequently prescribed medication classes at discharge among nonhomeless ED visits, 2010-2015 NHAMCS-ED (n=443,122,756 medications)

	No. (%) *in thousands*
CNS; analgesics; narcotic analgesic combos	76,943 (17.36)
Hydrocodone / APAP	50,583 (65.74)
Oxycodone / APAP	20,542 (26.70)
Codeine / APAP	4,670 (6.07)
Hydrocodone / IBU	528 (0.69)
Propoxyphene / APAP	432 (0.56)
Codeine / Butalbital / APAP / Caffeine	101 (0.13)
Buprenorphine / Naloxone	32 (0.04)
Pentazocine / Naloxone	14 (0.02)
Meperidine / Promethazine	13 (0.02)
Oxycodone / ASA	9 (0.01)
Hydrocodone / ASA	8 (0.01)
Codeine / Butalbital / ASA / Caffeine	7 (0.01)
Dihydrocodeine / APAP / Caffeine	2 (0.00)
Hydrocodone / APAP / Ethanol / Glycerin / Parabens	2 (0.00)
CNS; analgesics; NSAID	55,253 (12.47)
Ibuprofen	36,795 (66.59)
Naproxen	11,563 (20.93)
Ketorolac	2,999 (5.43)
Diclofenac	1,411 (2.55)
Indomethacin	905 (1.64)
Meloxicam	788 (1.43)
Etodolac	230 (0.42)
Ketoprofen	127 (0.23)
Nabumetone	100 (0.18)
Piroxicam	35 (0.06)
Diclofenac / Misoprostol	25 (0.05)
Ibuprofen / Famotidine	20 (0.04)
Oxaprozen	20 (0.04)
Sulindac	18 (0.03)
Naproxen / Esomeprazole	7 (0.01)
Meclofenamate	6 (0.01)
Unknown	203 (0.37)
CNS; analgesics, narcotic	21,755 (4.91)
Tramadol	13,120 (60.67)
Oxycodone	3,644 (16.75)
Hydrocodone	2,233 (10.26)
Hydromorphone	1,193 (5.49)
Morphine	484 (2.23)
Hydrocodone / Homatropine	374 (1.72)
Codeine	218 (1.00)
Fentanyl	101 (0.42)

		Methadone	92 (0.36)
		Meperidine	79 (0.18)
		Tapentadol	39 (0.18)
		Oxymorphone	20 (0.09)
		Pentazocine	19 (0.09)
		Propoxyphene	16 (0.08)
		Buprenorphine	13 (0.06)
		Butorphanol	9 (0.04)
		Nalbuphine	8 (0.04)
		Unknown	12 (0.05)
CNS analgesics; misc	141 (4.71)	CNS; muscle relaxants; skeletal muscle relaxants	17,413 (3.93)
Acetaminophen	141 (99.84)	Cyclobenzaprine	11,966 (68.72)
Unknown	0.233 (0.16)	Methocarbamol	3,061 (17.58)
		Orphenadrine	840 (4.82)
		Carisoprodol	453 (2.60)
		Metaxalone	451 (2.59)
		Baclofen	300 (1.72)
		Tizanidine	224 (1.28)
		Chlorzoxazone	106 (0.61)
		Unknown	12 (0.07)
CNS; antiemetic/antivertigo agents; 5HT3 receptor agonist	109 (3.64)	CNS; antiemetic/antivertigo agents; 5HT3 receptor agonist	17,102 (3.86)
Ondansetron	109 (100)	Ondansetron	17,102 (100)

APAP=acetaminophen; IBU=ibuprofen; ASA=aspirin

4.3.2 Summary

In summary, the proposed hypotheses for Specific Aim 1F, the variable tested, and the results are listed in Table 4.8.

Table 4.8 Summary of hypothesis testing the difference in Predisposing, Enabling, and Need characteristics between homeless and nonhomeless ED users

Hypothesis tested		Variable from data	Results
H013:	There is no difference between Characteristics of medication prescribing at ED discharge between homeless and non-homeless ED users.	Medication prescription at ED discharge, Number of medications prescribed at ED discharge, Controlled status of medications prescribed at ED discharge, Schedule of controlled medications prescribed at ED discharge, Opioid	This hypothesis was rejected. A smaller proportion of homeless ED users received a *medication prescription at ED discharge* compared to nonhomeless ED users ($p<.001$). There was no difference in the *Number of medications prescribed at ED discharge* between homeless and nonhomeless ED users ($p=.21$).

		status of medications prescribed at ED discharge, Prescription status of medications prescribed at ED discharge	There was no difference in the *Controlled status of mediations prescribed at ED discharge* between homeless and nonhomeless ED users (p=.05). There was no difference in the *Schedule of controlled medications prescribed at ED discharge* between homeless and nonhomeless ED users (p=.06) A smaller proportion of homeless ED users received an *Opioid medication at ED discharge* compared to nonhomeless ED users (p=.01). There was no difference in the *Prescription status of medications prescribed at ED discharge* between homeless and nonhomeless ED users (p=.26).

4.4 Specific Aim 2A

Examine the relationship between prescription of a medication at ED discharge and housing status, controlling for the predisposing (age, gender, race/ethnicity), enabling (primary source of payment), and need (ED diagnosis, diagnosis of comorbidity) characteristics as well as the ED use characteristics (provider seen, geographic region) among homeless and non-homeless adults in the U.S.

The results of the bivariate logistic regression analysis (unadjusted odds ratio (OR), 95% confidence interval (CI)), and multivariable logistic regression analysis (adjusted odds ratio (AOR), 95% CI) are summarized in Table 4.9.

4.4.1 Unadjusted analysis

4.4.1.1 Predisposing Characteristics

Among the predisposing variables, the unadjusted model yielded statistically significant differences in the odds of medication prescribing at ED discharge between age groups and gender. Compared to ED visits made by 18- to 24-year-olds, ED visits made by 55- to 64-year-olds were 20% less likely to result in a prescription at discharge (OR 0.80, 95% CI: 0.74-0.88), and visits made by ED users 65 years of age and older were 43% less likely to result in a prescription at discharge (OR 0.57, 95% CI: 0.53-0.61). The odds of ED visits resulting in a prescription at discharge, did not differ between minority racial/ethnic groups and whites. Men were 9% less likely to receive a prescription at discharge compared to women (OR 0.91, 95% CI: 0.87-0.94).

4.4.1.2 Enabling Characteristics

Homeless ED visits were 45% less likely to result in a prescription at ED discharge compared to nonhomeless ED visits (OR 0.55, 95% CI: 0.42-0.73). Compared to private insurance, ED visit covered by Medicare were 22% less likely to results in a medication prescription at discharge (OR 0.78, 95% CI: 0.72-0.84), visits covered by Medicaid were 28% more likely to result in a prescription at discharge (OR 1.28, 95% CI: 1.18-1.38), visits covered by Self-pay were 51% more likely to result in a prescription at discharge (OR 1.51, 95% CI: 1.39-1.64), and visits covered by No charge/charity were 34% more likely to result in a prescription at discharge (OR 1.34, 95% CI: 1.04-1.74). The odds of ED visits covered by payers classified as Other resulting in a medication prescription at ED discharge did not differ significantly from the odds of ED visits covered by Private insurance.

4.4.1.3 Need Characteristics

ED users with no chronic physical condition diagnosis were 32% less likely to be prescribed a medication at ED discharge compared to ED users diagnosed with a chronic physical condition (OR 0.68, 95% CI: 0.64-0.72). ED users with no acute physical condition diagnosis were 36% less likely to be prescribed a medication at ED discharge compared to ED users diagnosed with an acute physical condition (OR 0.64, 95% CI: 0.60-0.68). ED users with no mental health condition diagnosis were 89% more likely to receive a prescription at ED discharge compared to ED users diagnosed with a mental health condition (OR 1.89, 95% CI: 1.67-2.13). ED users with no substance use condition diagnosis were 4.5 times more likely to receive a prescription at ED discharge compared to ED users with a substance use condition (OR 4.50, 95% CI: 3.88-5.21). ED users with no diagnosis of any of the five major comorbid conditions were 23% more likely to receive a prescription at ED discharge compared to ED users who were diagnosed with at least one of the five comorbid conditions (OR 1.23, 95% CI: 1.13-1.33).

4.4.1.4 ED use characteristics

ED users who were not seen by a medical doctor were 30% more likely to receive a prescription at ED discharge compared to ED users who were seen by a medical doctor (OR 1.30, 95% CI: 1.10-1.55). Compared to ED visits that took place in the South, visits that took place in the Northeast were 28% less likely to result in a medication prescription at ED discharge (OR 0.72, 95% CI: 0.62-0.83), and visits that took place in the West were 22% less likely to result in a medication prescription at ED discharge (OR 0.78, 95% CI: 0.66-0.93). The odds of Midwestern ED visits resulting in a medication prescription at discharge did not differ significantly from the odds of Southern ED visits.

4.4.2 Adjusted analysis

All variables in Table 16 were included in the adjusted model. The multivariable logistic regression model was assessed for multicollinearity. The Variance Inflation Factors (VIFs) were below the cutoff of 10, between 1.01 and 2.04, indicating multicollinearity was not a concern for this model. Eigenvalues and condition indices were also examined, and no indications of multicollinearity were found.

4.4.2.1 Predisposing Characteristics

Controlling for all other variables in the model, 55- to 64-year-olds were 12% less likely to receive a medication prescription at ED discharge compared to 18- to 24-year-olds (AOR 0.88, 95% CI: 0.80-0.97). ED users 65 years of age and older were 35% less likely to receive a medication prescription at discharge compared to 18- to 25-year-olds (AOR 0.65, 95% CI: 0.59-0.72). Men are 6% more likely to receive a medication prescription at ED discharge compared to women (AOR 0.94, 95% CI: 0.89-0.98). The odds of any minority racial/ethnic groups receiving a medication prescription at discharge did not differ significantly from the odds of White ED users.

4.4.2.2. Enabling Characteristics

After controlling for all other variables, the odds of homeless ED users receiving a medication prescription at discharge did not differ significantly from the odds of nonhomeless ED users (AOR 0.78, 95% CI: 0.58-1.05). Compared to ED visits covered by private insurance, visits covered by Medicaid were 24% more likely to results in a medication at ED discharge (AOR 1.24, 95% CI: 1.14-1.35), and visits covered by Self-pay were 37% more likely to receive a prescription at ED discharge (AOR 1.37, 95% CI: 1.26-1.49). The odds of ED visits covered by

payers classified as Other resulting in a medication prescription at ED discharge did not differ significantly from the odds of ED visits covered by Private insurance.

4.4.2.3 Need Characteristics

Controlling for all other variables, ED users with no chronic physical condition diagnosis were 30% less likely to be prescribed a medication at ED discharge compared to ED users diagnosed with a chronic physical condition (OR 0.70, 95% CI: 0.66-0.75). ED users with no acute physical condition diagnosis were 31% less likely to be prescribed a medication at ED discharge compared to ED users diagnosed with an acute physical condition (OR 0.69, 95% CI: 0.64-0.73). ED users with no mental health condition diagnosis were 70% more likely to receive a prescription at ED discharge compared to ED users diagnosed with a mental health condition (OR 1.70, 95% CI: 1.49-1.93). ED users with no substance use condition diagnosis were 4 times more likely to receive a prescription at ED discharge compared to ED users with a substance use condition (OR 4.08, 95% CI: 3.48-4.78). ED users with no diagnosis of any of the five major comorbid conditions were 12% more likely to receive a prescription at ED discharge compared to ED users who were diagnosed with at least one of the five comorbid conditions (OR 1.12, 95% CI: 1.03-1.22).

4.4.2.4 ED use characteristics

After controlling for all other variables in the model, ED users who did not see a medical doctor were 25% more likely to receive a medication prescription at ED discharge compared to ED users who did see a medical doctor (AOR 1.25, 95% CI: 1.05-1.49). Compared to ED visits taking place in the South, visits taking place in the Northeast were 24% less likely to receive a medication prescription at ED discharge (AOR 0.76, 95% CI: 0.65-0.88). The odds for

Midwestern and Western ED visits to receive a medication prescription at discharge did not differ from the odds of Southern ED visits.

