Trends in Injection Use by Rural Opioid-Abusing Youth

Michael M. Love
Radford University

A Dissertation

Presented in Partial Fulfillment of the Requirements for the
Degree of Doctor of Psychology in Counseling Psychology
in
the Department of Psychology
in
the College of Humanities and Behavioral Sciences
Radford University
Radford, VA
2015

Tracy J. Cohn, Ph.D. Dissertation chair	7.21.15 Date
Sarah L. Hastings, Ph.D. Committee member	7-21-2015 Date
Thomas W. Pierce, Ph.D. Committee Member	7/21/15 Date

Abstract

Current epidemiological data has indicated increases in the prevalence of abuse of prescription opioid analgesics in the United States; additionally, these increases seem to be more rapid in rural areas. A growing body of research has supported the notion that rural opioid abuse involves different risk factors, protective factors, and prevalence than opioid abuse in urban areas. Building upon cross-sectional studies that raise the question of whether rural opioid abusers are using injection as a method of administration more frequently than their non-rural counterparts, the following study used longitudinal data from a national survey dataset to investigate whether a sample of adolescents who have used prescription opioids (an understudied subpopulation of interest) have increased their use of injection between 1994 and 2008. A multilevel modeling procedure found that multiple measures of injection use increased in the combined sample of rural and non-rural participants, and that rural participants increased in their lifetime use of injection. However, residence in a rural community did not significantly predict any form of injection use. Rural residence also did not predict prescription opioid use by any route of injection, although prescription opioid use also increased in the combined sample. These findings challenge existing theories that regard rural opioid use as a distinct phenomenon and call for replication.

Table of Contents

List of Tables

Chapter 1: Overview

Prescription Opioid Abuse in the United States

In the United States, the abuse of prescription opioids was identified in medical literature as early as the late 19th century (Kane, 1880; Terry & Pellens, 1928). More recently, the U.S. Community Epidemiology Work Group (U.S. Department of Health, 2004) reported that abuse of prescription analgesic drugs, typically opioids, had been rising in the United States since at least the mid-1990s, with more recent findings reflecting the abuse of prescription opioids increased between 2002 and 2004 (Cicero, Inciardi, and Munoz, 2005; SAMHSA, 2004, 2010).

Prescription drug abuse differs significantly from traditional models of illicit drug use. Prescription drug abuse depends upon a model of drug distribution and access which is predominantly legally licit and detached from criminal organizations, in contrast to the distribution of street drugs (Prather, 2003). National survey data (SAMHSA, 2007) found that the majority of respondents who reported using painkillers, which constituted the majority of prescription drugs used illegally, obtained them directly from a prescribing physician or from friends or relatives, who in turn obtained the drugs from a physician. Only 4% of respondents obtained drugs from drug dealers or other strangers.

Opioid Abuse in Rural Communities

Those who abuse drugs in rural communities appear in the empirical literature as a unique population in many regards. Dew, Elifson, and Dozier (2007) argue that declining rural economies, changes in rural versus urban populations, and other shifts in rural sociocultural variables have weakened many of the protective factors against drug abuse previously present in rural communities. Reduced access to care poses a risk factor, in that rural drug users also access treatment for substance abuse less frequently than their urban counterparts due to reduced

availability of services in rural areas, problems related to geographical dispersion, economic barriers to obtaining health care, and culturally-sanctioned beliefs against seeking treatment that does not coincide with cultural beliefs about mental health problems (Cellucci, Vik, & Nirenberg, 2003; Elder, Robertson, & Ardelt, 1994; Human & Wasem, 1991; Robertson & Donnermeyer, 1997).

A number of differences in drug use have been reported between rural and urban areas. Rural individuals may be more likely than urban individuals to abuse prescription analgesics (Cicero, Inciardi, and Munoz, 2005). Comparisons between rural and urban individuals on probation (Havens et al., 2007), rural and urban women (Shannon, Havens, & Hayes, 2009), and rural and urban pregnant women (Heil, Sigmon, Jones, & Wagner, 2008; Shannon, Havens, & Hayes, 2010) have all found higher prevalence of prescription opioid abuse among rural samples. Rural individuals who use prescription drugs may begin use at earlier ages than urban individuals (Young, Havens, & Leukefeld, 2010) and may also be more likely to die by overdose involving prescription drugs and polydrug combinations (Wunsch, Nakamoto, Behonick, & Massello, 2009). In rural populations, opioid abuse seems to be highly related to polydrug abuse. Furthermore, in rural samples, prescription opioid abuse has been significantly correlated with the use of benzodiazepines (Havens, Walker, & Leukefeld, 2010; Shannon, Havens, & Hayes, 2010) as well as cocaine and methamphetamine (Havens et al., 2009).

Opioid Abuse Among Rural Youth

Adolescents and young adults form a demographic that is important in understanding substance abuse. The Substance Abuse and Mental Health Service Administration (SAMHSA, 2007) found that individuals aged 18 to 25 were more likely to report illicit drug use in the past month than both older and younger groups; additionally, an increase in past-month illicit use of

prescription drugs among these individuals was documented between 2002 and 2006. Younger adults may be more likely to use prescription opioids for recreational purposes, whereas older individuals may be more likely to use the same drugs for pain relief (Rigg and Ibañez, 2010). A 2004 report by the U.S. Department of Health and Human Services found significant increases in prescription opioid analgesic abuse by adolescents across the United States, indicating high prevalence of Vicodin® abuse among high school students, a general increase in painkiller abuse among young adults, and an increase in treatment admissions for males in their twenties for abuse of narcotic painkillers.

A study of rural Appalachian youth by Collins, Abadi, Johnson, Shamblen, and Thompson (2011) found that minors in their sample were more likely to abuse prescription drugs than any other drug except for alcohol. Havens, Young, and Havens (2010) found that rural adolescents were 26% more likely than their urban counterparts to use prescription drugs for nonmedical purposes when controlling for race, health, and use of other substances.

The Role of Injection in Opioid Abuse

Just as opioid abuse is an established phenomenon, so is opioid use by injection. Following the introduction of hypodermic injection technology in the 19th Century, multiple medical authorities expressed the opinion that injecting opioids contributed greatly to their addictive potential (Kane, 1880; Terry & Pellens, 1928). Injection is desirable to those who use because of the speed and efficiency with which it delivers opioid compounds to receptor sites in the central nervous system; injection maximizes the amount of drug delivered (i.e., versus smoking, in which many active compounds fail to be ingested) and bypassing the first-pass metabolism, as in oral ingestion (Strang et al., 1992). Injection of opioids has been demonstrated to be associated with greater severity of self-reported dependence, as well as more frequent use

and greater dosage, when compared with other methods of administration (Gossop et al., 1992; Strang et al., 1999).

Although the transition from oral ingestion to intravenous use of prescription opioid analgesics is relatively new, transition to injection among heroin users is an established phenomenon. It has been established that, among heroin users, transition to injection from other methods of administration (e.g., smoking) becomes more likely with time (Griffiths, Gossop, Powis, & Strang, 1994). Using data from primarily urban samples, it has been theorized that transition may be partially motivated by economic hardship, possibly leading to a perceived need to administer opioids more efficiently, especially in situations in which drug prices are perceived as high (Abelson et al., 2006; Fischer, Manzoni, & Rehm, 2006; Firestone & Fischer, 2008; Neaigus et al., 2001; Roy et al., 2003). Other risk factors for transition to injection may include younger age at initiation to drug use, curiosity, peer influences, sexual contact with injectors, and involvement in transactional sex (Bravo et al., 2003; Firestone & Fischer, 2008; Fuller et al., 2002; Neaigus et al., 2001; Sherman et al., 2005). Previous initiation to drug use may be a complex variable, however, as Trenz and colleagues (2012) found support for early onset of alcohol and polysubstance use as predictors of later initiation to injection, but did not find the same support for cannabis or tobacco use.

Injection Use in the Rural United States

Little is known about injection use by rural residents aside from indications that injection is becoming more popular as a delivery method, particularly among those who abuse prescription drugs. In an analysis of data collected in 1991, Leukefeld and colleagues (2002) found that about 16% of the participants in their rural Kentucky sample reported using injection. However, more recently, Havens, Walker, and Leukefeld (2007) found that their sample had a 44.3% lifetime

prevalence of injection drug use, with 35.3% reporting injection of oral opioid analgesics. Young and Havens (2012) found a 78% lifetime prevalence of injection use in a similar sample.

Among rural individuals who use injection, prescription opioids are involved in a majority of individuals' experiences of transition to injection, and using prescription opioids orally may predict later transition to injection (Young & Havens, 2012). Rural individuals who inject drugs are more likely to inject prescription analgesics than heroin (Havens, Oser, Crosby, & Leukefeld, 2010). Rural individuals are also more likely to use alternative routes of ingestion (e.g., insufflation and injection) than urban users, who were more likely to administer the drugs orally (Young, Havens, & Leukefeld, 2010). In a study of pregnant women entering inpatient treatment, rural women were 5.9 times more likely than the urban participants to report injection drug use in the 30 days prior to admission (Shannon, Havens, & Hayes, 2010).

Limitations of the Literature

The majority of data on rural opioid use has come from a restricted geographical region in Central Appalachia. Much work on this phenomenon comes from researchers located in Kentucky (e.g., Havens, Walker, & Leukefeld, 2007; Leukefeld et al., 2007; Leukefeld et al., 2002; Young, Havens, & Leukefeld, 2012;), Tennessee (Collins, 2011), and Virginia (Wunsch, Nakamoto, Behonick, & Massello, 2009), and which is largely confined to the regions adjacent to these states. It is uncertain whether the phenomena described in their literature successfully describe rural communities in all regions of the United States, or whether it merely describes those in Central Appalachia.

The majority of the research on the topic of rural prescription opioid abuse is cross-sectional. Cross-sectional studies are those that analyze a sample of the population at one point in time; examining multiple cross-sectional studies from similar samples over time may suggest

hypotheses for longitudinal research but does not in itself allow for statistical inferences about how prevalence of behaviors changes over time. Although a few significant studies have analyzed longitudinal data (e.g., Havens, Oser, & Leukefeld, 2007), none of these studies analyze trends in injection use in rural communities. Because a series of studies (Young & Havens, 2012; Havens, Walker, & Leukefeld, 2007; Leukefeld et al., 2002) have found progressively higher rates of injection use among rural individuals who abuse prescription opioids, it is logical to ask whether an actual increase in injection use has occurred. However, that question is currently unanswered.

Additionally, research on injection use in the rural United States tends to focus on adult users. Data from the National Survey on Drug Use and Health (SAMHSA, 2012) indicate that young adults are at particularly high risk for illicit drug use of all types. The US Department of Health (2004) has additionally found that prescription analgesics are widely abused by adolescents and young adults. Further, data from studies of rural youth (Collins et al., 2011; Havens, Young, & Havens, 2010) indicate that young people in rural communities abuse prescription opioids at higher rates than their urban counterparts. Research that has focused on injection in urban samples has associated injection with opioid abuse for recreational purposes, which is more common among youth, and injection use may be highest among young people (Rigg & Ibañez , 2010; SAMHSA, 2009; Griffith et al., 1994).

The Present Study

The profession of psychology has a complicated relationship with the treatment of substance use disorders. Margolis and Zweben (2011) identified two historical "rifts" between psychology and the mainstream addiction treatment community: a "practical rift" between psychologists and a field dominated by physicians, and a more persistent "philosophical rift"

between a purely biological "disease" model of addiction and the more psychosocial learning model of addiction accepted by the psychological community. However, the authors also noted that these rifts have become less prominent as the contributions of psychologists have gradually become more accepted by the medical community, and as the mainstream addiction treatment view has come to reflect a more interdisciplinary approach. The psychological community has changed as well, with a growing emphasis on addiction treatment. The American Psychological Association established Division 50, the Society of Addiction Psychology, in 1975 (Hanbury, Tucker, & Vuchinich, 2000). Within counseling psychology, Lichtenberg (1999) identified substance abuse problems as a particular focus of the profession's applied discipline.

Nevertheless, some writers have argued that psychology has not adequately emphasized substance use problems in practice. Miller (2002) has expressed concern that psychologists often fail to understand psychology's major contributions to the understanding, treatment, and prevention of substance use disorders, and despite having high levels of contact with individuals who struggle with substance use disorders, frequently hold a belief that these disorders necessitate "specialist treatments."

The present study therefore represents an attempt to recognize the need for psychologists to identify important issues in substance abuse trends which have a direct bearing upon treatment of vulnerable populations. Those who are in charge of program development and administration would be well served by longitudinal research on epidemiological trends in substance abuse, as they may more effectively structure services to meet current demands as well as to anticipate future needs.

Additionally, the present study represents an ongoing movement within the empirical literature to more appropriately understand how a culturally unique population responds to a

particular form of pathology. Psychologists have recognized that rural populations have distinctive cultures, representing a dimension of multiculturalism often overlooked in traditional conceptualizations of culture (Slama, 2004).

Hypotheses. Based upon implications of previous data, the present study tested the following hypotheses in a national sample of participants who illicitly use prescription opioids:

1a. Among rural adolescents who endorse lifetime prescription opioid use, the prevalence of past-month injection use has increased between 1994 and 2008.

1b. The prevalence of past-month injection use between 1994 and 2008 has increased more severely among rural than non-rural youth who endorse lifetime prescription opioid use.

2a. Among rural adolescents who endorse lifetime prescription opioid use, the prevalence of lifetime injection use has increased between 1994 and 2008.

2b. The prevalence of lifetime injection use between 1994 and 2008 has increased more severely among rural than non-rural youth who endorse lifetime prescription opioid use.

Methods

Participants

The analyses are based on Waves I through IV of data of the National Longitudinal Survey of Adolescent Health (Add Health; Harris et al., 2009), a nationally representative sample of adolescent health-related behaviors, including substance use. Other data collected included demographics, socioeconomic characteristics, household structure, and other psychosocial variables. Wave I in-home interviews were conducted in 1995 with 20,747 participants in grades

7 through 12; Waves II through IV involved follow-up in-home interviews in 1996, 2001-2002, and 2007-2008. By the last interview, participants were between 24 and 32 years old.

Of the participants in Wave I of data collection, 51.6% were female and 48.4% were male. Sixty-six percent of participants in Wave I identified as White, whereas 24.9% identified as Black or African American, 4.2% identified as Asian or Pacific Islander, 3.6% identified as Native American, and 6.5% identified their race as "other." Additionally, 11.4% of Wave I participants identified themselves as being of Latino or Hispanic origin.

Measures

Rural status. In Wave I, neighborhood type was coded by the interviewer in response to the question, "How would you describe the immediate area or street (one block, both sides) where the respondent lives?"

Interviewers coded the immediate area with the following types: rural; suburban; urban/residential only; 3 or more commercial properties/mostly retail; or 3 or more commercial properties/mostly wholesale/industrial. In Wave I, 27.6% of the sample was coded as living in rural areas. In Wave IV, in which the neighborhood type variable was expanded to include separate categories of "rural farm" and "rural town," a combined 19.7% of the sample was coded as living in rural areas. This measure of rural/urban status has been previously used in several studies using the Add Health data set (Adedokun & Balschwid, 2008; Cohn & Leake, 2012; Galliher, Rostosky, & Hughes, 2004). Participants' responses resulted in the coding of a dichotomous variable as rural or non-rural.

Prescription opioid misuse. Participants were identified as engaging in illicit use of prescription opioids based upon their response to questions in Wave III and IV. In Wave III, nonmedical use of prescription opioids was measured with the following question: "Since June

1995, have you taken any of the following drugs without a doctor's permission?: pain killers, such as Darvon, Demerol, Percodan, or Tylenol with codeine?" A similar but more detailed item was used in Wave IV:

> Which of the following types of prescription drugs have you taken that were not prescribed for you, taken in larger amounts than prescribed, more often than prescribed, for longer periods than prescribed, or that you took only for the feeling or experience they caused?: pain killers or opioids, such as Vicodin, OxyContin, Percocet, Demerol, Percodan, or Tylenol with codeine (Harris et al., 2009).

A positive response to either item resulted in the positive coding of a dichotomous variable indicating that nonprescription use of prescription opioids is present.

Injection use and history. As reflected in reports from the Substance Abuse and Mental Health Service Administration (SAMHSA, 2012), substance abuse behaviors can be operationalized in multiple ways, including frequency of use, whether an individual receives treatment, whether the individual meets diagnostic criteria for a substance use disorder, and so on. Variables in the Add Health set allow the present study to measure injection use in terms of both broad (lifetime frequency) and narrow (past-month frequency) definitions. Interviews in Waves I and IV both included the question, "During your life, have you ever injected (shot up with a needle) any illegal drug?" In Wave II, participants were asked, "Since [Wave I], have you injected, shot up with a needle, any illegal drug, such as heroin or cocaine?" Wave III used the following wording: "Since June 1995, have you injected (shot up with a needle) any illegal drug, such as heroin or cocaine?" Frequency of injection was also established in all four waves with the question, "During the past 30 days, how many times did you inject an illegal drug?" or, "During the past 30 days, how often did you take an illegal drug using a needle?" Past month and

lifetime use have been routinely used as a measure in reports on substance use by various government agencies (e.g., SAMHSA, 2007; US Department of Health, 2004). In literature related to the use of injection in rural populations, lifetime prevalence has been used as an operationalization by several major sources (e.g., Havens, Walker, & Leukefeld, 2007; Leukefeld et al., 2002; Young & Havens, 2012)

Procedures

All hypotheses were tested by a multilevel modeling procedure as described in Heck, Thomas, and Tabata (2012). Multilevel modeling, which is known by a variety of names in the literature, is a method for analyzing categorical outcomes in data sets characterized by a hierarchical "nesting of individual observations within higher level groups, or within individuals if the data consist of repeated measures" (p. 6). The statistical test conducted in the analysis of a categorical outcome is a test of differences between expected (as per the sampling distribution) and observed distributions of categorical outcome variables. In IBM SPSS software, this test is conducted via the Wald chi-square statistic, which provides a test of whether the value of a regression coefficient for a given predictor differs significantly from zero (Field, 2009, pp. 269-270).

