VARIABLE-CENTERED VERSUS PERSON-CENTERED APPROACHES IN EXAMINING THE U.S. OPIOID EPIDEMIC: UNDERSTANDING METHODOLOGICAL DIFFERENCES

A Dissertation

by

FRANCISCO ALEJANDRO MONTIEL ISHINO

Submitted to the Office of Graduate and Professional Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Chair of Committee,	Tamika Gilreath
Committee Members,	Idethia Shevon Harvey
	Patricia Goodson
	Xiaohui Xu
Head of Department,	Melinda Sheffield-Moore

August 2019

Major Subject: Health Education

ABSTRACT

In 2017, the U.S. Department of Health and Human Services acknowledged the U.S. opioid epidemic, although the first wave was traced to the 1990s. As each year passed, the overall incidence and prevalence of opioid misuse, as well as the human and economic costs, increased. Current conventional misuse interventions targeting opioid prescription incidence have provided little amelioration to the public health burden and are projected to have a negligible impact in the coming years. Although current analytic approaches have been instrumental in identifying the risk factors associated with opioid misuse, these analytic approaches have been limited. The majority of these analytic approaches have been variable-centered, which help identify risk factors by estimating relationships on variables, not persons at risk. Person-centered approaches provide the ability to not only identify risk factors but also identify previously unobserved risk profiles. To identify opioid misuse risk factors and at-risk groups, I first performed a systematic literature review. I identified all known risk factors associated with opioid misuse from January 1999 to January 2019 from the review. I then used a variable-centered approach on the 2017 National Survey on Drug Use and Health (NSDUH) among noninstitutionalized U.S. adults aged 18 and older to test the associations of known risk factors by means of logistic regression. The logistic regression findings indicated that age, residence, employment, criminality, overall health, mental health, and other substance dependences/abuses were significant population-level risk factors. The person-centered approach using latent class analysis on the 2017 NSDUH identified four

opioid misuse subgroups: (1) single opioid users (25.7% of sample); (2) prescription or combination opioid user (4.7% of sample); (3) prescription opioid user (14.5% of sample); and (4) mixed opioid use (55.2% of sample). Prescription or combination opioid users were considered to be the highest risk subgroup because they had the highest conditional probability of using a combination of heroin and prescription opioids. This subgroup represents a possible transition group from purely prescription opioids to combinatorial use. Findings revealed that the opioid epidemic is multifaceted and should use both targeted variable-centered and person-centered approaches to tailor salient intervention programs to stem the opioid epidemic.

DEDICATION

I dedicate this work to my younger siblings Karlita and Tiki, as well as to my current and former mentees and underlings (i.e., Dino, Bernice, Sharmila, Marc, Rita, Mason, Grant, Bridget, Catherine, Hanne, Cara, Emily, KT, Hannah, Caitlin, Caroline, Cassandra, Chinwe, Nathan, Tara, Jordan, Joseph, Eric, Aubrey, Kaitlyn, Sarah, Samantha, Harrison, Yari, Larry, Rohith, Kayleyne, Safa, Alyssa, Jessica, Shay, Alana, Venessa, Jackie, Abbey, and Claire). This work is dedicated to them in order to demonstrate how nothing is out of reach or improbable with hard work. Finally, my last dedication goes to Raya and Reed, and to their future, in hopes that they may live in an equitable world that my research can contribute to building.

ACKNOWLEDGEMENTS

I would like to thank my committee chair, Dr. Tamika "G" Gilreath, and my committee members, Dr. Patricia Goodson, Dr. Idethia Shevon Harvey, and Dr. Xiaohui Xu, for their guidance and support throughout the course of this research. I would also like to thank the Transdisciplinary Center for Health Equity Research, as well as the Aggie Research Program, for the support they provided to conduct my research. Thanks also go to Dr. Gary King from the Department of Biobehavioral Health at Penn State University for his support and encouragement.

In addition, I would like to thank my friends and colleagues and the Department of Health and Kinesiology faculty and staff for making my time at Texas A&M University a great experience—especially Dr. Rahma Mkuu. Special thanks to the Aggie Research Scholars working in my lab for their excitement and eagerness that made research a more fulfilling experience. I would also like to thank my friends Dr. Philip McNab and Dr. Amanda Alexander for their help in keeping me sane throughout my Ph.D. trajectory, because without them I would not have made it this far. Thanks also go to Qian Ji and Jales Fonseca, future Ph.D.'s and writing partners, without whose motivation my dissertation would not have been completed. I also extend thanks to my future mentor, Dr. Faustine Williams, for her encouragement and support. Finally, thanks to my grandparents, mother, stepfather, and father for their encouragement and to my wife, Jamie, for her patience and love.

CONTRIBUTORS AND FUNDING SOURCES

Contributors

This work was supervised by a dissertation committee consisting of Dr. Gilreath, Dr. Goodson, and Dr. Harvey of the Department of Health and Kinesiology in the College of Education and Human Development and Dr. Xiaohui Xu of the Department of Epidemiology and Biostatistics, School of Public Health.

I consulted with Margaret Foster from TAMU Libraries Systematic Review Services to ensure that the literature search for the systematic literature review in Chapter II was exhaustive, as well as to ensure that the reporting of information was as complete as possible. All other work conducted in the course of this dissertation was completed by me independently.

Funding Sources

My graduate studies were supported by a research fellowship and scholarship from Texas A&M University and a research fellowship from the Ford Foundation and Alfred P. Sloan Foundation. The contents of this dissertation are solely the responsibility of the author and do not necessarily represent the official views of the University, the Ford Foundation, or the Sloan Foundation.

NOMENCLATURE

CBSA	Core-Based Statistical Area
HCV	Hepatitis C virus
HHS	U.S. Department of Health & Human Services
HIV	Human immunodeficiency virus
K6	Kessler-6 Distress Scale
NSDUH	National Survey on Drug Use and Health
OMB	Office of Management and Budget
SAMHSA	Substance Abuse and Mental Health Services Administration
SES	Socioeconomic Status
TAMU	Texas A&M University

TABLE OF CONTENTS

Page

LIST OF FIGURES

Page

LIST OF TABLES

Page

CHAPTER I

INTRODUCTION

Characterizing the U.S. Opioid Epidemic

The U.S. Department of Health and Human Services (2019) declared a public health opioid emergency in 2017, although the first wave of the epidemic can be traced to the early 1990s. Currently, estimates indicate that 21 to 29% (approximately 11.4 million) of U.S. patients medically prescribed opioids for chronic pain misuse them (National Institute on Drug Abuse, 2019; U.S. Department of Health and Human Services, 2019). Of those misusing, 8 to 12% develop a misuse disorder (U.S. Department of Health and Human Services, 2019). This misuse can lead to opioid dependence and abuse in medical users, as well as nonmedical users (Jones, 2017).

Opioid misuse is defined as taking prescription pain relievers in a manner not indicated by a health professional. This type of misuse includes using another individual's prescription, acquiring pain relievers illegally (i.e., without a prescription; drug dealer), or taking the pain reliever for a desired psychological and/or physiological effect (i.e., to get high; National Institute on Drug Abuse, 2019; U.S. Department of Health and Human Services, 2019). Misuse also involves the use of illicit opioid substances like heroin. In 2017, 886,000 people reported using heroin, with 81,000 using for the first time (National Institute on Drug Abuse, 2019) and 652,000 estimated to have a use disorder (Center for Behavioral Health Statistics and Quality, 2018). Moreover, 80% of people who used heroin were first reported to misuse prescription

opioids (U.S. Department of Health and Human Services, 2019), and 4 to 6% of individuals misusing prescription opioids transitioned to heroin (U.S. Department of Health and Human Services, 2019). Regardless of which was used first, opioids have a highly addictive nature, with various health consequences that become more apparent year to year.

Opioid use affects multiple organ systems, and with continuous use has been shown to deteriorate these systems, as well as cause various negative health outcomes. General health issues include constipation, sleep apnea, bone fractures, and hypothalamic-pituitary-adrenal axis dysregulation (U.S. Department of Health and Human Services, 2019). Other health risks associated with intravenous opioid use are an increase in human immunodeficiency virus (HIV) and hepatitis C virus (HCV) infection (U.S. Department of Health and Human Services, 2019). An indirect health risk, but one of note, is the rising incidence of children born with withdrawal syndrome because of the mother's opioid use and misuse (National Institute on Drug Abuse, 2019). The ultimate consequence of misuse is death by overdose, which is increasing in the United States.

Costs and Projections of Opioid Misuse

Human Cost of Opioid Misuse

A 30% upsurge in opioid overdose was reported from July 2016 through September 2017 in 45 states (U.S. Department of Health and Human Services, 2019). Related deaths have increased 345% from 2001 to 2016 (i.e., from 33.3 to 130.7 deaths per million population), with more than 42,000 overdose deaths reported in 2016—higher than any previous year on record (National Institute on Drug Abuse, 2019).

Opioid misuse led to more than 1.68 million years of life lost in 2016 (Gomes, Tadrous, Mamdani, Paterson, & Juurlink, 2018). Of all opioid overdoses, 40% of deaths involved prescription opioids (National Institute on Drug Abuse, 2019). Current estimates indicate that over 130 people die every day from opioid overdose (National Institute on Drug Abuse, 2019), and the public health burden will only grow since projections estimate a 61% increase by 2025 (Chen et al., 2019). A projected status quo model—that is, a model based on if current misuse and overdose death trajectories continue unabated—estimated that there will be 235,000 opioid-related deaths (i.e., 85,000 from prescriptions and 150,000 from heroin) from 2016 to 2020 (Pitt, Humphreys, & Brandeau, 2018). Furthermore, the same status quo model projected 510,000 opioid-related deaths (i.e., 170,000 from prescriptions and 340,000 from heroin) from 2016 to 2025 (Pitt et al., 2018). The cost in human life of opioid abuse is heavy and may be underreported (Seth, Rudd, Noonan, & Haegerich, 2018).

Economic Costs of Opioid Misuse

The economic burden of opioid misuse was estimated to have cost the U.S. over $78.5 billion in 2013, which included both nonfatal and fatal costs (Florence, Zhou, Luo, & Xu, 2016). These estimates include amounts calculated from healthcare, substance use treatment, justice system, and lost productivity costs. The aggregate societal cost was higher in nonfatal costs ($56.990 billion) than in fatal costs ($21.513 billion) (Florence et al., 2016). Moreover, while opioid misuse and overdose deaths are projected to increase, prevention strategies and intervention programs are not ameliorating the burden

of the opioid epidemic because mainstream universal interventions targeting opioid misuse have had mixed results.

Projected Trajectories of Opioid Misuse Interventions

Current predictive models for interventions targeting the decrease of prescription opioid misuse are bleak; they project a decrease of overdose deaths by only 3.0 to 5.3% (Chen et al., 2019). If frontrunner interventions designed to decrease the incidence of misuse continue on a modest trajectory, they would have a minimal impact on the projected course of overdose deaths between 2016 and 2025 when compared to a constant-incidence model (Chen et al., 2019). The modest-incidence-decrease model projected an overall reduction of 3.8%, which is a 2.0% decrease in illicit opioid deaths and 10.7% decrease in prescription opioid deaths (Chen et al., 2019). The worst-case scenario model, in which opioid fatality and incidence would stabilize by 2025, projected a continuous increase of overdose deaths for which any level of intervention would have no decreasing effect (i.e., bend the curve) on overdose deaths (Chen et al., 2019). The majority of deaths (88%) in this model would be assignable to illicit opioids (Chen et al., 2019). The cumulative effect on the number of overdose deaths from 2016 to 2025 from misuse interventions in the worst-case scenario model would be 3.0% to 4.3% (Chen et al., 2019). The best-case scenario model, in which the decrease in incidence of prescription opioid misuse would be at a 50% higher rate than historical trends, would decrease overdose deaths by 5.3%—a 2.8% decrease in illicit opioid deaths and 14.9% decrease in opioid prescription deaths (Chen et al., 2019). Conclusively, the models projected by Chen et al. (2019) revealed that general

prevention and intervention programs will have minimal effects on opioid misuse overdose deaths.

Pitt et al. (2018), in a similar modeling study, projected how 11 interventions under a status quo trajectory would change overdose deaths, life years, and quality-adjusted life years. Over a projected 5-year intervention, the promotion of naloxone availability, needle exchange programs, medication-assisted treatment, and psychosocial treatment were found to increase life years and quality-adjusted life years, as well as reduced opioid deaths. In the same projection, reduced prescribing for pain patients and surfeit opioid management increased life years and quality-adjusted life years as it reduced opioid prescriptions and related deaths. However, in this model, prescription users with dependence switched to heroin use. The switch to heroin among patients with reduced prescriptions for pain and excess opioid management interventions were found to increase heroin-related deaths. The largest projected reduction of deaths was 4%, accomplished by increasing the availability of naloxone. Similar to Chen et al.'s (2019) projections, Pitt et al. (2018) found that no single policy in their 5- and 10-year projections substantially intervened on opioid-related deaths.

Overall, the findings by Chen et al. (2019) and Pitt et al. (2018) suggest that current intervention strategies must be tailored to have a meaningful impact on the opioid epidemic and allude to the multidimensional and dynamic nature of the epidemic. Targeted interventions and policies are needed to improve on misuse outcomes, as well as mitigate the associated public health burden. Usually, this improvement is accomplished by accounting for multiple biopsychosocial factors such as demographic

characteristics, socioecological indicators, general and mental health status, as well as co-substance dependence and abuse. In this manner, the most successful public health strategies identify the salient factors that can be hidden in the epidemiological data to address unique, high-risk subgroups.

Risk Factors Associated with Opioid Misuse

Critical to curbing the impact of the opioid epidemic is gaining an understanding of the etiology of misuse—that is, the factors leading to dependence and abuse. Of importance is understanding overdose risk profiles and deaths across demographic characteristics, such as age, race/ethnicity, biological sex, sexual identity, educational attainment, and employment. Epidemiological, descriptive, and variable-centered approaches—methods to describe the associations between variables—have used various demographic characteristics to independently and collectively assess their relationship to opioid misuse that leads to dependence and abuse. When analyzing these epidemiological studies, the media has primarily focused on middle-income, non-Hispanic Whites; however, misuse and overdose deaths occur in other groups depending on risk and protective factors. Non-Hispanic Whites and Native Americans/Alaska Natives are the groups most likely to be impacted by opioid overdose deaths; nevertheless, affected groups increase or decrease in rates of overdose death from year to year (Joshi, Weiser, & Warren-Mears, 2019; Scholl, Seth, Kariisa, Wilson, & Baldwin, 2019).

Current Epidemiological Trends in the U.S. Opioid Epidemic

Scholl et al. (2019) reported that from 2016 to 2017, opioid-involved overdose deaths increased among both sexes and among those over the age of 25. The largest increase reported was among males aged 25 to 44 years old (i.e., increase of 4.6 per 100,000). During this same time span, overdose deaths increased in non-Hispanic Whites and Blacks, as well as Hispanics, with the largest relative change occurring among non-Hispanic Blacks. Prescription opioid-related death rates remained stable across all racial/ethnic groups in most states. At the same time, heroin-related overdose deaths declined among males and the 15-24 age group. While heroin-related overdose death rates declined overall in 2017 compared to 2016, death rates increased among older adults ages 55 and above. Those over 65 had the largest relative rate increase. Death rates also increased among racial/ethnic groups, and non-Hispanic Blacks had the largest relative rate increase.

Studies Examining Opioid Misuse Risk Factors

The epidemiological findings presented by Scholl et al. (2019) revealed a complex relationship between sociodemographic factors and opioid misuse. Age was a significant indicator, particularly among younger age groups. Older adults, previously overlooked, have presently become a major focus. Among older adults, the younger age groups of 50-64 have been found to be most at-risk of opioid misuse when in chronic pain (Chang, 2018) and when using emergency department services (Choi, DiNitto, Marti, & Choi, 2018). Age has generally been a definitive risk factor in opioid misuse, as has race/ethnicity at an epidemiological level. However, when considering non-

epidemiological studies, race/ethnicity had a similarly tenuous relationship with opioid misuse as did age. The relationship of race/ethnicity to opioid misuse must be contextually addressed, as myriad other health disparity studies on any given outcome have demonstrated. The current opioid misuse literature has found that race/ethnicity alone is not a strong predictor for misuse when considered in the context of other biopsychosocial factors.

For instance, race/ethnicity must be considered in conjunction with other sociodemographic factors like sex/gender. Nicholson and Vincent (2018) observed that the prevalence of prescription opioid misuse varied among Black women and men. Nicholson and Vincent found that among Black women, lower socioeconomic status (SES) increased the probability of misuse, while older age, higher educational attainment, and rural residence lowered the probability. Substance diversion from "drug dealers," illicit substances, marijuana, nicotine use, other prescription misuse, and poor self-reported health increased the probability of misuse among Black men. Sex/gender independently was less clear in its relationship with opioid misuse (Nicholson & Vincent, 2018). Although men have been found to be more likely to misuse opioids at the population level, women in certain cases have been found to be at higher odds of misusing (Huhn, Tompkins, Campbell, & Dunn, 2019; Serdarevic, Striley, & Cottler, 2017). For example, women catastrophizing pain—perceiving pain in a more intense and exaggerated manner compared to others—were more likely to misuse opioids (Huhn, Tompkins, Campbell, & Dunn, 2019). Other studies have found women to have higher lifetime prescription opioid use compared to men (Serdarevic, Striley, & Cottler, 2017).

Nonmedical prescription opioid use among females 24 and older were also found to use other illicit substances at 1.9 higher odds compared to males (Tetrault et al., 2008).

Other socioecological and sociodemographic variables (although understudied), like criminality and sexual identity, have been associated with misuse. Individuals with criminality or involvement with the legal system had a prevalence of 22.4% for prescription opioid use, 33.2% for prescription opioid misuse, 51.7% for prescription opioid use disorder, and 76.8% for heroin use (Winkelman, Chang, & Binswanger, 2018). Winkelman et al. (2018) suggested that individuals using opioids have high levels of criminal justice system involvement, as well as complex health profiles. Similarly, Pierce et al. (2017) found that, when adjusting for cocaine use, sex/gender, age, and birth cohort, individuals testing positive for opioid use had higher rates of criminality. Gender differences were observed in females, with a larger rate ratio increase compared to males in opioid use initiation. Though findings appear clearly defined, both studies adjusted their models to account for multiple sociodemographic characteristics.

Sexual minorities, such as those identifying as gay/lesbian or bisexual, have been situationally reported to be at risk of misusing opioids (Duncan, Zweig, Hambrick, & Palamar, 2019; Kecojevic, Wong, Corliss, & Lankenau, 2015; Schuler, Rice, Evans-Polce, & Collins, 2018). For instance, Duncan et al. (2019) found that those identifying as bisexual or gay/lesbian were at 78% or 115% increased odds for opioid misuse than heterosexuals, respectively. Stratifying analyses by sex, Duncan et al. observed that these associations became limited to females only. Inversely, Kecojevic et al. (2015) found that 18- to 29-year-old young men who have sex with men (YMSM) and who

suffered physical abuse and high levels of perceived stress during childhood were more likely to report opioid misuse. Schuler et al. (2018) took a more holistic approach to understand the disparities between sexual minorities and those identifying as heterosexual, accounting for not only sexual identity and sex/gender but also age and other substance dependence/abuse. Similar to Duncan et al. (2019), Schuler et al. (2018) found that, when compared to heterosexual women, bisexual women had high odds at all ages in all substance dependence/abuse outcomes. Those identifying as gay/lesbian individuals between the ages of 18 and 25 had elevated odds for substance use when compared to same-sex/gender heterosexuals.

General health and its role in opioid misuse is also not clearly understood. Most individuals who are prescribed opioid medications are attending to some type of physical pain. In some cases, in adjusted models, those who identified as being in poor health were more likely to misuse opioids (Nicholson & Vincent, 2018). Opioid misuse in light of mental health issues is also unclear because epidemiological studies have not focused on the role of mental health outcomes such as depression, anxiety, or suicidality. However, some mental health prevalence on opioid misuse and the interplay of mental health issues—such as negative emotions from chronic pain (Garland et al., 2018), mental illness (Novak, Feder, Ali, & Chen, 2019; Prince, 2019), and suicidality (Ashrafioun, Heavey, Canarapen, Bishop, & Pigeon, 2019; Conroy & Bjork, 2018; Prince, 2019)—have been found to have mixed associations to opioid misuse.

Health insurance has also been identified as a having a role in opioid misuse, although the relationship is not well defined. Schatman (2011) argued that due to the

profiteering nature of insurance companies, there is a perpetuation of suboptimal pain management that facilitates opioid misuse. Thus, having health insurance actually encourages opioid misuse, regardless of the larger macroeconomic motivations that lead to the facilitation of opioid access to patients. Wettstein (2019), for instance, observed a dose-response relationship with access to insurance on opioid overdose deaths. However, the young adult provision of the Affordable Care Act was found to reduce opioid death among 19- to 25-year-olds. Specifically, for every 1% more coverage, there is a 19.8% reduction of opioid deaths among young adults (Wettstein, 2019).

The use of other substances, whether legal, illicit, or prescribed, has also been linked to misuse. Most concurrent substances have been positively associated with opioid misuse (Degenhardt et al., 2013; Grigsby & Howard, 2019), such as nicotine and tobacco dependence (John et al., 2019; Rajabi, Dehghani, Shojaei, Farjam, & Motevalian, 2019), alcohol overdose (Fernandez et al., 2019), sedatives (Kelley et al., 2019), methamphetamines (Ellis, Kasper, & Cicero, 2018), tranquilizers (Jones, Mogali, & Comer, 2012; Maree, Marcum, Saghafi, Weiner, & Karp, 2016), and other analgesics (Peckham et al., 2018). Marijuana tends to have a tenuous relationship; use has been associated with both increased and decreased opioid use (Campbell, Hall, & Nielsen, 2018). Regardless of the findings, to determine the various risk factors that provide context for opioid misuse, two methodological approaches predominate: variable-centered and person-centered approaches.

Variable-Centered Versus Person-Centered Approaches

The literature is unclear regarding the contributing patterns of opioid misuse and patterns of biopsychosocial characteristics associated with increased likelihood of opioid use. Although variable-centered approaches clarify the relationship of variables to variables based on averages (Howard & Hoffman, 2017; Laursen & Hoff, 2006; Morin, Gagne, & Bujacz, 2016), it is generally acknowledged that these approaches cannot easily examine outliers (Gunver, Senocak, & Vehid, 2017; Prykhodko, Prykhodko, Makarova, & Pugachenko, 2017; Rousseeuw & Hubert, 2011). In addition, variable-centered approaches assume linear additive relationships between variables, which at times can be limiting since behavioral health risk factors are dynamic and do not accumulate in an additive fashion (Bámaca-Colbert & Gayles, 2010; Meeusen, Meuleman, Abys, & Bergh, 2018). Furthermore, regressive approaches are also often limited by variation or the lack thereof. If variables are collinear, the variation is decreased, and the relationship becomes tenuous. Often, the approach requires a more parsimonious model whereby important indicators are dropped from the model (Howard & Hoffman, 2017). Some of these indicators may be critical to determine salient risk profiles but will often be overlooked as outliers in public health research—although not so much in social sciences research.

A critical aspect to understanding risk in context is to identify and examine how combinations of behavioral and biopsychosocial factors co-occur. Using a person-centered approach provides a methodological platform to answer questions regarding the confluence of factors that might be associated with the risk of misusing opioids, which

can then lead to dependence or abuse. Person-centered approaches such as latent class analysis (LCA) allow the researcher to identify and examine co-occurring risk profiles that are not possible in variable-centered approaches because LCAs, rather than relying on traditional linear regressive methods, rely on a mixture analysis (Laursen & Hoff, 2006; Howard & Hoffman, 2017; Muthén & Muthén, 2000). Relationships are determined by classes or groups in which inclusivity or exclusivity of variables do not hinder the analysis as much as it would in a regression. LCA uses observed and measured indicators of various risk factors on latent outcomes, or an unobserved variable (Laursen & Hoff, 2006). It can identify various risk profiles from classes that can then be used to categorize individuals at differential risk (Howard & Hoffman, 2017; Muthén & Muthén, 2000). As such, the individual is not reduced to a sole variable but can be accounted for in greater complexity by analyzing a constellation of variables to identify their possible risk profile. For example, John et al. (2019) used LCA to assess the prevalence of opioid misuse and use disorder by sociodemographic indicators and past-year polysubstance use focusing on tobacco use among primary care patients.

Dissertation Purpose

To my knowledge, no person-centered approaches have been used to identify generalizable risk profiles of opioid dependence and abuse. Person-centered approaches (e.g., LCA) in public health research are burgeoning due to their ability to identify risk groups for targeted interventions. The goals of this dissertation were to fill the associated gaps in the opioid misuse literature and to expand person-centered analyses in public health research. To accomplish these goals, I derived three aims to compare and contrast

variable-centered and person-centered approaches and to scrutinize the use of these approaches in addressing the current opioid epidemic. **Aim 1** was a systematic review of the opioid misuse literature to identify the existing associations of demographic, socioecological, health, and substance co-use risk and protective factors on opioid dependence and abuse. Next, for **Aim 2**, I tested the findings/gaps from the systematic literature review by examining the risk and protective factors of opioid misuse using a variable-centered approach on a nationally representative sample. Biopsychosocial factors such as demographic characteristics, socioecological factors, health status, and other substance dependences or abuse status identified in the review were significant in developing the variable-centered model. The final aim (**Aim 3**) was to extend the previous findings/gaps from the literature review of Aim 1 and the variable-centered approach from Aim 2 by identifying and examining risk groups of opioid dependence or abuse using a person-centered approach. Biopsychosocial factors such as demographic characteristics, socioecological factors, health status, and heroin and/or pain reliever dependence or abuse were used to assess risk group/class membership. Covariates used were other substance dependences or abuse. Overall, biopsychosocial indicators were used to identify important risk factors for opioid misuse in the variable-centered model, while they provided a comprehensive risk profile in the person-centered model.

Last, for the purposes of this dissertation, I methodologically compared and contrasted the variable-centered and person-centered approaches used to identify opioid misuse risk. I synthesized the findings within and across methods, as well as suggested next steps for opioid-related public health research, prevention, and interventions to best

address the U.S. opioid epidemic. Using both approaches, I provided methodological context to best address the issues where current, conventional interventions are failing. For instance, the findings from the systematic literature review elucidated the quality of findings concerning opioid misuse risk factors. Using the latest nationally representative dataset of opioid dependence and abuse to test both variable-centered and person-centered approaches, I also elucidated the strengths and weaknesses of both variable-centered and person-centered methodologies in addressing the growing public health crisis in order to identify the population-level risk factors to opioid misuse, as well as identify risk subgroups currently dependent on or abusing opioids. By applying this process, prevention strategies and intervention programs can be designed to efficiently and efficaciously intervene in opioid misuse and overdose death.

Dissertation Overview

My dissertation is formatted into three publishable works and consists of five chapters. In Chapter I, I provided a brief overview of the opioid epidemic, the human and economic burdens, and the general risk factors associated with opioid misuse and overdose. I also provided an overview of variable-centered and person-centered approaches and their strengths and weaknesses. The focus of the introduction was to discuss the public health burden of opioid misuse and the merits of the two approaches in addressing the public health crisis and health disparities. Chapter II (Aim 1) is a systematic literature review that provides a reference frame for the known risk factors of opioid misuse. Specifically, the review addresses what is known about the impact of demographic, socioecological, health, and other substance dependences or abuse risks

and protective factors related to the opioid public health crisis. I highlight the findings of the opioid epidemic by the variable-centered and the person-centered approach and discuss how they have been applied to examine opioid dependence and abuse. Chapters III and IV describe the methodological applications of both the variable-centered approach (using a logistic regression) and the person-centered approach (using an LCA), respectively, on the 2017 National Survey on Drug Use and Health (NSDUH), which contains a nationally representative sample of noninstitutionalized U.S. adults. Chapter III (Aim 2) discusses a logistic regression to extend previous findings and gaps in the systematic literature review by examining the risk and protective factors of opioid dependence or abuse. In Chapter IV (Aim 3), I explore the use of an LCA to extend previous findings and gaps in the literature from Aim 1 and findings of the variable-centered approach from Aim 2 to identify at-risk groups. The person-centered approach helped identify risk subgroups in opioid misuse and key risk indicators and factors among subgroups. A design similar to John et al. was used to create a comprehensive assessment of opioid misuse. In the conclusion, Chapter V, I discuss and synthesize the relevant findings of Chapters III and IV. Chapter V highlights the strengths and weaknesses of each approach and the public health impact each has in addressing the opioid epidemic. This study was reviewed by the Texas A&M University Institutional Review Board (IRB protocol number 2019-0306).

References

Ashrafioun, L., Heavey, S., Canarapen, T., Bishop, T. M., & Pigeon, W. R. (2019). The relationship between past 12-month suicidality and reasons for prescription opioid misuse. *Journal of Affective Disorders, 249,* 45-51. doi:10.1016/j.jad.2019.02.008

Bámaca-Colbert, M. Y., & Gayles, J. G. (2010). Variable-centered and person-centered approaches to studying Mexican-origin mother–daughter cultural orientation dissonance. *Journal of Youth and Adolescence, 39*(11), 1274-1292. doi:10.1007/s10964-009-9447-3

Campbell, G., Hall, W., & Nielsen, S. (2018). What does the ecological and epidemiological evidence indicate about the potential for cannabinoids to reduce opioid use and harms? A comprehensive review. *International Review of Psychiatry, 30*(5), 91-106. doi:10.1080/09540261.2018.1509842

Center for Behavioral Health Statistics. (2018). *2017 National Survey of Drug Use and Health final analytic codebook.* Rockville, MD: Substance Abuse and Mental Health Services Administration.

Center for Behavioral Health Statistics and Quality. (2018). *2017 National Survey on Drug Use and Health: Detailed tables*. Rockville, MD: Substance Abuse and Mental Health Services Administration.

Chang, Y.-P. (2018). Factors associated with prescription opioid misuse in adults aged 50 or older. *Nursing Outlook, 66*(2), 112-120. doi:https://doi.org/10.1016/j.outlook.2017.10.007

Chen, Q., Larochelle, M. R., Weaver, D. T., Lietz, A. P., Mueller, P. P., Mercaldo, S., . . . Chhatwal, J. (2019). Prevention of prescription opioid misuse and projected overdose deaths in the United States. *JAMA Network Open, 2*(2), e187621. doi:10.1001/jamanetworkopen.2018.7621

Choi, B. Y., DiNitto, D. M., Marti, C. N., & Choi, N. G. (2018). Emergency department visits and overnight hospital stays among persons aged 50 and older who use and misuse opioids. *Journal of Psychoactive Drugs*, 1-11. doi:10.1080/02791072.2018.1557356

Conroy, S. C., & Bjork, J. M. (2018). Death ambivalence and treatment seeking: Suicidality in opiate addiction. *Current Treatment Options in Psychiatry, 5*(3), 291-300. doi:10.1097/ADM.0000000000000451

Degenhardt, L., Whiteford, H. A., Ferrari, A. J., Baxter, A. J., Charlson, F. J., Hall, W. D., . . . Vos, T. (2013). Global burden of disease attributable to illicit drug use and dependence: Findings from the Global Burden of Disease Study 2010. *The Lancet, 382*(9904), 1564-1574. doi:10.1016/S0140-6736(13)61530-5

Duncan, D. T., Zweig, S., Hambrick, H. R., & Palamar, J. J. (2019). Sexual orientation disparities in prescription opioid misuse among U.S. adults. *American Journal of Preventive Medicine, 56*(1), 17-26. doi:10.1016/j.amepre.2018.07.032

Ellis, M. S., Kasper, Z. A., & Cicero, T. J. (2018). Twin epidemics: The surging rise of methamphetamine use in chronic opioid users. *Drug and Alcohol Dependence, 193*, 14-20. doi:10.1016/j.drugalcdep.2018.08.029

Fernandez, A. C., Bush, C., Bonar, E. E., Blow, F. C., Walton, M. A., & Bohnert, A. S. B. (2019). Alcohol and drug overdose and the influence of pain conditions in an addiction treatment sample. *Journal of Addiction Medicine, 13*(1). doi:10.1097/ADM.0000000000000451

Florence, C. S., Zhou, C., Luo, F., & Xu, L. (2016). The economic burden of prescription opioid overdose, abuse, and dependence in the United States, 2013. *Medical Care, 54*, 901-906. doi:10.1097/MLR.0000000000000625

Furukawa, T. A., Kessler, R. C., Slade, T., & Andrews, G. (2003). The performance of the K6 and K10 screening scales for psychological distress in the Australian National Survey of Mental Health and Well-Being. *Psychological Medicine, 33*, 357-362.

Garland, E. L., Hanley, A. W., Bedford, C. E., Zubieta, J.-K., Howard, M. O., Nakamura, Y., . . . Froeliger, B. (2018). Reappraisal deficits promote craving and emotional distress among chronic pain patients at risk for prescription opioid misuse. *Journal of Addictive Diseases*, 1-9. doi:10.1080/10550887.2018.1459148

Gomes, T., Tadrous, M., Mamdani, M. M., Paterson, J. M., & Juurlink, D. N. (2018). The burden of opioid-related mortality in the United States, 2001-2016. *JAMA Network Open, 1*(2), e180217. doi:10.1001/jamanetworkopen.2018.0217

Grigsby, T. J., & Howard, J. T. (2019). Prescription opioid misuse and comorbid substance use: Past 30-day prevalence, correlates and co-occurring behavioral indicators in the 2016 National Survey on Drug Use and Health. *The American Journal on Addictions*, 1-8. doi:10.1111/ajad.12866

Howard, M. C., & Hoffman, M. E. (2017). Variable-centered, person-centered, and person-specific approaches: Where theory meets method. *Organizational Research Methods, 21*(4), 846-876. doi:10.1177/1094428117744021

Huhn, A. S., Tompkins, D. A., Campbell, C. M., & Dunn, K. E. (2019). Individuals with chronic pain who misuse prescription opioids report sex-based differences in pain and opioid withdrawal. *Pain Med,* 1-6. doi:10.1093/pm/pny295

John, W. S., Zhu, H., Mannelli, P., Subramaniam, G. A., Schwartz, R. P., McNeely, J., & Wu, L.-T. (2019). Prevalence and patterns of opioid misuse and opioid use disorder among primary care patients who use tobacco. *Drug and Alcohol Dependence, 194*, 468-475. doi:10.1016/j.drugalcdep.2018.11.011

Jones, C. M. (2017). The paradox of decreasing nonmedical opioid analgesic use and increasing abuse or dependence—An assessment of demographic and substance use trends, United States, 2003–2014. *Addictive Behaviors, 65*, 229-235. doi:10.1016/j.addbeh.2016.08.027

Jones, J. D., Mogali, S., & Comer, S. D. (2012). Polydrug abuse: A review of opioid and benzodiazepine combination use. *Drug and Alcohol Dependence, 125*(1), 8-18. doi:10.1016/j.drugalcdep.2012.07.004

Joshi, S., Weiser, T., & Warren-Mears, V. (2019). Drug, opioid-involved, and heroin-involved overdose deaths among American Indians and Alaska Natives—Washington, 1999-2015. *MMWR Morbidity and Mortality Weekly Report, 67*, 1384-1387. doi:10.15585/mmwr.mm6750a2

Kecojevic, A., Wong, C. F., Corliss, H. L., & Lankenau, S. E. (2015). Risk factors for high levels of prescription drug misuse and illicit drug use among substance-using young men who have sex with men (YMSM). *Drug and Alcohol Dependence, 150*, 156-163. doi:10.1016/j.drugalcdep.2015.02.031

Kelley, M. L., Bravo, A. J., Votaw, V. R., Stein, E., Redman, J. C., & Witkiewitz, K. (2019). Opioid and sedative misuse among veterans wounded in combat. *Addictive Behaviors, 92*, 168-172. doi:10.1016/j.addbeh.2018.12.007

Kessler, R. C., Barker, P. R., Colpe, L. J., Epstein, J. F., Gfroerer, J. C., Hiripi, E., . . . Zaslavsky, A. M. (2003). Screening for serious mental illness in the general population. *Archives of General Psychiatry, 60*(2), 184-189.

Laursen, B., & Hoff, E. (2006). Person-Centered and Variable-Centered Approaches to Longitudinal Data. *Merrill-Palmer Quarterly, 52*(3), 377-389. doi:10.1353/mpq.2006.0029

Maree, R. D., Marcum, Z. A., Saghafi, E., Weiner, D. K., & Karp, J. F. (2016). A systematic review of opioid and benzodiazepine misuse in older adults. *The American Journal of Geriatric Psychiatry, 24*, 949-963. doi:10.1016/j.jagp.2016.06.003

Meeusen, C., Meuleman, B., Abys, K., & Bergh, R. (2018). Comparing a variable-centered and a person-centered approach to the structure of prejudice. *Social Psychology and Personality Science, 9*(6), 645-655. doi:10.1177/1948550617720273

Miller, J. J. (1978). The inverse of the Freeman-Tukey double arcsine transformation. *American Statistician, 32*(4), 138.

Morin, A. J. S., Gagne, M., & Bujacz, A. (2016). Call for papers: Person-centered methodologies in the organizational sciences. *Organizational Research Methods, 19,* 8-9.

Muthén, B., & Muthén, L. K. (2000). Integrating person-centered and variable-centered analyses: Growth mixture modeling with latent trajectory classes. *Alcoholism: Clinical and Experimental Research, 24*(6), 882-891. doi:10.1111/j.1530-0277.2000.tb02070.x

Nagelkerke, N. J. D. (1991). A note on a general definition of the coefficient of determination. *Biometrika, 78,* 691-692.

National Institute on Drug Abuse. (2019). *Opioid overdose crisis*. Retrieved from https://www.drugabuse.gov/drugs-abuse/opioids/opioid-overdose-crisis

Nicholson, H. L., & Vincent, J. (2018). Gender differences in prescription opioid misuse among U.S. Black adults. *Substance Use & Misuse*, 1-12. doi:10.1080/10826084.2018.1531427

Novak, P., Feder, K. A., Ali, M. M., & Chen, J. (2019). Behavioral health treatment utilization among individuals with co-occurring opioid use disorder and mental illness: Evidence from a national survey. *Journal of Substance Abuse Treatment, 98,* 47-52. doi:10.1016/j.jsat.2018.12.006

Nylund, K. L., Asparouhov, T., & Muthén, B. O. (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. *Structural Equation Modeling*, *14*, 535-569.

Peckham, A. M., Evoy, K. E., Covvey, J. R., Ochs, L., Fairman, K. A., & Sclar, D. A. (2018). Predictors of gabapentin overuse with or without concomitant opioids in a commercially insured U.S. population. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy*, *38*, 436-443. doi:10.1002/phar.2096

Pierce, M., Hayhurst, K., Bird, S. M., Hickman, M., Seddon, T., Dunn, G., & Millar, T. (2017). Insights into the link between drug use and criminality: Lifetime offending of criminally-active opiate users. *Drug and Alcohol Dependence, 179*, 309-316. doi:10.1016/j.drugalcdep.2017.07.024

Pitt, A. L., Humphreys, K., & Brandeau, M. L. (2018). Modeling health benefits and harms of public policy responses to the U.S. opioid epidemic. *American Journal of Public Health, 108*, 1394-1400. doi:10.2105/AJPH.2018.304590

Prince, J. D. (2019). Correlates of opioid use disorders among people with severe mental illness in the United States. *Substance Use & Misuse*, 1-11. doi:10.1080/10826084.2018.1559192

Prykhodko, S., Prykhodko, N., Makarova, L., & Pugachenko, K. (2017, May). Detecting outliers in multivariate non-Gaussian data on the basis of normalizing transformations. In *2017 IEEE First Ukraine Conference on Electrical and Computer Engineering (UKRCON)* (pp. 846-849).

Rajabi, A., Dehghani, M., Shojaei, A., Farjam, M., & Motevalian, S. A. (2019). Association between tobacco smoking and opioid use: A meta-analysis. *Addictive Behaviors, 92*, 225-235. doi:10.1016/j.addbeh.2018.11.043

Rousseeuw, P. J., & Hubert, M. (2011). Robust statistics for outlier detection. *Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery, 1*(1), 73-79. doi:10.1002/widm.2

Schatman, M. E. (2011). The role of the health insurance industry in perpetuating suboptimal pain management. *Pain Medicine, 12*, 415-426. doi:10.1111/j.1526-4637.2011.01061.x

Scholl, L., Seth, P., Kariisa, M., Wilson, N., & Baldwin, G. (2019). Drug and opioid-involved overdose deaths—United States, 2013-2017. *MMWR Morbidity and Mortality Weekly Report, 67*(5152), 1419-1427.

Schuler, M. S., Rice, C. E., Evans-Polce, R. J., & Collins, R. L. (2018). Disparities in substance use behaviors and disorders among adult sexual minorities by age, gender, and sexual identity. *Drug and Alcohol Dependence, 189*, 139-146. doi:10.1016/j.drugalcdep.2018.05.008

Serdarevic, M., Striley, C. W., & Cottler, L. B. (2017). Gender differences in prescription opioid use. *Current Opinion in Psychiatry, 30*(4), 238-246. doi:10.1097/YCO.0000000000000337

Seth, P., Rudd, R. A., Noonan, R. K., & Haegerich, T. M. (2018). Quantifying the epidemic of prescription opioid overdose deaths. *American Journal of Public Health, 108*, 500-502. doi:10.2105/AJPH.2017.304265

Tetrault, J. M., Desai, R. A., Becker, W. C., Fiellin, D. A., Concato, J., & Sullivan, L. E. (2008). Gender and non-medical use of prescription opioids: results from a national U.S. survey. *Addiction, 103*(2), 258-268. doi:10.1111/j.1360-0443.2007.02056.x

U.S. Department of Health and Human Services. (2019). *What is the U.S. opioid epidemic?* Retrieved from https://www.hhs.gov/opioids/about-the-epidemic/index.html

Wettstein, G. (2019). Health insurance and opioid deaths: Evidence from the Affordable Care Act young adult provision. *Health Economics*, 1-12. doi:10.1002/hec.3872

Winkelman, T. N. A., Chang, V. W., & Binswanger, I. A. (2018). Health, polysubstance use, and criminal justice involvement among adults with varying levels of opioid use. *JAMA Network Open, 1*(3), e180558. doi:10.1001/jamanetworkopen.2018.0558

CHAPTER II

A SYSTEMATIC LITERATURE REVIEW OF OPIOID MISUSE IN THE UNITED STATES

Introduction

The main objective of the systematic literature review was to identify reports of biopsychosocial characteristics as risk factors on opioid misuse from U.S. representative samples in the peer-reviewed and gray literature (e.g., conference proceedings, organizational reports, clinical trials, dissertations, theses). The secondary objective was to evaluate the findings on biopsychosocial characteristics as predictors of risk on opioid misuse. Biopsychosocial characteristics identified as risk factors included sociodemographic, socioecological, and health indicators, as well as other substances used. The studies eligible for inclusion provided the biopsychosocial characteristic risk factors that could be tested at the population-level and group-level on opioid misuse. Protocol will be registered under the PROSPERO International prospective register of systematic reviews.

Methods

Selection Criteria

All studies that reported the biopsychosocial characteristics of (a) only prescription opioid misuse, (b) only illicit opioid heroin misuse, or (c) prescription opioid and heroin misuse met the inclusion criteria. Studies conducted from January 1999 to January 2019 were included; where 1999 is a conservative timing estimate as to

when the opioid epidemic can be traced to according to the National Institute on Drug Abuse (2019). Findings from the literature needed to be completed using (a) a variable-centered approach (e.g., regressive methods) or (b) a person-centered approach (i.e., latent class analysis). Only studies conducted using a representative U.S. adult population were included. Any research conducted on non-U.S. groups or populations were excluded.

Factors

The biopsychosocial characteristic predictors of opioid misuse were gleaned from sociodemographic indicators (e.g., age group; race/ethnicity; sexual identity; family income; employment status; educational attainment), socioecological indicators (e.g., criminality), health indicators (e.g., general self-reported health; mental health status; suicidality; access to healthcare), and other substances used (e.g., nicotine; alcohol; marijuana; cocaine; methamphetamine; inhalants; tranquilizers; sedatives; stimulants).

Comparators/Control

Comparison or control groups demonstrated no opioid use or misuse. Comparison groups also varied by biopsychosocial characteristics on misuse outcome (e.g., sociodemographic-stratified analyses by sex/gender, race/ethnicity, and sexual identity). Some comparison groups were based on two categories, while other indicators had more than two.