Table 4.9 Association between housing status and the receipt of a medication at ED discharge among homeless and nonhomeless adults using urban EDs in the United States, 2010-2015 NHAMCS-ED (n=502,614,359)

	Unadjusted		Adjusted	
	OR	95% CI	OR	95% CI
Predisposing				
Age				
18—24 (Ref)	—	—	—	—
25—34	1.06	0.99, 1.15	1.12	1.03, 1.22
35—44	1.07	1.00, 1.15	1.13	1.05, 1.22
45—54	0.95	0.88, 1.03	1.02	0.93, 1.12
55—64	0.80	0.74, 0.88	0.88	0.80, 0.97
65+	0.57	0.53, 0.61	0.65	0.59, 0.72
Gender				
Female (Ref)	—	—	—	—
Male	0.91	0.87, 0.94	0.94	0.89, 0.98
Race/ethnicity				
White (Ref)	—	—	—	—
Black	1.21	1.10, 1.32	1.08	0.99, 1.17
Hispanic	1.06	0.97, 1.16	0.99	0.91, 1.09
Other	0.92	0.80, 1.06	0.92	0.80, 1.06
Enabling				
Residence				
Nonhomeless (Ref)	—	—	—	—
Homeless	0.55	0.42, 0.73	0.78	0.58, 1.05
Primary payer				
Private insurance (Ref)	—	—	—	—
Medicare	0.78	0.72, 0.84	0.92	0.84, 1.00
Medicaid	1.28	1.18, 1.38	1.24	1.14, 1.35
Self-pay	1.51	1.39, 1.64	1.37	1.26, 1.49
No charge/charity	1.34	1.04, 1.74	1.26	0.96, 1.65
Other	1.04	0.92, 1.17	0.95	0.84, 1.07
Need				
Visit related diagnoses				
Chronic physical condition				
Yes (Ref)	—	—	—	—
No	0.68	0.64, 0.72	0.70	0.66, 0.75
Acute physical condition				
Yes (Ref)	—	—	—	—
No	0.64	0.60, 0.68	0.69	0.64, 0.73
Mental health condition				
Yes (Ref)	—	—	—	—
No	1.89	1.67, 2.13	1.70	1.49, 1.93
Substance use condition				
Yes (Ref)	—	—	—	—
No	4.50	3.88, 5.21	4.08	3.48, 4.78
Comorbid condition				
Yes (Ref)	—	—	—	—
No	1.23	1.13, 1.33	1.12	1.03, 1.22
ED use characteristics				

Provider seen				
MD (Ref)	—	—	—	—
Other	1.30	1.10, 1.55	1.25	1.05, 1.49
Region				
South (Ref)	—	—	—	—
Midwest	0.84	0.71, 1.01	0.83	0.69, 1.01
Northeast	0.72	0.62, 0.83	0.76	0.65, 0.88
West	0.78	0.66, 0.93	0.84	0.70, 1.00

4.4.3 Summary

In summary, the proposed hypothesis for Specific Aim 2A, the variable tested, and the results are listed in Table 4.10.

Table 4.10 Summary of hypotheses testing the association of housing status with medication prescription at ED discharge, controlling for Predisposing, Enabling, Need, and ED use characteristics[a]

Hypothesis tested		Variable from data	Results
HA14:	Homeless ED users are less likely to be prescribed a medication at ED discharge compared to nonhomeless ED users.	Housing status	This hypothesis was rejected. After controlling for Predisposing, Enabling, Need, and ED use characteristics, the odds of homeless ED users receiving a medication prescription at ED discharge did not differ significantly from that of nonhomeless ED users (AOR 0.78, 95% CI: 0.58-1.05).

[a]Pain assessment, Patient-reported pain, and Triage level were not included in the logistic regression model.

4.5 Specific Aim 2B

Table 4.11 contains the results of the regression decomposition analysis examining the contribution of predisposing, enabling, and need characteristics to the difference in rate of medication prescribing at ED discharge observed between homeless and nonhomeless ED users in Table 4.5. The proportion of homeless ED users receiving a medication prescription at discharge was 0.35, and the proportion of nonhomeless ED users receiving a medication prescription was 0.52. The overall housing gap in medication prescription at ED discharge is

17%. The separate contributions of differences in housing status by predisposing characteristics was -3%, -6% by enabling characteristics, 58% by need characteristics, and 1.94% for ED use characteristics.

Predisposing Characteristics

Age contributed significantly to closing the disparity in medication prescribing at ED discharge between homeless and nonhomeless ED users. Because a smaller proportion of homeless ED users are 65 years of age and older compared to nonhomeless ED users, an age group associated with lower odds of medication prescribing at ED discharge, differences in patient age between homeless and nonhomeless ED users favors homeless housing status. Therefore, age closes the disparity observed in medication prescription at ED discharge by housing status by 6%. As the majority of homeless ED visits are made by men, and male gender is associated with a lower odds of medication prescribing at ED discharge, gender differences observed between homeless and nonhomeless ED users contributes to the gap in medication prescription at discharge by 3% Racial/ethnic differences between homeless and nonhomeless ED visits do not significantly contribute to the disparity in medication prescribing at ED discharge.

4.5.2 Enabling Characteristics

Primary payer contributed significantly to the disparity in medication prescribing at ED discharge between homeless and nonhomeless ED users. Visits covered by Medicare, Medicaid, and Self-pay were associated with greater odds of resulting in a medication prescription at discharge compared to visits covered by private insurance. Because a greater proportion of homeless visits are covered by Medicaid and Self-pay, differences observed in primary payer by

housing status favors homeless ED user. This enabling explanatory variable closes the gap in medication prescription at ED discharge between homeless and nonhomeless ED users by 6%.

4.5.3 Need Characteristics

ED diagnosis contributed significantly to the disparity in medication prescribing at ED discharge between homeless and nonhomeless ED users. The absence of a chronic or acute physical condition diagnosis was associated with a lower likelihood of receiving a medication prescription at ED discharge, and the absence of a mental health or substance use condition diagnosis was associated with a higher likelihood of receiving a medication prescription at ED discharge A smaller proportion of homeless ED users were diagnosed with a chronic or acute physical condition, diagnoses that favor medication prescribing, and a greater proportion of homeless ED users were diagnosed with a mental health or substance use condition, diagnoses that do not favor medication prescribing. Therefore, the set of ED diagnoses explanatory variables contributes greatly to the observed disparity in medication prescribing at ED discharge by housing status. This 57% contribution drives the majority of the observed disparity between homeless and nonhomeless ED users.

4.5.4 ED use characteristics

Region contributed significantly to the disparity in medication prescribing at ED discharge between homeless and nonhomeless ED users. Compared to ED visits that took place in the Northeast, the Midwest, and the West regions, those that took place in the South were associated with a higher odds of medication prescription at ED discharge. A smaller proportion of homeless ED visits took place in the South, compared to nonhomeless, which contributed to the observed disparity in medication prescribing at discharge between the two groups by 2.5%.

Table 4.11 Decomposition of homeless/nonhomeless gap in medication prescription at ED discharge (n=502,614,359)

	Coefficient	%
Homeless mean	0.3473	
Nonhomeless mean	0.5199	
Homeless-nonhomeless gap	0.1726	
Contribution from housing differences in:		
Predisposing		-2.98
Age	-0.0106[c]	-6.15
Gender	0.0054[d]	3.12
Race/ethnicity	0.0001	0.05
Enabling		-6.08
Primary payer[a]	-0.0105[c]	-6.08
Need		57.67
ED diagnosis[b]	0.0994[d]	57.59
Comorbidity diagnosis	0.0001	0.08
ED use characteristics		1.94
Provider	-0.0010	-0.56
Region	0.0043[d]	2.50
All included variables	0.0872	50.55

[a]Primary payer includes Private insurance, Medicare, Medicaid, Self-pay, No charge/charity, and Other
[b]ED diagnosis includes chronic physical condition diagnosis, acute physical condition diagnosis, mental health condition diagnosis, and substance use condition diagnosis.
[c]Contributed significantly to closing the disparity observed in medication prescribing at ED discharge
[d]Contributed significantly to the disparity observed in medication prescribing at ED discharge

4.6 Specific Aim 3

Examine the predisposing (age, gender, race/ethnicity), enabling (primary source of payment), and need characteristics (ED diagnosis, diagnosis of comorbidity), as well as the ED use characteristics (provider seen, geographic region) that predict the prescription of a medication at discharge among homeless adults in the U.S.

The results of the bivariate logistic regression analysis (unadjusted odds ratio (OR), 95% confidence interval (CI)), and multivariable logistic regression analysis (adjusted odds ratio (AOR), 95% CI), are summarized in Table 4.12.

4.6.1 Unadjusted analysis

4.6.1.1 Predisposing Characteristics

Among the predisposing variables, the unadjusted model yielded a statistically significant difference in the odds of being prescribed a medication at ED discharge between men and women. Among homeless ED users, men were 44% less likely to be prescribed a medication at ED discharge compared to women (OR 0.56, 95% CI: 0.34-0.92). The odds of ED visits resulting in a prescription at ED discharge did not differ among homeless ED users by age or race/ethnicity.

4.6.1.2. Enabling Characteristics

Compared to ED visits covered by private insurance, the unadjusted model indicated a statistically significant difference in the odds of an ED visit resulting in a medication prescription at ED discharge for ED visits covered by Medicare or Other payer. Visits covered by Medicare were 82% less likely to result in a medication prescription at ED discharge (OR .18, 95% CI: 0.03-0.94), and visits covered by Other payer were 86% less likely (OR 0.14, 95% CI: 0.02-0.85).

4.6.1.3 Need Characteristics

Homeless ED users with no diagnosis of a chronic physical condition were 42% less likely to receive a medication prescription at ED discharge compared to homeless diagnosed with a chronic physical condition (OR 0.58, 95% CI: 0.34-0.97). Homeless ED users with no diagnosis of an acute physical condition were 43% less likely to receive a medication at ED discharge compared to homeless diagnosed with an acute physical condition (OR 0.57, 95% CI: 0.3-0.92). Homeless ED users with no diagnosis of a substance use condition were 3.67 times more likely to receive a medication prescription at ED discharge compared to homeless diagnosed with a substance use condition (OR 3.67, 95% CI: 2.30-5.86).

The unadjusted model indicated no statistically significant difference in the odds of receiving a medication prescription at ED discharge between homeless ED users with no diagnosis, and those diagnosed with, a mental health condition. There was also no significant difference in odds of medication prescription at discharge between homeless ED users with no comorbidity diagnosis and those with a comorbidity diagnosis.

4.6.1.4 ED use characteristics

Homeless ED visits that took place in the Northeast region were 61% less likely to result in a medication prescription at ED discharge compared to homeless (OR 0.39, 95% CI: 0.20-0.76). There was no statistically significant difference in odds of medication prescription at ED discharge between ED visits that took place in the Midwest or West compared to those in the South. Odds of medication prescription did not differ significantly between homeless ED users seen by a medical doctor and those seen by other providers.

4.6.2 Adjusted analysis

4.6.2.1 Predisposing characteristics

After adjusting for predisposing, enabling, need and ED use characteristics, no statistically significant differences in odds of medication prescribing at ED discharge were found by the predisposing variables, age, gender, and race/ethnicity among homeless ED users.

4.6.2.2 Enabling characteristics

The adjusted model indicated a statistically significant difference in odds of medication prescribing at ED discharge between visits covered by Medicare and by Other payer compared to visits covered by private insurance among homeless ED users. Visits covered by Medicare were 78% less likely to result in medication prescription at ED discharge compared to visits covered by private insurance (AOR 0.22, 95% CI: 0.06-0.90). Visits covered by Other payer were 84% less

likely to result in medication prescription at ED discharge compared to visits covered by private insurance (AOR 0.16, 95% CI: 0.03-0.79).

4.6.2.3 Need characteristics

Homeless ED users with no substance us condition were 2.89 times more likely to receive a medication prescription at D discharge compared to homeless diagnosed with a substance use condition (AOR 2.89, 95% CI: 1.75-4.79). No difference in odds of medication prescribing at ED discharge were found between homeless ED uses with and without diagnoses of a chronic physical condition, an acute physical condition, a mental health condition, or a comorbidity.

4.6.2.4 ED use characteristics

Homeless ED visits that took place in the Northeast region were 61% less likely to result in a medication prescription at ED discharge compared to homeless (OR 0.39, 95% CI: 0.17-0.91). There was no statistically significant difference in odds of medication prescription at ED discharge between ED visits that took place in the Midwest or West compared to those in the South. Odds of medication prescription did not differ significantly between homeless ED users seen by a medical doctor and those seen by other providers.