For both parts of hypothesis 1, which involved past-month injection, a multinomial sampling distribution describing the probability of participants' responses in three categories ("Never," "1 time or 2 times," "3 or more times") was linked to a general linear model by means of a cumulative logit transformation. A logit transformation is based on the logarithm of the odds $p/(1-p)$ where p represents the probability that a participant belongs in one membership category, rather than another. The analysis provided tests of statistical significance for the main effects of Time of Testing and for Rural Status, indicating whether (1) prevalence of past-month injection

use has increased over time and (2) prevalence in past-month injection use differs between rural and non-rural participants. The analysis also provided a test of statistical significance for the interaction between Time of Testing and Rural Status, indicating whether the degree of change in the prevalence of past-month injection use is different for participants in the rural group than it is for those in the non-rural group.

For both parts of hypothesis 2 (i.e., that rural adolescents who engage in illicit use of opioids have exhibited an increase in lifetime prevalence, and that this increase is significantly higher than among non-rural adolescents), a binomial sampling distribution representing the probability of participants' responses in two categories was linked to a general linear model by means of a logit transformation. Similarly to hypothesis 1, the analysis of the general linear model produced tests of statistical significance for the main effects of Time of Testing and Rural Status, indicating whether lifetime injection use has increased over time and whether prevalence of lifetime injection use differs between rural and non-rural participants. Also tested was the interaction between Time of Testing and Rural Status, indicating whether rural and non-rural groups exhibit different rates of change in prevalence of lifetime injection use.

Results

In this and all other analyses which include all four waves of data, the N for the sample is approximately quadrupled due to the need to restructure data in the "long format" for repeated-measures analysis in SPSS. Among rural participants who reported using prescription opioids within their lifetimes, significant changes between times of testing in past-month injection use between 1994 and 2008 were not observed, Wald χ^2 (1, N = 1452) = 2.544, p = .111. Also, rural status did not significantly predict past-month injection use when collapsing results across all four waves of testing, Wald χ^2 (1, N = 4985) = .112, p = .737. Nevertheless, among a combined

sample of rural and non-rural participants who endorsed lifetime prescription opioid use, Time of Testing did significantly predict past-month injection use, Wald χ^2 (1, N = 4985) = 5.233, p = .022, with past-month injection use increasing over time. Findings did not support hypothesis 1a.

From 1994 to 2008, the pattern of change over time in past-month injection use did not differ significantly between rural and non-rural participants, Wald χ^2 (1, N = 4985) = .056, p = .813. Findings did not support hypothesis 1b.

Among rural participants who reported lifetime use of prescription opioids, the number of individuals reporting injection use in their lifetimes increased significantly between 1994 and 2008, Wald χ^2 (1, N = 1436) = 22.557, $p < .001$. Additionally, Time of Testing significantly predicted lifetime injection use among all individuals who reported having used prescription opioids, Wald χ^2 (1, N = 4945) = 22.407, $p < .001$. Among non-rural participants who reported lifetime use of prescription opioids, the number of individuals reporting injection use in their lifetimes also increased between 1994 and 2008, Wald χ^2 (1, N = 3509) = 52.656, $p < .001$. However, rural status (i.e., whether a participant lived in a rural or non-rural area) did not significantly predict lifetime injection use among individuals who reported having used prescription opioids, Wald χ^2 (1, N = 4945) = .330, p = .566. Hypothesis 2a was supported.

An interaction between Time of Testing and Rural Status for lifetime injection use was not observed, Wald χ^2 (1, N = 4945) = .195, p = .659. Hypothesis 2b was not supported.

Exploratory analyses. In order to clarify the results reported above, a series of exploratory analyses were also conducted, using the data set to examine whether, among the entire sample, differences existed between rural and non-rural individuals in terms of patterns of lifetime use of prescription opioids for nonmedical purposes between Waves III and IV (the only

waves in which prescription opioid use was assessed). Time of testing predicted lifetime use of prescription opioids, Wald χ^2 (1, N = 5627) = 338.932, $p < .001$. However, rural status did not significantly predict prescription opioid use, Wald χ^2 (1, N = 4921) = .573, $p = .449$.

Discussion

Based upon prior findings that indicated that rural individuals using prescription opioids were more likely than non-rural users to engage in injection (Shannon, Havens, and Hays, 2010; Young, Havens, & Leukefeld, 2010), and that injection use was strongly connected to prescription opioid abuse in rural samples (Havens et al., 2009; Havens, Oser, Crosby, & Leukefeld, 2010), the present study was expected to find differences in lifetime and past-month injection use between rural and non-rural populations. However, although both rural and non-rural groups exhibited increases over time in their lifetime use of injection, rural status did not predict lifetime injection use. There are two primary explanations for this discrepancy: that rural and non-rural opioid use are not distinct phenomena, or that actual differences in these populations were not reproduced in the sample.

The first explanation, that rural and non-rural opioid use are not distinct phenomena, requires explanation in the context of existing literature. Although the present study did not attempt to support a null hypothesis (i.e., to show that two groups within the sample are the same), it is possible that rural and non-rural opioid-using populations are too similar in their patterns of lifetime injection use to be meaningfully different, and that previous assertions of difference between rural and non-rural opioid use are incorrect. If true, this possibility would need to be explained in the context of prior research which indicated that opioid use among rural and non-rural individuals are meaningfully different phenomena (Cicero, Inciardi, & Munoz, 2005; Havens et al., 2007; Young, Havens, & Leukefeld, 2012). Of these three prior studies, two

(Havens et al., 2007; Young, Havens, & Leukefeld, 2012) may be limited by their geographic restriction to a comparatively limited section of Central Appalachia and surrounding areas; therefore, their comparison may effectively be between Appalachian and non-Appalachian individuals rather than a true comparison between rural and non-rural individuals. These studies may be seen as part of a larger body of research (Collins et al., 2011; Havens, Oser, & Leukefeld, 2011; Wunsch, Nakamoto, Behonick, & Massello, 2009) which used data collected in the Appalachian regions of Tennessee, Virginia, and Kentucky. Additionally, Havens and colleagues (2007) compared rural and urban probationers, thus studying a population whose behaviors may not generalize well to the population of adolescents and young adults whose behaviors form the basis of the present study. The findings of Cicero, Inciardi, and Munoz (2005) are based upon a national network of key informants, and therefore could not be explained as a regional phenomenon; additionally, their data was collected from healthcare providers as well as individuals seeking treatment. In contrast, the present study uses data from participants who may or may not be seeking treatment. This difference in sampling may account for some differences between that study and this one, especially in light of findings by Cellucci and Vik (2001) and Robertson and Donnermeyer (1997), which indicate that rural individuals exhibit different treatment-seeking behavior from their non-rural counterparts.

This conflict with prior research raises the possibility that prior research has mistakenly generalized a Central Appalachian phenomenon to the rural United States as a whole. It is possible that prescription opioid abuse in rural eastern Kentucky is different in important and unknown ways from prescription opioid abuse in rural Montana, but the current body of research appears more characteristic of the former than the latter. Rural communities vary widely from one another in a range of factors that include access to amenities and economic trajectories

which can significantly influence the culture of any given rural community (Hamilton, Hamilton, Duncan, & Colocousis, 2008).

The second explanation, that actual differences in these populations were not reproduced in the sample, requires an explanation regarding flaws in the sample design. For reasons unknown, it could be that Add Health procedures undersampled individuals who engage in injection and thus did not accurately represent their behavior. In the Add Health cohort taken as a whole, including both those who reported illicit use of prescription opioids and those who did not, past-month injection use was notably rare. At Wave I a total of 12 individuals reported past-month injection, with Waves II, III, and IV respectively containing 10, 12, and 8 individuals reporting past-month injection. In none of the four waves do the individuals reporting past-month injection exceed 0.2% of the sample. This number is rather high considering the estimation of the National Survey of Drug Use and Health (SAMHSA, 2009) that .017% of the population have used injection in the past year; that is, that the Add Health sample's past-month injection use rate may exceed the national past-year injection use rate. Nevertheless, the number of individuals captured in the sample may have been too low to find an effect if one does in fact exist. Some contrasts are apparent with studies such as Young and colleagues (2012), which utilized a snowball sampling method, or with Havens, Young, and Leukefeld (2007), which sampled a population of probationers with likely high rates of injection use.

Implications of the Findings

Importantly, the current study provides some important information about national patterns of drug use. Findings reflect that both lifetime and past-month injection use increased between 1995 and 2008 among a combined national sample of rural and non-rural youth who used prescription opioids. These findings indicate that individuals who engage in the non-

medical use of prescription opioids become more likely over time to use injection at least once, as indicated by the findings on lifetime injection use. Additionally, the findings on past-month injection use indicate that a small but significant cohort of individuals who use prescription opioids develop a vulnerability over time to engaging in regular injection use.

This study also found that among a sample of rural youth who reported lifetime use of prescription opioids, injection use increased significantly between 1995 and 2008. Because of the large number of participants and nationally representative nature of the Add Health sample, this finding suggests that rural communities throughout the United States have experienced an increase in the prevalence of injection use; this increase is most strongly observed among the cohort of individuals aged between 31 and 41 in 2015.

The present study also makes significant contributions to the literature in its failure to support some hypotheses. This study did not find that rural status was a significant predictor of lifetime or past-month injection use among individuals who reported lifetime use of prescription opioids, which stands in contrast to the findings of others (Havens et al., 2009; Havens, Oser, Crosby, & Leukefeld, 2010; Shannon, Havens, & Hays, 2010; Young, Havens, & Leukefeld, 2010). Nor did this study find that rural status predicted either type of injection use among individuals who reported lifetime use of methamphetamine. Perhaps most surprising was that the present study did not find that rural status significantly predicted non-medical use of prescription opioids in participants' lifetimes. It is important to note that failure to reject a null hypothesis is not necessarily equivalent to accepting the null hypothesis, and that the question of whether failing to reject the null hypothesis actually supports the null hypothesis remains controversial among psychological statisticians (Frick, 1995; Kerlinger & Lee, 2000; Nickerson, 2000). As a result, the present study's negative findings should be interpreted with some caution.

Limitations

Some limitations may be due to the particular coding methods used in the survey. As was noted previously, neighborhood type was coded by the interviewers during data collection into various rural and non-rural categories. There exist the precedents of prior studies to support this coding as a valid means of differentiating rural versus non-rural participants (Adedokun & Balschwid, 2008; Cohn & Leake, 2012; Galliher, Rostosky, & Hughes, 2004), which used the Add Health neighborhood type coding in studying a range of topics. However, it is also possible that some objectivity is lost by this coding method compared to other conceptualizations of rurality such as population density. Isserman (2005) has argued that defining "rural" and "urban" is complicated, and that rurality may exist on a continuum; in this system, the status of a given community as rural may involve population density, proximity to metropolitan areas, influence of nearby urban communities, and other factors. An Add Health researcher's description of the "immediate area or street" may fail to properly account for such a complex definition of rurality. Similarly, a limitation may exist in the verbiage used in assessing injection, which specified the use of injection to deliver an "*illegal* drug" (emphasis added), which participants may have legitimately interpreted as excluding prescription opioids. Different coding standards were applied across waves for the number of times past-month injection occurred, which may have also unintentionally resulted in the loss of some variability in the data.

Additionally, inconsistencies in coding between Add Health waves may pose a limitation of the present study. Notably, participants were only asked about illicit use of opioid analgesics in Waves III and IV. Opioid-using participants who participated in Waves I and II but not III and IV would therefore be unintentionally excluded from this study's analyses. It is also notable that Wave IV's question was worded in considerably more detail and gave considerably more

examples of opioid analgesics than that in Wave III. It is therefore possible that some individuals who would have met the criteria for having used opioids nonmedically were thereby accidentally excluded from the analysis.

Future Research

The findings of this study would be much clarified by replication of the current research design. The present study failed to support hypotheses that predicted significant differences between rural and non-rural populations on past-month or lifetime injection use among users of prescription opioids and further did not find significant differences between rural and non-rural populations in lifetime use of prescription opioids by any method of administration

The present study therefore challenges the position that rural and urban opioid use are meaningfully distinct phenomena. Further replication of the present study will serve to strengthen or diminish the impact of this challenge.

Ideally, replication of the present study would allow the results from the Add Health sample to be compared to findings from a similar national sample which includes similar data from the same era, such as the National Survey of Substance Abuse Treatment Services (D'Aunno & Price, 2009). Because numerous sources discussed in the review of the literature point to the prominence of Oxycontin® use in rural communities (e.g., Cicero, Inciardi, & Munoz, 2005; Leukefeld et al., 2007; Young and Havens, 2012), a continued focus on the time period including the mid-1990s, when Oxycontin® was introduced to the market, would be helpful.

Future research on injection use among rural and non-rural populations would benefit considerably from prospective longitudinal studies which continue to track patterns of use. Longitudinal studies are useful in that these studies present the strongest evidence for trends

within a population over time. While retrospective studies may confirm or challenge prevailing opinions about rural drug use in the past two decades, public health policy should also be informed in respect to current and emerging trends. Therefore, it is strongly suggested that researchers continue to collect longitudinal data on injection use in rural communities.

The present study failed to support rural status as a predictor for any outcome variable studied (past-month injection use, lifetime injection use, or prescription opioid use). In order to address the question of whether previous research drew too-broad inferences based on primarily Central Appalachian samples, future research may make comparisons between Appalachian users of illicit prescription opioids and their counterparts in other rural regions of the United States.

In summary, the present study confirmed some aspects of prior theory (i.e., that on a national level, injection use increased among youth who used prescription opioids between 1994 and 2008). It also challenged aspects of theory which posed significant differences between rural and urban patterns of prescription opioid use. While limited by certain issues in sampling and the coding of variables important to the present study, this study nevertheless suggests important directions for future research, such as analyzing similar trends in other national samples and comparing populations from culturally different and geographically dissimilar rural communities.

Chapter 2: Literature Review

The abuse of opioid drugs is a serious problem in the United States, affecting the health of millions of individuals. Vulnerable populations, such as adolescents, young adults, and those living in poverty in rural communities, are especially affected. Opioid abuse is also closely connected with the use of injection, which carries further serious health risks. It is therefore important for psychologists and other providers of mental health services to understand the exact scope of the problem, but the specific nature of injection use by youth in rural communities has been the focus of little research. This study proposes to address this issue through the use of national longitudinal survey data to understand trends over time, putting the problem into a historical, time-oriented context. The intent of this study is to draw attention to the significance of this issue for those who work with rural populations and to equip practitioners with vital knowledge about the communities in which they practice.

A Brief History of Opioid Use and Abuse

Opioids are a class of psychoactive compounds chemically related to the peptides found in the opium poppy, *papaver somniferum*, which bind to opioid receptors in the central and peripheral nervous systems. The action of these drugs at the G-protein coupled receptors produces a variety of pharmacological effects depending upon the specific class of receptors to which the drugs bind. Most relevant for both medical and recreational use is the mu (μ) receptor, found in the brain, spinal cord, gastrointestinal tract, and other parts of the peripheral nervous system. Opioid action at the mu receptor produces a variety of sought-after effects including analgesia, euphoria, respiratory effects, and reduced motility of the gastrointestinal tract. It is also action at this receptor which is most strongly associated with physiological dependence (Julien, Advokat, & Comaty, 2007).

Opiates as a class of chemicals include many drugs which are generally classified by origin. The natural opiates are those which may be extracted from the resin of the opium poppy, primarily morphine and codeine. Semi-synthetic opioids, which emerged in the 19th Century, are those that are chemically derived from natural opiates, such as hydrocodone. Finally, synthetic opioids are those that do not originate from natural opiates but which also exhibit action at opioid receptors. Some classification systems also include partial opioid agonists and opioid antagonists, which block or counteract the effects of opioid agonist drugs, such as those described above; these partial agonists and antagonists are often used in the medical treatment of opioid overdose or in the prevention of opioid abuse (Julien et al., 2007).

Opium has been used as a drug since ancient times. Although historians have debated the exact point of origin, reliable historical evidence has shown that opium poppies were cultivated, likely for their narcotic properties, as early as the fourth millennium B.C.E. in Neolithic Europe. By 3400 B.C.E., opium was certainly cultivated in Mesopotamia, where Sumerian scribes referred to opium as the "joy plant," and where it may have played a role in religious ceremonies (Booth, 1996; Brownstein, 1993). Opium entered medical use at least as early as 1500 B.C.E., when an Egyptian medical text suggested it as a remedy for excessive crying in children and as a means for relieving surgical pain. The phenomenon of opiate abuse was identified in Europe and the Middle East by the Sixteenth Century; in the Seventeenth Century, European colonial influence fostered widespread addiction to smoked opium in China (Brownstein, 1993). For centuries, raw opium was the only form of the drug known, consumed either by orally ingesting a preparation of opium sap or by smoking a concentration of its alkaloids. The form of opium predominantly used changed in 1823, when morphine was first extracted, although nearly a century elapsed before morphine could be produced on an industrial scale (Booth, 1996). The

invention of the hypodermic syringe in the 1850s made it possible for morphine to be widely used as an analgesic (Brownstein, 1993).

In the United States, the abuse of medical opioids was identified in medical literature as early as the late Nineteenth Century. Day (1868), reflecting on the aftermath of the recently concluded American Civil War, wrote:

> Maimed and shattered survivors from a hundred battle-fields, diseased and disabled soldiers released from hostile prisons, anguished and hopeless wives and mothers, made so by the slaughter of those who were dearest to them, have found, many of them, temporary relief from their sufferings in opium. (p. 7)

Earle (1880) discussed the problem of opioid addiction in an urban sample, commenting that native-born Americans were more likely to abuse the drug than their immigrant counterparts, and that addiction to morphia (i.e., morphine) was more common among middle- and working-class individuals than among the wealthy. Another American author, Kane (1880), devoted an entire chapter of his textbook on the medical use of hypodermic injections of morphia to the problem of addiction. In this chapter he extensively argued in support of European predecessors who regarded the use of injection as a particularly serious risk factor for the development of "this terrible habit" (pp. 267-305) of drug dependence in patients, even in cases in which the drug was correctly and responsibly prescribed. Medical literature of the subsequent decades indicates that concern about opioid misuse remained widespread; Terry and Pellens (1928) wrote with candid concern about opioid addiction as a serious public health problem which they attributed to the irresponsible prescribing of the drug by physicians.

