AN ABSTRACT OF THE DISSERTATION OF

Annie Larson for the degree of Doctor of Philosophy in Public Health presented on May 22, 2018.

Title: Health Service Utilization among Medicaid Enrollees in Oregon: Assessing Variation by Level of Rurality

Abstract Approved:

Jeff Luck Viktor Bovbjerg

Research Objective:

Nearly 60 million people in the United States reside in a rural area. Residents in rural areas have higher rates of chronic disease, risky health behaviors, disability, infant mortality, and age-adjusted mortality than their urban counterparts. Health insurance and access to care mitigate those risks, in part because insured persons are more likely to receive preventive care. Before implementation of the Affordable Care Act (ACA), 16% of the US population was uninsured. By 2016 the uninsured rate dropped to 10.5%. Many of those obtained coverage through state Medicaid expansion. It is important to

understand how those newly enrolled in Medicaid are utilizing care, especially in more rural parts of the US where access may be more challenging.

This study examined whether there were differences across levels of rurality in preventive and behavioral health service utilization among new expansion enrollees in Oregon compared to those previously enrolled.

Study Design:

This study used a quasi-experimental, retrospective cohort design utilizing: Oregon Medicaid claims and eligibility, as well as Rural Urban Commuting Areas (RUCAs), American Community Survey, and Health Resources and Services Administration Primary Care Service Area data. Linear probability models were used to estimate the effect of rurality on preventive and behavioral health service utilization among new versus previous Medicaid enrollees. Additionally, this study examined the effects of continuity of coverage on health service utilization by level of rurality among those newly enrolled and previous enrollees. Models controlled for age, sex, race, ethnicity, eligibility category, chronic conditions, and enrollment in a Medicaid accountable care organization (Coordinated Vare Organization or CCO) as well as the number of primary care providers per population, and median home value.

Population Studied:

The study population included adults age 18-64 who lived in Oregon and were enrolled in Medicaid at least one day from 2014 through 2015. The analysis included 314,131 men

and 375,201 women for a total of 15,281,308 eligible person-months.

Principal Findings:

The predicted probability of preventive service use in a given month among urban enrollees was 20.7%. Those living in small rural towns utilized 1.6 percentage points fewer preventive services in a given month than those living in urban areas ($p < 0.001$) and 1.5 percentage points fewer than those in large rural towns. However, the predicted probability of health services use in a given month among previous enrollees was 24.1% as compared to 18.1% among new enrollees. The variation between previous enrollees and new enrollees was greater for urban residents as compared to those residing in more rural parts of Oregon. Unadjusted rates by month indicate most of that difference was in the first few months post-expansion.

The predicted probability of receiving preventive services in a given month for enrollees living in urban areas enrolled the length of study period was 22.0 percent. It 3.7 percentage points lower for those enrolled continuously for less than one year. Continuity of coverage had different effects on those receiving tobacco cessation or substance abuse services. While urban enrollees and previous enrollees enrolled the entire study period utilized more cessation and substance abuse treatment services than urban enrollees and previous enrollees enrolled less than one year. However, new enrollees and rural enrollees enrolled the length of the study period utilized fewer behavioral health services than those enrolled less than one year.

The strongest predictors of receiving preventive services were enrollment in a CCO (7.8 percentage points greater than those not enrolled in a CCO), gender (6.8 percentage points greater for women than men), and having a chronic condition (53.3 percentage points greater than those with no chronic conditions).

Conclusions:

This study found that Medicaid residents in rural parts of Oregon received quantitatively fewer preventive and behavioral health services than those living in urban areas. Furthermore, continuity of coverage had differing effects on the utilization of preventive services across the urban-rural continuum, but overall, continuity of coverage was found to be an important component of preventive and behavioral health service utilization. This study did find that rural residents had less variation in service use by expansion type than urban residents. Furthermore, rural residents had less variation in service use regardless of the length of time they were continuously enrolled in Medicaid as compared to urban residents.

Implications:

The findings from this study suggest that factors other than the level of rurality may play a more important role in assisting Medicaid in accessing and utilizing health care. Factors such as gender, enrollment in a CCO and being newly enrolled in Medicaid all had a greater association with use of preventive and behavioral health care services than the level of rurality.

It may take more time for new enrollees to use preventive services at the same rate as those previously enrolled. However, it appears state efforts such as community health worker programs and telehealth services may be working to decrease disparities in preventive service use among new expansion enrollees residing in rural parts of Oregon.

Health Service Utilization among Medicaid Enrollees in Oregon: Assessing Variation by Level of Rurality

by

Annie Larson

A DISSERTATION

submitted to

Oregon State University

in partial fulfillment of

the requirements for the

degree of

Doctor of Philosophy

Presented May 22, 2018

Commencement June 2019

Doctor of Philosophy dissertation of Annie Larson presented on May 22, 2018

APPROVED:

Co-major Professor, representing Public Health

Co-major Professor, representing Public Health

Head of the School of Biological and Population Health Services

---

Dean of the Graduate School

I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

Annie Larson, Author

ACKNOWLEDGEMENTS

I want to expresses my deepest appreciation to my committee members for their time, expertise, and guidance through all my stops, starts and changes in direction. I owe a great deal to my classmates and coworkers who have been an unending source of understanding and support through it all. Thank you to all my friends, near and far, for the support and encouragement you have provided, for putting up with months of absences, and forcing me to take needed breaks. Finally, I cannot thank my family enough. I know I would not have made it here without your support, your willingness to listen and providing a place for me rest when I needed one.

TABLE OF CONTENTS

INTRODUCTION 1
Overview 2
Public Health Issues: Rural Disparities 2
Importance of Preventive Care 3
Affordable Care Act and Medicaid Expansion 4
Health System Transformation in Oregon 5
Gaps in the Literature 7
Purpose of Study 7
Significance of the Study 9

BACKGROUND 12
Rural Health Disparities 13
Preventive Care – Importance, Access and Barriers 14
Continuity of Enrollment and Care 17
Medicaid and Medicaid Expansion 18
Medicaid Expansion among Rural Populations 21
Health System Transformation in Oregon – Coordinated Care Organizations 22
Health System Transformation in Oregon – Patient Centered Primary Care Homes 26
Conceptual Model 28
Predisposing Characteristics 30
Enabling Resources 31
Need Factors 31
Specific Aims and Hypotheses 33

METHODS 37
Overview of Methods 38
Data Sources 38
Medicaid Claims and Medicaid Eligibility 38
Rural Urban Commuting Area 38
American Community Survey 39
Primary Care Service Area Data 39
Outcomes 39
Main Variables of Interest 41
Individual Level Covariates 44
Area-Based Covariates 45
Empirical Framework 48
Linear Probability Models 48
Final Models 52
Research Question 1 53
Research Question 2a & 2b 54
Research Question 3 55
Research Question 4a & 4b 55
Sensitivity Analyses 55

IRB Approval 56
RESULTS 57
Analytic Sample 58
Summary Statistics 58
Study Population 58
Between RUCA Movement 59
Continuity of Enrollment 59
Covariates 60
Outcomes 60
Aim 1: Preventive Service Use among New Enrollees by Rurality 61
Number of Services Received 63
Tests for Validity of Linear Probability Models 64
Sensitivity Analyses 64
Aim 2: Behavioral Health Service Use among New Enrollees by Rurality 65
Number of Services Received 68
Tests for Validity of Linear Probability Models 69
Sensitivity Analyses 69
Aim 3: Continuity of Coverage - Preventive Service Use 71
Tests for Validity of Linear Probability Models 71
Sensitivity Analyses 72
Aim 4: Continuity of Coverage – Behavioral Health Service Use 72
Tests for Validity of Linear Probability Models 74
Sensitivity Analyses 74
DISCUSSION, IMPLICATIONS AND CONCLUSION 111
DISCUSSION 112
Summary of Findings 112
Association Between Rurality and Health Service Utilization: Key Findings 112
Association Between Continuity of Enrollment and Health Service Utilization: Key Findings 114
Strengths and Limitations 116
Strengths 116
Limitations 117
IMPLICATIONS 119
Implication #4: Future Cost Savings 122
Future Research 123
CONCLUSION 124
REFERENCES 127
APPENDICES 139
Appendix A: Count Model - Preventive Service Use 140
Appendix A: Count Model – Tobacco Cessation Service Use 140

Appendix A: Count Model – ETOH Treatment 140
Appendix B: OHP List of Prioritized Services ICD-9, ICD-10 and CPT Codes 141
Appendix C: RUCA B Codes 142
Appendix D: OHP Medicaid Eligibility Codes 144
Appendix E: List of Chronic Conditions and ICD Codes..... 145

LIST OF FIGURES

Figure 1: Coordinated Care Organization Service Areas 35

Figure 2: Andersen's Behavioral Model of Health Service Use..... 36

Figure 3: Trends in Preventive Service Use by RUCA and Month, 2012 to 2015..... 77

Figure 4: Trends in Cessation Service Use Among Smokers by RUCA and Month, 2012 to 2015 78

Figure 5: Trends in Substance Abuse Treatment Among Abusers by RUCA and Month, 2012 to 2015 79

Figure 6: Trends in Preventive Service Use by Medicaid Enrollment Type, 2012-2015. 80

Figure 7: Trends in Cessation Service Use Among Smokers by Medicaid Enrollment Status, 2012-2015 81

Figure 8: Trends in Substance Abuse Treatment Among Abusers by Medicaid Enrollment Status, 2012-2015 82

LIST OF TABLES

Table 1a: Oregon Medicaid Enrollees Person-Months 2014-2015 83
Table 1b: Oregon Medicaid Enrollees Frequency, 2014-2015 85
Table 2: RUCA Moves (2014 - 2015) 86
Table 3: Continuity of Enrollment - Person Eligible Months 87
Table 4a: Pairwise Correlations 88
Table 4b: Pairwise Correlations, Area-Based SES Indices 88
Table 5: Unadjusted Rate of Service Use in a Given Month by RUCA 89
Table 5b: Unadjusted Rate of Service Use in a Given Month by RUCA and Expansion Type 89
Table 6: Aim 1 – Differential Impact of Rurality on Preventive Service Utilization 90
Table 7: Aim 1 Validity 91
Table 8: Aim 1 Sensitivity 92
Table 9: Aim 2 - Differential Impact of Rurality on Cessation Service Use, Smokers 93
Table 10: Aim 2 - Differential Impact of Rurality on ETOH Treatment, Substance Abusers 94
Table 11: Aim 2 Cessation Validity 95
Table 12: Aim 2 ETOH Validity 96
Table 13: Aim 2 Cessation Sensitivity 97
Table 14: Aim 2 ETOH Sensitivity 98
Table 15: Aim 3 – Differential Impact of Continuity of Coverage and Rurality on Preventive Service Utilization 99
Table 16: Aim 3 Validity 101
Table 17: Aim 3 Sensitivity 102
Table 18: Aim 4 – Differential Impact of Continuity of Coverage and Rurality on Tobacco Cessation 103
Table 19: Aim 4 - Differential Impact of Continuity of Coverage and Rurality on ETOH Treatment 105
Table 20: Aim 4 - Tobacco Validity 107
Table 21: Aim 4 - ETOH Validity 108

Table 22: Aim 4 - Tobacco Sensitivity 109
Table 23: Aim 4 - ETOH Sensitivity 110

CHAPTER 1

INTRODUCTION

Overview

Public Health Issues: Rural Disparities

Nearly 60 million people who live in the United States, almost 20 percent, reside in an area designed by the US Census as rural.[1] Healthy People 2020 and the National Institute of Health have identified rural health disparities and the lack of research on rural health as top priorities.[2,3] The limited research done shows disparities across a wide range of health behaviors and health outcomes among rural populations as compared to their suburban and/or urban counterparts.[4-10]

Some studies suggest that rural health disparities may be more a function of the demographic and socioeconomic differences between rural and urban populations than other aspects of rurality such as geographic isolation, cultural differences, or lack of services or practitioners.[11-13] Rural residents are more likely to have a family income below the federal poverty level, are less likely to have access to insurance through their employer and be less likely to have health insurance of any form than metropolitan residents.[14-16] Although rural America remains less racially and ethnically diverse than metropolitan areas, from 2000 to 2010, 83% of the non-metropolitan population growth came from minority groups.[6,17] Additionally, rural residents are, on average, older than urban residents.

In addition to these demographic differences between urban and rural populations, rural residents are more likely to report delaying or not receiving medical care due to cost.[18] Prior to implementation of the Affordable Care Act and Medicaid expansion, significantly more persons living in rural areas were covered by Medicaid than those living in metropolitan areas.[14,16]

Importance of Preventive Care

Although access to health care services alone does not ensure good health, it is recognized as an important component, particularly access to primary care and preventive health services.[19] Because primary care providers (PCPs) are often seen as the entry point into the health care system and often help coordinate and advocate for the care of their patients, understanding how their services are utilized is important for improving population health. A review of studies found a causal relationship between having health insurance and utilization of preventive health care services as well as improved health outcomes.[20] Increased primary care utilization has also been found to be associated with better health outcomes.[21] However, primary care access in rural communities is often seen as a challenge and increasing access to health care was the most frequently cited priority among state and local rural health respondents.[22]

Primary care providers deliver a multitude of services including tobacco cessation and alcohol and drug treatment. Although we have witnessed some success in reducing tobacco use it is still the leading cause of preventable death and disease in the United States while alcohol use is the third leading cause.[23] The U.S. Preventive Services Task Force recommends clinicians ask all adults about their tobacco use and advise them to quit smoking and provide cessation services to those ready to quit as well as to ask about alcohol misuse.[24]

Access to and use of health care services is influenced by a host of factors such as race, ethnicity, sex, income, education access to transportation, having health insurance, and provider availability.[25,26] Distance to care is also an important factor in determining

access and use.[7,27,28] More specifically, utilization of preventive health care services was found to be affected by geographic distance while utilization for acute and chronic care was less likely to be.[7] Factors such as access to transportation, having health insurance or higher income play an important role in non-emergent health care utilization, all issues rural residents are more likely to face.[7] Because health care resource availability tends to decline as population density declines, residents in rural areas often incur higher costs due to increased travel-time.[15]

Affordable Care Act and Medicaid Expansion

Medicaid serves an important role in ensuring that low-income populations are able to obtain needed and recommended care.[26,29,30] Prior to the implementation of the Affordable Care Act and Medicaid expansion, an estimated 41 million individuals, or about 16% of the nonelderly population, were living in the United States without health insurance.[31] About 17% of rural residents, roughly 7.3 million individuals, were uninsured.[32,33] By 2015, about 13 million people had gained health insurance and the uninsured rate among the nonelderly population dropped to 10.5%.[31] A large number of those newly enrolled in Medicaid were likely previously uninsured for a long period of time.[34] Although persons living in rural areas have similar rates of being uninsured as those living in metropolitan areas, those residing in rural areas have a greater reliance on Medicaid coverage. Before the implementation of the Affordable Care Act, 21% of rural residents were covered by Medicaid as compared only 16% of those living in metropolitan areas.[14] Increased reliance on Medicaid may be due in part to the fact that rural employers are less likely to provide health insurance.[14]

Although Medicaid provides insurance to many low-income persons, many enrollees find themselves without continuous coverage. Gaps in insurance coverage, also known as "churn" lead to lower rates of preventive health service utilization and worse health outcomes and more costly monthly medical expenditures.[35-37] Adults enrolled in Medicaid, on average, retain coverage for about 8 months[37] and roughly two-thirds of new enrollees lose their coverage within the first year.[38] Rates of Medicaid enrollment continuity among Oregon adults are similar to national rates.[37]

Previous cuts to Medicaid have resulted in poorer health outcomes among rural populations as compared to urban.[39] Concern about the provider supply and availability post-expansion exist among all populations.[40] Poverty and lack of insurance, both more prevalent among rural populations are found to be intertwined with fewer providers.[41] Additionally, because Medicaid expansion and the Affordable Care Act may have a greater impact on increasing insurance rates in rural areas coupled with an already limited supply of primary care providers in rural communities[42] some are concern that those providers will not be able to adequately serve the expanded insured populations.[16]

Health System Transformation in Oregon

Under the Patient Protection and Affordable Care Act (ACA), Medicaid coverage was expanded within the state of Oregon.[43] Oregon Health Plan (OHP, Oregon's Medicaid insurance program) enrollment increased dramatically, from December 2013 to February 2017, the number of eligible persons in Oregon increased by 155 percent, from 614,183 to 953,384.[44] OHP enrollment varies across the state; from 16% in Benton county to 38% in Josephine county.[45] Other provisions within the ACA may reduce gaps

in coverage by allowing persons to remain enrolled for longer periods of time and efforts to streamline enrollment processes.[43,46]

In addition to expanding Medicaid coverage, the state of Oregon has undergone other health system transformation efforts targeting OHP enrollees. In 2012, as part of an agreement between the state of Oregon and the Center for Medicaid and Medicare (CMS), Oregon established its first Coordinated Care Organizations (CCOs).[47-49] CCOs are tasked with integrating and coordinating behavioral, physical, and oral health care and have the overarching goal of improving health, improving care, and lowering costs.[49] CCOs are managed within global budgets that allow for alternative payment strategies to incentivize preventive care as well efficiency.[47,49,50] They are accountable for meeting certain benchmarks, but can be penalized for not meeting certain quality measures. Because CCOs are locally governed, each of the 16 CCOs currently in operation looks slightly different.

A central component of CCOs is to ensure enrollment in and access to patient-centered primary care homes (PCPCHs). Under Oregon regulation, PCPCHs are designed to "focus on wellness and prevention, coordination of care, active management and support of individuals with special health needs, and a patient and family-centered approach to all aspects of care."[51] The emphasis of PCPCHs is whole-person care that includes both physical and behavioral health care needs. As of the start of 2017, ninety-percent of those enrolled in OHP were also enrolled in a CCO.[44] Of those enrolled in a CCO, ninety-percent were also enrolled in one of the 655 currently recognized PCHPHs in Oregon.[45,52] Overall, Oregon's CCO model aims to increase accessibility to primary use and as well as ensure better coordination and comprehensiveness of care.[53]

Gaps in the Literature

The complexity of challenges facing residents in rural areas in accessing and utilizing health care services include a multitude of factors; from geographic challenges, to the demographic makeup of rural populations, to what Hartley (2004) called a "rural cultural health determinant."[54] Though many studies have examined the effects of Medicaid expansion on use of health care services, those studies have largely focused on urban populations or a combination of urban and rural populations. Little attention has been paid to the impact of these policy changes on rural populations, specifically.[29,55-57] One of these studies only examined the impact of a smaller expansion effort on rural, Wisconsin residents and enrollees in a multi-county area that is thought to be largely rural to define rurality.[30] In addition, no studies to our knowledge have examined the impact of Medicaid expansion on preventive and behavioral health service utilization among new versus previous Medicaid enrollees and how length on enrollment in Medicaid impacts health service utilization across different levels of the urban-rural continuum.

Purpose of Study

The purpose of this study is to understand whether differences in health service utilization exist among new Medicaid enrollees and those previously enrolled in Oregon after implementation of the Affordable Care Act across varying levels of rurality. Because rural populations differ demographically and in terms of resource availability from those who reside in more urban areas, it is it important to understand whether any differences in health care service utilization are a function of those differences or a function of geographic locality and context. Additionally, this study examines the impact continuity of enrollment has on utilization of health services among Oregon Medicaid

enrollees across differing levels of urbanization. In light of the potential for the Affordable Care Act or Medicaid expansion to be curtailed or rolled back, it will be important to understand any changes that have occurred. The specific aims include the following:

Aim 1: Utilization of Preventive Services Investigate the impact the level of rurality had on utilization of preventive care services among new and previous Medicaid enrollees in the state of Oregon. Utilization will be measured by whether the person ever accessed care and how many times. Research question to be addressed:
1a. What is the association between the level of rurality and utilization of preventive care services among new Medicaid enrollees in Oregon?

Aim 2: Utilization of Behavioral Health Services Investigate the impact the level of rurality had on utilization of behavioral health care services among new and previous Medicaid enrollees in the state of Oregon. Utilization will be measured by whether the person ever accessed care and if so, how many times. Research questions to be addressed:
2a. What is the association between the level of rurality and utilization of tobacco cessation services among new Medicaid enrollees diagnosed with tobacco use disorder in Oregon?

2b. What is the association between the level of rurality and utilization of alcohol or substance abuse treatment among new and previous Medicaid enrollees with a diagnosed alcohol and substance abuse condition in Oregon?

Aim 3: Continuity of Enrollment and Preventive Service Utilization Investigate the impact the level of rurality had on utilization of preventive care services among those continuously enrolled in Medicaid compared to those with gaps in coverage gaps within the state of Oregon. Research question to be addressed:

3a. How does continuity of insurance among Medicaid enrollees impact the utilization of preventive care services across differing levels of rurality?

Aim 4: Continuity of Enrollment and Behavioral Health Service Utilization Investigate the impact the level of rurality had on utilization of behavioral health services among those who were continuously enrolled in Medicaid compared to those who had coverage gaps within the state of Oregon. Research questions to be addressed:

4a. How does continuity of insurance among Medicaid enrollees compared to those who had gaps in coverage impact utilization of tobacco cessation services among those diagnosed with tobacco dependence across differing levels of rurality?