Table 4.12 Association between housing status and the receipt of a medication at ED discharge among homeless adults using urban EDs in the United States, 2010-2015 NHAMCS-ED (n=4,678,630)

	Unadjusted		Adjusted	
	OR	95% CI	OR	95% CI
Predisposing				
Age				
18—24 (Ref)	—	—	—	—
25—34	1.24	0.44, 3.53	1.15	0.39, 3.37
35—44	1.30	0.53, 3.17	1.51	0.50, 4.56
45—54	1.37	0.56, 3.32	1.52	0.57, 4.06
55—64	0.70	0.27, 1.84	0.84	0.28, 2.48
65+	0.74	0.24, 2.27	0.84	0.22, 3.14
Gender				
Female (Ref)	—	—	—	—
Male	0.56	0.34, 0.92	0.70	0.44, 1.11
Race/ethnicity				
White (Ref)	—	—	—	—
Black	0.81	0.51, 1.29	0.72	0.45, 1.14
Hispanic	0.72	0.43, 1.22	0.80	0.45, 1.43
Other	0.53	0.20, 1.41	0.56	0.18, 1.72
Enabling				
Primary payer				
Private insurance (Ref)	—	—	—	—
Medicare	0.18	0.03, 0.94	0.22	0.06, 0.90
Medicaid	0.40	0.08, 2.09	0.56	0.15, 2.17
Self-pay	0.26	0.05, 1.38	0.32	0.08, 1.28
No charge/charity	0.41	0.07, 2.38	0.45	0.10, 2.07
Other	0.14	0.02, 0.85	0.16	0.03, 0.79
Need				
ED diagnoses				
Chronic physical disease				
Yes (Ref)	—	—	—	—
No	0.58	0.34, 0.97	0.60	0.35, 1.01
Acute physical disease				
Yes	—	—	—	—
No	0.57	0.35, 0.92	0.88	0.52, 1.50
Mental health condition				
Yes	—	—	—	—
No	1.14	0.77, 2.60	1.31	0.67, 2.55
Substance use condition				
Yes	—	—	—	—
No	3.67	2.30, 5.86	2.89	1.75, 4.79
Comorbid condition				
Yes (Ref)	—	—	—	—
No	1.39	0.74, 2.58	1.65	0.83, 3.31
ED use characteristics				
Provider seen				
MD (Ref)	—	—	—	—
Other	1.63	0.83, 3.23	1.46	0.66, 2.00
Region				
South (Ref)	—	—	—	—
Midwest	1.51	0.55, 4.10	1.27	0.60, 2.70
Northeast	0.39	0.20, 0.76	0.39	0.17, 0.91
West	0.82	0.50, 1.34	0.95	0.52, 1.73

4.6.3 Summary or results

In summary, the proposed hypothesis for Specific Aim 3A, the variable tested, and the results are listed in Table 4.13.

Table 4.13 Summary of hypotheses testing the association of Predisposing, Enabling, Need, and ED use characteristics with medication prescription at ED discharge among homeless ED users[a]

Hypothesis tested		Variable from data	Results
HA15:	Non-Hispanic White homeless ED users are more likely to be prescribed a medication at discharge compared to homeless ED users of all other races, ethnicities.	Race/ethnicity	This hypothesis was rejected. There was no difference in the likelihood of medication prescribing at ED discharge between Non-Hispanic White homeless ED users and Black (AOR 0.72, CI: 0.45-1.14), Hispanic (AOR 0.80, CI: 0.45-1.43), or Other race (AOR 0.56, CI: 0.18-1.72).
HA16	Homeless ED users who are Self-pay are less likely to be prescribed a medication at discharge compared to homeless ED users with Private insurance.	Primary payer	This hypothesis was rejected. Homeless ED visits covered by Medicare were less likely to result in a medication prescription at ED discharge compared to homeless ED visits covered by Private insurance (AOR 0.22, CI: 0.06-0.09). Homeless ED visits covered by payers categorized as Other were less likely to result in a medication prescription at ED discharge (AOR 0.16, CI: 0.03-0.79).
	Homeless ED users with no diagnosis of a substance use condition are more likely to receive a medication prescription at ED discharge compared to homeless ED users with a diagnosis of a substance use condition.	Substance use condition diagnosis	This hypothesis was accepted. Homeless ED users with no diagnosis of a substance use condition were more likely to receive a medication prescription at ED discharge compared to homeless ED users diagnosed with a

			substance use condition (AOR 2.89, CI: 1.75-4.79).
	Homeless ED users who are seen by a medical doctor are more likely to be prescribed a medication at discharge compared to homeless ED users seen by Other types of providers.	Provider seen	This hypothesis was rejected. There was no difference in odds of medication prescription at ED discharge between homeless ED users seen by a medical doctor and those seen by Other types of providers (AOR 1.46, CI: 0.66-2.00).
	There is no association between other predisposing (age, gender), need (ED diagnosis, comorbidity diagnosis), and ED use characteristics (Provider seen, region) and medication prescribing at ED discharge among homeless ED users.	Age, Gender, Chronic physical condition diagnosis, acute physical condition diagnosis, mental health condition diagnosis, Comorbidity diagnosis, Region	This hypothesis was accepted. There was no difference in the likelihood of medication prescribing at ED discharge by *Age* among homeless ED users. There was no difference in the likelihood medication prescribing at ED discharge by *Gender* among homeless ED users. There was no difference in the likelihood of medication prescribing at ED discharge by *Chronic physical condition diagnosis* among homeless ED users There was no difference in the likelihood of medication prescribing at ED discharge by *Acute physical condition diagnosis* among homeless ED users. There was no difference in the likelihood of medication prescribing at ED discharge by *Mental health condition diagnosis* among homeless ED users. There was no difference in the likelihood of medication

			prescribing at ED discharge by *Comorbidity diagnosis* among homeless ED users. There was no difference in the likelihood of medication prescribing at ED discharge by *Region* among homeless ED users.

[a]Pain assessment, Patient-reported pain, and Triage level were not included in the logistic regression model.

Chapter 5: Discussion

5.1 Summary

The discussion of this study's results first provides context for the findings from the univariate analysis in Specific aim 1, drawing from national statistics and pertinent literature. Differences in predisposing, enabling, and need, and ED use characteristics and medication prescribing characteristics between homeless and nonhomeless ED users are also discussed. Next, study results from the unadjusted and adjusted logistic regression analyses is discussed as well as the findings of the decomposition analysis in Specific aim 2. Finally, results of the unadjusted and adjusted logistic regression analysis conducted in Specific aim 3 is discussed.

5.2 Specific aim 1

5.2.1 Predisposing characteristics

5.2.1.1 Age

In the Annual Homeless Assessment Report to Congress, HUD records three age categories: under 18 years, 18- to 24- years old, and 24 years of age and older. Ten percent of homeless individuals in the U.S. were between the ages of 18 and 24, and 80% were older than 24 years.[4] The results of this study indicated that 18- to 24-year-olds comprised 7% of ED visits made by homeless, and individuals older than 24 years comprised 93% of visits in this study. The median age among homeless ED users was 45, and the age group with the highest prevalence was 45- to 54-year-olds. This age structure is similar to what was found in a cross-sectional analysis of 2005-2009 NHAMCS data where adults over 50-years-old accounted for 35% of annual visits by homeless patients.[47] On a national level, the homeless population is

aging.[128] In 2005, the age group with the highest prevalence among the homeless was 37 to 45 years. In 2013, the median age among homeless was 50 years.[132] The changing age structure among homeless individuals in the U.S. appears to be reflected in the ED utilization of homeless individuals.

The age distribution of the population of nonhomeless ED utilizers differs somewhat from that of the US population. While 19- to 34-years-olds comprise 21% of the U.S. population, this study observed that 18- to 34-year-olds accounted for 35% of ED visits. The proportion of 55- to 64-year-olds among both the U.S. and nonhomeless ED user populations is similar at 13% and 12%, respectively. Individuals 65 and older comprise 15% of the U.S. population and 18% of ED visits made by nonhomeless individuals.[133]

The mean age for nonhomeless and homeless ED users was 45 and 44 years, respectively, but study findings indicate that housing status was significantly associated with age group. Nonhomeless individuals comprised a greater proportion of ED visits made by those in the two youngest age groups (18-24, 25-34), and homeless individuals comprised a greater proportion of ED visits made by those in older categories (35-44, 45-54, 55-64). Similarly, a study of an ED in an urban safety-net hospital, and an analysis of 2005-2006 NHAMCS data both found that homeless ED users were older compared to nonhomeless ED users (41 vs 36 years and 44 vs 36 years, respectively).[37,40] Although homeless ED users tended to be older, the proportion of nonhomeless ED users aged 65 years and older is notably higher than homeless ED users. Eighteen percent of nonhomeless ED visits were made by individuals 65 years of age and older, compared to 4% of homeless ED users. The low prevalence of homeless ED users in this age group is to be expected as the average life expectancy for homeless individuals is estimated at 42 to 52 years of age.[134]

5.2.1.2 Gender

While women comprise 39% of the national homeless population, they were found to only account for a quarter of homeless ED visits during the study period.[4] This is consistent with studies of previous years' NHAMCS data which found that about 25% of homeless ED visits are made by women and 75% are made by men.[24,37,73,123]The lower prevalence of ED use among homeless women relative to their representation within the overall homeless population could be due to their tendency to seek care in primary care settings. A secondary data analysis of 2,974 homeless individuals in assistance programs throughout the U.S. found that 77% of women, compared to 56% of men used ambulatory care in the last year.[125] A study of a sample of homeless adults living in Los Angeles found that male gender was associated with barriers to a regular source of care, which may explain why a greater proportion of homeless men seek care in the ED, compared to homeless women.[126]

However, a study of HCH clinics in the U.S., a primary care setting, found that 57% of patients were male, and 42% were female.[18] It's possible that gender differences in ED utilization among the homeless may be explained by differing utilization patterns observed between certain homeless subpopulations. A cross-sectional analysis of ED visit records in an urban academic medical center found that while homeless single women were more likely to have an ED encounter during the study period, adults with families, who are mostly comprised of women with dependent children, were less likely than single men and women to use the ED.[37] The lower rate of ED use observed by women in this study may be driven by the less frequent ED utilization by homeless women with children. It is impossible to say for certain if this is the case, as the NHAMCS-ED database does not collect data on family status among ED users. Among nonhomeless ED users, the proportion of women comprising ED visits in the U.S. was

58% during the study period, which is somewhat higher than the proportion of women comprising the U.S. population (51%).[136] This is consistent with studies of previous years' NHAMCS data which found that about 45% of nonhomeless ED visits are made by men and 55% are made by women.

Study findings indicate that gender differed significantly between homeless and nonhomeless ED users. Among homeless ED users, men made 75% of visits, compared to only 42% of nonhomeless men. This is to be expected given the larger proportion of men who are homeless in the U.S. compared to women. While men comprise 49% of the general population, they comprise 61% of the homeless population.[4,136] Thus, a higher prevalence of men among homeless ED users compared to nonhomeless is expected.

5.2.1.3 Race/ethnicity

The population of homeless ED utilizers differed in race distribution compared to the homeless population in the U.S. In 2016, Whites comprised 47% of homeless individuals nationwide, Blacks comprised 41%, and Hispanics comprised 22%.[i,4] Among homeless ED users, Whites accounted for 56% of visits, Blacks comprised 25% of homeless ED visits, Hispanics comprised 16%, and other minority populations comprised 4%. This finding is similar to a study of U.S. EDs in 2014 which found that 56% of homeless ED users were White, 25% were Black, and 13% were Hispanic.[137] The results of this study indicate that, unlike nonhomeless ED users, the distribution across racial/ethnic groups was not similar to that of the U.S. homeless population. Whites had a higher prevalence among homeless ED users, and

[i]Hispanic/Latino is not measured in POT counts as a mutually exclusive race category, but rather as a separate question regarding ethnicity. Individuals reporting a specific racial group, can also identify as being of Hispanic ethnicity. Therefore, these percentages equal to greater than 100%.

Blacks had a lower prevalence, relative to their respective representation in the homeless population.

In 2016, Whites comprised 61% of the U.S. population, Blacks comprised 12%, and Hispanics comprised 18%. The remaining 9% were comprised of Asians, American Indian/Alaska Natives, and Native Hawaiian/Other Pacific Islanders.[133] Among ED users the proportion of Whites was found to be similar at 59% during the study period, Blacks comprised 24%, Hispanics comprised 14%, and Asians, American Indian/Alaska Natives, and Native/Hawaiian/Other Pacific Islanders comprised only 3% of visits. In general, the population distribution across racial/ethnic groups in the U.S. is similar to that of nonhomeless ED users. Of note, Blacks were somewhat more prevalent among nonhomeless ED users relative to their representation in the general population.

The findings of this study indicate that there is no statistically significant difference in the distribution across racial/ethnic groups between nonhomeless and homeless ED users. This is consistent with the literature. A study of homeless and nonhomeless ED users in the U.S. also found a similar distribution across racial/ethnic groups by housing status. Sixty percent and 57% of homeless and nonhomeless ED visits, respectively, were made by Whites, 23% and 22% were made by Blacks, and 11% and 12% were made by Hispanics.[138]

5.2.2 Enabling Characteristics

5.2.2.1 Primary Payer

The primary payer covering the highest proportion of homeless ED visits was Medicaid (35%). A quarter of homeless ED visits were designated as Self-pay, and Medicare covered 14% of homeless ED visits. Private insurance covered 8% of homeless ED visits, and No charge/charity, and visits categorized as other each covered 9%. Fifty-seven percent of ED visits

by homeless individuals were covered by private or public (Medicare, Medicaid) health insurance, and 34% of homeless ED visits were made by individuals who were uninsured (Self-pay, No charge/charity).