By 1909, public concern about opiates was significant enough for the passage of the Smoking Opium Exclusion Act, which banned the importation of opium for any non-

pharmaceutical use, as well as its smoking, but notably not its medical use. The post-World War II era saw significant levels of opiate addiction among the veteran population. To some extent, addiction among veterans was tolerated as a health problem rather than a criminal one; however, in the following years, laws increasingly reflected a view of addicts as a "social menace" (Gahlinger, 2004, pp. 58-60). Mental health professionals began to regard opiate addiction as a serious social problem and observed its greater rates among ethnic minorities and those of lower socioeconomic status; a frequently cited case study from the postwar era (Gerard & Kornetsy, 1954) explicitly connected the heroin addiction of a young, African-American subject to the oppressive economic and social conditions endured by urban minority youth, describing addicts originating from "run-down, low status" neighborhoods as being "familiar" to mental health professionals (p. 367). In keeping with the predominant psychoanalytic paradigm of the era, Gerard and Kornetsky also presented a model of opiate addiction focused on personality types and developmental experiences now generally absent from current literature on substance use disorders.

The role of injection. Just as opioid abuse in general is a phenomenon with a long history, so is opioid use by injection. The history of injection is inextricably connected to the history of opioids. Miller (1994) reported that the first known case of intravenous administration of medicine occurred in 1657, when Christopher Wren devised an apparatus for injecting opium into a patient. Alexander Wood's invention of the hypodermic syringe in 1853 allowed physicians to deliver precise doses of medication quickly, precisely, and with a minimal risk of infection.

However, the associations between injection and addiction became swiftly apparent. Kane (1880), reflecting upon the proliferation of hypodermic injection technology, wrote: "There

is … no therapeutic discovery that has been so great a blessing and so great a curse to mankind as the hypodermic injection of morphi." (p. 5). Terry and Pellens (1928), summarizing the medical sources of the prior 50 years, demonstrated that the prevalent opinion was that injecting opioids contributed significantly to their addictive potential. In 1935, 42% of all men admitted to the National Institute of Mental Health hospital in Lexington, Kentucky disclosed injection use of opioids (O'Donnell & Jones, 1970). The National Survey on Drug Use and Health (SAMHSA, 2009b) estimated that an average of 425,000 people, or 0.17% of the population, annually use injection to deliver heroin or stimulants; notably, this estimate does not include the injection of prescription opioid analgesics, so the figure may be considered a conservative one.

Most research on injection of opioids focuses on heroin. Although it is uncertain how well this research generalizes to individuals who inject prescription opioids, the significant chemical similarities between the drugs, as well as the above established relationship between heroin and prescription opioid use, suggest that this research is relevant to questions of prescription analgesic abuse.

Injection may appeal to individuals who use opioids because of the speed and efficiency with which it delivers opioid compounds to receptor sites in the central nervous system; injection maximizes the amount of drug delivered compared to smoking, in which many active compounds fail to be ingested, and bypasses the first-pass metabolism, as in oral ingestion. Additionally, injection offers a rate of onset of drug effects more rapid than that provided by other methods. Thus it is perceived by users as offering a high degree of "bang for the buck" (Strang et al., 1992). In a cohort of individuals using heroin and other drugs, Gossop, Griffiths, Powis, and Strang (1992) found that those who primarily injected heroin produced significantly greater scores on the Severity of Dependence Scale (Gossop et al., 1995) than those who

primarily administered heroin via smoking. Strang and colleagues (1999) replicated the above finding in a study of urban, British individuals who used heroin; they also reported that individuals who injected heroin were initiated to heroin use at an earlier mean age than individuals who typically smoked heroin. Additionally, injection was associated with longer prior use of heroin, more frequent heroin use, more daily heroin use, more feelings of being "out of control," more association with a heroin-using culture, and more use of stimulants. Rigg and Ibañez (2010) found that, among participants they interviewed, alternative methods of drug administration (i.e., injection and insufflation or "snorting") were most common among those users who identified recreational motives as their primary reason for using prescription drugs.

Prescription opioid abuse in the modern United States. The U.S. Department of Health (2004) reported that abuse of "prescription-type psychotherapeutic drugs" (p.6), a classification including opioid analgesics, has been rising in the United States since at least the mid-1990s. The same report also related a finding that over 46 million Americans are estimated to have used prescription drugs nonmedically at least once in their lifetimes. Analgesics, which are typically opioid compounds, are the prescription drugs most commonly taken for nonmedical reasons, and are also reported more frequently than other classes of prescription drugs in past-year and past-month use (p. 12-13). Opioid analgesics were also strongly implicated in emergency room visits, especially among adolescents and young adults, at rates that significantly increased from 1995 to 2002 for many drug types (p. 25).

Cicero, Inciardi, and Munoz (2005) responded to what they described as concerns about a prescription painkiller "epidemic," largely initiated by media and local government complaints to Purdue Pharma and the US Food and Drug Administration surrounding the abuse of OxyContin® (a trade name for oxycodone, a semi-synthetic opioid), in specific geographical

regions, notably including the Appalachian region. The data-collection program subsequently developed by Purdue, titled "Researched Abuse, Diversion and Addiction-Related Surveillance" (RADARS®), collected longitudinal data from the United States, utilizing multiple sources including key informants the authors described as "clinicians, epidemiologists, treatment counselors, and other observers who are well-recognized experts in the field of substance abuse and who are in a position to know about new and emerging drug problems in their areas" (p. 663). Using RADARS® data collected between 2002 and 2004, Cicero and colleagues found that, once again, OxyContin® was the most widely-used prescription drug, with hydrocodone being reported as "a close second" (p. 667). OxyContin® and morphine use also exhibited a statistically significant increase in prevalence over time. The authors concluded that the abuse of prescription opioids in the United States increased between 2002 and 2004, noting that prescription drugs were widely abused in differently-sized communities, setting this pattern of abuse apart from the established use of heroin, which historically focused on large metropolitan centers.

Data collected by the Substance Abuse and Mental Health Services Administration (SAMHSA, 2001; 2003; 2004a; 2005; 2006; 2007; 2008; 2009a; 2010; 2011; 2012) indicate that some, though not all, indices of illicit opioid use among the national population have increased since the 1990s. The prevalence of past-month illicit use of pain relievers by individuals aged 12 years and older has remained somewhat stable on a national level since 1999, varying between 1.7 and 2.3% of the national sample endorsing past-month use. In contrast, estimates of nationwide numbers of individuals engaging in past-month use have increased from 2.6 million individuals in 1999 to a peak of 5.3 million individuals in 2009 (see Table 1).

Table 1. Past-month illicit use of pain relievers, in percentage of population and estimated numbers of users (in millions): National sample data

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
%	2.1	2.3	*	1.9	2.0	1.8	1.9	2.1	2.1	1.9	2.1	2.0	1.7
#	2.6	2.8	*	4.4	4.7	4.4	4.7	5.2	5.2	4.7	5.1	5.3	4.5

* Data not reported.

Source: SAMHSA, 2001, 2003, 2004a, 2005, 2006, 2007, 2008, 2009a, 2010, 2011, 2012

A larger increase can be found in the prevalence of lifetime use (i.e., the use of prescription opioids during any point in an individual's life); the percentage of SAMHSA survey participants reporting lifetime illicit use of prescription analgesics has increased from 10.9% in 1999 to 14% in 2008, declining to 13.3% in 2011, whereas numbers of individuals who have engaged in lifetime use has varied from a minimum of 29.6 million in 2002 to a maximum of 35 million in 2009 (see Table 2).

Table 2. Lifetime illicit use of pain relievers, in percentage of population and estimated numbers of users (in millions): Nartional sample data

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
%	10.9	10.9	*	12.6	13.1	13.2	13.4	13.6	13.3	14.0	13.9	13.8	13.3
#	34.1	32.4	*	29.6	31.2	31.8	32.7	33.5	33.1	34.9	35.0	34.9	34.2

* Data not reported.

Source: SAMHSA, 2001, 2003, 2004a, 2005, 2006, 2007, 2008, 2009a, 2010, 2011, 2012

The prevalence rate of substance use disorders involving prescription opioids has also been stable since 2002, remaining stable at 0.6 or 0.7% of the population (SAMHSA, 2008); however, the number of individuals affected increased from 1.5 million in 2002 to 1.9 million in

2010 (SAMHSA, 2003, 2011). By 2005, prescription analgesics were second only to cannabis as the category of illicit drugs with the highest rates of abuse and dependence (SAMHSA, 2006).

The national scale of prescription opioid misuse can also be understood in terms of the number of new initiates each year. SAMHSA (2002a) reported that the annual number of new users of analgesics for nonmedical purposes quintupled from the mid-1980s, in which approximately 400,000 new users were initiated to illicit opioid use per year, to approximately 2.0 million in 2000 (SAMHSA, 2002a). This number appeared to remain relatively stable as well, rising as high as 2.4 million new users in 2003 and 2004 and falling as low as 2.0 million new users in 2011 (SAMHSA, 2005, 2012). In 2005, SAMHSA reported that prescription pain relievers had more new initiates than any other class of illicit drugs except cannabis, a pattern that was repeated in 2005, 2006, 2007, 2008, 2009, 2010, and 2011.

Longitudinal data also supports the presence of an increase in emergency department usage related to the nonmedical use of narcotic analgesics. SAMHSA (2004b, 2010b) reported an upward trend from 42,857 emergency department visits in 1995 to 108,320 in 2002, with a second wave of data collection reporting an increase from 144,644 in 2004 to 305,885 in 2008.

The distribution networks involved in prescription drug abuse differ from traditional models of illicit drug use. These traditional models have primarily been based upon street drugs, which are illegal in practically any context in which they are acquired or used, in contrast with prescription analgesics, which can be procured through legal means, and which may be distributed without the involvement of criminal organizations. National survey data (SAMHSA, 2011) found that 54.2% of respondents reported using prescription painkillers that were illicitly obtained from friends or relatives for free, and 18.1% obtained them directly from one physician; whereas 3.9% obtained them from a drug dealer or a stranger, and only 0.3% obtained them from

the Internet. Those who obtained drugs from a friend or relative also reported that, in 81.6% of these cases, the individual providing the drugs obtained them from only one physician. The same survey data also reflected the types of prescription drugs being used illicitly; out of 7 million individuals reporting nonmedical use of prescription drugs, 5.2 million reported that the type of drugs they used were analgesics, a class of drugs practically synonymous with opioids. In the cases of individuals who obtain drugs directly from physicians via prescription, use is monitored and occurs within legal bounds; therefore, addiction can occur while remaining "hidden" from law enforcement authorities due to its legally licit nature and the lack of interaction with drug dealers or other criminal elements (Prather, 2003). National survey data also indicate that the abuse of several classes of prescription drugs, including narcotic analgesics, may be more frequent among women than among men (Simoni-Wastila, 2000; SAMHSA, 2012). This may be explained at least partially by women's greater usage of healthcare resources and higher rates of obtaining prescriptions (Freund & McGuire, 1995).

It appears that multiple motivations are involved in the use of prescription opioid analgesics. A mixed-methods study of individuals abusing prescription drugs by Rigg and Ibañez (2010) identified primary motivations among prescription drug users as recreation or "to get high," to promote sleep, and as a mechanism for coping with anxiety or stress. Some demographic variables have been associated with motivation to use; younger users were more likely to report using prescription drugs for recreational purposes, whereas older users were more likely to report using prescription drugs not prescribed to them for the purpose of managing pain.

As members of the same class of chemicals, prescription opioids share some pharmacological characteristics with heroin (Julien, Advokat, & Comaty, 2007). It appears that the use of prescription opioids may lead to the use of heroin or vice versa. Muhuri, Gfroerer, and

Davies (2013), in an analysis of data from the National Survey on Drug Use and Health (NSDUH), found that individuals aged 12 to 49 who had used prescription pain relievers nonmedically were 19 times more likely to report using heroin in the past year than those who had not used prescription pain relievers, although most individuals who use pain relievers nonmedically do not appear to progress to heroin use. The authors also found that nonmedical use of prescription pain relievers was almost twice as prevalent among individuals who had previously used heroin than those who had not, although they were careful to note that prior heroin use is but one of many pathways leading to nonmedical use of prescription opioids. This relationship between prescription drugs and heroin was also investigated in a qualitative study of urban injection users in Toronto, Canada by Firestone and Fischer (2008). The authors found that many users preferred prescription opioids to heroin for characteristics perceived as desirable, including price and drug purity.

Rural Drug Abuse and Treatment

Individuals from rural communities appear in the empirical literature on substance abuse as a unique population in many regards and may be meaningfully distinct from their urban counterparts. During the 1980s, a debt-propelled collapse in the American agricultural economy, colloquially known as the "farm crisis," particularly impacted rural communities in which most agriculture occurred (Barrett, 1987). Since this time, a pervasive decline in rural economies, changes in rural versus urban populations, and other shifts in rural sociocultural variables have exposed many rural families to significant hardship (McGranahan, 2003). Dew, Elifson, and Dozier (2007) argue that these changes have weakened many of the protective factors against drug abuse previously present in rural communities, particularly family characteristics among which the authors list "limited shifts in household composition, cohesion, interdependent

socialization patterns, and discipline" (p. 17). Murray and Keller (1991) argued that the farm crisis, by creating systemic stressors such as those named above, created serious risks for mental health problems among the rural population. Dew, Elifson, and Dozier (2007) also state that at present, rural users may show a unique set of risk and protective factors, including the role of extended families, religious and school influences, and the expansion of illicit drug trafficking networks into rural areas.

Rural individuals who abuse drugs also access treatment for substance abuse less frequently than their urban counterparts, as found by Robertson and Donnermeyer (1997) in their analysis of NSDUH data. This reduced access of treatment occurs despite the fact that rural participants were more likely than urban participants to report certain mental health problems, including feeling depressed, getting into arguments, and experiencing reduced work productivity. Similarly, in Cellucci and Vik's (2001) survey of psychologists in Idaho, rural practitioners were significantly more likely than their urban counterparts to treat clients with substance abuse problems. Murray and Keller (1991) argued that rural Americans face specific barriers to accessing care that may be absent in urban areas; these include greater geographic dispersion (and thus greater distances to healthcare providers), lack of public transportation, and fewer numbers of service providers and institutions; psychologists in particular are concentrated in urban areas, with few available in rural communities. Cellucci, Vik, and Nirenberg (2003) reported that "[i]t is not unusual for rural communities to lack detoxification and psychiatric services; jail is used to observe patients with both substance abuse and psychiatric symptoms" (p. 55), citing a lack of both treatment providers and funding for services. Elder, Robertson, and Ardelt (1994) stated that, in rural families facing economic hardship, healthcare expenses like health insurance may be among the first expenses to be reduced or eliminated. Additionally,

Human and Wasem (1991) discussed cultural barriers to the acceptability of seeking mental health care in rural communities; seeking help may be discouraged when services are not offered in a manner that coincides with community values, traditions, and beliefs about the problem.

Opioid abuse in rural communities. Individuals who use drugs in rural communities may be particularly likely to abuse prescription opioid analgesics in comparison to their urban counterparts. In the above-mentioned longitudinal study by Cicero, Inciardi, and Munoz (2005), the authors found that prescription opioid abuse was more common in rural areas, whereas heroin was more popular in urban centers, arguing that this is due to the relative availability of the two classes of drug in each type of area. A comparison of rural and urban individuals on probation (Havens et al., 2007) found that 36.6% of rural residents reported abusing prescription opiates in the three months prior to their arrest, compared with only 9.5% of urban residents; these authors also speculated that this difference was due to the relative availability of prescription opioids compared to heroin. Residents of rural counties were also more likely to report the use of cannabis and tranquilizers, whereas urban residents were more likely to report the use of alcohol, cocaine, and heroin. Young, Havens, and Leukefeld (2012) compared urban and rural drug users in Kentucky and found that rural drug users had significantly earlier ages of onset for a range of drugs, including oxycodone, hydrocodone and benzodiazepines. Rural drug users also had higher lifetime and recent likelihood of use of several prescription opioid analgesics, including methadone, oxycodone, and OxyContin®.

Although longitudinal data is necessary to make definitive statements about epidemiological trends, such research in regard to the illicit use of prescription opioids in rural populations is rare. Havens, Oser, and Leukefeld (2007) conducted one such study among 800 individuals on probation in rural Kentucky between 2001 and 2004; the use of prescription

opioids increased significantly, rising from 26.7% of the sample in 2001 to 44.1% of the sample in 2004. The authors additionally analyzed the use of other drugs (benzodiazepines, cocaine, heroin, and marijuana), finding no such pattern for any of these.

Rural differences in patterns of drug use are also reflected in overdose deaths. In a study of medical examiners' records in Virginia (Wunsch, Nakamoto, Behonick, & Massello, 2009), deaths due to drug overdose in rural western Virginia were found to increase by 300% between 1997 and 2003; prescription opiates were indicated as a cause of death in 74% of the deaths recorded during this time. The authors also compared toxicology in deaths between rural and urban areas, finding that individuals who died in rural areas were more likely to die by overdose involving prescription drugs and polydrug combinations than their urban counterparts. Additionally, a comparison of number of deaths with population density determined that, in western Virginia, rural individuals were more likely than urban individuals to die of a drug overdose.

Shannon, Havens, Mateyoke-Scrivener, and Walker (2009) examined patterns of substance abuse in Kentucky, comparing women in the rural Appalachian region of the state with those in non-Appalachian regions, including major cities. Among the Appalachian group of women, 56% reported use of opiates versus 35% of non-Appalachian women; similarly, rates of use of tranquilizers were also significantly higher among Appalchian women (47% versus 34%), whereas other drugs (cocaine, alcohol, methamphetamine, and cannabis) were more predominant in use by the non-Appalachian population. A comparison of pregnant women who abused opioids in rural versus urban populations by Heil, Sigmon, Jones, and Wagner (2008) found that rural women were less likely to use opioids during pregnancy, were less likely to use cocaine, and were more likely to be employed than their urban counterparts. The authors concluded that

rural women presented with more factors than urban women associated with positive treatment outcomes; among those were that rural women were more likely to be employed and less likely to use cocaine. However, rural women also had less access to treatment resources. Shannon, Havens, and Hays (2010), in a sample of pregnant women from both rural and urban areas entering an inpatient detoxification program, found that rural women were 8.4 times more likely to report illicit use of opioids during pregnancy than urban pregnant women. They were also 3.3 times more likely to use benzodiazepines, 5.9 times more likely to report administering drugs by injection, and 2.8 times more likely to engage in polysubstance use.

In rural populations, opioid abuse seems to be highly correlated with polydrug abuse. Havens, Walker, & Leukefeld (2010) found that, in a sample of individuals in rural Kentucky who reported nonmedical use of prescription opioids in the last 30 days, 92.8% of individuals also reported nonmedical use of benzodiazepines in the last 30 days. This phenomenon is not limited to benzodiazepines, however. Havens and colleagues (2009) analyzed data from a sample of individuals who reported past-month use of cocaine and methamphetamines in rural areas of Arkansas, Kentucky, and Ohio, finding that 53% of participants reported nonmedical use of prescription opioids in the prior six months. Individuals who endorsed prescription opioid use were more likely than those who did not to also report use of heroin, cocaine, methamphetamine, and cannabis, to produce higher Brief Symptom Inventory scores for depression and anxiety, and to report injection drug use in the prior six months.