Literature Searches

The following search engines for the peer-review literature were used: Medline, Embase, CINAHL, and Cochrane Central. The gray literature was searched using the following engines: Northern Light, WHOCRSP, ClinicalTrials.gov, and ProQuest Dissertations & Theses. The search parameters contained the following criteria: (1) exp Opioid-Related Disorders/; (2) ((opioid* or opiat*) adj2 (misuse* or abuse* or dependenc* or addict*)).ti,ab.; (3) 1 or 2; (4) exp review/ or exp meta analysis/ or exp Systematic Review/ or (literature adj3 review$).ti,ab.; (5) RETRACTED ARTICLE/ or (medline or medlars or embase or pubmed or cinahl or amed or psychlit or psyclit or psychinfo or psycinfo or scisearch or cochrane).ti,ab.; (6) (systematic$ adj2 (review$ or overview)).ti,ab.; (7) (meta?anal$ or meta anal$ or meta-anal$ or metaanal$ or metanal$).ti,ab.; (8) (4 and 5) or 6 or 7; (9) exp cohort analysis/ or exp longitudinal study/ or exp prospective study/ or exp follow up/ or cohort$.tw. or exp case control study/ or (case$ and control$).tw.; (10) exp regression analysis/; (11) exp health survey/; (12) exp cross-sectional study/; (13) (cross sectional or regression analys* or (survey* or questionnaire*)).ti,ab.; (14) or/10-13; (15) 3 and 14; (16) limit 15 to yr="1999 -Current"; (17) animals/ not humans/; (18) 16 not 17; (19) 8 and 3; (20) exp Risk Factors/; (21) (risk adj1 factor*).ti,ab.; (22) exp Models, Statistical/; (23) latent class analy*.ti,ab.; (24) or/20-23; and (25) 19 and 24.

Data Extraction for Selection and Coding

Paired reviewers (FAMI and CR: undergraduate research assistant) were used to standardize the review process in order to then have FAMI individually extract the data

for independent assessment. Data collected and reported were on the following: (a) study characteristics (e.g., author name, publication year, study design, sample size); (b) biopsychosocial characteristics (i.e., sociodemographic, socioecological, and health indicators, as well as other substances used) as risk factors of opioid misuse; and (c) outcome for opioid misuse (e.g., dependence, abuse, or overdose) and other substances concurrently used.

Strategy for Data Synthesis

I used Gwet's AC1 statistic to assess agreement for full-text eligibility and risk of bias assessment between myself and CR (research assistant). Agreement of over 0.8, which is considered very good, was achieved (Wongpakaran, Wongpakaran, Wedding, & Gwet, 2013). Odds ratios with an associated 95% confidence interval were presented. When odds ratio were not available, measures were converted to odds ratios.

Risk of Bias and Quality Assessment

I independently assessed risk of bias using The Joanna Briggs Institute (JBI) critical appraisal tools for use in JBI Systematic Reviews Checklist for Prevalence Studies, as detailed in Munn, Moola, Lisy, Riitano, and Tufanaru (2015). The checklist includes assessment of (1) sample frame; (2) appropriateness of participant sample; (3) adequate sample size; (4) sufficient description of participant sample; (5) data analysis undertaken with sufficient sample coverage; (6) validity of methods for identification of outcome; (7) outcome measured in a standardized, reliable method; (8) appropriate statistical analysis; and (9) response rate adequate.

Results

Study Selection

Of 3,650 reviewed reports, six were included in this systematic review. These six studies used nationally representative datasets to assess the prevalence of opioid misuse, which included nonmedical prescription opioid dependence or abuse, or heroin dependence or abuse. Studies also provided prevalence of biopsychosocial indicators on opioid misuse, assessment of nonmedical opioid misuse and/or substance co-use, frequency of substance use disorders, and health conditions of opioid users. See Figure 2.1 for the detailed PRISMA flow chart (available from PRISMA, 2015), which is based on the PRISMA Statement (Moher, Liberati, Tetzlaff, & Altman, 2009); see also PRISMA Explanation and Elaboration by Liberati et al. (2009). All PRISMA documents are distributed under the terms of the Creative Commons Attribution License (i.e., permits unrestricted use, distribution, and reproduction in any medium as long as the credit is given to the original author and source).

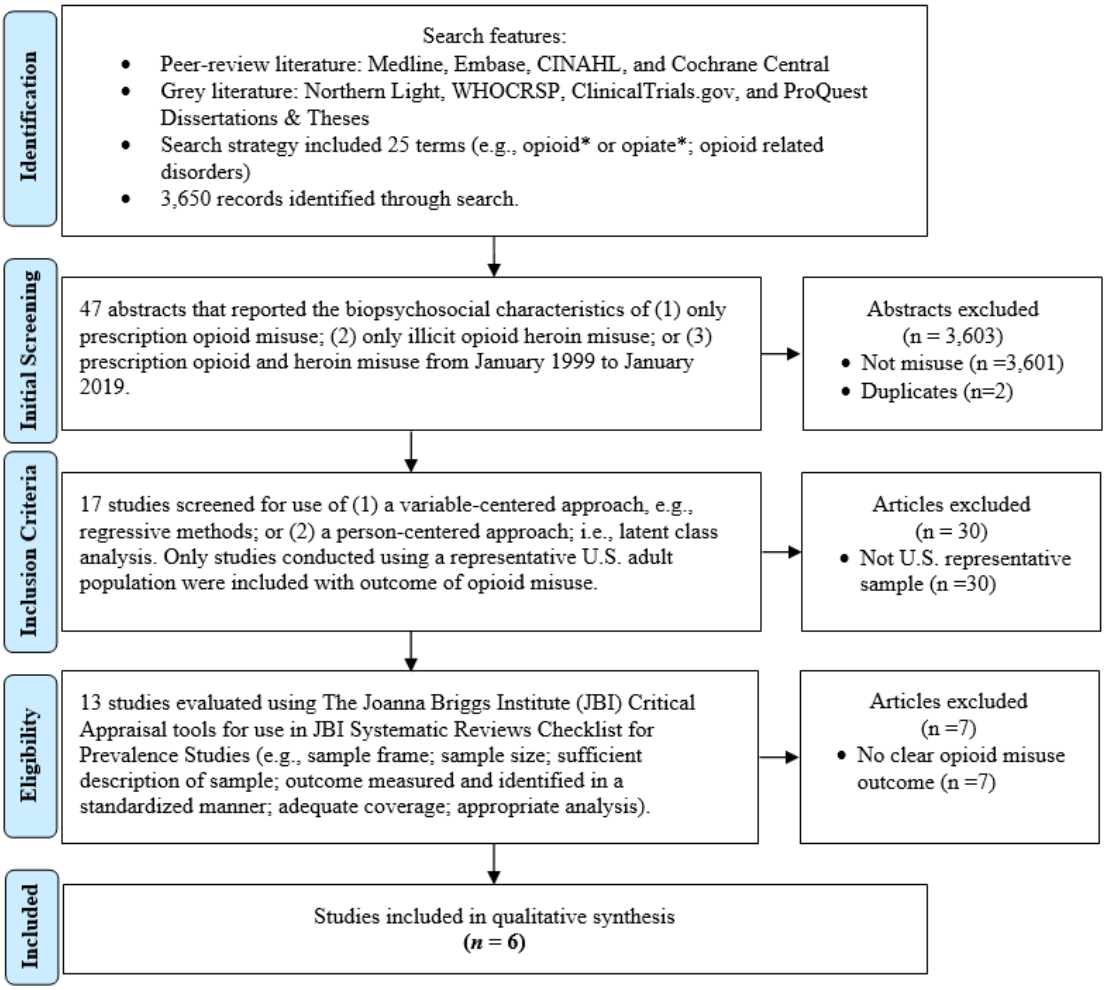

Figure 2.1. PRISMA flowchart of opioid misuse systematic literature review.

Study Characteristics

Biopsychosocial characteristics were identified as risk factors to opioid misuse. All studies selected for this systematic review could include both nonmedical prescription pain relievers and heroin use; however, none included heroin use within their classification of opioid misuse. No study came from the same journal or from a similar author group. All studies did use a cross-sectional survey study design to report prevalence of opioid misuse using some variable-centered approach for analysis (see Table 2.1).

Table 2.1. Study characteristics of selected studies for nonmedical opioid misuse prevalence (*N* = 6).

Authors (Year)	Study Design	Dataset	*N* (sample frame)	Opioid Misuse	Statistical Approach
Grigsby & Howard (2019)	Survey cross-sectional	2016 NSDUH [a]	26,033 (U.S. non-institutionalized representative sample)	Self-reported past month prescription opioid and other substance use: opioid only; opioid and licit, opioid and illicit, or opioid + polydrug; and recreational polydrug w/o opioid.	Variable-centered (multinomial logistic regression)
Mojtabai et al. (2019)	Survey cross-sectional	2015-16 NSDUH [b]	31,068 (U.S. non-institutionalized representative sample)	DSM-IV criteria for either abuse or dependence: past-year misused prescription opioids and no prescription opioid misuse.	Variable-centered (multinomial logistic regression)
Han et al. (2017)	Survey cross-sectional	2015 NSDUH [b]	19,000 (U.S. non-institutionalized representative sample)	DSM-IV criteria for either abuse or dependence: past-year prescription opioid use w/o misuse; prescription opioid misuse w/o use disorder; and prescription opioid use disorder.	Variable-centered (Descriptive)
Wu et al. (2011)	Survey cross-sectional	2001–02 NESARC [b]	43,093 (U.S. civilian representative sample)	DSM-IV criteria for either abuse or dependence and defined as the use of substance(s) either without a prescription; in higher amounts, more often, or longer than prescribed; or for a reason other than prescribed by a health professional. Nonmedical prescription opioid user: abuse or dependence.	Variable-centered (multinomial logistic regression)
Cicero et al. (2011)	Survey cross-sectional	SKIP [b]	1,983 (national sample of opioid treatment clients)	DSM-IV criteria for either abuse or dependence and the most frequently misused substance by participant. Method participants used for diverted (e.g., "pill mill," regular doctor, theft, dealer, sharing or trading) prescription misused in last 90 days.	Variable-centered (multinomial logistic regression)
Tetrault et al. (2008)	Survey cross-sectional	2003 NSDUH [a]	55,023 (U.S. non-institutionalized representative sample stratified)	DSM-IV criteria for either abuse or dependence, defined as the use of substance(s either without a prescription; in higher amounts, more often, or longer than prescribed; or for a reason other than prescribed by a health professional. Heroin use was assessed separately.	Variable-centered (chi-square, logistic regression)

Note. DSM-IV = Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition; MDE = major depressive episode; NSDUH = National Survey on Drug Use and Health; NESARC = National Epidemiologic Survey on Alcohol and Related Conditions; SKIP = Survey of Key Informants' Patients.

[a] 12 years old and over.

[b] 18 years old and over.

[c] Not significant in opioid only.

[d] Only in opioid + polydrug.

Study sample frames came from larger nationally representative surveys. Four studies came from NSDUH, one from NESARC, and the other from SKIP. Of the six studies, five clearly identified using the *Diagnostic and Statistical Manual of Mental Disorders* (Fourth Edition; DSM-IV) to define substance abuse or dependence. While Grigsby and Howard (2019) did not mention the use of DSM-IV criteria, the NSDUH does use DSM criteria to assess substance abuse or dependence from interview data, according to the Center for Behavioral Health Statistics (2018).

Furthermore, I identified four major categories within biopsychosocial characteristics: (1) sociodemographic factors; (2) socioecological factors; (3) health factors; and (4) other substance use or misuse. Sociodemographic factors included—at minimum—sex/gender, age groups, and race/ethnicity. Socioecological factors included some level of criminality. I grouped factors such as theft and sale of illegal substances, as well as history of arrest, parole, or probation. Health factors included self-reports of physiological health and mental health issues, as well as healthcare access. Physiological health issues ranged from sexually transmitted infections, to chronic medical conditions, to overall self-reported health. Mental health issues included some variation on reports of major depressive episodes, psychological distress, and suicidality. Healthcare access included some use of health insurance, state health benefits, or emergency department services. Other substance use or misuse included the use of single or multiple licit and/or illicit substances. See Table 2.2 for further details.

Table 2.2. Study characteristics of identified biopsychosocial factors as risk factors to opioid misuse.

	Biopsychosocial Characteristics			
Authors	**Sociodemographic Factors**	**Socioecological Factors**	**Health Factors**	**Other Substance Use/Misuse**
Grigsby & Howard (2019)	Sex/gender[±] Age group[±] Race/ethnicity[±] Family income[±]	Theft[†] Selling illegal drugs[±]	Major dep. ep.[†] STI[±] Suicidal ideation[†] Perc. treatment for subst. use[†]	Licit [b,f] Illicit [b,g] Polydrug (licit + illicit)[b]
Mojtabai et al. (2019)	Sex/gender[†] Age group[†] Race/ethnicity[±] Family income[± a] Education[±] Marital status[±] Employment status[±] Place of residence[±]	Any illegal activities[†d] Hist. of arrest, parole, or prob.[†d]	Chronic med. conditions[±] # of chronic med. conditions[†] Health ins. [±] # of healthcare visits[†d] ED visits[†d] Med. marij. use[†d] Psych. distress[†d] Major dep. ep.[†] Suicidal ideation[†d] Suicidal plans[†d] Suicide attempts[†d]	Prescription opioids[†d] Heroin use disorder[†d] Alcohol use disorder[†d] Other drug use disorder[†d] Any subst. use disorder[†d] Benzo. misuse[†d] Nicotine dependence[†c]
Han et al. (2017)	Sex/gender Age group Race/ethnicity Family income Education level Marital status Employment status Region of residence Place of residence		Health ins. Overall self-rated health ED visit [d] Chronic medical conditions Major dep. ep. Suicidal ideation	Tobacco use and disorder[h] Alcohol use and disorder[i] Marij. use and disorder[i] Cocaine use and disorder[i] Heroin use and disorder[j] Hallucinogen use and disorder[j] Inhalant use and disorder[j] Rx sed./tranq. use and disorder[j] Rx stimulant use and disorder[j]
Wu et al. (2011)	Sex/gender[↓] Age group Race/ethnicity Family income Education level[‡]			Lifetime subst. abuse treatment[↓‡] Family hist. of subst. abuse[↓]

Table 2.2. Continued.

Authors	Biopsychosocial Characteristics			
	Sociodemographic Factors	**Socioecological Factors**	**Health Factors**	**Other Substance Use/Misuse**
Cicero et al. (2011)	Sex/gender[†] Age group[±] Race/ethnicity Yearly income[±]	Theft[b]	Severe pain[e]	Inject primary drug[†]
Tetrault et al. (2008)	Sex/gender[b] Age group[† †] Race/ethnicity[†] Level of education completed[† †] Family income[† †] Marital status[† †] Employment status[† †] Missed 1+ day of work[† †c]		Overall self-rated health[†] Health insurance (w/o [d])[† †] State sponsored med. asst.[†d] # of times treated in ED[† †d] Needle use ever for drug[† †] Serious mental illness[† †]	Cigarette use[† †d] Crack cocaine use [† †d] Alcohol[† †d] Marij. use[† †d] Heroin use[† †d] Cocaine use[† †d] Hallucinogen use[† †d] Inhalant use[† †d] Nonmed. stimulant[† †d] Nonmed tranq. and sed.[† †d]

Note. asst. = assistance; benzo. = benzodiazepine; dep. = depressive; ED = emergency department; ep. = episode; hist. = history; ins. = insurance; marij. = marijuana; med. = medical; perc. = perceived; prob. = probation; psych. = psychological; Rx = prescription; sed. = sedative; STI = sexually transmitted infection; subst. = substance; tranq. = tranquilizer; w/o = without; if text is colored green then at some level is significant based on 95% confidence interval, or $p < .05$.

[†] significant under 95% confidence interval, or $p < .05$.

[±] variable at some level is significant under 95% confidence interval, or $p < .05$.

[ɬ] significant at some level for opioid abuse under 95% confidence interval.

[‡] significant at some level for opioid dependence under 95% confidence interval.

[†] significant at some level for female under 95% confidence interval.

[†] significant for male at some level under 95% confidence interval.

[a] Converted into federal poverty level.

[b] Used as a stratification variable, not indicator.

[c] In past month or 30 days.

[d] Past year or 12 months.

[e] Past week or 7 days.

[f] Alcohol and cigarettes.

[g] Marijuana, cocaine, crack, heroin, LSD, PCP, ecstasy, ketamine, DMT/AMT/FOXY, salvia, inhalants, and methamphetamine.

[h] Past-month, past-yr., lifetime w/o past yr. use, or never-use.

[i] Past-yr. use dis., past-yr. no use dis., lifetime w/o past yr. use, or never-use.

[j] Past-yr., past-yr., lifetime w/o past yr. use, or never-use.

Results of Individual Studies

The prevalence of biopsychosocial characteristics on nonmedical prescription opioid misuse, overall, has not been well scrutinized. Past-month comorbid prescription opioid misuse and recreational substance use were examined by Grigsby and Howard (2019) using the 2016 NSDUH. A multivariate logistic regression was used to examine sociodemographic, criminality, health factors, and concurrent substance on opioid use. Most prescription opioid misusers in the past-month reported using licit substances like nicotine, alcohol, and marijuana, as well as other illicit substances like cocaine, methamphetamines, and so on. Males and younger age groups had a substantially higher likelihood of past-month prescription opioid misuse with illicit substance or polysubstance use. Prescription opioid and polysubstance users had the greatest probability of past-year criminality (i.e., theft; selling drugs), mental health issues (e.g., suicidal ideations; major depressive episodes), as well as perceived need for treatment compared to opioid-only, opioid and licit, and opioid and illicit misusers (Grigsby & Howard, 2019).

Mojtabai et al. (2019) assessed the prevalence of biopsychosocial characteristics on nonmedical opioid misuse in the U.S. for individuals reporting opioid use in the past year with a weighted sample representing more than 89 million adults. Prevalence of prescribed opioids was defined as using a prescription longer than medically advised or frequently using larger doses, as well as DSM-IV criteria. Mojtabai et al. used multivariate logistic regression models and the machine-learning method of boosted regression to examine opioid misuse correlates. Prescribed-opioid misuse was strongly

associated with concomitant non-prescribed opioid misuse, history of criminality, mental health distress, benzodiazepine misuse and other substance abuse or dependence. Prescription opioid misuse was also found to be associated with opioid-use disorder (Mojtabai et al., 2019).

Tetrault et al. (2008) focused on expanding the literature on known gender-related biopsychosocial factors associated with nonmedical prescription opioid use. Tetrault et al. used a multivariable logistic regression on the 2003 NSDUH to assess risk factors for past-year prescription opioid use stratified by gender. Participants were ages 12 and older; however, I only focused on findings from 18 and older groups. Females and males reported alcohol abuse or dependence, marijuana, and other illicit substance use from nonmedical stimulants, cocaine, hallucinogens, sedatives and tranquilizers, all of which were associated with past-year prescription opioid use. Among females, for first illicit drug use reported at 24 years of age and older, serious psychological distress and nicotine use were related to prescription opioid use. Among men, past-year inhalant use was related to nonmedical prescription opioid use.

Wu et al. (2011) had two different analytical samples of abuse or dependence: nonmedical prescription opioid users and remission from nonmedical prescription opioids. For the purposes of this systematic review, I focused on nonmedical prescription use—in particular reports of abuse or dependence. The 2001-2002 NESARC was used for Wu et al.'s multivariable logistic regression. Approximately 5% or participants reported nonmedical prescription opioid use, and 0.3% used heroin. Nonmedical prescription opioid abuse was found to be more prevalent than dependence

and reported heroin use. The mean age for nonmedical prescription opioid and heroin use was about 37 and 42 years, respectively. Education level was also similar; respondents using prescription opioids and respondents using heroin had about 10 and 9 years of education, respectively. Those abusing prescription opioids were mainly male, White, in the low-SES group, or had a college education. The inverse was found among those with a dependence on prescription opioids. They were more likely to be female, report a lower family income, be less educated, and have used substance abuse treatment. Those using heroin were more likely to be non-White.

Cicero et al. (2011) technically performed two studies. One was a national sample of opioid treatment clients that uses SKIP, while the other was a study in South Florida trying to understand opioid abuse in a diverse subpopulation. Only the national sample using logistic regression was focused on for this systematic literature review. Women were found to be more likely to use a doctor's prescription and share prescription opioids, as well as marginally commit theft. Younger prescription opioid abusers (i.e., 18 to 24 year olds) were more likely to obtain opioids through dealers or theft, while those 45 and older were more likely to use a clinical purveyor. Lower income participants were more likely to acquire opioids through dealers, sharing, and theft than the highest income group participants. The highest income group was more likely to obtain opioids through a prescription when compared to the lower income group participants.

Han et al. (2017) reported on prevalence using a descriptive weighted analysis. The weighted 2015 NSDUH observations revealed that 37.8% participants used

prescription opioids, 4.7% misused them, and about .8% had a misuse disorder. More than 12.5% of adults reporting prescription opioid use were misusing them. Adults with no health insurance, that were unemployed, reported low family income, or had some mental health issues were the most common factors reported among those misusing and with use disorders. Men were observed to have a lower prevalence of prescription opioid use compared to women, and Hispanics had a lower prevalence compared to non-Hispanic Whites. Similarly, college graduates were found to have a lower prevalence of prescription opioid use compared to those not having a high school degree. Adults with no health insurance had a lower prevalence than those with insurance. Regarding self-reported health, participants who described themselves in excellent health had lower prevalence than all other lesser self-reports. Conversely, those reporting no major depressive episodes nor suicidality had a lower prevalence of opioid use, misuse, and misuse with disorder. Table 2.2 also provides the identified biopsychosocial characteristics by study that were significant or present in opioid misuse.

Synthesis of Findings

Finding from all studies measured the outcome of nonmedical opioid use. Although outcomes were measured at different levels and stratifications, there were significant biopsychosocial characteristics associated with opioid misuse. Overall, sociodemographic, socioecological, and health factors, as well as other substance use or misuse were significant or prevalent at one or multiple levels of nonmedical opioid use. The outcome of misuse, however, was measured at different levels or stratified and thus

did not reveal consistent findings by factor. As such, no consistent individual findings could be drawn across all studies (see Table 2.2).

Risk of Bias across Studies

The JBI critical appraisal tools for Systematic Reviews Checklist for Prevalence Studies (Munn et al., 2015) were used to assess all six studies. The first of nine questions assessing the risk of bias was the sample frame assessment to address the target population. The second assessed if participants were appropriately sampled. The third assessed if the sample size was adequate. The fourth assessed if the study subjects and setting were adequately described. The fifth assessed if the data analyses of the identified sample were conducted with sufficient coverage. The sixth assessed if valid methods were used for the identified condition. The seventh assessed if conditions were measured in a standard, reliable way for all participants. The eighth assessed if appropriate statistical analyses were used. The ninth assessed if the response rate was adequate, or if not, whether the responses were managed appropriately (Munn et al., 2015).

Five of the six studies used nationally representative data sets that have been validated elsewhere. Four of the six studies used the NSDUH, which used a complex sampling frame to achieve a representative sample of U.S. noninstitutionalized civilians (Center for Behavioral Health Statistics, 2018). Similarly, the NESARC used a complex sampling frame of a representative U.S. civilian sample (Grant et al., 2003). As for Cicero et al.'s (2011) study, the SKIP used a national sample of opioid treatment clients from approximately 100 centers balanced geographically across rural, suburban, and

urban treatment centers (Cicero, Ellis, Paradis, & Ortbal, 2010; Cicero, Surratt, & Inciardi, 2007). Cicero et al.'s (2011) SKIP study presented the greatest risk of bias. The sampling frame, participant sample appropriateness, and adequate response rate were unknown and, as such, were uncertain. Half the studies were also conducted without sufficient coverage (i.e., Grigsby & Howard, 2019; Han et al., 2017; Cicero et al., 2011). Overall, Mojtabai et al. (2019), Wu et al. (2011), and Tetrault et al. (2008) were the highest-quality studies, with no risk of bias identified. See Table 2.3 for the full JBI critical appraisal checklist of all studies reviewed.

Table 2.3. Critical appraisal checklist for systematic reporting of opioid misuse prevalence studies.

	Grigsby et al.	Mojtabai et al.	Han et al.	Wu et al.	Cicero et al.	Tetrault et al.
Sample frame to address target population	✓	✓	✓	✓	-	✓
Study sampled appropriately	✓	✓	✓	✓	-	✓
Adequate sample size	✓	✓	✓	✓	✓	✓
Subjects and setting described in detail	X	✓	✓	✓	✓	✓
Analysis conducted w/ sufficient coverage	X	✓	X	✓	X	✓
Valid methods for identification of condition	✓	✓	✓	✓	✓	✓
Condition measured in standardized manner	-	✓	✓	✓	✓	✓
Appropriate statistical analysis	✓	✓	X	✓	✓	✓
Adequate response rate	✓	✓	✓	✓	-	✓
Overall Appraisal						
Include	✓	✓	✓	✓		✓
Exclude					X	

Discussion

Summary of Evidence

All studies reviewed in this systematic review used a nationally representative sample. Five of the six used a U.S. civilian, noninstitutionalized representative sample.

The outcome of opioid misuse was measured similarly across all studies, which focused on both DSM-IV reports of abuse or dependence, as well as on reports of diversion or attainment of opioid. Nevertheless, the outcome of misuse was reported differently between studies. Many were stratified—by diversion, by sex/gender, by abuse or dependence, or by multiple substance use. Therefore, no clear manner exists in which to ascertain the general role of each biopsychosocial characteristic on nonmedical opioid misuse. This flaw is a larger symptom of the literature and studies available, which consist of descriptive statistics or inconsistent linear models to define nonmedical opioid misuse risk factors.

Limitations

I conducted a thorough search of the literature with the help of TAMU Libraries Systematic Review Services. However, one limitation is that a possibility exists that relevant studies may have been missed or overlooked without the use of a trained team of systematic researchers. Another limitation is that studies had to be in English and constrained to the U.S., which introduces selection bias. Unfortunately, extending the search parameters can also introduce bias, both measurement and cultural biases. The quality of this systematic review can be strengthened and can limit bias by using a team of researchers with access to Cochrane review. While this is the first systematic literature review assessing biopsychosocial characteristics on opioid misuse prevalence, some weaknesses can be expected. Furthermore, this review also revealed a lack of person-centered approaches in opioid misuse research, which introduces a possible methodological bias in examining the ongoing epidemic and ensuing crisis.

Conclusions

The systematic review provides a clear and concise summary of findings based on the quality of evidence. The comprehensive evaluation of study findings were assessed using a variable-centered approach since no person-centered studies were found in the systematic literature search. Variable-centered methods like regressions were assessed based on strength of associations. The biopsychosocial characteristics identified as risk factors to opioid misuse can be used in subsequent variable-centered and person-centered approaches testing for intervenable factors to opioid misuse. This review also helps extend and establish a solid foundation to understand the multidimensional and dynamic risk factors associated with opioid misuse and serves to identify the most intervenable factors on the opioid epidemic.

Context of Findings within the Dissertation

The findings from this systematic literature review revealed multiple biopsychosocial characteristic as possible predictors of opioid misuse to examine in this dissertation. Biopsychosocial characteristics were divided into four categories: (1) sociodemographic indicators; (2) sociological indicators; (3) health indicators; and (4) other substance use. Sociodemographic indicators were selected as static variables to describe participants and determine the sample's variation, as well as allow for cross-sectional survey comparison (Hoffmeyer-Zlotnik & Warner, 2014; Przeworski & Teune, 1970). Socioecological indicators were defined as dynamic variables that captured sociobehavioral outcomes due to human-environment interactions (Glaser, Ratter, Krause, & Welp, 2012). Few socioecological indicators were used in the studies

reviewed and centered on criminality. Criminality has been examined as major socioecological indicator elsewhere (see Bottoms, 2007; Burgess, 1923; and Vila, 1994). Health, to be represented holistically, was comprised of three factors: (1) physiological health; (2) mental health; and (3) access to health services. Lastly, other substance use was defined as dependence or abuse of licit and illicit substances. Significant indicators from this review were included for both variable-centered and person-centered approaches using data from the 2017 NSDUH.

Sociodemographic factors selected. Four sociodemographic indicators were consistent across all studies, although not measured consistently. These indicators were age group, sex/gender, race/ethnicity, and income. Age group was used inconsistently across the reviewed studies. For the purposes of this dissertation, age groups 18 and older were selected and examined by the 2017 NSDUH demarcations. Sex/gender was used an indicator or as a stratifying variable in the reviewed studies, but was used as an indicator for analytic purposes in this dissertation. Race/ethnicity was also examined differently by study, nevertheless race/ethnicity was used in this dissertation by 2017 NSDUH demarcations. Family income was selected for analysis using the default 2017 NSDUH categories. Other sociodemographic variables selected were based on the findings from this review, which were available in the 2017 NSDUH, included educational attainment, employment status, and place of residence. Sexual identity (i.e., gay or lesbian; bisexual; heterosexual or straight) was included from the literature review in Chapter I, as it was an important indicator to opioid misuse, although not discussed in any of the studies reviewed in Chapter II.

Socioecological variable selected. One socioecological variable was selected for analysis based on the systematic literature review. The studies reviewed used various indicators (e.g., theft of some kind; any illegal activities; history of being involved in the criminal justice system) to capture criminality. The 2017 NSDUH provided a variable that encompassed criminality as any illegal action in which the participant was arrested and booked. As such, this variable captured criminal behavior and involvement in the criminal justice system, which both are associated with opioid misuse.

Health factors selected. In the studies reviewed, health factors were the most inconsistently examined. Using the literature review from Chapter I and the systematic literature review, the respective correlates available in the 2017 NSDUH for physiological health, mental health, and access to healthcare were selected: (1) self-reported health status (see Kaplan & Camacho, 1983; and Idler & Benyamini, 1997); (2) serious psychological distress and suicidality; and (3) private health insurance (see Blackwell, Martinez, Gentleman, Sanmartin, & Berthelot, 2009; and Woolhandler & Himmelstein, 2017).

Substance use factors selected. Studies in the systematic literature review also examined substances inconsistently. For the purposes of this dissertation, substances either licit or illicit were included if there was a prior association on opioid misuse identified in Chapters I or II. Substance dependence or abuse for nicotine/tobacco, alcohol, marijuana, cocaine, inhalants, methamphetamine, tranquilizers, stimulants, hallucinogens, and sedatives were included in the analysis.

Overall, the literature review from Chapter I and findings of the systematic literature review guided the models selected for our variable-centered and person-centered approaches. Changes were made, however, to the NSDUH especially in the 2017 cycle (Center for Behavioral Health Statistics, 2018). As such, some variables potentially or actually cannot be cross-compared nor are compatible with previous versions of the NSDUH; which were reviewed in this dissertation. This may account for possible inconsistencies across NSDUH measures used for analysis. In addition, this also accounts for differences in the biopsychosocial factors selected, as well as indicator levels selected for the analytic portion of this dissertation.

References

Blackwell, D. L., Martinez, M. E., Gentleman, J. F., Sanmartin, C., & Berthelot, J. M. (2009). Socioeconomic status and utilization of health care services in Canada and the United States: findings from a binational health survey. *Medical care*, *47*(11), 1136-1146.

Bottoms, A. E. (2007). Place, space, crime, and disorder. In M. Maguire, R. Morgan, and R. Reiner (Eds.), *The Oxford handbook of criminology* (4th ed., pp. 528-574). Oxford York: Oxford University Press.

Burgess, E. W. (1923). The study of the delinquent as a person. *American Journal of Sociology*, *28*(6), 657-680.

Center for Behavioral Health Statistics. (2018). *2017 National Survey of Drug Use and Health final analytic codebook.* Rockville, MD: Substance Abuse and Mental Health Services Administration.

Cicero, T. J., Ellis, M. S., Paradis, A., & Ortbal, Z. (2010). Determinants of fentanyl and other potent μ opioid agonist misuse in opioid-dependent individuals. *Pharmacoepidemiology and Drug Safety, 19*(1), 1-7.

Cicero, T. J., Kurtz, S. P., Surratt, H. L., Ibanez, G. E., Ellis, M. S., Levi-Minzi, M. A., & Inciardi, J. A. (2011). Multiple determinants of specific modes of prescription opioid diversion. *Journal of Drug Issues*, *41*(2), 283-304. doi:10.1177/002204261104100207

Cicero, T. J., Surratt, H., & Inciardi, J. A. (2007). Relationship between therapeutic use and abuse of opioid analgesics in rural, suburban and urban locations in the United States. *Pharmacoepidemiology and Drug Safety*, *16*, 827-840.

Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P. A, . . . Moher, D. (2009) The PRISMA Statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and Elaboration. *PLoS Medicine*, *6*(7), e1000100. doi:10.1371/journal.pmed.1000100

Glaser, M., Ratter, B. M., Krause, G., & Welp, M. (2012). New approaches to the analysis of human–nature relations. In M. Glaser, G. Krause, B. M.W. Ratter, & M. Welp (Eds.), *Human-nature interactions in the Anthropocene* (pp. 21-30). New York, NY: Routledge.

Grant, B. F., Chu, A., Sigman, R., Amsbary, M., Kali, J., Sugawara, Y., . . . Goldstein, R. (2003). *National Epidemiologic Survey on Alcohol and Related Conditions-III (NESARC-III) source and accuracy statement.* Bethesda, MD: National Institute on Alcohol Abuse and Alcoholism.

Grigsby, T. J., & Howard, J. T. (2019). Prescription opioid misuse and comorbid substance use: Past 30-day prevalence, correlates and co-occurring behavioral indicators in the 2016 National Survey on Drug Use and Health. *The American Journal on Addictions*, *28*(2), 111-118. doi:10.1111/ajad.12866

Han, B., Compton, W. M., Blanco, C., Crane, E., Lee, J., & Jones, C. M. (2017). Prescription opioid use, misuse, and use disorders in US adults: 2015 National Survey on Drug Use and Health. *Annals of Internal Medicine, 167*, 293-301. doi:10.7326/M17-0865

Hoffmeyer-Zlotnik, J. H. P., & Warner, U. (2014). *Harmonising demographic and socio-economic variables for cross-sectional comparative survey research.* Dordrecht: Springer Science + Business Media.

Idler, E. L., & Benyamini, Y. (1997). Self-rated health and mortality: a review of twenty-seven community studies. *Journal of Health and Social Behavior, 38*(1), 21-37.

Kaplan, G. A., & Camacho, T. (1983). Perceived health and mortality: a nine-year follow-up of the human population laboratory cohort. *American Journal of Epidemiology, 117*(3), 292-304.

Mojtabai, R., Amin-Esmaeili, M., Nejat, E., & Olfson, M. (2019). Misuse of prescribed opioids in the United States. *Pharmacoepidemiology and Drug Safety, 28*, 345-353. doi:10.1002/pds.4743

Munn, Z., Moola, S., Lisy, K., Riitano, D., & Tufanaru, C. (2015). Methodological guidance for systematic reviews of observational epidemiological studies reporting prevalence and incidence data. *International Journal Evidence-Based Healthcare, 13*(3), 147-153. doi:10.1097/XEB.0000000000000054

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Annals of Internal Medicine, 151*, 264-269.

National Institute on Drug Abuse. (2019). *Opioid overdose crisis*. Retrieved from https://www.drugabuse.gov/drugs-abuse/opioids/opioid-overdose-crisis

Przeworski, A., & Teune, H. (1970). *The logic of comparative social inquiry*. New York, NY: John Wiley.

Tetrault, J. M., Desai, R. A., Becker, W. C., Fiellin, D. A., Concato, J., & Sullivan, L. E. (2008). Gender and non-medical use of prescription opioids: Results from a national U.S. survey. *Addiction, 103*(2), 258-268. doi:10.1111/j.1360-0443.2007.02056.x

Vila, B. (1994). A general paradigm for understanding criminal behavior: Extending evolutionary ecological theory. *Criminology, 32*(3), 311-360.

Wongpakaran, N., Wongpakaran, T., Wedding, D., & Gwet, K. L. (2013). A comparison of Cohen's kappa and Gwet's AC1 when calculating inter-rater reliability coefficients: A study conducted with personality disorder samples. *BMC Medical Research Methodology, 13*(1), 61. doi:10.1186/1471-2288-13-61

Woolhandler, S., & Himmelstein, D. U. (2017). The relationship of health insurance and mortality: Is lack of insurance deadly?. *Annals of Internal Medicine, 167*, 424–431. doi:10.7326/M17-1403

Wu, L. T., Woody, G. E., Yang, C., Mannelli, P., & Blazer, D. G. (2011). Differences in onset and abuse/dependence episodes between prescription opioids and heroin: Results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Substance Abuse and Rehabilitation, 2*, 77-88. doi:10.2147/SAR.S18969

CHAPTER III

BIOPSYCHOSOCIAL RISK FACTORS ASSOCIATED WITH OPIOID MISUSE IN A U.S. REPRESENATIVE SAMPLE: A VARIABLE-CENTERED APPROACH

Introduction

Estimates indicate that up to 29% of persons misuse prescription pain relievers for chronic pain (Vowles et al., 2015), and 8 to 12% of that group develop a misuse disorder (Cicero, Ellis, Surratt, & Kurtz, 2014; National Institute on Drug Abuse, 2019). The U.S. Department of Health and Human Services (2019) declared a public health emergency in 2017, although the first wave of the epidemic can be traced to the 1990s (National Institute on Drug Abuse, 2019). In 2016 alone, the record numbers of opioid misuse and overdose death provided a stark realization of how the epidemic has become a public health crisis (Cicero et al., 2014). Related deaths increased 345% from 2001 to 2016, with more than 42,000 overdose deaths reported in 2016—higher than any previous year on record (U.S. Department of Health and Human Services, 2019). An increase of 30% in opioid overdose was reported from July 2016 through September 2017 in 45 states (Vivolo-Kantor et al., 2018), which means that more than 66% of drug overdose deaths in the U.S. involved an opioid—42,249 of 63,632 deaths (Seth, Rudd, Noonan, & Haegerich, 2018).

Projections also revealed that if prevention and intervention programs do not change their respective strategies, the rate of misuse and overdose death will increase. Not only will misuse increase 61% by 2025, current strategies designed to target

prescription opioid incidence would have minimal impact, preventing only 3.0% to 5.3% of overdose deaths (Chen et al., 2019). Other interventions were projected to have a similar negligible impact on overdose death, life years, and quality-adjusted life years, with the largest change estimated to bring about a 4% decrease in opioid-related deaths (e.g., naloxone increase; Pitt, Humphreys, & Brandeau, 2018). While interventions like reduced prescribing for pain patients and excess opioid management can be projected to increase life years and quality-adjusted life years, overdose deaths would increase among those with opioid dependence due to a move from prescription opioids to heroin (Pitt et al., 2018).

To ameliorate the impact of the opioid epidemic, we must identify and understand the risk factors regarding the etiology of misuse to thereby curb dependence and abuse. We must understand the biopsychosocial characteristics that underpin the risk profiles of misuse at specific population levels to stem overdose deaths. Biopsychosocial characteristics include sociodemographic (e.g., age group, race/ethnicity, biological sex, sexual identity, family income, educational attainment, and employment), socioecological (e.g., criminality), and health factors (e.g., self-reported general health; mental health, suicidality; access to health services), as well as other substance dependence or abuse. Current epidemiological studies, however, have not focused on comprehensive risk profiles. For instance, while non-Hispanic Whites and Native Americans/Alaska Natives are a primary focus, affected groups are found to be at differential risk depending on biopsychosocial characteristics studies selected from year to year (Joshi, Weiser, & Warren-Mears, 2019; Scholl, Seth, Kariisa, Wilson, &

Baldwin, 2019). Therefore, I comprehensively examined biopsychosocial characteristics in four domains to determine risk factors to opioid misuse in a representative, noninstitutionalized U.S. adult sample.

The four biopsychosocial domains I tested were sociodemographic factors, socioecological factors, health factors, and other substance dependence or abuse. I hypothesized that sociodemographic factors, while crucial to adjust for the comprehensive risk profile, would not be as critical a risk factor when compared to socioecological factors, health factors, or other substance dependence or abuse. The purpose of this study was to add to a critical gap in the literature to improve population-level prevention strategies by identifying the most salient predictors of opioid misuse.

Methods

I used multivariable logistic regression to analyze data from the 2017 National Survey on Drug Use and Health (NSDUH), examining the relationship between biopsychosocial characteristics and opioid misuse (measured as opioid dependence or abuse). Characteristics were tested independently in unadjusted models to examine their effect on opioid misuse. Models were then built using a block entry method to test biopsychosocial characteristics as risk factors in four blocks: (1) sociodemographic factors; (2) socioecological factors; (3) health factors; and (4) other substance dependence or abuse. All factors were retained as controls and covariates in subsequent models.

Risk and Protective Biopsychosocial Characteristics

Sociodemographic variables and factors. Five age categories were used: (1) 18 to 25 years of age; (2) 26 to 34 years of age; (3) 35 to 49 years of age; (4) 50 to 64 years of age; and (5) 65 years and older. The sex/gender binary of male and female was used. Race/ethnicity was divided into seven categories: (1) non-Hispanic White; (2) non-Hispanic Black/African American; (3) non-Hispanic Native American/Alaska Native; (4) non-Hispanic Native Hawaiian/other Pacific Islander; (5) non-Hispanic Asian; (6) non-Hispanic more than one race; and (7) Hispanic. Sexual identity had three categories: (1) heterosexual; (2) gay/lesbian; and (3) bisexual. Place of residence was based on 2009 Core-Based Statistical Areas (CBSAs) defined by the Office of Management and Budget (2009): (1) CBSA with 1 million or more persons; (2) CBSA with fewer than 1 million persons; and (3) segment not in a CBSA. Total family income was divided into four categories: (1) less than $20,000; (2) $20,000 to $49,999; (3) $50,000 to $74,999; and (4) $75,000 or more. Employment within the past week was divided into eight categories: (1) full-time job; (2) part-time job; (3) has job or volunteer work, and did not work in past week; (4) unemployed/laid-off, looking for work, or no job with other reason; (5) disabled; (6) retired; (7) keeping house full time; and (8) in school/training. Educational attainment was divided into four categories: (1) less than high school; (2) high school graduate; (3) some college/associate's degree; and (4) college graduate.

Socioecological factors. Criminality was assessed if the participant had been arrested and booked for breaking the law (excluding minor traffic violations). *Booked*

was defined as taken into custody and processed by the legal system, even if later released.

Health factors. Participants were asked to rank their overall health in the following manner: (1) excellent; (2) very good; (3) good; (4) fair/poor. A severe psychological distress indicator within the past year was based on responses from past-month Kessler-6 (K6) items and the worst month in the past-year K6 items. K6 items are from a screening instrument for nonspecific psychological distress developed by Furukawa, Kessler, Slade, and Andrews (2003) and Kessler et al. (2003). The K6 measures how frequently participants experience psychological distress during the past 30 days and during a month in the past year where they felt more depressed, anxious, or emotionally stressed than in the past month. Participants who had a score of 13 and above were considered to be in severe psychological distress. Suicidality was assessed if at any time in the past year a participant had seriously thought about trying to commit suicide. Private health insurance was also assessed. A participant possessed private health insurance if the participant had insurance that could be obtained (1) through work by paying premiums to an insurance company; (2) through the Health Insurance Marketplace; or (3) through a health maintenance organization (HMO), fee-for-service plans, or single-service plans.

Other substance dependence or abuse factors. Nicotine dependence in the past month was assessed using Nicotine Dependence Syndrome Scale scores and the Fagerstrom Test of Nicotine Dependence scale. Alcohol dependence and abuse in the last year was also ascertained. Dependence and abuse in the past year for the following

substances were also determined: marijuana, cocaine, hallucinogens, inhalants, methamphetamine, tranquilizers, stimulants (i.e., independent of methamphetamine), and sedatives (Center for Behavioral Health Statistics, 2018).

Statistical Analysis

All analyses accounted for the 2017 NSDUH complex survey design to best present a representative sample of noninstitutionalized U.S. adults. In other words, all models were weighted and accounted for clustering and stratification. SAS 9.4 (SAS Institute Inc.) was used for all analyses. The final model was assessed by model convergence and max-rescaled R^2. Max-rescaled R^2 was used because it is a useful method to compare competing models; the larger the value indicates the better model (Nagelkerke, 1991). All findings are reported in odds ratios (ORs) using a 95% confidence interval (CI) for significance criteria.

Results

Sample Characteristics

The sample consisted of 42,554 individuals (weighted *N* = 247,160,541) over the age of 18. Male and female participants were represented about equally—48% male (weighted *N* = 119,287,343) and 52% female (weighted *N* = 127,873,198), respectively. The majority of the weighted sample was non-Hispanic White (63.8%), resided in a high population density CBSA (54.3%), identified as heterosexual (94.9%), had a family income of $75,000 or more (38.5%), were college graduates (32.3%), were employed (46.9%), had no history of arrest and booking (83.2%), were in very good health (36.6%), had no serious psychological distress (88.8%), displayed no suicidality (95.6%), and had private health insurance (66.7%). See Table 3.1 for a detailed breakdown of the sample's biopsychosocial characteristics.