This is similar to what has been found in previous studies. An analysis of 2014 State Emergency Department Databases of eight U.S. states found that among so-called "treat-and-release" homeless ED users visiting teaching hospitals, Medicaid was the most prevalent primary payer, covering 47% of visits, Medicare covered 16% of visits, and 28% of visits were Self-pay. Private insurance, however, was found to cover only 4% of visits[129] A prospective study of homeless patients visiting an urban ED in Pennsylvania also had similar findings. Medicaid was the most prevalent primary payer covering 57% of ED visits, and Medicare covered 13% of visits. Only 14% of visits were designated as self-pay.[139]

Among nonhomeless ED visits, 78% were covered by insurance. Forty percent were covered by private insurance, 15% by Medicare, and 22% by Medicaid. Eighteen percent of nonhomeless ED visits were comprised of uninsured individuals (Self-pay, No charge/charity). According to the U.S. Census Bureau, 91% of individuals in the U.S. have health insurance. Sixty-eight percent are covered under a private plan, and 37% are covered under a government health plan either through Medicare (17%), Medicaid (19%), or military healthcare (5%). Nine percent of the U.S. population is uninsured.[130] A report by the Healthcare Cost and Utilization Project (HCUP) found that health insurance coverage of ED visits in the U.S. differs by age group. Medicaid was the most common primary payer of ED visits by 18- to 44-year-olds, covering 36% of visits.[140] Private insurance covered 33% of visits in this age group. Among 45- to 64-year-olds, Private insurance was the most common primary payer of ED visits, covering 38% of visits, and Medicaid covered a quarter of visits. Among those 65 years and older,

Medicare covered 87% of ED visits.[140] This is consistent with rates of health insurance coverage across the country, and with our findings from which we conclude that Private insurance and Medicaid are the two most common primary payers of emergency visits in the U.S.

This study found that primary payer differed significantly between homeless and nonhomeless ED users. This appears to be mostly driven by the difference in the proportion of privately insured ED users between the two groups. While 40% of ED visits made by nonhomeless individuals were covered by private insurance, only 8% of visits by homeless were covered by private insurance. A greater proportion of homeless ED visits were covered by Medicaid (35%) compared to nonhomeless (22%), but proportions of visits covered by Medicaid among nonhomeless and homeless were similar at 15% and 14%, respectively.

5.2.3 Need characteristics

5.2.3.1 Chronic physical health condition diagnosis

Twenty-one percent of homeless ED users were diagnosed with a chronic physical condition. Thirty-two percent of nonhomeless ED users had a discharge diagnosis related to a chronic health condition, which is similar to findings of early NHAMCS data where 39% of nonhomeless ED visits were related to ambulatory care-sensitive conditions in 2007.

While it was hypothesized that there would be no difference in the rate of diagnosis of a chronic physical health condition between homeless and nonhomeless ED users, this measure was significantly lower among homeless ED users compared to nonhomeless. Prior studies have found that, except for hypertension, a disease more common among homeless individuals in the U.S., homeless and nonhomeless individuals have similar rates of chronic disease, such as diabetes and hyperlipidemia.[131] Further, health care utilization studies have found that homeless individuals do seek appropriate care for conditions that are generally asymptomatic, such as

hypertension or a positive tuberculosis skin test. Conditions well-known in the general public to have long-term negative health outcomes are prioritized among homeless individuals.[90] Perhaps these conditions are more frequently treated in ambulatory care settings among homeless individuals which leads to reduced need for emergency care.

5.2.3.2 Acute physical health condition diagnosis

Sixteen percent of homeless ED users were diagnosed with an acute physical condition during the study period. Twenty percent of nonhomeless ED users were diagnosed with an acute physical condition. This study found that the prevalence of acute physical condition diagnoses differed significantly between homeless and nonhomeless ED users. Homeless ED users had a lower rate of acute physical condition diagnosis compared to nonhomeless ED users, which supports the study hypothesis. Health care utilization studies have found that while acute physical conditions can certainly be debilitating, homeless individuals do not necessarily seek treatment, and have likely learned to cope or get by.[90] Thus, the finding that the diagnosis of an acute physical health condition in the ED was lower among homeless ED users compared to nonhomeless is expected.

5.2.3.2 Mental health and substance use condition diagnoses

Homeless ED users had a mental-health and substance use discharge diagnosis at 17% and 28% of visits during the study period, respectively. This is consistent with what has been found in the literature. Studies of homeless in ED settings found that 21% to 38% of homeless were dependent on alcohol and 14% to 26% abused other drugs.[138] In an urban safety-net ED, a substantial portion of visits by homeless were due to excessive alcohol use.[40] Mental health and substance use conditions are highly prevalent among homeless individuals. Among the homeless population in the U.S., 20% to 25% of individuals are diagnosed with some form of severe

mental illness. One-third are diagnosed with any psychiatric condition, and 46% live with concurrent mental health and substance use conditions.[138,143] Results of this study, and what is documented in the literature, indicate that mental health and substance use conditions impact ED utilization among homeless individuals.

Four percent of nonhomeless ED users were diagnosed with a mental health condition, and 3% were diagnosed with a substance use condition. Among the U.S. population, the prevalence of any mental health condition was 18.3, and 6% were diagnosed with severe mental health conditions.[144,145] In the ED setting, 4% of patients 15 years of age and older were diagnosed with depression, anxiety, and stress reactions, and a little over 1% were diagnosed with psychosis and bipolar disorders. Two-and-a-half percent of ED users were diagnosed with alcohol and substance use conditions.[146]

The prevalence of mental health and substance use condition diagnoses differed significantly between homeless and nonhomeless ED users. A greater proportion of Homeless ED users were diagnosed with mental health and substance use conditions at substantially higher rates compared to nonhomeless ED visits. This is consistent with the difference in national estimates of prevalence observed between the homeless population and the general population. Within the ED setting, 49% to 68% percent of homeless ED users had any mental health condition, including alcohol and substance use conditions, compared to 14% of nonhomeless ED users.[138] Comparatively, the rates reported in this study seem somewhat lower than what has been previously reported in the literature among both homeless and nonhomeless ED users, but that could be due to the difference in health care setting.

There is evidence in the literature to support the possibility that the disparity between mental health condition diagnosis in homeless and nonhomeless may be over-estimated due to

undiagnosed mental health conditions among nonhomeless ED users. A study that took place in a level 1 inner-city trauma center and ED in a teaching hospital found that 45% adults presenting to the ED for non-psychiatric complaints have an undiagnosed mental health condition, of whom none had a stated history of mental health conditions.[147] Further, a study of ED patients in an urban safety-net hospital found that nonhomeless and homeless ED users had similar psychiatric comorbidity.[40] Thus, the prevalence of mental health condition-related diagnosis among nonhomeless ED users could potentially be higher than what is found in this study.

5.2.3.3 Pain assessment and patient-reported pain

Homeless ED users reported pain at 64% of visits. Severe pain was reported at 43% of visits, moderate pain at 15% of visits, and mild pain at 6% of visits. Nonhomeless ED users reported pain at 77% of visits. Severe pain was reported at 48% of ED visits, moderate pain at 21% of visits, and mild pain at 8% of visits. These rates are consistent with what has been found in the literature regarding patient reported pain during emergency services use among the general population. In a study of 840 patients at twenty North American EDs, 80% reported pain.[148] Patient reports of severe pain appears to be on the rise. An analysis of NHAMCS data from 2000 to 2010, found that the percentage of patients reporting severe pain increased from 25% in 2003 to 50% in 2008, a finding the authors concluded warrants further research.[149] According to the results of this study, the prevalence of severe pain in recent years has remained relatively constant since 2008.

Results of this study indicate that patient-reported pain differed significantly between homeless and nonhomeless ED users. Homeless ED users tended to report lower levels of pain compared to nonhomeless ED users. Pain is a more common symptom in acute health conditions for which this study found that homeless individuals seek emergency care at the lowest rate, and

treatment for the causes of pain highly prevalent in the homeless is not available in the ED, such as dental care.[88,,150] These factors may contribute to the lower level of pain reported during homeless ED visits. Results of this study indicate that homeless ED users had a significantly lower rate of pain assessment compared to nonhomeless ED users. Homeless individuals were asked to report pain in 71% of visits versus 76% in in nonhomeless visits. Decreased assessment in the homeless could be contributing to an underreporting of pain among homeless ED users.

5.2.3.4 Triage acuity

Sixty-three percent of homeless ED visits were triaged as urgent. Results of previous studies examining triage acuity in the homeless yield mixed results. One study of ED records in an urban medical center found that only 56% of visits by homeless were triaged as urgent, but an analysis of electronic health records of visits by homeless individuals in the ED of a hospital in Fort Worth, TX found that 24% of visits were deemed urgent following the NY University ED algorithm standards.[137,151] Thus, the proportion of homeless ED visits triaged as urgent found in this study seems markedly higher compared to other studies of homeless individuals in ED settings.

Sixty-two percent of nonhomeless ED visits were triaged as urgent. Similarly, a study of 2006-2009 NHAMCS data found that 61% of visits were urgent.[152] In a literature review of triage acuity in ED settings, twenty-six studies found that on average, nonurgent triage acuity occurred in about 37% of visits, ranging from 8% to 62%.[153] It was found that factors predicting nonurgent use in the ED were younger age, finding the ED more convenient compared to alternatives, referral to the ED by a PCP, and negative perceptions regarding primary care providers.

Results of this study indicate there were no differences in triage acuity between homeless and nonhomeless groups. This is consistent with what is known in the literature. A study comparing triage level between nonhomeless and homeless in the U.S. using 2005-2006 NHAMCS data also found no difference in triage level between the two groups. Fifty-four percent and 49% of homeless and nonhomeless ED visits, respectively, were triaged as urgent.[137] Diagnosis of any psychiatric conditions was associated with low-acuity problems and, considering the disproportionately higher rate of mental-health conditions among homeless ED users, the finding that there was no difference in triage acuity between the groups may be unexpected.[154]

5.2.3.5 Comorbidity diagnosis

Fourteen percent of homeless ED users and 16% of nonhomeless ED users were diagnosed with one of the five comorbid conditions recorded on the NHAMCS 2010-2015 patient record forms. Results indicate that there was no difference in comorbidity diagnosis between homeless and nonhomeless ED users. This is similar to the findings of a study in an urban safety net hospital which concluded that homeless ED users had a similar number of comorbid conditions as that of nonhomeless ED users.[40]

5.2.4 ED Use Characteristics

5.2.4.1 Arrival by ambulance

The rate of ambulance arrival to the ED by homeless ED users was 43%, which is somewhat consistent with previous years NHAMCS data. An analysis of 2010 data indicated an ambulance arrival rate of 48%.[135] From 2005 to 2010, NHAMCS data indicates that rates of ambulance arrival by ED users increased 14%, from 34% in 2005 to 48% in 2010.

Seventeen percent of nonhomeless patients arrived at the ED via ambulance during the study period. Rates of ambulance arrival have remained more consistent among nonhomeless ED users compared to homeless ED users. This study's findings are consistent with previous years' NHAMCS data indicating consistent ambulance arrival rates of 14% to 15%.[123,141,142]

Study results indicated that homeless ED users arrive to the ED via ambulance at a significantly greater rate compared to nonhomeless ED users. This is consistent with what is known in the literature.[40,154] Rates of ambulance arrival by homeless has been found to be as high as three times that of nonhomeless, and arrival by ambulance was found to be almost six times more likely if the patient was homeless.[135]

Patients arriving to the ED via ambulance differ from similarly triaged walk-in patients with reference to sociodemographic characteristics, visit-related health conditions, and emergency services utilization. They are more likely to belong to what AHRQ defines as a vulnerable population, and homelessness and public insurance are associated with ambulance arrival to the ED.[154] Conventionally, patients who arrive to the ED via ambulance are more likely to be acutely ill or severely injured, but homelessness and psychiatric disease, a condition frequently related to homeless ED visits, are associated with low-acuity complaints.[154] Patients who arrive via ambulance are more likely to receive laboratory and radiographic tests and are admitted to the hospital at a higher rate compared to similarly triaged walk-in patients.[154]

The reason for increased service utilization among patients arriving by ambulance regardless of triage acuity is unclear. The perception of a more severe health status is associated with ambulance arrival. Less expensive transportation alternatives to ambulances may be worth considering, especially in vulnerable populations. In a survey study of ED users, the majority of patients who arrived to the ED by ambulance for a low-acuity problem would consider

alternative transport such as taxis, gurney vans (non-medical transport for stable patients who must remain supine), and paratransit fares (the provision of funds for transportation services for patients with disabilities).[155]

5.2.4.2 Seen in the last 72 hours

Ten percent of homeless ED users, compared to 5% of nonhomeless ED users, were seen at the same ED 72 hours prior to the index visit. The results of this study found that homeless ED users have a significantly higher rate of being seen in the last 72 hours compared to nonhomeless ED users. This is consistent with previous years' NHACMS data which found that 11% of homeless ED users and 4% of nonhomeless ED users were seen in the last 72 hours in 2010.[135,156] In 2005-2006, 13% and 4% of homeless and nonhomeless ED users, respectively, were seen in the last 72 hours. In face-to-face interviews with homeless ED users, study authors found the primary reason for returning to the ED was fear or uncertainty about their condition due to insufficient evaluation and treatment.[157]

Repeat ED visits and high ED use frequency of homeless individuals is well-documented in the literature (REFs). A cross-sectional analysis of hospital records for ED visits taking place in an urban medical center in 2006 found that 13% of frequent ED users were homeless (Ku et al 2014) A prospective cohort study of patients in HCH clinics found that frequent ED use (defined as two or more visits in a 12-year period) was predicted by certain comorbid conditions secondary to the reason for the ED visit. A diagnosis of hepatitis C was associated with 4.5 times greater odds of frequent use, and a history of illicit substance abuse or a mental health condition was associated with 2.5 times greater odds.[158] Among homeless patients 15- to 25-years-old, repeat ED visits were more likely in females with a diagnosis of injury, and males with a

diagnosis of an acute medical condition.[158] Thus conditions with higher prevalence among homeless compared to nonhomeless can predispose this group to more frequent ED visits.