A sample of community informants that included healthcare providers, law enforcement officers, and educators in rural Kentucky (Leukefeld et al., 2007) reported perceptions that prescription opioid abuse had a history “in the mountains” at least since the Vietnam War, with some participants also reporting a perceived increase in abuse with the introduction of

OxyContin® to the prescription drug market in 1996. This date was widely perceived by informants as the initiation of the modern prescription drug abuse "epidemic." The informants, who included healthcare providers, law enforcement officials, and community leaders, also identified specific motives for prescription opioid use common to users, generally organized in roughly two pathways to abuse. One of these pathways was grounded in the experience of chronic physical pain, in which individuals took opioids (obtained through licit or illicit channels) for their analgesic properties. A second pathway was recreational or otherwise nonmedical; some informants described users as focused on "getting high" or using for recreational reasons before becoming dependent, whereas others described a course of addiction related to psychological problems and coping with a "lack of opportunity" in rural communities. The need to "escape" economic and social stressors seemed highly relevant to individuals using drugs in the Appalachian counties where the study was conducted, as these were located in some of the poorest areas of Kentucky. Many informants also identified multiple sources for accessing opiates, which ranged from legitimate prescriptions to questionable provision by healthcare providers to black market trade, often involving sale of prescription drugs by Medicaid recipients. Participants explained that Medicaid participation allowed individuals with disabilities to acquire drugs for between $1 and $3 for each prescription (p. 511), then sell the drugs at large profit margins to generate much-needed income.

Opioid Abuse Among Youth

Adolescents and young adults form a demographic that is important in understanding substance abuse in the United States. In the division of age groups used in SAMHSA data, individuals aged 18 to 25 are more likely to report illicit drug use in the past month than both older and younger groups. Additionally, an increase in past-month illicit use of prescription

drugs among these individuals increased between 2002 and 2006 (SAMHSA, 2007; US Department of Health, 2004). Rigg and Ibañez (2010), in their analysis of motives for prescription drug abuse, found that younger users were more likely to be motivated by recreational reasons, in contrast with older users, who were more likely to use prescription drugs for pain relief.

SAMHSA's National Survey on Drug Use and Health (NSDUH) reports data separately for adolescents (aged 12 to 17) and young adults (aged 18 to 25). SAMHSA reported that lifetime nonmedical use of analgesics among adolescents aged 12 to 17 increased from 1.2% in 1989 to 9.6% in 2001 to 11.2% in 2002. Past month use among adolescents on a national scale has followed a trend of general stability since 2000, similar to that in adults; the percentage of adolescents aged 12 to 17 reporting past month use has ranged from a minimum of 2.1% in 2000 to a maximum of 3.2% in 2003, subsequently falling to 2.5% in 2010 (see Table 3). Young adults reported past month use at somewhat higher rates ranging from 3.6% in 2001 and 2011 to 4.9% in 2006 (see Table 4).

Table 3. Percentage of adolescents aged 12 to 17 reporting past-month illicit use of prescription opioids: National sample data

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
%	2.1	2.3	*	3.2	3.2	3.0	2.7	2.7	2.7	2.3	2.7	2.5	2.8

* Data not reported.

Source: SAMHSA, 2001, 2003, 2004a, 2005, 2006, 2007, 2008, 2009a, 2010, 2011, 2012

Table 4. Percentage of young adults aged 18 to 25 reporting past-month illicit use of prescription opioids: National sample data

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
%	3.7	3.6	*	4.1	4.7	4.7	4.7	4.9	4.6	4.6	4.8	4.5	3.6

* Data not reported.

Source: SAMHSA, 2001, 2003, 2004a, 2005, 2006, 2007, 2008, 2009a, 2010, 2011, 2012

A 2004 report by the U.S. Department of Health found significant increases in prescription opioid analgesic abuse by adolescents across the United States, indicating high prevalence of the abuse of Vicodin®, an opioid analgesic typically prescribed for severe pain, among high school students; a general increase in painkiller abuse among young adults; and an increase in treatment admissions for males in their twenties for abuse of narcotic painkillers. This report also confirmed the frequency of the use of opioids in combination with other drugs, particularly benzodiazepines and alcohol; however, this report did not distinguish between reports for urban and rural users.

Opioid Abuse Among Rural Youth

A study of Appalachian youth by Collins and colleagues (2011) found that minors in their sample, derived from a rural Tennessee county, were more likely to abuse prescription drugs (defined as sleeping medications, stimulants, tranquilizers, or analgesics) than any other drug except for alcohol, with 35% of the sample reporting having used prescription drugs for nonprescription purposes. This rate is notably taken in the context of national data, in which lifetime prevalence of *all* illicit drugs by adolescents aged 12 to 17 was estimated at 25.7% (SAMHSA, 2011).

Although the 2010 NSDUH did not report a separate estimate for the lifetime prevalence of psychotherapeutic abuse by individuals aged 12 to 17, the prevalence rate reported by Collins and colleagues (2011) is higher than the 2010 NSDUH (SAMHSA, 2011) reported lifetime prevalence of marijuana use by adolescents (17.0%) and similar to the 2010 NSDUH reported lifetime prevalence of alcohol use by adolescents (35.2%). Collins and colleagues (2011) found that nonmedical use of prescription drugs was the second most popular form of substance use following alcohol in their overall sample; prescription drug use was reported at a higher lifetime prevalence than cigarettes and cannabis. Among fifth and seventh graders in the sample, prescription drugs were used at higher prevalence rates than any other substance. The authors also identified risk factors for nonmedical prescription drug use among minors in the sample, which included the number of an individual's friends who engaged in nonmedical use of prescription drugs, as well as perceived availability of prescription drugs. Protective factors included perception of risk related to nonmedical prescription drug use, a perception of disapproval by one's parents, greater commitment to school, and a perception of community norms against nonmedical prescription drug use.

Havens, Young, and Havens (2010), reporting from their analysis of 2008 NSDUH data, found that, in comparison with urban adolescents, rural adolescents were 1.26 times more likely to use prescription drugs (defined as "pain relievers, tranquilizers, sedatives, and stimulants") when controlling for race, health, and use of other substances. It was notable that rural and urban adolescents did not significantly differ on prevalence for all illicit drug use combined. Rather, urban and rural adolescents used different classes of drugs at different rates. For rural adolescents, nonmedical prescription drug use was significantly correlated with dropping out of school, experience of major depressive episodes, and "fair" or "poor" health status; living in a

two-parent household emerged as a significant protective factor against nonmedical prescription drug use.

Transition to Injection

Although the transition from oral ingestion to intravenous use of prescription opioid analgesics has relatively little representation in the literature, the transition to injection of heroin from other methods of administration is a phenomenon with an established evidence base. Griffiths, Gossop, Powis, and Strang (1994) found that 39% of individuals using heroin in their sample had made one or more transitions between primary methods of administration. Additionally, they found that most individuals currently using injection had previously used another method, typically smoking; cases in which individuals transitioned from injection to smoking were much less common, occurring in only 16% of the sample. Although many participants with a long-term history of smoking heroin never made the transition to injection, the authors' survival analysis revealed that individuals who used heroin for longer periods of time were more likely to inject, with the odds of injection rising rapidly after the fourth year of use.

Using data from primarily urban samples, research has sought to identify the risk factors that predict transition to injection of heroin. Neaigus and colleagues (2001) analyzed demographic variables in a sample of New Yorkers who currently used heroin without injection, some of whom had a former history of injection, comparing "frequent former injectors" with "infrequent former injectors" and "never injectors." Frequent former injectors emerged as more likely to be homeless, unemployed, long-term users, younger at age of initiation to heroin, to have used injection during their first use of heroin, to be unafraid of needles, to have insufflated (i.e., "snorted") heroin with injection users, and to have had sex partners who had injected

heroin. Both frequent and infrequent former injectors had used heroin for a longer period of time and had begun using heroin at a younger age than those who had never injected. Many of these risk factors seem to indicate economic hardship as a force that drives injection use, and the social and age characteristics of frequent former injectors tend to suggest that qualitatively different social conditions may separate individuals who use injection from those who do not. Fischer, Manzoni, and Rehm (2006) found similar risk factors in a European sample, also finding a correlation between injection use and mental health status. Also working in Europe, Bravo and colleagues (2003) found that individuals who initiated heroin use via injection reported that injection was found in their social environment, being used by friends or sexual partners; additionally, individuals who transitioned to injection from another method of administration cited reasons involving effectiveness and efficiency of injection. Individuals who transitioned to injection also frequently cited pressures of the social environment. Conversely, individuals who used heroin but never injected stated that they were able to afford heroin of sufficient quality to be smoked or insufflated, and that they were concerned about the possible health risks of injection. Neaigus and colleagues (2006) conducted a longitudinal study following both individuals who had previously, but not currently, injected drugs, as well as those who used drugs but who had never injected, in New York, finding that the two groups had different predictors for transition to injection. "Never-injectors" were more likely to transition if homeless, if exposed to greater use of injection drugs by others, experiencing physical abuse, using larger amounts of heroin, using heroin for greater than nine years, and if in social environments accepting of injection use. "Former-injectors," on the other hand, were at higher general risk for initiating injection, and were more likely to transition if in social environments accepting of injection use, if identifying as of White ethnicity, not being afraid of needles, and if younger in

age. Firestone and Fischer (2008) conducted a qualitative study of Canadian individuals who reported using both injection drugs and crack cocaine; prominent themes included polydrug use of crack and prescription opioids, unstable housing, and unreliable income. Many participants identified a preference for injecting prescription opioids over heroin, and many reported a transition from primarily using heroin to using prescription opioids. Additionally, participants varied in their preferences for specific opioids, but generally agreed in their perception of prescription drugs as superior in quality to heroin. Many participants also discussed obtaining drugs, and a perception that dealers preferred to sell prescription opioids was reported. Previous initiation to drug use may predict injection use but should be regarded as a complex variable. Trenz and colleagues (2012) found support for early onset of alcohol and polysubstance use as predictors of later initiation to injection. The same study also tested early onset of tobacco and cannabis use as predictors of later injection use, but these were not supported.

Some of the literature on transition to injection has focused on adolescents and young adults. A five-year longitudinal study by Roy and colleagues (2003) in Montreal, following "street-active" youth (i.e., those who used street youth agencies) who had never injected drugs, found that initiation of injection drug use was predicted by being homeless in the prior six months; being younger than 18; using heroin, hallucinogens, or cocaine in the prior six months; having experienced extrafamilial sexual abuse; and, among females only, having a friend who injected drugs. Abelson and colleagues (2006), who studied adolescents and young adults in both rural and urban Australia, found that initiation of injection before age 17 was predicted by factors including dropping out of school, "unreliable" income (which could include income from illegal activities such as drug dealing or sex work), being homeless or in unreliable housing at the time of first injection, belonging to an oppressed ethnic group (in this case, Indigenous

Australians or Torres Strait Islanders), having family members who injected drugs, and beginning drug use earlier in life. In this sample, 46% of the participants initiated their first injection with an opioid drug. Fuller and colleagues (2005) compared individuals who initiated injection use in adolescence with those who initiated in adulthood; those who initiated in adolescence were more likely to be African-American, and to live in neighborhoods with high levels of minority residents and low adult educational levels. A longitudinal study by Fuller and colleagues (2002) focused on young (aged 15-20) individuals using injection drugs in Baltimore, Maryland, finding that injection was predicted by high school dropout, engaging in transactional sex, and recent experience of being the victim of violence, with African-American individuals at slightly higher risk.

Injection and health. Injection drug use presents particular challenges for public health. Individuals who use injection drugs are at high risk for the transmission of serious blood-borne illnesses. In a national sample of individuals who used drugs by injection (SAMHSA, 2009b), 29% reported cleaning needles before their last use; 13% of the sample used a needle that they knew or suspected had previously been used by someone else, and 17.7% reported that someone else used their needles after them. In an urban sample, individuals who transition to injection earlier reported higher frequencies of high-risk sexual behavior, including transactional sex, unprotected sex, and sex before age 14. These individuals also reported high-risk injection behavior, such as sharing injection equipment among multiple users, including strangers (Fuller et al., 2005). An urban sample of injection drug users found that 78% of participants were positive for hepatitis C infection within two years of initiation into injection (Thomas et al., 1995). Conversely, approximately 40% of cases of hepatitis C infection are attributed to injection drug use (Alter, 1997). In urban samples of injection drug users in the United States, hepatitis B

infection has been estimated at 25% (Des Jarlais et al, 2003). A study of a comparable population in Eastern Europe estimated the prevalence of hepatitis B among injection users at 55.2% (Shapatva et al., 2006). Similarly, an urban sample of injection drug users found that 10% of participants were positive for HIV (Chaisson et al., 1987), although a more recent investigation of an urban sample estimated HIV prevalence at 5% (Des Jarlais et al., 2003). It has been estimated by the Centers for Disease Control and Prevention (CDC, 2009) that 16% of new HIV cases can be attributed to transmission via intravenous drugs. Injection drug users may transmit diseases through multiple routes. For example, a CDC report (2004) indicated that sexual contact with injection drug users exists as a significant vector for HIV transmission. Injection use among heroin users also has been demonstrated to predict overdose when compared with other administration methods. Gossop and colleagues (1996) found that in their sample of heroin users, 31% of injection users overdosed, compared with only 2% of individuals who used methods other than injection. Brugal and colleagues (2002) found that individuals who injected heroin were at higher risk than those who used smoking or insufflation to administer heroin, explaining that injection allows "the rapid entry into the blood of a large amount of heroin that overwhelms an organism's low capacity to compensate (tolerance level)," (p. 324), facilitating the accidental administration of more heroin than intended.

Injection use in the rural United States. Little is known about injection use by rural substance abusers aside from indications that injection may be becoming more popular as a delivery method among rural substance users, particularly among those who abuse prescription drugs. Prior research on rural drug abuse indicated that injection was a rarely-used method of administration. In an analysis of data collected in 1991, before the introduction of OxyContin®, Leukefeld and colleagues (2002) collected data on injection use in rural Kentucky from multiple

sources. Among a jail sample, 16% of participants reported having used drugs by injection in their lifetime, whereas a sample in the urban area of Lexington, composed of many individuals from rural origins, produced a lifetime injection prevalence rate of 12%.

More recent studies from the same region have presented different conclusions, although the samples are not directly generalizable to one another. Havens, Walker, and Leukefeld (2007), in a cross-sectional study of participants from the Appalachian region of Kentucky who reported using prescription opioids, found that their sample had a 44.3% lifetime prevalence of injection drug use, with 35.3% reporting that they had injected oral formulations of opioid analgesics. Young and Havens (2012) surveyed 503 residents of Appalachian Kentucky who reported past-month use of prescription opioids, heroin, and stimulants. The authors found a 78% lifetime prevalence of injection use in the sample. Individuals who reported injection use were more likely than those who did not to report a history of encounters with the criminal justice system, as well as sex with individuals who used drugs by injection. Additionally, individuals who used both OxyContin® and stimulants were 6.5 times more likely than those who did not to have a history of injection. Individuals who used both heroin and illicitly-acquired methadone were also at elevated risk of injection, but not as high as those who used OxyContin® and stimulants. Finally, an analysis of time from initiation of illicit drug use to transition to injection found that multiple prescription opioids, particularly oxycodone-containing drugs, produced an elevated risk of transition to injection.

Rural injection use also seems to be closely connected to the use of prescription opioids. Young and Havens (2012) found that among rural injection drug users, 62.4% of the sample identified prescription opioid drugs as involved in their initiation into injection use. Of these, 48.2% specifically identified OxyContin®, which was involved in almost as many initiations as

stimulants, heroin, and all other prescription drugs combined; rural users of OxyContin® were thus 6.7 times more likely to use injection than users of other drugs, with a median time of 3 years between starting illicit drug use and initiation to injection. Havens, Walker, and Leukefeld (2007) reported that among their sample OxyContin® was also most popular, although non-prescription methadone and hydrocodone were also widely used. In a comparison between rural and urban abusers of prescription opioids (Young, Havens, & Leukefeld, 2010), rural users were significantly more likely to use alternative routes of ingestion (e.g., insufflation and injection) than urban users, who were more likely to administer the drugs orally. Among the rural users, insufflation was the preferred method of administration for hydrocodone, methadone, OxyContin®, and oxycodone, whereas injection was preferred for hydromorphone and morphine. However, data from Appalachian samples indicates that those rural drug users who do make use of intravenous administration are 13 times more likely to inject prescription analgesics than heroin (Havens, Oser, Crosby, & Leukefeld, 2010). Havens and colleagues (2009), in their study of polydrug use by rural individuals who used stimulants, found that individuals who reported abusing prescription opioids were significantly more likely to use injection than those who did not use prescription opioids, with 25.8% of individuals who reported abusing prescription opioids also reporting the use of injection, compared with only 7.5% among individuals who did not abuse prescription opioids. Shannon, Havens, and Hays (2010), in their study of rural versus urban pregnant women entering inpatient treatment, found that the rural participants were 5.9 times more likely than the urban participants to report injection drug use in the 30 days prior to admission. Additionally, 38.8% of the rural sample reported using injection to administer drugs in the past twelve months, compared to 10.3% of the urban sample.

As with urban samples, injection use in rural communities has potentially troubling attributes. Havens and colleagues (2013) found that in a sample of rural Appalachian injection users the prevalence of hepatitis C infection was 54.6%, compared with about 2% in the general public; risk factors for hepatitis C infection included injection of prescription opioids and sharing of syringes. Among a cohort of rural felony probationers who reported drug use by injection in rural Appalachian Kentucky, 34.5% of participants reported using syringes that they believed had previously been used, whereas 97.1% of participants reported giving or selling used syringes that had not been cleaned to other users (Havens, Oser, & Leukefeld, 2011).