4b. How does continuity of insurance among Medicaid enrollees compared to those who had gaps in coverage impact utilization of alcohol and substance abuse treatment among those diagnosed with an alcohol and substance abuse condition across differing levels of rurality?

Significance of the Study

One might expect that with the implementation of CCOs and PCPCHs access to, and utilization of, preventive care services would increase among Oregon's Medicaid

population. However, a shortage in primary care provider availability has been suggested as a potential side effect of Medicaid expansion.[40,58] Primary care providers make up a larger portion of the health care workforce in rural areas[42] and prior to Medicaid expansion, rural areas had significantly fewer primary care providers per population compared to more urban areas.[42,59,60] Despite these concerns, early studies indicate the availability of primary care appointments for new Medicaid patients have increased in Oregon post-Medicaid expansion.[61] However, evidence of the effects of Medicaid expansion on increasing utilization of primary care and preventive services is conflicting.[62,63] Additionally, no studies have differentiated the effects of preventive service utilization post-Medicaid expansion between urban and rural populations. By using a more precise tool to categorize urban and rural residents, this study may be better able to untangle variations that exist across varying levels of urbanization.

Because rural areas have seen a greater increase in Medicaid enrollees as a result of Medicaid expansion, are more likely to face primary care provider shortages, and face other access and use challenges, it is essential that we understand whether these residents are able to access and utilize primary care services as needed. Understanding urban and rural differences in utilizing health services will be especially important among higher risk populations such as tobacco users and those with alcohol or substance abuse needs. Because the ACA has a strong emphasis on preventive care, this study will add to the few studies that have examined the impact of preventive health service use. Additionally, this study will add to the existing body of research examining the effects of Medicaid expansion on those newly enrolled by providing the first look at the effects among rural residents.

Efforts to repeal and replace the ACA may mean millions of people could lose their health insurance. Understanding how newly insured individuals access and utilize preventive care in rural areas, especially where residents are more dependent on Medicaid, will be important as cuts to Medicaid are considered. These cuts have the potential to have very different effects on residents and providers in rural parts of the United States as compared to those in more urban areas.

CHAPTER 2

BACKGROUND

Rural Health Disparities

One of the challenges in studying rural health and rural health disparities comes from the fact that there is not one clear definition of what rural is. Rural is seen as a multifaceted concept in which it is sometimes defined in relation to the physical or geographic environment, others look at aspects of the social environment, and others define it in terms of access or proximity to certain types of care or services.[64,65] With regard to measuring health and health disparities, depending on how rural is defined disparities may be incorrectly estimated.[66] A clear definition and method for measuring urban and rural differences is important for determining grant funding or program eligibility.[67] Many researchers use a dichotomous definition of urban and rural, often based upon county of residence.[65,68] Use of such a classification scheme however, assumes rural areas are homogenous and may result is hiding real differences that exist.

Despite these challenges in measuring and defining rural and urban areas, research has consistently shown that residents in rural areas have higher rates of chronic diseases, risky health behaviors, disability, infant mortality and age-adjusted mortality than their urban counterparts.[6,9,15] Nationally, mortality rates for adults under the age of 65 are highest in nonmetropolitan counties.[6] Between 1968 and 2004 disparities in age-adjusted mortality rates have steadily increased from 12.5 to 71.6 excess deaths per 100,000 in nonmetropolitan areas.[69] Much of this increase may be due to the slower pace at which mortality rates have decreased for the five leading causes of death in nonmetropolitan areas.[8] Additionally, geographic disparities in heart disease, hypertension, diabetes, cancer, stroke, and chorionic obstructive pulmonary diseases have been found to increase as rurality increases.[6,15]

Disparities in rates of diseases between urban and rural residents may be a function of health-related behaviors. Adults residing in rural areas are more likely to be inactive or report being obese.[6,10,15] Smoking is still the leading cause of death and disability in the United Stated.[70,71] Teens and adults living in the most rural areas are more likely to smoke than those in metro areas.[6,15] In some regions of the United States, there is a two-fold difference in smoking rates between rural and metro residents. Other risky health behaviors, such as excessive drinking and drug overdose deaths account for about 135,000 deaths per year.[72,73] Although rates of alcohol consumption across different levels of urbanization appear to be relatively flat on the national level, in the Western region of the United States, alcohol consumption increases as population density decreases.[6] Additionally, residents of rural counties have higher rates of drug-related deaths including deaths from opioids as well as higher rates of opioid misuse.[74,75]

Preventive Care – Importance, Access and Barriers

Access to and use of services from primary care providers is important in the health and wellbeing of individuals.[76] Those who access care through a primary care provider are more likely to be vaccinated, receive appropriate and necessary tests, receive health counseling, and necessary services to manage chronic conditions.[21,77] These people are, in turn, less likely to develop infectious diseases or more complicated chronic conditions that require advanced or more expensive medical treatment.[77] Underutilization of preventive care has been shown to result in the failure to identify potentially serious health issues, help in the early management of diseases and reduce unnecessary care.[19]

Research has shown there is an association between increased primary care provider availability and reduced mortality rates, preventable hospitalizations, low birth

weight, improved self-rated health status, as well as decreased inequalities in self-reported health across levels of socio-economic status.[21,76,78] Additionally, physician interventions have been found to significantly increase tobacco quit rates[79,80] and are shown to be cost effective among those who abuse alcohol.[79] Some believe that emphasizing preventive care services may even help reduce certain health inequities [76] and may mitigate some of the adverse effects social determinants play on overall population health.[21]

Multiple factors have been found to influence the use of primary care services. These include individual barriers due to cost of care such as having health insurance, out-of-pocket payments or socioeconomic status; longer wait times; provider supply and availability; and transportation barriers[60,81-86] In the United States, those who lack health insurance are less likely to receive or access preventative care services.[87] A survey examining complexities in accessing and utilizing preventive care among low-income adults found that system-level barriers such as insurance coverage; financial barriers; and access barriers such as transportation or appointment availability were reported more often than individual or provider-level barriers.[88] Additionally, the study found that individual, provider and system-level barriers were all associated with delays in receiving needed medical care as well as forgoing care.[88] Research has indicated that having a primary care physician is associated with receipt of preventive health services.[84] Continelli et al. (2010) found that as the rate of primary care doctors increased per capita, so too did the odds of having a primary care physician.[84] Adults in Oregon newly enrolled in Medicaid identified reasons for not utilizing care after gaining insurance

including: confusion about what services were covered; perception they did not need care; not being satisfied with the care they did receive; and barriers in access to care.[89]

Persons who reside in rural areas may be more likely to have trouble or not be able to access preventive health care. A study comparing medical care access in rural and metropolitan areas found that, while provider supply and availability was not an barrier, rural residents did have more financial barriers in obtaining care.[60] Additionally, residents of rural areas often have further to travel to receive health care services.[15,60] A review examining the association between transportation and health care access found that most of the studies included identified the distance and time needed to get to a provider were barriers to preventive care utilization.[83] Allen et al. (2017) found that among new Medicaid enrollees in rural Oregon, distance to care was a barrier to accessing care by most survey respondents and many reported forgoing any type of care because of transportation issues.[90]

Other research has pointed to neighborhood structures that impact access to and use of health care. Despite a wide range of definitions and measures used to study neighborhoods, a review looking at the association between neighborhood effects and health found evidence of neighborhood effects across multiple health outcomes.[91] Other studies found an association between neighborhood socioeconomic status and health service utilization. Children with asthma in lower SES neighborhoods have higher rates of emergency department readmissions than those residing in more advantaged neighborhoods, even after controlling for individual-level characteristics[92]. A study of health care use found that persons living in poorer neighborhoods used more health services, particularly physician services, than those residing in more advantaged

neighborhoods[93]. Independent of individual effects, recommended health screenings used to identify cancers have been found to be less likely to happen, or occur later, in lower SES neighborhoods.[94-96] Without taking nighborhood factors into account, we may not truely understand the impact individual level characteristics play.

Continuity of Enrollment and Care

Having health insurance is one factor related to accessing needed and recommended health care. Not only is having insurance important, but being continuously enrolled in health insurance is associated with increased utilization of any type of health service. Research has found that those with as little as a one to three month gap in insurance were significantly less likely to have a usual source of care and they were significantly more likely to delay care because of cost.[97] Furthermore, continuity of coverage has been shown to be a significant predictor in better access, increased quality and decreased cost of care.[36,37] Studies indicate that individuals coming off periods with intermittent coverage may require a catch-up period before they access and utilize preventive services at the same rate as those without gaps in coverage.[35,36,98,99] Others suggest that those coming off periods without insurance may have "pent up demand" and may have higher costs and greater need for care at the beginning of their enrollment.[37]

Individuals who gain health insurance after a period with none have fewer physician visits, but significantly more hospital emergency department and outpatient visits.[100] Almost 20% of adults living in the United States have had a gap in coverage for at least part of the previous year.[97] Originally established in 1986, The Transitional Medical Assistance (TMA) under Medicaid requires states to continue Medicaid benefits to some that would otherwise lose coverage for an additional 4 months. A 2008 law

extended that period of coverage to anywhere from 6 months to one year.[101] This additional coverage, however, is periodically set to expire. A report to the Congress on Medicaid and CHIP has recommended making 12-months of continuous enrollment for adults, similar to what is in place for CHIP, more permanent.[102]

Research indicates that Medicaid enrollees are particularly vulnerable to gaps in coverage, often referred to as "churn." Churn may happen because of changes in income; switching between private and public insurance options; or changes in Medicaid eligibility, any of which could result in a change in eligibility and may in turn lead to a gap in or complete loss of coverage.[103] Prior to the Affordable Care Act and Medicaid expansion, the probability of new enrollees remaining on Medicaid with no gap in coverage for a full year was 38%.[38] Because higher rates of rural residents are insured by Medicaid[104] they may be particularly vulnerable to churn as compared to urban counterparts.

Medicaid and Medicaid Expansion

Since the start of 2013, the rate of those uninsured in the United States has fallen dramatically. It is estimated to have dropped from 20.3% in 2012 to 11.5% as of the beginning of 2016.[105] A large reason for these improvements were provisions within the Affordable Care Act (ACA) which resulted in most states expanding Medicaid eligibility at the end of 2012.[105,106] As of early 2016, an estimated 20 million people are now covered by health insurance because of the ACA.[105] Many of the those newly enrolled in Medicaid were found to have been previously uninsured, the majority of whom where uninsured for a year or longer.[107] While Medicaid expansion has been found to be one of

the key drivers in reducing the rate of those uninsured, state policies and outreach efforts also play a role in reducing the uninsured population.[108]

In addition to providing health insurance to more people, one of the goals of the ACA is to improve health outcomes. Along with increasing the number of people eligible for Medicaid, the ACA also expanded coverage for preventive and wellness services and now mandates no cost-sharing for many of these services.[77] Preventive services covered include evidence based screening and counseling, tobacco cessation, immunizations, screening and other preventative services for children and youth, and preventative services for women.[109,110] The law also mandates expansion of substance abuse coverage and service delivery integration with the goal of better integrating substance abuse services with physical health care.[111] Studies have shown that Medicaid expansion has successfully improved access to and use of health care as well as decreased uncompensated costs for the health care system.[112-115]

A review of 108 studies looking at the impact of Medicaid expansion found that, overall, expansion states have had an increase in preventive care visits among those newly enrolled.[112] The increase in preventive care visits may be the result of the ACA and Medicaid expansion reducing financial barriers to access needed medical care.[116] Additionally, patients newly enrolled in Medicaid post-expansion were more likely to obtain tobacco treatment than commercially insured patients. This may be especially important given smoking rates among Medicaid enrollees is nearly twice that of persons commercially insured.[117]

In 2008 the state of Oregon opened its Medicaid program, OHP, to low-income adults through a lottery system of waitlisted names. This early expansion effort created a

sort of natural experiment whereby those enrolled could be studied and compared to those who remained on the waitlist, but were not selected through the lottery. One study found significant increases in office visits and some preventive screenings among new enrollees, but no change in emergency department visits.[57] Another study looking at patients who accessed services through community health centers compared those newly enrolled to those not selected through the lottery.[57] Those newly enrolled were found to have significantly more primary care visits, but no difference in behavioral health care visits was found.

A more recent study of the Oregon Experiment examined primary care utilization rates comparing those with at least 12 months of continuous coverage prior to the OHP lottery to newly insured OHP enrollees and "returning enrollees" who had been insured some time in the two years prior to the lottery.[118] They found that new and returning enrollees had significantly lower primary care utilization rates in the first three months as compared to those continuously insured. However, by four months, rates of both newly and returned insured persons surpassed those of the continuously insured group. Rates of primary care utilization did not differ significantly after 1-year of coverage. Their findings suggest that it takes time to find and establish a medical home.

It should be noted that Oregon's early expansion efforts were on a much smaller scale than the expansion resulting from the ACA and did not include the individual mandate further increasing the rate of those with health insurance. Furthermore, these early expansion efforts did not change mandates for covered services and were prior to Oregon's own health system transformation efforts. Combined, these factors may result

in very different outcomes for those newly enrolled as well as returning and continuously enrolled persons on Medicaid.

Medicaid Expansion among Rural Populations

Because rural areas often face shortages in primary care providers, there has been concern that the increase in the insured population would be more likely to overwhelm providers in rural areas.[58,62] However, a survey of rural physicians found they did not report feeling overwhelmed by the increase in visits due to Medicaid expansion.[119] One study using simulated requests for primary care appointments found there was an increase in appointment availability for Medicaid enrollees, including enrollees in Oregon.[61,120] Two studies using National Health Interview Survey data found conflicting results about whether use of primary care providers changed after expansion.[62,121]

Sommers et al. (2016) examined the effects of Medicaid expansion in primary care provider (PCP) shortage areas and found there were improvements in preventive checkup visits and care for chronic conditions in PCP shortage areas in states that expanded Medicaid compared to those that did not.[122] These improvements, though, were smaller in provider shortage areas than they were among the pooled sample. While there may be some correlation between PCP shortage areas and rurality, because the study designated PCP shortage areas by county, they may not have adequately accounted for counties that face PCP shortages in some, but not all parts of the county. Additionally, not all rural counties are designated health provider shortage areas and while these rural communities may not face provider shortages, may still face other challenges that limit preventive care visits.[123]

The state of Wisconsin also underwent early expansion of its Medicaid program in 2009. Burns et al. (2014) looked at changes in health care utilization among residents in rural Wisconsin after expansion.[30] The study found an increase in the number of preventive care visits among new enrollees as compared to those waitlisted, but inconclusive results pertaining to emergency department and behavioral health visits. The study did not, however, compare changes in utilization among rural residents to residents in urban areas.

Research by Allen et al. (2017) of Oregon's 2008 Medicaid lottery compared urban and rural residents.[90] They found there were no significant differences in the treatment effect of Medicaid enrollment among urban versus rural residents. However, there were several limitations of their study design. They used a dichotomous urban/rural definition based on Rural Urban Continuum Codes (RUCCs) to categorize residents. Because RUCCs are based on county of residence, and because there are counties in Oregon with rural areas that also have a metropolitan center, this classification scheme may have resulted in underestimating any real differences. Additionally, use of a dichotomous urban and rural definition may not detect nuances across the urban-rural continuum.

Health System Transformation in Oregon – Coordinated Care Organizations

Within the state of Oregon, health system transformation has extended beyond the Affordable Care Act and Medicaid expansion. In 2012, as part of House Bill 3650, Coordinated Care Organizations (CCOs) were established.[47,124] With funding and a waiver from the Centers for Medicaid and Medicare, Oregon made promises to reduce the rate of Medicaid spending from an average of 5.4% to 3.4% while maintaining quality

of care.[125] Failure to meet those promises could result in substantial financial losses to the state. CCOs are similar to Accountable Care Organizations with several key differences; they were established to assess the ability to improve access to care and population health among Medicaid enrollees as opposed to Medicare enrollees; they are locally governed by those who provide care, OHP enrollees, local government officials, and those who take financial risk; they have global budgets that may be used with some flexibility; and there are benchmarks each CCO is mandated to meet that result in financial incentives or penalties.[48,50,126] The result of the flexibility within CCOs means each one looks and operates a little differently. Fifteen CCOs are currently in operation within the state of Oregon after FamilyCare closed its doors on January 31, 2018 (*see Figure 1*).

Each CCO is accountable to the State through a set of 17 mandatory quality measures that provides financial incentives for improving health outcomes and ultimately improve the quality of care provided.[49,125] Additionally, the State is accountable to the Centers for Medicaid and Medicare for a set of 33 measures, 16 of which overlap with CCO metrics.[125] These incentives include an emphasis on prevention, evidence-based medicine and coordination of care. Included in the list of incentives are metrics for enrollment in a patient centered primary care home and tobacco use prevalence.[127] Screening for alcohol and substance misuse has been an incentive metric, but was removed for calendar year 2017 until an electronic health record-based measure can be developed and this measure will be reinstated as a metric in 2018.[127] The 2016 Mid-Year Report for CCOs indicates enrollment in a primary care home grew almost 40 percentage points from 52% in 2012 to 91% as of September 2016.[128] Screening for alcohol or other

substance misuse grew 10 percentage points from 2011 to mid-2016. Because cigarette smoking is a new metric, no trends by CCO are reported.

Each of the 16 CCOs receives a global budget from the State based on the number of patients they serve as well as the health of those individuals.[125] There is flexibility in the way these budgets can be spent, meaning alternative strategies such as bundled payments may help put less emphasis on higher quantity over higher quality and CCOs are encouraged to tailor strategies to the populations they serve. While CCOs are given a global budget, providers are still reimbursed of a fee-for-service basis for services included on the OHP Prioritized List. However, CCOs are encouraged to use alternative payment strategies to incentivize providers for person-center, comprehensive care.[47] There is some question as to whether providers will buy-in to the CCO model, but early reports show that primary care providers are contracting with CCOs.[125] Additionally, research indicates that as of the end of 2015, CCOs were associated with a 7 percentage point decrease in expenditures for five service areas.[63]

As of 2017, almost 25 percent of Oregonians are insured through OHP and of those, about 90% are enrolled in a CCO.[44,128] Each CCO is mandated to provide integrated physical, behavioral, and oral health care for their patient population they serve. In an effort to better coordinate care for OHP members, CCOs put an emphasis on medical homes, referred to as Patient-Centered Primary Care Homes (PCPCHs). The goal of CCOs is to have primary care providers deliver the majority of care to OHP enrollees. This may require increased communication with patients through the use of Community Health Workers, social workers, electronic communication or tele-health. This emphasis on prevention will be key to improving health and controlling costs. Though enrollment

in PCPCHs has grown, there has been conflicting evidence of the use of primary care services post-CCO implementation. One study examining the effect of the first two years of CCO implementation found primary care visits decreased along with spending for evaluation and management services.[63] A 2017 report to the Oregon State Legislature found CCOs spent a larger percent of medical spending on primary care than other major payer source.[129] The percent spent on primary care services by CCOs, however, decreased from 2014 to 2015 whereas they increased among all other payer sources.

With the exception of the Portland-metropolitan area and southwest Oregon, there is very little geographic overlap of the CCOs. This means most OHP enrollees are assigned to the CCO that covers the ZIP code they reside in. Because CCOs are geographically defined they can vary substantially in the number of patients served; from 221,257 in Health Share of Oregon to 10,952 in PrimaryHealth of Josephine County as of the June 2016.[128] Additionally, CCOs vary in terms of their demographic make-up[128]. Providers contract with CCOs, but they may contract with more than one CCO.[50] A provider may not refuse to contract with a CCO if their services are necessary unless the reimbursement is not "reasonable" to cover the cost of that service.[47]

The combination of closed provider networks, geographically diverse areas and populations and flexibility in spending mean there are 16 incubator projects running throughout the state of Oregon. While all CCOs have the same general guidelines and targets, the variety of services, supports and strategies each one implements may result in differences in outcomes among their patient populations. Of note, the Mathematic mid-Point Evaluation of CCOs stated there has been a "lack of focused attention on the unique needs of rural communities."[130]

The final CCO evaluation report found improvement in many of the quality measures they examined relative to how Washington state Medicaid program was performing. [131] These findings included decreases in avoidable emergency department utilization, an increase in self-reported overall health among CCO enrollees and a decrease in overall spending per-member per-month. Additionally, the evaluation found improvements in many prevention and wellness care measures including improvements in tobacco counseling. However, the evaluation also found that the percent of CCO members with any primary care decreased and there were decreases in alcohol or drug treatment among CCO enrollees.