Table 3.1. Descriptive biopsychosocial characteristics of the 2017 NSDUH representative sample (*N* = 42,554; weighted *N* = 247,160,541).

	N	Weighted *N*	SE	%
Age Groups				
18-25 years old	13,840	34,306,312	574,946	13.88
26-34 years old	8,786	39,559,271	591,850	16.01
35-49 years old	11,214	60,963,591	795,401	24.67
50-64 years old	4,997	62,458,057	962,107	25.27
65 or older	3,717	49,873,311	1,116,852	20.18
Sex/Gender				
Male	19,987	119,287,343	1,139,976	48.26
Female	22,567	127,873,198	1,209,432	51.74
Race/Ethnicity				
White	25,870	157,649,306	1,649,074	63.78
Black/African American	5,230	29,460,536	930,571	11.92
Native American/Alaska Native	640	1,326,686	110,870	0.54
Native Hawaiian/Other Pacific Islander	195	957,395	152,767	0.39
Asian	2,070	13,977,480	468,826	5.66
Non-Hispanic more than one race	1,381	4,050,463	267,462	1.64
Hispanic	7,168	39,738,675	1,079,486	16.08
Area of Residence by Population Density				
Segment in a CBSA with 1 million or more	17,857	134,228,253	1,268,575	54.31
Segment in a CBSA with less than 1 million	21,202	98,425,658	1,424,517	39.82
Segment not in a CBSA	3,495	14,506,630	806,408	5.87
Sexual Identity				
Heterosexual, i.e., straight	38,862	230,458,807	1,781,353	94.93
Lesbian or gay	951	4,815,318	272,130	1.98
Bisexual	1,989	7,480,558	258,000	3.08
Family Income				
Less than $20,000	8,370	39,858,134	837,676	16.13
$20,000-$49,999	13,321	72,790,284	1,118,333	29.45
$50,000-$74,999	6,704	39,336,329	733,309	15.92
$75,000 or more	14,159	95,175,794	1,474,951	38.51
Level of Education				
Less than high school	5,395	30,286,502	808,944	12.25
High school graduate	11,269	60,269,350	940,128	24.38
Some college/associate's degree	14,288	76,814,204	1,117,733	31.08
College graduate	11,602	79,790,484	1,471,119	32.28
Employment Status (past week)				
Worked at full-time job	20,726	115,001,494	1,228,846	46.95
Worked at part-time job	5,654	27,526,144	518,702	11.24
Has job or volunteer worker, did not work	2,348	11,519,610	403,639	4.70
Unemployed/laid off/looking for work	5,349	24,757,893	476,522	10.11
Disabled	1,546	11,486,025	369,423	4.69
Keeping house full-time	1,938	9,115,864	277,250	3.72
In school/training	1,477	4,517,261	185,088	1.84
Retired	3,075	41,001,799	928,254	16.74
Ever Arrested and Booked				
No	34,989	205,040,372	1,771,646	83.27
Yes	7,411	41,186,483	628,284	16.73

Table 3.1. Continued.

	N	Weighted *N*	SE	%
Overall Health Status				
Fair/poor	4,829	34,281,053	760,566	13.88
Good	11,800	70,418,663	989,602	28.50
Very good	16,151	90,430,046	1,091,958	36.60
Excellent	9,761	51,936,820	968,872	21.02
Serious Psychological Distress Indicator (past year)				
No	35,934	219,428,393	1,782,252	88.78
Yes	6,620	27,732,148	521,899	11.22
Suicidality (past year)				
No	39,652	234,837,595	1,841,729	95.61
Yes	2,588	10,789,164	391,116	4.39
Covered by Private Health Insurance				
No	15,331	81,958,362	1,165,322	33.31
Yes	27,005	164,081,359	1,819,226	66.69

Of the weighted sample, 2,018,922 individuals (n = 476) reported opioid misuse. Opioid misuse was characterized by three categories: (1) those using heroin only; (2) those using prescription pain relievers; and (3) those that used both heroin and prescription pain relievers. The majority of the weighted sample used only pain relievers (66.0%). Other substances that the sample had dependence on or abused were nicotine, alcohol, marijuana, cocaine, inhalants, methamphetamine, tranquilizers, stimulants, hallucinogens, and sedatives. See Table 3.2 for a complete report of the sample's substance dependence and abuse profile.

Table 3.2. Substance dependence and abuse descriptives among the 2017 NSDUH representative sample.

	N	Weighted *N*	SE	%
Nicotine dependence (past month)				
No	37,295	220,176,618	1,753,729	89.08
Yes	5,259	26,983,923	536,289	10.92
Alcohol dependence or abuse (past year)				
No/Unknown	39,352	233,120,658	1,736,561	94.32
Yes	3,202	14,039,883	368,169	5.68
Marijuana dependence or abuse (past year)				
No/Unknown	41,528	243,761,480	1,771,558	98.62
Yes	1,026	3,399,061	156,208	1.38
Cocaine dependence or abuse (past year)				
No/Unknown	42,336	246,207,296	1,821,123	99.61
Yes	218	953,245	83,112	0.39
Inhalant dependence or abuse (past year)				
No	42,529	247,081,929	1,826,055	99.97
Yes	25	78,612	23,659	0.03
Methamphetamine dependence or abuse (past year)				
No	42,344	246,181,316	1,823,711	99.60
Yes	210	979,226	83,033	0.40
Tranquilizer dependence or abuse (past year)				
No	42,391	246,472,747	1,822,516	99.72
Yes	163	687,794	76,503	0.28
Stimulant dependence or abuse (past year)				
No	42,410	246,652,454	1,810,136	99.79
Yes	144	508,087	56,146	0.21
Hallucinogen dependence or abuse (past year)				
No	42,480	246,895,056	1,820,361	99.89
Yes	74	265,485	39,301	0.11
Sedative dependence or abuse (past year)				
No	42,520	246,956,278	1,815,154	99.92
Yes	34	204,264	49,397	0.08
Opioid dependence or abuse (past year)				
No	42,078	245,141,619	1,814,631	99.18
Yes	476	2018,922	131,226	0.82

Logistic Regression

Independent unadjusted models. All biopsychosocial characteristics were tested independently in unadjusted models to examine the relationship of each characteristic on opioid misuse. All characteristics tested independently at some level were found to be a significant risk factor to opioid misuse. Table 3.3 shows the associations.

Table 3.3. The unadjusted relationships between independent biopsychosocial characteristics and opioid misuse (*N* = 42,554; weighted *N* = 247,160,541).

		95% CI	
	OR	Lower	Upper
Age			
18-25 years old	**16.36**	**6.77**	**39.50**
26-34 years old	**18.42**	**7.86**	**43.18**
35-49 years old	**9.96**	**4.08**	**24.34**
50-64 years old	**10.48**	**4.20**	**26.13**
65 years and older	ref.	-	-
Sex/Gender			
Male	**1.65**	**1.23**	**2.23**
Female	ref.	-	-
Race/Ethnicity			
White	**3.75**	**1.42**	**9.92**
Black/African American	2.52	0.82	7.72
Native American/AK Native	**7.93**	**2.50**	**25.22**
Native HI/Other Pacific Islander	2.97	0.31	28.14
Non-Hispanic more than one race	**3.80**	**1.27**	**11.40**
Hispanic	1.28	0.41	4.02
Asian	ref.	-	-
Sexual Identity			
Lesbian or gay	1.32	0.62	2.78
Bisexual	**2.40**	**1.55**	**3.71**
Heterosexual, i.e., straight	ref.	-	-
Educational attainment			
Less than high school	**2.69**	**1.54**	**4.71**
High school grad	**1.93**	**1.24**	**3.00**
Some college/associate's degree	**2.25**	**1.42**	**3.56**
College graduate	ref.	-	-
Family Income			
Less than $20,000	**2.99**	**1.88**	**4.76**
$20,000-$49,999	**1.94**	**1.33**	**2.84**
$50,000-$74,999	**1.95**	**1.16**	**3.29**
$75,000 or more	ref.	-	-
Population Density			
Segment in a CBSA with 1 million+	1.17	0.76	1.81
Segment in a CBSA with less than 1 million	**1.65**	**1.05**	**2.58**
Segment not in a CBSA	ref.	-	-
Employment (past week)			
Disabled	**8.64**	**3.62**	**20.63**
Has job/volunteer worker, did not work past week	1.54	0.64	3.69
In school/training	2.51	0.85	7.38
Retired	0.46	0.15	1.43
Unemployed/laid-off, looking for work	**7.78**	**3.67**	**16.50**
Worked at full-time job	**2.61**	**1.19**	**5.72**
Worked at part-time job	2.27	0.90	5.74
Keeping house full-time	ref.	-	-
Arrested and Booked for Breaking the Law			
No	ref.	-	-
Yes	**8.26**	**6.19**	**11.02**

Table 3.3. Continued.

		95% CI	
	OR	Lower	Upper
Overall Health Status			
Fair/Poor	**8.32**	**5.09**	**13.59**
Good	**5.29**	**3.28**	**8.52**
Very Good	**3.25**	**2.08**	**5.08**
Excellent	ref.	-	-
Serious Psychological Distress in Past Year			
No	ref.	-	-
Yes	**10.56**	**8.11**	**13.75**
Suicidality in Past Year			
No	ref.	-	-
Yes	**8.94**	**6.50**	**12.31**
Private Health Insurance			
No	**3.66**	**2.65**	**5.06**
Yes	ref.	-	-
Nicotine Dependence (past month)			
No	ref.	-	-
Yes	**10.61**	**7.82**	**14.40**
Alcohol Dependence or Abuse (past year)			
No/Unknown	ref.	-	-
Yes	**5.61**	**4.25**	**7.41**
Marijuana Dependence or Abuse (past year)			
No/Unknown	ref.	-	-
Yes	**16.95**	**10.95**	**26.24**
Cocaine Dependence or Abuse (past year)			
No/Unknown	ref.	-	-
Yes	**54.88**	**34.72**	**86.73**
Inhalant Dependence or Abuse (past year)			
No	ref.	-	-
Yes	**133.03**	**36.47**	**485.30**
Methamphetamine Dependence or Abuse (past year)			
No	ref.	-	-
Yes	**55.35**	**34.91**	**87.74**
Tranquilizer Dependence or Abuse (past year)			
No	ref.	-	-
Yes	**132.24**	**86.83**	**201.40**
Stimulant Dependence or Abuse (past year)			
No	ref.	-	-
Yes	**68.84**	**40.61**	**116.67**
Hallucinogen Dependence or Abuse (past year)			
No	ref.	-	-
Yes	**41.60**	**21.67**	**79.85**
Sedative Dependence or Abuse (past year)			
No	ref.	-	-
Yes	**77.83**	**30.93**	**195.86**

Note. ref. = reference group

Adjusted multivariate logistic regression models. Model 1 found that sociodemographic factors such as age, sex/gender, race/ethnicity, sexual identity, educational attainment, family income, residence based on population density, and employment were positively predictive of opioid misuse. In Model 2, I added the socioecological factor of past criminality, which was predictive of opioid misuse, while controlling for sociodemographic factors. In Model 3, health factors such as overall reported health, serious psychological distress in past year, suicidality in the past year, and not having private health insurance were added (while controlling for sociodemographic and socioecological factors), and were predictive of opioid misuse. In Model 4, other substance dependences and abuses were added to the model, which was controlled for sociodemographic, socioecological, and health factors. The model fit using a max-rescaled R^2 value of 0.36 revealed that Model 4 was superior, and as such was selected for interpretation (see Table 3.4 for complete model comparisons).

Age groups were associated with opioid misuse; 26- to 34-year-olds were at 4.5 odds (95% CI: 1.2-16.2) and 50- to 64-years-olds were at 3.6 odds (95% CI: 1.1-11.7) of opioid misuse compared to 65 and older individuals. Those participants residing in a CBSA with 1 million or more individuals or residing in a CBSA with less 1 million individuals were at about 2.1 odds (95% CI: 1.3-3.5 and 95% CI: 1.2-3.6, respectively) of opioid misuse compared to those not residing in CBSA. Types of employment were also predictive of opioid misuse; a participant working a full-time job was at 2.4 odds (95% CI: 1.1-5.5) and an unemployed participant was at 3.1 odds (95% CI: 1.4-6.7) of opioid misuse compared to those participants who kept house full-time. Criminality, as

compared to no prior history of criminality, was a positive predictor of opioid misuse (AOR = 2.9, 95% CI: 2.1-3.9). Moreover, overall self-reported health was a positive predictor of opioid misuse when individuals reported fair/poor (AOR = 3.0, 95% CI: 1.7-35.4), good (AOR = 2.9, 95% CI: 1.7-4.9), and very good health (AOR = 2.3, 95% CI: 1.5-3.6) rather than excellent health. Participants with mental health indicators, such as serious psychological distress in the past year or suicidality in the past year, were at 3.8 odds (95% CI: 2.4-6.0) and 1.7 odds (95% CI: 1.0-2.8) of opioid misuse when compared to those participants having no respective reports in the past year. Participants not having health insurance were associated with 2.1 increased odds (95% CI: 1.8-3.4) of opioid misuse compared to participants with health insurance. Participants exhibiting substance dependence or abuse, with the notable exception of alcohol, were positively associated with increased odds of opioid misuse compared to those with no substance dependence or abuse (nicotine: AOR = 3.0, 95% CI: 2.1-4.2; marijuana: AOR = 2.9, 95% CI: 1.4-5.9; cocaine: AOR = 3.2, 95% CI: 1.6-6.5; inhalant: AOR = 13.8, 95% CI: 3.2-59.9; methamphetamine: AOR = 3.7, 95% CI: 1.7-8.2; tranquilizers: AOR = 13.8, 95% CI: 5.9-32.1; sedatives: AOR = 5.3, 95% CI: 1.8-15.6).

Table 3.4. Adjusted multivariate logistic regression models testing the relationship of biopsychosocial factors on opioid misuse on the 2017 NSDUH sample.

	Model 1			Model 2			Model 3			Model 4		
		95% CI			95% CI			95% CI			95% CI	
	AOR	Lower	Upper	AOR	Lower	Upper	AOR	Lower	Upper	AOR	Lower	Upper
Age												
18-25 years old	**11.45**	**3.61**	**36.26**	**11.10**	**3.45**	**35.73**	**5.86**	**1.85**	**18.53**	3.52	1.00	12.41
26-34 years old	**16.90**	**5.28**	**54.15**	**11.49**	**3.50**	**37.78**	**6.29**	**1.91**	**20.67**	**4.52**	**1.26**	**16.20**
35-49 years old	**9.31**	**2.84**	**30.60**	**6.06**	**1.82**	**20.22**	**3.65**	**1.10**	**12.16**	3.12	0.88	11.10
50-64 years old	**7.78**	**2.53**	**23.98**	**5.67**	**1.83**	**17.62**	**4.44**	**1.43**	**13.81**	**3.57**	**1.09**	**11.67**
65 years and older	ref.	-	-	ref.	-	-	ref.	-	-	ref.	-	-
Sex/Gender												
Male	**1.49**	**1.11**	**2.00**	1.02	0.77	1.36	1.33	1.00	1.76	1.25	0.90	1.73
Female	ref.	-	-	ref.	-	-	ref.	-	-	ref.	-	-
Race/Ethnicity												
White	**3.27**	**1.21**	**8.84**	2.29	0.85	6.14	2.00	0.68	5.82	1.34	0.47	3.79
Black/African American	1.32	0.44	3.91	0.93	0.31	2.77	0.87	0.28	2.76	0.72	0.26	2.02
Native American/Alaska Native	**3.99**	**1.23**	**12.90**	2.19	0.68	7.08	2.14	0.59	7.69	1.28	0.37	4.47
Native Hawaiian/Pacific Islander	1.75	0.18	17.11	1.23	0.14	11.15	1.04	0.11	9.77	0.65	0.07	6.10
Non-Hispanic more than one race	2.14	0.69	6.69	1.35	0.43	4.27	1.08	0.32	3.67	0.89	0.26	3.00
Hispanic	0.59	0.19	1.87	0.50	0.15	1.64	0.49	0.14	1.70	0.45	0.13	1.55
Non-Hispanic Asian	ref.	-	-	ref.	-	-	ref.	-	-	ref.	-	-
Sexual Identity												
Lesbian or gay	1.07	0.49	2.30	1.00	0.45	2.20	0.75	0.33	1.70	0.54	0.20	1.50
Bisexual	**1.63**	**1.04**	**2.56**	1.46	0.92	2.31	0.84	0.51	1.38	0.64	0.35	1.17
Heterosexual, i.e., straight	ref.	-	-	ref.	-	-	ref.	-	-	ref.	-	-
Educational Attainment												
Less than high school	**2.69**	**1.54**	**4.71**	**2.01**	**1.15**	**3.54**	1.57	0.90	2.75	1.08	0.55	2.14
High school grad	**1.93**	**1.24**	**3.00**	1.48	0.94	2.34	1.27	0.82	1.97	1.12	0.67	1.89
Some college/associate's degree	**2.25**	**1.42**	**3.56**	**1.77**	**1.09**	**2.89**	1.46	0.91	2.33	1.22	0.68	2.20
College graduate	ref.	-	-	ref.	-	-	ref.	-	-	ref.	-	-
Family Income												
Less than $20,000	**2.05**	**1.19**	**3.53**	1.56	0.93	2.64	0.88	0.56	1.40	0.71	0.43	1.20
$20,000-$49,999	**1.74**	**1.12**	**2.71**	1.48	0.96	2.28	0.94	0.63	1.40	0.91	0.58	1.41
$50,000-$74,999	**1.81**	**1.02**	**3.19**	1.62	0.92	2.85	1.31	0.76	2.25	1.25	0.69	2.28
$75,000 or more	ref.	-	-	ref.	-	-	ref.	-	-	ref.	-	-

Table 3.4. Continued.

	Model 1			Model 2			Model 3			Model 4		
		95% CI			95% CI			95% CI			95% CI	
	AOR	Lower	Upper	AOR	Lower	Upper	AOR	Lower	Upper	AOR	Lower	Upper
Population Density of Residence												
In a CBSA with 1 million+	**1.92**	**1.20**	**3.07**	**1.84**	**1.16**	**2.94**	**1.90**	**1.22**	**2.97**	**2.09**	**1.25**	**3.51**
In a CBSA with < 1 million	**1.95**	**1.23**	**3.08**	**1.88**	**1.18**	**2.98**	**1.92**	**1.22**	**3.02**	**2.11**	**1.23**	**3.63**
Not in a CBSA	ref.	-	-	ref.	-	-	ref.	-	-	ref.	-	-
Employment (past week)												
Worked at full-time job	**2.45**	**1.14**	**5.27**	**2.36**	**1.08**	**5.15**	**2.80**	**1.23**	**6.38**	**2.42**	**1.07**	**5.46**
Worked at part-time job	2.23	0.89	5.59	2.27	0.90	5.70	2.05	0.78	5.40	1.94	0.74	5.06
Has job/volunteer worker	1.60	0.65	3.90	1.53	0.61	3.81	1.26	0.45	3.51	0.62	0.14	2.81
Unemployed/laid-off	**6.72**	**3.23**	**13.95**	**6.44**	**3.10**	**13.41**	**5.00**	**2.28**	**10.98**	**3.10**	**1.43**	**6.71**
In school/training	1.65	0.56	4.87	2.00	0.67	5.97	2.20	0.72	6.71	2.72	0.93	7.93
Retired	1.74	0.42	7.26	1.71	0.39	7.40	1.43	0.35	5.81	1.37	0.32	5.86
Disabled	**6.55**	**2.77**	**15.51**	**5.60**	**2.33**	**13.45**	2.39	0.93	6.18	1.96	0.74	5.15
Keeping house full-time	ref.	-	-	ref.	-	-	ref.	-	-	ref.	-	-
Arrested and Booked				**5.64**	**4.29**	**7.40**	**4.27**	**3.32**	**5.49**	**2.89**	**2.14**	**3.90**
Overall Health												
Fair/poor							**4.19**	**2.44**	**7.19**	**3.00**	**1.65**	**5.44**
Good							**3.85**	**2.33**	**6.37**	**2.88**	**1.71**	**4.86**
Very good							**2.85**	**1.81**	**4.50**	**2.32**	**1.51**	**3.56**
Excellent							ref.	-	-	ref.	-	-
Serious Psychological Distress [a]							**4.93**	**3.43**	**7.07**	**3.82**	**2.44**	**6.00**
Suicidality in Past Year [a]							**2.12**	**1.42**	**3.16**	**1.67**	**1.01**	**2.75**
No Private Health Insurance [a]							**2.48**	**1.82**	**3.39**	**2.12**	**1.46**	**3.09**
Nicotine Dependence [a]										**3.01**	**2.14**	**4.23**
Alcohol Dependence or Abuse [a]										1.26	0.87	1.81
Marijuana Dependence or Abuse [a]										**2.88**	**1.39**	**5.94**
Cocaine Dependence or Abuse [a]										**3.18**	**1.57**	**6.45**
Inhalant Dependence or Abuse [a]										**13.76**	**3.16**	**59.94**
Methamphetamine Dependence or Abuse [a]										**3.71**	**1.68**	**8.20**
Tranquilizer Dependence or Abuse [a]										**13.75**	**5.90**	**32.07**
Stimulant Dependence or Abuse [a]										**5.25**	**1.76**	**15.63**
Model Fit												
Max-rescaled R^2		0.115			0.169			0.263			0.363	

Notes. ref. = reference group; [a] Compared to those not experiencing the condition.

Discussion

A comprehensive approach to understand the role of biopsychosocial characteristics as risk factors influencing opioid misuse in the form of dependence or abuse was undertaken. I found that the domains of sociodemographic, sociocultural, and health factors, as well as other substance dependence or abuse, were significant biopsychosocial risk characteristics predicting opioid misuse. Sociodemographic factors of age group, population density of residence, and employment in past week were significant. The socioecological factor of criminality was also significant. All health factors, which are self-reported health status, serious psychological distress, suicidality, and private health insurance, were significant risk characteristics of opioid misuse. Nicotine, marijuana, cocaine, inhalant, methamphetamine, tranquilizer, and stimulant substance dependence or abuse were significant predictors of opioid misuse.

Sociodemographic indicators such as age have generally been a definitive risk factor in opioid misuse, as has sex/gender and race/ethnicity at an epidemiological level when considering overdose death studies like Scholl et al. (2019) and Joshi et al. (2019). However, I found that sociodemographic factors in the comprehensive model were not the strongest predictors to opioid misuse. Similar to Scholl et al.'s findings on opioid overdose deaths, which reported that from 2016 to 2017 there was an increase in misuse among those over the age of 25, I found that the age groups of 26- to 34-year-olds and 50- to 64-year-olds remained as predictors of opioid misuse. Scholl et al. found that the largest increase was among males aged 25 to 44 years old. An inverse relationship was observed in heroin-related overdose deaths, which declined among males and those in

the 15- to 24-year-old age group (Scholl et al., 2019), which may explain my findings concerning the 18- to 25-year-old age group. Thus, 18- to 25-year-olds may be at increased risk, but we must interpret with caution (AOR = 3.5, 95% CI: 1.0-12.4). In regard to the 50- to 64-year-old age group misusing opioids, recent studies have reported this relationship in certain scenarios. Chang (2018) found 50- to 64-year-olds to be at risk of opioid misuse when in chronic pain, and Choi, DiNitto, Marti, and Choi (2018) found this older adult group at risk when using emergency department services.

Age, sex/gender, and race/ethnicity demonstrate a mixed relationship with opioid misuse and disorders. In the comprehensive model, neither sex/gender nor race/ethnicity was found to be predictive of opioid misuse, which may be indicative of prescription opioid-related deaths remaining stable across all racial/ethnic groups in most states (Scholl et al., 2019). However, other variables may be confounding the effects of race/ethnicity on opioid misuse. Jones (2017) took a comprehensive approach to examine the trend of decreasing nonmedical use of prescription opioids from the 2003 to 2014 NSDUH. In that study, the sociodemographic indicators of race/ethnicity and family income were found to be predictive of opioid dependence or abuse, specifically among non-Hispanic Whites when compared to other race/ethnicities and income groups under $50,000 compared to those over the $75,000 family income bracket. Jones, however, did not include sexual identity, criminality, general health, or mental health indicators, such as psychological distress and suicidality. Winkelman Chang, and Binswanger (2018) found that those reporting any level of opioid use versus no opioid use had a higher likelihood to be non-Hispanic White, have a lower family income,

reporting chronic health condition, severe mental health issues, disability, or co-occurring substance use.

Examining opioid misuse using nationally representative data, Mojtabai, Amin-Esmaeili, Nejat, & Olfson (2019) found that prescribed-opioid misuse was associated with criminality, mental health distress, benzodiazepine misuse and other substance abuse or dependence. Similarly, Grigsby & Howard (2019) found that prescription opioid and polysubstance users had the greatest probability of past-year criminality and mental health distress. Moreover, Prince (2019) found that individuals with opioid misuse disorder who had a severe mental illness were at an increased risk of criminality and suicidality. The risk increased between those using only heroin, both heroin and prescription opioids, and all other substance use disorders, in that order.

Other substance dependence or abuse has been associated with opioid misuse based on varying sociodemographic factors (John et al., 2019; Jones, 2017; Nicholson & Vincent, 2018; Snyder, Morse, & Bride, 2019; Tetrault et al., 2008). I specifically examined nicotine (John et al., 2019; Rajabi, Dehghani, Shojaei, Farjam, & Motevalian, 2019), marijuana (John et al., 2019), cocaine (Snyder et al., 2019), inhalant (Tetrault et al., 2008), methamphetamine (Ellis, Kasper, & Cicero, 2018), tranquilizers (Jones, Mogali, & Comer, 2012; Maree, Marcum, Saghafi, Weiner, & Karp, 2016; Schepis, Simoni-Wastila, & McCabe, 2019), and stimulants (Kecojevic, Wong, Corliss, & Lankenau, 2015) and found a relationship of increased odds toward opioid misuse in the adjusted models. Although the present study revealed an increased association of opioid misuse with marijuana compared to non-marijuana users, the relationship in the

literature has been mixed. A more recent review found that marijuana use may have a decrease the probability of opioid misuse (Campbell, Hall, & Nielsen, 2018). In fact, in reviewing ecological and epidemiological studies, Campbell et al. (2018) found that medical cannabis laws/use decreases opioid overdose deaths in states that allow marijuana use compared to states that do not have medical marijuana laws. Furthermore, unlike the findings of other studies (e.g., Fernandez et al., 2019), alcohol dependence or abuse was not associated with opioid misuse in my adjusted model.

Overall, prevention strategies and prevention programs must focus on both the combined use of legal and illicit substances and medically prescribed psychotherapeutic substances (e.g., benzodiazepines) to stave off the opioid epidemic. Our study took a comprehensive approach to understand how multiple biopsychosocial variables combine to predict opioid misuse. Individuals are influenced by collections of multiple factors, and any research should account for this variety of factors when considering causes, effects, and cures. Although comprehensive models can be cumbersome, they allow the researcher the ability to examine multiple risk factors to create profiles of misuse at a population level.

Limitations

To my knowledge, this is the first U.S. population-level study to comprehensively address risk profiles of opioid misuse using the latest data available. As with most surveys of this kind, there are limitations to the NSDUH. The most prominent limitation is the use of self-reported data. These data are subject to the individual participant's bias, truthfulness, recollection, and knowledge. Although studies have

established the validity of the NSDUH, the data are not longitudinal, but cross-sectional. The data are nationally representative; however, they do exclude a small population subset. The NSDUH targets noninstitutionalized U.S. citizens, so active-duty military members and institutionalized groups (e.g., prisoners, hospital patients, treatment center patients, and nursing home members) are excluded. Thus, if substance use differs between U.S. noninstitutionalized and institutionalized groups by more than 3%, data may be problematic for the total U.S. population (Center for Behavioral Health Statistics, 2018). Another issue that may have introduced bias is participant knowledge or lack thereof concerning opioids and other substances (Palamar, 2018). Finally, opioid misuse data does not fully account for synthetic opioids like fentanyl.

Conclusion

This study provides the most recent and comprehensive risk assessment of possible biopsychosocial characteristics indicative of opioid misuse. Findings provide the population-level risk factors to improve risk assessments and to tailor future interventions to stem and ameliorate the opioid epidemic. For instance, at-risk individuals were both full-time employed or unemployed with a history of criminality, serious psychological distress, suicidality, no private health insurance, and substance dependence or abuse. Individuals, however, are not variables representative of risk factors on an outcome to opioid misuse. At a population-level analysis, we must acknowledge that findings of a person-centered approach such as this work only represent findings based on a population average. More specialized approaches, such as variable-centered ones, are necessary to study specific at-risk groups. Thus, these

findings serve a population-level risk profile using the most recent U.S. nationally-representative data to inform epidemiological trends and possible large-scale interventions.

References

Campbell, G., Hall, W., & Nielsen, S. (2018). What does the ecological and epidemiological evidence indicate about the potential for cannabinoids to reduce opioid use and harms? A comprehensive review. *International Review of Psychiatry, 30*(5), 91-106. doi:10.1080/09540261.2018.1509842

Center for Behavioral Health Statistics. (2018). *2017 National Survey of Drug Use and Health final analytic codebook.* Rockville, MD: Substance Abuse and Mental Health Services Administration.

Chang, Y.-P. (2018). Factors associated with prescription opioid misuse in adults aged 50 or older. *Nursing Outlook, 66*(2), 112-120. doi:10.1016/j.outlook.2017.10.007

Chen, Q., Larochelle, M. R., Weaver, D. T., Lietz, A. P., Mueller, P. P., Mercaldo, S., . . . Chhatwal, J. (2019). Prevention of prescription opioid misuse and projected overdose deaths in the United States. *JAMA Network Open, 2*(2), e187621. doi:10.1001/jamanetworkopen.2018.7621

Choi, B. Y., DiNitto, D. M., Marti, C. N., & Choi, N. G. (2018). Emergency department visits and overnight hospital stays among persons aged 50 and older who use and misuse opioids. *Journal of Psychoactive Drugs*, 1-11. doi:10.1080/02791072.2018.1557356

Cicero, T. J., Ellis, M. S., Surratt, H. L., & Kurtz, S. P. (2014). The changing face of heroin use in the United States: A retrospective analysis of the past 50 years. *JAMA Psychiatry, 71,* 821-826. doi:10.1001/jamapsychiatry.2014.366

Ellis, M. S., Kasper, Z. A., & Cicero, T. J. (2018). Twin epidemics: The surging rise of methamphetamine use in chronic opioid users. *Drug and Alcohol Dependence, 193,* 14-20. doi:10.1016/j.drugalcdep.2018.08.029

Fernandez, A. C., Bush, C., Bonar, E. E., Blow, F. C., Walton, M. A., & Bohnert, A. S. B. (2019). Alcohol and drug overdose and the influence of pain conditions in an addiction treatment sample. *Journal of Addiction Medicine, 13*(1). doi:10.1097/ADM.0000000000000451

Furukawa, T. A., Kessler, R. C., Slade, T., & Andrews, G. (2003). The performance of the K6 and K10 screening scales for psychological distress in the Australian National Survey of Mental Health and Well-Being. *Psychological Medicine, 33*, 357-362.

Grigsby, T. J., & Howard, J. T. (2019). Prescription opioid misuse and comorbid substance use: Past 30-day prevalence, correlates and co-occurring behavioral indicators in the 2016 National Survey on Drug Use and Health. *The American Journal on Addictions, 28*(2), 111-118. doi:10.1111/ajad.12866

John, W. S., Zhu, H., Mannelli, P., Subramaniam, G. A., Schwartz, R. P., McNeely, J., & Wu, L.-T. (2019). Prevalence and patterns of opioid misuse and opioid use disorder among primary care patients who use tobacco. *Drug and Alcohol Dependence, 194*, 468-475. doi:10.1016/j.drugalcdep.2018.11.011

Jones, C. M. (2017). The paradox of decreasing nonmedical opioid analgesic use and increasing abuse or dependence—An assessment of demographic and substance use trends, United States, 2003–2014. *Addictive Behaviors, 65*, 229-235. doi:10.1016/j.addbeh.2016.08.027

Jones, J. D., Mogali, S., & Comer, S. D. (2012). Polydrug abuse: A review of opioid and benzodiazepine combination use. *Drug and Alcohol Dependence, 125*(1), 8-18. doi:10.1016/j.drugalcdep.2012.07.004

Joshi, S., Weiser, T., & Warren-Mears, V. (2019). Drug, opioid-involved, and heroin-involved overdose deaths among American Indians and Alaska Natives—Washington, 1999-2015. *MMWR Morbidity and Mortality Weekly Report, 67*, 1384-1387. doi:10.15585/mmwr.mm6750a2

Kecojevic, A., Wong, C. F., Corliss, H. L., & Lankenau, S. E. (2015). Risk factors for high levels of prescription drug misuse and illicit drug use among substance-using young men who have sex with men (YMSM). *Drug and Alcohol Dependence, 150*, 156-163. doi:10.1016/j.drugalcdep.2015.02.031

Kessler, R. C., Barker, P. R., Colpe, L. J., Epstein, J. F., Gfroerer, J. C., Hiripi, E., . . . Zaslavsky, A. M. (2003). Screening for serious mental illness in the general population. *Archives of General Psychiatry, 60*(2), 184-189.

Maree, R. D., Marcum, Z. A., Saghafi, E., Weiner, D. K., & Karp, J. F. (2016). A systematic review of opioid and benzodiazepine misuse in older adults. *The American Journal of Geriatric Psychiatry, 24*, 949-963. doi:10.1016/j.jagp.2016.06.003

Mojtabai, R., Amin-Esmaeili, M., Nejat, E., & Olfson, M. (2019). Misuse of prescribed opioids in the United States. *Pharmacoepidemiology and Drug Safety*, *28*, 345-353. doi:10.1002/pds.4743

Nagelkerke, N. J. D. (1991). A note on a general definition of the coefficient of determination. *Biometrika*, *78*, 691-692.

National Institute on Drug Abuse. (2019). *Opioid overdose crisis*. Retrieved from https://www.drugabuse.gov/drugs-abuse/opioids/opioid-overdose-crisis

Nicholson, H. L., & Vincent, J. (2018). Gender differences in prescription opioid misuse among U.S. Black adults. *Substance Use & Misuse*, *54*(4), 639-650. doi:10.1080/10826084.2018.1531427

Office of Management and Budget. (2009). *OMB Bulletin No. 10-02: Update of statistical area definitions and guidance on their uses*. Washington, DC: The White House.

Palamar, J. J. (2018). Barriers to accurately assessing prescription opioid misuse on surveys. *The American Journal of Drug and Alcohol Abuse*, 1-7. doi:10.1080/00952990.2018.1521826

Pitt, A. L., Humphreys, K., & Brandeau, M. L. (2018). Modeling health benefits and harms of public policy responses to the U.S. opioid epidemic. *American Journal of Public Health*, *108*, 1394-1400. doi:10.2105/AJPH.2018.304590

Prince, J. D. (2019). Correlates of opioid use disorders among people with severe mental illness in the United States. *Substance Use & Misuse*, *54*(6), 1024-1034. doi:10.1080/10826084.2018.1559192

PRISMA. (2015). PRISMA flow diagram. Retrieved from http://www.prisma-statement.org/PRISMAStatement/FlowDiagram

Rajabi, A., Dehghani, M., Shojaei, A., Farjam, M., & Motevalian, S. A. (2019). Association between tobacco smoking and opioid use: A meta-analysis. *Addictive Behaviors, 92*, 225-235. doi:10.1016/j.addbeh.2018.11.043

Schepis, T. S., Simoni-Wastila, L., & McCabe, S. E. (2019). Prescription opioid and benzodiazepine misuse is associated with suicidal ideation in older adults. *International Journal of Geriatric Psychiatry, 34*(1), 122-129. doi:10.1002/gps.4999

Scholl, L., Seth, P., Kariisa, M., Wilson, N., & Baldwin, G. (2019). Drug and opioid-involved overdose deaths—United States, 2013-2017. *MMWR Morbidity and Mortality Weekly Report, 67*(5152), 1419-1427.

Seth, P., Rudd, R. A., Noonan, R. K., & Haegerich, T. M. (2018). Quantifying the epidemic of prescription opioid overdose deaths. *American Journal of Public Health, 108*, 500-502. doi:10.2105/AJPH.2017.304265

Snyder, S. M., Morse, S. A., & Bride, B. E. (2019). A comparison of 2013 and 2017 baseline characteristics among treatment-seeking patients who used opioids with co-occurring disorders. *Journal of Substance Abuse Treatment, 99*, 134-138. doi:10.1016/j.jsat.2019.01.023

Tetrault, J. M., Desai, R. A., Becker, W. C., Fiellin, D. A., Concato, J., & Sullivan, L. E. (2008). Gender and non-medical use of prescription opioids: Results from a national U.S. survey. *Addiction, 103*, 258-268. doi:10.1111/j.1360-0443.2007.02056.x

U.S. Department of Health and Human Services. (2019). *What is the U.S. opioid epidemic?* Retrieved from https://www.hhs.gov/opioids/about-the-epidemic/index.html

Vivolo-Kantor, A. M., Seth, P., Gladden, R. M., Mattson, C. L., Baldwin, G. T., Kite-Powell, A., & Coletta, M. A. (2018). Vital signs: Trends in emergency department visits for suspected opioid overdoses—United States, July 2016-September 2017. *MMWR Morbidity and Mortality Weekly Report, 67*, 279-285. doi:10.15585/mmwr.mm6709e1

Vowles, K. E., McEntee, M. L., Julnes, P. S., Frohe, T., Ney, J. P., & van der Goes, D. N. (2015). Rates of opioid misuse, abuse, and addiction in chronic pain: A systematic review and data synthesis. *Pain, 156*, 569-576. doi:10.1097/01.j.pain.0000460357.01998.f1

Winkelman, T. N. A., Chang, V. W., & Binswanger, I. A. (2018). Health, polysubstance use, and criminal justice involvement among adults with varying levels of opioid use. *JAMA Network Open, 1*(3), e180558. doi:10.1001/jamanetworkopen.2018.0558

CHAPTER IV

IDENTIFYING THE HIDDEN RISK PROFILES OF THE U.S. OPIOID EPIDEMIC: A PERSON-CENTERED APPROACH

Introduction

The statistics delineating the opioid epidemic in the United States are both staggering and sobering. Over 130 people die daily from opioid overdose (National Institute on Drug Abuse, 2019). Opioid misuse in the U.S. resulted in an estimated 1.68 million years of life lost in 2016 (Gomes, Tadrous, Mamdani, Paterson, & Juurlink, 2018). Every year, opioid-related deaths have increased and are projected to continue to increase in the years to come. Over 63,630 overdose deaths were reported in 2016, with 66.4% (42,249) involving an opioid of some kind (Hedegaard, Warner, & Miniño, 2017). In 2017, more than 67.8% (47,600) of the 70,237 overdose deaths reported in the U.S. involved opioids (Scholl, Seth, Kariisa, Wilson, & Baldwin, 2019). The true extent of overdose deaths may also be underestimated (Seth, Rudd, Noonan, & Haegerich, 2018). Despite the staggering number of opioid overdose deaths attributed to misuse, prevention strategies and intervention programs have been seemingly ineffective in stemming the opioid epidemic.

Conventional interventions, while effective in stemming overdose deaths, have had a minimal impact since deaths have only increased from year to year. Projections have also been foreboding; opioid overdose deaths are estimated to increase 61% by 2025 (Chen et al., 2019). For instance, Chen et al. (2019) modeled how interventions

targeting the incidence of opioid prescriptions would decrease overdose deaths by 2025. It was found that the worst-case scenario would decrease overdose deaths by 3.0% and the best-case scenario by 5.3%. The best-case scenario was projected under the scenario of a 50% decrease in prescribing opioids based on historical trends. A similar study by Pitt, Humphreys, and Brandeau (2018) modeled how multiple interventions would affect the status quo trajectory of the opioid epidemic.

Pitt et al. (2018) found some interventions over a 5-year projection would have a positive impact on life years, quality-adjusted life years, and opioid related-overdose deaths. Such interventions included naloxone availability, needle exchange programs, opioid medication-assisted addiction treatment, as well as psychosocial treatment. Other interventions, such as reduced prescribing for pain patients and excess opioid medication management, would positively impact life years and quality-adjusted life years, but not overdose deaths. The 5-year projections found that in the case of these interventions, overdose deaths would actually increase and be heroin-related because patients would transition to heroin use. The most poignant finding from Pitt et al. was that the largest projected impact from an intervention was increasing naloxone availability. The projected overdose death decrease was 4%. However, much work is still needed to improve surveillance and response needed to effectively provide naloxone in the United States (Dodson, Enki Yoo, Martin-Gill, & Roth, 2018).

Chen et al. (2019) and Pitt et al.'s (2018) studies revealed that current universal interventions are not enough in addressing the multidimensional and dynamic aspects of the opioid epidemic. Various factors such as age, race/ethnicity, county population

levels, and others are related to opioid overdose deaths (Scholl et al., 2019). Before providing treatment, we must first understand opioid misuse and related disorders that lead to overdose. Patients prescribed opioids for chronic pain misuse them at rates estimated between 21 to 29% in the U.S. (National Institute on Drug Abuse, 2019; U.S. Department of Health and Human Services, 2019). Misuse can then lead to 12% of patients developing a misuse disorder (U.S. Department of Health and Human Services, 2019).

Multiple biopsychosocial factors—such as demographic characteristics (Nicholson & Vincent, 2018; Tetrault et al., 2008), socioecological indicators (Winkelman, Chang, & Binswanger, 2018), overall general and mental health status (Becker, Sullivan, Tetrault, Desai, & Fiellin, 2008; Braden, Edlund, & Sullivan, 2017), and co-substance dependence and abuse (Grigsby & Howard, 2019; Rajabi, Dehghani, Shojaei, Farjam, & Motevalian, 2019)—have been related to opioid misuse disorders (Havens et al., 2009; Schuler, Rice, Evans-Polce, & Collins, 2018). By exploring these factors, the most successful public health strategies identify the most salient factors to address unique, high-risk subgroups that can be hidden in the epidemiological data.

To ameliorate the public health burden and intervene upon opioid-related deaths, we need targeted interventions designed from identifying risk profiles of opioid misuse. I identified risk subgroups using biopsychosocial characteristics as risk factors leading to opioid misuse in the form of heroin, prescription pain relievers, or heroin and prescription pain reliever use. This study is among the first to use a person-centered approach, as opposed to a variable-centered approach like logistic regression, to identify

and examine opioid misuse subgroup risk profiles. While it is known that individual's misusing opioids will use heroin, prescription pain relievers, or a combination of both, the respective risk profiles are unknown. The purpose of this study is to fill a critical gap in the literature by identifying opioid misuse risk subgroups to better inform prevention strategies and intervention programs.

Methods

Latent class analysis (LCA) is a person-centered approach that allows for observed variables to group on an unobserved or latent outcome. This approach provides a less biased model because algorithms, not the researcher, group variables into classes or risk subgroups based on the outcome. The 2017 National Survey on Drug Use and Health (NSDUH) provided a representative sample of noninstitutionalized U.S. adults 18 years and older that self-reported opioid dependence or abuse. LCA was used on the 2017 NSDUH to identify the number of risk subgroups using biopsychosocial characteristics as observed risk factors to opioid misuse—in other words, the distal outcome. Other substance dependence or abuse was also accounted for as covariates in the model.

Risk Factors, Indicator Variables, and Latent Outcome

Opioid misuse risk groups were identified using the following 14 observed variables from the 2017 NSDUH: (1) age group; (2) sex/gender; (3) race/ethnicity (i.e., non-Hispanic White, Black, and other racial/ethnic groups, which included Native American/Alaska Native, Native Hawaiian/other Pacific Islander, Asian, and Hispanic); (4) sexual identity (i.e., heterosexual and sexual minorities such as lesbian, gay, or

bisexual); (5) residence (i.e., based on core-based statistical areas [CBSAs] detailed in the Office of Management and Budget, 2009); (6) family income; (7) educational attainment; (8) employment; (9) past criminality (i.e., arrested and booked in lifetime); (10) overall general health; (11) serious psychological distress in past year; (12) suicidality in past year; (13) private health insurance; and (14) type of opioid dependence and abuse (i.e., heroin, prescription pain reliever, or both heroin and prescription pain reliever). All aforementioned observed variables were used as risk indicators to model the latent categorical distal outcome of *opioid misuse*.