5.2.4.3 Wait time to be seen by provider, length of ED visit, and number of procedures and tests

Wait times were less than 30 minutes for 53% of homeless ED users, and less than one hour for 74% of homeless ED users. Five percent of homeless ED users waited over four hours to be seen by a provider. On average, homeless ED users waited 61 minutes, which is shorter than the average wait time found in a study of 2009-2010 NHAMCS data of 67 minutes.[135] Wait times were less than 30 minutes for 58% of nonhomeless ED users, and less than one hour or 77% of nonhomeless ED users. Two percent of nonhomeless ED users waited over four hours to be seen by a provider. On average, nonhomeless ED users waited 47 minutes, which is shorter than the average wait time found in a study of 2009-2010 NHAMCS data of 58 minutes.[135] Wait time differed significantly between homeless and nonhomeless ED users. However, clinical significance of the observed difference is likely negligible.

Sixty-nine percent of homeless ED visits lasted less than six hours, 19% lasted between six and 12 hours, and 12% lasted greater than 12 hours. The average length of homeless ED visits was 358 minutes (about 6 hours). This is a longer length of visit compared to what has been found in the literature among homeless individuals. A previous study in the ED of a single urban safety net hospital found that homeless ED visits lasted an average of 4.4 hours.[40]

Eighty-six percent of nonhomeless ED visits lasted less than six hours, 11% lasted between six and 12 hours, and 3% lasted greater than 12 hours. The average length of nonhomeless ED visits was 231 minutes (about 3.9 hours). This is consistent with what has been found in the literature. A study that took place in the ED of a single urban safety net hospital found that nonhomeless ED visits lasted an average of 3.8 hours.[40]

Homeless ED users had significantly longer lengths of ED visit compared to nonhomeless ED users. Slightly longer wait times could be contributing to longer visit times among homeless ED users, but another ED use characteristic related to extended visits is number of diagnostic tests and procedures conducted in the ED.[160] Homeless ED users received a mean of 3.58 tests and procedures, and nonhomeless ED users received a mean of 3.98 tests and procedures. Results of this study indicate that homeless ED users received a significantly lower number of diagnostic tests and procedures compared to nonhomeless ED users. In the literature, studies have shown that for every five additional tests, the ED length of visit increased 10 minutes, and each 30-minute increase in lab result turn-around time results in a 5.1% (17 minutes) increase. Because the magnitude of difference in the number of tests and procedures received between homeless and nonhomeless ED users is minimal, this factor does not appear to be a major contributor to the longer ED wait times experienced by homeless ED users, regardless of statistical significance.

To explain the longer length of ED visit seen among homeless ED users, it's possible that homeless individuals simply do not need to be seen with the same immediacy as nonhomeless individuals. This does not appear to be the case, since, according to the results of this study, there was no difference in triage level between homeless and nonhomeless ED users, a measure directly related with the immediacy with which a patient must be seen. Homeless individuals are more likely to visit the ED for a repeat visit, which may explain the longer wait time. Although triage level does not tend to differ, perhaps the prioritization of a patient who was seen within the last three days for the same problem is slightly lower than for a patient who has never been treated.

ED visits lasting six or more hours are associated with hospital admission and short-term mortality. A previous study examining adverse consequences associated with longer ED visits found that the odds of death within seven days of an ED visit, and the odds of hospital admission following an ED visit, were 1.8 and 2.0 times higher, respectively, among visits lasting six or more hours, compared to those lasting less than one hour in high-acuity patients. Among low-acuity patients, the odds of these adverse outcomes were each 1.7 times higher among low-acuity patients. (Guttman A et al 2011 Assoc b/t wait times and short-term mortality and hospital admission).

5.2.4.4 ED disposition

Seventy-five percent of homeless ED users were discharged from the ED, 11% were admitted to the hospital, 7% were transferred, and 7%. had a disposition categorized as other. In the literature, discharge status among homeless ED users is conflicting. Studies of past years' NHAMCS data analyzing ED disposition by housing status indicate that 10.3% of homeless ED users in 2009 and 21% in 2010 were admitted to the hospital, compared to 13% and 15% of nonhomeless ED users, respectively.[122,137,161] Studies conducted within a single ED found that 47% to 64% of homeless ED users were discharged from the ED after treatment and returned to the street, and as many as 53% of homeless ED users were admitted to the hospital.[137,161]

Eight-three percent of nonhomeless ED users were discharged from the ED, 13% were admitted to the hospital, 2% were transferred and 3% had a disposition categorized as other. Discharge from the ED differed significantly between homeless and nonhomeless ED users. It was hypothesized that ED discharge would not differ significantly between homeless and nonhomeless ED users, but study findings did not support this hypothesis. Little is known in the literature regarding ED disposition among homeless and nonhomeless ED users. According to

one study, individuals who left against medical advice (a disposition that corresponds with Other in this study) were 3.5 times more likely to be homeless compared to those that did not leave against medical advice.[1224] Another study found that hospital admission did not differ significantly between homeless and nonhomeless ED users. [122]

5.2.4.5 Region

The greatest proportion of homeless ED visits took place in the West region, accounting for 46% of visits. Twenty-three percent of homeless ED visits took place in the South, and both the Northeast and Midwest regions each saw 16% of homeless ED visits. This is similar to what was found in a study of 2005-2006 NHAMCS data where the majority of homeless ED visits also took place in the West (39%), and 28% took place in the South. More homeless visits took place in the Northeast region (21%) and fewer visits took place in the Midwest (12%) during the 2005-2006 study years compared to the findings of this study.[137]

Among nonhomeless ED visits, the greatest proportion took place in the South (36%), and the Midwest and West each saw about 23% of nonhomeless ED visits. Nineteen percent of nonhomeless visits took place in the Northeast region. A slightly different trend was seen in HCUP 2015 data in which it was found that the South contributed 40% of visits, the Midwest contributed 19%, and the Northeast and the West each contributed about 19%.

Geographic region of ED visits differed significantly between homeless and nonhomeless ED users. Little is known about the determinants of ED use by region in either the general nor the homeless population in the U.S. The distribution of nonhomeless ED visits across U.S. regions tends to coincide with the overall health of states within each region. Three of the top five heathiest states in the U.S. (Massachusetts, Hawaii, Vermont, Utah, and Connecticut) were located in the Northeast region and the remaining two states were located in the Western region,

the two regions contributing the lowest proportion of ED visits across both NHAMCS and HCUP data.[162] The five unhealthiest states (Mississippi, Louisiana, Arkansas, Alabama, and West Virginia) are located in the Southern region, the highest contributing region of ED visits in the U.S.[162]

Unlike the trend observed in nonhomeless ED visits, the distribution of homeless ED visits across U.S. regions does not coincide with the health of the states within each region. One may assume that the number of ED visits by homeless individuals in a particular region is related to the population of homeless individuals in that region. That is, the more homeless individuals residing in that the region, the more ED visits are made by homeless. Yet, this does not appear to be the case.

Of the top ten cities with the highest homeless population, the Northeast had the highest number of homeless individuals, 110,395, but, according to the findings of this study, contributed to the lowest proportion of homeless ED visits.[163] The second most populous cities were in the West, the region with the highest proportion of homeless ED visits, with 88,804 homeless individuals.[163] The third most populous cities for homelessness (and the region with the second-highest proportion of ED visits) were located in the South with 20,855 individuals, and the Midwest contained the fourth most populous cities for homelessness (and the region with the lowest proportion of homeless ED visits) with 9,200 individuals.[163] Thus, more information is needed regarding the community-level determinants of ED use by homeless individuals.

5.2.5 Medication prescribing characteristics at ED discharge

5.2.5.1 Medication prescription at ED discharge

Forty-five percent of homeless ED visits, compared to 60% of nonhomeless visits, were prescribed at least one medication at ED discharge. The rate of medication prescribing among

homeless ED users was significantly lower compared to that of nonhomeless ED users. To our knowledge, this is the first study of prescribing patterns at ED discharge among a nationally representative homeless population in an ED setting. Differences in medication use in homeless populations have been identified in the ambulatory care setting. Homelessness is associated with decreased access to antiretroviral therapy, and a lower likelihood for tuberculosis therapy completion.[61,62,64,62]

Little is known in the literature regarding the rate of medications prescribed at ED discharge. However, in the ambulatory care setting, the proportion of homeless individuals taking at least one medication ranges from 42% to 84% among sheltered homeless women, and 81% of sheltered homeless men reported taking at least one medication.[164,165] Sixty percent of homeless and vulnerably housed homeless individuals reported being prescribed at least one medication, though 26% reported not taking those medications prescribed.[165] In the general population, nationwide statistics estimate that 49% of people in the U.S. take at least one medication.[166] Comparatively, the rate of medication prescribing in the ED is lower than rate of prescription medication taking in the homeless and general population. This is appropriate, since the ED is just one health care setting in which patients receive prescribed medications.

Due to factors found in the general population that are particularly prevalent in the homeless, such as mental health and substance use conditions, and reporting of lower levels of pain, we hypothesized that homeless ED users would have significantly lower odds of medication prescribing. More information is needed regarding factors related to medication prescribing among homeless ED users. The results of a regression analysis predicting the outcome of medication prescribing at discharge will be discussed in Specific Aim 2.

5.2.5.2 Number of medications prescribed

It was hypothesized that the number of medications prescribed at ED discharge would not differ significantly between homeless and nonhomeless ED users. This hypothesis was accepted. Of those who were prescribed medications, 46% and 43% of nonhomeless and homeless, respectively, received one medication, 34% and 37% received two medications, and 14% and 9% received three medications. A tenth of homeless ED users, compared to 6% of nonhomeless ED users, were prescribed four or more medications.

Little is known in the literature regarding the number of medications homeless individuals are prescribed, particularly in the ED setting. The findings of this study differ somewhat from what has been found in the previous studies analyzing the number of medications prescribed to homeless individuals. Forty-five percent of homeless patients of an urban health clinic taking medications reported taking one to two medications, whereas 80% of homeless ED users prescribed a medication at ED discharge were prescribed at least two medications.[77] Fifty-six percent of homeless individuals in the clinic setting reported taking three or more medications, with 16% taking greater than six medications. Twenty-four percent of homeless ED users were prescribed taking at least three medications, with 10% taking four or more. Because prescription medications come from multiple sources, a difference between these study findings and those in an ambulatory care setting are expected.

5.2.5.3 Controlled medication prescription, schedule of controlled medications prescribed, and opioid medication prescription

While the rate of and schedule of controlled medications did not differ significantly between homeless and nonhomeless ED users, a significantly smaller proportion of homeless

individuals received an opioid prescription at ED discharge compared to nonhomeless individuals.

To our knowledge, this is the first report of controlled medication prescribing patterns among the homeless population. The decreased prevalence of opioid prescription among homeless ED users may be due to the large proportion of ED visits related to mental health and substance abuse conditions among homeless ED users. The diagnosis of a mental health condition is associated with decreased likelihood of opioid prescription for pain-related ED visits (Chang HY et al 2014), and the prescription of controlled medication for patients with substance use conditions is a complicated issue for prescribers. Many times, the risk of enabling potential medication misuse and abuse outweighs the risk of undertreating health conditions associated with controlled prescription treatment.[167] Thus, the proportion for homeless ED users diagnosed with mental health (17% versus 4%) and substance use (28% versus 3%) conditions compared to nonhomeless ED users may explain in-part the decreased rate of medication prescribing at ED discharge among homeless ED users.

5.2.5.4 Top five medication classes prescribed at ED discharge

The top five most frequently prescribed classes of medications prescribed at ED discharge differed between homeless and nonhomeless. ED users. However, the two most frequently prescribed classes of medications in both groups were pain medications. Nonsteroidal anti-inflammatory drugs (NSAIDs) were prescribed the most frequently among homeless ED users at discharge, comprising 14% of medications. Ibuprofen and naproxen comprised 90% of NSAIDs prescribed.

The second most frequently prescribed class of medication to homeless ED users was narcotic analgesic combinations, comprising 13% of medications. These medications are a

combination of a narcotic, usually an opioid such as oxycodone or hydrocodone, coupled with non-narcotic analgesics such as acetaminophen, ibuprofen, or aspirin. Among homeless ED users, the opioids hydrocodone and oxycodone, both in combination with acetaminophen, comprised 86% and 10%, respectively, of narcotic/analgesic combinations among homeless ED users, respectively. Acetaminophen is the analgesic component in all the narcotic/analgesic combinations among homeless ED users.