Health System Transformation in Oregon – Patient Centered Primary Care Homes

The medical home concept was originally put forth by the American Academy of Pediatrics in 1967.[132] It was not until 2007 that many of the major primary care physician organizations came together to outline the *Joint Principles of the Patient-Centered Medical Home*.[132] Many of these same principles were adopted to become part of what is defined as the main features of a medical home; patient-centered, comprehensive, coordinated, accessible, and committed to safety and quality care. The Patient Protection and Affordable Care Act made medical homes a central component through the inclusion of several provisions to support such efforts. These efforts included time-limited supplemental payments to primary care providers who saw Medicaid patients and funding for pilot programs such as the Comprehensive Primary Care Initiative (CPC).[43,133] While not all provisions were directly targeted at Medicaid patients, provisions that changed health care delivery within a practice would effect all patients

seen within that practice. A review of PCMHs across the United States found they improved health outcomes, lowered costs for patients, employers, and insurers, and were receiving increasing support from the private and public sector.[134]

In 2009 the Oregon legislature passed House Bill 2009 which established the Patient-Centered Primary Care (PCPCH) program.[51] The Bill also changed payments to practices that provided care in a medical home. To further PCPCH efforts in Oregon, they were made central component of CCOs.[47] CCOs are required to include PCPCHs in their network and enrollment in a PCPCH is one of the metrics upon which CCOs are incentivized.[128] As of the mid-2016, ninety percent of those enrolled in a CCO were also enrolled in a PCPCH.[128] Currently, CCOs are spending a larger proportion of their total medical spending on primary care services as compared to any other major insurer in Oregon.[129] To become a recognized PCPCH, clinics must meet the following standards; accessible, accountable, comprehensive, continuous, coordinated, and patient and family centered.[53] As of April 2017, there were 655 recognized PCPCHs in Oregon.[52]

A 2016 evaluation of the PCPCH program compared service utilization and expenditures among those enrolled in a PCPCH compared to those who were not.[135] The evaluation found significant increases in primary care expenditures and use among enrollees. The increases in expenditures for primary care were offset by decreases in specialty care, emergency department, and inpatient care expenditures. Additionally, it was found the longer a PCPCH was in operation, the larger the increase in primary care services.[135] The results suggested that for every $1 increase in primary care expenditures, there was $13 in saving for clinics in their third year of operation.

Another program changing the primary care delivery system in Oregon is the Comprehensive Primary Care (CPC) program. At the end of 2012, Oregon was selected as one of seven regions to receive funding from the Center for Medicare & Medicaid Innovation and CMS to participate. Similar to the PCMH and PCPCH model, the focus of the program is to change the delivery of care through access and continuity, preventive and chronic care, risk-stratified care, better engagement between the patient and caregiver, and improved care coordination.[136] While the program is focused on Medicare Fee-For-Service (FFS) patients, clinics that were selected to participate were also required to provide the same services to all the patients they saw. As of the end of 2014 participating clinics in Oregon had served 52,559 FFS Medicare patients plus an additional 477,910 patients that were not FFS. In Oregon there were significant decreases in emergency department utilization in the first two years, but also a significant decrease in primary care service use in the first year. It was suggested this may have been due to a shift from clinic visits to non-billable alternative methods of care delivery such as tele-health or care management that were supported through CPC fees as these methods are not reported in claims data.[136]

Conceptual Model

The purpose of this study is to understand how those newly enrolled in Medicaid across varying levels of rurality utilization preventive and behavioral health services in the state of Oregon. Additionally, this study seeks to examine whether the level of rurality interacts with continuity of enrollment and if that interaction is associated with utilization of preventive and behavioral health services among Medicaid enrollees in Oregon. An increasing body of research has found that the health and well-being of a

person is more than biology or individual choice, but it is also a function of a person's physical environment, as well as their social and cultural environment.[70,137,138] People function within a multitude of environmental, organizational, economic and social contexts that may influence their behavior including the use of health care services. In addition to greater geographic distances to access care, rural residents may also face social and cultural differences that impact their utilization of health care services.[41,54] Higher rates of disease in rural areas may be a function of demographic differences between urban and rural areas; however, cultural and geographic differences may also influence differences in health behaviors and outcomes.

Neoclassic economic theory suggests that people want to be healthy and to stay healthy people demand healthcare.[139] Demand for healthcare can be influenced by need or desire for services, changes in medicine and medical technology along with changes in income or insurance status. However, limited resources may be available to supply the amount of care that is actually in demand. This limited supply of healthcare might be influenced by limited number of providers or other resources such as space or medical equipment.[139] Additionally, opportunity costs such as time and distance to care play a role in the amount of care actually utilized.

It is recognized that health care is not a perfectly competitive market. Cost and quality of care are usually unknown; most people do not know when they will need care; and those who have insurance often don't have to worry about paying the market price, whereas those without insurance are left to pay out of pocket.[139] Behavioral economic theory suggests that factors such as time discounting and loss aversion mean that people are more likely to favor the present over the future and a have a tendency to focus on

avoiding losses even if it means engaging in less healthy behavior.[140] This might mean the time needed to get to or access care may be prioritized over receiving recommended preventive or behavioral health care. Additionally, the theory suggests people are limited in the information they have available and may make mistakes in assessing risk and are often inconsistent in their decision-making.[140,141] A person who feels healthy may not think they need to see their doctor for a yearly check-up. However, behavioral economic theory also suggests people's choices and decisions can change over time and may be influenced by their geographic, social or even cultural environment.[140] Individuals may behave differently if they have a change in insurance status or change in their copayments for health services.

Andersen's Behavioral Model of Health Services Use has been used to help understand what specific factors may contribute to health service use.[25,142,143] In his model, Anderson suggests health care use is a function of three components; predisposing characteristics, enabling resources, and need factors.[25,142,143] Although the initial framework did not specifically include contextual factors, he did acknowledge geographic accessibility as a contributing factor.[144] Later revisions included community attributes as a component of health service utilization.[142,143]

Predisposing Characteristics

Predisposing characteristics include demographic factors such as sex or age and social structures such as race and ethnicity. Studies have found associated with use of health services include age, race, ethnicity, and sex.[25,27,145,146] Women have been found to use preventive care services more than men.[25] Casey et al. (2001) found that those who

were older were significantly more likely to receive preventive services.[27] However, a review of studies found, although age was significant in most, the direction of the association varied.[25] This same review found that whites were more likely to utilize a variety of health care services. Holden et al. (2015), however, found whites were less likely to utilize preventive services than Hispanics or African Americans.[146]

Enabling Resources

Enabling resources include individual resources such as income, having health insurance and distance to care as well as community resources such as provider or healthcare facility availability or social relationships that might come from differing neighborhood structures. Research has found that persons newly enrolled in health have fewer physician visits and may require at period of time before they utilize services at the same rate as those already enrolled.[35,36,98-100] Multiple studies, including a review by Starfield et al. (2005), have found a relationship between primary care physician supply and health status and health outcomes.[76,147] The review found that primary care physician supply was one mechanism associated with better health. Another review of rural health disparities found that much of the variation in health service use and preventable health conditions could be explained by socioeconomic factors.[11] Neighborhood factors such as median household income and percent living below the federal poverty level have also been shown to be associated with preventive health service use.[148]

Need Factors

Need factors include both perceived as well as recommended health care. Persons

with pre-existing conditions or who feel unwell have been found to be more likely to access care than those who feel well.[81] However, persons with chronic health conditions may be less influenced by distance to care as compared to persons accessing care for an acute problem or preventive care.[7]

We assume that use of health care services is a function of these demographic characteristics, the resources people have available individually, as well as health system characteristics and the socioeconomic environment of the communities in which people reside, in addition to health need. As these theories relate to the present study, we assume that rural areas may face an interaction between short supply of providers along with an increased demand for services that may accompany the increase in the number of persons with health insurance because of the the ACAs mandate for health insurance along with Medicaid expansion. These policy changes may also result in an decrease in the number of persons with gaps in coverage.

In addition, rural residents might face higher opportunity costs in terms of the time, distance, or other resources needed to obtain care. The social, cultural, economic and environmental differences between those living in rural areas as compared to those in more urban areas may influence individual perceptions of the importance of health care as well as provider behavior. As such, rural residents may be less likely to utilize preventive or behavioral health services than those in urban areas due to the greater resources needed to get access to a provider, the lower supply of providers and even cultural differences surrounding the utilization of health care. However, through the ACA and Medicaid expansion, the increased number of persons with health insurance, lower copayments for some types of care along with improvements in continuity of enrollment

there may be a shift in the culture surrounding preventive care utilization among rural residents in Oregon, especially those who have newly gained insurance.

(*See Figure 2*)

Specific Aims and Hypotheses

Aim 1: Utilization of Preventive Services Investigate the impact the level of rurality had on utilization of preventive care services among new and previous Medicaid enrollees in the state of Oregon. Utilization will be measured by whether the person ever accessed care and how many times.

Aim 2: Utilization of Behavioral Health Services Investigate the impact the level of rurality had on utilization of behavioral health care services among new and previous Medicaid enrollees in the state of Oregon. Utilization will be measured by whether the person ever accessed care and if so, how many times.

Hypothesis Aim 1 & Aim 2: Given the additional barriers in obtaining care, lack of provider availability and increased demand for care, we hypothesized that new Medicaid enrollees who reside in more rural parts of Oregon would utilize health care services for preventive care, alcohol and substance abuse and tobacco cessation at lower rates than among those who reside in more urban areas. Furthermore, we hypothesized that new Medicaid enrollees in rural areas would utilize fewer preventive care visits, fewer visits for tobacco cessation and fewer visits for alcohol and substance misuse treatment than their suburban or urban counterparts.

Aim 3: Continuity of Enrollment and Preventive Service Utilization Investigate the impact the level of rurality had on utilization of preventive care services among those continuously enrolled in Medicaid compared to those with gaps in coverage gaps within the state of Oregon.

Aim 4: Continuity of Enrollment and Behavioral Health Service Utilization Investigate the impact the level of rurality had on utilization of behavioral health services among those who were continuously enrolled in Medicaid compared to those who had coverage gaps within the state of Oregon.

Hypothesis Aim 3 & Aim 4: Given the effects continuity of insurance and availability of providers has on utilization of preventive and behavioral health services we hypothesized that gaps in insurance coverage would have a greater impact on rural residents and that rural residents would receive fewer preventive and behavioral health services than urban residents.

Figure 1: Coordinated Care Organization Service Areas

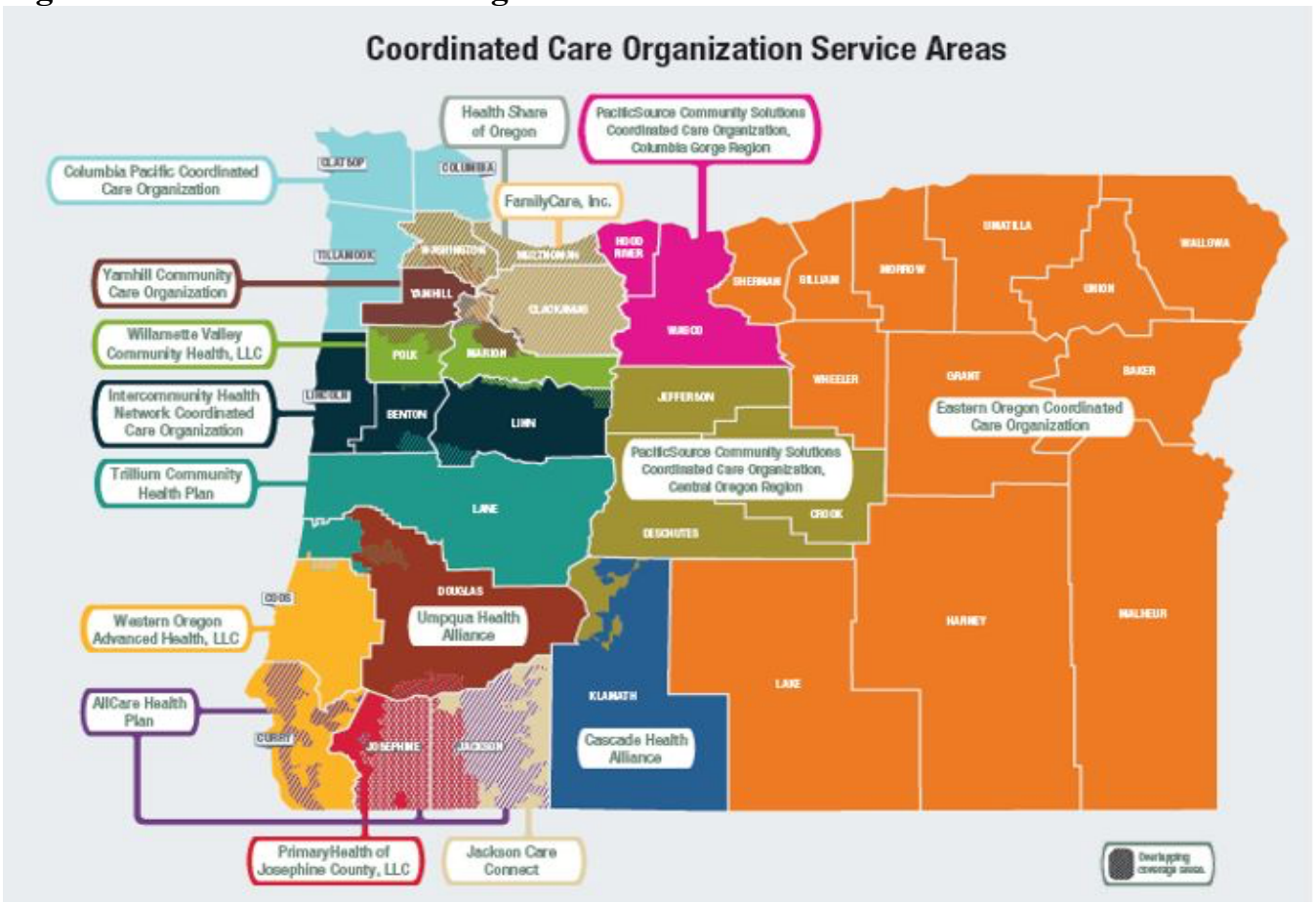
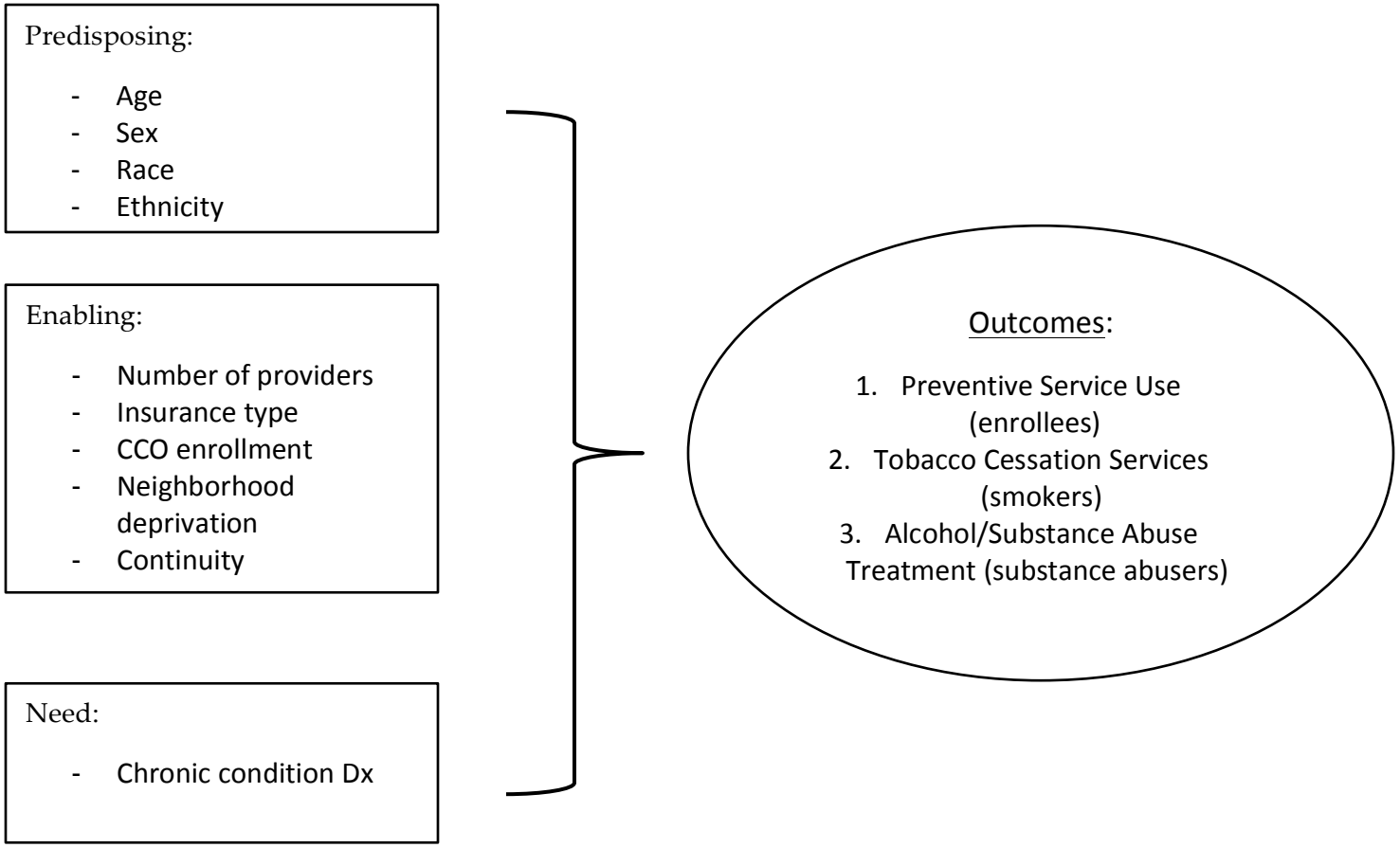


Figure 2: Andersen's Behavioral Model of Health Service Use



CHAPTER 3

METHODS

Overview of Methods

This study is a quasi-experimental, retrospective cohort study. The study population includes adults 18 through 64 years of age who lived in Oregon and were enrolled in Medicaid at least one day from 2014 through 2015. We utilized the following data sources: Oregon Medicaid claims and eligibility data files, Rural Urban Commuting Area data files, American Community Survey data, and Health Resources and Services Administration Primary Care Service Area data.

Data Sources

Medicaid Claims and Medicaid Eligibility

Medicaid claims and eligibility data from 2012-2015 was obtained from the Office of Health Analytics, a division of the Oregon Health Authority.[149]

Rural Urban Commuting Area

The Rural Urban Commuting Area (RUCA) version 2 data file comes from the Rural Health Research Center website and was linked to Medicaid data files using the 2010 ZIP Code relationship file from the U.S. Census.[150] RUCA codes are based on 2000 Census work commuting data and Census Bureau definitions of urbanized areas and urban clusters. Urban areas are defined as cities of 50,000 and greater population and urban clusters are defined as cities or towns of from 2,500 to 49,999 population.[66] To create the analytic file, Census tracts were matched to ZIP Code Tabulation Area (ZCTA) in the Medicaid data using the crosswalk file obtained from the US Census Bureau.

Because some ZIP codes map onto more than one Census tract and some Census tracts map onto more than one ZIP code, ZIP codes in our data falling into more than one Census tract were assigned to the largest area grouping.

American Community Survey

Area-based socioeconomic measure data came from the U.S. Census 5-Year estimates 2014 American Community Survey data files.[151-153] These are publically available data files and Census-tracts were linked to Medicaid data files using the 2010 ZCTA crosswalk file available from the U.S. Census. ZIP code to Census tract linkage followed the same process of that used to link RUCAs to Medicaid data files.

Primary Care Service Area Data

Area-based primary care provider information was obtained from the Health Resources & Services Administration (HRSA) data warehouse.[154] Primary Care Service Area (PCSA) data are based on small geographic units that aim to be reflective of patient utilization patterns and help account for boundaries within which they are most likely to seek primary care services.[84] Information on the number of primary care providers by Census tract was mapped onto ZCTA using the same procedure as that used to map RUCAs to Medicaid data files.

Outcomes

Each of the outcome variables, tobacco cessation, substance abuse treatment, and prevention services with evidence of effectiveness, were identified using ICD-9 and ICD-10 codes or CPT codes from the OHP List of Prioritized Services (*Appendix B*).

Preventive Health Services

A dichotomous variable and was assigned ‘0’ for no preventive service use and ‘1’ for any preventive service use in a given month during the study period, 2014 through 2015. Preventive services include communicable and infectious disease screening and treatment, cancer screening, STI screening, vaccinations, and general wellness exams. Additionally, a count variable was created indicating the number of preventive service visits received during each calendar year of the study period.

Tobacco Use and Cessation Service

Tobacco Use: Enrollees were considered current or recent smokers if they had at least one of the ICD-9 or ICD-10 codes from the OHP List of Prioritized Services or one of the CPT codes for counseling with a physician any time during the period 2012 through 2015.

Cessation Services: A dichotomous variable and was assigned ‘0’ for no tobacco cessation services received and ‘1’ for any tobacco cessation service received in a given month. Additionally, a count variable indicating the number of tobacco cessation services received during each calendar year of the study period was created to examine whether the number of services received varied.

Alcohol or Substance Abuse and Treatment

Alcohol or Substance Abuse: Enrollees were considered current or recent abusers of alcohol or other substances if they had at least one of the ICD-9 or ICD-10 codes from the OHP List of Prioritized Services or one of the CPT codes for counseling with a physician in the period 2012 through 2015.

Substance Abuse Treatment: A dichotomous variable and was assigned '0' for no alcohol or substance abuse treatment and '1' for any alcohol or substance abuse treatment received in a given month. Additionally, a count variable indicating the number of alcohol or substance abuse treatment services received during each calendar year of the study period was created to examine whether the number of services received varied.

Main Variables of Interest

Level of Rurality - The U.S. Census, Office of Management and Budget (OMB), Rural Urban Commuting Codes (RUCCs), Urban Influence Codes (UICs), Rural Urban Commuting Areas (RUCAs) and others use many factors to define rurality including: population density, adjacency to an urbanized area, degree of urbanization, percent that commute to a more urban area for work, or proximity to services.[65,68,155-157] These boundaries are often based on state, county, ZIP codes or Census tract boundaries and they are sometimes built around geographic boundaries as well.[68] OMB, RUCCs, and UICs all use counties to define urban and rural areas. However, county-based classification schemes may be less accurate in how accurately they are able to capture rural-urban disparities. This may be particularly problematic in states with geographically large counties, such as Oregon[68].