Substance Dependence and Abuse Covariates

Nicotine dependence in the past month was assessed using Nicotine Dependence Syndrome Scale scores, as well as the Fagerstrom Test of Nicotine Dependence scale. Self-reported alcohol and marijuana dependence and abuse in the last year was also ascertained. Moreover, dependence and abuse in the past year were ascertained for the following substances: cocaine, hallucinogens, inhalants, methamphetamines, tranquilizers, stimulants (independent of methamphetamine), and sedatives.

Latent Class Analysis Model Assessment

A model comparison approach was used to determine the number of classes. Multiple models were created (i.e., 2-, 3-, 4-, 5-class solutions, and so on) to then select the best model based on two criteria: (1) high entropy (i.e., the acceptable quality of classification); and (2) parsimony assessed via a sample-size-adjusted Bayesian information criterion (ssaBIC; Nylund, Asparouhov, & Muthén, 2007). Models were also assessed on their practical and theoretical implications. The one-class model was

calculated to assess fit indices and compare with subsequent models. Covariates were assessed using multinomial logistic regression on the final model selected. All LCAs were conducted using Mplus 8.2 (Muthén & Muthén).

Results

Sample Characteristics

The sample selected for analysis from the 2017 NSDUH was restricted to noninstitutionalized U.S. adults 18 years and older who self-reported opioid dependence or abuse (N = 476; weighted N = 2,018,922). The weighted sample's age was almost evenly distributed between 18- to 25-year-olds and 50- to 64-year-olds. The weighted sample was mostly male (60.6%), non-Hispanic White (77.9%), resided in a CBSA with less than 1 million people (48.4%), was heterosexual (90.5%), had a family income of $50,000 or more (39.8%), had some college or an associate's degree (39.2%), worked full-time (42.4%), had been arrested and booked (61.8%), was in overall good health (37.1%), had serious psychological distress (56.2%), had no suicidality (71.9%), and was covered by private health insurance (64.4%). See Table 4.1 for full sample biopsychosocial characteristics.

Table 4.1. Sample descriptive characteristics (*N* = 476; Weighted *N* = 2,018,922).

	N	Weighted *N*	SE	%
Age Groups				
18-25 years old	184	434,589	40,663	21.53
26-34 years old	135	563,428	54,187	27.91
35-49 years old	112	472,721	47,539	23.41
50 and older	45	548,185	90,514	27.15
Sex				
Male	265	1,222,669	115,706	60.56
Female	211	796,254	75,701	39.44
Race/Ethnicity				
White	338	1,571,681	110,436	77.85
Black/African American	39	197,841	42,519	9.80
Hispanic	55	135,898	29,026	6.73
Other	44	113,503	23,833	5.62
Area of Residence by Population Density				
Segment in a CBSA with 1 million or more	174	953,553	89,220	47.23
Segment in a CBSA with less than 1 million	271	977,657	85,843	48.42
Segment not in a CBSA	31	87,712	19,306	4.34
Sexual Identity				
Heterosexual, i.e., straight	415	1,787,231	124,244	90.54
Lesbian or gay or bisexual	56	186,810	32,311	9.46
Family Income				
Less than $20,000	146	554,213	58,753	27.45
$20,000-$49,999	160	660,461	76,797	32.71
$50,000 or more	170	804,248	89,361	39.84
Level of Education				
Less than high school	85	365,647	69,763	18.11
High school graduate	170	574,564	49,728	28.46
Some college/associate's degree	178	791,363	83,051	39.20
College graduate	43	287,347	52,808	14.23
Employment Status (past week)				
Not employed	244	978,466	76,555	49.15
Employed	226	1,012,321	106,086	50.85
Ever Arrested and Booked				
No	199	769,653	71,355	38.24
Yes	274	1,242,914	117,828	61.76
Overall Health Status				
Fair/poor	199	568,500	64,611	28.25
Good	179	746,798	76,174	37.11
Very good/excellent	177	696,856	81,016	34.63
Serious Psychological Distress Indicator (past year)				
No	208	883,497	80,824	43.76
Yes	268	1,135,425	101,215	56.24
Suicidality (past year)				
No	342	1,443,794	112,109	71.86
Yes	131	565,507	74,671	28.14
Covered by Private Health Insurance				
No	173	714,748	94,283	35.62
Yes	302	1,292,060	103,667	64.38

Opioid misuse was characterized by three categories: (1) those using heroin only; (2) those using prescription pain relievers; and (3) those who used both heroin and prescription pain relievers. The majority of the weighted sample used only pain relievers (66.0%). The weighted sample also reported 55.6% nicotine dependence in the past month, as well as 24.7% alcohol and 17.6% marijuana dependence or abuse in the past year. Other concurrent substance dependence or abuse in the past year (35.5) was also reported (i.e., inhalants, methamphetamine, tranquilizers, stimulants, hallucinogens, and sedatives). The substance that NSDUH participants reported having the highest dependence on was nicotine (55.6%). See Table 4.2 for the sample's full substance dependence or abuse profile.

Table 4.2. Substance dependence and abuse among 2017 NSDUH sample (*N* = 476; Weighted *N* = 2,018,922).

	N	Weighted *N*	SE	%
Nicotine Dependence (past month)				
No	209	896,857	97,419	44.42
Yes	267	1,122,066	104,780	55.58
Alcohol Dependence or Abuse (past year)				
No/unknown	334	1,520,322	115,962	75.30
Yes	142	498,601	55,085	24.70
Marijuana Dependence or Abuse (past year)				
No/unknown	394	1,664,216	115,234	82.43
Yes	82	354,706	66,896	17.57
Other Substance Dependences or Abuse (past year)				
No/unknown	301	1,307,249	103,939	64.75
Yes	60	711,673	75,572	35.25
Opioid Dependence or Abuse (past year)				
Heroin only	103	433,756	60,786	21.48
Pain reliever only	311	1,333,263	104,414	66.04
Heroin and pain reliever	62	251,903	42,231	12.48

Latent Class Analysis Model Selection

The four-class model with low ssaBIC and high entropy was favored (see Figure 4.1).

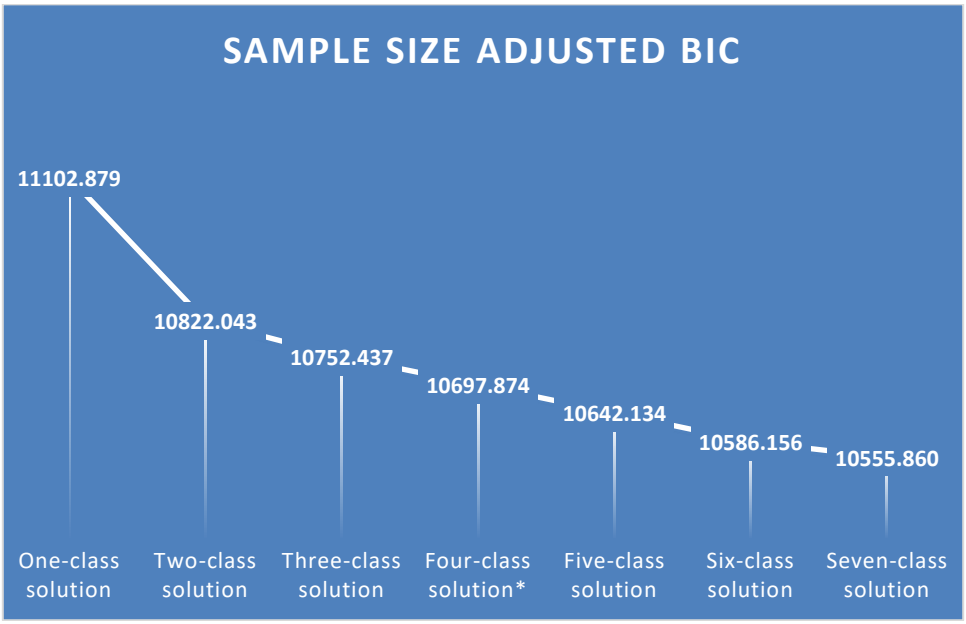

Figure 4.1. ssaBIC for latent class analysis models to assess opioid misuse risk profiles.

Classification accuracy of the four-class model solution was high, with an entropy value of 0.864 (see Table 4.3).

Table 4.3. LCA fit statistics for model comparisons.

Models	Sample Size Adjusted BIC	Entropy
One-class solution	11102.879	-
Two-class solution	10822.043	0.743
Three-class solution	10752.437	0.777
Four-class solution [a]	10697.874	0.864
Five-class solution	10642.134	0.859
Six-class solution	10586.156	0.860
Seven-class solution	10555.860	0.852

Note. [a] Model chosen for interpretation.

Latent Class Analysis

Class 1, or *single opioid users* (25.7% of sample), primarily used prescription opioids or heroin (71.5% and 24.0% conditional probability, respectively). This class was not defined by a single age group, but had a high conditional probability of being in the 26-34 age group (31.1%). Single opioid users had a high likelihood of being male (87.5%), identifying as heterosexual (95.3%), residing in a CBSA with more than 1 million individuals (60.6%), reporting a family income of more than $50,000 (72.2%), being employed (84.4%), having some college or associate's degree (46.0%), and never being arrested and booked (66.9%). *Single opioid users* also had one of the most racially/ethnically diverse groups, as well as the highest likelihood of non-Hispanic Black/African Americans (12.6%) and Hispanics (11.6%) compared to any other classes. Health wise, single opioid users reported a higher likelihood of excellent or very good health (55.9%), no serious psychological distress in the past year (72.8%), no past year suicidality (85.9%), and having private health insurance (72.9%).

Class 2, or *prescription opioid or combination users* (4.7% of sample), used either prescription opioids or a combination of heroin and prescription opioids (78.1% and 21.9% conditional probability, respectively). This class was exclusively in the 50 and older age group, male, non-Hispanic White, heterosexual, resided in a CBSA with more than 1 million individuals, was in good overall health, and had no private health insurance. Prescription opioid or combination users had a high likelihood of having a family income of $50,000 or more (77.4%), being unemployed in the past week (65.3%),

having a college degree (55.9%), having been arrested and booked (66.1%), no serious psychological distress (66.0%), and past-year suicidality (56.6%).

Class 3, or *prescription opioid users* (14.5% of sample), almost exclusively used prescription opioids (89.9% conditional probability). This group was not defined by a single age group, but the 50 and older group had a 41.4% higher likelihood of being in this group as compared to other age groups. Prescription opioid users were found to have the highest conditional probabilities of being female (93.8%), residing in a CBSA with less than 1 million individuals (56.8%), having private health insurance (81.7%), and having serious psychological distress within the past year (76.7%). Prescription opioid users also had a high likelihood of having been employed in the past week (76.3%) and reporting past-year suicidality (46.8%). Finally, Class 4, or *mixed opioid users* (55.2% of sample), used heroin, prescription opioids, or a combination of heroin and prescription opioids (27.4%, 56.5%, and 16.0% conditional probability, respectively). This class, similar to single opioid users, had a higher likelihood (31.4%) of being 26-34 years of age. Mixed opioid users were almost evenly split between males and females and had the highest conditional probability of being in a sexual minority (12.1%), having a family income of less than $20,000 (47.0%), having been arrested and booked (74.2%), being unemployed in the past week (68.8%), and being in fair/poor overall health (44.4%). Mixed opioid users also had a high probability of residing in a CBSA with less than 1 million individuals (56.7%), reporting serious psychological distress in the past year (66.3%), exhibiting no suicidality in past year (72.5%), and having no private health insurance (89.8%). See Table 4.4 for more detail.

Table 4.4. LCA four-class solution model of opioid misuse risk profiles.

	Class 1 Single opioid users	Class 2 Prescription or combination opioid users	Class 3 Prescription opioid users	Class 4 Mixed opioid users
	25.7% (*n* = 122)	4.7% (*n* = 22)	14.5% (*n* = 69)	55.2% (*n* = 263)
Age Category				
18-25 years old	0.263	0.000	0.228	0.208
26-34 years old	0.311	0.000	0.172	0.314
35-49 years old	0.251	0.000	0.186	0.258
50 and older	0.175	1.000	0.414	0.220
Sex/Gender				
Male	0.875	1.000	0.062	0.585
Female	0.125	0.000	0.938	0.415
Race/Ethnicity				
White	0.707	1.000	0.863	0.772
Black/African American	0.126	0.000	0.059	0.103
Hispanic	0.116	0.000	0.042	0.057
Other	0.052	0.000	0.037	0.068
Sexual Identity				
Heterosexual	0.953	1.000	0.901	0.879
Sexual minority	0.047	0.000	0.099	0.121
Population Density				
Segment in CBSA 1 million +	0.606	1.000	0.430	0.378
Segment in CBSA less than 1 million	0.346	0.000	0.568	0.567
Segment not in CBSA	0.048	0.000	0.002	0.055
Family Income				
Less than $20,000	0.001	0.007	0.084	0.470
$20,000-$49,999	0.277	0.219	0.264	0.375
$50,000 or over	0.722	0.774	0.652	0.155
Employment Status, Past Week				
Unemployed	0.156	0.653	0.237	0.688
Employed	0.844	0.347	0.763	0.312
Education				
Less than high school	0.081	0.321	0.005	0.260
High school graduate	0.298	0.000	0.112	0.345
Some college/associate's degree	0.460	0.120	0.456	0.367
College graduate	0.161	0.559	0.427	0.028
Ever Arrested and Booked for Breaking the Law				
No	0.331	0.339	1.000	0.258
Yes	0.669	0.661	0.000	0.742
Overall Health				
Fair/poor	0.075	0.000	0.106	0.444
Good	0.366	1.000	0.327	0.333
Excellent/very good	0.559	0.000	0.568	0.222
Serious Psychological Distress Indicator in Past Year				
No	0.728	0.660	0.233	0.337
Yes	0.272	0.340	0.767	0.663

Table 4.4. Continued.

	Class 1 Single opioid users	Class 2 Prescription or combination opioid users	Class 3 Prescription opioid users	Class 4 Mixed opioid users
	25.7% (*n* = 122)	4.7% (*n* = 22)	14.5% (*n* = 69)	55.2% (*n* = 263)
Seriously Thought About Killing Self in Past Year				
No	0.859	0.434	0.532	0.725
Yes	0.141	0.566	0.468	0.275
Private Health Insurance				
No	0.271	1.000	0.183	0.898
Yes	0.729	0.000	0.817	0.102
Opioid Dependence or Abuse				
Heroin only	0.240	0.000	0.002	0.274
Pain reliever only	0.715	0.781	0.899	0.565
Heroin and pain reliever	0.045	0.219	0.098	0.160

The multinomial logistic regression (see Table 4.5) revealed that prescription opioid users (Class 3) were about 77% less likely (95% CI: .23-.82) to report nicotine dependence in the last month compared to single opioid users (Class 1). In contrast, mixed opioid users (Class 4) were 350% more likely (OR = 4.54, 95% CI: 2.18-9.46) to report nicotine dependence in the last month, as well as almost 200% more likely (OR = 2.98, 95% CI: 1.17-7.60) to report a combination of substance dependence or abuse, than single opioid users (Class 1).

Table 4.5. Multinomial logistic regression of substance dependence and abuse covariates for four-class solution model using single opioid users (Class 1) as reference group.

	Class 2 Prescription opioid and combination users			Class 3 Prescription opioid users			Class 4 Mixed opioid users		
		95% CI			95% CI			95% CI	
	OR	Lower	Upper	OR	Lower	Upper	OR	Lower	Upper
Nicotine Dependence	2.87	0.28	28.99	**0.23**	**0.07**	**0.82**	**4.54**	**2.18**	**9.46**
Alcohol Dependence or Abuse	0.49	0.03	7.77	0.91	0.30	2.70	0.75	0.28	2.03
Marijuana Dependence or Abuse	4.81	0.32	73.00	0.91	0.17	4.91	1.04	0.30	3.60
Other Substances Dependence or Abuse	1.77	0.27	11.65	1.29	0.42	3.94	**2.98**	**1.17**	**7.60**

Discussion

This study revealed four risk subgroups of opioid misuse. I identified single opioid users, prescription or combination opioid users, prescription opioid users, and mixed opioid users. The single opioid user class had a high likelihood of either using only prescription pain relievers or heroin, in that order. This group was racially and ethnically diverse—although participants of color were limited in the sample—followed by the mixed opioid user class, both of which echoed the epidemiological findings of opioid overdose deaths reported in Scholl et al. (2019). Specifically, the two racial/ethnic groups with the largest overdose death increase were observed in Black/African Americans and Hispanics. The prescription opioid user class was comparatively less diverse and predominantly shifted toward non-Hispanic White. The prescription or combination opioid use class was the only exclusive non-Hispanic White risk subgroup. Unlike what the media has portrayed (Hansen & Netherland, 2016), the opioid epidemic involves many racial/ethnic groups.

I considered the prescription or combination opioid user class to be the highest at-risk group because of the reported likelihood of a combination of heroin and prescription pain reliever use. The combination opioid misuse suggests that this class may have transitioned to heroin use from prescription pain relievers since there was no likelihood of heroin-only use. This class exclusively used prescription opioids that are known to be risk factor to heroin use (Becker et al., 2008; Carlson, Nahhas, Martins, & Daniulaityte, 2016; Cicero, Ellis, Surratt, & Kurtz, 2014; Jones, 2013; Muhuri, Gfroerer, & Davies, 2013). Becker et al. (2008), using the 2001-2004 NSDUH, found that

individuals using heroin had almost four times increased odds of reporting nonmedical use of opioids, as well as almost triple the odds of being dependent on or abusing opioids compared to those who did not use heroin. Muhuri et al. (2013), using multiple waves of the NSDUH, found that approximately 80% of recent heroin users had initiated opioid use with nonmedically prescribed pain relievers. Similarly, Jones (2013), using U.S. epidemiological data, found that over 77% of combination heroin and nonmedical prescription opioid users reported opioid initiation with prescription pain relievers.

A temporal effect may also exist with combination opioid use and initiation. Cicero et al. (2014) reported that from the 1960s to the 1990s there has been a near linear decrease in heroin being the opioid initiation. Based on the prescription or combination opioid use class being exclusively age 50 or older, if opioid initiation were to have occurred between the 1960s and 1970s, the retrospective probability of heroin use would have been more than 80% to 70%, respectively. Inversely, from the 1990s to the 2000s, there was a 50% to 75% probability of opioid misuse being a result of prescription pain relievers. In the 2010s, however, there was another shift where heroin initiation began to increase as prescription opioid initiation dropped (Cicero et al., 2014). Initiation cannot be ascertained or if a transition occurred; nevertheless, the high combination use of opioids within this class is indicative of specialized prevention strategies. Particularly as past-year prescription opioid misuse has been related to a lower perception of harm from heroin initiation and risk of regular use (Kapadia & Bao, 2019). The prescription opioid user class may also be at high risk of transitioning to combined opioid use, although likelihood of combination use was low.

The mixed opioid user class had the second highest likelihood of combined heroin and prescription opioid use, as well as the highest likelihood of heroin-only use. This risk subgroup may be affected by temporality and initiation effects of heroin use, as previously discussed concerning the prescription or combination opioid class. However, combination heroin and prescription opioid use, as well as heroin-only use, have been associated with various geographic factors (i.e., rural versus urban), socioeconomic status, socioecological factors (e.g., criminality), sexual identity (i.e., sexual minority), overall health (i.e., poor/fair health), mental health issues (e.g., psychological distress, depression, or anxiety), suicidality, and substance-dependence/abuse (Becker et al., 2008; Braden et al., 2017; Havens et al., 2009; Schuler et al., 2018; Winkelman et al., 2018).

Moreover, the mixed opioid use class had almost three times the odds of multiple substance dependence or abuse than did the single opioid user class. This fact is especially troublesome because mixed opioid users already have a risk of moving from the intended oral administration route of prescription pain relievers to non-oral routes of administration. Misuse may then take routes of ingestion via non-intended forms (e.g., chewing; mixing with water or other substances; rectal administration), inhalation (e.g., smoking, snorting, or vaping), or injection (Gasior, Bond, & Malamut, 2016; Kestenbaum et al., 2014; Kirsh, Peppin, & Coleman, 2012). When using alternative routes of administration, opioid tolerance can also result more readily, which will often necessitate a preferred dosing route to increase the potency of the particular substance in patterns of increasing abuse (Gasior et al., 2016; Kestenbaum et al., 2014; Kirsh et al.,

2012). Other bodily harms are associated with alternative routes of administration that can range from minor irritations to tissue necrosis. Intravenous routes of administration have also been associated with increased risk of HIV and HCV exposure (Havens, Walker, & Leukefeld, 2007; Surratt, Kurtz, & Cicero, 2011; Zibbell et al., 2018). The ultimate consequence of alternative routes of administration are unintentional death due to overdose (Gasior et al., 2016; Kirsh et al., 2012).

Limitations

The NSDUH is a nationally representative instrument for collecting estimates of drug use and mental health; however, there are limitations associated with using it. One limitation is the use of self-report data, which is subject to the individual bias, truthfulness, and recollection of the responder. To address this issue, the NSDUH employed the use of audio computer-assisted self-interview (ACASI) software instead of human interviewers. While studies have established the validity of the NSDUH, the ACASI design and other implementation procedures are designed to boost recall. Nevertheless, as is the nature with these survey types, a level of under- and over-reporting exist (Palamar, 2018). For the purposes of recall in the 2017 cycle, prescription drug inquiries for specific and related medications allowed participants to report any use/misuse in the past 12 months to allow for the data collection of a given active ingredient. These self-reports do not guarantee accuracy in identifying the drugs taken, particularly when drugs are reported by brand name. Furthermore, the 2017 NSDUH did not include a section for synthetic opioids like fentanyl. Another limitation of the NSDUH is the data are not longitudinal, but cross-sectional. Thus, each survey cycle

offers a momentary prevalence of substance use. Finally, although the data are nationally representative, they do exclude a small population subset. The NSDUH targets noninstitutionalized U.S. citizens, so active-duty military members and institutionalized groups (e.g., prisoners, hospital patients, treatment center patients, and nursing home members) are excluded. Therefore, if substance use differs between U.S. noninstitutionalized and institutionalized groups by more than approximately 3%, estimates provided by the NSDUH data may be inaccurate for the total U.S. population (Center for Behavioral Health Statistics, 2018). This inaccuracy has been suggested for the prevalence of heroin since it is a less commonly used drug (Center for Behavioral Health Statistics, 2018; Palamar, 2018).

Public Health Implications

Person-centered approaches such as LCA allow a less biased method to identify risk profiles. Latent class analysis uses a mixture analysis wherein algorithms group variables to reveal latent or unobserved patterns. Variable-centered approaches like logistic regressions may lead to unintentional bias because variables must be selected to assess the relationship to an outcome. The person-centered approach, as compared to variable-centered approach, provides a method where observed biopsychosocial characteristics reveal unobserved opioid misuse risk profiles. Consequently, from a single variable of opioid dependence or abuse, I was able to identify four risk subgroups. These four subgroups had varied sociodemographic, socioecological, and health indicators with varying probabilities of licit and illicit substance dependence and abuse. The subgroups identified also provide possible emergent risk groups that should be

further examined to determine their levels of increasing or transitioning risk. Of importance is the fact that all four groups identified were dependent and/or abusing opioids and will need tailored interventions to intervene against the possible outcome of overdose death. Using LCA, we can examine the risk profiles of each risk subgroup or class to create the best and most salient selective interventions, thereby replacing those universal opioid prevention strategies that have been found lacking (Fraser & Plescia, 2019).

Human Participant Protection

The Texas A&M University Institutional Review Board assessed the research protocol, and no approval was necessary since it was secondary data from a publicly available source.

References

Becker, W. C., Sullivan, L. E., Tetrault, J. M., Desai, R. A., & Fiellin, D. A. (2008). Non-medical use, abuse and dependence on prescription opioids among U.S. adults: Psychiatric, medical and substance use correlates. *Drug and Alcohol Dependence, 94*, 38-47.

Braden, J. B., Edlund, M. J., & Sullivan, M. D. (2017). Suicide deaths with opioid poisoning in the United States: 199-2014. *American Journal of Public Health, 107*, 421-426. doi:10.2105/AJPH.2016.303591

Carlson, R. G., Nahhas, R. W., Martins, S. S., & Daniulaityte, R. (2016). Predictors of transition to heroin use among initially non-opioid dependent illicit pharmaceutical opioid users: A natural history study. *Drug and Alcohol Dependence, 160*, 127-134. doi:10.1016/j.drugalcdep.2015.12.026

Center for Behavioral Health Statistics. (2018). *2017 National Survey of Drug Use and Health final analytic codebook.* Rockville, MD: Substance Abuse and Mental Health Services Administration.

Conroy, S. C., & Bjork, J. M. (2018). Death ambivalence and treatment seeking: Suicidality in opiate addiction. *Current Treatment Options in Psychiatry, 5*(3), 291-300. doi:10.1097/ADM.0000000000000451

Chen, Q., Larochelle, M. R., Weaver, D. T., Lietz, A. P., Mueller, P. P., Mercaldo, S., . . . Chhatwal, J. (2019). Prevention of prescription opioid misuse and projected overdose deaths in the United States. *JAMA Network Open, 2*(2), e187621. doi:10.1001/jamanetworkopen.2018.7621

Cicero, T. J., Ellis, M. S., Surratt, H. L., & Kurtz, S. P. (2014). The changing face of heroin use in the United States: A retrospective analysis of the past 50 years. *JAMA Psychiatry, 71*(7), 821-826. doi:10.1001/jamapsychiatry.2014.366

Dodson, Z. M., Enki Yoo, E. H., Martin-Gill, C., & Roth, R. (2018). Spatial methods to enhance public health surveillance and resource deployment in the opioid epidemic. *American Journal of Public Health, 108*(9), 1191-1196. doi:10.2105/AJPH.2018.304524

Fraser, M., & Plescia, M. (2019). The opioid epidemic's prevention problem. *American Journal of Public Health, 109*(2), 215-217. doi:10.2105/AJPH.2018.304859

Gasior, M., Bond, M., & Malamut, R. (2016). Routes of abuse of prescription opioid analgesics: A review and assessment of the potential impact of abuse-deterrent formulations. *Postgraduate Medicine, 128*(1), 85-96. doi:10.1080/00325481.2016.1120642

Gomes, T., Tadrous, M., Mamdani, M. M., Paterson, J. M., & Juurlink, D. N. (2018). The burden of opioid-related mortality in the United States, 2001-2016. *JAMA Network Open, 1*(2), e180217. doi:10.1001/jamanetworkopen.2018.0217

Grigsby, T. J., & Howard, J. T. (2019). Prescription opioid misuse and comorbid substance use: Past 30-day prevalence, correlates and co-occurring behavioral indicators in the 2016 National Survey on Drug Use and Health. *The American Journal on Addictions*, 1-8. doi:10.1111/ajad.12866

Hansen, H., & Netherland, J. (2016). Is the prescription opioid epidemic a white problem? *American Journal of Public Health*, *106*(12), 2127-2129. doi:10.2105/AJPH.2016.303483

Havens, J. R., Stoops, W. W., Leukefeld, C. G., Garrity, T. F., Carlson, R. G., Falck, R., . . . Booth, B. M. (2009). Prescription opiate misuse among rural stimulant users in a multistate community-based study. *The American Journal of Drug and Alcohol Abuse*, *35*(1), 18-23.

Havens, J. R., Walker, R., & Leukefeld, C. G. (2007). Prevalence of opioid analgesic injection among rural nonmedical opioid analgesic users. *Drug and Alcohol Dependence*, *87*(1), 98-102. doi:10.1016/j.drugalcdep.2006.07.008

Hedegaard, H., Warner, M., & Miniño, A. M. (2017). *Drug overdose deaths in the United States, 1999–2016*. NCHS Data Brief, No 294. Hyattsville, MD: National Center for Health Statistics.

Jones, C. M. (2013). Heroin use and heroin use risk behaviors among nonmedical users of prescription opioid pain relievers—United States, 2002-2004 and 2008-2010. *Drug and Alcohol Dependence*, *132*(1-2), 95-100.

Kapadia, S. N., & Bao, Y. (2019). Prescription painkiller misuse and the perceived risk of harm from using heroin. *Addictive Behaviors, 93*, 141-145. doi:10.1016/j.addbeh.2019.01.039

Kestenbaum, M. G., Vilches, A. O., Messersmith, S., Connor, S. R., Fine, P. G., Murphy, B., . . . Muir, J. C. (2014). Alternative routes to oral opioid administration in palliative care: A review and clinical summary. *Pain Medicine, 15*(7), 1129-1153. doi:10.1111/pme.12464

Kirsh, K., Peppin, J., & Coleman, J. (2012). Characterization of prescription opioid abuse in the United States: Focus on route of administration. *Journal of Pain & Palliative Care Pharmacotherapy, 26*(4), 348-361. doi:10.3109/15360288.2012.734905

Muhuri, P. K., Gfroerer, J. C., & Davies, M. C. (2013). *Associations of nonmedical pain reliever use and initiation of heroin use in the United States*. CBHSQ Data Review. Retrieved from https://www.samhsa.gov/data/sites/default/files/DR006/DR006/nonmedical-pain-reliever-use-2013.htm

National Institute on Drug Abuse. (2019). *Opioid overdose crisis*. Retrieved from https://www.drugabuse.gov/drugs-abuse/opioids/opioid-overdose-crisis

Nicholson, H. L., & Vincent, J. (2018). Gender differences in prescription opioid misuse among U.S. Black adults. *Substance Use & Misuse*, *54*(4), 639-650. doi:10.1080/10826084.2018.1531427

Nylund, K. L., Asparouhov, T., & Muthén, B. O. (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. *Structural Equation Modeling*, *14*, 535-569.

Office of Management and Budget. (2009). *OMB Bulletin No. 10-02: Update of statistical area definitions and guidance on their uses*. Washington, DC: The White House.

Palamar, J. J. (2018). Barriers to accurately assessing prescription opioid misuse on surveys. *The American Journal of Drug and Alcohol Abuse*, 1-7. doi:10.1080/00952990.2018.1521826

Pitt, A. L., Humphreys, K., & Brandeau, M. L. (2018). Modeling health benefits and harms of public policy responses to the U.S. opioid epidemic. *American Journal of Public Health, 108*, 1394-1400. doi:10.2105/AJPH.2018.304590

Rajabi, A., Dehghani, M., Shojaei, A., Farjam, M., & Motevalian, S. A. (2019). Association between tobacco smoking and opioid use: A meta-analysis. *Addictive Behaviors, 92*, 225-235. doi:10.1016/j.addbeh.2018.11.043

Scholl, L., Seth, P., Kariisa, M., Wilson, N., & Baldwin, G. (2019). Drug and opioid-involved overdose deaths—United States, 2013-2017. *MMWR Morbidity and Mortality Weekly Report, 67*(5152), 1419-1427. doi:10.15585/mmwr.mm675152e1

Schuler, M. S., Rice, C. E., Evans-Polce, R. J., & Collins, R. L. (2018). Disparities in substance use behaviors and disorders among adult sexual minorities by age, gender, and sexual identity. *Drug and Alcohol Dependence, 189*, 139-146. doi:10.1016/j.drugalcdep.2018.05.008

Seth, P., Rudd, R. A., Noonan, R. K., & Haegerich, T. M. (2018). Quantifying the epidemic of prescription opioid overdose deaths. *American Journal of Public Health, 108*, 500-502. doi:10.2105/AJPH.2017.304265

Surratt, H., Kurtz, S. P., & Cicero, T. J. (2011). Alternate routes of administration and risk for HIV among prescription opioid abusers. *Journal of Addictive Diseases, 30*, 334-341. doi:10.1080/10550887.2011.609805

Tetrault, J. M., Desai, R. A., Becker, W. C., Fiellin, D. A., Concato, J., & Sullivan, L. E. (2008). Gender and non-medical use of prescription opioids: Results from a national U.S. survey. *Addiction, 103*(2), 258-268. doi:10.1111/j.1360-0443.2007.02056.x

U.S. Department of Health and Human Services. (2019). *What is the U.S. opioid epidemic?* Retrieved from https://www.hhs.gov/opioids/about-the-epidemic/index.html

Winkelman, T. N. A., Chang, V. W., & Binswanger, I. A. (2018). Health, polysubstance use, and criminal justice involvement among adults with varying levels of opioid use. *JAMA Network Open, 1*(3), e180558. doi:10.1001/jamanetworkopen.2018.0558

Zibbell, J. E., Asher, A. K., Patel, R. C., Kupronis, B., Iqbal, K., Ward, J. W., & Holtzman, D. (2018). Increases in acute hepatitis C virus infection related to a growing opioid epidemic and associated injection drug use, United States, 2004 to 2014. *American Journal of Public Health, 108*(2), 175-181. doi:10.2105/AJPH.2017.304132

CHAPTER V

CONCLUSIONS

To my knowledge, no previous studies have used a systematic literature review to construct a comprehensive risk profile of opioid misuse in the United States. The findings from the systematic literature review elucidated the quality of findings concerning opioid misuse risk factors. Similarly, no previous study has used the latest wave of the 2017 National Survey on Drug Use and Health (NSDUH; i.e., a nationally representative dataset containing opioid misuse data) to construct a population-level risk profile and subgroup risk profiles of individuals misusing opioid. Moreover, to my knowledge, no known studies have previously identified at-risk subgroups of opioid misuse using a person-centered approach.

Previous chapters have discussed the strengths and weaknesses of both variable-centered and person-centered methodologies in addressing the growing public health crisis of the opioid epidemic using the latest NSDUH and examined the findings of both approaches. The goal of this comparative process was to identify population-level risk factors to opioid misuse and identify risk subgroups currently dependent on or abusing opioids. By using this process, prevention strategies and intervention programs can be designed to efficiently and efficaciously intervene upon opioid misuse, specifically in regard to heroin and/or prescription opioid use. To this end, this study's contribution to the literature can further inform strategies and programs to substantially stem overdose deaths by helping develop tailored interventions.

Review of Findings

Current opioid misuse interventions minimally affect U.S. overdose deaths. Every year since the first wave of the opioid epidemic, misuse and overdose deaths have increased—so much so that, some two decades after the onset, the U.S. Department of Health and Human Services (2019) finally acknowledged the opioid epidemic in 2017. However, even after more than two decades of research, projections of prevention strategies and intervention programs reveal that by 2025 misuse and overdose deaths will only continue to rise (Chen et al., 2019; Pitt, Humphreys, & Brandeau, 2018). Thus, in this dissertation, I first assessed the high-quality research available on opioid misuse risk factors. Next, using the latest nationally representative data set, I tested the risk factors that were identified using a variable-centered approach; that is, the relationship of risk factors for opioid misuse were assessed using a multivariable logistic regression. The next step was to assess the various risk subgroups for opioid misuse. Four subgroups were identified to inform the literature as to what subgroups were at highest risk and what biopsychosocial characteristics defined them. By using this process, researchers can tailor successful prevention strategies and intervention programs to specific symptoms. Each of the three studies contained herein were the first of their kind and will be published accordingly. The findings will ultimately inform the gaps in the literature and help provide some amelioration to the ever growing opioid epidemic and the associated public health crisis.

The Methodological Differences of Variable-Centered and Person-Centered Approaches to Understand the U.S. Opioid Epidemic

Critical to curbing the impact of the opioid epidemic is gaining an understanding of the etiology of nonmedical misuse—that is, the factors leading to dependence and abuse. Currently, a reductionist, linear perspective predominates the research landscape. Variable-centered and linear approaches within that perspective are critical to understanding the relationships between biopsychosocial risk factors and opioid misuse, and work under the assumption of population homogeneity, which can be presented as either a strength or a weakness; this attribution can be tenuous nevertheless. What can be attributed as a strength is that inferences can be drawn at a population level. In my case, however, relationships are likely not linear or additive, and may be indicative of some rudimentary or crude correlations; as the relationships and trends from linear approaches are based on averages, which may obscure contextual group or individual level differences. Subpopulations and subgroups tend to deviate from assumptions of population homogeneity, as in many cases they are outliers. As such, variable-centered approaches do not provide a reliable manner to study outlier groups. Person-centered approaches using mixture models like latent class analysis (LCA) allow for a method to deviate from population-level assumptions and generalize all individuals within the subpopulation being studied (Howard & Hoffman, 2017).

Using data from the NSDUH, I reviewed the strengths and weaknesses of the variable-centered approach using logistic regression. I also reviewed the strengths and

weaknesses of the person-centered approach using LCA and explored how this approach can complement variable-centered approaches.

Study Strengths, Limitations, and Future Directions

I will first focus on my findings of race/ethnicity on opioid misuse to discuss differences between variable-centered and person-centered approaches. Using a variable-centered approach, race/ethnicity at the population level was not a direct factor on opioid misuse; although it did have a stronger role in the LCA. Possible issues in the variable-centered approach could be other variances from variables in the model were explaining the relationship, or perhaps possible unseen interaction effects. Albeit, person-centered approaches are not sensitive to averages as variable-centered approaches. I must contend with the issue of race/ethnicity as a categorical construct, like many other biopsychosocial characteristics (Lillie-Blanton & Laveist, 1996; Nazroo & Williams, 2006). Thus, the issue with race/ethnicity is threefold. First, it is a construct by which marginalization is experienced and perpetrated into biological reality (Gravlee, 2009). Second, the construct is a non-intervenable factor, but a predictor of risk (Kriger, 1987; Nazroo & Williams, 2006; Williams, Lavizzo-Mourey, & Warren, 1994). Third, race is not ethnicity (Helms & Talleyrand, 1997; Nazroo & Williams, 2006), yet most constructs use them interchangeably. I cannot discern what the possible issues might be as analyses would require further stratification by racial categories and ethnicities.

Moreover, race/ethnicity is a social construct that has become a disease etiology through biological embodiment (see Kuzawa & Sweet, 2009). As revealed through health disparities research and social determinants of health, race and ethnicity have a

predictive component to health and dependence outcomes. In the unadjusted models of Chapter III, race/ethnicity was seen as a significant predictor to opioid dependence and abuse, specifically for the categories of non-Hispanic White and Native American/Alaska Native. In other similar studies that looked at different biopsychosocial characteristics, race/ethnicity was found to be predictive, but not in the same type of comprehensive model tested in this study. Using the final adjusted model from Chapter III, I found that race/ethnicity was not predictive of opioid misuse. This effect was probably because other factors within the model explained the variation on opioid misuse in a more meaningful manner. Furthermore, there may be a hidden interaction from socioecological, health, or other substance-use factors that can be explored in subsequent studies (e.g., sex/gender and sexual identity; family income and employment; employment and educational attainment; criminality and educational attainment). Other sociodemographic factors like the adult age groups, sex/gender, and sexual identity also were found to not be predictive in the model, whereas in other studies they were found to be significant. Again, in such studies the factors were not presented in comprehensive models, and in some they were stratified, which could be considered to be parsimonious models. The advantages and disadvantages that exist in using parsimonious models will not be discussed here. Nevertheless, in parsimonious models, the complexity of individuals is lost; moreover, no individual can choose to be represented by biopsychosocial characteristics at any given time.

Using person-centered approaches like LCA enables the researcher to account for a constellation of variables outside of the conventional linear model (Howard &

Hoffman, 2017). In direct contrast to findings from the variable-centered approach in Chapter III, while using a person-centered approach in Chapter IV, I found that race/ethnicity was a significant indicator to opioid misuse. For instance, in some models not selected for interpretation as well as the final selected model, non-Hispanic Whites were at the highest risk of combination opioid misuse compared to other risk subgroups or classes. Other subgroups more racially/ethnically diverse were also observed to have higher likelihoods of heroin use or mixed opioid use.

Sex/gender differences are also a major point of contention in opioid misuse studies. In my variable-centered analysis, sex/gender was not a significant predictor, but in the LCA it was a major indicator. These contrasting results suggest a gendering in opioid misuse reports since there is evidence of gender differences in opioid misuse and initiation (Serdarevic, Striley, & Cottler, 2017; Tetrault et al., 2008), although the majority of the epidemiological data report that men have a higher likelihood of substance misuse in general (National Institute on Drug Abuse, 2019b).

Overall, when comparing the variable-centered approach to the person-centered approach, dynamic differences exist. In the variable-centered approach, I used the multivariable logistic regression to find a relationship between variables, which revealed that an individual's racial/ethnic affiliation or self-report is not significant in light of opioid misuse even though paradoxically the epidemiological data indicate that it is, especially when considering opioid overdose death (e.g., Scholl, Seth, Kariisa, Wilson, & Baldwin, 2019). Similarly, although race/ethnicity is a social construct that is not intervenable, other factors like criminality or health status may be more indicative of

opioid misuse risk in certain types of parsimonious linear models. The adjusted model in Chapter III also presents an interesting paradox because variable-to-variable relationships are being assessed even as variations are being considered within a model. In other words, the relationships are interpreted individually but their variations are accounted for collectively. These models are subject to researcher bias as well because the variables within the models must be selected and accounted for by the researcher.

On the other hand, using a person-centered approach such as LCA allows the constellation of variables to group using an algorithm (Muthén & Muthén, 2000; Nylund, Asparouhov, & Muthén, 2007) to help minimize the bias introduced by the researcher. The indicator variables provide a constellation of combinations that group into a possible outcome to help explain the likelihood of the type of opioid misuse. Latent class analysis helps captures the complex dynamic systems in which individuals' misuse of opioids are embedded. If methods do not capture the dynamic systems, then the issues at hand cannot be dealt with. For instance, as is the case with opioid prescription reduction, if the incidence and prevalence of opioid prescribing is dealt with, then an individual's misuse of prescription opioids may transition to either heroin only or a combination of heroin and prescription opioid use. Moreover, dynamic systems must also employ multiple lines of interventions to work in concert to help deal with the opioid epidemic and subsequent overdose deaths. Furthermore, dynamic systems are systems based on models of equilibria—as a system adapts, only the status quo will follow. Interventions are the catalysts needed to break a system from a status quo model.

As such, we must identify the most intervenable and changeable factors within the dynamic system of opioid misuse.

We must also recognize that there is an additional methodological approach that looks at individuals as dynamic systems while acknowledging that population homogeneity is a rigid construct (Howard & Hoffman, 2017). This person-specific, or idiosyncratic, approach is to make person-specific inferences that do not necessarily describe the larger population. Sometimes individuals are not reflections of the population in general, nor is the population in general a reflection of an individual. This approach recognizes that individuals are unique; in order to describe and understand an individual, an individualized model is needed. Such models can be achieved through methods like state-space modeling or dynamic factor analysis (Howard & Hoffman, 2017). In future applications, using person-specific methods can help develop more effective and efficacious universal and selective interventions, as well as help develop indicated interventions. Indicated interventions for opioid misuse can be targeted to individuals at early stages of dependence in which salient prevention strategies and intervention programs can be applied in clinical and community settings (Fraser & Plescia, 2019). Clinical interventions might include a prescription drug monitoring program, identifying those seeking opioids inappropriately, psychosocial counseling, medication-assisted treatment (MAT), and recovery programs when possible. Community setting interventions can include needle exchange programs as well as referral services to clinical treatment, public health services, and recovery programs (Fraser & Plescia, 2019). No study to date has attempted to study how opioid misuse

affects risk factors, such as identity, sexuality, educational attainment, and employment. The majority of the attempts look at how risk factors affect opioid misuse. By using person-specific approaches, we will be able to use more dynamic models and understand feedback loops among these factors rather than just exploring linear trends.

Concluding Thoughts

Currently, while there are multiple prevention strategies and prevention programs for opioid misuse, a need exists to go beyond the standard public health research track and include more social justice solutions in order to create meaningful change. One such solution might be to target companies responsible for the opioid epidemic and current crisis. The U.S. federal government has indicated a willingness to take such additional steps to resolve the opioid epidemic. For instance, the federal government for the first time indicted the Rochester Drug Cooperative (Hopkins, 2019), one of the largest U.S. drug distributors, which paid $20 million to settle civil and criminal claims against its executives for distributing opioids illegally. Stiffer penalties may need to be enforced because some the costs of the epidemic in 2013 alone were $78.5 billion (Florence, Zhou, Luo, & Xu, 2016). Companies such Purdue Pharma, which patented OxyContin, has made over $35 billion on opioids alone, was valued at $35 billion in 2017 (Stickler, 2019), and has an annual revenue of about $3 billion a year (Morrell, 2015). Opioid companies, much like Big Tobacco, should be fined to pay for (a) misrepresenting the medication as non-habit forming, (b) damages, and (c) treatment. Big Tobacco has paid over $100 billion to settle claims during the past 20 years (Mann, 2018), so opioid pharmaceutical and distributors should bear the economic burden as well.

Prevention strategies and intervention programs. Multiple interventions exist (e.g., prescription monitoring programs; acute/chronic pain management prevention programs; transitioning pain programs; prescription pain reliever rescheduling; substance reformulation; opioid disposal programs; needle exchanges and similar programs; MAT; psychosocial services and treatment; Pitt et al., 2018; Substance Abuse and Mental Health Services Administration, 2019a). Nevertheless, only four interventions are projected to have an impact on opioid overdose deaths, the ultimate consequence of abuse: psychosocial treatment, needle exchange programs, opioid medication-assisted addiction treatment, and naloxone availability (Pitt et al., 2018).