The Present Study: Overview, Justification, and Hypotheses

Overview of the literature. Historically, opioid abuse and dependence has been closely connected with the misuse of medications, especially following the development of the hypodermic syringe (Booth, 1996; Brownstein, 1993); the abuse of illicitly manufactured and distributed heroin may be seen as an exception to the historical rule. Currently, the abuse of prescription opioids is widespread and occurs not only in urban areas but in suburban and rural communities as well (SAMHSA, 2012; Cicero, Inciardi, & Munoz, 2005). On a national level, illicit use of prescription opioids became more prevalent in the 1990s and early 2000s, after which prevalence rates appeared to stabilize (SAMHSA, 2012). The introduction of OxyContin® appears to have coincided with this increase, although it is not possible to infer a causal relationship. At present, prescription opioid abuse appears as a unique phenomenon; prescription opioids are often preferred to heroin due to their purity, strength, and safety, although individuals may move back and forth between heroin and prescription opioid use (Muhuri, Gfroerer, & Davies, 2013; Firestone & Fischer, 2008). Additionally, individuals who use prescription drugs for nonmedical purposes often obtain them through legally licit channels or non-criminal peer

networks rather than through drug dealers and their associated criminal organizations (SAMHSA, 2011; Prather, 2003). Many users of prescription opioids transition from oral administration of pills to injection, desiring faster onset and more efficient use of drug resources (Griffiths et al., 1994; Strang et al., 1992). However, as with heroin, the injection of prescription opioids carries a risk of spreading blood-borne pathogens such as hepatitis C and HIV, and tends to be associated with a range of high-risk behaviors, particularly among youth (SAMHSA, 2009b; CDC, 2009; Fuller et al., 2005; Fuller et al., 2002; Neaigus et al., 2001).

In rural communities, the illicit use of prescription opioids may be more common than in their urban counterparts (Young, Havens, & Leukefeld, 2012; Shannon et al., 2009). This use appears to be associated with a decline in rural economies, as well as with other health problems common to rural communities for which opioids are frequently prescribed (Murray & Keller, 1991). Rural adolescents and young adults in particular use prescription drugs in high numbers (Collins et al., 2011; Havens, Young, & Havens, 2010). Many rural individuals who use prescription opioids for nonmedical purposes have also transitioned to the use of injection to administer drugs, and indications exist which suggest that the health problems associated with injection use are now appearing in rural communities (Havens et al., 2013; Young & Havens, 2012).

Limitations of the literature. The majority of data on rural opioid use has come from a restricted geographical region in Central Appalachia. Much work on this phenomenon comes from a team of researchers located at the University of Kentucky, who have researched prescription drug abuse in their own and adjacent states (e.g., Young, Havens, & Leukefeld, 2012; Havens, Walker, & Leukefeld, 2007; Leukefeld et al., 2007; Leukefeld et al., 2002). Additionally, Collins and colleagues (2011) conducted their study of illicit prescription drug use

among adolescents in the Appalachian region of Tennessee. It is currently uncertain to what extent this geographical restriction limits the generalizability of these researchers' findings; that is, it is unknown whether the phenomena described in their literature successfully describe rural communities in all regions of the United States, or whether it merely describes those in Central Appalachia.

The majority of the research on the topic of rural prescription opioid abuse is cross-sectional. Cross-sectional studies are those that analyze a sample of the population at one point in time; examining multiple cross-sectional studies from similar samples over time may suggest hypotheses for longitudinal research but does not in itself allow for statistical inferences about how prevalence of behaviors changes over time. Although a few significant studies have analyzed longitudinal data (e.g., Havens, Oser, & Leukefeld, 2007), none of these studies analyze trends in injection use in rural communities. Because a series of studies (Young & Havens, 2012; Havens, Walker, & Leukefeld, 2007; Leukefeld et al., 2002) have found progressively higher rates of injection use among rural individuals who abuse prescription opioids, it is logical to ask whether an actual increase in injection use has occurred. However, that question is currently unanswered.

Additionally, research on injection use in the rural United States tends to focus on adult users. This restriction of focus is problematic for those concerned about drug abuse in the rural population. Data from the National Survey on Drug Use and Health (SAMHSA, 2012) indicate that young adults are at particularly high risk for illicit drug use of all types, and the US Department of Health (2004) has additionally found that prescription analgesics are widely abused by adolescents and young adults. Further, data from studies of rural youth (Collins et al., 2011; Havens, Young, & Havens, 2010) indicate that young people in rural communities abuse

prescription opioids at higher rates than their urban counterparts. Research that has focused on injection in urban samples has associated injection with opioid abuse for recreational purposes, which is more common among youth, and injection use may be highest among young people (Griffith et al., 1994; Rigg & Ibañez , 2010; SAMHSA, 2009b). Additionally, numerous studies focused on risk factors for injection have identified economic hardship and early initiation to drug use as significant predictors of transition to injection (Neaigus et al., 2006; Roy et al., 2003; Neaigus et al., 2001). Because rural communities are vulnerable to significant economic hardship in the modern era, and because prior work has demonstrated that substances of abuse (particularly prescription drugs) are available to youth in these communities, the possibility that rural adolescents and young adults are using drugs by injection is particularly concerning.

The present study.

Significance. Professional psychology has a complicated relationship with the treatment of substance use disorders. Margolis and Zweben (2011) identified two historical "rifts" between psychology and the mainstream addiction treatment community: a "practical rift" between psychologists and a field dominated by physicians, and a more persistent "philosophical rift" between a purely biological "disease" model of addiction and the more psychosocial learning model of addiction accepted by the psychological community. However, the authors also noted that these rifts have become less prominent as the contributions of psychologists have gradually become more accepted by the medical community and as the mainstream addiction treatment view has come to reflect a more interdisciplinary approach. The psychological community has changed as well, with a growing emphasis on addiction treatment. The American Psychological Association established Division 50, the Society of Addiction Psychology, in 1975 (Hanbury, Tucker, & Vuchinich, 2000). Within counseling psychology, Lichtenberg (1999) identified

substance abuse problems as a particular focus of the profession's applied discipline. Additionally, Chwalisz and Obasi (2008) have argued that counseling psychologists should be concerned with issues of public health and reducing disease.

Nevertheless, some writers have argued that psychology has not adequately emphasized substance use problems in practice. Miller (2002) has expressed concern that psychologists often fail to understand psychology's major contributions to the understanding, treatment, and prevention of substance use disorders, and that despite having high levels of contact with individuals who struggle with substance use disorders they frequently hold a belief that these disorders necessitate "specialist treatments." Miller also noted that:

> Unfortunately, specialist treatment services for SUD in the United States are often run and delivered by professionals or paraprofessionals without scientific training and, in some cases, with an antiscientific bias. Consequently, there is little or no overlap between the treatment methods used in standard practice and the approaches shown in clinical trials to be efficacious in treating SUD. (p.292)

DeAngelis (2001) listed many of the same concerns, also noting that by deferring to specialist treatments psychologists may miss important opportunities to provide effective interventions. A similar argument was made by Washton (2002), who argued that most psychologists have adequate basic skills to treat substance use disorders effectively, but that most are not adequately trained in the research. Previously, Miller and Brown (1997) also noted that despite a substantial body of evidence supporting psychological treatments for addiction, psychologists are underrepresented in substance abuse treatment. These authors identified barriers to psychologists working in this field including lack of training and a failure to disseminate research.

The present study therefore represents an attempt to recognize the need for psychologists to identify important issues in substance abuse trends which have a direct bearing upon treatment of vulnerable populations. Those who are in charge of program development and administration would be well-served by longitudinal research on epidemiological trends in substance abuse, as they may more effectively structure services to meet current demands as well as to anticipate future needs.

Additionally, the present study represents an ongoing movement within the empirical literature to more appropriately understand how a culturally unique population responds to a particular form of pathology. Psychologists have recognized that rural populations have distinctive cultures, representing a dimension of multiculturalism often overlooked in traditional conceptualizations of culture (Slama, 2004). Counseling psychology in particular has identified an obligation for psychologists to provide culturally appropriate services to a diverse public (Bieschke & Mintz, 2012; Sue & Sue, 2012). In order to work effectively with rural populations, therefore, psychologists must be informed by research specific to rural populations.

The present study seeks to resolve unanswered questions and to provide important information about substance abuse in American rural communities. Prior research raises the possibility that rural youth are at particular risk for engaging in injection drug use (Collins et al., 2011; Havens, Young, & Havens, 2010; Neaigus et al., 2006); practitioners would benefit from knowing whether this is so and to what extent the problem has occurred.

By making use of data from a national survey, it may be possible to gain a more comprehensive understanding of injection use in the rural United States as a whole. The use of longitudinal data may allow the present study to more accurately answer the question of whether trends in injection use by rural illicit opioid users are indeed increasing, as the cross-sectional

data suggests. Further, a comparison of trends between rural and urban individuals who illicitly use opioids may lead to a clearer understanding of differences between these groups.

This study will focus on individuals currently in young adulthood. This age group is important to understanding national trends in injection drug use; prior national survey data (SAMHSA, 2009b) has indicated that injection drug use is highest among individuals aged 18 to 34. Among urban residents, the median age of initiation has been variously reported as occurring in the teens or early twenties (Fuller et al., 2005). Although equivalent data for rural residents is thus far unavailable, it is thus likely that a longitudinal study of rural youth from their teenage years through young adulthood will manage to capture the time period in which initiation to injection occurs. A study of adolescents and young adults will therefore assist in focusing on the phenomenon of interest as well as drawing attention to a vulnerable and important population.

***Hypotheses*.** Based upon implications of previous data, the present study will test the following hypotheses in a national sample of adolescents and young adults who illicitly use prescription opioids:

1a. Among rural adolescents who endorse lifetime prescription opioid use, the prevalence of past-month injection use has increased between 1994 and 2008.

1b. The prevalence of past-month injection use between 1994 and 2008 has increased more severely among rural than non-rural youth who endorse lifetime prescription opioid use.

2a. Among rural adolescents who endorse lifetime prescription opioid use, the prevalence of lifetime injection use has increased between 1994 and 2008.

2b. The prevalence of lifetime injection use between 1994 and 2008 has increased more severely among rural than non-rural youth who endorse lifetime prescription opioid use.

Chapter 3: Methods

As stated in the previous chapter, the current study seeks to investigate longitudinal trends in the use of injection among rural adolescents and young adults who illicitly use prescription opioids and to compare these trends to those among urban and suburban adolescents and young adults. The following hypotheses were tested:

1a. Among rural adolescents who endorse lifetime prescription opioid use, the prevalence of past-month injection use has increased between 1994 and 2008.

1b. The prevalence of past-month injection use between 1994 and 2008 has increased more severely among rural than non-rural youth.

2a. Among rural adolescents who endorse lifetime prescription opioid use, the prevalence of lifetime injection use has increased between 1994 and 2008.

2b. The prevalence of lifetime injection use between 1994 and 2008 has increased more severely among rural than non-rural youth.

Participants

The analyses were based on the first through fourth waves of data of the National Longitudinal Survey of Adolescent Health (Add Health; Harris et al., 2009), a nationally representative sample of adolescent health-related behaviors. Add Health was developed by a group of demography researchers at the University of North Carolina at Chapel Hill under the direction of Kathleen Mullan Harris. Funded by 24 nonprofit foundations and federal agencies, Add Health was established in response to a Congressional mandate to collect data on a wide range of health measures, as well as factors that may influence health. Data collected by Add Health includes variables related to family, peer groups, dating and romantic relationships,

education, and communities. Other data collected included demographics, socioeconomic characteristics, and household structure.

Add Health data were collected in four successive cycles which researchers have named Waves I through IV (Harris et al., 2009). Wave I was conducted in a period from September 1994 to April 1995, involving 80 high schools and associated "feeder" schools (i.e., intermediate schools whose seventh grade graduates attended the high schools), totaling 132 schools. Schools participating in Wave I were selected for their ability to provide a sample of adolescents that would be representative for the United States. An initial in-school questionnaire was administered to over 90,000 students, leading to the selection of a representative "core" sample, as well as four "special oversamples." The first of these special oversamples focused on four ethnic groups of interest (African-American students who had at least one parent with a college degree, Chinese, Cuban, and Puerto Rican). The second special oversample was a "saturation sample" from two large schools and 14 small schools intended for the analysis of social networks. Additionally, researchers selected a special oversample of 589 students with limb use-related disabilities, and a "genetic sample" of sibling pairs living in the same household, including monozygotic twins, dizygotic twins, half-siblings, and non-related pairs. Between April and December 1995, in-home interviews were conducted with 20,747 participants in grades 7 through 12. During in-home interviews, participant responses were obtained in two ways. For topics deemed "less sensitive," interviewers asked questions aloud and recorded participant responses; for topics deemed "more sensitive," participants listened to pre-recorded questions through headphones and entered their own responses on a laptop computer. Participants' parents also completed an interviewer-assisted interview which covered topics

including inheritable health conditions, marriage and family factors, education and income, and other psychosocial and socioeconomic variables.

Wave II of data collection involved another round of in-home interviews in 1996, targeting "almost 15,000" of the participants from Wave I, excluding certain members of special oversamples (Harris et al., 2009). Wave III took place between August 2001 and April 2002, conducting in-home interviews with 15,170 participants from Wave I who were between 18 and 28 years old at the time of the interviews. Wave III also collected data on a range of new variables of interest, including marriage, relationships, and cohabitation, and also investigated participants' history of pregnancy, parenting, involvement in the labor market, military service, and contact with the criminal justice system. Wave III also involved in-home interviews with participants' domestic partners, as well as collection of biological specimens for testing. During Wave III, paper questionnaires were discontinued and all data were recorded on laptop computers.

Wave IV was conducted in 2008 and 2009 in a manner similar to that in Wave III. Wave IV did not include partner interviews but did include physical measurements and collection of biomarkers. Wave IV participants were between the ages of 24 and 34.

Of the participants in Wave I of data collection, 51.6% were female and 48.4% were male. The majority of participants in Wave I identified as White (66.0%), whereas 24.9% identified as Black or African American, 4.2% identified as Asian or Pacific Islander, 3.6% identified as Native American, and 6.5% identified their race as "other." Additionally, 11.4% of the sample in Wave I identified themselves as being of Latino or Hispanic origin.

Measures

Rural status. Highly relevant to the present study is the contrast between rural and non-rural populations. In Wave I, neighborhood type was coded by the interviewer in response to the question, "How would you describe the immediate area or street (one block, both sides) where the respondent lives?"

Interviewers coded the immediate area with the following types: rural, suburban, urban/residential only, 3 or more commercial properties/mostly retail, or 3 or more commercial properties/mostly wholesale/industrial. In Wave I, 27.6% of the sample was coded as living in rural areas. In Wave IV, in which the neighborhood type variable was expanded to include separate categories of "rural farm" and "rural town," a combined 19.7% of the sample was coded as living in rural areas. This measure of rural/urban status has been previously used in several studies using the Add Health data set (Adedokun & Balschwid, 2008; Cohn & Leake, 2012; Galliher, Rostosky, & Hughes, 2004; Snyder & McLaughlin, 2004).

Prescription opioid misuse. Participants were identified as engaging in illicit use of prescription opioids based upon their response to questions in Wave III and IV. In Wave III, nonmedical use of prescription opioids was measured with the following question: "Since June 1995, have you taken any of the following drugs without a doctor's permission?: pain killers, such as Darvon, Demerol, Percodan, or Tylenol with codeine?" (Harris et al., 2009). A similar but more detailed item was used in Wave IV:

> Which of the following types of prescription drugs have you taken that were not prescribed for you, taken in larger amounts than prescribed, more often than prescribed, for longer periods than prescribed, or that you took only for the feeling or experience they caused?: pain killers or opioids, such as Vicodin, OxyContin, Percocet, Demerol, Percodan, or Tylenol with codeine (Harris et al., 2009)

A positive response to either item resulted in the positive coding of a dichotomous variable indicating that nonprescription use of prescription opioids is present.

Injection use and history. As reflected in reports from the Substance Abuse and Mental Health Service Administration (SAMHSA, 2012), substance abuse behaviors can be operationalized in multiple ways, including frequency of use, whether an individual receives treatment, whether the individual meets diagnostic criteria for a substance use disorder, and so on. Variables in the Add Health data set allow the present study to measure injection use in terms of both broad (lifetime frequency) and narrow (past-month frequency) definitions. Interviews in Waves I and IV both included the question, "During your life, have you ever injected (shot up with a needle) any illegal drug?" In Wave II, participants were asked, "Since [Wave I], have you injected, shot up with a needle, any illegal drug, such as heroin or cocaine?" Wave III used the following wording: "Since June 1995, have you injected (shot up with a needle) any illegal drug, such as heroin or cocaine?" Frequency of injection was also established in all four waves with the question, "During the past 30 days, how many times did you inject an illegal drug?" or, "During the past 30 days, how often did you take an illegal drug using a needle?" Past month and lifetime use have been routinely used as a measure in reports on substance use by various government agencies (e.g., SAMHSA, 2007; US Department of Health, 2004). In literature related to the use of injection in rural populations, lifetime prevalence has been used as an operationalization by several major sources (e.g., Havens et al., 2013; Havens, Walker, & Leukefeld, 2007; Leukefeld et al., 2002; Young & Havens, 2012)

Procedures

As previously stated, this study tested the following hypotheses:

1a. Among rural adolescents who endorse lifetime prescription opioid use, the prevalence of past-month injection use has increased between 1994 and 2008.

1b. The prevalence of past-month injection use between 1994 and 2008 has increased more severely among rural than non-rural youth.

2a. Among rural adolescents who endorse lifetime prescription opioid use, the prevalence of lifetime injection use has increased between 1994 and 2008.

2b. The prevalence of lifetime injection use between 1994 and 2008 has increased more severely among rural than non-rural youth.

First, participants were excluded from the sample provided by Add Health if they did not endorse illicit prescription opioid use.

All hypotheses were tested by a multilevel modeling procedure as described in Heck, Thomas, and Tabata (2012). Multilevel modeling, which is known by a variety of names in the literature (p. 1), is a method for analyzing categorical outcomes in data sets characterized by a hierarchical "nesting of individual observations within higher level groups, or within individuals if the data consist of repeated measures" (p. 6). Repeated-measures designs, such as that employed in the present study, are thus conceptualized as "two-level … models where time periods are nested within subjects" (p. 7).