Five percent of medications prescribed to homeless ED users at discharge were first generation cephalosporin antibiotics, the sole medication of which being cephalexin, indicated for the treatment of urinary tract infections, respiratory tract infections, and skin and soft-tissue infections.[168] That an antibiotic is the third most frequently prescribed medications among homeless ED users is expected given the increased prevalence of infectious disease in this population.[169,170,171] While conditions treated by cephalosporin antibiotics are usually considered ambulatory care-sensitive conditions, antibiotics prescribed to homeless ED users may be prescribed secondary to an ED visit related to a more urgent condition, or the treatment for an infection has been delayed to the point that urgent intervention is necessary.[172] Delaying care for ambulatory-sensitive conditions until they progress to severe disease is common among homeless individuals who face multiple needs that compete with receiving regular health.[173]

Opioid/analgesic combinations is the class of medications prescribed most commonly to nonhomeless ED users, comprising 17% of all medications prescribed. As observed among homeless ED users, hydrocodone/acetaminophen and oxycodone/acetaminophen were the most frequently prescribed opioid analgesic combinations, comprising 66% and 27% of prescribed medications belonging to this class. Less than 1% of opioid/analgesic combinations contained an analgesic other than acetaminophen. The second most prescribed class of medications to

nonhomeless ED users at discharge was NSAIDs, comprising 13% of medications. Ibuprofen and naproxen comprised 88% of NSAIDs prescribed.

Narcotics alone, not in combination with analgesics, were the third most frequently prescribed class of medications among nonhomeless ED users, comprising 5% of all medications prescribed at discharge. Of these narcotic prescriptions, tramadol was prescribed 61% of the time. Oxycodone and hydrocodone were the second and third most frequently prescribed narcotic analgesics, respectively. Although tramadol is a centrally acting opioid, it was approved by the FDA in 1995 as a non-controlled analgesic due to clinical trial investigators' conclusions of low abuse potential and lack of other adverse morphine-like effects, such as respiratory depression, as a function of its weaker agonism of μ-opioid receptors.[174,175,176,177] That is until August 2014 when, amidst the rise of the opioid epidemic and growing concern for opioid abuse and overdose in the U.S., the DEA announced its placement into Schedule IV of the Controlled Substances Act.[178,179]

The impact of tramadol prescription since its rescheduling is unknown, and recent editorials and opinion pieces on the matter appear mixed.[180,181] Although tramadol's Schedule IV classification occurred toward the latter half of this study period, its safety concerns were prevalent prior to the FDA's response. Despite such concerns, our study indicates that in the ED setting, tramadol is the most frequently prescribed opioid analgesic at discharge. Over 13,120,000 tramadol prescriptions were given to nonhomeless ED users at discharge over the six-year study period averaging to about 2,187,000 prescriptions per year.

Perhaps the most immediate observation when comparing classes of medications at ED discharge between homeless and nonhomeless ED users is the lower prevalence of controlled pain medications among the homeless. The first most commonly prescribed class of medication

at ED discharge among nonhomeless ED users were narcotic/analgesic combinations and the third most commonly prescribed class was narcotic analgesics alone. Among homeless ED users, only the second most prescribed class of medications were narcotic analgesic combinations. The fourth most commonly prescribed class of medication was comprised of the over-the-counter medication acetaminophen, a medication class that does not appear on the top five most frequently prescribed medication classes among nonhomeless ED users. This indicates that pain medications used to treat moderate to severe pain are more often prescribed among nonhomeless ED users, and those used in the treatment of mild pain are more often prescribed to homeless ED users.

This can be explained by several observations made in our study. First, homeless individuals reported less pain on average compared to nonhomeless ED users suggesting that narcotic analgesics may not be indicated as often among homeless. Second, homeless individuals have a higher prevalence of ED visits related to mental health conditions, the treatment guidelines for which do not include narcotic analgesics.[182] Third, the higher prevalence of substance use conditions related to ED visits by homeless suggests that medications with any abuse potential should be avoided among homeless ED users, especially for those with substance use conditions discharged from the ED back to the street, as opposed to undergoing a hospital admission or transfer to another health care institution.[167,183]

In making these observations, the concern for homeless ED users when is that, with the higher prevalence of substance use conditions among homeless, compared to nonhomeless individuals, provider bias may lead to undertreatment of pain, particularly for the 72% of homeless ED users not presenting to the ED with a substance use condition. However, non-narcotic analgesics and narcotic/analgesic combinations are the two most frequently prescribed

classes of medications among homeless ED users, indicating a high priority for pain treatment among homeless.

Another immediate observation worth noting is the high amount of acetaminophen-containing medications being prescribed to homeless ED users at discharge. Not only does acetaminophen make up the fourth most commonly prescribed class of medications among homeless ED users, narcotic/analgesic combinations, all of which containing acetaminophen, are the second most frequently prescribed class of medications. Recently, there has been a growing concern regarding the ubiquitous use of acetaminophen. While much of its use in narcotic/analgesic combination drugs is to deter abuse and overdose of opioids rather than provide analgesia, recent reports suggest that it may be the more dangerous component of these combination drugs in cases of regular use and misuse.[184—186] Nearly half of all cases of acetaminophen-related liver failure in the U.S. was a result of use of narcotic/analgesic combinations.[187]

The results of our study indicate that over the six-year period, over 516,000 (about 86,000 per year on average) medications containing acetaminophen, either on its own or in combination with a narcotic, were prescribed to homeless ED users, comprising 17% of all medications prescribed to homeless. In contrast, these medications comprised 1% of all medications prescribed to nonhomeless ED users. This is particularly concerning for homeless individuals since many risk factors for acetaminophen-related hepatotoxicity are highly prevalent in this population, including concomitant alcohol use or abuse and poor nutritional status.[28,29,188—190] The curbing of acetaminophen prescribing among homeless individuals in the ED setting may be warranted.

5.3 Specific Aim 2

The purpose of this analysis was to determine if the odds of being prescribed a medication at ED discharge differed significantly between homeless and nonhomeless ED users, controlling for predisposing (age, gender, race/ethnicity), enabling (primary payer), and need (ED diagnosis, comorbidity diagnosis), and ED use characteristics (provider seen, region). It was hypothesized that homeless ED users were significantly less likely to be prescribed a medication at ED discharge compared to nonhomeless ED users.

The bivariate analysis and unadjusted logistic regression indicated a significantly lower odds of receiving a medication prescription at ED discharge among homeless ED users compared to nonhomeless. Forty-five percent of homeless ED users were prescribed a medication at ED discharge, compared to 60% of nonhomeless ED users, and according to the results of the Chi-square analysis, this was a statistically significant difference. The unadjusted logistic regression model found that homeless ED users were 45% less likely to receive a prescription at ED discharge compared to nonhomeless ED users, a statistically significant result. However, once the model was adjusted for predisposing, enabling, need, and ED use characteristics, statistical significant was not retained.

The study hypothesis that the odds of medication prescribing at ED discharge would be significantly lower among homeless ED users compared to nonhomeless ED users after controlling for predisposing, enabling, need, and ED characteristics was rejected. However, the fact that the bivariate and unadjusted regression model indicates a disparity exists between the two groups is still an important consideration for prescribers providing care in the ED setting.

In the literature, disparities in medication prescribing in the ED setting have focused exclusively on analgesia prescribing among racial/ethnic minorities. Blacks and Latinos were

found to be less likely to receive analgesia for the treatment of isolated long-bone fractures compared to Whites, and Blacks, compared to Whites, were less likely to be prescribed an opioid for the treatment of migraines or any analgesic for the treatment of musculoskeletal pain.[191—193] Disparities in health care provision have been associated with higher rates of hospitalization, injury, and mortality in minority groups, and safety-net providers caring for vulnerable populations should ensure the equitable provision of care.

To quantify the individual contribution of each set of predisposing, enabling, and need, and ED use characteristics to the disparity observed in the receipt of medication prescription at ED discharge, a decomposition analysis was conducted. While the predisposing variable, gender, and the ED use characteristic, region, both contributed to the gap in medication prescription at ED discharge between homeless and nonhomeless ED users by 3.1% and 2.5%, respectively, the main driver of the observed disparity was the Need characteristics, ED diagnosis, which contributed to 58% of the observed disparity. The multivariable logistic regression analysis indicated that ED diagnoses were associated with significantly higher and lower odds of receipt of a medication prescription at ED discharge depending on the diagnosis. Diagnosis of chronic and acute physical conditions were associated with a higher odds of receipt of medication prescription at ED discharge compared to homeless and nonhomeless ED users with no chronic or acute physical condition diagnosis, which is to be expected. A more surprising finding is that a diagnosis of a mental health or substance use condition is associated with a significantly lower odds of a receipt of a medication prescription at ED discharge. The treatment guidelines for psychiatric and substance use disorder emergencies include pharmacological intervention.[194] However, it is documented in the literature that psychiatric patients, which includes those presenting with substance use conditions, pose a unique challenge to emergency physicians

which have been found to stem from inadequate training, lack of education in the care of psychiatric patients, and a shortage of services to treat these patients.

Bivariate and unadjusted multivariable models indicate a significant difference in medication prescribing at ED discharge between homeless and nonhomeless ED users. Although statistical significance was not retained once adjusting for predisposing, enabling, need, and ED use characteristics, the results of the multivariable and decomposition analysis provide insight into the characteristic that contribute to this disparity in medication prescribing at ED discharge. Providers should ensure equal prescribing practices to their patients regardless of housing status.

Homeless and nonhomeless ED users are 70% more likely to receive a medication prescription at ED discharge if they have not been diagnosed with a mental health condition, compared to those that have, after controlling for all other predisposing, enabling, and need, and ED use characteristics. Further, homeless and nonhomeless ED users with no substance use diagnosis were 4 times more likely to receive a medication prescription at ED discharge compared to ED users that had been diagnosed with a substance use condition.

Twenty-seven percent of homeless ED users were diagnosed with a substance use condition, compared to only 3% of nonhomeless ED users, and the lack of a substance use diagnosis is associated with a 4 times greater odds of mediation prescribing at ED discharge. Further, the results of the decomposition analysis indicate that ED diagnosis contributes to 58% the disparity in medication prescribing at ED discharge between homeless and nonhomeless ED users. Thus, it does not appear that an unexplained bias toward homeless housing status explains the disparity in medication prescribing at ED discharge observed in the bivariate and unadjusted analysis, but rather the increased rate of substance use disorders observed among homeless individuals is resulting in a lower likelihood of a receiving a medication at ED discharge.

5.4 Specific Aim 3

5.4.1 Predisposing characteristics

It was hypothesized that among homeless ED users, White race, compared to Black, Hispanic, and Other races, would be associated with a higher odds of receipt of a medication at ED discharge. In both the unadjusted and adjusted analysis, the odds of White homeless ED users receiving a medication prescription at ED discharge did not differ significantly from that of homeless ED users of minority races/ethnicities. This hypothesis was rejected. Based on the results of the multivariable analysis of both homeless and nonhomeless ED users in specific aim 2, which also found a non-significant difference in odds of medication prescription at ED discharge between White and minority races/ethnicities, this result is expected.

Given the racial/ethnic disparities of analgesia prescribing in ED settings among the general population, the finding of this analysis is unexpected. Racial/ethnic minorities have consistently been under-prescribed appropriate pain medication in the ED compared to Whites with similar diagnosis and disease or condition severity. Other studies of racial/ethnic disparities in health and health care utilization among homeless individuals have found an opposite tend compared to that observed in the general population. Among homeless individuals with severe mental illness receiving community treatment, intensity of service utilization decreased over time for Whites, whereas Blacks increased service utilization over time.[195] Whites also had a significantly lower rate of case management visits compared to Blacks and Latinos.[195] A study of sheltered and unsheltered homeless women in Los Angeles, CA found that White women had a higher rte of alcohol and drug problems, physical and sexual assault, recent depression, and bodily pain copared to Black and Latinas. White women were two and five times more likely to report an unmet health care need compared to Blacks and Latinas, respectively.[50]

While these health and health care utilization differences between racial/ethnic groups can't necessarily be extrapolated to what we would expect for medication prescribing characteristics, it is clear that racial disparities among homeless individuals do not present in the same manner as the general population. Upon a closer look at the literature, it makes sense that racial/ethnic disparities in ED discharge prescribing characteristics observed in the general population does not predict disparities in medication prescribing at ED discharge among homeless ED users.

It was hypothesized that there would be no difference in the odds of medication prescribing at ED discharge between men and women. In the unadjusted analysis, men were significantly less likely to receive a medication prescription at ED discharge. Once adjusting for predisposing, enabling, and need characteristics, and ED use characteristics, there was no significant difference in the likelihood of medication prescribing at ED discharge between men and women and this hypothesis was accepted. Although the multivariable logistic regression of homeless and nonhomeless ED users in specific aim 2 found a significantly lower odds of medication prescription at ED discharge among men compared to women, there was only a 6% lower likelihood. Thus, this null finding isn't unexpected.