MAT for opioid dependence has relied on methadone, buprenorphine, and naltrexone (Substance Abuse and Mental Health Services Administration, 2019a). All three MATs are somewhat controversial but do provide a level of relief from opioid dependence. Methadone and buprenorphine can be misused to provide a "high" as well. Furthermore, methadone is an opioid agonist that can only be provided in clinical settings, although clinical trials have tested the use of methadone in non-clinical settings. Buprenorphine is an opioid antagonist and partial agonist, which can be dispensed outside of clinical settings that can block the effects of other narcotic substances. Both buprenorphine and naltrexone can be dispensed outside of clinical settings from pharmacies (Substance Abuse and Mental Health Services Administration, 2019a). Purdue Pharma, however, holds the patent for buprenorphine (Ivanova, 2018), which may become conflict of interest in the near future. Only naltrexone, of the three MATs, provides a non-dependence forming opioid antagonist that works for other narcotic

substances as well (Substance Abuse and Mental Health Services Administration, 2019a). Naltrexone, however, should not be used in combination with other substances, especially opioids. This medication does reduce opioid tolerance, so relapse can lead to overdose and death (Substance Abuse and Mental Health Services Administration, 2019a).

Most recently, the use of naloxone as MAT for opioid overdose has emerged into the limelight. Naloxone is an opioid antagonist that helps reverse and stop the effects of opioid overdose. Naloxone is used to prevent opioid misuse and is often given in combination with buprenorphine. This combination is often used to prevent the diversion effect and prevent misuse (National Institute on Drug Abuse, 2019a; Substance Abuse and Mental Health Services Administration, 2019b). Thus, naloxone has been found to be an effective MAT for the opioid epidemic (Dodson, Enki Yoo, Martin-Gill, & Roth, 2018) that can curb some of the associated overdose deaths (Pitt et al., 2018). Nevertheless, current and projected interventions face many challenges, and if current usage trajectories continue apace, they will have a minimal overall impact. Conversely, the use of both universal and selective interventions can have a meaningful impact on the epidemic (Fraser & Plescia, 2019), but only if targeted prevention strategies are accounted for using the appropriate methodological approaches and methods.

By applying the findings contained in this study, we can identify population-level risk factors for opioid misuse and improve on possible surveillance and intervention strategies. Furthermore, though current opioid misuse interventions are severely limited, the findings contained herein can help strengthen the current literature to inform

prevention strategies and intervention programs. My person-centered analysis also allowed me to find at-risk subgroups that might be more vulnerable to particular opioid substances. By identifying these risk subgroups, we can better tailor interventional measures and strategies to stem the impact of the opioid epidemic and reduce overdose deaths. Future studies, as such, should stratify their analyses by race/ethnicity and sex/gender to examine the unique risks associated between- and within-groups.

References

Chen, Q., Larochelle, M. R., Weaver, D. T., Lietz, A. P., Mueller, P. P., Mercaldo, S., . . . Chhatwal, J. (2019). Prevention of prescription opioid misuse and projected overdose deaths in the United States. *JAMA Network Open, 2*(2), e187621. doi:10.1001/jamanetworkopen.2018.7621

Dodson, Z. M., Enki Yoo, E. H., Martin-Gill, C., & Roth, R. (2018). Spatial methods to enhance public health surveillance and resource deployment in the opioid epidemic. *American Journal of Public Health, 108*, 1191-1196. doi:10.2105/AJPH.2018.304524

Florence, C. S., Zhou, C., Luo, F., & Xu, L. (2016). The economic burden of prescription opioid overdose, abuse, and dependence in the United States, 2013. *Medical Care, 54*, 901-906. doi:10.1097/MLR.0000000000000625

Fraser, M., & Plescia, M. (2019). The opioid epidemic's prevention problem. *American Journal of Public Health*, *109*(2), 215-217. doi:10.2105/AJPH.2018.304859

Gravlee, C. C. (2009). How race becomes biology: Embodiment of social inequality. *American Journal of Physical Anthropology*, *139*(1), 47-57. doi:10.1002/ajpa.20983

Helms, J. E., & Talleyrand, R. M. (1997). Race is not ethnicity. *American Psychologist, 52*, 1246-1247. doi:10.1037/0003-066X.52.11.1246

Hopkins, J. S. (2019). Upstate New York drug distributor settles charges in opioid case. *The Wall Street Journal*. Retrieved from https://www.wsj.com/articles/upstate-new-york-drug-distributor-settles-charges-in-opioid-case-11556053989

Howard, M. C., & Hoffman, M. E. (2017). Variable-centered, person-centered, and person-specific approaches: Where theory meets method. *Organizational Research Methods, 21,* 846-876. doi:10.1177/1094428117744021

Ivanova, I. (2018). OxyContin maker gets patent for drug to treat opioid addiction. *CBS News.* Retrieved from https://www.cbsnews.com/news/oxycontin-maker-receives-patent-for-drug-to-treat-opioid-addiction/

Krieger, N. (1987). Shades of difference: Theoretical underpinnings of the medical controversy on Black/White differences in the United States, 1830-1870. *International Journal of Health Services, 17*(2), 259-278. doi:10.2190/DBY6-VDQ8-HME8-ME3R

Kuzawa, C. W., & Sweet, E. (2009). Epigenetics and the embodiment of race: developmental origins of US racial disparities in cardiovascular health. *American Journal of Human Biology: The Official Journal of the Human Biology Association, 21*(1), 2-15.

Lillie-Blanton, M., & Laveist, T. (1996). Race/ethnicity, the social environment, and health. *Social Science & Medicine, 43*(1), 83-91.

Mann, B. (2018). Opioid-makers face wave of lawsuits in 2019. NPR. Retrieved from https://www.npr.org/2018/12/31/680741170/opioid-makers-face-wave-of-lawsuits-in-2019

Morrell, A. (2015). The OxyContin clan: The $14 billion newcomer to Forbes 2015 list of richest U.S. families. *Forbes*. Retrieved from https://www.forbes.com/sites/alexmorrell/2015/07/01/the-oxycontin-clan-the-14-billion-newcomer-to-forbes-2015-list-of-richest-u-s-families/#3d8ec76f75e0

Muthén, B., & Muthén, L. K. (2000). Integrating person-centered and variable-centered analyses: Growth mixture modeling with latent trajectory classes. *Alcoholism: Clinical and Experimental Research, 24*, 882-891. doi:10.1111/j.1530-0277.2000.tb02070.x

National Institute on Drug Abuse. (2019a). *Opioid overdose reversal with naloxone (Narcan, Evzio)*. Retrieved from https://www.drugabuse.gov/related-topics/opioid-overdose-reversal-naloxone-narcan-evzio

National Institute on Drug Abuse. (2019b). *Substance use in women.* Retrieved from https://www.drugabuse.gov/publications/research-reports/substance-use-in-women/sex-gender-differences-in-substance-use

Nazroo, J. Y., & Williams, D. R. (2006). The social determination of ethnic/racial inequalities in health. In M. G. Marmot & R. G. Wilkinson (Eds.), *Social determinants of health* (2nd ed., pp. 238-266). New York, NY: Oxford University Press.

Nylund, K. L., Asparouhov, T., & Muthén, B. O. (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. *Structural Equation Modeling*, *14*, 535-569.

Pitt, A. L., Humphreys, K., & Brandeau, M. L. (2018). Modeling health benefits and harms of public policy responses to the U.S. opioid epidemic. *American Journal of Public Health, 108*, 1394-1400. doi:10.2105/AJPH.2018.304590

Scholl, L., Seth, P., Kariisa, M., Wilson, N., & Baldwin, G. (2019). Drug and opioid-involved overdose deaths—United States, 2013-2017. *MMWR Morbidity and Mortality Weekly Report, 67*(5152), 1419-1427.

Serdarevic, M., Striley, C. W., & Cottler, L. B. (2017). Gender differences in prescription opioid use. *Current Opinion in Psychiatry, 30*(4), 238-246. doi:10.1097/YCO.0000000000000337

Stickler, L. (2019). OxyContin maker Purdue Pharma agrees to $270M settlement with Oklahoma: source. *NBC News.* Retrieved from https://www.nbcnews.com/news/us-news/oxycontin-maker-purdue-pharma-agrees-270-million-settlement-oklahoma-source-n987391

Substance Abuse and Mental Health Services Administration. (2019a). *Medication-assisted treatment (MAT)*. Retrieved from https://www.samhsa.gov/medication-assisted-treatment

Substance Abuse and Mental Health Services Administration. (2019b). *Naloxone*. Retrieved from https://www.samhsa.gov/medication-assisted-treatment/treatment/naloxone

Tetrault, J. M., Desai, R. A., Becker, W. C., Fiellin, D. A., Concato, J., & Sullivan, L. E. (2008). Gender and non-medical use of prescription opioids: results from a national U.S. survey. *Addiction, 103*(2), 258-268. doi:10.1111/j.1360-0443.2007.02056.x

U.S. Department of Health and Human Services. (2019). *What is the U.S. opioid epidemic?* Retrieved from https://www.hhs.gov/opioids/about-the-epidemic/index.html

Williams, D. R., Lavizzo-Mourey, R., & Warren, R. C. (1994). The concept of race and health status in America. *Public Health Reports*, *109*(1), 26-41.