Like statistical tests with continuous outcomes, multilevel modeling procedures with categorical outcomes must calculate the probability of selecting a given outcome variable based upon a sampling distribution. Unlike the normal distribution used to describe probability in statistical tests with continuous outcomes (e.g., ANOVA), however, the sampling distributions of categorical variables violate the assumption of normality necessary for such tests and therefore require tests that can make use of binomial distributions (as in logistic regression) or other

multinomial distributions (Heck, Thomas, & Tabata, pp. 13-15). A link function (Azen & Walker, 2011, p. 119) is used to transform the expected value of the random component of the outcome variable "so that it can be modeled as a linear function of a set of predictors" (Heck, Thomas, & Tabata, p. 16). The statistical test conducted in the analysis of a categorical outcome is a test of differences between expected (as per the sampling distribution) and observed distributions of categorical outcome variables. In IBM SPSS software, this test is conducted via the Wald chi-square statistic, which calculates whether the value of a regression coefficient for a given predictor differs significantly from zero (Field, 2009, pp. 269-270).

For both parts of hypothesis 1, which involved past-month injection, a multinomial sampling distribution describing the probability of participants' responses in three categories ("Never," "1 time or 2 times," "3 or more times") was linked to a general linear model by means of a cumulative logit transformation. A logit transformation is based on the logarithm of the odds $p/(1-p)$ where p represents the probability that a participant belongs in one membership category, rather than another. The analysis of the general linear model produced a test of statistical significance for main effects of Time of Testing and for Rural Status, indicating whether (1) prevalence of past-month injection use has increased over time and (2) whether prevalence in past-month injection use differs between rural and non-rural participants. The analysis also provided a test of statistical significance for the interaction of Time of Testing and Rural Status, indicating whether the degree of change in the prevalence of past-month injection use is different for participants in the rural group than it is for those in the non-rural group.

For both parts of hypothesis 2 (i.e., that rural adolescents who engage in illicit use of opioids have exhibited an increase in lifetime prevalence, and that this increase is significantly higher than among non-rural adolescents), a binomial sampling distribution representing the

probability of participants' responses in two categories was linked to a general linear model by means of a logit transformation. Similarly to hypothesis 1, the analysis of the general linear model produced tests of statistical significance for main effects of Time of Testing and Rural Status, indicating whether lifetime injection use has increased over time and whether prevalence of lifetime injection use differs between rural and non-rural participants. Also tested was the interaction between Time of Testing and Rural Status, indicating whether rural and non-rural groups exhibit different rates of change in prevalence of lifetime injection use.

Human participants. In accordance with the guidelines of Radford University regarding the protection of human participants, a request for exemption from IRB review was submitted to the RU Institutional Review Board for approval to conduct analysis on the existing dataset for this study. IRB exemption was received on December 6, 2013.

Chapter 4: Results

As previously stated, this study tested the following hypotheses:

1a. Among rural adolescents who endorse lifetime prescription opioid use, the prevalence of past-month injection use has increased between 1994 and 2008.

1b. The prevalence of past-month injection use between 1994 and 2008 has increased more severely among rural than non-rural youth.

2a. Among rural adolescents who endorse lifetime prescription opioid use, the prevalence of lifetime injection use has increased between 1994 and 2008.

2b. The prevalence of lifetime injection use between 1994 and 2008 has increased more severely among rural than non-rural youth.

The results of these tests are reported below.

Hypothesis 1a

The findings failed to support Hypothesis 1a. Among rural participants who reported using prescription opioids within their lifetimes, significant changes between times of testing in past-month injection use between 1994 and 2008 were not observed, Wald χ^2 (1, N = 1452[1]) = 2.544, p = .111. See Table 5 for frequencies and percentages illustrating this effect.

[1] In this and all other analyses which include all four waves of data, the N for the sample is approximately quadrupled due to the need to restructure data in the "long format" for repeated-measures analysis in SPSS.

Table 5. Past-Month Injection Use Among Rural and Non-Rural Adolescents Who Report Lifetime Use of Prescription Opioids

Number of positive responses / number of total responses (%)

Wave: Population	0 times	1 or 2 times	3 or more times
I: Rural	400/400 (100%)	0/400 (0%)	0/400 (0%)
I: Non-Rural	970/973 (99.7%)	2/973 (.2%)	1/973 (.1%)
II: Rural	308/310 (99.3%)	1/310 (.3%)	1/310 (.3%)
II: Non-Rural	788/790 (99.7%)	1/790 (.1%)	1/790 (.1%)
III: Rural	365/368 (99.2%)	1/368 (.3%)	2/368 (.5%)
III: Non-Rural	874/882 (99.1%)	3/882 (.3%)	5/882 (.6%)
IV: Rural	372/374 (99.4%)	1/374 (.3%)	1/374 (.3%)
IV: Non-Rural	882/888 (99.4%)	2/888 (.2%)	4/888 (.5%)

It is also noteworthy that Rural Status did not significantly predict past-month injection use when collapsing results across all four waves of testing, Wald χ^2 (1, N = 4985) = .112, p = .737. Nevertheless, among a combined sample of rural and non-rural participants who endorsed lifetime prescription opioid use, Time of Testing did significantly predict past-month injection use, Wald χ^2 (1, N = 4985) = 5.233, p = .022, with generally more use occurring in later waves. Frequencies and percentages illustrating this effect can be found in Table 6.

Table 6. Past-Month Injection Use Among All Adolescents Who Report Lifetime Use of Prescription Opioids

Number of positive responses / number of total responses (%)

Wave	0 times	1 or 2 times	3 or more times
I	1383/1386 (99.8%)	2/1386 (.1%)	1/1386 (.1%)
II	1105/1109 (99.7%)	2/1109 (.2%)	2/1109 (.2%)
III	1249/1260 (99.1%)	4/1260 (.3%)	7/1260 (.6%)
IV	1267/1275 (99.4%)	3/1275 (.2%)	5/1275 (.4%)

Hypothesis 1b

The findings failed to support Hypothesis 1b. From 1994 to 2008, the pattern of change over time in past-month injection use did not differ significantly between rural and non-rural participants , Wald χ^2 (1, N = 4985) = .056, p = .813. See Table 6 for frequencies and percentages relating to this analysis.

Hypothesis 2a

The findings supported Hypothesis 2a. Among rural participants who reported lifetime use of prescription opioids, the number of individuals reporting injection use in their lifetimes increased significantly between 1994 and 2008, Wald χ^2 (1, N = 1436) = 22.557, p < .001. These results are illustrated by frequencies and percentages reported in Table 7.

Table 7. Lifetime Injection Use Among Rural and Non-Rural Adolescents Who Report Lifetime Use of Prescription Opioids

Number of positive responses / number of total responses (%)

Wave: Population	Number of lifetime injectors
I: Rural	5/398 (1.3%)
I: Non-Rural	9/964 (.9%)
II: Rural	7/308 (2.3%)
II: Non-Rural	13/786 (1.7%)
III: Rural	16/359 (4.5%)
III: Non-Rural	33/877 (3.8%)
IV: Rural	11/374 (2.9%)
IV: Non-Rural	26/888 (2.9%)

Additionally, Time of Testing significantly predicted lifetime injection use among all individuals who reported having used prescription opioids, Wald χ^2 (1, N = 4945) = 22.407, $p <$ .001. See Table 8 for frequencies and percentages illustrating this effect. Among non-rural participants who reported lifetime use of prescription opioids, the number of individuals reporting injection use in their lifetimes also increased between 1994 and 2008, Wald χ^2 (1, N = 3509) = 52.656, $p < .001$. However, Rural Status (i.e., whether a participant lived in a rural or non-rural area) did not significantly predict lifetime injection use among individuals who reported having used prescription opioids, Wald χ^2 (1, N = 4945) = .330, $p = .566$. See Table 7 for frequencies and percentages related to this analysis.

Table 8. Lifetime Injection Use Among All Adolescents Who Report Lifetime Use of Prescription Opioids

Number of positive responses / number of total responses (%)

Wave	Number of lifetime injectors
I	14/1375 (1.0%)
II	20/1103 (1.8%)
III	49/1246 (3.9%)
IV	37/1275 (2.9%)

Hypothesis 2b

The findings failed to support Hypothesis 2b. An interaction between Time of Testing and Rural Status for lifetime injection use was not observed, Wald χ^2 (1, N = 4945) = .195, p = .659.

Exploratory Analyses

In order to clarify the results reported above, a series of exploratory analyses were also conducted.

The present study used the data set to examine whether, among the entire Add Health cohort, differences existed between rural and non-rural individuals in terms of patterns of lifetime use of prescription opioids for nonmedical purposes between Waves III and IV (the only waves in which prescription opioid use was assessed). Time of Testing predicted lifetime use of prescription opioids, Wald χ^2 (1, N = 5627) = 338.932, $p < .001$, with an increasing number of individuals reporting lifetime use at later times of testing. However, Rural Status did not significantly predict prescription opioid use, Wald χ^2 (1, N = 4921) = .573, p = .449. An interaction between Time of Testing and Rural Status was not observed, Wald χ^2 (1, N = 4921) = .940, p = .332.

In the review of the literature on injection use among individuals who use opioids, the delivery of stimulants such as crystal methamphetamine was also studied concurrently (Havens et al., 2009; Strang et al., 1999; Young & Havens, 2012); therefore, the present study conducted exploratory analyses for injection use among participants who indicated lifetime use of crystal methamphetamine. A similar pattern of lifetime injection use was observed to that among lifetime users of prescription opioids; lifetime use of injection increased over time, Wald χ^2 (1, N = 2015) = 76.864, $p < .001$, but Rural Status did not predict lifetime use of injection, Wald χ^2 (1, N = 2015) = 1.423, $p = .233$. The interaction of Time of Testing with Rural Status did not predict lifetime injection use, Wald χ^2 (1, N = 2015) = .972, $p = .324$. Among individuals who reported having used methamphetamine within their lifetimes, Time of Testing significantly predicted past-month injection use, Wald χ^2 (1, N = 2296) = 8.384, $p = .004$, with past-month use increasing in later waves. Rural Status also failed to predict past-month injection use, Wald χ^2 (1, N = 2296) = .227, $p = .633$. The interaction of Time of Testing with Rural Status did not significantly predict past-month use of injection, Wald χ^2 (1, N = 2296) = .035, $p = .851$. Additionally, among rural individuals who reported lifetime methamphetamine use, no past-month injection trend was observed, Wald χ^2 (1, N = 764) = 2.851, $p = .091$.

Chapter 5: Discussion

This chapter will discuss findings of the present study, the possible implications of and explanations for these findings, the significance of the present study in the body of empirical literature, the limitations of the present study, and its meaning for future research.

Findings From the Study

To review, the following hypotheses were examined:

1a. Among rural adolescents who endorse lifetime prescription opioid use, the prevalence of past-month injection use has increased between 1994 and 2008.

1b. The prevalence of past-month injection use between 1994 and 2008 has increased more severely among rural than non-rural youth.

2a. Among rural adolescents who endorse lifetime prescription opioid use, the prevalence of lifetime injection use has increased between 1994 and 2008.

2b. The prevalence of lifetime injection use between 1994 and 2008 has increased more severely among rural than non-rural youth.

With regard to hypothesis 1a, the present study failed to find significant increases in past-month injection use among rural participants. In regard to hypothesis 1b, the present study did not find significant differences between rural and urban participants' patterns of transition to injection use. These findings raise a number of important questions discussed below.

With regard to hypothesis 2a, this study's finding that lifetime injection use increased among rural participants between 1994 and 2008 was consistent with findings by Havens, Walker, and Leukefeld (2007), Leukefeld, Logan, Farabee, and Clayton (2002), and Young and Havens (2012), whose research indicated that the lifetime prevalence of injection in rural communities increased between the early 1990s and the mid-2000s. However, due to the cross-

sectional nature of these prior studies, they could not confirm the existence of that trend, as examining multiple cross-sectional studies from similar samples over time may suggest hypotheses for longitudinal research but does not in itself allow for statistical inferences about how prevalence of behaviors changes over time. The present study lends support to the position by confirming that changes occurred in a single sample of rural opioid-using individuals over time. It was expected that the present study would confirm a general increase in lifetime prevalence rates across the four waves of data collection. Lifetime injection use is defined as the condition of having used injection ever in one's life; therefore, lifetime non-injectors can become lifetime injectors, but not vice versa. As the Add Health cohort aged, it was therefore unsurprising that many individuals who engaged in illicit use of prescription opioids would use injection at some point to administer opioids or other substances.

With regard to hypothesis 2b, which predicted that rural participants' rates of injection would rise more steeply than those of their non-rural counterparts between 1994 and 2008, such a difference was not supported. Rural status was not found to be a predictor of injection use. Once again, the implications of the failure to support this hypothesis are discussed in the next section below.

Additionally, an exploratory analysis of the present study confirmed an increase in past-month injection use among a combined sample of rural and non-rural individuals who reported use of prescription opioids. This was also consistent with prior research. Griffiths, Gossop, Powis, and Strang (1994) reported that 39 percent of individuals in their sample transitioned between methods of administration. Therefore, it was expected that a meaningful increase in transitions to injection from other means of administration (e.g., oral administration) would occur over the 1994-2008 period.

The exploratory analyses conducted in Chapter 4 also concluded that individuals who reported having ever used methamphetamine followed a similar pattern of increasing use of injection to those individuals who reported ever having used prescription opioids, confirming that multiple drugs of abuse present similar pathways to injection use as individuals seek faster or more effective means of administration. The present study found that more individuals reported ever having used prescription opioids in 2008-2009 than in 2001-2002, meaning that these drugs appear to have gained popularity on a national level over the last decade.

Situating the Findings in the Literature

Based upon the existing body of literature, the present study was expected to find differences in lifetime and past-month injection use between rural and non-rural populations. This expectation was largely based upon prior findings indicating that rural individuals using prescription opioids were more likely than non-rural users to engage in injection or insufflation (Shannon, Havens, and Hays, 2010; Young, Havens, & Leukefeld, 2010), and that injection use was strongly connected to prescription opioid abuse in rural samples (Havens et al., 2009; Havens, Oser, Crosby, & Leukefeld, 2010). However, no difference was observed between rural and non-rural participants in the sample; although both rural and non-rural groups exhibited increases over time in their lifetime use of injection, rural status did not predict lifetime injection use. There are two primary explanations for this discrepancy: that rural and non-rural opioid use are not distinct phenomena, or that actual differences in these populations were not reproduced in the sample.

The first explanation, that rural and non-rural opioid use are not distinct phenomena, requires explanation in the context of existing literature. Although our study did not attempt to support a null hypothesis (i.e., to show that two groups within the sample are the same), one

possibility for this failure to find differences between rural and non-rural participants is that rural and non-rural opioid-using populations are too similar in their patterns of lifetime injection use to be meaningfully different. In other words, it may be that rural and non-rural individuals who use prescription opioids for non-medical purposes do so with enough similarity that the behavior may be regarded as the same in both groups, and that previous assertions of difference between rural and non-rural opioid use are incorrect. If true, this possibility would need to be explained in the context of prior findings by Cicero, Inciardi, and Munoz (2005), Havens and colleagues (2007), and Young, Havens, and Leukefeld (2012), all of whose findings indicated that opioid use among rural and non-rural individuals are meaningfully different phenomena, with rural individuals more likely than their urban counterparts to use prescription opioids, whereas urban individuals were more likely to use heroin. Of these three prior studies, the latter two (Havens et al., 2007; Young, Havens, & Leukefeld, 2012) may be limited by their geographic restriction to a comparatively limited section of Central Appalachia and surrounding areas; therefore, their comparison may effectively be between Appalachian and non-Appalachian individuals rather than a comparison between rural and non-rural individuals which generalizes to the United States as a whole. These studies may be seen as part of a larger body of research including work such as Collins and colleagues (2011); Havens, Oser, and Leukefeld (2011); and Wunsch, Nakamoto, Behonick, and Massello (2009), which used data collected in the Appalachian regions of Tennessee, Virginia, and Kentucky. Additionally, Havens and colleagues (2007) compared rural and urban probationers, thus studying a population whose behaviors may not generalize well to the population of adolescents and young adults whose behaviors form the basis of the present study. The findings of Cicero, Inciardi, and Munoz (2005) are based upon a national network of key informants and therefore could not be explained as a regional phenomenon. It should be

noted that Cicero, Inciardi, and Munoz (2005) collected data from healthcare providers as well as individuals seeking treatment, whereas the present study uses data collected from adolescents and young adults who may or may not be seeking treatment. This difference in sampling may account for some differences between that study and this one, especially in light of findings by Cellucci and Vik's (2001) and Robertson and Donnermeyer (1997), which indicate that rural individuals exhibit different treatment-seeking behavior from their non-rural counterparts.

This conflict with prior research raises the possibility that prior research has mistakenly generalized a Central Appalachian phenomenon to the rural United States as a whole. It is entirely possible that prescription opioid abuse in rural eastern Kentucky is different in important and unknown ways from prescription opioid abuse in rural Montana, but the current body of research appears more characteristic of the former than the latter. Hamilton, Hamilton, Duncan, and Colocousis (2008) argued that rural communities vary widely from one another in a range of factors that include access to amenities and economic trajectories which can significantly influence the culture of any given rural community. In their taxonomy of "four rural Americas in the Twenty-First Century," much of Central Appalachia may be considered "chronically poor" or "declining resource-dependent," meaning that Central Appalachian communities may be considered to be different in "problems, issues, and relationship to the natural environment that originally defined it" (p. 6) from "amenity-rich" or "amenity/decline" communities such as those in the rural areas of the Rocky Mountains or parts of the Pacific Northwest.

Regarding the second explanation, that actual differences in these populations were not reproduced in the sample, requires an explanation regarding flaws in the sample design. For reasons unknown, it could be that the sampling procedures used in Add Health under-sampled individuals who engage in injection and thus did not accurately represent their behavior. In the

Add Health cohort taken as a whole, including both those who reported illicit use of prescription opioids and those who did not, past-month injection use was notably rare. At Wave I a total of 12 individuals reported past-month injection, with Waves II, III, and IV respectively containing 10, 12, and 8 individuals reporting past-month injection out of an average of 1246 participants per wave. In none of the four waves do the individuals reporting past-month injection exceed 0.2 percent of the sample. This number is rather high considering the estimation of the National Survey of Drug Use and Health (SAMHSA, 2009) that .017 percent of the population have used injection in the past year; that is, that the Add Health sample's past-month injection use rate may exceed the national past-year injection use rate. Nevertheless, the number of individuals captured in the sample may have been too low to find an effect if one does in fact exist. Some contrasts are apparent with studies such as Young and colleagues (2012), which utilized a snowball sampling method, or with Havens, Young, and Leukefeld (2007), which sampled a population of probationers with likely high rates of injection use.