Little is known about differences in medication prescribing characteristics between homeless men and women. Studies assessing health between homeless men and women have found that women tend to have less frequent substance use conditions compared to men, but among chronically homeless women and men, substance use rates are equivalent.[31,196] The findings of this study indicate that substance use condition diagnosis are a major factor in decreasing the likelihood of medication prescribing at ED discharge. It is difficult to say without knowing certain homelessness characteristics, such as length of time homeless, whether or not a

higher rate of substance use by gender is probably in our study sample of homeless ED users. More information regarding homelessness characteristics is needed to adequately provide context of the null study finding.

Compared to 18- to 24-year-olds, it was hypothesized that there would be no difference in the odds of medication prescribing at ED discharge among all other age groups. Both the unadjusted and adjusted analysis indicated no significant differences in the likelihood of medication prescription at ED discharge between age groups among homeless ED users, and this hypothesis was accepted. This finding is somewhat unexpected given the results of the multivariable regression among homeless and nonhomeless ED users in specific aim 2 which found a significantly lower odds of medication prescribing at ED discharge between 55- to 64-year-olds and ED users 65 years old and over, and 18- to 24-year-olds.

It has been reported in the literature that, compared to younger homeless adults, older homeless adults are more likely to report a chronic disease, functional disability, poorer health, high blood pressure, and high cholesterol.[90,197] Older homeless individuals are more likely than younger homeless individuals use community-based health services compared to the ED, so it's likely that, given the chronic nature of these health conditions more commonly seen in older homeless individuals, older ED users were receiving prescription management in other health care settings.[197]

5.4.2 Enabling characteristics

It was hypothesized that visits covered by Self-pay would be less likely to result in a medication prescription at ED discharge compared to visits covered by Private insurance, but there would be no other significant differences between visits covered by other primary payers compared to visits covered by Private insurance among homeless ED users. This hypothesis was

rejected in both the unadjusted and the adjusted analysis. Visits covered by Medicare and Other payer had significantly lower odds of resulting in a medication prescription at ED discharge compared to visits covered by Private insurance. These findings are surprising given that Medicare and Other payer are likely to cover prescription medications, particularly Medicare, while for a visit that is Self-pay, the ED user would presumably be covering the out-of-pocket costs of prescribed medications as well. Based on these findings, it doesn't appear that ability to afford medications among homeless ED users is a consideration among ED providers in their decision to prescribe medication at ED discharge.

Studies have shown that a patient's insurance type can impact the quality of care received in hospitals. For example, Patients who are uninsured, underinsured, or have Medicaid tend to receive lower-quality of care compared to patients who are privately insured.[198,199] An analysis of State Inpatient Database records from eleven states in 2006-2008 found that Medicare enrollees had higher risk-adjusted mortality rates compare to privately insured patients.[200] These results are in-line with this study's findings. After adjusting for differences in predisposing, enabling, need, and ED use characteristics, homeless Medicare enrollees were less likely to receive a mediation prescription at ED discharge compared to homeless ED users with private insurance. This may be an indication of a lower quality of care being provided to homeless ED users with Medicare.

5.4.3 Need characteristics

Among homeless ED users, it was hypothesized that a lack of a substance use condition diagnosis would be associated with a greater likelihood of medication prescribing at ED discharge, and there would be no difference in the likelihood of medication prescribing between homeless ED users with and without chronic and acute physical condition diagnoses and a

mental health condition diagnosis. In the unadjusted analysis, chronic and acute physical condition diagnosis was associated with a higher odds of medication prescription at ED discharge, and a substance use condition diagnosis was associated with a lower odds of medication prescription among homeless ED users. After adjusting for predisposing, enabling, and need diagnosis, and ED use characteristics, only a substance use condition diagnosis was significantly associated with a lower odds of medication prescription at ED discharge. Thus, this hypothesis was accepted.

The odds of medication prescription at ED discharge did not differ between homeless ED users with no mental health condition diagnosis and those diagnosed with a mental health condition. This is particularly unexpected given the results of the multivariable analysis in specific aim 2 which found that a lack of a mental health condition diagnosis was associated with a 1.7 times higher odds of medication prescription of ED discharge among homeless and nonhomeless ED users.

It is documented in the literature that mental and health and substance use conditions impact prescribing patterns and medication adherence among homeless individuals. Active substance abuse has been shown to compromise the treatment of other diseases and is associated with poor medication adherence. Providers may choose to hold off on prescribing medication until the substance abuse condition is resolved.[183] A mental health condition, including a substance use condition, is associated with a decreased likelihood of receiving an opioid prescription for pain-related ED visits.as the prescription of controlled medication for patients with substance use conditions is a complicated issue for prescribers.[149,201] Many times, the risk of enabling potential medication misuse and abuse outweighs the risk of undertreating health conditions associated with controlled prescription treatment. These considerations may explain

why the results of this study indicate a significantly lower odds of medication prescribing at ED discharge

5.4.4 ED use characteristics

It was hypothesized that homeless ED users seen by a medical doctor would have a higher likelihood of medication prescribing at ED discharge compared to homeless ED users seen by another type of provider. This hypothesis was rejected as both the unadjusted and adjusted analysis indicated that the odds of medication prescribing did not differ by type of provider seen. This indicates that compared to that of medical doctors, medication prescribing characteristics among interns, residents, nurse practitioners, and physician assistants are consistent in the ED setting when providing care to homeless ED users.

Previous studies support these findings. The care of patients by residents and interns is overseen by a medical doctor likely influencing the prescribing practices of the interns and residents and resulting in consistent medication prescribing characteristics.[137] Studies comparing prescribing patterns between nurse practitioners and medical doctors in the primary care setting found no significant differences in medication prescribing characteristics between the two providers.[201,202]

Compared to visits that took place in the South region, it was hypothesized that there would be no difference in the likelihood of medication prescribing at ED discharge among visits that took place in the Midwest, Northeast, and West regions. This hypothesis was rejected as both the unadjusted and adjusted analysis found that visits that took place in the Northeast were significantly less likely than those taking place in the South to result in medication prescribing at ED discharge. This is similar to the findings in the multivariable analysis in specific aim 2.

5.5 Clinical and policy recommendations

Based on the findings of this study, there are several clinical and policy recommendations that could improve the care provided to homeless individuals in the ED settings, and optimize health outcomes from these encounters.

5.5.1 Integrate substance use and mental health treatment with in homeless community services

Seventeen percent and 28% of homeless ED users were diagnosed with a mental health and substance use condition, respectively. The rate of diagnoses for these conditions was significantly higher than nonhomeless ED users. In a multivariable logistic regression, after controlling for predisposing, enabling, need, and ED use characteristics, mental health and substance use conditions were associated with a significantly lower likelihood of receiving a medication at ED discharge among homeless and nonhomeless ED users. Results of a decomposition analysis indicated that ED diagnosis contributed to 58% of the disparity observed in medication prescribing between homeless and nonhomeless ED users, which was likely driven by mental health and substance use condition diagnoses. Homeless ED users with a substance use condition had a significantly lower likelihood of receiving a medication at ED discharge compared to homeless ED users with no diagnosis of a substance use condition.

Given the significantly greater prevalence of mental health and substance use conditions among homeless ED users, and the barrier it presents to medication prescription at ED discharge, more resources are needed to address the issue of mental health and substance use conditions among homeless individuals. Emergency care for the treatment of mental health and substance use is frequently accessed by homeless individuals. One study of patients in a psychiatric ED found that homeless individuals made 30% of ED visits.[203]

This burden on the acute care component of the community mental health system may indicate that mental health and substance treatment provided in outpatient and ambulatory care settings are not meeting the needs of homeless individuals.[16,203] It has been found that substance use predicts decreased adherence to community mental health treatment which may be an indication that the treatment for these conditions, which often occur as dual diagnoses, are being siloed. To optimize mental health and substance use treatment in the community, and decrease the need for acute psychiatric care, the treatment for these conditions must be integrated with one another.

5.5.2 Providing care to older homeless individuals in the ED setting

The homeless population in the U.S. is aging. The percentage of homeless individuals 50 years of age and older increased 20% from 2007 to 2014, and now make up one-third of the nation's homeless population. According to the findings of this study, this trend is reflected in the demographics of homeless ED users, one-third of whom were aged 45 to 55 years.

Safety-net providers in ED settings trained in providing care to a younger homeless population with a unique set of needs may find those needs changing as the homeless population ages. A study of homeless patients in the ED setting found that older homeless individuals had fewer discharge diagnoses related to psychiatric conditions and drug abuse, but more diagnoses related to alcohol abuse.[47] They tended to utilize more ED services compared to younger ED users, such as arriving to the ED via ambulance (48% vs 36%) and being admitted to the hospital following an ED visit (20% vs 11%).[47] While health priorities for younger homeless patients focus on reducing the risk for communicable diseases, unintentional injuries, and drug- and alcohol-related problems, older homeless patients require different health services such as optimization of chronic disease management.

Safety-net providers may also need to provide care for geriatric conditions while accounting for frailty and the prioritization of quality of life versus treatment optimization. Although a small proportion of homeless ED users (4%) were older than 65, the average life expectancy for homeless individuals is estimated at 42 to 52 years of age[134,135] Thus, homeless individuals in what are considered more "middle-age" categories may require guidance in navigating hospice and end-of-life care commonly seen in the oldest old of the general population.

Providers should be aware that older homeless patients will likely present to the ED with different health needs and priorities compared to younger homeless patients, and ensure they are prepared to provide appropriate, high-quality care to older members of this vulnerable population.

5.5.3 Medicaid expansion, the Affordable Care Act, and the health of homeless

Beginning in 2012, under the provisions of the Affordable Care Act (ACA), states began to expand Medicaid coverage, allowing a greater number of people to be eligible for medical insurance. This appears to have had a positive impact on the insurance coverage rates among the homeless. Among states who expanded Medicaid, health coverage rates of patients of HCH clinics increased from 45% in 2012 to 67% in 2014.[134,204] Rates of health coverage in HCH patients in no expansion states went from 26% to 30% in the same period.[134,204]

Still, homeless individuals face barriers to health insurance coverage, even in Medicaid-expanded states. A cross-sectional survey of non-critically ill adults in an urban county Level 1 trauma center ED found that homeless individuals were more likely to have never heard of the ACA compared to nonhomeless patients (26% vs 10%). The most common barrier to enrollment was lack of information as 70% of homeless patients reported not seeking enrollment because

they weren't sure if they would qualify. Ninety-one percent of individuals with this response reported an income level less than 138% of the federal poverty level, which likely qualifies them for Medicaid.[56137,]

An analysis of 2005-2006 NHAMCS data examining the determinants of ED use among homeless found that a lack of insurance was significantly associated with ED visits by homeless. Health and homeless care providers should support efforts to increase ACA enrollment among vulnerable groups in order to avoid inappropriate ED use and economic consequences of uninsured ED visits.

5.5.4 Considerations for homeless ED users being discharged from the ED

The results of this study found that, although a greater proportion of homeless ED users were transferred to other facilities upon ED disposition, three-quarters were being discharged from the ED back to the street. Studies of ED utilization in homeless populations have found that repeat ED visits are common. A study of 2005-2006 NHAMCS data found that homeless individuals were 4 times more likely to have visited the ED in the last three days.[137] The findings of this study indicated that 10% of homeless ED users, versus 5% of nonhomeless ED users, visited the same ED in the previous three days. Improving discharge practices at ED disposition may be able to mitigate repeat visits among homeless ED users.

The results of semi-structured interviews with homeless individuals returning to a shelter following discharge from the ED or hospital yielded three common recommendations regarding transitions of care for homeless or unstably housed patients. First, providers should consider unstable housing status a health concern; second, hospitals and shelter providers should communicate during discharge planning; and finally, the discharge process should include transportation.[161]

Study investigators also recommended the support of medical respite care for recently discharged homeless individuals. Most patients require periods of rest following a ED or hospital discharge, but this opportunity is rarely afforded to homeless individuals. A systematic review of thirteen articles describing homeless medical respite programs found evidence that future hospital admission, inpatient days, and hospital readmissions were reduced for homeless clients of respite programs.[161]

Accounting for the unique needs of homeless ED users at ED discharge may ensure that patients receive optimal treatment from the ED encounter, while also decreasing the chances of a repeat ED visit. Providers should coordinate appropriate after-care with other homeless care providers in the community. Medical respite programs for homeless individuals may be a cost-effective method in improving health outcomes after an ED encounter.

5.6 Future Directions

5.6.1 Medication prescribing at ED discharge

This work is the first study of medication prescribing among homeless individuals in an ED setting. The purpose of the study was to assess the difference in rate of medication prescribing at ED discharge between homeless and nonhomeless ED users. Results of the bivariate analysis and the unadjusted logistic regression indicate that a significant difference in medication prescribing. Once adjusting for predisposing, enabling, need, and ED use characteristics, the difference in medication prescribing at ED discharge between homeless and nonhomeless ED users was nonsignificant. In a multivariable logistic regression analysis assessing the association between predisposing, enabling, need, and ED use characteristics many variables hypothesized to predict medication prescribing at ED discharge were not significantly associated with this outcome.