APPENDIX A

SAS 9.4 SYNTAX AND COMMAND PROCEDURES FOR VARIABLE-CENTERED APPROACH IN CHAPTER III

```
LIBNAME NSDUH 'C:\Users\...\NSDUH\2017\';
FILENAME NSDUH17 'C:\Users\...\NSDUH_2017-data-sas.stc';
PROC CIMPORT INFILE=NSDUH17 LIBRARY=WORK; *IMPORT STC FILE;
RUN;
DATA NSDUH.diss; *SET DATA PERM;
      SET PUF2017_100918;
RUN;

DATA NSDUH.dissr; *SAS DATA STEP FOR MISS;
SET NSDUH.diss;
*USER-DEFINED MISSING VALUES RECODE TO SAS SYSMIS;
 IF (ACTD2001  >= 85 ) THEN ACTD2001  = .;
 IF (ACTD7590  >= 85 ) THEN ACTD7590  = .;
 IF (ACTD9001  >= 85 ) THEN ACTD9001  = .;
 IF (ACTDEVER  >= 85 ) THEN ACTDEVER  = .;
 IF (ACTDPRIV  >= 85 ) THEN ACTDPRIV  = .;
 IF (ACTDVIET  >= 85 ) THEN ACTDVIET  = .;
 IF (ADCOUNS  >= 94 ) THEN ADCOUNS  = .;
 IF (ADDPDISC  >= 85 ) THEN ADDPDISC  = .;
 IF (ADDPLSIN  >= 85 ) THEN ADDPLSIN  = .;
 IF (ADDPPROB  >= 94 ) THEN ADDPPROB  = .;
 IF (ADDPR2WK  >= 85 ) THEN ADDPR2WK  = .;
 IF (ADDPREV  >= 85 ) THEN ADDPREV  = .;
 IF (ADDSCEV  >= 94 ) THEN ADDSCEV  = .;
 IF (ADDSLSIN  >= 94 ) THEN ADDSLSIN  = .;
 IF (ADFAMDOC  >= 94 ) THEN ADFAMDOC  = .;
 IF (ADHERBAL  >= 94 ) THEN ADHERBAL  = .;
 IF (ADLOSEV  >= 94 ) THEN ADLOSEV  = .;
 IF (ADLSI2WK  >= 97 ) THEN ADLSI2WK  = .;
 IF (ADNURSE  >= 94 ) THEN ADNURSE  = .;
 IF (ADOTHDOC  >= 94 ) THEN ADOTHDOC  = .;
 IF (ADOTHHLP  >= 94 ) THEN ADOTHHLP  = .;
 IF (ADOTHMHP  >= 94 ) THEN ADOTHMHP  = .;
 IF (ADPB2WK  >= 85 ) THEN ADPB2WK  = .;
 IF (ADPBAGE  >= 985 ) THEN ADPBAGE  = .;
 IF (ADPBDLYA  >= 94 ) THEN ADPBDLYA  = .;
 IF (ADPBINTF  >= 94 ) THEN ADPBINTF  = .;
 IF (ADPBNUM  >= 9994 ) THEN ADPBNUM  = .;
 IF (ADPBRMBR  >= 94 ) THEN ADPBRMBR  = .;
 IF (ADPSDAYS  >= 994 ) THEN ADPSDAYS  = .;
 IF (ADPSHMGT  >= 94 ) THEN ADPSHMGT  = .;
 IF (ADPSRELS  >= 94 ) THEN ADPSRELS  = .;
 IF (ADPSSOC  >= 94 ) THEN ADPSSOC  = .;
 IF (ADPSWORK  >= 94 ) THEN ADPSWORK  = .;
```

```
IF (ADPSYCH  >= 94 ) THEN ADPSYCH  = .;
IF (ADPSYMD  >= 94 ) THEN ADPSYMD  = .;
IF (ADRELIG  >= 94 ) THEN ADRELIG  = .;
IF (ADRX12MO  >= 85 ) THEN ADRX12MO  = .;
IF (ADRXHLP  >= 94 ) THEN ADRXHLP  = .;
IF (ADRXNOW  >= 97 ) THEN ADRXNOW  = .;
IF (ADSEEDOC  >= 85 ) THEN ADSEEDOC  = .;
IF (ADSMMDEA  >= 94 ) THEN ADSMMDEA  = .;
IF (ADSOCWRK  >= 94 ) THEN ADSOCWRK  = .;
IF (ADTMTHLP  >= 94 ) THEN ADTMTHLP  = .;
IF (ADTMTNOW  >= 94 ) THEN ADTMTNOW  = .;
IF (ADWRAGE  >= 985 ) THEN ADWRAGE  = .;
IF (ADWRCHR  >= 94 ) THEN ADWRCHR  = .;
IF (ADWRCONC  >= 94 ) THEN ADWRCONC  = .;
IF (ADWRDBTR  >= 94 ) THEN ADWRDBTR  = .;
IF (ADWRDCSN  >= 94 ) THEN ADWRDCSN  = .;
IF (ADWRDEPR  >= 94 ) THEN ADWRDEPR  = .;
IF (ADWRDIET  >= 94 ) THEN ADWRDIET  = .;
IF (ADWRDISC  >= 94 ) THEN ADWRDISC  = .;
IF (ADWRDLOT  >= 94 ) THEN ADWRDLOT  = .;
IF (ADWRDST  >= 94 ) THEN ADWRDST  = .;
IF (ADWRELES  >= 94 ) THEN ADWRELES  = .;
IF (ADWREMOR  >= 94 ) THEN ADWREMOR  = .;
IF (ADWRENRG  >= 94 ) THEN ADWRENRG  = .;
IF (ADWRGAIN  >= 94 ) THEN ADWRGAIN  = .;
IF (ADWRGNL2  >= 994 ) THEN ADWRGNL2  = .;
IF (ADWRGROW  >= 94 ) THEN ADWRGROW  = .;
IF (ADWRHRS  >= 85 ) THEN ADWRHRS  = .;
IF (ADWRIMP  >= 94 ) THEN ADWRIMP  = .;
IF (ADWRJINO  >= 94 ) THEN ADWRJINO  = .;
IF (ADWRJITT  >= 94 ) THEN ADWRJITT  = .;
IF (ADWRLOSE  >= 94 ) THEN ADWRLOSE  = .;
IF (ADWRLSIN  >= 94 ) THEN ADWRLSIN  = .;
IF (ADWRLSL2  >= 994 ) THEN ADWRLSL2  = .;
IF (ADWRNOGD  >= 94 ) THEN ADWRNOGD  = .;
IF (ADWRPLSR  >= 94 ) THEN ADWRPLSR  = .;
IF (ADWRPREG  >= 98 ) THEN ADWRPREG  = .;
IF (ADWRPROB  >= 94 ) THEN ADWRPROB  = .;
IF (ADWRSATP  >= 97 ) THEN ADWRSATP  = .;
IF (ADWRSLEP  >= 94 ) THEN ADWRSLEP  = .;
IF (ADWRSLNO  >= 94 ) THEN ADWRSLNO  = .;
IF (ADWRSLOW  >= 94 ) THEN ADWRSLOW  = .;
IF (ADWRSMOR  >= 94 ) THEN ADWRSMOR  = .;
IF (ADWRSPLN  >= 94 ) THEN ADWRSPLN  = .;
IF (ADWRSTHK  >= 94 ) THEN ADWRSTHK  = .;
IF (ADWRTHOT  >= 94 ) THEN ADWRTHOT  = .;
IF (ADWRWRTH  >= 94 ) THEN ADWRWRTH  = .;
IF (AD_MDEA1  >= 94 ) THEN AD_MDEA1  = .;
IF (AD_MDEA2  >= 94 ) THEN AD_MDEA2  = .;
IF (AD_MDEA3  >= 94 ) THEN AD_MDEA3  = .;
IF (AD_MDEA4  >= 94 ) THEN AD_MDEA4  = .;
IF (AD_MDEA5  >= 94 ) THEN AD_MDEA5  = .;
IF (AD_MDEA6  >= 94 ) THEN AD_MDEA6  = .;
```

```
IF (AD_MDEA7  >= 94 ) THEN AD_MDEA7  = .;
IF (AD_MDEA8  >= 94 ) THEN AD_MDEA8  = .;
IF (AD_MDEA9  >= 94 ) THEN AD_MDEA9  = .;
IF (AIRDUSTER  >= 85 ) THEN AIRDUSTER  = .;
IF (AL30EST  >= 91 ) THEN AL30EST  = .;
IF (ALBSTWAY  >= 85 ) THEN ALBSTWAY  = .;
IF (ALCAGLST  >= 985 ) THEN ALCAGLST  = .;
IF (ALCBNG30D  >= 85 ) THEN ALCBNG30D  = .;
IF (ALCCUT1X  >= 83 ) THEN ALCCUT1X  = .;
IF (ALCCUTDN  >= 83 ) THEN ALCCUTDN  = .;
IF (ALCCUTEV  >= 83 ) THEN ALCCUTEV  = .;
IF (ALCDAYS  >= 85 ) THEN ALCDAYS  = .;
IF (ALCEMCTD  >= 83 ) THEN ALCEMCTD  = .;
IF (ALCEMOPB  >= 83 ) THEN ALCEMOPB  = .;
IF (ALCEVER  >= 85 ) THEN ALCEVER  = .;
IF (ALCFMCTD  >= 83 ) THEN ALCFMCTD  = .;
IF (ALCFMFPB  >= 83 ) THEN ALCFMFPB  = .;
IF (ALCGTOVR  >= 83 ) THEN ALCGTOVR  = .;
IF (ALCKPLMT  >= 83 ) THEN ALCKPLMT  = .;
IF (ALCLAWTR  >= 83 ) THEN ALCLAWTR  = .;
IF (ALCLIMIT  >= 83 ) THEN ALCLIMIT  = .;
IF (ALCLOTTM  >= 83 ) THEN ALCLOTTM  = .;
IF (ALCLSACT  >= 83 ) THEN ALCLSACT  = .;
IF (ALCLSEFX  >= 83 ) THEN ALCLSEFX  = .;
IF (ALCMFU  >= 85 ) THEN ALCMFU  = .;
IF (ALCMLU  >= 85 ) THEN ALCMLU  = .;
IF (ALCNDMOR  >= 83 ) THEN ALCNDMOR  = .;
IF (ALCPDANG  >= 83 ) THEN ALCPDANG  = .;
IF (ALCPHCTD  >= 83 ) THEN ALCPHCTD  = .;
IF (ALCPHLPB  >= 83 ) THEN ALCPHLPB  = .;
IF (ALCREC  >= 85 ) THEN ALCREC  = .;
IF (ALCSERPB  >= 83 ) THEN ALCSERPB  = .;
IF (ALCTRY  >= 985 ) THEN ALCTRY  = .;
IF (ALCUS30D  >= 985 ) THEN ALCUS30D  = .;
IF (ALCWD2SX  >= 83 ) THEN ALCWD2SX  = .;
IF (ALCWDSMT  >= 83 ) THEN ALCWDSMT  = .;
IF (ALCYFU  >= 9985 ) THEN ALCYFU  = .;
IF (ALCYLU  >= 9985 ) THEN ALCYLU  = .;
IF (ALCYRBFR  >= 85 ) THEN ALCYRBFR  = .;
IF (ALCYRTOT  >= 985 ) THEN ALCYRTOT  = .;
IF (ALDAYPMO  >= 85 ) THEN ALDAYPMO  = .;
IF (ALDAYPWK  >= 85 ) THEN ALDAYPWK  = .;
IF (ALDAYPYR  >= 985 ) THEN ALDAYPYR  = .;
IF (ALDYSFG  >= 98 ) THEN ALDYSFG  = .;
IF (ALFQFLG  >= 98 ) THEN ALFQFLG  = .;
IF (ALTOTFG  >= 98 ) THEN ALTOTFG  = .;
IF (AMYLNIT  >= 85 ) THEN AMYLNIT  = .;
IF (ANYHLTI2  >= 94 ) THEN ANYHLTI2  = .;
IF (ANYNDLREC  >= 91 ) THEN ANYNDLREC  = .;
IF (APPDRGMON  >= 85 ) THEN APPDRGMON  = .;
IF (ASTHMAAGE  >= 985 ) THEN ASTHMAAGE  = .;
IF (ASTHMAEVR  >= 85 ) THEN ASTHMAEVR  = .;
IF (ASTHMANOW  >= 85 ) THEN ASTHMANOW  = .;
```

```
IF (AUALACUP  >= 85 ) THEN AUALACUP  = .;
IF (AUALCHIR  >= 94 ) THEN AUALCHIR  = .;
IF (AUALHERB  >= 94 ) THEN AUALHERB  = .;
IF (AUALHLIN  >= 94 ) THEN AUALHLIN  = .;
IF (AUALINET  >= 94 ) THEN AUALINET  = .;
IF (AUALMASG  >= 85 ) THEN AUALMASG  = .;
IF (AUALOTH  >= 94 ) THEN AUALOTH  = .;
IF (AUALOTS2  >= 985 ) THEN AUALOTS2  = .;
IF (AUALRELG  >= 85 ) THEN AUALRELG  = .;
IF (AUALSGRP  >= 94 ) THEN AUALSGRP  = .;
IF (AUALTYR  >= 85 ) THEN AUALTYR  = .;
IF (AUINAHSP  >= 94 ) THEN AUINAHSP  = .;
IF (AUINMEDU  >= 94 ) THEN AUINMEDU  = .;
IF (AUINPGEN  >= 94 ) THEN AUINPGEN  = .;
IF (AUINPSYH  >= 85 ) THEN AUINPSYH  = .;
IF (AUINPYR  >= 85 ) THEN AUINPYR  = .;
IF (AUINRESD  >= 94 ) THEN AUINRESD  = .;
IF (AUINSFAC  >= 94 ) THEN AUINSFAC  = .;
IF (AUMOTVYR  >= 85 ) THEN AUMOTVYR  = .;
IF (AUNMAHS2  >= 994 ) THEN AUNMAHS2  = .;
IF (AUNMCLN2  >= 985 ) THEN AUNMCLN2  = .;
IF (AUNMDOC2  >= 985 ) THEN AUNMDOC2  = .;
IF (AUNMDTM2  >= 985 ) THEN AUNMDTM2  = .;
IF (AUNMMED2  >= 994 ) THEN AUNMMED2  = .;
IF (AUNMMEN2  >= 985 ) THEN AUNMMEN2  = .;
IF (AUNMOTO2  >= 994 ) THEN AUNMOTO2  = .;
IF (AUNMPGE2  >= 994 ) THEN AUNMPGE2  = .;
IF (AUNMPSY2  >= 985 ) THEN AUNMPSY2  = .;
IF (AUNMRES2  >= 994 ) THEN AUNMRES2  = .;
IF (AUNMSFA2  >= 994 ) THEN AUNMSFA2  = .;
IF (AUNMTHE2  >= 985 ) THEN AUNMTHE2  = .;
IF (AUOPCLNC  >= 85 ) THEN AUOPCLNC  = .;
IF (AUOPDOC  >= 85 ) THEN AUOPDOC  = .;
IF (AUOPDTMT  >= 85 ) THEN AUOPDTMT  = .;
IF (AUOPMENT  >= 85 ) THEN AUOPMENT  = .;
IF (AUOPOTOP  >= 94 ) THEN AUOPOTOP  = .;
IF (AUOPTHER  >= 85 ) THEN AUOPTHER  = .;
IF (AUOPTYR  >= 85 ) THEN AUOPTYR  = .;
IF (AUOPYRS2  >= 85 ) THEN AUOPYRS2  = .;
IF (AUPINEMP  >= 94 ) THEN AUPINEMP  = .;
IF (AUPINFM2  >= 85 ) THEN AUPINFM2  = .;
IF (AUPINFRE  >= 85 ) THEN AUPINFRE  = .;
IF (AUPINMCD  >= 94 ) THEN AUPINMCD  = .;
IF (AUPINMCR  >= 94 ) THEN AUPINMCR  = .;
IF (AUPINMIL  >= 94 ) THEN AUPINMIL  = .;
IF (AUPINOFM  >= 94 ) THEN AUPINOFM  = .;
IF (AUPINPHI  >= 94 ) THEN AUPINPHI  = .;
IF (AUPINPRV  >= 94 ) THEN AUPINPRV  = .;
IF (AUPINPUB  >= 94 ) THEN AUPINPUB  = .;
IF (AUPINREH  >= 94 ) THEN AUPINREH  = .;
IF (AUPINSLF  >= 85 ) THEN AUPINSLF  = .;
IF (AUPOPAMT  >= 85 ) THEN AUPOPAMT  = .;
IF (AUPOPEMP  >= 94 ) THEN AUPOPEMP  = .;
```

```
IF (AUPOPFRE  >= 85 ) THEN AUPOPFRE  = .;
IF (AUPOPMCD  >= 94 ) THEN AUPOPMCD  = .;
IF (AUPOPMCR  >= 94 ) THEN AUPOPMCR  = .;
IF (AUPOPMIL  >= 94 ) THEN AUPOPMIL  = .;
IF (AUPOPMOS  >= 97 ) THEN AUPOPMOS  = .;
IF (AUPOPOFM  >= 94 ) THEN AUPOPOFM  = .;
IF (AUPOPPHI  >= 94 ) THEN AUPOPPHI  = .;
IF (AUPOPPRV  >= 85 ) THEN AUPOPPRV  = .;
IF (AUPOPPUB  >= 94 ) THEN AUPOPPUB  = .;
IF (AUPOPREH  >= 94 ) THEN AUPOPREH  = .;
IF (AUPOPSLF  >= 85 ) THEN AUPOPSLF  = .;
IF (AURXYR  >= 85 ) THEN AURXYR  = .;
IF (AUUNBUSY  >= 94 ) THEN AUUNBUSY  = .;
IF (AUUNCFID  >= 94 ) THEN AUUNCFID  = .;
IF (AUUNCMIT  >= 94 ) THEN AUUNCMIT  = .;
IF (AUUNCOST  >= 85 ) THEN AUUNCOST  = .;
IF (AUUNENUF  >= 94 ) THEN AUUNENUF  = .;
IF (AUUNFOUT  >= 94 ) THEN AUUNFOUT  = .;
IF (AUUNHNDL  >= 94 ) THEN AUUNHNDL  = .;
IF (AUUNJOB  >= 94 ) THEN AUUNJOB  = .;
IF (AUUNMTYR  >= 85 ) THEN AUUNMTYR  = .;
IF (AUUNNBR  >= 94 ) THEN AUUNNBR  = .;
IF (AUUNNCOV  >= 94 ) THEN AUUNNCOV  = .;
IF (AUUNNHLP  >= 94 ) THEN AUUNNHLP  = .;
IF (AUUNNOND  >= 94 ) THEN AUUNNOND  = .;
IF (AUUNNTSP  >= 94 ) THEN AUUNNTSP  = .;
IF (AUUNRIM2  >= 85 ) THEN AUUNRIM2  = .;
IF (AUUNSOR  >= 94 ) THEN AUUNSOR  = .;
IF (AUUNWHER  >= 94 ) THEN AUUNWHER  = .;
IF (BKARSON  >= 85 ) THEN BKARSON  = .;
IF (BKBURGL  >= 85 ) THEN BKBURGL  = .;
IF (BKDRUG  >= 85 ) THEN BKDRUG  = .;
IF (BKDRUNK  >= 85 ) THEN BKDRUNK  = .;
IF (BKDRVINF  >= 85 ) THEN BKDRVINF  = .;
IF (BKFRAUD  >= 85 ) THEN BKFRAUD  = .;
IF (BKLARCNY  >= 85 ) THEN BKLARCNY  = .;
IF (BKMVTHFT  >= 85 ) THEN BKMVTHFT  = .;
IF (BKOTH  >= 85 ) THEN BKOTH  = .;
IF (BKOTHOF2  >= 85 ) THEN BKOTHOF2  = .;
IF (BKPOSTOB  >= 85 ) THEN BKPOSTOB  = .;
IF (BKROB  >= 85 ) THEN BKROB  = .;
IF (BKSEXNR  >= 85 ) THEN BKSEXNR  = .;
IF (BKSMASLT  >= 85 ) THEN BKSMASLT  = .;
IF (BKSRVIOL  >= 85 ) THEN BKSRVIOL  = .;
IF (BLNT30C1  >= 98 ) THEN BLNT30C1  = .;
IF (BLNT30C2  >= 98 ) THEN BLNT30C2  = .;
IF (BLNT30DY  >= 85 ) THEN BLNT30DY  = .;
IF (BLNTAGE  >= 981 ) THEN BLNTAGE  = .;
IF (BLNTEVER  >= 85 ) THEN BLNTEVER  = .;
IF (BLNTMFU  >= 81 ) THEN BLNTMFU  = .;
IF (BLNTNOMJ  >= 91 ) THEN BLNTNOMJ  = .;
IF (BLNTREC  >= 81 ) THEN BLNTREC  = .;
IF (BLNTYFU  >= 9981 ) THEN BLNTYFU  = .;
```

```
IF (BLRECFL2  >= 98 ) THEN BLRECFL2  = .;
IF (BOOKED  >= 85 ) THEN BOOKED  = .;
IF (CABINGAGE  >= 985 ) THEN CABINGAGE  = .;
IF (CABINGEVR  >= 85 ) THEN CABINGEVR  = .;
IF (CABINGFLG  >= 85 ) THEN CABINGFLG  = .;
IF (CABINGMFU  >= 85 ) THEN CABINGMFU  = .;
IF (CABINGYFU  >= 9985 ) THEN CABINGYFU  = .;
IF (CABLADDER  >= 85 ) THEN CABLADDER  = .;
IF (CABLOLEULYM  >= 85 ) THEN CABLOLEULYM  = .;
IF (CABPLACE  >= 91 ) THEN CABPLACE  = .;
IF (CABREAST  >= 85 ) THEN CABREAST  = .;
IF (CABUNDAG  >= 91 ) THEN CABUNDAG  = .;
IF (CABUYFRE  >= 85 ) THEN CABUYFRE  = .;
IF (CABUYWHO  >= 91 ) THEN CABUYWHO  = .;
IF (CACERVIX  >= 85 ) THEN CACERVIX  = .;
IF (CACOLNRECT  >= 85 ) THEN CACOLNRECT  = .;
IF (CADRBAR  >= 89 ) THEN CADRBAR  = .;
IF (CADRCAR  >= 91 ) THEN CADRCAR  = .;
IF (CADREVNT  >= 91 ) THEN CADREVNT  = .;
IF (CADRHOME  >= 85 ) THEN CADRHOME  = .;
IF (CADRKCOCN  >= 91 ) THEN CADRKCOCN  = .;
IF (CADRKDRUG  >= 85 ) THEN CADRKDRUG  = .;
IF (CADRKHALL  >= 91 ) THEN CADRKHALL  = .;
IF (CADRKHERN  >= 91 ) THEN CADRKHERN  = .;
IF (CADRKINHL  >= 91 ) THEN CADRKINHL  = .;
IF (CADRKMARJ  >= 91 ) THEN CADRKMARJ  = .;
IF (CADRKMETH  >= 91 ) THEN CADRKMETH  = .;
IF (CADRLAST  >= 985 ) THEN CADRLAST  = .;
IF (CADROTH  >= 91 ) THEN CADROTH  = .;
IF (CADROTHM  >= 91 ) THEN CADROTHM  = .;
IF (CADROTS2  >= 85 ) THEN CADROTS2  = .;
IF (CADRPEOP  >= 85 ) THEN CADRPEOP  = .;
IF (CADRPUBL  >= 91 ) THEN CADRPUBL  = .;
IF (CADRSCHL  >= 91 ) THEN CADRSCHL  = .;
IF (CAESOPSTOM  >= 85 ) THEN CAESOPSTOM  = .;
IF (CAFRESP2  >= 85 ) THEN CAFRESP2  = .;
IF (CAFREWHO  >= 85 ) THEN CAFREWHO  = .;
IF (CAGALLIVPAN  >= 85 ) THEN CAGALLIVPAN  = .;
IF (CAGVMONY  >= 91 ) THEN CAGVMONY  = .;
IF (CAGVWHO  >= 91 ) THEN CAGVWHO  = .;
IF (CAIDCHIP  >= 85 ) THEN CAIDCHIP  = .;
IF (CAKIDNEY  >= 85 ) THEN CAKIDNEY  = .;
IF (CALARYLUNG  >= 85 ) THEN CALARYLUNG  = .;
IF (CAMELANOM  >= 85 ) THEN CAMELANOM  = .;
IF (CAMOUTTHRO  >= 85 ) THEN CAMOUTTHRO  = .;
IF (CANCEREVR  >= 85 ) THEN CANCEREVR  = .;
IF (CANCERYR  >= 85 ) THEN CANCERYR  = .;
IF (CAOTHER2  >= 85 ) THEN CAOTHER2  = .;
IF (CAOVARY  >= 85 ) THEN CAOVARY  = .;
IF (CAPROSTEST  >= 85 ) THEN CAPROSTEST  = .;
IF (CASKINDK  >= 85 ) THEN CASKINDK  = .;
IF (CASKINOTH  >= 85 ) THEN CASKINOTH  = .;
IF (CATHYROID  >= 85 ) THEN CATHYROID  = .;
```

```
IF (CAUTERUS  >= 85 ) THEN CAUTERUS  = .;
IF (CC30EST  >= 91 ) THEN CC30EST  = .;
IF (CCBSTWAY  >= 85 ) THEN CCBSTWAY  = .;
IF (CCDAYPMO  >= 89 ) THEN CCDAYPMO  = .;
IF (CCDAYPWK  >= 85 ) THEN CCDAYPWK  = .;
IF (CCDAYPYR  >= 985 ) THEN CCDAYPYR  = .;
IF (CCFQFLG  >= 98 ) THEN CCFQFLG  = .;
IF (CCTOTFG  >= 98 ) THEN CCTOTFG  = .;
IF (CELLNOTCL  >= 85 ) THEN CELLNOTCL  = .;
IF (CELLWRKNG  >= 85 ) THEN CELLWRKNG  = .;
IF (CG30EST  >= 91 ) THEN CG30EST  = .;
IF (CGR30BR2  >= 9991 ) THEN CGR30BR2  = .;
IF (CGR30USE  >= 91 ) THEN CGR30USE  = .;
IF (CGRAGLST  >= 985 ) THEN CGRAGLST  = .;
IF (CHAMPUS  >= 85 ) THEN CHAMPUS  = .;
IF (CHMNDLREC  >= 91 ) THEN CHMNDLREC  = .;
IF (CI30EST  >= 91 ) THEN CI30EST  = .;
IF (CIG100LF  >= 91 ) THEN CIG100LF  = .;
IF (CIG30AV  >= 85 ) THEN CIG30AV  = .;
IF (CIG30BR2  >= 9985 ) THEN CIG30BR2  = .;
IF (CIG30MEN  >= 85 ) THEN CIG30MEN  = .;
IF (CIG30MLN  >= 85 ) THEN CIG30MLN  = .;
IF (CIG30RO2  >= 85 ) THEN CIG30RO2  = .;
IF (CIG30TPE  >= 85 ) THEN CIG30TPE  = .;
IF (CIG30USE  >= 85 ) THEN CIG30USE  = .;
IF (CIGAGE  >= 985 ) THEN CIGAGE  = .;
IF (CIGAGLST  >= 985 ) THEN CIGAGLST  = .;
IF (CIGAREVR  >= 94 ) THEN CIGAREVR  = .;
IF (CIGARMFU  >= 85 ) THEN CIGARMFU  = .;
IF (CIGARMLU  >= 85 ) THEN CIGARMLU  = .;
IF (CIGARREC  >= 91 ) THEN CIGARREC  = .;
IF (CIGARTRY  >= 985 ) THEN CIGARTRY  = .;
IF (CIGARYFU  >= 9985 ) THEN CIGARYFU  = .;
IF (CIGARYLU  >= 9985 ) THEN CIGARYLU  = .;
IF (CIGAVOID  >= 85 ) THEN CIGAVOID  = .;
IF (CIGCRAGP  >= 85 ) THEN CIGCRAGP  = .;
IF (CIGCRAVE  >= 85 ) THEN CIGCRAVE  = .;
IF (CIGDLLST  >= 985 ) THEN CIGDLLST  = .;
IF (CIGDLMFU  >= 85 ) THEN CIGDLMFU  = .;
IF (CIGDLMLU  >= 85 ) THEN CIGDLMLU  = .;
IF (CIGDLYFU  >= 9985 ) THEN CIGDLYFU  = .;
IF (CIGDLYLU  >= 9985 ) THEN CIGDLYLU  = .;
IF (CIGDLYMO  >= 91 ) THEN CIGDLYMO  = .;
IF (CIGFNLKE  >= 85 ) THEN CIGFNLKE  = .;
IF (CIGFNSMK  >= 85 ) THEN CIGFNSMK  = .;
IF (CIGINCRS  >= 85 ) THEN CIGINCRS  = .;
IF (CIGINCTL  >= 85 ) THEN CIGINCTL  = .;
IF (CIGINFLU  >= 85 ) THEN CIGINFLU  = .;
IF (CIGIRTBL  >= 85 ) THEN CIGIRTBL  = .;
IF (CIGLOTMR  >= 85 ) THEN CIGLOTMR  = .;
IF (CIGMFU  >= 85 ) THEN CIGMFU  = .;
IF (CIGMLU  >= 85 ) THEN CIGMLU  = .;
IF (CIGNMCHG  >= 85 ) THEN CIGNMCHG  = .;
```

```
IF (CIGNOINF  >= 85 ) THEN CIGNOINF  = .;
IF (CIGOFRSM  >= 94 ) THEN CIGOFRSM  = .;
IF (CIGPLANE  >= 85 ) THEN CIGPLANE  = .;
IF (CIGREC  >= 91 ) THEN CIGREC  = .;
IF (CIGREGDY  >= 85 ) THEN CIGREGDY  = .;
IF (CIGREGNM  >= 85 ) THEN CIGREGNM  = .;
IF (CIGREGWK  >= 85 ) THEN CIGREGWK  = .;
IF (CIGRNOUT  >= 85 ) THEN CIGRNOUT  = .;
IF (CIGSATIS  >= 85 ) THEN CIGSATIS  = .;
IF (CIGSVLHR  >= 85 ) THEN CIGSVLHR  = .;
IF (CIGTRY  >= 985 ) THEN CIGTRY  = .;
IF (CIGWAKE  >= 85 ) THEN CIGWAKE  = .;
IF (CIGWILYR  >= 85 ) THEN CIGWILYR  = .;
IF (CIGYFU  >= 9985 ) THEN CIGYFU  = .;
IF (CIGYLU  >= 9985 ) THEN CIGYLU  = .;
IF (CIGYRBFR  >= 85 ) THEN CIGYRBFR  = .;
IF (CIRROSAGE  >= 985 ) THEN CIRROSAGE  = .;
IF (CIRROSEVR  >= 85 ) THEN CIRROSEVR  = .;
IF (CLEFLU  >= 85 ) THEN CLEFLU  = .;
IF (COCAGE  >= 985 ) THEN COCAGE  = .;
IF (COCAGLST  >= 985 ) THEN COCAGLST  = .;
IF (COCCUT1X  >= 85 ) THEN COCCUT1X  = .;
IF (COCCUTDN  >= 85 ) THEN COCCUTDN  = .;
IF (COCCUTEV  >= 91 ) THEN COCCUTEV  = .;
IF (COCEMCTD  >= 91 ) THEN COCEMCTD  = .;
IF (COCEMOPB  >= 85 ) THEN COCEMOPB  = .;
IF (COCEVER  >= 85 ) THEN COCEVER  = .;
IF (COCFLBLU  >= 91 ) THEN COCFLBLU  = .;
IF (COCFMCTD  >= 91 ) THEN COCFMCTD  = .;
IF (COCFMFPB  >= 85 ) THEN COCFMFPB  = .;
IF (COCGTOVR  >= 85 ) THEN COCGTOVR  = .;
IF (COCKPLMT  >= 91 ) THEN COCKPLMT  = .;
IF (COCLAWTR  >= 85 ) THEN COCLAWTR  = .;
IF (COCLIMIT  >= 85 ) THEN COCLIMIT  = .;
IF (COCLOTTM  >= 85 ) THEN COCLOTTM  = .;
IF (COCLSACT  >= 85 ) THEN COCLSACT  = .;
IF (COCLSEFX  >= 85 ) THEN COCLSEFX  = .;
IF (COCMFU  >= 85 ) THEN COCMFU  = .;
IF (COCMLU  >= 85 ) THEN COCMLU  = .;
IF (COCNDMOR  >= 85 ) THEN COCNDMOR  = .;
IF (COCNEEDL  >= 85 ) THEN COCNEEDL  = .;
IF (COCPDANG  >= 85 ) THEN COCPDANG  = .;
IF (COCPHCTD  >= 91 ) THEN COCPHCTD  = .;
IF (COCPHLPB  >= 85 ) THEN COCPHLPB  = .;
IF (COCREC  >= 85 ) THEN COCREC  = .;
IF (COCSERPB  >= 85 ) THEN COCSERPB  = .;
IF (COCUS30A  >= 85 ) THEN COCUS30A  = .;
IF (COCWD2SX  >= 91 ) THEN COCWD2SX  = .;
IF (COCWDSMT  >= 91 ) THEN COCWDSMT  = .;
IF (COCYFU  >= 9985 ) THEN COCYFU  = .;
IF (COCYLU  >= 9985 ) THEN COCYLU  = .;
IF (COCYRBFR  >= 85 ) THEN COCYRBFR  = .;
IF (COCYRTOT  >= 985 ) THEN COCYRTOT  = .;
```

```
IF (COLDMEDS  >= 94 ) THEN COLDMEDS  = .;
IF (COLDREC  >= 85 ) THEN COLDREC  = .;
IF (COMBATPY  >= 85 ) THEN COMBATPY  = .;
IF (CONDLREC  >= 91 ) THEN CONDLREC  = .;
IF (COPDAGE  >= 985 ) THEN COPDAGE  = .;
IF (COPDEVER  >= 85 ) THEN COPDEVER  = .;
IF (CR30EST  >= 91 ) THEN CR30EST  = .;
IF (CRAKREC  >= 85 ) THEN CRAKREC  = .;
IF (CRBSTWAY  >= 85 ) THEN CRBSTWAY  = .;
IF (CRDAYPMO  >= 85 ) THEN CRDAYPMO  = .;
IF (CRDAYPWK  >= 85 ) THEN CRDAYPWK  = .;
IF (CRDAYPYR  >= 991 ) THEN CRDAYPYR  = .;
IF (CRFQFLG  >= 98 ) THEN CRFQFLG  = .;
IF (CRKAGE  >= 985 ) THEN CRKAGE  = .;
IF (CRKAGLST  >= 985 ) THEN CRKAGLST  = .;
IF (CRKEVER  >= 85 ) THEN CRKEVER  = .;
IF (CRKMFU  >= 85 ) THEN CRKMFU  = .;
IF (CRKMLU  >= 85 ) THEN CRKMLU  = .;
IF (CRKUS30A  >= 85 ) THEN CRKUS30A  = .;
IF (CRKYFU  >= 9985 ) THEN CRKYFU  = .;
IF (CRKYLU  >= 9985 ) THEN CRKYLU  = .;
IF (CRKYRTOT  >= 985 ) THEN CRKYRTOT  = .;
IF (CRTOTFG  >= 98 ) THEN CRTOTFG  = .;
IF (DAMTFXREC  >= 91 ) THEN DAMTFXREC  = .;
IF (DIABETEAG  >= 985 ) THEN DIABETEAG  = .;
IF (DIABETEVR  >= 85 ) THEN DIABETEVR  = .;
IF (DIFFDRESS  >= 85 ) THEN DIFFDRESS  = .;
IF (DIFFERAND  >= 85 ) THEN DIFFERAND  = .;
IF (DIFFHEAR  >= 85 ) THEN DIFFHEAR  = .;
IF (DIFFSEE  >= 85 ) THEN DIFFSEE  = .;
IF (DIFFTHINK  >= 85 ) THEN DIFFTHINK  = .;
IF (DIFFWALK  >= 85 ) THEN DIFFWALK  = .;
IF (DIFGETCOC  >= 85 ) THEN DIFGETCOC  = .;
IF (DIFGETCRK  >= 85 ) THEN DIFGETCRK  = .;
IF (DIFGETHER  >= 85 ) THEN DIFGETHER  = .;
IF (DIFGETLSD  >= 85 ) THEN DIFGETLSD  = .;
IF (DIFGETMRJ  >= 85 ) THEN DIFGETMRJ  = .;
IF (DMTAMTFXY  >= 91 ) THEN DMTAMTFXY  = .;
IF (DRVINALCO  >= 85 ) THEN DRVINALCO  = .;
IF (DRVINALON  >= 85 ) THEN DRVINALON  = .;
IF (DRVINCOCN  >= 85 ) THEN DRVINCOCN  = .;
IF (DRVINHALL  >= 91 ) THEN DRVINHALL  = .;
IF (DRVINHERN  >= 91 ) THEN DRVINHERN  = .;
IF (DRVININHL  >= 85 ) THEN DRVININHL  = .;
IF (DRVINMARJ  >= 85 ) THEN DRVINMARJ  = .;
IF (DRVINMETH  >= 91 ) THEN DRVINMETH  = .;
IF (DSTCHR12  >= 85 ) THEN DSTCHR12  = .;
IF (DSTCHR30  >= 85 ) THEN DSTCHR30  = .;
IF (DSTEFF12  >= 85 ) THEN DSTEFF12  = .;
IF (DSTEFF30  >= 85 ) THEN DSTEFF30  = .;
IF (DSTHOP12  >= 85 ) THEN DSTHOP12  = .;
IF (DSTHOP30  >= 85 ) THEN DSTHOP30  = .;
IF (DSTNGD12  >= 85 ) THEN DSTNGD12  = .;
```

```
IF (DSTNGD30  >= 85 ) THEN DSTNGD30  = .;
IF (DSTNRV12  >= 85 ) THEN DSTNRV12  = .;
IF (DSTNRV30  >= 85 ) THEN DSTNRV30  = .;
IF (DSTRST12  >= 85 ) THEN DSTRST12  = .;
IF (DSTRST30  >= 85 ) THEN DSTRST30  = .;
IF (DSTWORST  >= 85 ) THEN DSTWORST  = .;
IF (ECSTMOAGE  >= 985 ) THEN ECSTMOAGE  = .;
IF (ECSTMOAGL  >= 985 ) THEN ECSTMOAGL  = .;
IF (ECSTMOLLY  >= 91 ) THEN ECSTMOLLY  = .;
IF (ECSTMOMFU  >= 85 ) THEN ECSTMOMFU  = .;
IF (ECSTMOMLU  >= 85 ) THEN ECSTMOMLU  = .;
IF (ECSTMOREC  >= 91 ) THEN ECSTMOREC  = .;
IF (ECSTMOYFU  >= 9985 ) THEN ECSTMOYFU  = .;
IF (ECSTMOYLU  >= 9985 ) THEN ECSTMOYLU  = .;
IF (EDFAM18  >= 98 ) THEN EDFAM18  = .;
IF (EDUFULPAR  >= 85 ) THEN EDUFULPAR  = .;
IF (EDUSCHGRD2  >= 98 ) THEN EDUSCHGRD2  = .;
IF (EDUSCHLGO  >= 85 ) THEN EDUSCHLGO  = .;
IF (EDUSCKCOM  >= 94 ) THEN EDUSCKCOM  = .;
IF (EDUSCKEST  >= 94 ) THEN EDUSCKEST  = .;
IF (EDUSCKMON  >= 85 ) THEN EDUSCKMON  = .;
IF (EDUSKPCOM  >= 85 ) THEN EDUSKPCOM  = .;
IF (EDUSKPEST  >= 85 ) THEN EDUSKPEST  = .;
IF (EDUSKPMON  >= 85 ) THEN EDUSKPMON  = .;
IF (ETHER  >= 85 ) THEN ETHER  = .;
IF (FELTMARKR  >= 85 ) THEN FELTMARKR  = .;
IF (GAS  >= 85 ) THEN GAS  = .;
IF (GHB  >= 94 ) THEN GHB  = .;
IF (GHBREC  >= 91 ) THEN GHBREC  = .;
IF (GLUE  >= 85 ) THEN GLUE  = .;
IF (GNNDCLEN  >= 85 ) THEN GNNDCLEN  = .;
IF (GNNDGET2  >= 85 ) THEN GNNDGET2  = .;
IF (GNNDLSH1  >= 85 ) THEN GNNDLSH1  = .;
IF (GNNDLSH2  >= 85 ) THEN GNNDLSH2  = .;
IF (GNNDREUS  >= 85 ) THEN GNNDREUS  = .;
IF (GRPHLTIN  >= 85 ) THEN GRPHLTIN  = .;
IF (HALFQFLG  >= 98 ) THEN HALFQFLG  = .;
IF (HALLAGLST  >= 985 ) THEN HALLAGLST  = .;
IF (HALLDYPMO  >= 85 ) THEN HALLDYPMO  = .;
IF (HALLDYPWK  >= 85 ) THEN HALLDYPWK  = .;
IF (HALLDYSYR  >= 985 ) THEN HALLDYSYR  = .;
IF (HALLEASWY  >= 85 ) THEN HALLEASWY  = .;
IF (HALLMOLST  >= 85 ) THEN HALLMOLST  = .;
IF (HALLUC30E  >= 91 ) THEN HALLUC30E  = .;
IF (HALLUC30N  >= 83 ) THEN HALLUC30N  = .;
IF (HALLUCAGE  >= 985 ) THEN HALLUCAGE  = .;
IF (HALLUCEVR  >= 91 ) THEN HALLUCEVR  = .;
IF (HALLUCMFU  >= 85 ) THEN HALLUCMFU  = .;
IF (HALLUCOT1  >= 9985 ) THEN HALLUCOT1  = .;
IF (HALLUCOT2  >= 9985 ) THEN HALLUCOT2  = .;
IF (HALLUCOT3  >= 9985 ) THEN HALLUCOT3  = .;
IF (HALLUCOT4  >= 9991 ) THEN HALLUCOT4  = .;
IF (HALLUCOT5  >= 9991 ) THEN HALLUCOT5  = .;
```

```
IF (HALLUCOTH  >= 91 ) THEN HALLUCOTH  = .;
IF (HALLUCREC  >= 91 ) THEN HALLUCREC  = .;
IF (HALLUCYFQ  >= 985 ) THEN HALLUCYFQ  = .;
IF (HALLUCYFU  >= 9985 ) THEN HALLUCYFU  = .;
IF (HALLYRLST  >= 9985 ) THEN HALLYRLST  = .;
IF (HALTOTFG  >= 98 ) THEN HALTOTFG  = .;
IF (HALUCUTDN  >= 91 ) THEN HALUCUTDN  = .;
IF (HALUCUTEV  >= 91 ) THEN HALUCUTEV  = .;
IF (HALUEMCTD  >= 91 ) THEN HALUEMCTD  = .;
IF (HALUEMOPB  >= 91 ) THEN HALUEMOPB  = .;
IF (HALUFMCTD  >= 91 ) THEN HALUFMCTD  = .;
IF (HALUFMFPB  >= 91 ) THEN HALUFMFPB  = .;
IF (HALUGTOVR  >= 91 ) THEN HALUGTOVR  = .;
IF (HALUKPLMT  >= 91 ) THEN HALUKPLMT  = .;
IF (HALULAWTR  >= 91 ) THEN HALULAWTR  = .;
IF (HALULIMIT  >= 91 ) THEN HALULIMIT  = .;
IF (HALULOTTM  >= 91 ) THEN HALULOTTM  = .;
IF (HALULSACT  >= 91 ) THEN HALULSACT  = .;
IF (HALULSEFX  >= 91 ) THEN HALULSEFX  = .;
IF (HALUNDMOR  >= 91 ) THEN HALUNDMOR  = .;
IF (HALUPDANG  >= 91 ) THEN HALUPDANG  = .;
IF (HALUPHCTD  >= 91 ) THEN HALUPHCTD  = .;
IF (HALUPHLPB  >= 91 ) THEN HALUPHLPB  = .;
IF (HALUSERPB  >= 91 ) THEN HALUSERPB  = .;
IF (HEALTH  >= 94 ) THEN HEALTH  = .;
IF (HEOTNDL  >= 91 ) THEN HEOTNDL  = .;
IF (HEOTOTH  >= 91 ) THEN HEOTOTH  = .;
IF (HEOTSMK  >= 91 ) THEN HEOTSMK  = .;
IF (HEOTSNF  >= 91 ) THEN HEOTSNF  = .;
IF (HEOTSP  >= 85 ) THEN HEOTSP  = .;
IF (HEPBCAGE  >= 985 ) THEN HEPBCAGE  = .;
IF (HEPBCEVER  >= 85 ) THEN HEPBCEVER  = .;
IF (HER30USE  >= 85 ) THEN HER30USE  = .;
IF (HERAGE  >= 985 ) THEN HERAGE  = .;
IF (HERAGLST  >= 985 ) THEN HERAGLST  = .;
IF (HERCUT1X  >= 91 ) THEN HERCUT1X  = .;
IF (HERCUTDN  >= 91 ) THEN HERCUTDN  = .;
IF (HERCUTEV  >= 91 ) THEN HERCUTEV  = .;
IF (HEREMCTD  >= 91 ) THEN HEREMCTD  = .;
IF (HEREMOPB  >= 91 ) THEN HEREMOPB  = .;
IF (HEREVER  >= 94 ) THEN HEREVER  = .;
IF (HERFMCTD  >= 91 ) THEN HERFMCTD  = .;
IF (HERFMFPB  >= 91 ) THEN HERFMFPB  = .;
IF (HERGTOVR  >= 91 ) THEN HERGTOVR  = .;
IF (HERKPLMT  >= 91 ) THEN HERKPLMT  = .;
IF (HERLAWTR  >= 91 ) THEN HERLAWTR  = .;
IF (HERLIMIT  >= 91 ) THEN HERLIMIT  = .;
IF (HERLOTTM  >= 91 ) THEN HERLOTTM  = .;
IF (HERLSACT  >= 91 ) THEN HERLSACT  = .;
IF (HERLSEFX  >= 91 ) THEN HERLSEFX  = .;
IF (HERMFU  >= 85 ) THEN HERMFU  = .;
IF (HERMLU  >= 85 ) THEN HERMLU  = .;
IF (HERNDMOR  >= 91 ) THEN HERNDMOR  = .;
```

```
IF (HERNEEDL  >= 91 ) THEN HERNEEDL  = .;
IF (HERPDANG  >= 91 ) THEN HERPDANG  = .;
IF (HERPHCTD  >= 91 ) THEN HERPHCTD  = .;
IF (HERPHLPB  >= 91 ) THEN HERPHLPB  = .;
IF (HERREC  >= 91 ) THEN HERREC  = .;
IF (HERSERPB  >= 91 ) THEN HERSERPB  = .;
IF (HERSMOKE  >= 91 ) THEN HERSMOKE  = .;
IF (HERSNIFF  >= 91 ) THEN HERSNIFF  = .;
IF (HERWD3SX  >= 91 ) THEN HERWD3SX  = .;
IF (HERWDSMT  >= 91 ) THEN HERWDSMT  = .;
IF (HERYFU  >= 9985 ) THEN HERYFU  = .;
IF (HERYLU  >= 9985 ) THEN HERYLU  = .;
IF (HERYRTOT  >= 985 ) THEN HERYRTOT  = .;
IF (HIGHBPAGE  >= 985 ) THEN HIGHBPAGE  = .;
IF (HIGHBPEVR  >= 85 ) THEN HIGHBPEVR  = .;
IF (HIGHBPMED  >= 85 ) THEN HIGHBPMED  = .;
IF (HIVAIDSAG  >= 985 ) THEN HIVAIDSAG  = .;
IF (HIVAIDSEV  >= 85 ) THEN HIVAIDSEV  = .;
IF (HLCALL99  >= 98 ) THEN HLCALL99  = .;
IF (HLCALLFG  >= 98 ) THEN HLCALLFG  = .;
IF (HLCLAST  >= 94 ) THEN HLCLAST  = .;
IF (HLCNOTMO  >= 85 ) THEN HLCNOTMO  = .;
IF (HLCNOTYR  >= 85 ) THEN HLCNOTYR  = .;
IF (HLLOSRSN  >= 85 ) THEN HLLOSRSN  = .;
IF (HLNVCOST  >= 94 ) THEN HLNVCOST  = .;
IF (HLNVNEED  >= 94 ) THEN HLNVNEED  = .;
IF (HLNVOFFR  >= 94 ) THEN HLNVOFFR  = .;
IF (HLNVREF  >= 94 ) THEN HLNVREF  = .;
IF (HLNVSOR  >= 94 ) THEN HLNVSOR  = .;
IF (HLTINALC  >= 85 ) THEN HLTINALC  = .;
IF (HLTINDRG  >= 85 ) THEN HLTINDRG  = .;
IF (HLTINMNT  >= 85 ) THEN HLTINMNT  = .;
IF (HLTINNOS  >= 94 ) THEN HLTINNOS  = .;
IF (HPALCAMT  >= 85 ) THEN HPALCAMT  = .;
IF (HPALCCUT  >= 91 ) THEN HPALCCUT  = .;
IF (HPALCFRQ  >= 85 ) THEN HPALCFRQ  = .;
IF (HPALCNOT  >= 85 ) THEN HPALCNOT  = .;
IF (HPALCPRB  >= 91 ) THEN HPALCPRB  = .;
IF (HPALCTX  >= 91 ) THEN HPALCTX  = .;
IF (HPDRGTALK  >= 85 ) THEN HPDRGTALK  = .;
IF (HPQTTOB  >= 85 ) THEN HPQTTOB  = .;
IF (HPUSEALC  >= 85 ) THEN HPUSEALC  = .;
IF (HPUSEDRG  >= 85 ) THEN HPUSEDRG  = .;
IF (HPUSETOB  >= 85 ) THEN HPUSETOB  = .;
IF (HR30EST  >= 91 ) THEN HR30EST  = .;
IF (HRBSTWAY  >= 85 ) THEN HRBSTWAY  = .;
IF (HRDAYPMO  >= 85 ) THEN HRDAYPMO  = .;
IF (HRDAYPWK  >= 85 ) THEN HRDAYPWK  = .;
IF (HRDAYPYR  >= 985 ) THEN HRDAYPYR  = .;
IF (HRFQFLG  >= 98 ) THEN HRFQFLG  = .;
IF (HRNDLREC  >= 91 ) THEN HRNDLREC  = .;
IF (HRSMKREC  >= 91 ) THEN HRSMKREC  = .;
IF (HRSNFREC  >= 91 ) THEN HRSNFREC  = .;
```

```
IF (HRTCONDAG  >= 985 ) THEN HRTCONDAG  = .;
IF (HRTCONDEV  >= 85 ) THEN HRTCONDEV  = .;
IF (HRTCONDYR  >= 85 ) THEN HRTCONDYR  = .;
IF (HRTOTFG  >= 98 ) THEN HRTOTFG  = .;
IF (HTANSWER  >= 85 ) THEN HTANSWER  = .;
IF (HTINCHE2  >= 985 ) THEN HTINCHE2  = .;
IF (IICGAVD  >= 98 ) THEN IICGAVD  = .;
IF (IICGCRGP  >= 98 ) THEN IICGCRGP  = .;
IF (IICGCRV  >= 98 ) THEN IICGCRV  = .;
IF (IICGINCR  >= 98 ) THEN IICGINCR  = .;
IF (IICGINFL  >= 98 ) THEN IICGINFL  = .;
IF (IICGIRTB  >= 98 ) THEN IICGIRTB  = .;
IF (IICGLMR  >= 98 ) THEN IICGLMR  = .;
IF (IICGNCG  >= 98 ) THEN IICGNCG  = .;
IF (IICGNCTL  >= 98 ) THEN IICGNCTL  = .;
IF (IICGNINF  >= 98 ) THEN IICGNINF  = .;
IF (IICGPLN  >= 98 ) THEN IICGPLN  = .;
IF (IICGRGDY  >= 98 ) THEN IICGRGDY  = .;
IF (IICGRGNM  >= 98 ) THEN IICGRGNM  = .;
IF (IICGRGWK  >= 98 ) THEN IICGRGWK  = .;
IF (IICGROUT  >= 98 ) THEN IICGROUT  = .;
IF (IICGSAT  >= 98 ) THEN IICGSAT  = .;
IF (IICGSLHR  >= 98 ) THEN IICGSLHR  = .;
IF (IMPCONCN  >= 85 ) THEN IMPCONCN  = .;
IF (IMPDYFRQ  >= 85 ) THEN IMPDYFRQ  = .;
IF (IMPGOUT  >= 85 ) THEN IMPGOUT  = .;
IF (IMPGOUTM  >= 94 ) THEN IMPGOUTM  = .;
IF (IMPHHLD  >= 85 ) THEN IMPHHLD  = .;
IF (IMPHHLDM  >= 97 ) THEN IMPHHLDM  = .;
IF (IMPPEOP  >= 85 ) THEN IMPPEOP  = .;
IF (IMPPEOPM  >= 94 ) THEN IMPPEOPM  = .;
IF (IMPREMEM  >= 85 ) THEN IMPREMEM  = .;
IF (IMPRESP  >= 85 ) THEN IMPRESP  = .;
IF (IMPRESPM  >= 94 ) THEN IMPRESPM  = .;
IF (IMPSOC  >= 85 ) THEN IMPSOC  = .;
IF (IMPSOCM  >= 94 ) THEN IMPSOCM  = .;
IF (IMPWEEKS  >= 85 ) THEN IMPWEEKS  = .;
IF (IMPWORK  >= 85 ) THEN IMPWORK  = .;
IF (IMPYDAYS  >= 985 ) THEN IMPYDAYS  = .;
IF (INHAL30ES  >= 91 ) THEN INHAL30ES  = .;
IF (INHAL30N  >= 85 ) THEN INHAL30N  = .;
IF (INHALAGE  >= 985 ) THEN INHALAGE  = .;
IF (INHALEVER  >= 91 ) THEN INHALEVER  = .;
IF (INHALMFU  >= 85 ) THEN INHALMFU  = .;
IF (INHALOT1  >= 9985 ) THEN INHALOT1  = .;
IF (INHALOT2  >= 9985 ) THEN INHALOT2  = .;
IF (INHALOT3  >= 9985 ) THEN INHALOT3  = .;
IF (INHALOT4  >= 9991 ) THEN INHALOT4  = .;
IF (INHALOT5  >= 9991 ) THEN INHALOT5  = .;
IF (INHALOTH  >= 85 ) THEN INHALOTH  = .;
IF (INHALREC  >= 85 ) THEN INHALREC  = .;
IF (INHALYFQ  >= 985 ) THEN INHALYFQ  = .;
IF (INHALYFU  >= 9985 ) THEN INHALYFU  = .;
```

```
IF (INHDYPMO  >= 85 ) THEN INHDYPMO  = .;
IF (INHDYPWK  >= 85 ) THEN INHDYPWK  = .;
IF (INHDYSYR  >= 985 ) THEN INHDYSYR  = .;
IF (INHEASWY  >= 85 ) THEN INHEASWY  = .;
IF (INHFQFLG  >= 98 ) THEN INHFQFLG  = .;
IF (INHLAGLST  >= 985 ) THEN INHLAGLST  = .;
IF (INHLCUTDN  >= 85 ) THEN INHLCUTDN  = .;
IF (INHLCUTEV  >= 91 ) THEN INHLCUTEV  = .;
IF (INHLEMCTD  >= 91 ) THEN INHLEMCTD  = .;
IF (INHLEMOPB  >= 85 ) THEN INHLEMOPB  = .;
IF (INHLFMCTD  >= 91 ) THEN INHLFMCTD  = .;
IF (INHLFMFPB  >= 85 ) THEN INHLFMFPB  = .;
IF (INHLGTOVR  >= 85 ) THEN INHLGTOVR  = .;
IF (INHLKPLMT  >= 91 ) THEN INHLKPLMT  = .;
IF (INHLLAWTR  >= 85 ) THEN INHLLAWTR  = .;
IF (INHLLIMIT  >= 85 ) THEN INHLLIMIT  = .;
IF (INHLLOTTM  >= 85 ) THEN INHLLOTTM  = .;
IF (INHLLSACT  >= 85 ) THEN INHLLSACT  = .;
IF (INHLLSEFX  >= 85 ) THEN INHLLSEFX  = .;
IF (INHLMOLST  >= 85 ) THEN INHLMOLST  = .;
IF (INHLNDMOR  >= 85 ) THEN INHLNDMOR  = .;
IF (INHLPDANG  >= 85 ) THEN INHLPDANG  = .;
IF (INHLPHCTD  >= 91 ) THEN INHLPHCTD  = .;
IF (INHLPHLPB  >= 85 ) THEN INHLPHLPB  = .;
IF (INHLSERPB  >= 85 ) THEN INHLSERPB  = .;
IF (INHLYRLST  >= 9985 ) THEN INHLYRLST  = .;
IF (INHOSPYR  >= 85 ) THEN INHOSPYR  = .;
IF (INHTOTFG  >= 98 ) THEN INHTOTFG  = .;
IF (IRABUPOSHAL  >= 91 ) THEN IRABUPOSHAL  = .;
IF (IRABUPOSINH  >= 91 ) THEN IRABUPOSINH  = .;
IF (IRABUPOSMTH  >= 91 ) THEN IRABUPOSMTH  = .;
IF (IRABUPOSPNR  >= 91 ) THEN IRABUPOSPNR  = .;
IF (IRABUPOSSED  >= 91 ) THEN IRABUPOSSED  = .;
IF (IRABUPOSSTM  >= 91 ) THEN IRABUPOSSTM  = .;
IF (IRABUPOSTRQ  >= 91 ) THEN IRABUPOSTRQ  = .;
IF (IRALCAGE  >= 991 ) THEN IRALCAGE  = .;
IF (IRALCBNG30D  >= 91 ) THEN IRALCBNG30D  = .;
IF (IRALCFM  >= 91 ) THEN IRALCFM  = .;
IF (IRALCFY  >= 991 ) THEN IRALCFY  = .;
IF (IRALCYFU  >= 9999 ) THEN IRALCYFU  = .;
IF (IRCD2YFU  >= 9993 ) THEN IRCD2YFU  = .;
IF (IRCDUAGE  >= 991 ) THEN IRCDUAGE  = .;
IF (IRCGRAGE  >= 991 ) THEN IRCGRAGE  = .;
IF (IRCGRFM  >= 91 ) THEN IRCGRFM  = .;
IF (IRCGRYFU  >= 9999 ) THEN IRCGRYFU  = .;
IF (IRCIGAGE  >= 991 ) THEN IRCIGAGE  = .;
IF (IRCIGFM  >= 91 ) THEN IRCIGFM  = .;
IF (IRCIGYFU  >= 9999 ) THEN IRCIGYFU  = .;
IF (IRCOCAGE  >= 991 ) THEN IRCOCAGE  = .;
IF (IRCOCFM  >= 91 ) THEN IRCOCFM  = .;
IF (IRCOCFY  >= 991 ) THEN IRCOCFY  = .;
IF (IRCOCYFU  >= 9999 ) THEN IRCOCYFU  = .;
IF (IRCRKAGE  >= 991 ) THEN IRCRKAGE  = .;
```

```
IF (IRCRKFM  >= 91 ) THEN IRCRKFM  = .;
IF (IRCRKFY  >= 991 ) THEN IRCRKFY  = .;
IF (IRCRKYFU  >= 9999 ) THEN IRCRKYFU  = .;
IF (IRDEPENDHAL  >= 91 ) THEN IRDEPENDHAL  = .;
IF (IRDEPENDINH  >= 91 ) THEN IRDEPENDINH  = .;
IF (IRDEPENDMTH  >= 91 ) THEN IRDEPENDMTH  = .;
IF (IRDEPENDPNR  >= 91 ) THEN IRDEPENDPNR  = .;
IF (IRDEPENDSED  >= 91 ) THEN IRDEPENDSED  = .;
IF (IRDEPENDSTM  >= 91 ) THEN IRDEPENDSTM  = .;
IF (IRDEPENDTRQ  >= 91 ) THEN IRDEPENDTRQ  = .;
IF (IRECSTMOAGE  >= 991 ) THEN IRECSTMOAGE  = .;
IF (IRECSTMOYFU  >= 9999 ) THEN IRECSTMOYFU  = .;
IF (IRHALLUC30N  >= 91 ) THEN IRHALLUC30N  = .;
IF (IRHALLUCAGE  >= 991 ) THEN IRHALLUCAGE  = .;
IF (IRHALLUCYFQ  >= 991 ) THEN IRHALLUCYFQ  = .;
IF (IRHALLUCYFU  >= 9999 ) THEN IRHALLUCYFU  = .;
IF (IRHERAGE  >= 991 ) THEN IRHERAGE  = .;
IF (IRHERFM  >= 91 ) THEN IRHERFM  = .;
IF (IRHERFY  >= 991 ) THEN IRHERFY  = .;
IF (IRHERYFU  >= 9999 ) THEN IRHERYFU  = .;
IF (IRINHAL30N  >= 91 ) THEN IRINHAL30N  = .;
IF (IRINHALAGE  >= 991 ) THEN IRINHALAGE  = .;
IF (IRINHALYFQ  >= 991 ) THEN IRINHALYFQ  = .;
IF (IRINHALYFU  >= 9999 ) THEN IRINHALYFU  = .;
IF (IRLSDAGE  >= 991 ) THEN IRLSDAGE  = .;
IF (IRLSDYFU  >= 9999 ) THEN IRLSDYFU  = .;
IF (IRMARIT  >= 99 ) THEN IRMARIT  = .;
IF (IRMETHAM30N  >= 91 ) THEN IRMETHAM30N  = .;
IF (IRMETHAMAGE  >= 991 ) THEN IRMETHAMAGE  = .;
IF (IRMETHAMYFQ  >= 991 ) THEN IRMETHAMYFQ  = .;
IF (IRMETHAMYFU  >= 9999 ) THEN IRMETHAMYFU  = .;
IF (IRMJAGE  >= 991 ) THEN IRMJAGE  = .;
IF (IRMJFM  >= 91 ) THEN IRMJFM  = .;
IF (IRMJFY  >= 991 ) THEN IRMJFY  = .;
IF (IRMJYFU  >= 9999 ) THEN IRMJYFU  = .;
IF (IROTHHLT  >= 99 ) THEN IROTHHLT  = .;
IF (IRPCPAGE  >= 991 ) THEN IRPCPAGE  = .;
IF (IRPCPYFU  >= 9999 ) THEN IRPCPYFU  = .;
IF (IRPNRNM30FQ  >= 91 ) THEN IRPNRNM30FQ  = .;
IF (IRPNRNMAGE  >= 993 ) THEN IRPNRNMAGE  = .;
IF (IRPNRNMINIT  >= 91 ) THEN IRPNRNMINIT  = .;
IF (IRPNRNMYFU  >= 9993 ) THEN IRPNRNMYFU  = .;
IF (IRSEDNM30FQ  >= 91 ) THEN IRSEDNM30FQ  = .;
IF (IRSEDNMAGE  >= 993 ) THEN IRSEDNMAGE  = .;
IF (IRSEDNMINIT  >= 91 ) THEN IRSEDNMINIT  = .;
IF (IRSEDNMYFU  >= 9993 ) THEN IRSEDNMYFU  = .;
IF (IRSMKLSS30N  >= 91 ) THEN IRSMKLSS30N  = .;
IF (IRSMKLSSTRY  >= 991 ) THEN IRSMKLSSTRY  = .;
IF (IRSMKLSSYFU  >= 9999 ) THEN IRSMKLSSYFU  = .;
IF (IRSTMNM30FQ  >= 91 ) THEN IRSTMNM30FQ  = .;
IF (IRSTMNMAGE  >= 993 ) THEN IRSTMNMAGE  = .;
IF (IRSTMNMINIT  >= 91 ) THEN IRSTMNMINIT  = .;
IF (IRSTMNMYFU  >= 9993 ) THEN IRSTMNMYFU  = .;
```

```
IF (IRTRQNM30FQ  >= 91 ) THEN IRTRQNM30FQ  = .;
IF (IRTRQNMAGE  >= 993 ) THEN IRTRQNMAGE  = .;
IF (IRTRQNMINIT  >= 91 ) THEN IRTRQNMINIT  = .;
IF (IRTRQNMYFU  >= 9993 ) THEN IRTRQNMYFU  = .;
IF (IRWELMOS  >= 99 ) THEN IRWELMOS  = .;
IF (IRWRKSTAT  >= 99 ) THEN IRWRKSTAT  = .;
IF (IRWRKSTAT18  >= 99 ) THEN IRWRKSTAT18  = .;
IF (KETMINESK  >= 91 ) THEN KETMINESK  = .;
IF (KETMINREC  >= 91 ) THEN KETMINREC  = .;
IF (KIDNYDSAG  >= 985 ) THEN KIDNYDSAG  = .;
IF (KIDNYDSEV  >= 85 ) THEN KIDNYDSEV  = .;
IF (LGAS  >= 85 ) THEN LGAS  = .;
IF (LSD  >= 91 ) THEN LSD  = .;
IF (LSDAGE  >= 985 ) THEN LSDAGE  = .;
IF (LSDAGLST  >= 985 ) THEN LSDAGLST  = .;
IF (LSDMFU  >= 85 ) THEN LSDMFU  = .;
IF (LSDMLU  >= 85 ) THEN LSDMLU  = .;
IF (LSDREC  >= 91 ) THEN LSDREC  = .;
IF (LSDYFU  >= 9985 ) THEN LSDYFU  = .;
IF (LSDYLU  >= 9985 ) THEN LSDYLU  = .;
IF (MEDICARE  >= 85 ) THEN MEDICARE  = .;
IF (MEDMJALL  >= 85 ) THEN MEDMJALL  = .;
IF (MEDMJYR  >= 85 ) THEN MEDMJYR  = .;
IF (MEFQFLG  >= 98 ) THEN MEFQFLG  = .;
IF (MESC  >= 91 ) THEN MESC  = .;
IF (METHAGLST  >= 985 ) THEN METHAGLST  = .;
IF (METHAM30E  >= 91 ) THEN METHAM30E  = .;
IF (METHAM30N  >= 85 ) THEN METHAM30N  = .;
IF (METHAMAGE  >= 985 ) THEN METHAMAGE  = .;
IF (METHAMEVR  >= 94 ) THEN METHAMEVR  = .;
IF (METHAMMFU  >= 85 ) THEN METHAMMFU  = .;
IF (METHAMREC  >= 91 ) THEN METHAMREC  = .;
IF (METHAMYFQ  >= 985 ) THEN METHAMYFQ  = .;
IF (METHAMYFU  >= 9985 ) THEN METHAMYFU  = .;
IF (METHCUT1X  >= 91 ) THEN METHCUT1X  = .;
IF (METHCUTDN  >= 91 ) THEN METHCUTDN  = .;
IF (METHCUTEV  >= 91 ) THEN METHCUTEV  = .;
IF (METHDYPMO  >= 85 ) THEN METHDYPMO  = .;
IF (METHDYPWK  >= 85 ) THEN METHDYPWK  = .;
IF (METHDYSYR  >= 985 ) THEN METHDYSYR  = .;
IF (METHEASWY  >= 85 ) THEN METHEASWY  = .;
IF (METHEMCTD  >= 91 ) THEN METHEMCTD  = .;
IF (METHEMOPB  >= 91 ) THEN METHEMOPB  = .;
IF (METHFLBLU  >= 91 ) THEN METHFLBLU  = .;
IF (METHFMCTD  >= 91 ) THEN METHFMCTD  = .;
IF (METHFMFPB  >= 91 ) THEN METHFMFPB  = .;
IF (METHGTOVR  >= 91 ) THEN METHGTOVR  = .;
IF (METHKPLMT  >= 91 ) THEN METHKPLMT  = .;
IF (METHLAWTR  >= 91 ) THEN METHLAWTR  = .;
IF (METHLIMIT  >= 91 ) THEN METHLIMIT  = .;
IF (METHLOTTM  >= 91 ) THEN METHLOTTM  = .;
IF (METHLSACT  >= 91 ) THEN METHLSACT  = .;
IF (METHLSEFX  >= 91 ) THEN METHLSEFX  = .;
```

```
IF (METHMOLST  >= 85 ) THEN METHMOLST  = .;
IF (METHNDLRC  >= 91 ) THEN METHNDLRC  = .;
IF (METHNDMOR  >= 91 ) THEN METHNDMOR  = .;
IF (METHNEEDL  >= 91 ) THEN METHNEEDL  = .;
IF (METHPDANG  >= 91 ) THEN METHPDANG  = .;
IF (METHPHCTD  >= 91 ) THEN METHPHCTD  = .;
IF (METHPHLPB  >= 91 ) THEN METHPHLPB  = .;
IF (METHSERPB  >= 91 ) THEN METHSERPB  = .;
IF (METHWD2SX  >= 91 ) THEN METHWD2SX  = .;
IF (METHWDSMT  >= 91 ) THEN METHWDSMT  = .;
IF (METHYRLST  >= 9985 ) THEN METHYRLST  = .;
IF (METOTFG  >= 98 ) THEN METOTFG  = .;
IF (MILSTAT  >= 85 ) THEN MILSTAT  = .;
IF (MILTCHLDR  >= 85 ) THEN MILTCHLDR  = .;
IF (MILTFAMLY  >= 85 ) THEN MILTFAMLY  = .;
IF (MILTPARNT  >= 85 ) THEN MILTPARNT  = .;
IF (MILTSIBLN  >= 85 ) THEN MILTSIBLN  = .;
IF (MILTSPPAR  >= 85 ) THEN MILTSPPAR  = .;
IF (MJAGE  >= 985 ) THEN MJAGE  = .;
IF (MJDAY30A  >= 85 ) THEN MJDAY30A  = .;
IF (MJEVER  >= 94 ) THEN MJEVER  = .;
IF (MJFQFLG  >= 98 ) THEN MJFQFLG  = .;
IF (MJMFU  >= 85 ) THEN MJMFU  = .;
IF (MJREC  >= 91 ) THEN MJREC  = .;
IF (MJYFU  >= 9985 ) THEN MJYFU  = .;
IF (MJYRTOT  >= 985 ) THEN MJYRTOT  = .;
IF (MOVSINPYR2  >= 985 ) THEN MOVSINPYR2  = .;
IF (MR30EST  >= 91 ) THEN MR30EST  = .;
IF (MRBSTWAY  >= 85 ) THEN MRBSTWAY  = .;
IF (MRDAYPMO  >= 85 ) THEN MRDAYPMO  = .;
IF (MRDAYPWK  >= 85 ) THEN MRDAYPWK  = .;
IF (MRDAYPYR  >= 985 ) THEN MRDAYPYR  = .;
IF (MRJAGLST  >= 985 ) THEN MRJAGLST  = .;
IF (MRJCUTDN  >= 83 ) THEN MRJCUTDN  = .;
IF (MRJCUTEV  >= 83 ) THEN MRJCUTEV  = .;
IF (MRJEMCTD  >= 83 ) THEN MRJEMCTD  = .;
IF (MRJEMOPB  >= 83 ) THEN MRJEMOPB  = .;
IF (MRJFMCTD  >= 83 ) THEN MRJFMCTD  = .;
IF (MRJFMFPB  >= 83 ) THEN MRJFMFPB  = .;
IF (MRJGTOVR  >= 83 ) THEN MRJGTOVR  = .;
IF (MRJKPLMT  >= 83 ) THEN MRJKPLMT  = .;
IF (MRJLAWTR  >= 83 ) THEN MRJLAWTR  = .;
IF (MRJLIMIT  >= 83 ) THEN MRJLIMIT  = .;
IF (MRJLOTTM  >= 83 ) THEN MRJLOTTM  = .;
IF (MRJLSACT  >= 83 ) THEN MRJLSACT  = .;
IF (MRJLSEFX  >= 83 ) THEN MRJLSEFX  = .;
IF (MRJMLU  >= 85 ) THEN MRJMLU  = .;
IF (MRJNDMOR  >= 83 ) THEN MRJNDMOR  = .;
IF (MRJPDANG  >= 83 ) THEN MRJPDANG  = .;
IF (MRJPHCTD  >= 83 ) THEN MRJPHCTD  = .;
IF (MRJPHLPB  >= 83 ) THEN MRJPHLPB  = .;
IF (MRJSERPB  >= 83 ) THEN MRJSERPB  = .;
IF (MRJYLU  >= 9985 ) THEN MRJYLU  = .;
```

```
IF (MRJYRBFR  >= 85 ) THEN MRJYRBFR  = .;
IF (MRTOTFG  >= 98 ) THEN MRTOTFG  = .;
IF (MXMJPNLT  >= 85 ) THEN MXMJPNLT  = .;
IF (NDMORTALC  >= 91 ) THEN NDMORTALC  = .;
IF (NDMORTCOC  >= 91 ) THEN NDMORTCOC  = .;
IF (NDMORTHAL  >= 91 ) THEN NDMORTHAL  = .;
IF (NDMORTHER  >= 91 ) THEN NDMORTHER  = .;
IF (NDMORTINH  >= 91 ) THEN NDMORTINH  = .;
IF (NDMORTMRJ  >= 91 ) THEN NDMORTMRJ  = .;
IF (NDMORTMTH  >= 91 ) THEN NDMORTMTH  = .;
IF (NDMORTOTH  >= 91 ) THEN NDMORTOTH  = .;
IF (NDMORTPNR  >= 91 ) THEN NDMORTPNR  = .;
IF (NDMORTSED  >= 91 ) THEN NDMORTSED  = .;
IF (NDMORTSTM  >= 91 ) THEN NDMORTSTM  = .;
IF (NDMORTTRQ  >= 91 ) THEN NDMORTTRQ  = .;
IF (NDMORTXYR  >= 85 ) THEN NDMORTXYR  = .;
IF (NDMRDKWHR  >= 91 ) THEN NDMRDKWHR  = .;
IF (NDMREFFRT  >= 91 ) THEN NDMREFFRT  = .;
IF (NDMRFNDOU  >= 91 ) THEN NDMRFNDOU  = .;
IF (NDMRHANDL  >= 91 ) THEN NDMRHANDL  = .;
IF (NDMRJOBNG  >= 91 ) THEN NDMRJOBNG  = .;
IF (NDMRMIMPT  >= 91 ) THEN NDMRMIMPT  = .;
IF (NDMRNBRNG  >= 91 ) THEN NDMRNBRNG  = .;
IF (NDMRNOCOV  >= 91 ) THEN NDMRNOCOV  = .;
IF (NDMRNOHLP  >= 91 ) THEN NDMRNOHLP  = .;
IF (NDMRNONED  >= 91 ) THEN NDMRNONED  = .;
IF (NDMRNOTPY  >= 91 ) THEN NDMRNOTPY  = .;
IF (NDMRNSTOP  >= 91 ) THEN NDMRNSTOP  = .;
IF (NDMRNTIME  >= 91 ) THEN NDMRNTIME  = .;
IF (NDMROTRSN  >= 91 ) THEN NDMROTRSN  = .;
IF (NDMRPFULL  >= 91 ) THEN NDMRPFULL  = .;
IF (NDMRTSPHR  >= 91 ) THEN NDMRTSPHR  = .;
IF (NDMRWANTD  >= 91 ) THEN NDMRWANTD  = .;
IF (NDTXDKWHR  >= 91 ) THEN NDTXDKWHR  = .;
IF (NDTXEFFRT  >= 91 ) THEN NDTXEFFRT  = .;
IF (NDTXFNDOU  >= 91 ) THEN NDTXFNDOU  = .;
IF (NDTXHANDL  >= 91 ) THEN NDTXHANDL  = .;
IF (NDTXJOBNG  >= 91 ) THEN NDTXJOBNG  = .;
IF (NDTXMIMPT  >= 85 ) THEN NDTXMIMPT  = .;
IF (NDTXNBRNG  >= 91 ) THEN NDTXNBRNG  = .;
IF (NDTXNOCOV  >= 91 ) THEN NDTXNOCOV  = .;
IF (NDTXNOHLP  >= 91 ) THEN NDTXNOHLP  = .;
IF (NDTXNONED  >= 91 ) THEN NDTXNONED  = .;
IF (NDTXNOTPY  >= 91 ) THEN NDTXNOTPY  = .;
IF (NDTXNSTOP  >= 91 ) THEN NDTXNSTOP  = .;
IF (NDTXNTIME  >= 91 ) THEN NDTXNTIME  = .;
IF (NDTXOTRSN  >= 91 ) THEN NDTXOTRSN  = .;
IF (NDTXPFULL  >= 91 ) THEN NDTXPFULL  = .;
IF (NDTXTSPHR  >= 91 ) THEN NDTXTSPHR  = .;
IF (NDTXWANTD  >= 91 ) THEN NDTXWANTD  = .;
IF (NDTXYOTH1  >= 9985 ) THEN NDTXYOTH1  = .;
IF (NDTXYOTH2  >= 9985 ) THEN NDTXYOTH2  = .;
IF (NDTXYOTH3  >= 9985 ) THEN NDTXYOTH3  = .;
```

```
IF (NDTXYOTH4  >= 9991 ) THEN NDTXYOTH4  = .;
IF (NDTXYOTH5  >= 9991 ) THEN NDTXYOTH5  = .;
IF (NDTXYRADG  >= 85 ) THEN NDTXYRADG  = .;
IF (NDTXYRALC  >= 91 ) THEN NDTXYRALC  = .;
IF (NDTXYRCOC  >= 91 ) THEN NDTXYRCOC  = .;
IF (NDTXYRHAL  >= 91 ) THEN NDTXYRHAL  = .;
IF (NDTXYRHER  >= 91 ) THEN NDTXYRHER  = .;
IF (NDTXYRINH  >= 91 ) THEN NDTXYRINH  = .;
IF (NDTXYRMRJ  >= 91 ) THEN NDTXYRMRJ  = .;
IF (NDTXYRMTH  >= 91 ) THEN NDTXYRMTH  = .;
IF (NDTXYROTH  >= 91 ) THEN NDTXYROTH  = .;
IF (NDTXYRPNR  >= 91 ) THEN NDTXYRPNR  = .;
IF (NDTXYRSED  >= 91 ) THEN NDTXYRSED  = .;
IF (NDTXYRSTM  >= 91 ) THEN NDTXYRSTM  = .;
IF (NDTXYRTRQ  >= 91 ) THEN NDTXYRTRQ  = .;
IF (NITOXID  >= 85 ) THEN NITOXID  = .;
IF (NMERTMT2  >= 985 ) THEN NMERTMT2  = .;
IF (NMNGTHS2  >= 985 ) THEN NMNGTHS2  = .;
IF (NMVSOEST  >= 94 ) THEN NMVSOEST  = .;
IF (NMVSOPT2  >= 985 ) THEN NMVSOPT2  = .;
IF (NOBOOKY2  >= 985 ) THEN NOBOOKY2  = .;
IF (NOMARR2  >= 94 ) THEN NOMARR2  = .;
IF (NONABOVEV  >= 85 ) THEN NONABOVEV  = .;
IF (OTCFLAG  >= 98 ) THEN OTCFLAG  = .;
IF (OTDGNDLA  >= 9985 ) THEN OTDGNDLA  = .;
IF (OTDGNDLB  >= 9985 ) THEN OTDGNDLB  = .;
IF (OTDGNDLC  >= 9985 ) THEN OTDGNDLC  = .;
IF (OTDGNDLD  >= 9985 ) THEN OTDGNDLD  = .;
IF (OTDGNDLE  >= 9985 ) THEN OTDGNDLE  = .;
IF (OTDGNDLRC  >= 91 ) THEN OTDGNDLRC  = .;
IF (OTDGNEDL  >= 94 ) THEN OTDGNEDL  = .;
IF (OTHAEROS  >= 85 ) THEN OTHAEROS  = .;
IF (OXCNANYYR  >= 81 ) THEN OXCNANYYR  = .;
IF (OXCNNMAGE  >= 981 ) THEN OXCNNMAGE  = .;
IF (OXCNNMMFU  >= 81 ) THEN OXCNNMMFU  = .;
IF (OXCNNMYFU  >= 9981 ) THEN OXCNNMYFU  = .;
IF (OXCNNMYR  >= 81 ) THEN OXCNNMYR  = .;
IF (PAROLREL  >= 85 ) THEN PAROLREL  = .;
IF (PCP  >= 91 ) THEN PCP  = .;
IF (PCPAGE  >= 985 ) THEN PCPAGE  = .;
IF (PCPAGLST  >= 985 ) THEN PCPAGLST  = .;
IF (PCPMFU  >= 85 ) THEN PCPMFU  = .;
IF (PCPMLU  >= 85 ) THEN PCPMLU  = .;
IF (PCPREC  >= 91 ) THEN PCPREC  = .;
IF (PCPYFU  >= 9985 ) THEN PCPYFU  = .;
IF (PCPYLU  >= 9985 ) THEN PCPYLU  = .;
IF (PEYOTE  >= 91 ) THEN PEYOTE  = .;
IF (PIPE30DY  >= 91 ) THEN PIPE30DY  = .;
IF (PIPEVER  >= 94 ) THEN PIPEVER  = .;
IF (PNRANYLIF  >= 94 ) THEN PNRANYLIF  = .;
IF (PNRANYREC  >= 83 ) THEN PNRANYREC  = .;
IF (PNRLCUT1X  >= 83 ) THEN PNRLCUT1X  = .;
IF (PNRLCUTDN  >= 83 ) THEN PNRLCUTDN  = .;
```

```
IF (PNRLCUTEV  >= 83 ) THEN PNRLCUTEV  = .;
IF (PNRLEMCTD  >= 83 ) THEN PNRLEMCTD  = .;
IF (PNRLEMOPB  >= 83 ) THEN PNRLEMOPB  = .;
IF (PNRLFMCTD  >= 83 ) THEN PNRLFMCTD  = .;
IF (PNRLFMFPB  >= 83 ) THEN PNRLFMFPB  = .;
IF (PNRLGTOVR  >= 83 ) THEN PNRLGTOVR  = .;
IF (PNRLKPLMT  >= 83 ) THEN PNRLKPLMT  = .;
IF (PNRLLAWTR  >= 83 ) THEN PNRLLAWTR  = .;
IF (PNRLLIMIT  >= 83 ) THEN PNRLLIMIT  = .;
IF (PNRLLOTTM  >= 83 ) THEN PNRLLOTTM  = .;
IF (PNRLLSACT  >= 83 ) THEN PNRLLSACT  = .;
IF (PNRLLSEFX  >= 83 ) THEN PNRLLSEFX  = .;
IF (PNRLNDMOR  >= 83 ) THEN PNRLNDMOR  = .;
IF (PNRLPDANG  >= 83 ) THEN PNRLPDANG  = .;
IF (PNRLPHCTD  >= 83 ) THEN PNRLPHCTD  = .;
IF (PNRLPHLPB  >= 83 ) THEN PNRLPHLPB  = .;
IF (PNRLSERPB  >= 83 ) THEN PNRLSERPB  = .;
IF (PNRLWD3SX  >= 83 ) THEN PNRLWD3SX  = .;
IF (PNRLWDSMT  >= 83 ) THEN PNRLWDSMT  = .;
IF (PNRNM30AL  >= 83 ) THEN PNRNM30AL  = .;
IF (PNRNM30D  >= 83 ) THEN PNRNM30D  = .;
IF (PNRNM30ES  >= 83 ) THEN PNRNM30ES  = .;
IF (PNRNM30FQ  >= 83 ) THEN PNRNM30FQ  = .;
IF (PNRNMAGE  >= 983 ) THEN PNRNMAGE  = .;
IF (PNRNMINIT  >= 83 ) THEN PNRNMINIT  = .;
IF (PNRNMLAS1  >= 83 ) THEN PNRNMLAS1  = .;
IF (PNRNMLIF  >= 85 ) THEN PNRNMLIF  = .;
IF (PNRNMMFU  >= 83 ) THEN PNRNMMFU  = .;
IF (PNRNMREC  >= 83 ) THEN PNRNMREC  = .;
IF (PNRNMYFU  >= 9983 ) THEN PNRNMYFU  = .;
IF (PNRNORXFG  >= 98 ) THEN PNRNORXFG  = .;
IF (PNRRSDGFX  >= 83 ) THEN PNRRSDGFX  = .;
IF (PNRRSEMOT  >= 83 ) THEN PNRRSEMOT  = .;
IF (PNRRSEXPT  >= 83 ) THEN PNRRSEXPT  = .;
IF (PNRRSHIGH  >= 83 ) THEN PNRRSHIGH  = .;
IF (PNRRSHOOK  >= 83 ) THEN PNRRSHOOK  = .;
IF (PNRRSMAIN  >= 83 ) THEN PNRRSMAIN  = .;
IF (PNRRSOTRS2  >= 983 ) THEN PNRRSOTRS2  = .;
IF (PNRRSPAIN  >= 83 ) THEN PNRRSPAIN  = .;
IF (PNRRSRELX  >= 83 ) THEN PNRRSRELX  = .;
IF (PNRRSSLEP  >= 83 ) THEN PNRRSSLEP  = .;
IF (PNRRSSOR  >= 83 ) THEN PNRRSSOR  = .;
IF (PNRWYGAMT  >= 83 ) THEN PNRWYGAMT  = .;
IF (PNRWYLNGR  >= 83 ) THEN PNRWYLNGR  = .;
IF (PNRWYNORX  >= 83 ) THEN PNRWYNORX  = .;
IF (PNRWYOFTN  >= 83 ) THEN PNRWYOFTN  = .;
IF (PNRWYOTWY  >= 83 ) THEN PNRWYOTWY  = .;
IF (PREGNANT  >= 85 ) THEN PREGNANT  = .;
IF (PROBATON  >= 85 ) THEN PROBATON  = .;
IF (PRVHLTIN  >= 85 ) THEN PRVHLTIN  = .;
IF (PRXRETRY  >= 94 ) THEN PRXRETRY  = .;
IF (PRXYDATA  >= 94 ) THEN PRXYDATA  = .;
IF (PSILCY  >= 91 ) THEN PSILCY  = .;
```

```
IF (RKFQDBLT  >= 85 ) THEN RKFQDBLT  = .;
IF (RKFQPBLT  >= 85 ) THEN RKFQPBLT  = .;
IF (RSKBNGDLY  >= 85 ) THEN RSKBNGDLY  = .;
IF (RSKBNGWK  >= 85 ) THEN RSKBNGWK  = .;
IF (RSKCIGPKD  >= 85 ) THEN RSKCIGPKD  = .;
IF (RSKCOCMON  >= 85 ) THEN RSKCOCMON  = .;
IF (RSKCOCWK  >= 85 ) THEN RSKCOCWK  = .;
IF (RSKHERTRY  >= 85 ) THEN RSKHERTRY  = .;
IF (RSKHERWK  >= 85 ) THEN RSKHERWK  = .;
IF (RSKLSDTRY  >= 85 ) THEN RSKLSDTRY  = .;
IF (RSKLSDWK  >= 85 ) THEN RSKLSDWK  = .;
IF (RSKMRJMON  >= 85 ) THEN RSKMRJMON  = .;
IF (RSKMRJWK  >= 85 ) THEN RSKMRJWK  = .;
IF (RSKYFQDGR  >= 85 ) THEN RSKYFQDGR  = .;
IF (RSKYFQTES  >= 85 ) THEN RSKYFQTES  = .;
IF (RSNMRJMO  >= 98 ) THEN RSNMRJMO  = .;
IF (RSNOMRJ  >= 98 ) THEN RSNOMRJ  = .;
IF (SALVIADIV  >= 91 ) THEN SALVIADIV  = .;
IF (SALVIAREC  >= 91 ) THEN SALVIAREC  = .;
IF (SEDANYLIF  >= 94 ) THEN SEDANYLIF  = .;
IF (SEDANYREC  >= 83 ) THEN SEDANYREC  = .;
IF (SEDNM30AL  >= 83 ) THEN SEDNM30AL  = .;
IF (SEDNM30D  >= 83 ) THEN SEDNM30D  = .;
IF (SEDNM30ES  >= 91 ) THEN SEDNM30ES  = .;
IF (SEDNM30FQ  >= 83 ) THEN SEDNM30FQ  = .;
IF (SEDNMAGE  >= 983 ) THEN SEDNMAGE  = .;
IF (SEDNMINIT  >= 83 ) THEN SEDNMINIT  = .;
IF (SEDNMLAST  >= 83 ) THEN SEDNMLAST  = .;
IF (SEDNMLIF  >= 85 ) THEN SEDNMLIF  = .;
IF (SEDNMMFU  >= 83 ) THEN SEDNMMFU  = .;
IF (SEDNMREC  >= 83 ) THEN SEDNMREC  = .;
IF (SEDNMYFU  >= 9983 ) THEN SEDNMYFU  = .;
IF (SEDNORXFG  >= 98 ) THEN SEDNORXFG  = .;
IF (SEDRSDGFX  >= 83 ) THEN SEDRSDGFX  = .;
IF (SEDRSEMOT  >= 83 ) THEN SEDRSEMOT  = .;
IF (SEDRSEXPT  >= 85 ) THEN SEDRSEXPT  = .;
IF (SEDRSHIGH  >= 83 ) THEN SEDRSHIGH  = .;
IF (SEDRSHOOK  >= 83 ) THEN SEDRSHOOK  = .;
IF (SEDRSMAIN  >= 83 ) THEN SEDRSMAIN  = .;