Hart et al. (2005) suggests, "An appropriate rural and urban taxonomy should (1) measure something explicit and meaningful; (2) be replicable; (3) be derived from available, high-quality data; (4) be quantifiable and not subjective, and (5) have on-the-ground validity."[65] RUCAs utilize distance to a city center and commuting flows in addition to population size to classify rurality and have been found to be very sensitive to demographic changes[66]. Based on the RUCA classification, and for the purposes of this study, rurality is defined as: "Populations that are not within an Urbanized Area (*a city of 50,000 population or greater*) and have less than 30% of their work commuting going to an Urbanized Area."[66]

Using the RUCA-B classification developed by the Rural Health Research Center,[150] enrollees were categorized into one of three levels of urbanization and the variable assigned as '0' for urban, '1' for large rural city/town, and '2' for small and isolated small rural town (*see Appendix C for RUCA codes*). The level of urbanization was defined as follows:

"Urban": Metropolitan area (population ≥50,000) **or** town of any size with high primary commuting flow (30-49%) to an "Urban Core" and/or ≥30% secondary flow to an "Urban Area"

"Large Rural City/Town": A micropolitan area (population of from 10,000-49,999) with ≥10% primary commuting flow to an UC and/or <29% secondary commuting flow to an Urban Area.

"Small and Isolated Small Rural Town": A city/town core with a population size of 2,500-9,999 with ≥10% primary commuting flow to a small UC and/or with 10-29% secondary commuting flow to a UA **or** a town with a population core <2,500 with

primary commuting flow to a tract outside a UA or UC and/or with ≥10% secondary commuting flow to a UC or 10-29% secondary commuting flow to a UA.

Expansion Enrollee - A dichotomous variable used to identify those newly enrolled in Oregon's Medicaid program, or person not enrolled at any point during the calendar year 2013. The variable was assigned as '0' for those previously enrolled in OHP and '1' for those newly enrolled. For sensitivity analyses, a less restrictive definition of expansion enrollee was used and the variable was assigned as '0' for those previously enrolled in OHP and '1' for those newly enrolled. Women enrolled in 2013 due to a pregnancy were included in the category for those newly enrolled.

Continuity of Enrollment - Continuity of health insurance results in better access, quality and decreased cost of care.[37] Medicaid enrolled adults with one year of continuous coverage have 2/3 the level of average monthly medical expenditures of a person enrolled for 6-months. It has been suggested that 12-month continuous Medicaid eligibility for adults, similar to what is already in place for children, should be an option used by states to help reduce churn.[37,102] A categorical variable was used to capture those continuously enrolled in Medicaid for at least 12-months with no gaps in coverage. The variable was assigned as '0' for those enrolled continuously throughout the study period from 2014 to 2015, as '1' for those enrolled continuously in Medicaid for at least one year, but less than the two year study period, and '2' for those enrolled continuously for less than one year.

Individual Level Covariates

Because of the potential for discrepancies in demographic information across records, especially with regard to race and ethnicity information, all demographic variables were assigned using the first recorded value during the study period.

Age: A continuous variable ranging from 18 to 64. Additionally, to account for non-linear relationship between age and health service use, a squared term for age was included in the models.

Race: A categorical variable to capture the race/ethnicity the enrollee most identifies as. The variable was assigned as '1' for White, '2' for Black, '3' for American Indian or Alaska Native, '4' for Asian, '5' for Native Hawaiian/Pacific Islander, '6' for those who select Other as their race and '7' for unknown or missing race.

Ethnicity: A dichotomous variable assigned as '0' for non-Hispanic, '1' for Hispanic and '2' for unknown ethnicity.

Sex: A dichotomous variable assigned as '0' for male, '1' for female and '2' for unknown sex

OHP Eligibility Category: A categorical variable to identify the Medicaid eligibility category was assigned as '1' for standard or expansion enrollees, '2' for pregnant enrollees, '3' for CAWEM or uncategorized enrollees, and '4' for children (*see Appendix D for eligibility codes*). Because Oregon allows individuals up to 19 years of age to be enrolled in the Children's Health Insurance Program, some persons included in this study are categorized as 'children'.

CCO: Individuals were categorized as being enrolled in a CCO in given month or not enrolled in a CCO. A dichotomous variable was created and assigned as '0' for not enrolled in a CCO and '1' for enrolled in a CCO.

Health Conditions: Research suggests that persons with chronic health conditions are less influenced by geographic distance to care as compared to those receiving care for preventive services.[7] However, as pointed out by Laditka et al. (2009), using diagnosis of chronic diseases as a proxy for health need may itself be associated with use of preventive or behavioral health care services; those who already access care are more likely to be diagnosed.[158] Because of this, controlling for health need may introduce a form of endogeneity bias. As such, all models will be run with and without the chronic disease indicator as a sensitivity analysis. Using the list of the top ten chronic physical health conditions in the United States put together by Rand[159] and OHPs List of Prioritized Health Services, a dichotomous variable was created and assigned '0' for persons with no chronic health conditions and '1' for persons with a chronic health condition. Chronic physical health conditions include hypertension, diabetes, chronic obstructive pulmonary disorder (COPD), osteoarthritis, asthma, and heart disease (*see Appendix E for ICD 9 and ICD 10 codes*).

Area-Based Covariates

Census tracts were developed with the goal of providing geographic units for presenting statistical information that would remain relatively stable over time.[160] Census tracts contain between 1,200 and 8,000 persons, but ideally have a size of 4,000 persons.[160] When possible, they are follow identifiable features, but also follow governmental boundaries. Census tracts can vary widely in terms of geographic size. ZIP

Code Tabulation Areas (ZCTAs) are assigned by the Census Bureau by using the most frequently occurring ZIP code within each Census block and unassigned blocks are further examined to identify the most appropriate assignment.[161] While Census tract area-based measures would ideally be used, due to the information available in Medicaid data, area-level covariates were based on ZCTAs.[162]

Area Based Measures of Socioeconomic Status: Following the work of Drewnowsky et al. (2007), three measures of SES were tested for correlation and inclusion in the final model. These variables are: median household income, percent of population below federal poverty level, and median house value.[5] All three measures were obtained from the US Census, American Community Survey 2014, 5-year estimates and were ZCTA-level covariates. Because the American Community Survey data is at the census tract level and was then assigned to ZCTAs, any ZCTA with more than one Census tract used the Census tract average. The variables were specified as follows for all persons who reside within the ZCTA:

Median Household Income: models were run using both a continuous variable as well as a dichotomous variable using the state average as the cut-point assigned as '0' for a ZCTA with median household income above the state average and '1' for a ZCTA with a median household income below the state average.

Percent of Population Below Federal Poverty Level: models were run using both a continuous variable from 0 to 100 indicating the percent of the population below the federal poverty level as well as a dichotomous variable using the state average as the cut-point assigned as '0' for a ZCTA with a smaller percentage of the population living

below the poverty level than the state average and '1' for a ZCTA with a larger percentage of the residents living below the poverty level than the state average.

Median House Value: models were run using both a continuous variable as well as a dichotomous variable using the state average as the cut-point assigned as '0' for a ZCTA with median house values above the state average and '1' for a ZCTA with a median house values below the state average.

Health Provider Availability: Increased primary care physician supply has been found to be associated with better health outcomes.[163] However, physician supply is found to be lower in rural areas as compared to urban settings.[15,60] Inclusion of provier supply should produce estimates of the residual effects of rurality including factors such as qulatiy of care or cultural differences. However, as noted by Ladikta et al. (2009), inclusion of primary care provider supply is not without limitations.[158] While its inclusion should produce estimates of the residual effects of rurality on utilization of health services, it may over adjust estimates of the effect of rurality on health outcomes if PCP supply is a prominent factor that limits access in rural areas. Therefore, models were run with and without this variable.

Using the Primary Care Service Area (PCSA) data file containing the number of primary care providers per 1,000 population, a continuous variable was constructed. Because the PCSA data is available at the Census tract level, Census tracts were assigned to ZCTAs based on the same method used to map all other Census tract covariates onto ZCTAs.

Stata software, version 12.1 was used for data management and all analyses performed in this study.[164]

Empirical Framework

Linear Probability Models

Linear probability models (LPMs) apply Ordinary Least Squares (OLS) regression to binary variables and assume there is a linear relationship between the independent variables and outcome of interest. They can be useful, and have often been used, to estimate the predicted probability of health service utilization after Medicaid expansion.[57,104,115,121]

One of the main advantages of LPMs is their coefficients are easy to interpret, particularly interaction terms. As Buis (2010) points out, interaction terms in non-linear models are challenging, at best, to interpret and requires more complex computation of the marginal effects.[165,166] Coefficients obtained from linear probability models, including the coefficients of interaction terms, are the marginal effects. Regardless of the model selected, the direction and level of significance of the interaction term in non-linear models and linear probability models should remain the same.

When using LPMs three main OLS assumptions may be violated: 1. heteroskedastic errors, or variablity of the errors may be inconsistent for different values of the predictor, 2. clustering of the error term if errors are not independent of one another, or 3. the potential for nonsensical predictions, or predicted probabilities that fall outside the 0 – 1 range. With regard to the first and second issues, they have little consequence with regard to the estimated regression coefficient, only the uncertainty of that coefficient.[167] To help address the issue of heteroskedasticity, we used clustered-robust standard errors, with clustering on the individual to help account for within-person

variation. Additionally, research has found that use of linear regression models results in misleading significance tests when compared to logistic regression models, only with small samples.[167] Because the present study has a large sample size, that should not be a problem. To confirm the level of significance and directionality of our estimated effects, we ran both LPMs and logistic regression models to compare results and compared average marginal effects from both models. With regard to the potential for nonsensical predictions, we found that less than 3% of the predicted probabilities fell outside the 0-1 interval for all outcomes. To further examine the impact those estimate might have of the results, LPM trimmed models were run, restricted to those estimates that fell within the 0-1 range.

In addition to the potential for the violation of OLS assumptions, estimates obtained from LPMs are subject to three main sources of endogeneity bias: omitted variable bias when the explanatory variables included in the regression model are correlated with the error term, measurement error, and reverse causality. Presence of any one of these factors could result in biased estimates. Fixed-effects models are one method used to help address issues of endogeneity by utilizing within-individual variation over time to help remove bias due to unmeasured individual characteristics that are correlated with the outcome.[168] In the case of the present study, use of a fixed-effects model may also help to address bais that may arise due to individual movement between RUCAs during the course of the study period. Persons who move from one RUCA to another, for example from a small rural area to an urban area, may use services differntly from those living in an urban area.

Fixed-effects model, however, ignore between-person variation. This can come at a cost as it may result in producing much higher standard errors. Additionally, fixed effects models assume that these unobservable, omitted variables are time-invariant and they do not allow for any time-invariant, person-level characteristics to be estimated. In the present study, two of the main variables of interest, whether an individual is newly enrolled or previously enrolled in Medicaid and the length of time a person is continuously enrolled in Medicaid, are both time-invariant covariates. However, fixed-effects models may still be useful to check for the potential for omitted variable bias. As such linear fixed effects models and trimmed, linear fixed effects models were used to compare the relative magnitude of the difference in the main variables of interest that are time varying to estimates obtained from LPMs, time LPMs and logistic regression models.

To measure the impact of rurality on health service use among new Medicaid enrollees, we included an interaction term. For each outcome of interest, we estimated the following LPM regression model separately for each of the first two aims:

$$\Pr(Y_{irt} = 1) = \alpha + \beta_1(Expansion_i * RUCA_{it}) + \beta_2(Expansion_i * Time_t) + \beta_3 X_{it} + \beta_4 Z_i + \varepsilon$$

The comparison group for each model were previous enrollees living in urban areas where Y_{irt} represents a binary health care utilization outcome for individual *i* living in RUCA category *r* at month *t. Expansion* is a binary variable equal to '1' if the individual is newly enrolled in Medicaid and '0' if they were previously enrolled prior to expansion (i.e. any time during 2013). *RUCA* is a categorical variable equal to '1' if they

live in an urban area, '2' if they live in a large rural town, and '3' if they live in a small or isolated small rural town. *Time* is a linear trend. The coefficient for β_1 is an estimate of the association between the level of rurality on new Medicaid enrollees on the predicted probability of receiving health services in a given month. The coefficient β_2 is an estimate of the association between those newly enrolled in Medicaid and month post-Expansion on the predicted probability of receiving health services in a given month. X_i is a vector of time-invariant individual-level covariates: age, sex, race, and ethnicity. Z_{it} is a vector of time-varying covariates for each individual including: CCO, OHP eligibility category, and whether they had a diagnosis for a chronic condition in a given year in addition to the number of primary care providers in the ZIP code they reside in and ZIP-level median home value. We used clustered-robust standard errors with clustering at the individual level to account for within person correlation.

For aims 3 and 4, we extended the first model in the following way:

$$\begin{aligned}\Pr(Y_{irt} = 1) = {} & \alpha + \beta_1(Expansion_i * RUCA_{it}) + \beta_2(Expansion_i * Time_t) \\ & + \beta_3(Continuity_i * RUCA_{it}) + \beta_4(Continuity_i * Expansion_i) + \beta_5 X_{it} \\ & + \beta_6 Z_i + \varepsilon\end{aligned}$$

Building off the modle used to estimate Aims 1 and 2, categorical variable for length of continuous coverage was added ($Continuity$). Additionally, an interaction term for length on continuous coverage by level of rurality ($Continuity_i * RUCA_{it}$) and an interaction term for length of continuous coverage by expansion type ($Continuity_i * Expansion_i$) were added to the model to estimate differences in the effect of continuous Medicaid coverage by level of rurality and expansion type.

All individual-level covariates were included in the regression models. Given the interest in the effects of other covariates on health care utilization and the theoretical basis for their inclusion, all covariates were kept in regardless of whether they are found to not be of statistical significance at the 0.05 level or not.

RUCAs capture the effect of work commuting flows and population density. Additionally, inclusion of area-based measures such socioeconomic status and provider supply will produce estimates of the residual effects of rurality on access to care. These measures of rurality fail to account for things such as rural culture, care-seeking behaviors, effectiveness of providers, or the culture competency of providers. However, because these area-based measures are important components of the rural health care experience, their inclusion may over adjust, and wash out differences in the estimated effects of rurality we are interserted in understanding. As such, models were run with and without provider supply and area-based SES using person-month fixed-effects.

Final Models

Using a series of multivariate linear probability models, we compared utilization of health services among new Medicaid enrollees across varying levels of rurality. The main variables of interest in each of the models included level of rurality the enrollee resided in during a given month, whether they were newly enrolled in Medicaid and a variable indicating month. For Aim 3 and Aim 4, continuity of coverage was also included as a main variable of interest. Models used a binary variable for new enrollees interacted with a categorical variable for level of rurality allowing us to examine differing patterns of utilization among new enrollees as compared to those previously enrolled across RUCAs. In addition, the binary variable for new enrollees was interacted with a

time variable for month post expansion to control for any secular trends in service utilization among those newly enrolled in Medicaid.

Regression models also controlled for enrollee sex, age, race, ethnicity, Medicaid eligibility category, CCO they were enrolled in, and whether they had at least one chronic condition. Models also controlled for ZIP code level characteristics including number of primary care providers per 1,000 population, median home value and percent of population below the federal poverty level.

For persons with no ZIP code available, an additional RUCA category was created for 'missing'. Persons with a missing RUCA category were examined to test for differences in person-level characteristics compared to those with available ZIP codes. This information is presented in the descriptive tables, however, these persons were excluded from final analyses.

Regression-adjusted estimates are presented using the predicted rate of each of outcome by person-month.

Research Question 1

A linear probability regression model was fit to test the effect of the level of rurality on ever receiving any preventive care services in a given month among new Medicaid enrollees in Oregon. Due to the intrinsic heteroskedasticity in linear probability models, clustered-robust standard errors with clustering on an individual were obtained for all point estimates. Additionally, count models were used to estimate the effect of rurality on the number of preventive services received in a calendar year. Persons eligible for at least one month in a calendar year were considered eligible for the entire year. Frequency

distributions of the number of preventive services received in a calendar year were obtained first.

Negative binomial regression is often used for over-dispersed count data and due to the over-dispersion of zeros for all outcomes; negative binomial regression models were fit. Sensitivity analyses were run using a cutoff of at least 6-months of eligibility in a year to be considered eligible for the entire year.

Research Question 2a & 2b

Separate linear probability regression models were fit to test the effect of the level of rurality on ever receiving any amount of behavioral health care services for tobacco cessation services among tobacco users or substance abuse treatment for substance abusers among new Medicaid enrollees in Oregon. Due to the intrinsic heteroskedasticity in linear probability models, clustered-robust standard errors with clustering on an individual were obtained for all point estimates. Additionally, count models were used to estimate the effect of rurality on the number of cessation services received by tobacco users and substance abuse treatment services received by substance abusers in a calendar year. Persons eligible for at least one month in a calendar year were considered eligible for the entire year. Frequency distributions of the number of services received in a calendar year were obtained first.

Negative binomial regression is often used for over-dispersed count data and due to the over-dispersion of zeros for all outcomes; negative binomial regression models were fit. Sensitivity analyses were run using a cutoff of at least 6-months of eligibility in a year to be considered eligible for the entire year.

Research Question 3

A linear probability regression model was fit to test the effect continuity of coverage has on preventive health service utilization among new Medicaid enrollees and those previously enrolled in Oregon across differing levels of rurality. Due to the intrinsic heteroskedasticity in linear probability models, clustered-robust standard errors with clustering on an individual were obtained for all point estimates.

Research Question 4a & 4b

Separate linear probability regression model was fit to test the effect continuity of coverage has on receiving behavioral health services for alcohol and substance abuse treatment and tobacco cessation among new Medicaid enrollees and those previously enrolled in Oregon across differing levels of rurality. Due to the intrinsic heteroskedasticity in linear probability models, , clustered-robust standard errors with clustering on an individual were obtained for all point estimates.

Sensitivity Analyses

We also conducted additional analyses to test the assumptions of our models and to assess the sensitivity of our results. Sensitivity analyses included rerunning all models omitting the indicator variable for 1. presence of a chronic condition, 2. the CCO each individual was enrolled in to test whether being enrolled in a CCO had any influence on the outcomes of interest, 3. using RUCA-C categorization where small rural and isolated small rural towns are borken into separeate groups to determine whether there were significant differences in results between the most rural areas in Oregon, 4. using an alternate, less restictive definition for those newly enrolled that included women who had

been enrolled in Medicaid in 2013, but had been enrolled due to pregnancy, and 5. Omitting ZIP code level covariates.

Missing Data

Observations with missing data ZIP code on all eligibility records were not able to be assigned to a RUCA category, but were assigned as 'unknown'. While they were not included in the final analyses, they were examined to see if they differed in terms of sex, age and/or race or ethnicity from those who were not.

IRB Approval

An IRB determination form for the use of the Medicaid eligibility and Medicaid Claims data files was submitted to Oregon State University, and the study was determined to be IRB exempt. All other data sources are publicly available and did not require IRB approval. To ensure the security of the Medicaid Claims and Eligibility data, all data was be stored electronically on a secure server maintained by Oregon State University Information Services. Only researchers granted permission by the university had access to the secure files.

CHAPTER 4

RESULTS

Analytic Sample

Nearly one million unique persons were enrolled in OHP for at least one day during the post-expansion years 2014 and 2015. They contributed a total of 15,281,308 Medicaid eligible person-months. Of the eligible person-months, 83% were from individuals residing in an urban area, 14% from persons residing in a large rural city or town, and 4% from persons living in a small or isolated small rural city or town (*Table 1a*). Less than 1% of the study population was categorized as being in an unknown or missing RUCA.

A total of 523,450 persons newly enrolled in Oregon's Medicaid program at some point during 2014 or 2015 (*Table 1b*). Compared to American Community Survey 5-year estimates of Oregon's population from 2016, those enrolled in Medicaid in 2014 or 2015 were, on average, more likely to be female (55.5% versus 50.5%), less likely to be white (64.0% versus 85.1%), and be more likely to be Hispanic (15.5% versus 12.3%).

Summary Statistics

Study Population

Table 1a presents person-month demographic characteristics of those enrolled in Medicaid for at least one day during the study period, by level of rurality. Overall, those living in urban areas were quantitatively younger (39.2 years of age versus 41.4 years age), more racially diverse (64.5% white versus 70.3% white) and more ethnically diverse (16% Hispanic versus 14.7% Hispanic). They were more likely to live in an area with a higher median household income ($52,247 versus $43,159), less likely to have a diagnosis of a chronic condition some time during the study period (28.0% versus

33.8%). Additionally, those living in urban areas were more likely to live in a ZIP code with more primary care providers per population than those residing in small or isolated small rural parts of Oregon (140 per 1,000 versus 13 per 1,000). Across each level of rurality, the percent of eligible person-months contributed by those newly enrolled in Medicaid as of the beginning of 2014 was 57.7% in urban areas, 54.9% in large rural towns, and 57.1% in small rural towns.