The homeless population in the U.S. is heterogeneous and predisposing, enabling, need, and ED use characteristics differ by certain homelessness characteristics such as length of time homeless, sheltered or unsheltered status, and whether or not a homeless individual is single or belongs to a family. Women with children also differ significantly from single women across pertinent characteristics. Because of our data source, information on these homelessness characteristics were not available, and the multivariable models could not be adjusted for characteristics that have been shown in other studies to impact health and health care outcomes. Primary research analyzing medication prescription at ED discharge within the context of homelessness characteristics are needed to adequately explain factors that influence this outcome among homeless ED users.

A decomposition analysis suggested that the higher rate of a substance use condition diagnosis among homeless ED users was the factor most likely accounting for the decreased likelihood of medication prescribing between homeless and nonhomeless ED users. This finding poses additional questions, not just about medication prescribing among homeless ED users, but nonhomeless ED users as well, diagnosed with a substance use condition during their ED visit.

The decreased rate of medication prescribing among patients with a substance use condition may not be appropriate, particularly if they are presenting with an additional physical or mental health condition that would warrant the prescription of a medication at ED discharge. More information is needed regarding prescribing practices in the ED setting among patients with substance use conditions, particularly those belonging to vulnerable populations.

5.6.2 Opioid and controlled medication prescribing at ED discharge among homeless ED users

The findings of the bivariate analysis in this study assessing for differences in medication prescribing characteristics at ED discharge between homeless and nonhomeless ED users also

warrants further investigation. Thirty-one percent of homeless ED users were prescribed an opioid at ED discharge, compared to 41% of nonhomeless ED users, a statistically significant difference. Additionally, the schedule of controlled medications at ED discharge differed significantly between homeless and nonhomeless ED users, as a smaller proportion of homeless individuals received a schedule II medication compared to nonhomeless individuals.

A number of predisposing, enabling, need, and ED use characteristics differed significantly between homeless and nonhomeless ED users, any of which could account for the differences observed in medication prescribing characteristics. For example, older age, lack of chronic and acute physical condition diagnosis, and being diagnosed with a mental health were all associated with a significantly increased odds of medication prescribing at ED discharge. Yet, these characteristics occurred significantly more frequently among homeless ED users. A multivariable analysis in conjunction with a decomposition analysis may provide more understanding as to what factors are contributing to the disparity in opioid and controlled medication prescribing among homeless and nonhomeless ED users.

5.7 Study Limitations

Limitations of this study result from the cross-sectional study design, and the use of publicly available, secondary data. Cross-sectional studies are able to assess the association between two variables at a single point in time, but cannot be used to establish causality between the independent and dependent variables, since it is impossible to determine a temporal relationship between the cause and the effect.[100] Secondary data that is routinely collected is generally done so for purposes other than the study objective, and thus often lacks data on confounding factors. Additionally, investigators have no control over the data collection process, which often results in data collection methodology that is less ideal for testing the study

hypothesis. The following will describe how the limitations that result from a cross-sectional study of secondary data could specifically impact this study and provides a context for drawing appropriate conclusions from the study results.

The objective of this study is to assess the impact that homeless housing status has on prescribing patterns in the ED among the U.S. adult population. In this sense, the cause, or independent variable, is housing status, and the effect, or dependent variable is the prescription of a medication at ED discharge. The data for these variables were collected at a single point in time, and thus, a temporal relationship is not established, but because housing status is collected on ED arrival which always precedes ED discharge, we can be sure that housing status occurs simultaneously with ED discharge.

Another limitation due to the cross-sectional study design is the inability to assess patient medication-taking behavior after discharge. Observing prescribing patterns at ED discharge provides insight as to the medications that patients have access to, but it cannot be assumed that each prescription is filled or if the patient is adherent to the prescribed medication regimen. If patients are not filling these prescriptions, or taking the medications appropriately, then prescribing patterns may not ultimately impact health outcomes. However, because studies have found that only about 12 to 20% of medications prescribed at discharge are not filled, it is appropriate to assume that the majority of the medication prescribed at ED discharge are at the least being filled.[101,102] No studies to date assess secondary medication adherence of medications prescribed at ED discharge.

The purpose of the NHAMCS-ED is to describe the utilization and provision of ambulatory care services in hospital EDs in the U.S., and the data collection methodology fits this purpose. In this study, NHAMCS-ED data is being used to test hypotheses for which the

survey was not intended, and thus information for several potential confounding factors is excluded, which must be taken into account when drawing appropriate conclusions. For example, there is no variable that measures overall health status. Because poorer health is associated with homeless housing status and increases the likelihood for the need for medication, controlling for this characteristic would have strengthened internal validity.[18,19,20,24,26] That is, it would increase the confidence that any differences observed in prescribing patterns between homeless and nonhomeless patients is due to housing status, and not the fact that homeless individuals have poorer health than nonhomeless. To assess for health status differences, the ESI will be used as a proxy for disease severity to help control for the fact that health status tends to differ by both housing status as well as likelihood for prescription of medication at ED discharge.

The use of this secondary data source means that data describing the homelessness characteristics of homeless ED users is also unavailable, as this information is not necessary for the fulfillment of the NHAMCS-ED objectives. Homeless individuals in the U.S. comprise a heterogeneous population whose health, health care use, and health-determining characteristics tend to differ markedly by certain homelessness characteristics. These include family status, shelter status, length of time homeless, and urban, versus a rural, location. It is possible that, like other health measures, the study outcome, medication prescription at ED discharge, could be related to these characteristics, but due to the lack of information in the NHAMCS-ED, this study has no way of analyzing these potential associations. While the NHAMCS-ED data doesn't specify the urban or rural location of the ED users, this study uses the location of the hospital either in a MSA or outside of a MSA as a proxy for this information. However, the use of an ED located in a MSA does not mean that the individual also resides in that MSA. Oftentimes, the

closest ED available to residents of rural communities is one located at an urban hospital. Thus, homeless individuals residing in both urban and rural areas may be included in this study.

It is also common, when using secondary data, that the operational definitions used by the original investigators are not ideal for the study at hand. The definition for homelessness used by NHAMCS-ED developers is different from that of government organizations as well as those found in the literature. This creates a potential misclassification bias. Patient housing status in the NHAMCS-ED is categorized into one of the following categories: private residence, nursing home, homeless, and other.[112—117] Any patient with a residence marked as either "nursing home" or "other" are excluded from this study. Homeless housing status is chosen if the patient "has no home (e.g., lives on the street), or patient's current residence is a homeless shelter." Definitions of homelessness by government organizations as well as those seen in the literature also consider an individual to be homeless if they are living in a hotel, or if they are in jail or otherwise institutionalized, but have no place of residence to return to.[2,3] These two additional living situations are categorized as "other" in the NHAMCS-ED. Thus, it is important when extrapolating these results to consider that they may not apply to homeless individuals in living situations that are not on the street or in a homeless shelter.

Other limitations of using secondary data result from the requirement that identities of both the patients and hospitals remain anonymous. Thus, records at the individual patient or hospital level are not available. The basic sampling unit is the patient visit or encounter. Thus, while each visit is treated as an independent observation, one patient could be accounting for multiple encounters. When a small number of patients accounts for a large number of ED visits, there is the potential for that subgroup of repeat visitors to over-represent the sample of ED users in the U.S. which can affect the external generalizability of the survey. There is also the potential

for repeated visits to be a confounding factor in this analysis. Studies have shown that homeless individuals are more likely to repeatedly use the ED, and while there is no information in the literature regarding the impact of repeat visits on prescribing patterns, a repeated visit may affect the decision-making of the prescribing provider.[37,38,39] For each patient encounter, the NHAMCS-ED data indicates whether or not the patient was seen in the same ED for the same problem within the last 72 hours, which provides some insight into the frequency of repeat visits in the sample overall, as well as compare the frequency of repeat visits between homeless and nonhomeless patients. However, any visits that took place by a patient more than three days from the current visit, or if a visit did occur but it was for a different problem, then whether or not a repeat visit occurred by the same patient will remain unknown.

At the hospital level, because certain variables describing the hospital are de-identified, such as ownership or its status as a teaching hospital, controlling for effects that may occur as a result of differing characteristics across hospitals is not possible. For example, it has been found that prescribing patterns differ among interns and residents compared to attending physicians or hospitalist, and if one study group is more inclined than the other to visit a teaching hospital, that could confound our results. Nothing in the literature indicates that homeless individuals are more likely to visit a teaching hospital. However, within teaching hospitals, homeless patients are more likely to have their care provided by a medical resident or intern compared to housed people, which is a potential confounder that is being controlled for in this study.[40]

5.9 Study Conclusions

Among predisposing characteristics, age and gender differed significantly between homeless and nonhomeless ED users. A higher proportion of homeless ED users were older (45-54, 55-64), and male. Among enabling characteristics, insurance status differed significantly

between homeless and nonhomeless ED users. A higher proportion of homeless ED users were covered by Medicaid and Self-pay, and a higher proportion of nonhomeless ED users were covered by Private insurance. Among Need characteristics, ED diagnosis, pain assessment, and patient-reported pain differed significantly between the two groups. A greater proportion of homeless individuals were diagnosed with mental health and substance use conditions, and a smaller proportion were diagnosed with chronic and acute physical health conditions. A smaller proportion of homeless ED users had a pin assessment and tended to report less pain compared to nonhomeless users.

Among ED use characteristics, arrival by ambulance, wait time to be seen, ED disposition, length of ED visits, and geographic region differed significantly between homeless and nonhomeless ED users. A greater proportion homeless ED users arrived by ambulance, had an ED visit in the last 72 hours, had longer wait times, and had longer length of ED visit. A greater proportion of homeless ED visits resulted in a transfer from the ED to another facility, and occurred in the Western region of the U.S.

Among medication prescribing characteristics, receipt of a medication at D discharge, schedule of controlled medications prescribed at ED discharge, and opioid prescribing at ED discharge differed significantly between homeless and nonhomeless ED users. A smaller proportion of homeless ED users received a medication prescription at ED discharge, were prescribed a Schedule II prescription at ED discharge, and received an opioid prescription at ED discharge.

The likelihood of medication prescribing at ED discharge did not differ significantly between homeless and nonhomeless ED users after controlling for predisposing, enabling, need, and ED use characteristics. A decomposition analysis found that ED diagnosis contributed the

most to the disparity in medication prescribing between homeless and nonhomeless ED users. Among homeless ED users, those with Medicare or Other payer, those with a substance use condition, and those whose visit was located in the Northeast region of the U.S. were significantly less likely to be prescribed a medication at ED discharge.

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Appendix 1. Andersen-Gelberg Behavioral Model for Vulnerable Populations[90]

Population Characteristics				
Predisposing →	Enabling →	Need →	Health Behavior →	Outcomes
Traditional Domains				Traditional / Vulnerable Domains
Demographics Age Gender Marital status Veteran status	Personal/Family Resources Regular source of care Insurance Income Social support Perceived barriers to care	Perceived Health General population health conditions	Personal Health Practices Diet Exercise Self-care Tobacco use Adherence to care	Health Status Perceived health Evaluated health
Health Beliefs Values concerning health and illness Attitudes toward health services Knowledge about disease Social Structure Ethnicity Education Employment Social networks Occupation Family size Religion	Community Resources Residence Religion Health services resources	Evaluated Health General population health conditions	Use of Health Services Ambulatory care Inpatient care Alternative health care Long-term care	Satisfaction with Care General satisfaction Technical quality Interpersonal aspects Coordination Communication Financial aspects Time spend with clinician Access / Availability /Convenience Continuity Comprehensiveness Administrative hassle
Vulnerable Domains				
Social Structure Country of birth Acculturation / Immigration / Literacy Sexual Orientation	Personal/Family Resources Competing needs Hunger Public benefits Self-help skills	Perceived Health Vulnerable population health conditions	Personal Health Practices Food sources Hygiene Unsafe sexual behaviors	

	Ability to negotiate system Case manager / conservator Transportation Information sources	
Childhood characteristics Residential history Living conditions Mobility Length of time in the community Criminal behavior / prison history Victimization Mental illness Psychological resources Substance abuse	Community Resources Crime rates Social services resources	Evaluated Health Vulnerable population health conditions

Vita

Lauren Scott Cox was born on November 17, 1983 in Richmond, Virginia and is an American citizen. She graduated from Lloyd C. Bird High School, Chesterfield County, Virginia in 2012 and received her Bachelor of Science in Biology and Bachelor of Arts in Spanish from Virginia Commonwealth University, Richmond, Virginia in 2008. After receiving her Doctor of Pharmacy degree from Virginia Commonwealth University in 2012, Lauren worked part-time as a registered pharmacist in Richmond, Virginia while attending graduate school.