IF (SEDRSOTRS2  >= 983 ) THEN SEDRSOTRS2  = .;
IF (SEDRSRELX  >= 83 ) THEN SEDRSRELX  = .;
IF (SEDRSSLEP  >= 83 ) THEN SEDRSSLEP  = .;
IF (SEDRSSOR  >= 83 ) THEN SEDRSSOR  = .;
IF (SEDVCUT1X  >= 83 ) THEN SEDVCUT1X  = .;
IF (SEDVCUTDN  >= 83 ) THEN SEDVCUTDN  = .;
IF (SEDVCUTEV  >= 83 ) THEN SEDVCUTEV  = .;
IF (SEDVEMCTD  >= 83 ) THEN SEDVEMCTD  = .;
IF (SEDVEMOPB  >= 83 ) THEN SEDVEMOPB  = .;
IF (SEDVFMCTD  >= 83 ) THEN SEDVFMCTD  = .;
IF (SEDVFMFPB  >= 83 ) THEN SEDVFMFPB  = .;
IF (SEDVGTOVR  >= 83 ) THEN SEDVGTOVR  = .;
IF (SEDVKPLMT  >= 83 ) THEN SEDVKPLMT  = .;
IF (SEDVLAWTR  >= 83 ) THEN SEDVLAWTR  = .;
```

```
IF (SEDVLIMIT  >= 83 ) THEN SEDVLIMIT  = .;
IF (SEDVLOTTM  >= 83 ) THEN SEDVLOTTM  = .;
IF (SEDVLSACT  >= 83 ) THEN SEDVLSACT  = .;
IF (SEDVLSEFX  >= 83 ) THEN SEDVLSEFX  = .;
IF (SEDVNDMOR  >= 83 ) THEN SEDVNDMOR  = .;
IF (SEDVPDANG  >= 83 ) THEN SEDVPDANG  = .;
IF (SEDVPHCTD  >= 83 ) THEN SEDVPHCTD  = .;
IF (SEDVPHLPB  >= 83 ) THEN SEDVPHLPB  = .;
IF (SEDVSERPB  >= 83 ) THEN SEDVSERPB  = .;
IF (SEDVWD1SX  >= 83 ) THEN SEDVWD1SX  = .;
IF (SEDVWDSMT  >= 83 ) THEN SEDVWDSMT  = .;
IF (SEDWYGAMT  >= 83 ) THEN SEDWYGAMT  = .;
IF (SEDWYLNGR  >= 83 ) THEN SEDWYLNGR  = .;
IF (SEDWYNORX  >= 83 ) THEN SEDWYNORX  = .;
IF (SEDWYOFTN  >= 83 ) THEN SEDWYOFTN  = .;
IF (SEDWYOTWY  >= 83 ) THEN SEDWYOTWY  = .;
IF (SERVICE  >= 85 ) THEN SERVICE  = .;
IF (SEXATRACT  >= 85 ) THEN SEXATRACT  = .;
IF (SEXIDENT  >= 85 ) THEN SEXIDENT  = .;
IF (SMKAGLAST  >= 985 ) THEN SMKAGLAST  = .;
IF (SMKLSS30E  >= 91 ) THEN SMKLSS30E  = .;
IF (SMKLSS30N  >= 91 ) THEN SMKLSS30N  = .;
IF (SMKLSSEVR  >= 85 ) THEN SMKLSSEVR  = .;
IF (SMKLSSMFU  >= 85 ) THEN SMKLSSMFU  = .;
IF (SMKLSSREC  >= 85 ) THEN SMKLSSREC  = .;
IF (SMKLSSTRY  >= 985 ) THEN SMKLSSTRY  = .;
IF (SMKLSSYFU  >= 9985 ) THEN SMKLSSYFU  = .;
IF (SMKMOLAST  >= 85 ) THEN SMKMOLAST  = .;
IF (SMKYRLAST  >= 9985 ) THEN SMKYRLAST  = .;
IF (SNFAMJEV  >= 85 ) THEN SNFAMJEV  = .;
IF (SNRLDCSN  >= 85 ) THEN SNRLDCSN  = .;
IF (SNRLFRND  >= 85 ) THEN SNRLFRND  = .;
IF (SNRLGIMP  >= 85 ) THEN SNRLGIMP  = .;
IF (SNRLGSVC  >= 85 ) THEN SNRLGSVC  = .;
IF (SNYATTAK  >= 85 ) THEN SNYATTAK  = .;
IF (SNYSELL  >= 85 ) THEN SNYSELL  = .;
IF (SNYSTOLE  >= 85 ) THEN SNYSTOLE  = .;
IF (SOLVENT  >= 85 ) THEN SOLVENT  = .;
IF (SPEAKENGL  >= 85 ) THEN SPEAKENGL  = .;
IF (SPPAINT  >= 85 ) THEN SPPAINT  = .;
IF (STDANYYR  >= 85 ) THEN STDANYYR  = .;
IF (STIMCUT1X  >= 83 ) THEN STIMCUT1X  = .;
IF (STIMCUTDN  >= 83 ) THEN STIMCUTDN  = .;
IF (STIMCUTEV  >= 83 ) THEN STIMCUTEV  = .;
IF (STIMEMCTD  >= 83 ) THEN STIMEMCTD  = .;
IF (STIMEMOPB  >= 83 ) THEN STIMEMOPB  = .;
IF (STIMFLBLU  >= 83 ) THEN STIMFLBLU  = .;
IF (STIMFMCTD  >= 83 ) THEN STIMFMCTD  = .;
IF (STIMFMFPB  >= 83 ) THEN STIMFMFPB  = .;
IF (STIMGTOVR  >= 83 ) THEN STIMGTOVR  = .;
IF (STIMKPLMT  >= 83 ) THEN STIMKPLMT  = .;
IF (STIMLAWTR  >= 83 ) THEN STIMLAWTR  = .;
IF (STIMLIMIT  >= 83 ) THEN STIMLIMIT  = .;
```

```
IF (STIMLOTTM  >= 83 ) THEN STIMLOTTM  = .;
IF (STIMLSACT  >= 83 ) THEN STIMLSACT  = .;
IF (STIMLSEFX  >= 83 ) THEN STIMLSEFX  = .;
IF (STIMNDMOR  >= 83 ) THEN STIMNDMOR  = .;
IF (STIMPDANG  >= 83 ) THEN STIMPDANG  = .;
IF (STIMPHCTD  >= 83 ) THEN STIMPHCTD  = .;
IF (STIMPHLPB  >= 83 ) THEN STIMPHLPB  = .;
IF (STIMSERPB  >= 83 ) THEN STIMSERPB  = .;
IF (STIMWD2SX  >= 83 ) THEN STIMWD2SX  = .;
IF (STIMWDSMT  >= 83 ) THEN STIMWDSMT  = .;
IF (STMANYLIF  >= 94 ) THEN STMANYLIF  = .;
IF (STMANYREC  >= 83 ) THEN STMANYREC  = .;
IF (STMNDLREC  >= 85 ) THEN STMNDLREC  = .;
IF (STMNDLYR  >= 83 ) THEN STMNDLYR  = .;
IF (STMNM30AL  >= 83 ) THEN STMNM30AL  = .;
IF (STMNM30D  >= 83 ) THEN STMNM30D  = .;
IF (STMNM30ES  >= 91 ) THEN STMNM30ES  = .;
IF (STMNM30FQ  >= 83 ) THEN STMNM30FQ  = .;
IF (STMNMAGE  >= 983 ) THEN STMNMAGE  = .;
IF (STMNMINIT  >= 83 ) THEN STMNMINIT  = .;
IF (STMNMLAS1  >= 83 ) THEN STMNMLAS1  = .;
IF (STMNMLIF  >= 85 ) THEN STMNMLIF  = .;
IF (STMNMMFU  >= 83 ) THEN STMNMMFU  = .;
IF (STMNMREC  >= 83 ) THEN STMNMREC  = .;
IF (STMNMYFU  >= 9983 ) THEN STMNMYFU  = .;
IF (STMNORXFG  >= 98 ) THEN STMNORXFG  = .;
IF (STMRSALRT  >= 83 ) THEN STMRSALRT  = .;
IF (STMRSCONC  >= 83 ) THEN STMRSCONC  = .;
IF (STMRSDGFX  >= 91 ) THEN STMRSDGFX  = .;
IF (STMRSEXPT  >= 91 ) THEN STMRSEXPT  = .;
IF (STMRSHIGH  >= 91 ) THEN STMRSHIGH  = .;
IF (STMRSHOOK  >= 91 ) THEN STMRSHOOK  = .;
IF (STMRSMAIN  >= 83 ) THEN STMRSMAIN  = .;
IF (STMRSOTRS2  >= 983 ) THEN STMRSOTRS2  = .;
IF (STMRSSOR  >= 83 ) THEN STMRSSOR  = .;
IF (STMRSSTDY  >= 91 ) THEN STMRSSTDY  = .;
IF (STMRSWGHT  >= 83 ) THEN STMRSWGHT  = .;
IF (STMWYGAMT  >= 83 ) THEN STMWYGAMT  = .;
IF (STMWYLNGR  >= 91 ) THEN STMWYLNGR  = .;
IF (STMWYNORX  >= 83 ) THEN STMWYNORX  = .;
IF (STMWYOFTN  >= 91 ) THEN STMWYOFTN  = .;
IF (STMWYOTWY  >= 83 ) THEN STMWYOTWY  = .;
IF (SUICPLAN  >= 85 ) THEN SUICPLAN  = .;
IF (SUICTHNK  >= 85 ) THEN SUICTHNK  = .;
IF (SUICTRY  >= 85 ) THEN SUICTRY  = .;
IF (TOOLONG  >= 98 ) THEN TOOLONG  = .;
IF (TROUBUND  >= 98 ) THEN TROUBUND  = .;
IF (TRQANYLIF  >= 94 ) THEN TRQANYLIF  = .;
IF (TRQANYREC  >= 83 ) THEN TRQANYREC  = .;
IF (TRQLCUTDN  >= 83 ) THEN TRQLCUTDN  = .;
IF (TRQLCUTEV  >= 83 ) THEN TRQLCUTEV  = .;
IF (TRQLEMCTD  >= 83 ) THEN TRQLEMCTD  = .;
IF (TRQLEMOPB  >= 83 ) THEN TRQLEMOPB  = .;
```

```
IF (TRQLFMCTD  >= 83 ) THEN TRQLFMCTD  = .;
IF (TRQLFMFPB  >= 83 ) THEN TRQLFMFPB  = .;
IF (TRQLGTOVR  >= 83 ) THEN TRQLGTOVR  = .;
IF (TRQLKPLMT  >= 83 ) THEN TRQLKPLMT  = .;
IF (TRQLLAWTR  >= 83 ) THEN TRQLLAWTR  = .;
IF (TRQLLIMIT  >= 83 ) THEN TRQLLIMIT  = .;
IF (TRQLLOTTM  >= 83 ) THEN TRQLLOTTM  = .;
IF (TRQLLSACT  >= 83 ) THEN TRQLLSACT  = .;
IF (TRQLLSEFT  >= 83 ) THEN TRQLLSEFT  = .;
IF (TRQLNDMOR  >= 83 ) THEN TRQLNDMOR  = .;
IF (TRQLPDANG  >= 83 ) THEN TRQLPDANG  = .;
IF (TRQLPHCTD  >= 83 ) THEN TRQLPHCTD  = .;
IF (TRQLPHLPB  >= 83 ) THEN TRQLPHLPB  = .;
IF (TRQLSERPB  >= 83 ) THEN TRQLSERPB  = .;
IF (TRQNM30AL  >= 83 ) THEN TRQNM30AL  = .;
IF (TRQNM30D  >= 83 ) THEN TRQNM30D  = .;
IF (TRQNM30ES  >= 91 ) THEN TRQNM30ES  = .;
IF (TRQNM30FQ  >= 83 ) THEN TRQNM30FQ  = .;
IF (TRQNMAGE  >= 983 ) THEN TRQNMAGE  = .;
IF (TRQNMINIT  >= 83 ) THEN TRQNMINIT  = .;
IF (TRQNMLAS1  >= 83 ) THEN TRQNMLAS1  = .;
IF (TRQNMLIF  >= 85 ) THEN TRQNMLIF  = .;
IF (TRQNMMFU  >= 83 ) THEN TRQNMMFU  = .;
IF (TRQNMREC  >= 83 ) THEN TRQNMREC  = .;
IF (TRQNMYFU  >= 9983 ) THEN TRQNMYFU  = .;
IF (TRQNORXFG  >= 98 ) THEN TRQNORXFG  = .;
IF (TRQRSDGFX  >= 91 ) THEN TRQRSDGFX  = .;
IF (TRQRSEMOT  >= 85 ) THEN TRQRSEMOT  = .;
IF (TRQRSEXPT  >= 85 ) THEN TRQRSEXPT  = .;
IF (TRQRSHIGH  >= 85 ) THEN TRQRSHIGH  = .;
IF (TRQRSHOOK  >= 91 ) THEN TRQRSHOOK  = .;
IF (TRQRSMAIN  >= 85 ) THEN TRQRSMAIN  = .;
IF (TRQRSOTRS2  >= 985 ) THEN TRQRSOTRS2  = .;
IF (TRQRSRELX  >= 83 ) THEN TRQRSRELX  = .;
IF (TRQRSSLEP  >= 85 ) THEN TRQRSSLEP  = .;
IF (TRQRSSOR  >= 85 ) THEN TRQRSSOR  = .;
IF (TRQWYGAMT  >= 85 ) THEN TRQWYGAMT  = .;
IF (TRQWYLNGR  >= 85 ) THEN TRQWYLNGR  = .;
IF (TRQWYNORX  >= 83 ) THEN TRQWYNORX  = .;
IF (TRQWYOFTN  >= 85 ) THEN TRQWYOFTN  = .;
IF (TRQWYOTWY  >= 85 ) THEN TRQWYOTWY  = .;
IF (TXALCDAGE  >= 991 ) THEN TXALCDAGE  = .;
IF (TXALCDRGU  >= 91 ) THEN TXALCDRGU  = .;
IF (TXALCONAG  >= 991 ) THEN TXALCONAG  = .;
IF (TXALCONLY  >= 85 ) THEN TXALCONLY  = .;
IF (TXCURRENT  >= 85 ) THEN TXCURRENT  = .;
IF (TXDRGAAGE  >= 991 ) THEN TXDRGAAGE  = .;
IF (TXDRGALCU  >= 91 ) THEN TXDRGALCU  = .;
IF (TXDRGONAG  >= 991 ) THEN TXDRGONAG  = .;
IF (TXDRGONLY  >= 91 ) THEN TXDRGONLY  = .;
IF (TXENRLOCT  >= 85 ) THEN TXENRLOCT  = .;
IF (TXEVRRCVD  >= 85 ) THEN TXEVRRCVD  = .;
IF (TXFGADAGE  >= 91 ) THEN TXFGADAGE  = .;
```

```
IF (TXFGALAGE  >= 91 ) THEN TXFGALAGE  = .;
IF (TXFGDGAGE  >= 91 ) THEN TXFGDGAGE  = .;
IF (TXLTYALCO  >= 85 ) THEN TXLTYALCO  = .;
IF (TXLTYCOCN  >= 85 ) THEN TXLTYCOCN  = .;
IF (TXLTYDAYS2  >= 99985 ) THEN TXLTYDAYS2  = .;
IF (TXLTYHALL  >= 85 ) THEN TXLTYHALL  = .;
IF (TXLTYHERN  >= 85 ) THEN TXLTYHERN  = .;
IF (TXLTYINHL  >= 91 ) THEN TXLTYINHL  = .;
IF (TXLTYMAIN2  >= 85 ) THEN TXLTYMAIN2  = .;
IF (TXLTYMETH  >= 85 ) THEN TXLTYMETH  = .;
IF (TXLTYMNPL2  >= 985 ) THEN TXLTYMNPL2  = .;
IF (TXLTYMRJH  >= 85 ) THEN TXLTYMRJH  = .;
IF (TXLTYOCOM2  >= 85 ) THEN TXLTYOCOM2  = .;
IF (TXLTYOTHR  >= 85 ) THEN TXLTYOTHR  = .;
IF (TXLTYPNRL  >= 85 ) THEN TXLTYPNRL  = .;
IF (TXLTYSEDV  >= 85 ) THEN TXLTYSEDV  = .;
IF (TXLTYSTIM  >= 85 ) THEN TXLTYSTIM  = .;
IF (TXLTYTRQL  >= 85 ) THEN TXLTYTRQL  = .;
IF (TXPAYBOSS  >= 85 ) THEN TXPAYBOSS  = .;
IF (TXPAYCOUR  >= 85 ) THEN TXPAYCOUR  = .;
IF (TXPAYFAML  >= 85 ) THEN TXPAYFAML  = .;
IF (TXPAYFREE  >= 85 ) THEN TXPAYFREE  = .;
IF (TXPAYHINS  >= 85 ) THEN TXPAYHINS  = .;
IF (TXPAYMCAD  >= 85 ) THEN TXPAYMCAD  = .;
IF (TXPAYMCRE  >= 85 ) THEN TXPAYMCRE  = .;
IF (TXPAYMILT  >= 85 ) THEN TXPAYMILT  = .;
IF (TXPAYOTHR  >= 85 ) THEN TXPAYOTHR  = .;
IF (TXPAYOTSP2  >= 85 ) THEN TXPAYOTSP2  = .;
IF (TXPAYPUBL  >= 85 ) THEN TXPAYPUBL  = .;
IF (TXPAYSVNG  >= 85 ) THEN TXPAYSVNG  = .;
IF (TXRCVDREC  >= 85 ) THEN TXRCVDREC  = .;
IF (TXSHGALDB  >= 91 ) THEN TXSHGALDB  = .;
IF (TXSHGFLAG  >= 91 ) THEN TXSHGFLAG  = .;
IF (TXSHGWENT  >= 85 ) THEN TXSHGWENT  = .;
IF (TXYALDAAG  >= 991 ) THEN TXYALDAAG  = .;
IF (TXYALDDAG  >= 985 ) THEN TXYALDDAG  = .;
IF (TXYALODAG  >= 991 ) THEN TXYALODAG  = .;
IF (TXYALODRG  >= 85 ) THEN TXYALODRG  = .;
IF (TXYALONAG  >= 985 ) THEN TXYALONAG  = .;
IF (TXYDROAAG  >= 991 ) THEN TXYDROAAG  = .;
IF (TXYDROALC  >= 85 ) THEN TXYDROALC  = .;
IF (TXYDRONAG  >= 985 ) THEN TXYDRONAG  = .;
IF (TXYRALDGB  >= 85 ) THEN TXYRALDGB  = .;
IF (TXYRDRPAD  >= 91 ) THEN TXYRDRPAD  = .;
IF (TXYRDRPRV  >= 85 ) THEN TXYRDRPRV  = .;
IF (TXYREMRAD  >= 91 ) THEN TXYREMRAD  = .;
IF (TXYREMRGN  >= 85 ) THEN TXYREMRGN  = .;
IF (TXYRERDRG  >= 85 ) THEN TXYRERDRG  = .;
IF (TXYRERNUM2  >= 991 ) THEN TXYRERNUM2  = .;
IF (TXYRHOSAD  >= 91 ) THEN TXYRHOSAD  = .;
IF (TXYRHOSOV  >= 85 ) THEN TXYRHOSOV  = .;
IF (TXYRMHCAD  >= 91 ) THEN TXYRMHCAD  = .;
IF (TXYRMHCOP  >= 85 ) THEN TXYRMHCOP  = .;
```

```
IF (TXYRONDTX  >= 85 ) THEN TXYRONDTX  = .;
IF (TXYROTHAD  >= 91 ) THEN TXYROTHAD  = .;
IF (TXYROTHER  >= 85 ) THEN TXYROTHER  = .;
IF (TXYROTHSP2  >= 985 ) THEN TXYROTHSP2  = .;
IF (TXYROUTAD  >= 91 ) THEN TXYROUTAD  = .;
IF (TXYROUTPT  >= 85 ) THEN TXYROUTPT  = .;
IF (TXYRPRIAD  >= 91 ) THEN TXYRPRIAD  = .;
IF (TXYRPRISN  >= 85 ) THEN TXYRPRISN  = .;
IF (TXYRRECVD  >= 85 ) THEN TXYRRECVD  = .;
IF (TXYRRESAD  >= 91 ) THEN TXYRRESAD  = .;
IF (TXYRRESOV  >= 85 ) THEN TXYRRESOV  = .;
IF (TXYRSLFAD  >= 91 ) THEN TXYRSLFAD  = .;
IF (TXYRSLFHP  >= 85 ) THEN TXYRSLFHP  = .;
IF (WRK35WKUS  >= 85 ) THEN WRK35WKUS  = .;
IF (WRKDHRSWK2  >= 985 ) THEN WRKDHRSWK2  = .;
IF (WRKDPSTWK  >= 85 ) THEN WRKDPSTWK  = .;
IF (WRKDPSTYR  >= 85 ) THEN WRKDPSTYR  = .;
IF (WRKDRGALB  >= 85 ) THEN WRKDRGALB  = .;
IF (WRKDRGEDU  >= 85 ) THEN WRKDRGEDU  = .;
IF (WRKDRGHLP  >= 85 ) THEN WRKDRGHLP  = .;
IF (WRKDRGPOL  >= 85 ) THEN WRKDRGPOL  = .;
IF (WRKEFFORT  >= 94 ) THEN WRKEFFORT  = .;
IF (WRKHADJOB  >= 85 ) THEN WRKHADJOB  = .;
IF (WRKLASTYR2  >= 9985 ) THEN WRKLASTYR2  = .;
IF (WRKNJBPYR  >= 85 ) THEN WRKNJBPYR  = .;
IF (WRKNJBWKS  >= 85 ) THEN WRKNJBWKS  = .;
IF (WRKNUMJOB2  >= 85 ) THEN WRKNUMJOB2  = .;
IF (WRKOKPREH  >= 85 ) THEN WRKOKPREH  = .;
IF (WRKOKRAND  >= 85 ) THEN WRKOKRAND  = .;
IF (WRKRSNJOB  >= 985 ) THEN WRKRSNJOB  = .;
IF (WRKRSNNOT  >= 994 ) THEN WRKRSNNOT  = .;
IF (WRKSELFEM  >= 85 ) THEN WRKSELFEM  = .;
IF (WRKSICKMO  >= 85 ) THEN WRKSICKMO  = .;
IF (WRKSKIPMO  >= 85 ) THEN WRKSKIPMO  = .;
IF (WRKSTATWK2  >= 98 ) THEN WRKSTATWK2  = .;
IF (WRKTST1ST  >= 85 ) THEN WRKTST1ST  = .;
IF (WRKTSTALC  >= 85 ) THEN WRKTSTALC  = .;
IF (WRKTSTDRG  >= 85 ) THEN WRKTSTDRG  = .;
IF (WRKTSTHIR  >= 85 ) THEN WRKTSTHIR  = .;
IF (WRKTSTRDM  >= 85 ) THEN WRKTSTRDM  = .;
IF (WTANSWER  >= 85 ) THEN WTANSWER  = .;
IF (WTPOUND2  >= 9985 ) THEN WTPOUND2  = .;
IF (YEATNDYR  >= 85 ) THEN YEATNDYR  = .;
IF (YECOMACT  >= 85 ) THEN YECOMACT  = .;
IF (YEDECLAS  >= 85 ) THEN YEDECLAS  = .;
IF (YEDERGLR  >= 85 ) THEN YEDERGLR  = .;
IF (YEDESPCL  >= 85 ) THEN YEDESPCL  = .;
IF (YEDGPRGP  >= 85 ) THEN YEDGPRGP  = .;
IF (YEFAIACT  >= 85 ) THEN YEFAIACT  = .;
IF (YEFALDLY  >= 85 ) THEN YEFALDLY  = .;
IF (YEFMJEVR  >= 85 ) THEN YEFMJEVR  = .;
IF (YEFMJMO  >= 85 ) THEN YEFMJMO  = .;
IF (YEFPKCIG  >= 85 ) THEN YEFPKCIG  = .;
```

```
IF (YEGALDLY  >= 85 ) THEN YEGALDLY  = .;
IF (YEGMJEVR  >= 85 ) THEN YEGMJEVR  = .;
IF (YEGMJMO  >= 85 ) THEN YEGMJMO  = .;
IF (YEGPKCIG  >= 85 ) THEN YEGPKCIG  = .;
IF (YEHMSLYR  >= 85 ) THEN YEHMSLYR  = .;
IF (YELSTGRD  >= 85 ) THEN YELSTGRD  = .;
IF (YEOTHACT  >= 85 ) THEN YEOTHACT  = .;
IF (YEPALDLY  >= 85 ) THEN YEPALDLY  = .;
IF (YEPCHKHW  >= 85 ) THEN YEPCHKHW  = .;
IF (YEPCHORE  >= 85 ) THEN YEPCHORE  = .;
IF (YEPGDJOB  >= 85 ) THEN YEPGDJOB  = .;
IF (YEPHLPHW  >= 85 ) THEN YEPHLPHW  = .;
IF (YEPLMTSN  >= 85 ) THEN YEPLMTSN  = .;
IF (YEPLMTTV  >= 85 ) THEN YEPLMTTV  = .;
IF (YEPMJEVR  >= 85 ) THEN YEPMJEVR  = .;
IF (YEPMJMO  >= 85 ) THEN YEPMJMO  = .;
IF (YEPPKCIG  >= 85 ) THEN YEPPKCIG  = .;
IF (YEPPROUD  >= 85 ) THEN YEPPROUD  = .;
IF (YEPRBSLV  >= 85 ) THEN YEPRBSLV  = .;
IF (YEPRGSTD  >= 85 ) THEN YEPRGSTD  = .;
IF (YEPRTDNG  >= 85 ) THEN YEPRTDNG  = .;
IF (YEPVNTYR  >= 85 ) THEN YEPVNTYR  = .;
IF (YERLDCSN  >= 85 ) THEN YERLDCSN  = .;
IF (YERLFRND  >= 85 ) THEN YERLFRND  = .;
IF (YERLGIMP  >= 85 ) THEN YERLGIMP  = .;
IF (YERLGSVC  >= 85 ) THEN YERLGSVC  = .;
IF (YESCHACT  >= 85 ) THEN YESCHACT  = .;
IF (YESCHFLT  >= 85 ) THEN YESCHFLT  = .;
IF (YESCHIMP  >= 85 ) THEN YESCHIMP  = .;
IF (YESCHINT  >= 85 ) THEN YESCHINT  = .;
IF (YESCHWRK  >= 85 ) THEN YESCHWRK  = .;
IF (YESLFHLP  >= 85 ) THEN YESLFHLP  = .;
IF (YESTSALC  >= 85 ) THEN YESTSALC  = .;
IF (YESTSCIG  >= 85 ) THEN YESTSCIG  = .;
IF (YESTSDNK  >= 85 ) THEN YESTSDNK  = .;
IF (YESTSMJ  >= 85 ) THEN YESTSMJ  = .;
IF (YETCGJOB  >= 85 ) THEN YETCGJOB  = .;
IF (YETLKBGF  >= 94 ) THEN YETLKBGF  = .;
IF (YETLKNON  >= 85 ) THEN YETLKNON  = .;
IF (YETLKOTA  >= 94 ) THEN YETLKOTA  = .;
IF (YETLKPAR  >= 85 ) THEN YETLKPAR  = .;
IF (YETLKSOP  >= 94 ) THEN YETLKSOP  = .;
IF (YEVIOPRV  >= 85 ) THEN YEVIOPRV  = .;
IF (YEYARGUP  >= 85 ) THEN YEYARGUP  = .;
IF (YEYATTAK  >= 85 ) THEN YEYATTAK  = .;
IF (YEYFGTGP  >= 85 ) THEN YEYFGTGP  = .;
IF (YEYFGTSW  >= 85 ) THEN YEYFGTSW  = .;
IF (YEYHGUN  >= 85 ) THEN YEYHGUN  = .;
IF (YEYSELL  >= 85 ) THEN YEYSELL  = .;
IF (YEYSTOLE  >= 85 ) THEN YEYSTOLE  = .;
IF (YOCOUNS  >= 94 ) THEN YOCOUNS  = .;
IF (YODPDISC  >= 85 ) THEN YODPDISC  = .;
IF (YODPLSIN  >= 85 ) THEN YODPLSIN  = .;
```

```
IF (YODPPROB  >= 94 ) THEN YODPPROB  = .;
IF (YODPR2WK  >= 85 ) THEN YODPR2WK  = .;
IF (YODPREV  >= 85 ) THEN YODPREV  = .;
IF (YODSCEV  >= 94 ) THEN YODSCEV  = .;
IF (YODSLSIN  >= 94 ) THEN YODSLSIN  = .;
IF (YODSMMDE  >= 94 ) THEN YODSMMDE  = .;
IF (YOFAMDOC  >= 94 ) THEN YOFAMDOC  = .;
IF (YOHERBAL  >= 94 ) THEN YOHERBAL  = .;
IF (YOLOSEV  >= 94 ) THEN YOLOSEV  = .;
IF (YOLSI2WK  >= 94 ) THEN YOLSI2WK  = .;
IF (YONURSE  >= 94 ) THEN YONURSE  = .;
IF (YOOTHDOC  >= 94 ) THEN YOOTHDOC  = .;
IF (YOOTHHLP  >= 94 ) THEN YOOTHHLP  = .;
IF (YOOTHMHP  >= 94 ) THEN YOOTHMHP  = .;
IF (YOPB2WK  >= 85 ) THEN YOPB2WK  = .;
IF (YOPBAGE  >= 994 ) THEN YOPBAGE  = .;
IF (YOPBDLYA  >= 94 ) THEN YOPBDLYA  = .;
IF (YOPBINTF  >= 94 ) THEN YOPBINTF  = .;
IF (YOPBNUM  >= 9994 ) THEN YOPBNUM  = .;
IF (YOPBRMBR  >= 94 ) THEN YOPBRMBR  = .;
IF (YOPSDAYS  >= 985 ) THEN YOPSDAYS  = .;
IF (YOPSHMGT  >= 85 ) THEN YOPSHMGT  = .;
IF (YOPSRELS  >= 85 ) THEN YOPSRELS  = .;
IF (YOPSSOC  >= 85 ) THEN YOPSSOC  = .;
IF (YOPSWORK  >= 85 ) THEN YOPSWORK  = .;
IF (YOPSYCH  >= 94 ) THEN YOPSYCH  = .;
IF (YOPSYMD  >= 94 ) THEN YOPSYMD  = .;
IF (YORELIG  >= 94 ) THEN YORELIG  = .;
IF (YORX12MO  >= 85 ) THEN YORX12MO  = .;
IF (YORXHLP  >= 94 ) THEN YORXHLP  = .;
IF (YORXNOW  >= 97 ) THEN YORXNOW  = .;
IF (YOSEEDOC  >= 85 ) THEN YOSEEDOC  = .;
IF (YOSOCWRK  >= 94 ) THEN YOSOCWRK  = .;
IF (YOTMTHLP  >= 94 ) THEN YOTMTHLP  = .;
IF (YOTMTNOW  >= 97 ) THEN YOTMTNOW  = .;
IF (YOWRAGE  >= 994 ) THEN YOWRAGE  = .;
IF (YOWRCHR  >= 94 ) THEN YOWRCHR  = .;
IF (YOWRCONC  >= 94 ) THEN YOWRCONC  = .;
IF (YOWRDBTR  >= 94 ) THEN YOWRDBTR  = .;
IF (YOWRDCSN  >= 94 ) THEN YOWRDCSN  = .;
IF (YOWRDEPR  >= 94 ) THEN YOWRDEPR  = .;
IF (YOWRDIET  >= 94 ) THEN YOWRDIET  = .;
IF (YOWRDISC  >= 94 ) THEN YOWRDISC  = .;
IF (YOWRDLOT  >= 94 ) THEN YOWRDLOT  = .;
IF (YOWRDST  >= 94 ) THEN YOWRDST  = .;
IF (YOWRELES  >= 94 ) THEN YOWRELES  = .;
IF (YOWREMOR  >= 94 ) THEN YOWREMOR  = .;
IF (YOWRENRG  >= 94 ) THEN YOWRENRG  = .;
IF (YOWRGAIN  >= 94 ) THEN YOWRGAIN  = .;
IF (YOWRGNL2  >= 994 ) THEN YOWRGNL2  = .;
IF (YOWRGROW  >= 94 ) THEN YOWRGROW  = .;
IF (YOWRHRS  >= 85 ) THEN YOWRHRS  = .;
IF (YOWRIMP  >= 94 ) THEN YOWRIMP  = .;
```

```
IF (YOWRJINO  >= 94 ) THEN YOWRJINO  = .;
IF (YOWRJITT  >= 94 ) THEN YOWRJITT  = .;
IF (YOWRLOSE  >= 94 ) THEN YOWRLOSE  = .;
IF (YOWRLSIN  >= 94 ) THEN YOWRLSIN  = .;
IF (YOWRLSL2  >= 994 ) THEN YOWRLSL2  = .;
IF (YOWRNOGD  >= 94 ) THEN YOWRNOGD  = .;
IF (YOWRPLSR  >= 94 ) THEN YOWRPLSR  = .;
IF (YOWRPREG  >= 98 ) THEN YOWRPREG  = .;
IF (YOWRPROB  >= 94 ) THEN YOWRPROB  = .;
IF (YOWRSATP  >= 94 ) THEN YOWRSATP  = .;
IF (YOWRSLEP  >= 94 ) THEN YOWRSLEP  = .;
IF (YOWRSLNO  >= 94 ) THEN YOWRSLNO  = .;
IF (YOWRSLOW  >= 94 ) THEN YOWRSLOW  = .;
IF (YOWRSMOR  >= 94 ) THEN YOWRSMOR  = .;
IF (YOWRSPLN  >= 94 ) THEN YOWRSPLN  = .;
IF (YOWRSTHK  >= 94 ) THEN YOWRSTHK  = .;
IF (YOWRTHOT  >= 94 ) THEN YOWRTHOT  = .;
IF (YOWRWRTH  >= 94 ) THEN YOWRWRTH  = .;
IF (YO_MDEA1  >= 94 ) THEN YO_MDEA1  = .;
IF (YO_MDEA2  >= 94 ) THEN YO_MDEA2  = .;
IF (YO_MDEA3  >= 94 ) THEN YO_MDEA3  = .;
IF (YO_MDEA4  >= 94 ) THEN YO_MDEA4  = .;
IF (YO_MDEA5  >= 94 ) THEN YO_MDEA5  = .;
IF (YO_MDEA6  >= 94 ) THEN YO_MDEA6  = .;
IF (YO_MDEA7  >= 94 ) THEN YO_MDEA7  = .;
IF (YO_MDEA8  >= 94 ) THEN YO_MDEA8  = .;
IF (YO_MDEA9  >= 94 ) THEN YO_MDEA9  = .;
IF (YUDYANGR  >= 94 ) THEN YUDYANGR  = .;
IF (YUDYBKRU  >= 94 ) THEN YUDYBKRU  = .;
IF (YUDYDEPR  >= 94 ) THEN YUDYDEPR  = .;
IF (YUDYEATP  >= 94 ) THEN YUDYEATP  = .;
IF (YUDYFEAR  >= 94 ) THEN YUDYFEAR  = .;
IF (YUDYFITE  >= 94 ) THEN YUDYFITE  = .;
IF (YUDYFMLY  >= 94 ) THEN YUDYFMLY  = .;
IF (YUDYFRND  >= 94 ) THEN YUDYFRND  = .;
IF (YUDYOTPP  >= 94 ) THEN YUDYOTPP  = .;
IF (YUDYSCHL  >= 85 ) THEN YUDYSCHL  = .;
IF (YUDYSOR  >= 94 ) THEN YUDYSOR  = .;
IF (YUDYSUIC  >= 85 ) THEN YUDYSUIC  = .;
IF (YUDYTXN2  >= 985 ) THEN YUDYTXN2  = .;
IF (YUDYTXYR  >= 85 ) THEN YUDYTXYR  = .;
IF (YUFCANGR  >= 94 ) THEN YUFCANGR  = .;
IF (YUFCARN2  >= 985 ) THEN YUFCARN2  = .;
IF (YUFCARYR  >= 85 ) THEN YUFCARYR  = .;
IF (YUFCBKRU  >= 94 ) THEN YUFCBKRU  = .;
IF (YUFCDEPR  >= 94 ) THEN YUFCDEPR  = .;
IF (YUFCEATP  >= 94 ) THEN YUFCEATP  = .;
IF (YUFCFEAR  >= 94 ) THEN YUFCFEAR  = .;
IF (YUFCFITE  >= 94 ) THEN YUFCFITE  = .;
IF (YUFCFMLY  >= 94 ) THEN YUFCFMLY  = .;
IF (YUFCFRND  >= 94 ) THEN YUFCFRND  = .;
IF (YUFCOTPP  >= 94 ) THEN YUFCOTPP  = .;
IF (YUFCSCHL  >= 94 ) THEN YUFCSCHL  = .;
```

```
IF (YUFCSOR  >= 94 ) THEN YUFCSOR  = .;
IF (YUFCSUIC  >= 85 ) THEN YUFCSUIC  = .;
IF (YUFDANGR  >= 94 ) THEN YUFDANGR  = .;
IF (YUFDBKRU  >= 94 ) THEN YUFDBKRU  = .;
IF (YUFDDEPR  >= 85 ) THEN YUFDDEPR  = .;
IF (YUFDEATP  >= 94 ) THEN YUFDEATP  = .;
IF (YUFDFEAR  >= 94 ) THEN YUFDFEAR  = .;
IF (YUFDFITE  >= 94 ) THEN YUFDFITE  = .;
IF (YUFDFMLY  >= 94 ) THEN YUFDFMLY  = .;
IF (YUFDFRND  >= 94 ) THEN YUFDFRND  = .;
IF (YUFDOCN2  >= 985 ) THEN YUFDOCN2  = .;
IF (YUFDOCYR  >= 85 ) THEN YUFDOCYR  = .;
IF (YUFDOTPP  >= 94 ) THEN YUFDOTPP  = .;
IF (YUFDSCHL  >= 94 ) THEN YUFDSCHL  = .;
IF (YUFDSOR  >= 94 ) THEN YUFDSOR  = .;
IF (YUFDSUIC  >= 85 ) THEN YUFDSUIC  = .;
IF (YUHOANGR  >= 94 ) THEN YUHOANGR  = .;
IF (YUHOBKRU  >= 94 ) THEN YUHOBKRU  = .;
IF (YUHODEPR  >= 85 ) THEN YUHODEPR  = .;
IF (YUHOEATP  >= 94 ) THEN YUHOEATP  = .;
IF (YUHOFEAR  >= 94 ) THEN YUHOFEAR  = .;
IF (YUHOFITE  >= 94 ) THEN YUHOFITE  = .;
IF (YUHOFMLY  >= 94 ) THEN YUHOFMLY  = .;
IF (YUHOFRND  >= 94 ) THEN YUHOFRND  = .;
IF (YUHOOTPP  >= 94 ) THEN YUHOOTPP  = .;
IF (YUHOSCHL  >= 94 ) THEN YUHOSCHL  = .;
IF (YUHOSOR  >= 94 ) THEN YUHOSOR  = .;
IF (YUHOSPN2  >= 985 ) THEN YUHOSPN2  = .;
IF (YUHOSPYR  >= 85 ) THEN YUHOSPYR  = .;
IF (YUHOSUIC  >= 85 ) THEN YUHOSUIC  = .;
IF (YUIHANGR  >= 94 ) THEN YUIHANGR  = .;
IF (YUIHBKRU  >= 94 ) THEN YUIHBKRU  = .;
IF (YUIHDEPR  >= 94 ) THEN YUIHDEPR  = .;
IF (YUIHEATP  >= 94 ) THEN YUIHEATP  = .;
IF (YUIHFEAR  >= 94 ) THEN YUIHFEAR  = .;
IF (YUIHFITE  >= 94 ) THEN YUIHFITE  = .;
IF (YUIHFMLY  >= 94 ) THEN YUIHFMLY  = .;
IF (YUIHFRND  >= 94 ) THEN YUIHFRND  = .;
IF (YUIHOTPP  >= 94 ) THEN YUIHOTPP  = .;
IF (YUIHSCHL  >= 94 ) THEN YUIHSCHL  = .;
IF (YUIHSOR  >= 94 ) THEN YUIHSOR  = .;
IF (YUIHSUIC  >= 85 ) THEN YUIHSUIC  = .;
IF (YUIHTPN2  >= 985 ) THEN YUIHTPN2  = .;
IF (YUIHTPYR  >= 85 ) THEN YUIHTPYR  = .;
IF (YUJVDTN2  >= 985 ) THEN YUJVDTN2  = .;
IF (YUJVDTON  >= 85 ) THEN YUJVDTON  = .;
IF (YUJVDTYR  >= 85 ) THEN YUJVDTYR  = .;
IF (YUMHANGR  >= 94 ) THEN YUMHANGR  = .;
IF (YUMHBKRU  >= 94 ) THEN YUMHBKRU  = .;
IF (YUMHCRN2  >= 985 ) THEN YUMHCRN2  = .;
IF (YUMHCRYR  >= 85 ) THEN YUMHCRYR  = .;
IF (YUMHDEPR  >= 85 ) THEN YUMHDEPR  = .;
IF (YUMHEATP  >= 94 ) THEN YUMHEATP  = .;
```

```
 IF (YUMHFEAR  >= 94 ) THEN YUMHFEAR  = .;
 IF (YUMHFITE  >= 94 ) THEN YUMHFITE  = .;
 IF (YUMHFMLY  >= 94 ) THEN YUMHFMLY  = .;
 IF (YUMHFRND  >= 94 ) THEN YUMHFRND  = .;
 IF (YUMHOTPP  >= 94 ) THEN YUMHOTPP  = .;
 IF (YUMHSCHL  >= 94 ) THEN YUMHSCHL  = .;
 IF (YUMHSOR  >= 94 ) THEN YUMHSOR  = .;
 IF (YUMHSUIC  >= 85 ) THEN YUMHSUIC  = .;
 IF (YURSANGR  >= 94 ) THEN YURSANGR  = .;
 IF (YURSBKRU  >= 94 ) THEN YURSBKRU  = .;
 IF (YURSDEPR  >= 94 ) THEN YURSDEPR  = .;
 IF (YURSEATP  >= 94 ) THEN YURSEATP  = .;
 IF (YURSFEAR  >= 94 ) THEN YURSFEAR  = .;
 IF (YURSFITE  >= 94 ) THEN YURSFITE  = .;
 IF (YURSFMLY  >= 94 ) THEN YURSFMLY  = .;
 IF (YURSFRND  >= 94 ) THEN YURSFRND  = .;
 IF (YURSIDN2  >= 985 ) THEN YURSIDN2  = .;
 IF (YURSIDYR  >= 85 ) THEN YURSIDYR  = .;
 IF (YURSOTPP  >= 94 ) THEN YURSOTPP  = .;
 IF (YURSSCHL  >= 94 ) THEN YURSSCHL  = .;
 IF (YURSSOR  >= 94 ) THEN YURSSOR  = .;
 IF (YURSSUIC  >= 85 ) THEN YURSSUIC  = .;
 IF (YUSCEMYR  >= 85 ) THEN YUSCEMYR  = .;
 IF (YUSCPGYR  >= 85 ) THEN YUSCPGYR  = .;
 IF (YUSWANGR  >= 94 ) THEN YUSWANGR  = .;
 IF (YUSWBKRU  >= 94 ) THEN YUSWBKRU  = .;
 IF (YUSWDEPR  >= 94 ) THEN YUSWDEPR  = .;
 IF (YUSWEATP  >= 94 ) THEN YUSWEATP  = .;
 IF (YUSWFEAR  >= 94 ) THEN YUSWFEAR  = .;
 IF (YUSWFITE  >= 94 ) THEN YUSWFITE  = .;
 IF (YUSWFMLY  >= 94 ) THEN YUSWFMLY  = .;
 IF (YUSWFRND  >= 94 ) THEN YUSWFRND  = .;
 IF (YUSWOTPP  >= 94 ) THEN YUSWOTPP  = .;
 IF (YUSWSCHL  >= 94 ) THEN YUSWSCHL  = .;
 IF (YUSWSCYR  >= 85 ) THEN YUSWSCYR  = .;
 IF (YUSWSOR  >= 94 ) THEN YUSWSOR  = .;
 IF (YUSWSUIC  >= 85 ) THEN YUSWSUIC  = .;
 IF (YUTPANGR  >= 94 ) THEN YUTPANGR  = .;
 IF (YUTPBKRU  >= 94 ) THEN YUTPBKRU  = .;
 IF (YUTPDEPR  >= 94 ) THEN YUTPDEPR  = .;
 IF (YUTPEATP  >= 94 ) THEN YUTPEATP  = .;
 IF (YUTPFEAR  >= 94 ) THEN YUTPFEAR  = .;
 IF (YUTPFITE  >= 94 ) THEN YUTPFITE  = .;
 IF (YUTPFMLY  >= 94 ) THEN YUTPFMLY  = .;
 IF (YUTPFRND  >= 94 ) THEN YUTPFRND  = .;
 IF (YUTPOTPP  >= 94 ) THEN YUTPOTPP  = .;
 IF (YUTPSCHL  >= 94 ) THEN YUTPSCHL  = .;
 IF (YUTPSOR  >= 94 ) THEN YUTPSOR  = .;
 IF (YUTPSTN2  >= 985 ) THEN YUTPSTN2  = .;
 IF (YUTPSTYR  >= 85 ) THEN YUTPSTYR  = .;
 IF (YUTPSUIC  >= 85 ) THEN YUTPSUIC  = .;
RUN ;
PROC CONTENTS data=NSDUH.dissr varnum; *Data list;
```

```
run;


DATA NSDUHr; SET NSDUH.dissr; *Age recode of AGE2 to AGE2r;
 AGE2r = .;
  IF (AGE2=1) or (AGE2=2) or (AGE2=3) or (AGE2=4) or (AGE2=5) or
(AGE2=6) THEN AGE2r = 0; *12 to 17yo;
  IF (AGE2=7) or (AGE2=8) or (AGE2=9) or (AGE2=10) or (AGE2=11) or
(AGE2=12) THEN AGE2r = 1; *18 to 25yo;
  IF (AGE2=13) or (AGE2=14) THEN AGE2r =2; *26 to 34yo;
  IF (AGE2=15) THEN AGE2r =3; *35 to 49yo;
  IF (AGE2=16) THEN AGE2r =4; *50 to 64yo;
  IF (AGE2=17) THEN AGE2r =5; *65yo>;
  If (AGE2=.) THEN AGE2r =.;
  LABEL AGE2r = "Age (six categories)";
run;
PROC FORMAT; *AGE2r formatting;
value AGE2rlab
      0 = '12-17 Years Old'
      1 = '18-25 Years Old'
      2 = '26-34 Years Old'
      3 = '35-49 Years Old'
        4 = '50-64 Years Old'
        5 = '65 or Older';
RUN;
DATA NSDUHr; *AGE2r seeting label;
 SET NSDUHr;
FORMAT AGE2r AGE2rlab.;
RUN;
PROC FREQ DATA=NSDUHr; *testing AGE2 v AGE2r variable;
TABLES AGE2r CATAG6 AGE2r*CATAG6;
RUN;


PROC CONTENTS data=NSDUH.dissr varnum; *Data list;
run;
DATA NSDUHr; SET NSDUH.dissr; *Age recode of AGE2 to AGE4r;
 AGE4r = .;
  IF (AGE2=1) or (AGE2=2) or (AGE2=3) or (AGE2=4) or (AGE2=5) or
(AGE2=6) THEN AGE4r = 0; *12 to 17yo;
  IF (AGE2=7) or (AGE2=8) or (AGE2=9) or (AGE2=10) or (AGE2=11) or
(AGE2=12) THEN AGE4r = 1; *18 to 25yo;
  IF (AGE2=13) or (AGE2=14) THEN AGE4r =2; *26 to 34yo;
  IF (AGE2=15) THEN AGE4r =3; *35 to 49yo;
  IF (AGE2=16) or (AGE2=17) THEN AGE4r =4; *50yo>;
  If (AGE2=.) THEN AGE4r =.;
  LABEL AGE4r = "Age groups (5 categories)";
run;
PROC FORMAT; *AGE4r formatting;
value AGE4rlab
      0 = '12-17 Years Old'
      1 = '18-25 Years Old'
      2 = '26-34 Years Old'
```

```
      3 = '35-49 Years Old'
        4 = '50 or Older';
RUN;
DATA NSDUHr; *AGE4r seeting label;
 SET NSDUHr;
FORMAT AGE4r AGE4rlab.;
RUN;
PROC FREQ DATA=NSDUHr; *testing AGE2 v AGE2r variable;
TABLES AGE4r CATAG6 AGE4r*CATAG6;
RUN;

DATA NSDUHr; SET NSDUHr; *Employment recode to 8 cats;
 EMPLOY8 = .;
  IF (WRKSTATWK2=1)  THEN EMPLOY8 = 0; *Worked at full-time job, past
week;
  IF (WRKSTATWK2=2) THEN EMPLOY8 = 1; *Worked at part time job, past
week;
  IF (WRKSTATWK2=3) THEN EMPLOY8 =2; *Has job or volunteer worker, did
not work past wk;
  IF (WRKSTATWK2=4) OR (WRKSTATWK2=9) THEN EMPLOY8 =3; *Unemployed/No
work;
  IF (WRKSTATWK2=5) THEN EMPLOY8 =4; *Disabled;
  IF (WRKSTATWK2=6) THEN EMPLOY8 =5; *Keeping house full-time;
  IF (WRKSTATWK2=7) THEN EMPLOY8 =6; *In school/training;
  IF (WRKSTATWK2=8) THEN EMPLOY8 =7; *Retired;
  If (WRKSTATWK2=.) THEN EMPLOY8 =.;
  LABEL EMPLOY8 = "Employment type (8 categories)";
run;
PROC FORMAT; *EMPLOY8 formatting label;
value EMPLOY8lab
        0 = 'Worked at full-time job, past week'
      1 = 'Worked at part time job, past week'
      2 = 'Has job or volunteer worker, did not work past wk'
      3 = 'Unemployed/on layoff, looking for work/No job, other reason'
      4 = 'Disabled'
      5 = 'Keeping house full-time'
      6 = 'In school/training'
      7 = 'Retired';
RUN;
DATA NSDUHr; *EMPLOY8 setting label;
 SET NSDUHr;
FORMAT EMPLOY8 EMPLOY8lab.;
RUN;
DATA NSDUHr; SET NSDUHr; *Employment recode to 7 cats;
 EMPLOY7 = .;
  IF (WRKSTATWK2=1)  THEN EMPLOY7 = 0; *Worked at full-time job, past
week;
  IF (WRKSTATWK2=2) OR (WRKSTATWK2=3) THEN EMPLOY7 = 1; *Part time or
some type of employment;
  IF (WRKSTATWK2=4) OR (WRKSTATWK2=9) THEN EMPLOY7 =2; *Unemployed/No
work;
  IF (WRKSTATWK2=5) THEN EMPLOY7 =3; *Disabled;
  IF (WRKSTATWK2=6) THEN EMPLOY7 =4; *Keeping house full-time;
```

```
  IF (WRKSTATWK2=7) THEN EMPLOY7 =5; *In school/training;
  IF (WRKSTATWK2=8) THEN EMPLOY7 =6; *Retired;
  If (WRKSTATWK2=.) THEN EMPLOY7 =.;
  LABEL EMPLOY7 = "Employment type (7 categories)";
run;
PROC FORMAT; *EMPLOY7 formatting;
value EMPLOY7lab
        0 = 'Worked at full-time job, past week'
      1 = 'Worked at part time job, past week/Has job or volunteer
worker, did not work past wk'
      2 = 'Unemployed/on layoff, looking for work/No job, other reason'
      3 = 'Disabled'
      4 = 'Keeping house full-time'
      5 = 'In school/training'
      6 = 'Retired';
RUN;
DATA NSDUHr; *EMPLOY7 setting label;
 SET NSDUHr;
FORMAT EMPLOY7 EMPLOY7lab.;
RUN;
PROC FREQ DATA=NSDUHr; *testing employment recodes;
TABLES WRKSTATWK2 EMPLOY8 EMPLOY7 EMPLOY8*EMPLOY7 EMPLOY8*WRKSTATWK2
EMPLOY7*WRKSTATWK2;
RUN;

DATA NSDUHr; SET NSDUHr; *Employment recode to 6 cats;
 EMPLOY6 = .;
  IF (WRKSTATWK2=1)  THEN EMPLOY6 = 0; *Worked at full-time job, past
week;
  IF (WRKSTATWK2=2) OR (WRKSTATWK2=3) THEN EMPLOY6 = 1; *Part time or
some type of employment;
  IF (WRKSTATWK2=4) OR (WRKSTATWK2=9) THEN EMPLOY6 =2; *Unemployed/No
work;
  IF (WRKSTATWK2=5) THEN EMPLOY6 =3; *Disabled;
  IF (WRKSTATWK2=6) OR (WRKSTATWK2=7) THEN EMPLOY6 =4; *Keeping house
full-time and in school/training;
  IF (WRKSTATWK2=8) THEN EMPLOY6 =5; *Retired;
  If (WRKSTATWK2=.) THEN EMPLOY6 =.;
  LABEL EMPLOY6 = "Employment type (6 categories)";
run;
PROC FORMAT; *EMPLOY6 formatting;
value EMPLOY6lab
        0 = 'Worked at full-time job, past week'
      1 = 'Worked at part time job, past week/Has job or volunteer
worker, did not work past wk'
      2 = 'Unemployed/on layoff, looking for work/No job, other reason'
      3 = 'Disabled'
      4 = 'Other (Keeping house full-time and In school/training)'
      5 = 'Retired';
RUN;
DATA NSDUHr; *EMPLOY6 setting label;
 SET NSDUHr;
FORMAT EMPLOY6 EMPLOY6lab.;
```

```
RUN;
PROC FREQ DATA=NSDUHr; *testing employment recodes;
TABLES WRKSTATWK2 EMPLOY8 EMPLOY7 EMPLOY6 EMPLOY8*EMPLOY7
EMPLOY6*EMPLOY7  EMPLOY8*WRKSTATWK2 EMPLOY7*WRKSTATWK2
EMPLOY6*WRKSTATWK2;
RUN;

DATA NSDUHr; SET NSDUHr; *Employment last week recode;
  EMPLOYLW= .;
  IF (WRKDPSTWK=1)  THEN EMPLOYLW = 1; *Yes;
  IF (WRKDPSTWK=2) OR (WRKDPSTWK=4) THEN EMPLOYLW = 0; *No;
  If (WRKDPSTWK=.) THEN EMPLOYLW =.;
  LABEL EMPLOYLW = "Employed last week (2 categories)";
run;
PROC FORMAT; *EMPLOYLW formatting;
value EMPLOYLWlab
        0 = 'No'
      1 = 'Yes';
RUN;
DATA NSDUHr; *EMPLOYLW setting label;
 SET NSDUHr;
FORMAT EMPLOYLW EMPLOYLWlab.;
RUN;
PROC FREQ DATA=NSDUHr; *testing employment recodes;
TABLES WRKDPSTWK EMPLOYLW EMPLOYLW*WRKDPSTWK;
RUN;


DATA NSDUHr; SET NSDUHr; *Ever BOOKED recode;
  BOOKED1= .;
  IF (BOOKED=2)  THEN BOOKED1 = 0; *No;
  IF (BOOKED=1) OR (BOOKED=3) THEN BOOKED1 = 1; *Yes;
  If (BOOKED=.) THEN BOOKED1 =.;
  LABEL BOOKED1 = "Ever arrested and booked for breaking the law (2
categories)";
run;
PROC FORMAT; *BOOKED1 formatting;
value BOOKED1lab
        0 = 'No'
      1 = 'Yes';
RUN;
DATA NSDUHr; *BOOKED1 setting label;
 SET NSDUHr;
FORMAT BOOKED1 BOOKED1lab.;
RUN;
PROC FREQ DATA=NSDUHr; *testing employment recodes;
TABLES BOOKED BOOKED1 BOOKED*BOOKED1;
RUN;

DATA NSDUHr; SET NSDUHr; *NEWRACE2 recodes;
race4r=.;
IF (NEWRACE2=1) then race4r=1;
IF (NEWRACE2=2) then race4r=2;
```

```
IF (NEWRACE2=7) then race4r=3;
IF (NEWRACE2=3) or (NEWRACE2=4) or (NEWRACE2=5) or (NEWRACE2=6) then
race4r=4;
IF (NEWRACE2=.) then race4r=.;
      LABEL race4r="Race (4 categories)";
run;
PROC FORMAT; *NEWRACE2 formatting;
value race4rlab
        1 = 'White'
      2 = 'Black'
        3 = 'Hispanic'
        4 = 'Other';
RUN;
DATA NSDUHr; *NEWRACE2 setting label;
 SET NSDUHr;
FORMAT race4r race4rlab.;
RUN;
PROC FREQ DATA=NSDUHr; *testing race recodes;
TABLES NEWRACE2 race4r NEWRACE2*race4r;
RUN;

DATA NSDUHr; SET NSDUHr; *SEXIDENT recodes;
sexidenr=.;
IF (SEXIDENT=1) then sexidenr=1;
IF (SEXIDENT=2) or (SEXIDENT=3) then sexidenr=2;
IF (SEXIDENT=.) then sexidenr=.;
      LABEL sexidenr="Sexual identity (2 categories)";
run;
PROC FORMAT; *sexidenr formatting;
value sexidenrlab
        1 = 'Heterosexual'
      2 = 'Sexual minority (lesbian/gay/bi)';
RUN;
DATA NSDUHr; *sexidenr setting label;
 SET NSDUHr;
FORMAT sexidenr sexidenrlab.;
RUN;
PROC FREQ DATA=NSDUHr; *testing sexual identity recodes;
TABLES SEXIDENT sexidenr SEXIDENT*sexidenr;
RUN;

DATA NSDUHr; SET NSDUHr; *HEALTH2 recodes;
healthre=.;
IF (HEALTH2=4) then healthre=1;
IF (HEALTH2=3) then healthre=2;
IF (HEALTH2=2) or (HEALTH2=1) then healthre=3;
IF (HEALTH2=.) then healthre=.;
      LABEL healthre="Overall health (3 categories)";
run;
PROC FORMAT; *healthre formatting;
value healthrelab
        1 = 'Poor/Fair'
      2 = 'Good'
```

```
        3 = 'Very Good/Excellent';
RUN;
DATA NSDUHr; *healthre setting label;
 SET NSDUHr;
FORMAT healthre healthrelab.;
RUN;
PROC FREQ DATA=NSDUHr; *testing overall health recodes;
TABLES HEALTH2 healthre HEALTH2*healthre;
RUN;


DATA NSDUHr; SET NSDUHr; *INCOME recodes;
incomere=.;
IF (INCOME=1) then incomere=1;
IF (INCOME=2) then incomere=2;
IF (INCOME=3) or (INCOME=4) then incomere=3;
IF (INCOME=.) then incomere=.;
      LABEL incomere="Income (3 categories)";
run;
PROC FORMAT; *incomere formatting;
value incomerelab
        1 = 'Less than $20,000'
      2 = '$20,000 to $49,999'
        3 = '$50,000 or More';
RUN;
DATA NSDUHr; *incomere setting label;
 SET NSDUHr;
FORMAT incomere incomerelab.;
RUN;
PROC FREQ DATA=NSDUHr; *testing oincome recodes;
TABLES INCOME incomere INCOME*incomere;
RUN;



DATA NSDUHr; SET NSDUHr; *Other substance dependence or abuse recodes;
Othdrug=.;
IF (ABODCOC=0) or (UDPYINH=0) or (UDPYMTH=0) or (UDPYTRQ=0) or
(UDPYSTM=0) or (UDPYHAL=0) or (UDPYSED=0)  then Othdrug=0;
IF (ABODCOC=1) or (UDPYINH=1) or (UDPYMTH=1) or (UDPYTRQ=1) or
(UDPYSTM=1) or (UDPYHAL=1) or (UDPYSED=1)  then Othdrug=1;
IF (ABODCOC=.) or (UDPYINH=.) or (UDPYMTH=.) or (UDPYTRQ=.) or
(UDPYSTM=.) or (UDPYHAL=.) or (UDPYSED=.)  then Othdrug=.;
      LABEL Othdrug="Substance dependence/abuse (3 categories)";
run;
PROC FORMAT; *Othdrug formatting;
value Othdruglab
        0 = 'No'
      1 = 'Yes';
RUN;
DATA NSDUHr; *Othdrug setting label;
 SET NSDUHr;
FORMAT Othdrug Othdruglab.;
```

```
RUN;

ODS PDF file='NSDUH_2017_Descriptives_04112019.pdf';
OPTIONS ls=72;
PROC SURVEYFREQ DATA=NSDUHr; *Descriptives;
where AGE4r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
TABLES AGE4R IRSEX RACE4R SEXIDENR EDUHIGHCAT INCOMERE EMPLOYLW BOOKED1
PRVHLTIN HEALTHRE PDEN10 COUTYP4 SPDYR SUICTHNK
DNICNSP ABODALC ABODMRJ OTHDRUG;
run;
ODS PDF close;

*----------------------------------------------------------------;

ODS PDF file='NSDUH_2017_Data_List.pdf';
OPTIONS ls=72;
PROC CONTENTS data=NSDUHr varnum; *Data list of new set;
run;
ODS PDF close;


PROC SURVEYFREQ DATA=NSDUHr; *Descriptives;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
TABLES IRSEX*UDPYOPI IRSEX*UDPYHRPNR;
run;

PROC SURVEYFREQ DATA=NSDUHr; *Descriptives;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
TABLES NEWRACE2*UDPYOPI NEWRACE2*UDPYHRPNR;
run;

*--------------------------------Descriptives and single entry---------
-----------------------------------------------;
ODS PDF file='NSDUH_2017_Descriptives_SingleEntryModels_02132019.pdf';
OPTIONS ls=72;
PROC SURVEYFREQ DATA=NSDUHr; *Descriptives;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
TABLES AGE2r AGE4r IRSEX NEWRACE2 SEXIDENT EDUHIGHCAT INCOME EMPLOY6
EMPLOY7 EMPLOY8 BOOKED1 PRVHLTIN ANYHLTI2 PDEN10 COUTYP4 HEALTH2 SPDYR
SUICTHNK
```

```
DNICNSP ABODALC ABODMRJ ABODCOC UDPYINH UDPYMTH UDPYTRQ UDPYSTM UDPYHAL
UDPYSED UDPYPSY UDPYOPI ;
run;

*--------------------------------single entry indicators and factors---
-----------------------------------------------;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with age categories;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS AGE2r (ref='65 or Older');
MODEL UDPYOPI (desc) = AGE2r / expb clodds rsquare;
RUN;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with sex-gender categories;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS IRSEX (ref=last);
MODEL UDPYOPI (desc) = IRSEX / expb clodds rsquare;
RUN;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with income categories;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS INCOME (ref=last);
MODEL UDPYOPI (desc) = INCOME / expb clodds rsquare;
RUN;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with race/ethnicity categories;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS NEWRACE2 (ref='5 - NonHisp Asian');
MODEL UDPYOPI (desc) = NEWRACE2 / expb clodds rsquare;
RUN;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with sexual identity
categories;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS SEXIDENT (ref='1 - Heterosexual, that is, straight' );
MODEL UDPYOPI (desc) = SEXIDENT / expb clodds rsquare;
RUN;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with employment categories;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS WRKSTATWK2 (ref='1 - Worked at full-time job, past week');
```

```
MODEL UDPYOPI (desc) = WRKSTATWK2 / expb clodds rsquare;
RUN;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with employment 7 categories;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS EMPLOY7 (ref='Worked at full-time job, past week');
MODEL UDPYOPI (desc) = EMPLOY7 / expb clodds rsquare;
RUN;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with employment 8 categories;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS EMPLOY8 (ref='Keeping house full-time') ;
MODEL UDPYOPI (desc) = EMPLOY8 / expb clodds rsquare;
RUN;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with worked last week;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS WRKDPSTYR (ref='1 - Yes');
MODEL UDPYOPI (desc) = WRKDPSTYR / expb clodds rsquare;
RUN;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with last week categories;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS EMPLOYLW (ref='Yes');
MODEL UDPYOPI (desc) = EMPLOYLW / expb clodds rsquare;
RUN;

PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with ever arrested categories;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS BOOKED1 (ref='No' );
MODEL UDPYOPI (desc) = BOOKED1 / expb clodds rsquare;
RUN;

PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with ever on probation
categories;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS PROBATON (ref='2 - No' );
MODEL UDPYOPI (desc) = PROBATON / expb clodds rsquare;
RUN;
```

```
*--------------------------health indicators--------------------------
--------------------------------;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with overall health category;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS HEALTH2 (ref='1 - Excellent');
MODEL UDPYOPI (desc) = HEALTH2 / expb clodds rsquare;
RUN;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with serious psychological
distress indicator categories;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS SPDYR (ref='0 - No');
MODEL UDPYOPI (desc) = SPDYR / expb clodds rsquare;
RUN;

PROC SURVEYLOGISTIC DATA=NSDUHr; *Best model with nic dep, ALC NOT SIG,
marj, coke, inhalant, meth, trq, stm depabu;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS SUICTHNK (ref='2 - No');
MODEL UDPYOPI (desc) = SUICTHNK / expb clodds rsquare;
RUN;

PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with any health insurance;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS ANYHLTI2 (ref=last);
MODEL UDPYOPI (desc) = ANYHLTI2 / expb clodds rsquare;
RUN;

PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with private health insurance;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS PRVHLTIN (ref=last);
MODEL UDPYOPI (desc) = PRVHLTIN / expb clodds rsquare;
RUN;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with private health insurance;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
```

```
CLASS PRVHLTIN (ref=first);
MODEL UDPYOPI (desc) = PRVHLTIN / expb clodds rsquare;
RUN;

*------------------geography--------------------------;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with psychotherapeutic
dependence or abuse;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS PDEN10 (ref=last);
MODEL UDPYOPI (desc) = PDEN10/ expb clodds rsquare;
RUN;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with psychotherapeutic
dependence or abuse;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS COUTYP4 (ref=last);
MODEL UDPYOPI (desc) = COUTYP4/ expb clodds rsquare;;
RUN;

*----------------------------substance dependence and use--------------
--------------------------------;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with nicotine dependence using
NDSS and FTND;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS DNICNSP (ref='0 - No');
MODEL UDPYOPI (desc) = DNICNSP / expb clodds rsquare;
RUN;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with alcohol dependence or
abuse;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS ABODALC (ref='0 - No/Unknown');
MODEL UDPYOPI (desc) = ABODALC / expb clodds rsquare;
RUN;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with marijuana dependence or
abuse;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS ABODMRJ (ref='0 - No/Unknown');
MODEL UDPYOPI (desc) = ABODMRJ / expb clodds rsquare;
RUN;
```

```
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with cocaine dependence or
abuse;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS ABODCOC (ref='0 - No/Unknown');
MODEL UDPYOPI (desc) = ABODCOC / expb clodds rsquare;
RUN;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with inhalant dependence or
abuse;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS UDPYINH (ref='0 - No');
MODEL UDPYOPI (desc) = UDPYINH / expb clodds rsquare;
RUN;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with methamphetamine dependence
or abuse;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS UDPYMTH (ref='0 - No');
MODEL UDPYOPI (desc) = UDPYMTH / expb clodds rsquare;
RUN;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with tranquilizer dependence or
abuse;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS UDPYTRQ (ref='0 - No') ;
MODEL UDPYOPI (desc) = UDPYTRQ / expb clodds rsquare;
RUN;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with stimulant dependence or
abuse;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS UDPYSTM (ref='0 - No');
MODEL UDPYOPI (desc) = UDPYSTM / expb clodds rsquare;
RUN;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with hallucinogen dependence or
abuse;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS UDPYHAL (ref=first);
MODEL UDPYOPI (desc) = UDPYHAL / expb clodds rsquare;;
```

```
RUN;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with sedative dependence or
abuse;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS UDPYSED (ref=first);
MODEL UDPYOPI (desc) = UDPYSED / expb clodds rsquare;;
RUN;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Model with psychotherapeutic
dependence or abuse;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS UDPYPSY (ref=first);
MODEL UDPYOPI (desc) = UDPYPSY / expb clodds rsquare;;
RUN;
ODS PDF close;


*--------------------------------------Block entry method for sig
model-----------------------------------------;
ODS PDF file='NSDUH_2017_PrelimFinalModels_BlockEntered_03152019.pdf';
OPTIONS ls=72;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Demo indicators;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS AGE2r (ref='65 or Older') IRSEX (ref=last) INCOME (ref=last)
EMPLOY8 (ref='Keeping house full-time') PDEN10 (ref=last)
NEWRACE2 (ref='5 - NonHisp Asian') EDUHIGHCAT (ref='4 - College
graduate') SEXIDENT (ref='1 - Heterosexual, that is, straight');
MODEL UDPYOPI (desc) = AGE2r IRSEX NEWRACE2 SEXIDENT EDUHIGHCAT INCOME
PDEN10 EMPLOY8 / expb clodds rsquare;
RUN;

PROC SURVEYLOGISTIC DATA=NSDUHr; *Demo indicators;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS AGE2r (ref='65 or Older') IRSEX (ref=last) INCOME (ref=last)
EMPLOY8 (ref='Keeping house full-time') PDEN10 (ref=last)
NEWRACE2 (ref='5 - NonHisp Asian') EDUHIGHCAT (ref='4 - College
graduate') SEXIDENT (ref='1 - Heterosexual, that is, straight' )
BOOKED1 (ref='No');
MODEL UDPYOPI (desc) = AGE2r IRSEX NEWRACE2 SEXIDENT EDUHIGHCAT INCOME
PDEN10 EMPLOY8 BOOKED1 / expb clodds rsquare;
RUN;
```

```
PROC SURVEYLOGISTIC DATA=NSDUHr; *Health and health insurance
indicators;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS AGE2r (ref='65 or Older') IRSEX (ref=last) INCOME (ref=last)
EMPLOY8 (ref='Keeping house full-time') PDEN10 (ref=last)
NEWRACE2 (ref='5 - NonHisp Asian') EDUHIGHCAT (ref='4 - College
graduate') SEXIDENT (ref='1 - Heterosexual, that is, straight' )
HEALTH2 (ref='1 - Excellent') SPDYR (ref='0 - No') SUICTHNK (ref='2 -
No') PRVHLTIN (ref=first);
MODEL UDPYOPI (desc) = AGE2r IRSEX NEWRACE2 SEXIDENT EDUHIGHCAT INCOME
PDEN10 EMPLOY8 BOOKED1 HEALTH2 SPDYR SUICTHNK PRVHLTIN / expb clodds
rsquare;
RUN;

PROC SURVEYLOGISTIC DATA=NSDUHr; *all single entry sig substance
dependence and/or abuse var FULL MODEL FINAL;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS AGE2r (ref='65 or Older') IRSEX (ref=last) INCOME (ref=last)
EMPLOY8 (ref='Keeping house full-time')
NEWRACE2 (ref='5 - NonHisp Asian') EDUHIGHCAT (ref='4 - College
graduate') SEXIDENT (ref='1 - Heterosexual, that is, straight' )
HEALTH2 (ref='1 - Excellent') SPDYR (ref='0 - No') SUICTHNK (ref='2 -
No') PRVHLTIN (ref=first) PDEN10 (ref=last)
DNICNSP (ref='0 - No') ABODALC (ref='0 - No/Unknown')ABODMRJ (ref='0 -
No/Unknown') ABODCOC (ref='0 - No/Unknown')
UDPYINH (ref='0 - No') UDPYMTH (ref='0 - No') UDPYTRQ (ref='0 - No')
UDPYSTM (ref='0 - No');
MODEL UDPYOPI (desc) = AGE2r IRSEX NEWRACE2 SEXIDENT EDUHIGHCAT INCOME
PDEN10 EMPLOY8 BOOKED1 HEALTH2 SPDYR SUICTHNK PRVHLTIN
DNICNSP ABODALC ABODMRJ ABODCOC UDPYINH UDPYMTH UDPYTRQ UDPYSTM / expb
clodds rsquare;
RUN;
ODS PDF close;


ODS PDF
file='NSDUH_2017_PrelimFinalModels_BlockEntered_03112019_other.pdf';
OPTIONS ls=72;
*------------------Employment and sexual identity removed--------------
-----;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Demo indicators;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS AGE2r (ref='65 or Older') IRSEX (ref=last) INCOME (ref=last)
NEWRACE2 (ref='5 - NonHisp Asian')
```

```
EDUHIGHCAT (ref='4 - College graduate');
MODEL UDPYOPI (desc) = AGE2r IRSEX INCOME NEWRACE2 EDUHIGHCAT / expb
clodds rsquare;
RUN;
PROC SURVEYLOGISTIC DATA=NSDUHr; *Health indicators;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS AGE2r (ref='65 or Older') IRSEX (ref=last) INCOME (ref=last)
NEWRACE2 (ref='5 - NonHisp Asian') EDUHIGHCAT (ref='4 - College
graduate')
HEALTH2 (ref='1 - Excellent') SPDYR (ref='0 - No') SUICTHNK (ref='2 -
No') ;
MODEL UDPYOPI (desc) = AGE2r IRSEX INCOME NEWRACE2 EDUHIGHCAT HEALTH2
SPDYR SUICTHNK / expb clodds rsquare;
RUN;

PROC SURVEYLOGISTIC DATA=NSDUHr; *Best model all single entry sig
substance dependence and/or abuse var;
where AGE2r >= 1;
STRATA VESTR;
CLUSTER VEREP;
WEIGHT ANALWT_C;
CLASS AGE2r (ref='65 or Older') IRSEX (ref=last) INCOME (ref=last)
NEWRACE2 (ref='5 - NonHisp Asian') EDUHIGHCAT (ref='4 - College
graduate')
HEALTH2 (ref='1 - Excellent') SPDYR (ref='0 - No') SUICTHNK (ref='2 -
No')  DNICNSP (ref='0 - No') ABODALC (ref='0 - No/Unknown')
ABODMRJ (ref='0 - No/Unknown') ABODCOC (ref='0 - No/Unknown') UDPYINH
(ref='0 - No') UDPYMTH (ref='0 - No') UDPYTRQ (ref='0 - No')
UDPYSTM (ref='0 - No') ;
MODEL UDPYOPI (desc) = AGE2r IRSEX INCOME NEWRACE2 EDUHIGHCAT HEALTH2
SPDYR SUICTHNK DNICNSP ABODALC
ABODMRJ ABODCOC UDPYINH UDPYMTH UDPYTRQ UDPYSTM / expb clodds rsquare;
RUN;
ODS PDF close;
```