Between RUCA Movement

Table 2 presents the frequency and percentage of persons that moved from one RUCA to another during the study period. The total number of persons who moved from a rural area was smaller than the total number from urban or large rural town. However, as a percentage of total residents, 13.1% of rural residents moved to a larger RUCA compared to only 1.4% of urban residents that moved to a smaller RUCA. Of those that moved during the study period, 40.1% of that movement was to an urban area. It should be noted that this movement does not account for a person who may move from one small rural area to another.

Continuity of Enrollment

Table 3 presents the frequency and percent of person eligible months stratified by length of continuous enrollment in Medicaid during the study period and RUCA. There was little variation between RUCAs in the percent of eligible person months contributed by those enrolled continuously for each categorical length of time. In urban areas, 58.7% of eligible person months were contributed by those who were continuously enrolled for the entire length of the study period compared to 58.3% of eligible person months among

those residing in small or isolated rural towns. However, there were significant differences the in percent of eligible person months contributed by those enrolled for the entire study period, those enrolled continuously for at least one year, but less than two, and those enrolled for less than one year continuously ($p < 0.001$). In urban parts of Oregon, 58.7% of eligible person-months were contributed those enrolled continuously the length of the study period compared to 33.3% contributed by persons enrolled between one and two years, and 21.8% by those enrolled continuously for less than one year.

Covariates

Pairwise correlations between each of the covariates and each of the outcomes found no evidence of multicollinearity (*Table 4*). Pairwise correlation tests were also run between the area-based social deprivation covariates and we found that median household income was highly correlated with both percent of population below the federal poverty level (-0.747, $p < 0.001$) and median home value (0.696, $p < 0.001$). Furthermore, percent of population below the federal poverty level was not significant in any models. Therefore, the final models included only the covariate for median home value as an indicator of area-deprivation.

Outcomes

The unadjusted rate for use of services for each outcome of interest in a given month by level of rurality are presented in Table 5. During the enrtire study period, for all outcomes of interest, there were quantitatively higher rates of service utilization among persons residing in large rural cities as compared to those in urban areas or small rural

towns. Examination of trends by month found those residing in large rural towns utilized quantively more preventive services (*Figure 3*), cessation services among smokers (*Figure 4*) and alcohol and substance abuse treatment among those with a diagnosis for substance abuse (*Figure 5*) each month of the study period than those in urban or small rural towns. Unadjusted rates of service use by month for each outcome of interest by RUCA showed there was some variation by month, but trends across each level of rurality appeared to follow similar patterns.

Stratified by expansion and non-expansion enrollees, time trends for each outcome of interest found expansion enrollees utilized quantitaively fewer services for the length of the study period. However, examination of service utilization among new enrollees found most of the increase in service use occurred within the first few months of the study period (*Figure 6* - *Figure 8*) followed by a period where service use leveled off. In the two years post-ACA, expansion enrollees and those previously enrolled showed fairly consistent trends in preventive service utilization (*Figure 6*). Expansion enrollees who smoked (*Figure 7*) or had an alcohol or substance abuse diagnosis (*Figure 8*) utilized quantitatively fewer treatment services at the start of the study period, however, they showed increasing trends in service utilization from the beginning of 2014 through the end of 2015.

Aim 1: Preventive Service Use among New Enrollees by Rurality

Utilization of preventive services by Medicaid enrollees in Oregon in a given month was found to vary significantly by level of rurality (*Table 6*). The predicted probability of preventive service use in a given month among urban enrollees was 20.7

percent. Those living in small rural towns utilized 1.6 percentage points fewer preventive services in a given month than those living in urban areas ($p < 0.001$) and 1.5 percentage points fewer than those in large rural towns. However, no significant difference in the probability of preventive service use was found among those living in urban areas and those in large rural towns. Persons newly enrolled in Medicaid were 6.2 percentage points less likely to receive preventive services than those who had previously been enrolled ($p < 0.001$). However, rurality was found to have a significant, positive effect on those who were newly enrolled in Medicaid who lived in small rural towns (1.6 percentage points, $p < 0.001$) as well as among those residing in large rural towns (0.6 percentage points).

Although the probability of receiving preventive services among previous enrollees was significantly higher than for those who were newly enrolled in Medicaid, we found a small, but significant, negative time trend in service used among all enrollees (-0.001, $p < 0.001$). Conversly, the predicted probability of service use among those newly enrolled in Medicaid was a small, but significant, increase over time (0.07 percentage points, $p <0.001$).

We found significant differences in the rate of utilization by demographic characteristics as well (*Table 6*). Women were significantly more likely to utilize preventive services than men (6.8 percentage points, $p < 0.001$), as were those who were non-Hispanic (0.5 percentage points, $p < 0.001$). Older persons utilized more preventive services than younger enrollees, although this relationship was found to have a non-linear relationship. Compared to white Medicaid enrollees, those categorized as black, Asian, Native Hawaiian and those with an unknown race utilized significantly fewer preventive

services. American Indian and Alaskan Natives and those reported as "Other" race, however, utilized significantly more preventive services than white Medicaid enrollees. Having been diagnosed with a chronic condition during the study period or in the two years prior was the biggest predictor of receiving preventive services in a given month. Those with a diagnosis were 53.3 percentage points more likely than those without to utilize preventive services ($p < 0.001$).

For individuals enrolled in a CCO, the predicted probability of receiving preventive services in a given month was 7.8 percentage points higher than for those not enrolled in a CCO ($p < 0.001$). Additionally, the OHP eligibility category during the month the preventive service was received was found to be significantly associated with the probability of receiving services in a given month. Those enrolled as "Expansion" or "Standard" enrollees were significantly more likely to utilize preventive services than those enrolled for pregnancy (-1.0 percentage points, $p < 0.001$), those enrolled as children (-4.2 percentage points, $p < 0.001$) or those enrolled in CAWEM or any other eligibility category (-9.0 percentage points, $p < 0.001$). A one unit increase in the number of primary care providers per population was found to have a very small but significant, positive effect of the receipt of preventive health services.

Number of Services Received

Negative binomial regression models were fit to determine if the number of preventive services received in a calendar year varied by level of rurality. Estimated effects found little variation in the receipt of preventive care services across levels of rurality (*see Appendix A*). However, there was significant variation among the newly enrolled in Medicaid as compared to those previously enrolled.

Those previously enrolled in Medicaid living in urban areas received preventive health services at a rate 20% higher than those in small rural towns. The rate of difference in preventive service use among new enrollees was only 6% higher for those in small rural or large rural town compared to those in urban areas. However, the difference between urban residents who had previously been enrolled in Medicaid and those newly enrolled was much greater. Previous enrollees utilized preventive services at a rate 94% higher than those newly enrolled. Among small rural residents, the difference was 80% greater for previous enrollees and 85% greater for those residing in large rural towns.

Tests for Validity of Linear Probability Models

Results from the final linear probability model found that 2.6% of estimates fell outside of the 0-1 range. The estimated effects and level of significant for all variables included in the model were similar between the final linear probability and the linear probability model restricted to observations were the predicted probability fell within the 0-1 range (*Table 7*). Furthermore, the direction and level of significance of all coefficients were the same in the linear probability model as they were in the logistic regression model (*Table 7*). To test for the possibility of omitted variable bias, a fixed effects linear recession model was also estimated. The magnitude of the effect of rurality of receipt of preventive health services among expansion enrollees was similar between the linear probability model and fixed effects model.

Sensitivity Analyses

Sensitivity analyses found the main variables of interest retained significance and directionality across all models except the exclusion of the CCO enrollment variable and

the alternate definition of expansion enrollee (*Table 8*). Being enrolled in a CCO during the month service was received had the greatest effect of use of preventive services among those residing in more rural parts of Oregon. Additionally, removal of the CCO covariate resulted in preventive service use in large rural towns being significantly less than those in urban areas. The alternate definition of expansion enrollee that included women who had been enrolled in 2013, but only due to pregnancy, similarly resulted in preventive service use in large rural towns being significantly less than those in urban areas. Use of the RUCA-C classification, which separated small from isolated small rural towns, found those in isolated rural areas used fewer services than those in small rural towns. Additionally, the effect of rurality on those newly enrolled had less of an effect on enrollees in isolated rural towns than in small rural towns. Having a chronic disease diagnosis had the largest effect on receipt of preventive care among those newly enrolled in Medicaid, but also had a positive effect on those residing in small rural towns. The less restrictive variable used to define the newly enrolled population suggests that women enrolled solely for the purpose of a pregnancy may utilize services different once enrolled more permanently or for other reasons.

Aim 2: Behavioral Health Service Use among New Enrollees by Rurality

The predicted probability of using tobacco cessation services among urban smokers in a given month was 23.5 percent and 25.4 percent for substance abuse treatment services for substance abusers. Residents of small or isolated rural towns utilized significantly fewer behavioral health care services for both tobacco cessation (1.5 percentage point less, $p<0.001$) and alcohol or substance abuse treatment (1.8 percentage

point less, p=0.014) than those in urban or large rural (*Table 9 and Table 10*). Persons residing in large rural towns received 0.5 percentage points more tobacco cessation services than those in urban areas ($p < 0.001$), but we found no difference in service use for those receiving alcohol or substance abuse treatment ($p = 0.122$).

Similar to findings for preventive service use, those newly enrolled in Medicaid in Oregon used significantly fewer behavioral health care services than those who had previously been enrolled. Those newly enrolled with a diagnosis for tobacco dependence were 5.2 percentage points less likely to receive cessation services in a given month than those previously enrolled ($p< 0.001$, *Table* 9). New Medicaid enrollees with a diagnosis for alcohol or substance abuse were 6.3 percentage points less like to receive treatment in a given month than those previously enrolled ($p < 0.001$, *Table 10*). However, increasing levels of rurality were found to be positively associated with receipt of behavioral health services among new enrollees. Expansion enrollees residing in small or isolated rural parts of Oregon were 1.7 percentage points more likely to have received tobacco cessation services than new enrollees in urban areas if they had a tobacco diagnosis ($p < 0.001$, *Table 9*) and 1.7 percentage points more likely to have received treatment for an alcohol or substance abuse diagnosis than expansion enrollees in urban areas ($p < 0.001$, *Table 10*). Similar to those residing in small rural towns, we found a significant, positive interactive effect between new enrollees and those living in large rural areas for the receipt of tobacco cessation service (0.4 percentage points, $p < 0.001$).

For each additional month over the study period we found a very small, but significant decrease in the utilization of tobacco cessation and substance abuse treatment services among smokers and substance abusers (0.1 percentage points, $p < 0.001$).

Coversely, among those newly enrolled in Medicaid, the predicted probability of tobacco cessation and substance abuse services increased very slightly over the study period (0.2 percentage points, $p < 0.001$) .

The utilization of behavioral health services in a given month was found to differ across demographic groups. Women were nearly 5 percentage points more likely to have received either tobacco cessation or alcohol or substance abuse treatment than men in a given month ($p < 0.001$). We also found significant differences in receipt of services by race and ethnicity. Hispanics were 1.5 percentage points less like to utilize tobacco cessation services and 2.1 percentage point less likely to utilize substance abuse treatment services ($p < 0.001$). Compared to white enrollees blacks, Asians, Native Hawaiians, and those with an unknown race were less likely to utilize services. American Indian and Alaskan Natives and those categorized as 'Other' race were more likely than white enrollees to have utilized or received behavioral health services. Increasing age was also positively associated with an increase in service use. Having a diagnosis for a chronic condition was the greatest predictor of receipt of behavioral health services for both tobacco cessation and substance abuse services.

Medicaid eligibility group was also significantly associated with receipt of services. Those enrolled as 'Expansion' or 'Standard' members were more likely than pregnant, CAWEM, children or otherwise uncategorized members to have received behavioral health services. Tobacco users enrolled in a CCO were 6.3 percentage points more likely to receive cessation services in a given month than those not enrolled in a CCO ($p < 0.001$). Substance abusers enrolled in a CCO were 6.1 percentage points more likely to receive treatment in a given month than those not enrolled ($p < 0.001$). Although

the number of primary care providers per population had a very small but significant, positive effect on receipt of cessation services for tobacco users ($p < 0.001$), it had no effect on receipt of alcohol or substance treatment ($p = 0.868$).

Number of Services Received

Negative binomial regression models were fit to determine if the number of tobacco cessation or alcohol or substance abuse treatment services received in a calendar year varied by level of rurality. Estimated effects found little variation in the receipt of cessation or substance abuse treatment services across levels of rurality (*see Appendix A*). However, our study found significant variation among the newly enrolled in Medicaid as compared to those previously enrolled.

Non-expansion smokers living in urban areas utilized cessation services at a rate 19% higher than those in small rural areas. Among expansion enrollees, there was no difference. The rate of cessation services among urban enrollees was 53% higher for those previously enrolled as compared to those who were newly enrolled. In small, rural towns, the rate of cessation service utilization was 34% higher for previously enrollees as compared to those newly enrolled in Medicaid.

Non-expansion enrollees that resided in large rural cities with a diagnosed alcohol or substance abuse issue utilized substance abuse treatment services at a rate 9% higher than those in small rural towns and 6% higher than those in urban areas. Among residents of urban areas, those previously enrolled utilized treatment services 62% higher than those newly enrolled. Previously enrollees who were residents of small rural areas utilized treatment services at a rate 43% higher than expansion enrollees.

Tests for Validity of Linear Probability Models

Results of the final linear probability model found that 0.2% of estimates for cessation services and 0.3% of estimates for alcohol or substance abuse treatment fell outside of the 0-1 range. The estimated effects and level of significant for all variables included in the models for cessation and for substance abuse treatment were similar between the final linear probability models and the linear probability models restricted to estimates with a predicted probability that fell within the 0-1 range (*Table 11 & Table 12*). The direction and level of significance for all coefficients in both linear probability models for tobacco cessation were the same as the logistic regression models (*Table 11*). The direction and significance for all coefficients were the same in both linear probability models for substance abuse treatment, but varied in the level of significance for large rural towns between the linear probability models and logistic regression model (*Table 12*). Furthermore, linear fixed effects models were used to determine the potential for omitted variable bias in the estimated effects. For both tobacco cessation services use and substance abuse treatment services, the marginal effect size was similar between the linear probability models and fixed effects models.

Sensitivity Analyses

Sensitivity analyses found the main variables of interest retained significance and directionality across all models for both tobacco cessation and alcohol and substance abuse treatment except in the case of the alternate definition of the expansion population (*Table 13 & Table 14*).

Cessation Services: The less restrictive variable used to define those newly enrolled in Medicaid had the greatest effect on the predicted probability of the utilization

of tobacco cessation service use among residents of small rural towns. Additionally, the effect on residents in large rural towns became non-significant. Enrollment in a CCO had a positive effect on those residing in rural areas as well as those newly enrolled in Medicaid in the utilization of tobacco cessation services. Use of the RUCA-C classification, which separated small from isolated small rural towns, found those in isolated rural areas used significantly fewer services than those in small rural towns. While there was a positive effect on rural expansion enrollees as compared to urban enrollees, the effect on enrollees in isolated rural towns was not as large as it was in small rural towns for both cessation and substance abuse treatment. Having a chronic disease diagnosis had a positive effect on use of cessation services for both rural enrollees and those newly enrolled in Medicaid.

Alcohol and Substance Abuse Treatment Services: The less restrictive variable used to define those newly enrolled in Medicaid had the greatest effect on the predicted probability of the utilization of alcohol or substance abuse treatment in more rural parts of Oregon. Furthermore, the estimated effects of those in large rural towns became negatively significant. CCOs had a positive effect of both rural enrollees as well as new enrollee use of substance abuse treatment. The RUCA-C classification found those in isolated rural areas used fewer services than those in urban areas, and this effect was significant. Although rurality still had a positive effect on expansion enrollees, the effect on enrollees in isolated rural towns was not as large as it was in small rural towns for substance abuse treatment. Having a chronic disease diagnosis was positively associated with the use of substance abuse treatment services in rural areas as well as among expansion enrollees. Census level covariates had no effect on the variables of interest.

Aim 3: Continuity of Coverage - Preventive Service Use

Continuity of coverage was found to have a significant effect on preventive service use (*Table 15*). Those continuously enrolled for at least two years were 4.9 percentage points more likely than those continuously enrolled for one to two years and 5.2 percentage points more likely than those continuously enrolled for less than one year to use preventive care services in a given month. Living in the most rural parts of Oregon was found to have less of an effect on length of time a person was enrolled. The predicted probability of receiving preventive services in a given month for those in urban areas enrolled the entire study period was 22.0 percent, but 3.7 percentage points lower for those enrolled continuously for less than one year. Those living in small rural areas, however, utilized 2 percent point fewer services than those living in urban areas.

Although new Medicaid enrollees utilized preventive care services at a significantly lower rate than those previously enrolled in Medicaid, shorter periods of enrollment had less impact on new enrollees. Previous Medicaid enrollees who had been continuously enrolled for more than 2 years were 5.2 percent points more likely to utilize preventive services than those enrolled for less than one year. However, among new enrollees there was only a 2.4 percentage point difference between the two groups.

Tests for Validity of Linear Probability Models

We found that 2.8% of the predicted probabilities from the final linear probability feel outside the 0-1 range. Estimates from the truncated model restricted to those estimates that fell within the 0-1 range were nearly identical to those obtained from the final model and maintained the same level of significance (*Table 16*). Additionally,

results from the logistic regression model maintained the same level of significance. The estimated effects obtained from the fixed effects model were nearly identical to the LPM indicating omitted variable bias was likely not an issue.

Sensitivity Analyses

Having a chronic disease diagnosis had the greatest effect on the continuity of enrollment variables (*Table 17*). It was found to have a positive effect on those living in more rural parts of Oregon as well as on those newly enrolled in Medicaid. Enrollment in a CCO and the alternate variable defining those newly enrolled in Medicaid had the greatest effect on continuity of enrollment among those in more rural areas, and were both found to be positively associated with the use of preventive care services. Significant differences in preventive service use were found between Medicaid enrollees living in isolated rural towns and those in urban areas. However, they were found to use more than those in small rural towns. Finally, both Census level covariates, the number of primary care providers and median home value had a small, but significant effect on preventive service use in more rural towns. The main variables of interest were found to retain significance and directionality except for estimates for large rural town from the model excluding chronic disease, use of RUCA-C classification and the model excluding the Census level covariates.

Aim 4: Continuity of Coverage – Behavioral Health Service Use

OHP members enrolled continuously for the length of the study period used significantly more cessation or substance abuse treatment services than those enrolled for shorter periods of time ($p < 0.001$) (*Table 18* and *Table 19*). While this study found that

those who lived in small rural towns utilized fewer services overall, our study found less difference in the rate of service utilization by length of enrollment than among those who lived in urban areas. The difference was also smaller among those living in large rural areas for tobacco cessation services, but they were significantly more likely to receive treatment for tobacco cessation than those in urban areas or small rural towns (*Table 18*). The predicted probability of receiving tobacco cessation among urban smokers who were continuously enrolled the length of the study period was 24.2 percent compared to 22.8 percent among urban smokers enrolled continuously for less than one year. Smokers residing in small rural towns enrolled the full study period had the same predicted probability of receiving cessation services as those enrolled for less than one year continuously (23.3 percent, $p < 0.001$).

Similar patterns of treatment service use among were found among alcohol and substance abusers. Those residing in small rural towns received fewer treatment services in a given month than those in urban areas, but length of continuous enrollment had less of an effect on rural than urban residents (*Table 19*). Urban residents continuously enrolled the entire study period were 1.1 percentage points more likely to receive substance abuse treatment. Among enrollees in small rural, those enrolled less than one year continuously were 0.2 percentage points more likely to receive services. We found no significant difference between the two groups in large rural towns ($p = 0.328$).

As with cessation services, our study showed greater differences in receipt of treatment by continuity of enrollment between those previously enrolled in Medicaid and those newly enrolled. The predicted probability of substance abuse treatment in a given month among previous enrollees enrolled the length of the study period was 6.5

percentage points higher as compared to new enrollees enrolled the same length of time. Furthermore, the longer a pervious enrolled had coverage, the greater the predicted probability of receiving treatment. Among new enrollees, those continuously enrolled less than one year utilized significantly more substance abuse treatment services than those enrolled for one to two years (2.6 percentage points, $p < 0.001$) or those enrolled the length of the study period (2.4 percentage points, $p < 0.001$).

Tests for Validity of Linear Probability Models

The predicted probability from the final linear probability models, we found that 0.1% of the predicted probabilities for cessation service use and 0.2% of the predicted probabilities for substance abuse treatment fell outside the 0-1 range. Estimates obtained from restricted linear probability models fit using estimates that fell within 0-1 range for both tobacco cessation and substance abuse treatment were nearly identical to those obtained from the full models (*Tables 20 & 21*). Logistic regression model estimates for both models retained significance and directionality as did estimates obtained from the fixed effects models.

Sensitivity Analyses

Tobacco Cessation Services: Among the sensitivity analyses run, having a chronic disease diagnosis had the greatest impact on cessation service utilization among those with shorter lengths of continuous enrollment, particularly those in rural areas (*Table 22*). Enrollment in a CCO had a large, positive effect on cessation service use among those enrolled continuously for less than one year and a larger, positive effect on those in small rural areas. Using the RUCA-C classification, we found that continuity of enrollment had

less of an effect on those in isolated rural towns than those in urban towns, but there were significant differences between those in isolated towns and urban areas. The less restrictive definition for those newly enrolled in Medicaid found that the inclusion of additional persons who had been enrolled prior to Medicaid expansion because of a pregnancy resulted in larger disparities in cessation service use among those with shorter lengths of continuous coverage, particularly in more rural parts of Oregon, but also among new enrollees with shorter lengths of continuous coverage. Census level covariates were found to have a small, but negative effect on cessation service use.