Implications of the Findings

The present study has contributed to the body of literature on prescription opioid use by examining longitudinal patterns of injection use in a national sample of rural and non-rural youth. Importantly, the current study provides some important information about national patterns of drug use. Findings reflect that both lifetime and past-month injection use increased between 1995 and 2008 among a combined national sample of rural and non-rural youth who used prescription opioids. These findings indicate that individuals who engage in the non-medical use of prescription opioids become more likely over time to use injection at least once, as indicated by the findings on lifetime injection use. Additionally, the findings on past-month

injection use indicate that a small but significant cohort of individuals who use prescription opioids develop a vulnerability over time to engaging in regular injection use.

This study also found that among a sample of rural youth who reported lifetime use of prescription opioids, injection use increased significantly between 1995 and 2008. Because of the large number of participants and nationally representative nature of the Add Health sample, this finding suggests that rural communities throughout the United States have experienced an increase in the prevalence of injection use; this increase is most strongly supported among the cohort of individuals aged between 31 and 41 in 2015.

The present study also makes significant contributions to the literature in its failure to support some hypotheses. This study did not find that rural status was a significant predictor of lifetime or past-month injection use among individuals who reported lifetime use of prescription opioids, which stands in contrast to the findings of others (Havens et al., 2009; Havens, Oser, Crosby, & Leukefeld, 2010; Shannon, Havens, & Hays, 2010; Young, Havens, & Leukefeld, 2010). Nor did this study find that rural status predicted either type of injection use among individuals who reported lifetime use of methamphetamine. Perhaps most surprising was that the present study did not find that rural status significantly predicted non-medical use of prescription opioids in participants' lifetimes. It is important to note that failure to reject a null hypothesis is not necessarily equivalent to accepting the null hypothesis, and that the question of whether failing to reject the null hypothesis actually supports the null hypothesis remains controversial among psychological statisticians (Frick, 1995; Kerlinger & Lee, 2000; Nickerson, 2000). As a result, the present study's negative findings should be interpreted with some caution. The failure of this study to replicate prior findings on rural vs. non-rural differences in lifetime prescription opioid use (Cicero, Inciardi, & Munoz, 2005; Havens et al., 2007; Young, Havens, & Leukefeld,

2012) introduces some uncertainty into the proposition that rural individuals are more likely to use prescription opioids than their non-rural counterparts. The present study's lack of evidence to support rural status as a predictor of injection use (either lifetime or past-month) also may suggest that rural and non-rural individuals who use prescription opioids do so in essentially similar frequencies.

Limitations

Several of this study's limitations may be due in part to the particular coding methods used in the Add Health survey. The method for coding neighborhood type may be limited by problems with researcher objectivity, as discussed below. Additionally, Add Health attempted to record observations on a wide range of health-related behaviors, and some foci of attention in Add Health appear to have shifted from wave to wave; that is, some items were coded differently between waves, and some behavior was assessed in some waves but not in others. As a result, some of the measures related to substance use may have unintentionally obscured meaningful differences in the sample: these include the coding of illicit use of opioids, and the coding of past-month and lifetime injection use, all of which are discussed below.

As was noted previously, neighborhood type was coded by the interviewers during data collection into various rural and non-rural categories. As stated in Chapter 3, interviewers responded to the following question: "How would you describe the immediate area or street (one block, both sides) where the respondent lives?" There exist the precedents of prior studies to support this coding as a valid means of differentiating rural versus non-rural participants (Adedokun & Balschwid, 2008; Cohn & Leake, 2012; Galliher, Rostosky, & Hughes, 2004; Snyder & McLaughlin, 2004), which used the Add Health neighborhood type coding in studying a range of topics including delinquency, affective distress, self-esteem, and sexual risk behavior.

However, it is also possible that some objectivity is lost by this coding method compared to other conceptualizations of rurality such as population density. Isserman (2005) has argued that defining "rural" and "urban" is complicated, and that rurality may exist on a continuum; in this system, the status of a given community as rural may involve population density, proximity to metropolitan areas, influence of nearby urban communities, and other factors. An Add Health researcher's description of the "immediate area or street" may fail to properly account for such a complex definition of rurality.

It is also possible that Add Health's method for assessing illicit use of prescription opioids may have led to an incomplete coding of participants in the study. As discussed in Chapter 3, participants were only asked about illicit use of opioid analgesics in Waves III and IV. Opioid-using participants who participated in Waves I and II but not III and IV would therefore be unintentionally excluded from this study's analyses. It is also notable that Wave IV's question was worded in considerably more detail and gave considerably more examples of opioid analgesics than that in Wave III. In Wave III, nonmedical use of prescription opioids was measured with the following question: "Since June 1995, have you taken any of the following drugs without a doctor's permission?: pain killers, such as Darvon, Demerol, Percodan, or Tylenol with codeine?" A similar but more detailed item was used in Wave IV:

> Which of the following types of prescription drugs have you taken that were not prescribed for you, taken in larger amounts than prescribed, more often than prescribed, for longer periods than prescribed, or that you took only for the feeling or experience they caused?: pain killers or opioids, such as Vicodin, OxyContin, Percocet, Demerol, Percodan, or Tylenol with codeine (Harris et al., 2009).

It is therefore possible that some individuals who would have met the criteria for having used opioids nonmedically were thereby accidentally excluded from the analysis.

The particular verbiage used in assessing injection use may also have led to an unintended limitation in this study. In all four waves, the items assessing both past-month and lifetime injection use specified the use of injection to deliver an "*illegal* drug" (emphasis added), which participants may have legitimately interpreted as excluding prescription opioids, as these may be legally possessed with a prescription in the United States in contrast to "street drugs" such as heroin which are perceived as illegal in all circumstances. Although polydrug use is prevalent among rural opioid users and among injection users (Firestone & Fischer, 2008; Havens et al., 2009; Havens, Walker, & Leukefeld, 2010; Shannon, Havens, & Hays, 2010), it is also possible that the sample contained individuals who used injection to administer prescription opioids but not other illegal drugs. It is also noteworthy that injection items did not ask participants to specify what drugs were being injected. It is therefore possible that an individual could administer prescription opioids exclusively orally but inject stimulants exclusively, thus confounding the results.

Another potential limitation exists in the coding of the past-month injection use variable. Different coding standards for this variable were applied by Add Health across different waves. For instance, in Wave I participants' responses to the question, "During the past 30 days, how often did you take an illegal drug using a needle?" were coded as "Never," "1 time or 2 times," or "3 or more times." In contrast, during Wave II participants' responses to the equivalent item were coded as "Never, "one or two times," "three to ten times," or "more than ten times." In Waves III and IV the participant's estimated number of times injecting in the past month was directly recorded. Because of these differences in coding, it was necessary for this study to

recode responses in all four waves to match the scheme used in Wave I, as this scheme involved the simplest response set. It is possible that some variability in the data was lost as a result of this recoding, thus obscuring effects that would be of interest.

Future Research

Two directions for future research could include replication with different longitudinal sample sources and comparisons between different rural samples. Such future work would clarify the meaning of the present study's failure to support hypotheses and explore the possibility that different rural populations have been mistakenly conflated in previous research.

The findings of this study would be much clarified by replication in part or whole of the current research design. The present study failed to support hypotheses that predicted significant differences between rural and non-rural populations on past-month or lifetime injection use among users of prescription opioids; additionally, this study did not find significant differences between rural and non-rural populations in lifetime use (by any method of administration) of prescription opioids. As previously stated, this failure to reject null hypotheses does not necessarily advance a theory that rural and non-rural opioid-using populations are similar, but it does raise the possibility that they may be. Further replication of this study would help to confirm or disconfirm this notion; additional failure to find significant differences between rural and non-rural samples would support the theoretical position that rural and non-rural individuals use opioids at similar frequencies, whereas positive findings of significant differences would lend additional support to prior research that identifies rural opioid abuse as a meaningfully distinct phenomenon. Ideally, replication of the present study would allow the results from the Add Health sample to be compared to findings from a similar national sample which includes similar data from the same era, such as the National Survey of Substance Abuse Treatment

Services (D'Aunno & Price, 2009). Because numerous sources discussed in the review of the literature point to the prominence of Oxycontin® among substances used in rural communities (e.g., Cicero, Inciardi, & Munoz, 2005; Leukefeld et al., 2007; Young and Havens, 2012), a continued focus on the time period including the mid-1990s, when Oxycontin® was introduced to the market, would be helpful.

Future research on injection use among rural and non-rural populations would benefit considerably from prospective longitudinal studies which continue to track patterns of use. As in the case of the present study, longitudinal studies are useful in that these studies present the strongest evidence for trends within a population over time. While retrospective studies may confirm or challenge prevailing opinions about rural drug use in the past two decades, public health policy should also be informed in respect to current and emerging trends. Therefore, it is strongly suggested that researchers continue to collect longitudinal data on injection use in rural communities.

As previously noted, the present study failed to support rural status as a predictor for any outcome variable studied (past-month injection use, lifetime injection use, or prescription opioid use). Because of this discrepancy with previous research, this raises the question of whether previous research drew too-broad inferences based on primarily Central Appalachian samples. A useful direction in future research would be to make comparisons between Appalachian users of illicit prescription opioids and their counterparts in other rural regions of the United States. Future research may then compare users of prescription opioids in Central Appalachia to their counterparts in other rural regions. Variables used in this comparison might include rates of polydrug use, frequency of various administration methods, prevalence of blood borne illness, drug distribution networks, motivations for use, and risk and protective factors. These are factors

which have often been points of comparison between rural and non-rural samples, or which have been described as characteristic of rural opioid-using populations (Collins et al., 2011; Dew, Elifson, & Dozier, 2007; Havens et al., 2013; Havens, Walker, & Leukefeld, 2010; Havens, Oser, Crosby, & Leukefeld, 2010; Havens, Young, & Havens, 2010; Shannon, Havens, & Hays, 2010; Wunsch, Nakamoto, Behonick, & Massello, 2009; Young, Havens, & Leukefeld, 2010). Thus, further data on these variables among different rural samples would be useful in providing potential points of comparison between different rural populations.

Conclusion

In sum, the present study built upon a body of literature which theorized that prescription opioid use increased in the United States in the period following the mid-1990s, that transition to alternative methods of injection is common among a subset of individuals who use prescription opioids, and that rates of both opioid use and injection use are different, and likely higher, among individuals in rural communities. The present study confirmed the presence of increasing trends in past-month and lifetime injection use among a cohort of adolescents and young adults who endorsed non-medical use of prescription opioids between 1994 and 2008, supporting existing theories about trajectories of use and transition to injection. Perhaps of greater significance was the lack of support for hypothesized differences between rural and urban participants in injection use of either type or in use of prescription opioids by any method of administration. This study therefore represents a challenge to the existing body of knowledge, which has asserted that residents of rural communities engage in markedly different patterns of opioid use than their non-rural counterparts. The present study, while limited by certain issues in sampling and the coding of variables important to the present study, nevertheless suggests important directions for

future research, such as analyzing similar trends in other national samples and comparing populations from culturally different and geographically dissimilar rural communities.

References

Abelson, J., Treloar, C., Crawford, J., Kippax, S., Van Beek, I. & Howard, J. (2006), Some characteristics of early-onset injection drug users prior to and at the time of their first injection. *Addiction, 101,* 548–555. doi: 10.1111/j.1360-0443.2006.01379.x

Adedokun, O. A., & Balschwid, M. A. (2008). Community interactive processes and rural adolescents' educational attainment: Investigating the mediating effects of delinquency and self-esteem. *Journal of Youth Development, 3*, 63-78.

Alter, M. J. (1997). Epidemiology of hepatitis C. *Hepatology, 26,* 62S-65S.

Azen, R., & Walker, C. M. (2011). *Categorical data analysis for the behavioral and social sciences.* New York: Routledge.

Ballinger, G. A. (2004). Using generalized estimating equations for longitudinal data analysis. *Organizational research methods, 7,* 127-150. doi: 10.1177/1094428104263672

Barrett, J. (1987). *Mending a broken heartland: Community response to the farm crisis.* Alexandria, VA: Capitol Publications.

Bieschke, K. J., & Mintz, L. B. (2012). Counseling psychology model training values statement addressing diversity: History, current use, and future directions. *Training and Education in Professional Psychology, 6,* 196-203. doi: : 10.1037/a0030810

Booth, M. (1996). *Opium: A history.* New York: Thomas Dunne Books.

Bravo, M. J., Barrio, G., De La Fuente, L., Royuela, L., Domingo, L., & Silva, T. (2003), Reasons for selecting an initial route of heroin administration and for subsequent transitions during a severe HIV epidemic. *Addiction, 98,* 749–760. doi: 10.1046/j.1360-0443.2003.00393.x

Brownstein, M. J. (1993). A brief history of opiates, opioid peptides, and opioid receptors. *Proceedings of the National Academy of Sciences, 90,* 5391-5393.

Brugal, M. T., Barrio, G., De La Fuente, L., Regidor, E., Royela, L., & Suelves, J. M. (2002). Factors associated with non-fatal heroin overdose: assessing the effect of frequency and route of heroin administration. *Addiction, 97,* 319-327. doi: 10.1046/j.1360-0443.2002.00058.x

Cellucci, T., & Vik. P. (2001). Training for substance abuse treatment among psychologists in a rural state. *Professional Psychology: Research and Practice, 32,* 248-252. doi: 10.1037//0735-7028.32.3.248

Cellucci, T., Vik, P., & Nirenberg, T. (2003). Substance abuse in the rural community. In Stamm, B. (Ed.), *Behavioral healthcare in rural and frontier areas: An interdisciplinary handbook* (pp. 53-65). Washington, DC: American Psychological Association.

Centers for Disease Control and Prevention. (2004) HIV/AIDS Surveillance Report, vol. 15, 2003. Atlanta: US Department of Health and Human Services.

Centers for Disease Control and Prevention. (2009). Cases of HIV infection and AIDS in the United States and Dependent Areas, 2007: HIV/AIDS Surveillance Report, 2007. Atlanta: US Department of Health and Human Services.

Chaisson, R.E., Moss, A.R., Onishi, R., Osmond, D., & Carlson, J.R. (1987). Human immunodeficiency virus infection in heterosexual intravenous drug users in San Francisco. *American Journal of Public Health 77,* 169–172.

Chwalisz, K. & Obasi, E. (2008). Promoting health and preventing and reducing disease. In S. D. Brown & R. W. Lent (Eds.), *Handbook of counseling psychology* (4th ed.), pp. 517-534. Hoboken, NJ: Wiley.

Cicero, T.J., Inciardi, J.A., Munoz, A., (2005.) Trends in abuse of OxyContin® and other opioid analgesics in the United States: 2002–2004. *Journal of Pain, 6,* 662–672.

Cohen, J. (1992). A power primer. *Psychological bulletin, 112,* 155-159. doi: 10.1037/0033-2909.112.1.155

Cohn, T. J., & Leake, V. S. (2012). Affective distress among adolescents who endorse same-sex sexual attraction: Urban versus rural differences and the role of protective factors. *Journal of Gay and Lesbian Mental Health, 16*, 291-305. doi: 10.1080/19359705.2012.690931

Collins, D., Abadi, M. H., Johnson, K., Shamblen, S., & Thompson, K. (2011). Non-medical use of prescription drugs among youth in an Appalachian population: Prevalence, predictors, and implications for prevention. *Journal of Drug Education, 41,* 309-326.

D'Aunno, T., and Price, R. (2009). *National Drug Abuse Treatment System Survey, Waves II-IV*. Ann Arbor, MI: Inter-university Consortium for Political and Social Research. doi: 10.3886/ICPSR04146.v1

Day, H. B. (1868). *The opium habit.* New York: Harper.

DeAngelis, T. (2001). Substance abuse treatment: an untapped opportunity for practitioners. *Monitor on Psychology, 32 (6).*

Des Jarlais, D. C., Diaz, T., Perlis, T., Vlahov, D., Maslow, C., … Garfein, R. S. (2003). Variability in the incidence of human immunodeficiency virus, hepatitis B virus, and hepatitis C virus infection among young injecting drug users in New York City. *American Journal of Epidemiology, 157,* 467-471. doi: 10.1093/aje/kwf222

Dew, B., Elifson, K., & Dozier, M. (2007). Social and environmental factors and their influence on drug use vulnerability and resiliency in rural populations. *Journal of Rural Health, 23,* 16-21. doi: 10.1111/j.1748-0361.2007.00119.x

Earle, C.W. (1880.) The opium habit; a statistical and clinical lecture. *Chicago Medical Review, 2,* 442–498.

Elder, G. H., Jr., Robertson, E. B.. & Ardelt, M. (1994). Families under economic pressure. In R. D. Conger and G. H. Elder, Jr., Eds., *Families in troubled times: Adapting to change in rural America.* New York: Aldine De Gruyter.

Field, A. P. (2009). Logistic regression. In *Discovering statistics using SPSS* (3rd ed., pp. 264-315). London: Sage.

Firestone, M., & Fischer, B. (2008). A qualitative exploration of prescription opioid injection among street-based drug users in Toronto: behaviours, preferences and drug availability. *Harm Reduction Journal, 5,* 30. doi: 10.1186/1477-7517-5-30

Fischer, B., Manzoni, P., & Rehm, J. (2006). Comparing injecting and non-injecting illicit opioid users in a multisite Canadian sample (OPICAN Cohort). *European Addiction Research, 12,* 230-239.

Freund, P. E. S., & McGuire, M. B. (1995). *Health, illness, and the social body.* Englewood Cliffs, NJ: Prentice Hall.

Frick, R. W. (1995). Accepting the null hypothesis. *Memory & Cognition, 23,* 132-138. doi: 10.3758/BF03210562

Fuller, C. M., Borrell, L. N., Latkin, C. A., Galea, S., Ompad, D. C., Strathdee, S. A., & Vlahov, D. (2005). Effects of race, neighborhood, and social network on age at initiation of

injection drug use. *American Journal of Public Health, 95,* 689-695. doi: 10.2105/AJPH.2003.02178

Fuller, C. M., Vlahov, D., Ompad, D. C., Shah, N., Arria, A., & Strathdee, S. A. (2002). High-risk behaviors associated with transition from illicit non-injection to injection drug use among adolescent and young adult drug users: a case–control study. *Drug and Alcohol Dependence, 66,* 189-198.

Gahlinger, P. M. (2004). *Illegal drugs: A complete guide to their history, chemistry, use and abuse.* New York: Penguin.