APPENDIX B

SAS 9.4 SYNTAX AND COMMAND PROCEDURE FOR CONVERTING DATA TO USE IN MPLUS 8.2

```
DATA NSDUHdm; set NSDUHd; *setting array up for LCA in Mplus;
ARRAY miss (21)
AGE4R IRSEX RACE4R SEXIDENR EDUHIGHCAT INCOMERE EMPLOYLW BOOKED1
PRVHLTIN HEALTHRE PDEN10 COUTYP4 SPDYR SUICTHNK
DNICNSP ABODALC ABODMRJ OTHDRUG UDPYOPI UDPYHRPNR INCOME;
   do i=1 to 21;
      if miss {i}= . then miss {i}=999;
   end;
   drop i;

keep QUESTID2 ANALWT_C VEREP VESTR AGE4R IRSEX RACE4R SEXIDENR
EDUHIGHCAT INCOMERE EMPLOYLW BOOKED1 PRVHLTIN HEALTHRE PDEN10 COUTYP4
SPDYR SUICTHNK DNICNSP ABODALC ABODMRJ OTHDRUG UDPYOPI UDPYHRPNR
INCOME;
run;

ODS PDF file='NSDUH_2017_Data_List_LCA_deletedCases_0415A.pdf';
OPTIONS ls=72;
PROC CONTENTS data=NSDUHdm varnum;
*Data list of new set with deleted cases;
run;
ODS PDF close;

*--------------------------Export for Mplus --------------------------;
proc export data=NSDUHdm
outfile='C:\Users\famon\OneDrive\Docs\StatsProjects\NSDUH\2017\NSDUH201
7_diss3_del_0415A.csv' dbms=csv replace;
run;
```

APPENDIX C

MPLUS 8.2 SYNTAX AND COMMAND PROCEDURES FOR PERSON-CENTERED APPROACH IN CHAPTER IV: ONE CLASS MODEL

```
TITLE: Opioid risk indicators and profiles 1-class solution

DATA: FILE IS "C:\...\NSDUH2017_filename.csv";

VARIABLE: NAMES ARE QUESTID2, DNICNSP, ABODALC, ABODMRJ,
UDPYOPI, UDPYHRPR, SUICTHNK, SPDYR, IRSEX, EDUHI4, EDUHI3,
PRVHLTIN, PDEN10, COUTYP4, ANALWT, VESTR, VEREP, AGE4r,
EMPLOYLW, BOOKED1, race4r, sexidenr, healthre, incomere, Othdrug, INCOME;

USEVARIABLES ARE AGE4r IRSEX race4r INCOME EDUHI4 SPDYR SUICTHNK
healthre sexidenr EMPLOYLW BOOKED1 PRVHLTIN PDEN10 UDPYHRPR;
USEOBSERVATIONS = (UDPYOPI == 1);

CLASSES = c(1);

Categorical = AGE4r IRSEX race4r INCOME EDUHI4 SPDYR SUICTHNK
healthre sexidenr EMPLOYLW BOOKED1 PRVHLTIN PDEN10 UDPYHRPR;

IDVAR IS QUESTID2;
WEIGHT IS ANALWT;
CLUSTER IS VEREP;
STRATIFICATION IS VESTR;

Missing is all (999);

ANALYSIS:
type = mixture complex missing;
starts = 1000 100;
stiterations = 50;

OUTPUT:  SAMP stand cint tech11;
```

APPENDIX D

MPLUS 8.2 SYNTAX AND COMMAND PROCEDURES FOR PERSON-CENTERED APPROACH IN CHAPTER IV: MORE THAN ONE CLASS MODELS

```
TITLE: Opioid risk indicators and profiles x-class solution

DATA: FILE IS "C:\...\NSDUH2017_filename.csv";

VARIABLE: NAMES ARE QUESTID2, DNICNSP, ABODALC, ABODMRJ,
UDPYOPI, UDPYHRPR, SUICTHNK, SPDYR, IRSEX, EDUHI4, EDUHI3,
PRVHLTIN, PDEN10, COUTYP4, ANALWT, VESTR, VEREP, AGE4r,
EMPLOYLW, BOOKED1, race4r, sexidenr, healthre, incomere, Othdrug, INCOME;

USEVARIABLES ARE AGE4r IRSEX race4r INCOME EDUHI4 SPDYR SUICTHNK
healthre sexidenr EMPLOYLW BOOKED1 PRVHLTIN PDEN10 UDPYHRPR;
USEOBSERVATIONS = (UDPYOPI == 1);

CLASSES = c(x);
!x=n+1where n is any positive number one or greater for number of desired classes;

Categorical = AGE4r IRSEX race4r income EDUHI4 SPDYR SUICTHNK
healthre sexidenr EMPLOYLW BOOKED1 PRVHLTIN PDEN10 UDPYHRPR;

IDVAR IS QUESTID2;
WEIGHT IS ANALWT;
CLUSTER IS VEREP;
STRATIFICATION IS VESTR;

Missing is all (999);

auxiliary = DNICNSP (R3STEP) ABODALC (R3STEP) ABODMRJ (R3STEP)
Othdrug (R3STEP);

ANALYSIS:
type = mixture complex missing;
starts = 1000 100;
stiterations = 50;


OUTPUT:  SAMP stand cint tech11;
```