Substance Abuse Treatment: Having a chronic disease diagnosis had the greatest positive effect on the receipt of substance abuse treatment services among those continuously enrolled for less than the study period, but the largest effect on treatment was among those continuously enrolled for less than one year living in small rural towns (*Table 23*). Enrollment in a CCO had a similar, yet slightly smaller, positive impact on substance abuse treatment services among those continuously enrolled for less than one year living in rural towns as having a chronic disease diagnosis. Additionally, having a chronic disease diagnosis had a large, positive effect of receipt of treatment services among those newly enrolled in Medicaid. We found that by using the less restrictive expansion definition there were greater differences in the use of substance abuse treatment between those enrolled the entire study period and those enrolled for shorter lengths of time as well as greater disparities by continuity of enrollment in more rural areas. Use of the RUCA-C classification found that those living in isolated rural areas were significantly less likely to receive substance abuse treatment services than those in urban areas, but more likely than those in small rural towns. Additionally, those living in

isolated rural areas had less variation by length on continuous enrollment than those living in small rural areas. Census level covariates had a small, but negative impact of receipt of substance abuse services.

Figure 3: Trends in Preventive Service Use by RUCA and Month, 2012 to 2015

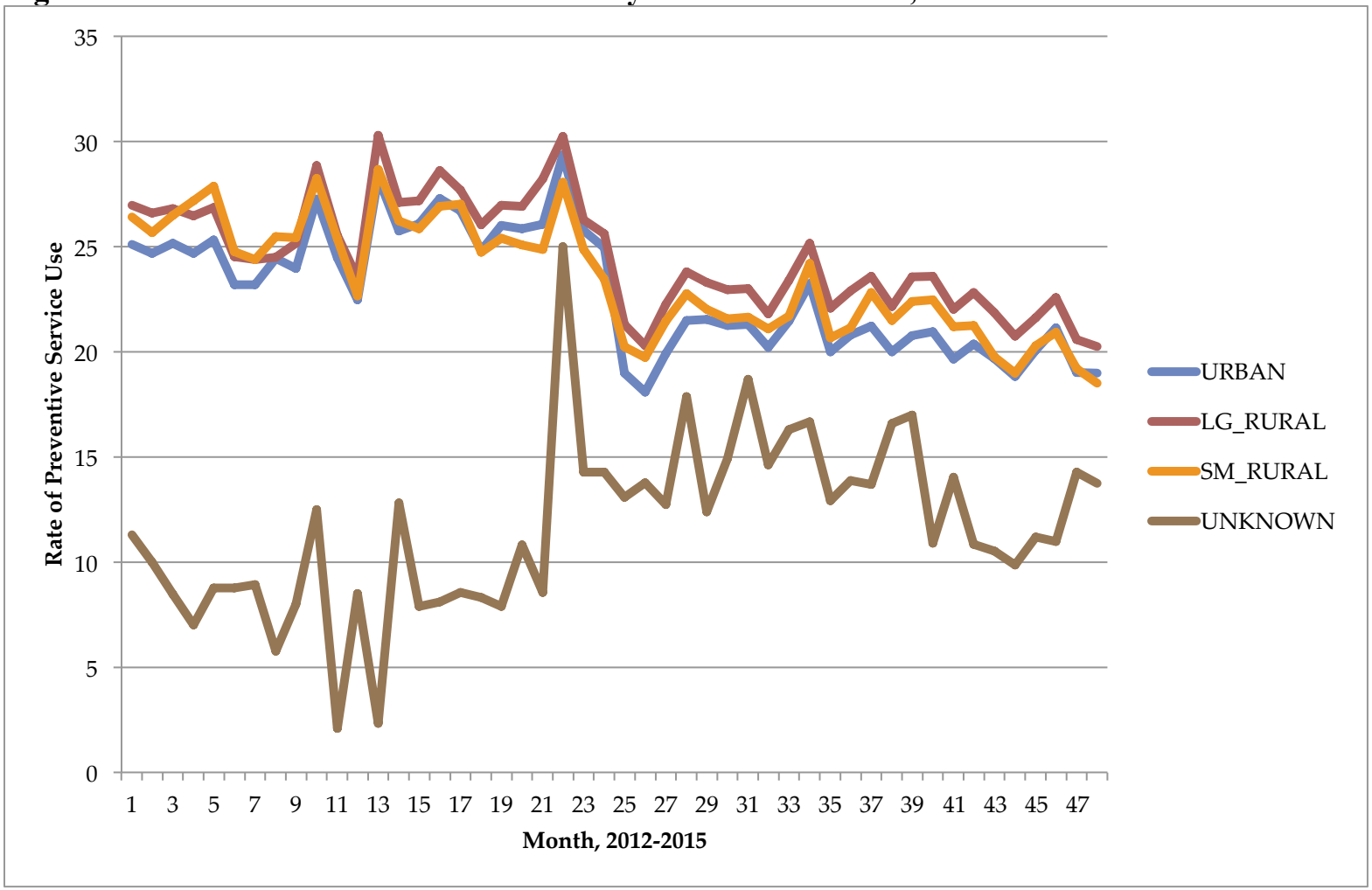


Figure 4: Trends in Cessation Service Use Among Smokers by RUCA and Month, 2012 to 2015

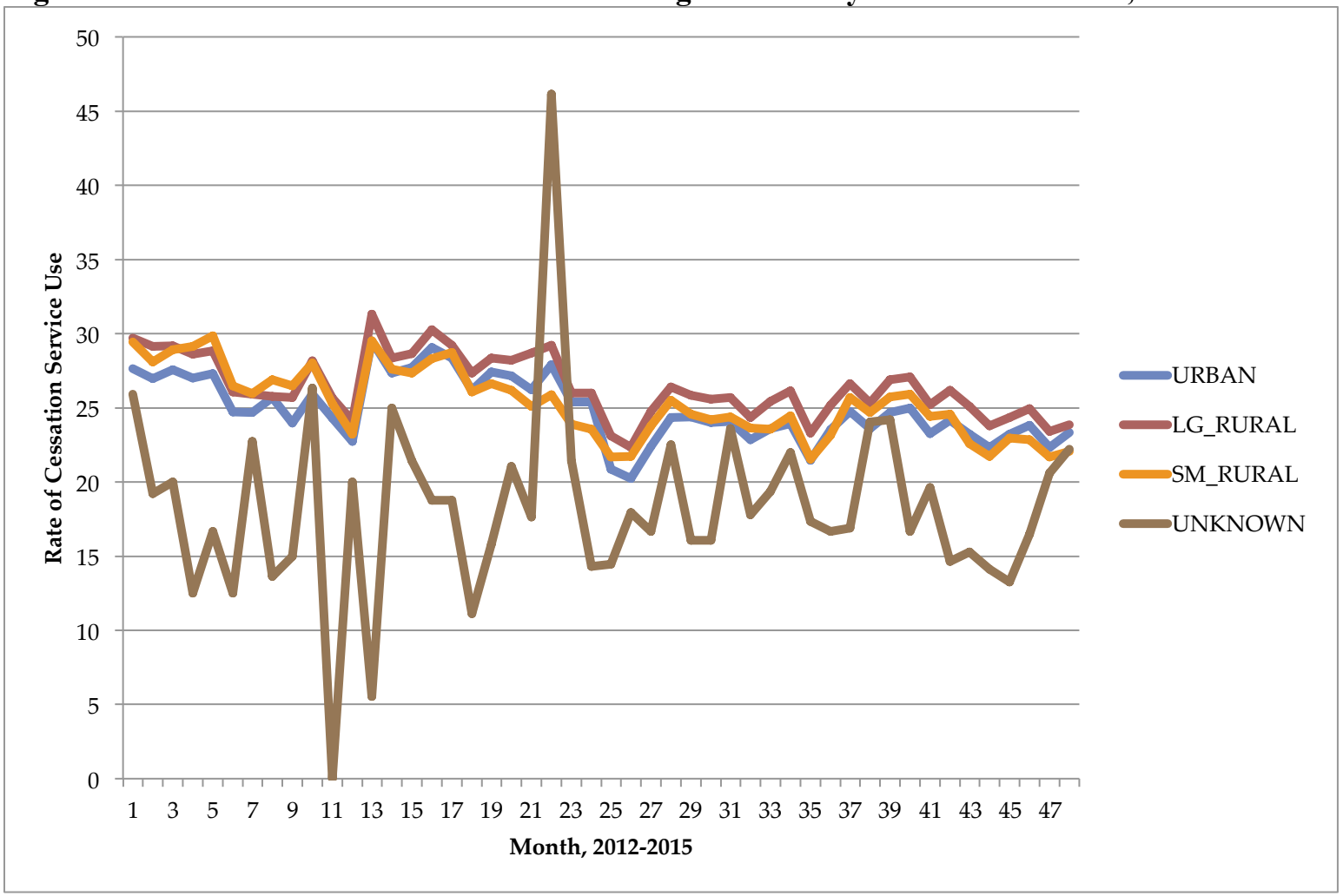


Figure 5: Trends in Substance Abuse Treatment Among Abusers by RUCA and Month, 2012 to 2015

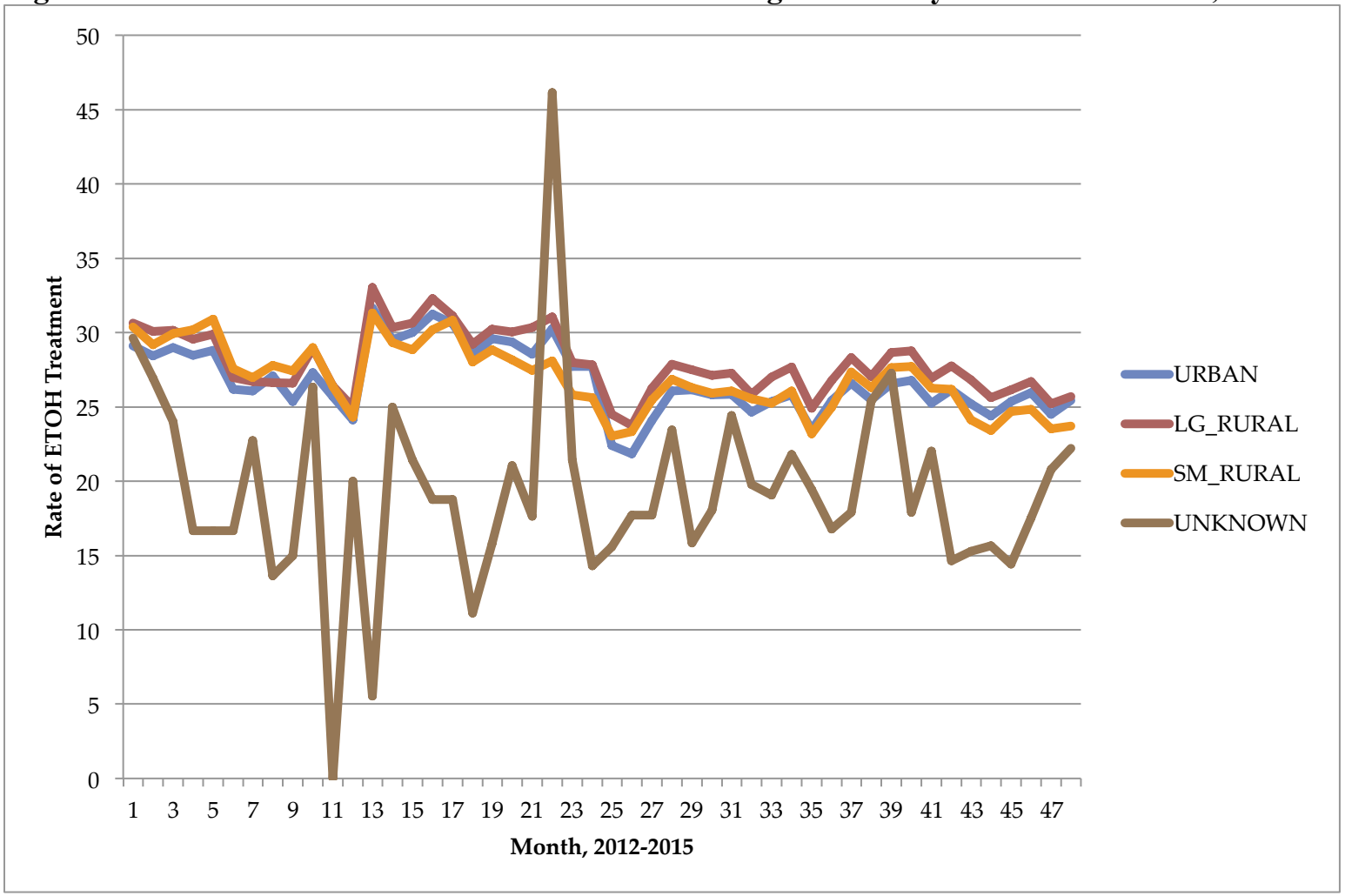


Figure 6: Trends in Preventive Service Use by Medicaid Enrollment Type, 2012-2015

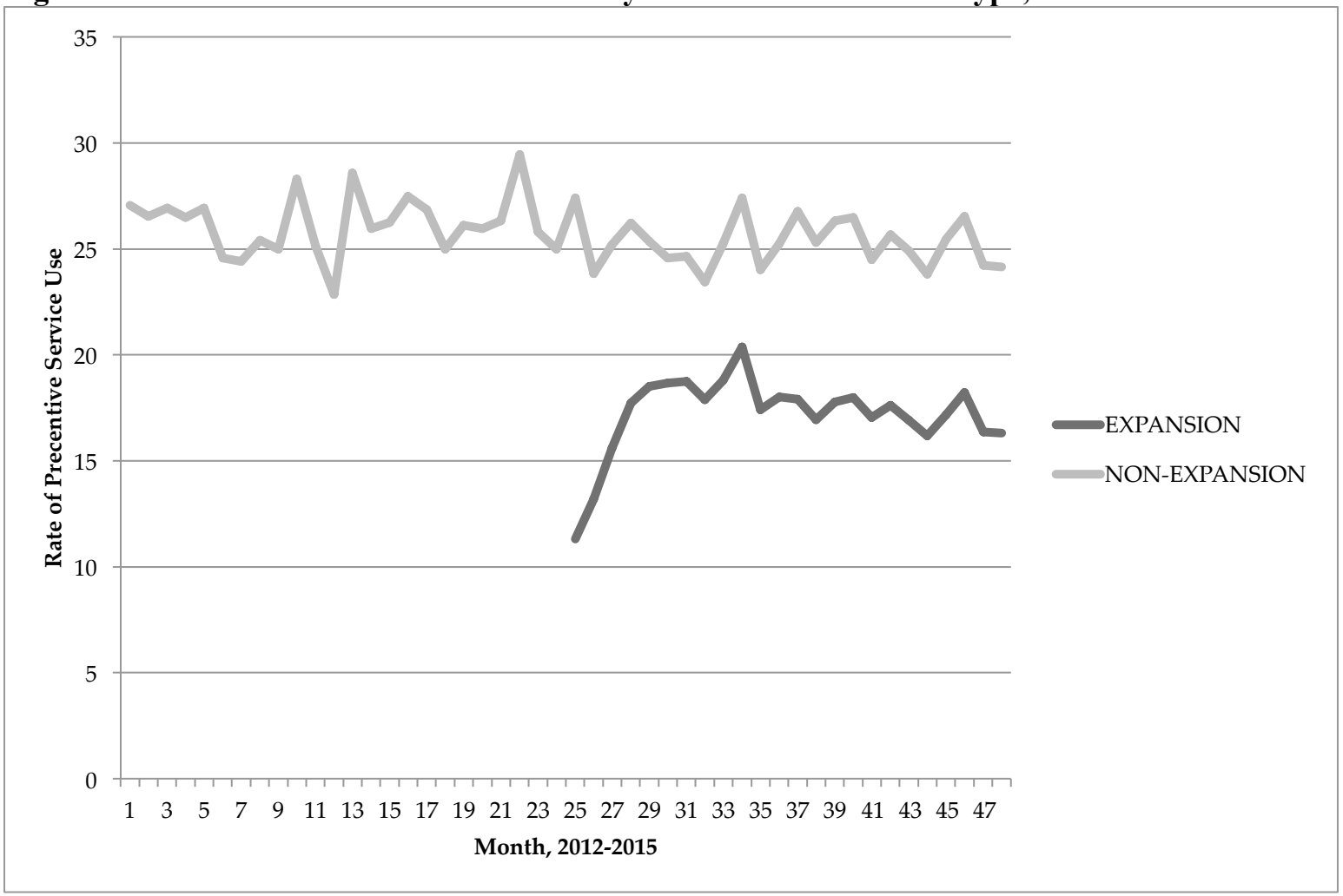


Figure 7: Trends in Cessation Service Use Among Smokers by Medicaid Enrollment Status, 2012-2015

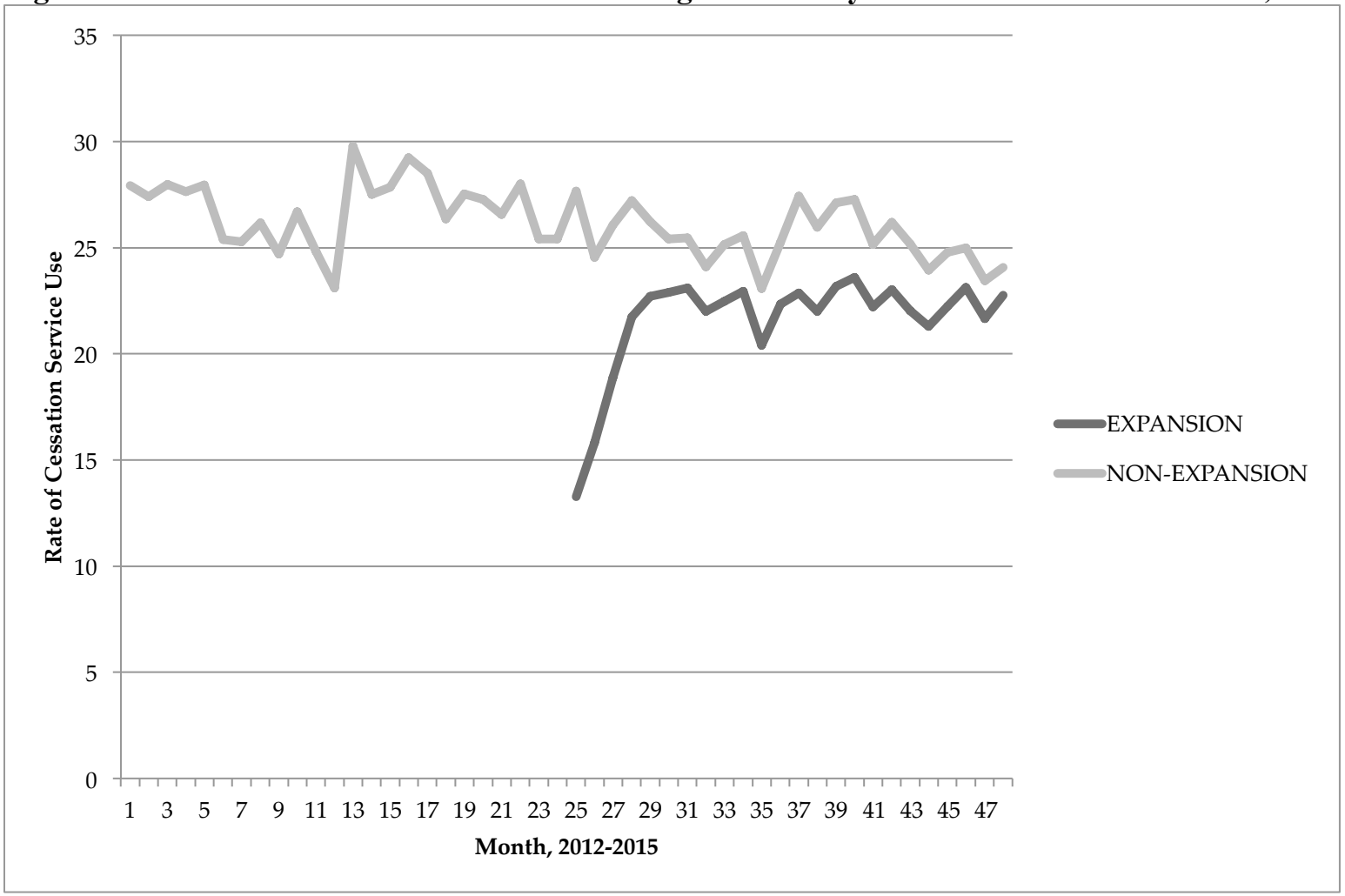


Figure 8: Trends in Substance Abuse Treatment Among Abusers by Medicaid Enrollment Status, 2012-2015