Galliher, R. V., Rostosky, S. S., & Hughes, H. K. (2004). School belonging, self-esteem, and depressive symptoms in adolescence: An examination of sex, sexual attraction status, and urbanicity. *Journal of Youth and Adolescence, 33,* 235-245. doi: 10.1023/B:JOYO.0000025322.11510.9d

Gerard, D. L., & Kornetsky, C. (1954). Adolescent opiate addiction: A case study. *Psychiatric Quarterly, 28,* 367-380. doi: 10.1007/BF01567058

Gossop, M., Drake, S., Griffiths, P., Hando, J., Powis, B., Hall, W., & Strang, J. (1995). The Severity of Dependence Scale (SDS): Psychometric properties of the SDS in English and Australian samples of heroin, cocaine, and amphetamine users. *Addiction, 90,* 607-614. doi: 10.1046/j.1360-0443.1995.9056072.x

Gossop, M., Griffiths, P., Powis, B., Williamson, S., & Strang, J. (1996). Frequency of non-fatal heroin overdose: survey of heroin users recruited in non-clinical settings. *British Medical Journal, 313,* 402.

Gossop, M., Griffiths, P., Powis, B., & Strang, J. (1992). Severity of dependence and route of administration of heroin, cocaine and amphetamines. *British Journal of Addiction, 87,* 1527-1536. doi: 10.1111/j.1360-0443.1992.tb02660.x

Griffiths, P., Gossop, M., Powis, B., & Strang, J. (1994). Transition in patterns of heroin administration: A study of heroin chasers and heroin injectors. *Addiction, 89,* 301-309. doi: 10.1111/j.1360-0443.1994.tb00896.x

Hamilton, L. C., Hamilton, L. R., Duncan, C. M., & Colocousis, C. R. (2008). *Place matters: Challenges and opportunities in four rural Americas.* Durham, NH: Carsey Insitute.

Hanbury, R. F., Tucker, J. A., & Vuchinich, R. E. (2000). A history of Division 50 (Addictions). In D. A. Dewsbury (Ed.), *Unification through division: Histories of the divisions of the American Psychological Association, volume V.* Washington, DC: American Psychological Association.

Harris, K. M., Halpern, C. T., Whitsel, E., Hussey, J., Tabor, J., Entzel, P., & Udry, R. R. (2009). *The National Longitudinal Study of Adolescent Health: Research design*. Retrieved from http://www.cpc.unc.edu/projects/addhealth/design.

Havens, J. R., Lofwall, M. R., Frost, S. D. W., Oser, C. B., Leukefeld, C. G., & Crosby, R. A. (2013). Individual and network factors associated with prevalent hepatitis C infection among rural Appalachian injection drug users. *American Journal of Public Health, 103,* e44-e52. doi:10.2105/AJPH.2012.300874

Havens, J. R., Oser, C., Crosby, R., & Leukefeld, C. (2010, July). *Social network factors predict engagement in HIV risk behaviors among rural Appalachian drug users in the United States.* Paper presented at the 18th International AIDS Conference, Vienna, Austria. Abstract retrieved from http://www.iasociety.org/Abstracts/A200738416.aspx

Havens, J. R., Oser, C. B., & Leukefeld, C. G. (2011). Injection risk behaviors among rural drug users: implications for HIV prevention. *AIDS Care, 23,* 638-645. doi: 10.1080/09540121.2010.516346

Havens, J. R., Oser, C. B., & Leukefeld, C. G. (2007). Increasing prevalence of prescription opiate misuse over time among rural probationers. *Journal of Opioid Management, 3,* 107-111.

Havens, J. R., Oser, C. B., Leukefeld, C. G., Webster, J. M., Martin, S. S., O'Connell, D. J., Surratt, H. L., & Inciardi J. A. (2007). Differences in prevalence of prescription opiate misuse among rural and urban probationers. *American Journal of Drug and Alcohol Abuse, 33,* 309-317. doi: 10.1080/00952990601175078

Havens, J. R., Stoops, W. W., Leukefeld, C. G., Garrity, T. F., Carlson, R. G., Falck, R., Wang, J., & Booth, B. M. (2009). Prescription opiate misuse among rural stimulant users in a multistate community-based study. *American Journal of Drug and Alcohol Abuse, 35,* 18-23. doi: 10.1080/00952990802326298

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,* 98-102.

Havens, J. R., Walker, R., & Leukefeld, C. G. (2010). Benzodiazepine use among rural prescription opioids users in a community-based study. *Journal of Addiction Medicine, 4,* 137-139.

Havens, J. R., Young, A. M., & Havens, C. E. (2010). Nonmedical prescription drug use in a nationally representative sample of adolescents: Evidence of greater use among rural adolescents. *Archives of Pediatrics and Adolescent Medicine, 165,* 250-255.

Heck, R. H., Thomas, S. L., & Tabata, L. N. (2012). *Multilevel modeling of categorical outcomes using IBM SPSS.* New York: Routledge.

Heil, S. H., Sigmon, S. C., Jones, H. E., & Wagner, M. (2008). Comparison of characteristics of opioid-using pregnant women in rural and urban settings. *American Journal of Drug and Alcohol Abuse, 34,* 463-471.

Human, J., & Wasem, C. (1991). Rural mental health in America. *American Psychologist, 46,* 232-239. doi: 10.1037/0003-066X.46.3.232

Isserman, A. M. (2005). In the national interest: Defining rural and urban correctly in research and public policy. *International regional science review, 28,* 465-499. doi: 10.1177/0160017605279000

Julien, R. E., Advokat, C. D., & Comaty, J. (2007). Opioid analgesics. In *A primer of drug action* (11th ed., pp. 529-571). New York: Worth.

Kane, H. H. (1880). *The hypodermic injection of morphia: Its history, advantages and dangers.* New York: C. L. Bermingham & Co.

Kerlinger, F. N., & Lee, H. B. (2000). Testing hypotheses and the standard error. In *Foundations of behavioral research* (4th ed., pp. 275-303). Belmont, CA: Cengage.

Leukefeld, C.G., Logan, T.K., Farabee, D., & Clayton, R. (2002.) Drug use and AIDS: estimating injection prevalence in a rural state. *Substance Use and Misuse 37,* 767–782.

Leukefeld, C., Walker, R., Havens, J., Leedham, C. A., & & Tolbert, V. (2007). What does the community say: Key informant perceptions of rural prescription drug use. *Journal of Drug Issues, 37,* 503-524. doi: 10.1177/002204260703700302

Lichtenberg, J. W. (1999). Archival description of counseling psychology. *The Counseling Psychologist, 27,* 589-592. doi: 10.1177/0011000099274006

Margolis, R. D., & Zweben, J. E. (2011). Psychologists in the substance abuse field. In R. D. Margolis & J. E. Zweben (Eds.), *Treating patients with alcohol and other drug problems: An integrated approach* (2nd ed.) Washington, DC: American Psychological Association.

McGranahan, D. A. (2003). How people make a living in rural America. In D. L. Brown, L. E. Swanson, & A. W. Barton, eds., *Challenges for rural America in the Twenty-First Century* (pp. 135-151). University Park, PA: The Pennsylvania State University Press.

Miller, D. R. (1994). Intravenous infusion anaesthesia and delivery devices. *Canadian Journal of Anaesthesia, 41,* 639-652. doi: 10.1007/BF03010006

Miller, W. R. (2002). Educating psychologists about substance abuse. In M. R. Haack & H. Adger (Eds.), *Strategic plan for interdisciplinary faculty development: Arming the nation's health professional workforce for a new approach to substance use disorders,* pp. 289-304. Providence, RI: Association for Medical Education and Research in Substance Abuse.

Miller, W. R., & Brown, S. B. (1997). Why psychologists should treat alcohol and drug problems. *American Psychologist, 52,* 1269-1279. doi: 10.1037/0003-066X.52.12.1269

Muhuri, P. K., Gfroerer, J. C., & Davies, M. C. (2013, August). Associations of nonmedical pain reliever use and initiation of heroin use in the United States. *Center for Behavioral Health Statistics and Quality Data Review,* 1-16.

Murray, J. D., & Keller, P. A. (1991). Psychology in rural America: Current status and future directions. *American Psychologist, 46,* 220-231. doi: 10.1037/0003-066X.46.3.220

Neaigus, A., Gyarmathy, V. A., Miller, M., Frajzyngier, V. M., Friedman, S. R., & Des Jarlais, D. C. (2006). Transitions to injecting drug use among noninjecting heroin users: social

network influence and individual susceptibility. *Journal of Acquired Immunodeficiency Syndrome, 41,* 493-503.

Neaigus, A., Miller, M., Friedman, S. R., Hagen, D. L., Sifaneck, S. J., … Des Jarlais, D. C. (2001). Potential risk factors for the transition to injecting among non-injecting heroin users: a comparison of former injectors and never injectors. *Addiction, 96,* 847-860. doi: 10.1046/j.1360-0443.2001.9668476.x

Nickerson, R. S. (2000). Null hypothesis significance testing: A review of an old and continuing controversy. *Psychological Methods, 5,* 241-301. doi: I0.1037//1082-989X.S.2.241

O'Donnell, J.A., & Jones, J.P. (1970). Diffusion of the intravenous technique among narcotic addicts. In J. C. Ball, & C. D. Chambers (Eds.), *The epidemiology of opiate addiction in the United States.* Springfield, IL: Charles C. Thomas, pp. 147–164.

Prather, J. E. (2003). Addiction to prescription analgesics and minor tranquilizers: A case study of hidden primary addiction. *Journal of Addictions Nursing, 14,* 35-41. doi: 10.1080/10884600305363

Rigg, K. K. & Ibañez, G. E. (2010). Motivations for non-medical prescription drug use: A mixed-methods analysis. *Journal of Substance Abuse Treatment, 39,* 236-247. doi: 10.1016/j.jsat.2010.06.004

Robertson, E. B. & Donnermeyer, J. F. (1997). Illegal drug use among rural adults: Mental health consequences and treatment utilization. *American Journal of Drug and Alcohol Abuse, 23,* 467-484. doi: 10.3109/00952999709016890

Roy, E., Haley, N., Leclerc, P., Cédras, L., Blais, L., & Boivin, J. F. (2003). Drug injection among street youths in Montreal: predictors of initiation. *Journal of Urban Health,80,* 92-105.

Shannon, L. M., Havens, J. R., & Hays, L. (2010). Examining differences in substance use among rural and urban pregnant women. *American Journal on Addictions, 19,* 467-473. doi: 10.1111/j.1521-0391.2010.00079.x

Shannon, L. M., Havens, J. R., Mateyoke-Scrivner, A., & Walker, R. (2009). Contextual differences in substance use for rural Appalachian treatment-seeking women. *American Journal of Drug and Alcohol Use, 35,* 59-62.

Shapatva, E., Nelson, K. E., Tsertsvadze, T., & del Rio, C. (2006). Risk behaviors and HIV, hepatitis B, and hepatitis C seroprevalence among injection drug users in Georgia. *Drug and Alcohol Dependence, 82,* S35-S38.

Sherman S. G., Fuller C. M., Shah N., Ompad D. V., Vlahov, D., & Strathdee, S. A. (2005). Correlates of initiation of injection drug use among young drug users in Baltimore, Maryland: the need for early intervention. *Journal of Psychoactive Drugs, 37,* 437–443.

Simoni-Wastila, N. (2000). The use of abusable prescription drugs: The role of gender. *Journal of Women's Health & Gender Based Medicine, 9,* 289-297.

Slama, K. (2004). Rural culture is a diversity issue. *Minnesota Psychologist, 53,* 9-12.

Snyder, A.R.; & McLaughlin, D.K. (2004, August). *Parents and peers: How much do they influence risky sexual behavior among rural teens?* Paper presented at the Rural Sociological Society Annual Meeting, Sacramento, CA. Presentation retrieved from http://www.authorstream.com/Presentation/Rafael-35154-ParentsandPeersTPP-Influence-Parents-Peers-Risky-Sexual-Behavior-Common-Questions-Data-YRBS-Add-Health-co-as-Entertainment-ppt-powerpoint/

Strang, J., Des Jarlais, D. C., Griffiths, P., & Gossop, M. (1992). The study of transitions in the route of drug use: The route from one route to another. *British Journal of Addictions, 87,* 473-483. doi: 10.1111/j.1360-0443.1992.tb01948.x

Strang, J., Griffiths, P., Powis, B., & Gossop, M. (1999). Heroin chasers and heroin injectors: Differences observed in a community sample in London, UK. *American Journal on Addictions, 8,* 148-160. doi: 10.1080/105504999305956

Substance Abuse and Mental Health Service Administration [SAMHSA]. (2001). *2000 National Survey on Drug Abuse: Summary Tables.* Retrieved from http://www.samhsa.gov/data/nhsda/2kdetailedtabs/pdf/pdf/2kNHSDAtables-PDF2.htm

Substance Abuse and Mental Health Service Administration [SAMHSA]. (2003). *Overview of Findings from the 2002 National Survey on Drug Use and Health.* Retrieved from http://www.samhsa.gov/data/nhsda/overview/2k2Overview.htm#chap5

Substance Abuse and Mental Health Service Administration [SAMHSA]. (2004a). *Overview of Findings from the 2003 National Survey on Drug Use and Health.* Retrieved from http://www.samhsa.gov/data/nhsda/2k3nsduh/2k3Overview.htm

Substance Abuse and Mental Health Service Administration [SAMHSA]. (2004b). *The DAWN Report: Narcotic Analgesics, 2002 Update.* Retrieved from http://www.samhsa.gov/data/driverrprt/dawn2k2/2k2narcotics.pdf

Substance Abuse and Mental Health Service Administration [SAMHSA]. (2005). *Overview of Findings from the 2004 National Survey on Drug Use and Health.* Retrieved from http://www.samhsa.gov/data/nsduh/2k4nsduh/2k4results/2k4Results.htm

Substance Abuse and Mental Health Service Administration [SAMHSA]. (2006). *Results from the 2005 National Survey on Drug Use and Health: National Findings.* Retrieved from http://www.samhsa.gov/data/nsduh/2k5nsduh/2k5Results.htm

Substance Abuse and Mental Health Service Administration [SAMHSA]. (2007). *Results From the 2006 National Survey on Drug Use and Health: National Findings.* Retrieved from http://www.samhsa.gov/data/nsduh/2k6nsduh/2k6results.pdf

Substance Abuse and Mental Health Service Administration [SAMHSA]. (2008). *Results From the 2007 National Survey on Drug Use and Health: National Findings.* Retrieved from http://www.samhsa.gov/data/NSDUH/2k7nsduh/2k7Results.htm

Substance Abuse and Mental Health Service Administration [SAMHSA]. (2009a). *Results From the 2008 National Survey on Drug Use and Health: National Findings.* Retrieved from http://www.samhsa.gov/data/nsduh/2k8nsduh/2k8results.pdf

Substance Abuse and Mental Health Service Administration [SAMHSA]. (2009b). *The NSDUH Report: Injection Drug Use and Related Risk Behaviors.* Retrieved from http://www.samhsa.gov/data/2k9/139/139IDU.htm

Substance Abuse and Mental Health Service Administration [SAMHSA]. (2010a). *Results From the 2009 National Survey on Drug Use and Health: National Findings.* Retrieved from http://www.samhsa.gov/data/nsduh/2k9nsduh/2k9results.pdf

Substance Abuse and Mental Health Service Administration [SAMHSA]. (2010b). *The DAWN Report: Trends in Emergency Department Visits Involving Nonmedical Use of Narcotic Pain Relievers.* Retrieved from http://www.samhsa.gov/data/2k10/DAWN016/OpioidEDHTML.pdf

Substance Abuse and Mental Health Service Administration [SAMHSA]. (2011). *Results From the 2010 National Survey on Drug Use and Health: National Findings.* Retrieved from http://www.samhsa.gov/data/nsduh/2k10nsduh/2k10results.pdf

Substance Abuse and Mental Health Service Administration [SAMHSA]. (2012). *Results From the 2011 National Survey on Drug Use and Health: National Findings.* Retrieved from http://www.samhsa.gov/data/nsduh/2k11nsduh/2k11results.pdf

Sue, D. W. & Sue, D. (2012). *Counseling the culturally diverse: Theory and practice* (6th ed.). Hoboken, NJ: Wiley.

Terry, C. E. & Pellens, M. (1928). *The Opium Problem*. Bureau of Social Hygiene, New York.

Thomas, D. L., Vlahov, D., Solomon, L., Cohn, S., Taylor, E., Garfein, R., & Nelson, K. E., (1995). Correlates of hepatitis C virus infections among injection drug users. *Medicine, 74,* 212-220.

Trenz, R. C., Scherer, M., Harrell, P., Zur, J., Sinha, A., & Latimer, W. (2012). Early onset of drug and polysubstance use as predictors of injection drug use among adult drug users. *Addictive Behavior, 37,* 367-372. doi: 10.1016/j.addbeh.2011.11.011

U.S. Department of Health and Human Services. (2004). National Institutes of Health. Community Epidemiology Work Group, 2004. Epidemiologic Trends in Drug Abuse. Advance Report: Prescription Drug Abuse.

Washton, A. M. (2002). Why psychologists should know how to treat substance use disorders. *NYS Psychologist, 14,* 9-13.

Wunsch, M. W., Nakamoto, K., Behonick, G., & Massello, W. (2009). Opioid deaths in rural Virginia: A description of the high prevalence of accidental fatalities involving

prescribed medications. *American Journal on Addictions, 18,* 5-14. doi: 10.1080/10550490802544938

Young, A. M., & Havens, J. R. (2012). Transition from first illicit drug use to first injection drug use among rural Appalachian drug users: a cross-sectional comparison and retrospective survival analysis. *Addiction, 107,* 587-596. doi:10.1111/j.1360-0443.2011.03635.x

Young, A. M., Havens, J. R., & Leukefeld, C. G. (2010). Route of administration for illicit prescription opioids: a comparison of rural and urban drug users. *Harm Reduction Journal, 7,* 24. doi: 10.1186/1477-7517-7-24

Young, A. M., Havens, J. R., & Leukefeld, C. G. (2012). A comparison of rural and urban nonmedical prescription opioid users' lifetime and recent drug use. *American Journal of Drug and Alcohol Abuse, 38,* 220-227. doi: 10.3109/00952990.2011.643971

Zacny, J., Bigelow, G., Compton, P., Foley, K., Iguchi, M., & Sannerud, C. (2003). College on Problems of Drug Dependence taskforce on prescription opioid non-medical use and abuse: Position statement. *Drug and Alcohol Dependence, 69,* 215-232. doi:10.1016/S0376-8716(03)00003-6