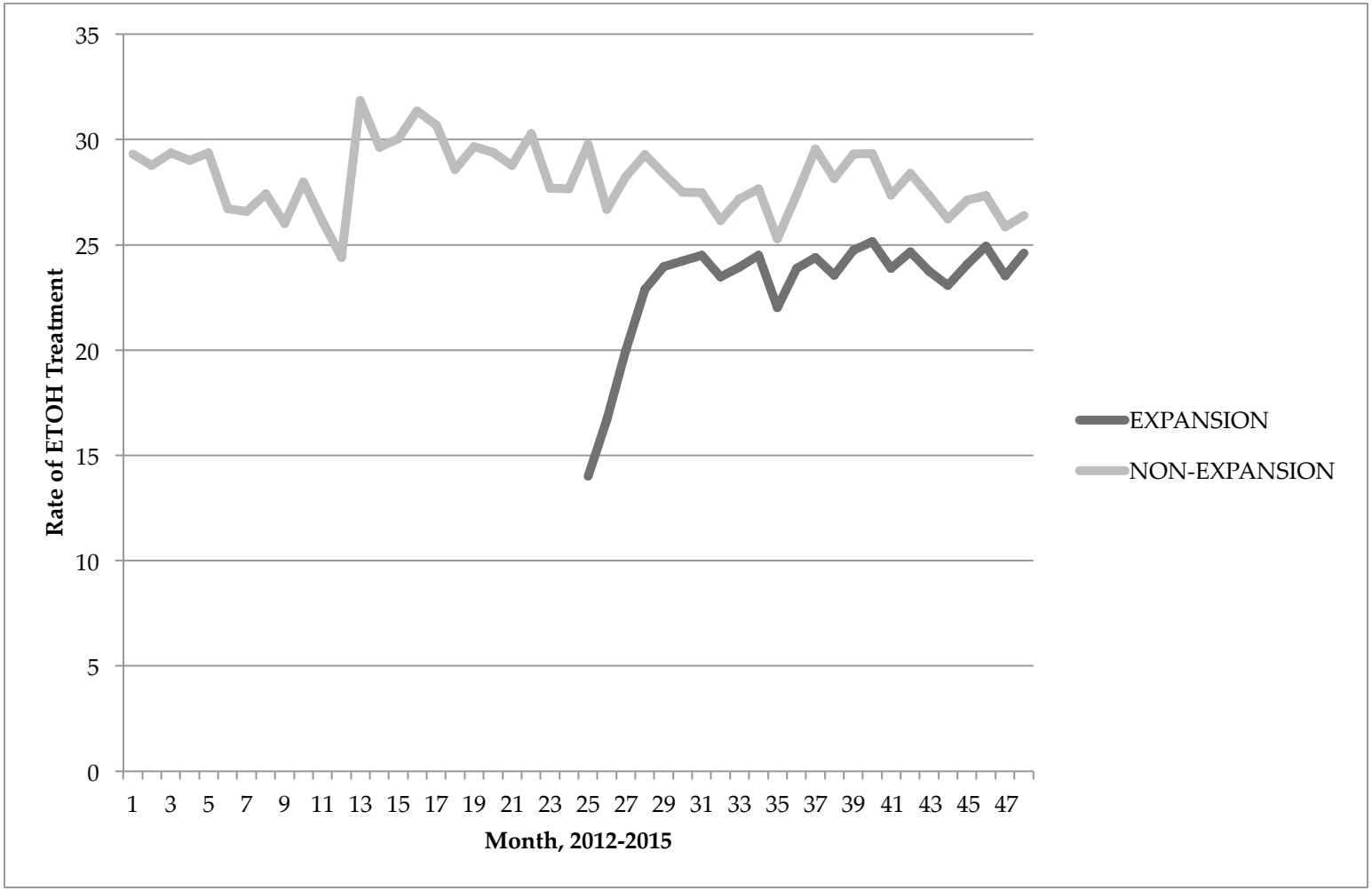


Table 1a: Oregon Medicaid Enrollees Person-Months 2014-2015

	Urban	Large Rural City	Small/Isolated Small Rural	Uncategorized	Total
Medicaid Enrollees					
Expansion Enrollees	57.74	54.9	57.08	73.5	57.3
Non-Expansion Enrollees	42.26	45.1	42.92	26.5	42.7
Age (mean)	39.19	40.32	41.43	38.93	38.6
18-21 years	7.74	7.95	7.01	8.84	7.7
22-35 years	38.10	34.75	32.04	35.90	37.40
36-50 years	29.34	28.15	28.79	32.63	29.20
51-64 years	24.82	29.16	32.16	22.62	25.70
Race					
White	64.57	75.2	70.32	66.14	66.3
Black	3.82	0.67	0.43	2.92	3.3
Asian	3.03	0.62	0.44	0.74	2.6
AI/AN	1.3	2.49	6.48	2.97	1.7
NHPI	0.36	0.24	0.17	0	0.3
Other	2.87	2.41	3.17	2.36	2.8
Unknown/Missing	24.05	18.37	18.99	24.83	23.1
Ethnicity					
Hispanic	16.02	13.85	14.65	14.21	15.7
Non-Hispanic	79.9	81.92	80.82	81.47	80.2
Unknown/Missing	4.08	4.24	4.52	4.33	4.1
Sex					
Female	55.33	55.92	55.83	50.4	55.4
Male	44.67	44.08	44.17	49.6	44.6
CCO Enrollment					
Yes	74.86	72.04	69.3	21.59	74.25
No	25.14	27.96	30.7	78.41	25.75
OHP Eligibility Category					
Standard/Expansion	76.15	77.58	77.34	77.22	76.4
Pregnant	13.97	14.62	13.99	15.93	14.1
CAWEM/Unrecognized	8.61	6.5	7.47	6.82	8.3
Children	1.27	1.31	1.2	0.03	1.3
SES					
Median household income	52,247	43,092	43,159	N/A	50,629
% Below FPL	17.7	18.7	18.1	N/A	17.9
Median house value	259,355	199,093	196,663	N/A	248,605

Table 1a: Oregon Medicaid Enrollees Person-Months 2014-2015 (cont.)

PCPs per 1,000					
Average # of PCPs	140	36	13	N/A	121
Chronic Condition					
Chronic Condition	35	41.7	40.6	29.2	36.1
No Chronic Condition	65	58.3	59.4	70.8	63.9

Table 1b: Oregon Medicaid Enrollees Frequency, 2014-2015

	Urban	Large Rural City	Small/Isolated Small Rural	Uncategorized	Total
Medicaid Enrollees					
Expansion Enrollees	436,468	71,573	22,320	352	315,539
Non-Expansion Enrollees	252,864	48,054	14,508	113	530,713
Age (mean)	38.8	39.8	40.7	38.9	
18-21 years	52,721	9,757	2,618	33	65,203
22-35 years	273,586	43,355	12,616	173	329,702
36-50 years	200,341	33,306	10,515	153	244,148
51-64 years	162,684	33,209	11,079	106	207,199
Race					
White	434,271	88,615	25,831	310	549,027
Black	25,159	880	172	10	26,221
Asian	20,000	751	168	6	20,925
AI/AN	9,102	2,938	2,299	9	14,348
NHPI	2,743	309	66	0	3,118
Other	22,054	3,044	1,151	19	26,268
Unknown/Missing	176,003	23,090	7,141	111	206,345
Ethnicity					
Hispanic	108,117	16,190	5,141	65	129,184
Non-Hispanic	553,146	98,524	30,141	373	682,184
Unknown/Missing	28,069	4,913	1,546	27	34,555
Sex					
Female	375,201	66,024	20,374	248	461,847
Male	314,131	53,603	16,454	217	384,405
CCO Enrollment					
Yes	488,799	81,703	24,116	106	
No	200,533	37,924	12,712	359	
OHP Category					
Expansion	516,515	91,471	27,976	347	636,267
Pregnant	99,463	18,416	5,584	89	123,602
CAWEM/Uncategorized	65,258	8,330	2,863	28	76,456
Children	8,096	1,410	405	1	9,927
Chronic Disease Diagnosis					
Yes	193,028	40,685	12,417	127	272,331
No	496,304	78,942	24,411	338	573,921

Unique person-age is based on age in RUCA

Table 2: RUCA Moves (2014 - 2015)

	Number of Changes	Number of Unique Persons	% Persons in RUCA that Moved
urban to large rural	7,104	6,905	1.00%
large rural to urban	7,156	6,943	5.80%
small rural to urban	2,833	2,763	7.50%
urban to small rural	3,095	3,035	0.44%
large rural to small rural	2,042	2,002	1.67%
small rural to large rural	2,107	2,052	5.57%
Total	24,926	17,375	2.09%

Table 3: Continuity of Enrollment - Person Eligible Months

Continuity (2014-2015)	**Urban**	**Large Rural City**	**Small/ Isolated Small Rural**	**Uncategorized**
Enrolled Entire Study Period	7,382,158	1,230,329	357,313	1,688
	58.71	58.84	58.27	44.82
Enrolled ≥ 1 yr Continuously < 2 yrs	3,977,279	658,213	195,508	1,652
	31.63	31.48	31.88	43.87
Enrolled < 1 year Continuously	1,213,973	202,377	60,392	426
	9.66	9.68	9.85	11.31

Pearson chi2 = 76.51; $p \leq 0.001$

Table 4a: Pairwise Correlations

	Preventive	Cessation	ETOH Treatment
Urban	-0.013	-0.017	-0.014
Large Rural	0.013	0.017	0.014
Small Rural	0.002	0.003	0.003
Female	0.082	0.066	0.068
White	0.079	0.081	0.086
Black	0.005	0.003	0.003
AI/AN	0.010	0.011	0.012
Asian	-0.008	-0.013	-0.015
NHPI	-0.011	-0.010	-0.011
Other Race	-0.008	-0.010	-0.011
Unknown Race	-0.085	-0.084	-0.089
Hispanic	-0.043	-0.044	-0.478
Age	0.122	0.123	0.122
CCO	0.104	0.093	0.097
PCP	-0.024	-0.026	-0.027
Median Home Value	-0.023	-0.025	-0.023
Median Income	-0.027	-0.028	-0.028
% Below FPL	0.010	0.008	0.010
100% Enrollment	0.213	0.200	0.206

NOTE: All correlations were significant at the 0.001 level

Table 4b: Pairwise Correlations, Area-Based SES Indices

	Median Home Value	Median Income	% Below FPL
Median Home Value	1.00		
Median Income	0.696**	1.00	
% Below FPL	-0.398**	-0.747**	1.00

* $p < 0.05$ ** $p < 0.001$

Table 5: Unadjusted Rate of Service Use in a Given Month by RUCA

All Eligible Persons	**Urban**	**Large Rural City**	**Small/Isolated Small Rural**
Preventive Services	20.37%	22.39%	21.13%
Tobacco Services - Among Smokers	23.33%	25.06%	23.65%
Alcohol/Substance Abuse Services - Among Abusers	25.21%	26.69%	25.33%

Table 5b: Unadjusted Rate of Service Use in a Given Month by RUCA and Expansion Type

	URBAN		**LARGE RURAL CITY**		**SMALL RURAL TOWN**	
All Eligible Persons	*Expansion*	*Non-Expansion*	*Expansion*	*Non-Expansion*	*Expansion*	*Non-Expansion*
Preventive Services	16.87%	25.14%	19.14%	26.35%	18.57%	24.54%
Tobacco Services - Among Smokers	21.39%	25.34%	23.41%	26.66%	22.84%	24.49%
Alcohol/Substance Abuse Services - Among Abusers	22.95%	27.57%	24.81%	28.53%	24.20%	26.53%

Table 6: Aim 1–Differential Impact of Rurality on Preventive Service Utilization

	Coef.	Std. Err.	P-value	95 % CI	
Expansion Enrollee	-0.0619	0.0007	<0.001	-0.0633	-0.0606
RUCA B					
Large Rural Town	-0.0013	0.0010	0.199	-0.0033	0.0007
Small Rural Town/Isolated	-0.0163	0.0017	<0.001	-0.0197	-0.0129
Expansion X RUCA B					
Expansion/Lg Rural	0.0059	0.0012	<0.001	0.0035	0.0083
Expansion/Sm Rural	0.0157	0.0021	<0.001	0.0115	0.0198
Expansion X Month	0.0006	<0.0001	<0.001	0.0005	0.0007
Female	0.0683	0.0004	<0.001	0.0675	0.0691
Hispanic					
Yes	-0.0049	0.0006	<0.001	-0.0060	-0.0038
Unknown/Missing	-0.0196	0.0010	<0.001	-0.0216	-0.0177
Race					
Black	-0.0234	0.0011	<0.001	-0.0256	-0.0211
AI/AN	0.0305	0.0017	<0.001	0.0271	0.0339
Asian	-0.0321	0.0012	<0.001	-0.0343	-0.0298
NHPI	-0.0474	0.0029	<0.001	-0.0531	-0.0418
Other	0.0098	0.0012	<0.001	0.0075	0.0121
Unknown/Missing	-0.0269	0.0005	<0.001	-0.0279	-0.0259
Age	0.0058	0.0001	<0.001	0.0056	0.0060
Age Squared	-0.0001	<0.0001	<0.001	-0.0001	0.0000
Time	-0.0007	<0.0001	<0.001	-0.0008	-0.0007
OHP Category					
Pregnant	-0.0099	0.0006	<0.001	-0.0110	-0.0088
CAWEM/Uncategorized	-0.0903	0.0007	<0.001	-0.0916	-0.0890
Children	-0.0415	0.0013	<0.001	-0.0441	-0.0389
Chronic Disease Dx	0.5329	0.0007	<0.001	0.5315	0.5342
CCO	0.0779	0.0005	<0.001	0.0769	0.0788
Primary Care Providers/1000	0.0000	<0.0001	<0.001	0.0000	0.0000
Median Home Value	0.0000	<0.0001	<0.001	0.0000	0.0000

Table 7: Aim 1 Validity

	Final Model	Truncated LPM	Logistic	Fixed-Effects
Expansion Enrollee	-0.0619**	-0.0656**	-0.4587**	(omitted)
RUCA B				
Large Rural Town	0.0013	-0.0017	-0.0095*	0.0003
Small Rural Town/Isolated	-0.0163**	-0.0169**	-0.1067**	-0.0023
Expansion#RUCA_B				
Expansion/Lg Rural	0.0059**	0.0073**	0.0542**	0.0044
Expansion/Sm Rural	0.0157**	0.0166**	0.1081**	0.0147**

** $p < 0.01$ * $p < 0.05$

Table 8: Aim 1 Sensitivity

	Final Model	Without Chronic Disease	Without CCOs	RUCA-C	Alternative Expansion	Without Census Covariate
Expansion Enrollee	-0.062**	-0.092**	-0.072**	-0.062**	-0.072**	-0.062**
RUCA B						
Large Rural Town	-0.001	0.000	-0.004**	-0.013	-0.005**	0.001
Small Rural Town/Isolated	0.02**	-0.020**	-0.021**	-0.018**	-0.024**	-0.016**
Isolated Town				-0.015**		
Expansion#RUCA_B						
Expansion/Lg Rural	0.006**	0.004**	0.007**	0.006**	0.010**	0.006**
Expansion/Sm Rural	0.016**	0.015**	0.020**	0.023**	0.023**	0.016**
Expansion/Isolated Town				0.008**		

** $p < 0.01$ * $p < 0.05$

Table 9: Aim 2 - Differential Impact of Rurality on Cessation Service Use, Smokers

	Coef.	Std. Err.	P-value	95% CI	
Expansion Enrollee	-0.0522	0.0008	<0.001	-0.0538	-0.0506
RUCA B					
Large Rural Town	0.0051	0.0011	<0.001	0.0030	0.0073
Small Rural Town/Isolated	-0.0145	0.0019	<0.001	-0.0181	-0.0108
Expansion X RUCA B					
Expansion/Lg Rural	0.0043	0.0014	0.002	0.0016	0.0070
Expansion/Sm Rural	0.0165	0.0024	<0.001	0.0118	0.0212
Expansion X Month	0.0019	<0.0001	<0.001	0.0018	0.0020
Female	0.0470	0.0005	<0.001	0.0460	0.0479
Hispanic					
Yes	-0.0151	0.0007	<0.001	-0.0165	-0.0137
Unknown/Missing	-0.0190	0.0012	<0.001	-0.0213	-0.0167
Race					
Black	-0.0331	0.0013	<0.001	-0.0356	-0.0306
AI/AN	0.0252	0.0019	<0.001	0.0215	0.0288
Asian	-0.0458	0.0014	<0.001	-0.0486	-0.0430
NHPI	-0.0445	0.0039	<0.001	-0.0522	-0.0368
Other	0.0062	0.0014	<0.001	0.0034	0.0090
Unknown/Missing	-0.0185	0.0006	<0.001	-0.0197	-0.0172
Age	0.0080	0.0001	<0.001	0.0077	0.0082
Age Squared	-0.0001	<0.0001	<0.001	-0.0001	-0.0001
Time	-0.0012	<0.0001	<0.001	-0.0013	-0.0012
OHP Category					
Pregnant	-0.0239	0.0006	<0.001	-0.0251	-0.0227
CAWEM/Uncategorized	-0.0442	0.0014	<0.001	-0.0471	-0.0414
Children	-0.0383	0.0015	<0.001	-0.0412	-0.0354
Chronic Disease Dx	0.4611	0.0007	<0.001	0.4597	0.4626
CCO	0.0630	0.0006	<0.001	0.0618	0.0641
Primary Care Providers/1000	0.0000	<0.0001	<0.001	0.0000	0.000

Table 10: Aim 2 - Differential Impact of Rurality on ETOH Treatment, Substance Abusers

	Coef.	Std. Err.	P-value	95% CI	
Expansion Enrollee	-0.0634	0.0009	<0.001	-0.0651	-0.0617
RUCA B					
Large Rural Town	0.0000	0.0012	0.989	-0.0023	0.0023
Small Rural Town/Isolated	-0.0177	0.0020	<0.001	-0.0217	-0.0138
Expansion X RUCA B					
Expansion/Lg Rural	0.0066	0.0015	<0.001	0.0037	0.0094
Expansion/Sm Rural	0.0168	0.0026	<0.001	0.0118	0.0218
Expansion X Month	0.0023	<0.0001	<0.001	0.0022	0.0024
Female	0.0491	0.0005	<0.001	0.0481	0.0502
Hispanic					
Yes	-0.0209	0.0008	<0.001	-0.0224	-0.0193
Unknown/Missing	-0.0205	0.0013	<0.001	-0.0229	-0.0180
Race					
Black	-0.0366	0.0014	<0.001	-0.0392	-0.0339
AI/AN	0.0256	0.0020	<0.001	0.0217	0.0295
Asian	-0.0557	0.0015	<0.001	-0.0587	-0.0527
NHPI	-0.0510	0.0041	<0.001	-0.0590	-0.0430
Other	0.0051	0.0015	0.001	0.0022	0.0081
Unknown/Missing	-0.0224	0.0007	<0.001	-0.0237	-0.0210
Age	0.0091	0.0001	<0.001	0.0088	0.0093
Age Squared	-0.0001	<0.0001	<0.001	-0.0001	-0.0001
Time	-0.0012	<0.0001	<0.001	-0.0012	-0.0011
OHP Category					
Pregnant	-0.0273	0.0007	<0.001	-0.0286	-0.0260
CAWEM/Uncategorized	-0.0618	0.0015	<0.001	-0.0647	-0.0590
Children	-0.0445	0.0016	<0.001	-0.0477	-0.0413
Chronic Disease Dx	0.4777	0.0007	<0.001	0.4763	0.4791
CCO	0.0610	0.0006	<0.001	0.0598	0.0623
Primary Care Providers/1000	0.0000	<0.0001	<0.001	0.0000	0.0000

Table 11: Aim 2 Cessation Validity

	Final Model	Truncated LPM	Logistic	Fixed Effects
Expansion Enrollee	-0.0522**	-0.0522**	-0.3403**	(omitted)
RUCA B				
Large Rural Town	0.0051**	0.0051**	0.0323**	0.0028
Small Rural Town/Isolated	-0.0145**	-0.0144**	-0.0869**	0.0026
Expansion#RUCA_B				
Expansion/Lg Rural	0.0043**	0.0043**	0.0297**	0.0046
Expansion/Sm Rural	0.0165**	0.0165**	0.1020**	0.0195**

** $p < 0.01$ * $p < 0.05$

Table 12: Aim 2 ETOH Validity

	Final Model	Truncated LPM	Logistic	Fixed Effects
Expansion Enrollee	-0.0634**	-0.0635**	-0.3930**	(omitted)
RUCA B				
Large Rural Town	< 0.000	< 0.000	0.0007	0.0011
Small Rural Town/Isolated	-0.0177**	-0.0177**	-0.1027**	0.0014
Expansion#RUCA_B				
Expansion/Lg Rural	0.0066**	0.0066**	0.0410**	0.0071
Expansion/Sm Rural	0.0168**	0.0168**	0.0988**	0.0133*

** $p < 0.01$ * $p < 0.05$

Table 13: Aim 2 Cessation Sensitivity

	Final	Without Chronic Disease	Without CCOs	RUCA-C	Alternative Expansion	Without Census Covariates
Expansion Enrollee	-0.052**	-0.077**	-0.060**	-0.052**	-0.065**	-0.052**
RUCA B						
Large Rural Town	0.005**	0.006**	0.002*	0.005**	0.001	0.005**
Small Rural Town (Isolated)	-0.015**	-0.019**	-0.019**	-0.020**	-0.026**	-0.015**
Isolated Small Town				-0.009**		
Expansion#RUCA_B						
Expansion/Lg Rural	0.004**	0.003*	0.005**	0.001**	0.010**	0.004**
Expansion/Sm Rural	0.017**	0.016**	0.020**	0.024**	0.029**	0.017**
				0.009**		

** $p < 0.01$ * $p < 0.05$

Table 14: Aim 2 ETOH Sensitivity

	Final	Wihtout Chronic Disease	Without CCOs	RUCA-C	Alternative Expansion	Without Census Covariates
Expansion Enrollee	-0.063**	-0.089**	-0.071**	-0.063**	-0.077**	-0.063**
RUCA B						
Large Rural Town	< 0.000	0.001	-0.002*	< 0.000	-0.006**	< 0.000
Small Rural Town (Isolated)	-0.018**	-0.022**	-0.022**	-0.020**	-0.029**	-0.018**
Isolated Town				-0.015**		
Expansion#RUCA_B						
Expansion/Lg Rural	0.007**	0.005**	0.008**	0.007**	0.014**	0.007**
Expansion/Sm Rural	0.017**	0.016**	0.021**	0.023**	0.029**	0.017**
				0.011**		

** p < 0.01 * p < 0.05

Table 15: Aim 3 – Differential Impact of Continuity of Coverage and Rurality on Preventive Service Utilization

	Coef.	Std. Err.	P-value	95 % CI	
Expansion Enrollee	-0.0712	0.0008	<0.001	-0.0727	-0.0696
RUCA B					
Large Rural Town	-0.0019	0.0011	0.099	-0.0041	0.0003
Small Rural Town/Isolated	-0.0204	0.0020	<0.001	-0.0242	-0.0165
Expansion X RUCA B					
Expansion/Lg Rural	0.0060	0.0012	<0.001	0.0036	0.0085
Expansion/Sm Rural	0.0134	0.0022	<0.001	0.0092	0.0176
Expansion X Month	0.0010	<0.0001	<0.001	0.0009	0.0011
Continuous Enrollment					
Enrolled ≥1 yr < 2 yrs	-0.0488	0.0008	<0.001	-0.0503	-0.0473
Enrolled < 1yr	-0.0527	0.0013	<0.001	-0.0553	-0.0500
Expansion X Continuous Enrollment					
Expansion / 1-2 Years Continuous	0.0266	0.0009	<0.001	0.0248	0.0283
Expansion / <1 Year Continuous	0.0282	0.0014	<0.001	0.0254	0.0310
RUCA B X Continuous Enrollment					
Enrolled ≥1 yr < 2 yrs/Lg Rural	0.0036	0.0013	0.005	0.0011	0.0061
Enrolled < 1yr /Lg Rural	-0.0022	0.0015	0.143	-0.0052	0.0007
Enrolled ≥1 yr < 2 yrs/Sm Rural	0.0140	0.0022	<0.001	0.0097	0.0183
Enrolled < 1yr/Sm Rural	0.0161	0.0027	<0.001	0.0108	0.0214
Female	0.0683	0.0004	<0.001	0.0675	0.0691
Hispanic					
Yes	-0.0063	0.0006	<0.001	-0.0074	-0.0052
Unknown/Missing	-0.0219	0.0010	<0.001	-0.0238	-0.0199
Race					
Black	-0.0226	0.0011	<0.001	-0.0248	-0.0203
AI/AN	0.0305	0.0017	<0.001	0.0272	0.0339
Asian	-0.0332	0.0012	<0.001	-0.0355	-0.0309
NHPI	-0.0435	0.0029	<0.001	-0.0491	-0.0378

Table 15: Aim 3 – Differential Impact of Continuity of Coverage and Rurality on Preventive Service Utilization (cont.)

Other	0.0102	0.0012	<0.001	0.0080	0.0125
Unknown/Missing	-0.0258	0.0005	<0.001	-0.0268	-0.0248
Age	0.0054	0.0001	<0.001	0.0052	0.0056
Age Squared	0.0000	<0.0001	<0.001	-0.0001	0.0000
Time	-0.0009	<0.0001	<0.001	-0.0009	-0.0008
OHP Category					
Pregnant	-0.0024	0.0006	<0.001	-0.0035	-0.0013
CAWEM/Uncategorized	-0.0891	0.0007	<0.001	-0.0904	-0.0878
Children	-0.0361	0.0013	<0.001	-0.0387	-0.0336
Chronic Disease Dx	0.5311	0.0007	<0.001	0.5297	0.5324
CCO	0.0764	0.0005	<0.001	0.0754	0.0773
Primary Care Providers/1000	0.0000	<0.0001	<0.001	0.0000	0.0000
Median Home Value	0.0000	<0.0001	<0.001	0.0000	0.0000

Table 16: Aim 3 Validity

	Final Model	Truncated LPM	Logistic	Fixed-Effects
Expansion Enrollee	-0.0711**	-0.0742**	-0.4976**	(omitted)
RUCA B				
Large Rural Town	-0.0019**	-0.0025*	-0.0166**	-0.0036
Small Rural Town/Isolated	-0.0204*	-0.0213**	-0.1344**	-0.0116**
Expansion X RUCA B				
Expansion/Lg Rural	0.0060**	0.0070**	0.0524**	0.0047
Expansion/Sm Rural	0.0134**	0.0142**	0.0896**	0.0141**
Continuous Enrollment				
Enrolled ≥1 yr < 2 yrs	-0.0488**	-0.0498**	-0.3249**	-0.0317**
Enrolled < 1yr	-0.0527**	-0.0546**	-0.3567**	(omitted)
Expansion X Continuous Enrollment				
Expansion / 1-2 Years Continuous	0.0266**	0.0260**	0.1422**	0.0198**
Expansion / <1 Year Continuous	0.0282**	0.0257**	0.1188**	(omitted)
RUCA B X Continuous Enrollment				
Enrolled ≥1 yr < 2 yrs/Lg Rural	0.0036*	0.0046**	0.0376**	0.0060
Enrolled < 1yr /Lg Rural	-0.0022	-0.0005	0.0039	0.0038
Enrolled ≥1 yr < 2 yrs/Sm Rural	0.0140**	0.0151**	0.1060**	0.0148**
Enrolled < 1yr/Sm Rural	0.0161**	0.0187**	0.1433**	0.0227**

** $p < 0.01$ * $p < 0.05$

Table 17: Aim 3 Sensitivity

	Final Model	Without Chronic Disease	Without CCOs	RUCA-C	Alternative Expansion	Without Census Covariates
Expansion Enrollee	-0.071**	-0.104**	-0.078**	-0.071**	-0.078**	-0.072**
RUCA B						
Large Rural Town	-0.002**	0.000	-0.005**	-0.002	-0.005**	0.001
Small Rural Town	-0.020*	-0.024**	-0.026**	-0.023**	-0.027**	-0.017**
Isolated Rural Town				-0.018**		
Expansion X RUCA B						
Expansion/Lg Rural	0.006**	0.004**	0.007**	0.006**	0.010**	0.007**
Expansion/Sm Rural	0.013**	0.012**	0.018**	0.021**	0.020**	0.014**
Expansion/Isolated Rural				0.007*		
Continuous Enrollment						
Enrolled ≥1 yr < 2 yrs	-0.049**	-0.061**	-0.046**	-0.049**	-0.048**	-0.049**
Enrolled < 1yr	-0.053**	-0.070**	-0.064**	-0.053**	-0.049**	-0.053**
Expansion X Continuous Enrollment						
Expansion / 1-2 Years Continuous	0.027**	0.036**	0.019**	0.027**	0.021**	0.026**
Expansion / <1 Year Continuous	0.028**	0.043**	0.025**	0.028**	0.019**	0.028**
RUCA B X Continuous Enrollment						
Enrolled ≥1 yr < 2 yrs/Lg Rural	0.004*	0.002	0.005**	0.004**	0.002	0.004**
Enrolled < 1yr /Lg Rural	-0.002	-0.004*	-0.003	-0.002	-0.003*	-0.002
Enrolled ≥1 yr < 2 yrs/Sm Rural	0.014**	0.015**	0.015**	0.016**	0.012**	0.014**
Enrolled < 1yr/Sm Rural	0.016**	0.018**	0.014**	0.015**	0.015**	0.016**
Enrolled ≥1 yr < 2 yrs/Isolated Rural				0.012**		
Enrolled < 1yr/Isolated Rural				0.017**		

** $p < 0.01$ * $p < 0.05$

Table 18: Aim 4 – Differential Impact of Continuity of Coverage and Rurality on Tobacco Cessation

	Coef.	Std. Err.	P-value	95 % CI	
Expansion Enrollee	-0.0656	0.0009	<0.001	-0.0673	-0.0638
RUCA B					
Large Rural Town	0.0052	0.0012	<0.001	0.0028	0.0077
Small Rural Town/Isolated	-0.0171	0.0021	<0.001	-0.0213	-0.0129
Expansion X RUCA B					
Expansion/Lg Rural	0.0042	0.0014	0.003	0.0015	0.0069
Expansion/Sm Rural	0.0143	0.0024	<0.001	0.0096	0.0190
Expansion X Month	0.0018	<0.0001	<0.001	0.0017	0.0019
Continuous Enrollment					
Enrolled ≥1 yr < 2 yrs	-0.0448	0.0008	<0.001	-0.0465	-0.0432
Enrolled < 1yr	-0.0523	0.0015	<0.001	-0.0552	-0.0495
Expansion X Continuous Enrollment					
Expansion / 1-2 Years Continuous	0.0418	0.0010	<0.001	0.0398	0.0438
Expansion / <1 Year Continuous	0.0764	0.0017	<0.001	0.0731	0.0796
RUCA B X Continuous Enrollment					
Enrolled ≥1 yr < 2 yrs/Lg Rural	0.0022	0.0014	0.136	-0.0007	0.0050
Enrolled < 1yr /Lg Rural	-0.0056	0.0020	0.005	-0.0095	-0.0017
Enrolled ≥1 yr < 2 yrs/Sm Rural	0.0108	0.0025	<0.001	0.0059	0.0157
Enrolled < 1yr/Sm Rural	0.0139	0.0035	<0.001	0.0071	0.0207
Female	0.0472	0.0005	<0.001	0.0463	0.0482
Hispanic					
Yes	-0.0148	0.0007	<0.001	-0.0162	-0.0133
Unknown/Missing	-0.0168	0.0012	<0.001	-0.0191	-0.0145
Race					
Black	-0.0323	0.0013	<0.001	-0.0348	-0.0298
AI/AN	0.0260	0.0019	<0.001	0.0224	0.0296
Asian	-0.0464	0.0014	<0.001	-0.0492	-0.0436
NHPI	-0.0428	0.0039	<0.001	-0.0505	-0.0351

Table 18: Aim 4 – Differential Impact of Continuity of Coverage and Rurality on Tobacco Cessation (cont.)

Other	0.0068	0.0014	<0.001	0.0040	0.0096
Unknown/Missing	-0.0177	0.0006	<0.001	-0.0190	-0.0165
Age	0.0077	0.0001	<0.001	0.0075	0.0080
Age Squared	-0.0001	<0.0001	<0.001	-0.0001	-0.0001
Time	-0.0013	<0.0001	<0.001	-0.0014	-0.0013
OHP Category					
Pregnant	-0.0174	0.0006	<0.001	-0.0186	-0.0162
CAWEM/Uncategorized	-0.0418	0.0014	<0.001	-0.0447	-0.0390
Children	-0.0318	0.0015	<0.001	-0.0347	-0.0290
Chronic Disease Dx	0.4598	0.0007	<0.001	0.4583	0.4612
CCO	0.0647	0.0006	<0.001	0.0635	0.0658
Primary Care Providers/1000	0.0000	<0.0001	<0.001	0.0000	0.0000
Median Home Value	0.0000	<0.0001	0.018	0.0000	0.0000

Table 19: Aim 4 - Differential Impact of Continuity of Coverage and Rurality on ETOH Treatment

	Coef.	Std. Err.	P-value	95 % CI	
Expansion Enrollee	-0.0770	0.0010	<0.001	-0.0789	-0.0751
RUCA B					
Large Rural Town	-0.0010	0.0013	0.439	-0.0037	0.0016
Small Rural Town/Isolated	-0.0210	0.0023	<0.001	-0.0255	-0.0165
Expansion X RUCA B					
Expansion/Lg Rural	0.0061	0.0015	<0.001	0.0032	0.0091
Expansion/Sm Rural	0.0146	0.0026	<0.001	0.0095	0.0197
Expansion X Month	0.0021	<0.0001	<0.001	0.0020	0.0022
Continuous Enrollment					
Enrolled ≥1 yr < 2 yrs	-0.0457	0.0009	<0.001	-0.0474	-0.0439
Enrolled < 1yr	-0.0520	0.0016	<0.001	-0.0551	-0.0489
Expansion X Continuous Enrollment					
Expansion / 1-2 Years Continuous	0.0429	0.0011	<0.001	0.0407	0.0450
Expansion / <1 Year Continuous	0.0805	0.0018	<0.001	0.0770	0.0840
RUCA B X Continuous Enrollment					
Enrolled ≥1 yr < 2 yrs/Lg Rural	0.0055	0.0015	<0.001	0.0025	0.0086
Enrolled < 1yr /Lg Rural	-0.0021	0.0021	0.328	-0.0062	0.0021
Enrolled ≥1 yr < 2 yrs/Sm Rural	0.0130	0.0027	<0.001	0.0078	0.0183
Enrolled < 1yr/Sm Rural	0.0133	0.0037	<0.001	0.0062	0.0205
Female	0.0495	0.0005	<0.001	0.0484	0.0506
Hispanic					
Yes	-0.0203	0.0008	<0.001	-0.0218	-0.0188
Unknown/Missing	-0.0178	0.0013	<0.001	-0.0203	-0.0153
Race					
Black	-0.0357	0.0014	<0.001	-0.0384	-0.0331
AI/AN	0.0264	0.0020	<0.001	0.0225	0.0303
Asian	-0.0563	0.0015	<0.001	-0.0593	-0.0533
NHPI	-0.0494	0.0041	<0.001	-0.0574	-0.0414

Table 19: Aim 4 - Differential Impact of Continuity of Coverage and Rurality on ETOH Treatment (cont.)

Other	0.0058	0.0015	<0.001	0.0029	0.0088
Unknown/Missing	-0.0216	0.0007	<0.001	-0.0230	-0.0203
Age	0.0088	0.0001	<0.001	0.0086	0.0091
Age Squared	-0.0001	<0.0001	<0.001	-0.0001	-0.0001
Time	-0.0013	<0.0001	<0.001	-0.0013	-0.0012
OHP Category					
Pregnant	-0.0209	0.0007	<0.001	-0.0222	-0.0196
CAWEM/Uncategorized	-0.0592	0.0015	<0.001	-0.0621	-0.0564
Children	-0.0379	0.0016	<0.001	-0.0411	-0.0347
Chronic Disease Dx	0.4763	0.0007	<0.001	0.4749	0.4778
CCO	0.0630	0.0006	<0.001	0.0618	0.0643
Primary Care Providers/1000	0.0000	<0.0001	<0.001	0.0000	0.0000
Median Home Value	0.0000	<0.0001	0.108	0.0000	0.0000

Table 20: Aim 4 - Tobacco Validity

	Final Model	Truncated LPM	Logistic	Fixed-Effects
Expansion Enrollee	-0.066**	-0.066**	-0.416**	(omitted)
RUCA B				
Large Rural Town	0.005**	0.005**	0.031**	-0.002
Small Rural Town/Isolated	-0.017**	-0.017**	-0.100**	-0.014**
Expansion X RUCA B				
Expansion/Lg Rural	0.004**	0.004**	0.029**	0.005
Expansion/Sm Rural	0.014**	0.014**	0.086**	0.019**
Continuous Enrollment				
Enrolled ≥1 yr < 2 yrs	-0.045**	-0.045**	-0.283**	-0.032**
Enrolled < 1yr	-0.052**	-0.052**	-0.367**	(omitted)
Expansion X Continuous Enrollment				
Expansion / 1-2 Years Continuous	0.042**	0.042**	0.260**	0.021**
Expansion / <1 Year Continuous	0.076**	0.077**	0.521**	(omitted)
RUCA B X Continuous Enrollment				
Enrolled ≥1 yr < 2 yrs/Lg Rural	0.002	0.002	0.021**	0.007
Enrolled < 1yr /Lg Rural	-0.006**	-0.006**	-0.036**	0.005
Enrolled ≥1 yr < 2 yrs/Sm Rural	0.011**	0.011**	0.066**	0.018**
Enrolled < 1yr/Sm Rural	0.014**	0.014**	0.084**	0.020**

** $p < 0.01$ * $p < 0.05$

Table 21: Aim 4 - ETOH Validity

	Final Model	Truncated LPM	Logistic	Fixed-Effects
Expansion Enrollee	-0.077**	-0.077**	-0.467**	(omitted)
RUCA B				
Large Rural Town	-0.001	-0.001	-0.006	-0.006
Small Rural Town/Isolated	-0.021**	-0.021**	-0.119**	-0.013**
Expansion X RUCA B				
Expansion/Lg Rural	0.006**	0.006**	0.038**	0.008
Expansion/Sm Rural	0.015**	0.015**	0.084**	0.013**
Continuous Enrollment				
Enrolled ≥1 yr < 2 yrs	-0.046**	-0.046**	-0.272**	-0.034**
Enrolled < 1yr	-0.052**	-0.052**	-0.335**	(omitted)
Expansion X Continuous Enrollment				
Expansion / 1-2 Years Continuous	0.043**	0.043**	0.252**	0.023**
Expansion / <1 Year Continuous	0.081**	0.081**	0.509**	(omitted)
RUCA B X Continuous Enrollment				
Enrolled ≥1 yr < 2 yrs/Lg Rural	0.006**	0.006**	0.037**	0.008
Enrolled < 1yr /Lg Rural	-0.002	-0.002	-0.015	0.005
Enrolled ≥1 yr < 2 yrs/Sm Rural	0.013**	0.013**	0.077**	0.019**
Enrolled < 1yr/Sm Rural	0.013**	0.013**	0.076**	0.024**

** $p < 0.01$ * $p < 0.05$

Table 22: Aim 4 - Tobacco Sensitivity

	Final Model	Without Chronic Disease	Without CCOs	RUCA-C	Alternative Expansion	Without Census Covariates
Expansion Enrollee	-0.066**	-0.094**	-0.071**	-0.066**	-0.075**	-0.066**
RUCA B						
Large Rural Town	0.005**	0.006**	0.002	0.005**	0.001	0.007**
Small Rural Town	-0.017**	-0.021**	-0.022**	-0.022**	-0.027**	-0.015**
Isolated Rural Town				-0.012**		
Expansion X RUCA B						
Expansion/Lg Rural	0.004**	0.003	0.005**	0.004**	0.010**	0.004**
Expansion/Sm Rural	0.014**	0.013**	0.018**	0.022**	0.027**	0.015**
Expansion/Isolated Rural				0.007*		
Continuous Enrollment						
Enrolled ≥1 yr < 2 yrs	-0.045**	-0.055**	-0.042**	-0.045**	-0.048**	-0.045**
Enrolled < 1yr	-0.052**	-0.066**	-0.063**	-0.052**	-0.050**	-0.052**
Expansion X Continuous Enrollment						
Expansion / 1-2 Years Continuous	0.042**	0.053**	0.035**	0.042**	0.037**	0.042**
Expansion / <1 Year Continuous	0.076**	0.096**	0.076**	0.076**	0.064**	0.076**
RUCA B X Continuous Enrollment						
Enrolled ≥1 yr < 2 yrs/Lg Rural	0.002	0.001	0.003*	0.002	0.001	0.002
Enrolled < 1yr /Lg Rural	-0.006**	-0.007**	-0.006*	-0.006**	-0.007**	-0.005**
Enrolled ≥1 yr < 2 yrs/Sm Rural	0.011**	0.011**	0.012**	0.012**	0.008**	0.011**
Enrolled < 1yr/Sm Rural	0.014**	0.016**	0.012**	0.008	0.010**	0.014**
Enrolled ≥1 yr < 2 yrs/Isolated Rural				0.010**		
Enrolled < 1yr/Isolated Rural				0.020**		

** $p < 0.01$ * $p < 0.05$

Table 23: Aim 4 - ETOH Sensitivity

	Final Model	Without Chronic Disease	Without CCOs	RUCA-C	Alternative Expansion	Without Census Covariates
Expansion Enrollee	-0.077**	-0.106**	-0.082**	-0.077**	-0.086**	-0.077**
RUCA B						
Large Rural Town	-0.001	0.000	-0.004**	-0.001	-0.007**	0.000
Small Rural Town	-0.021**	-0.025**	-0.026**	-0.024**	-0.031**	-0.019**
Isolated Rural Town				-0.018**		
Expansion X RUCA B						
Expansion/Lg Rural	0.006**	0.005**	0.007**	0.006**	0.013**	0.006**
Expansion/Sm Rural	0.015**	0.014**	0.019**	0.020**	0.027**	0.015**
Expansion/Isolated Rural				0.009*		
Continuous Enrollment						
Enrolled ≥1 yr < 2 yrs	-0.046**	-0.056**	-0.043**	-0.046**	-0.047**	-0.046**
Enrolled < 1yr	-0.052**	-0.066**	-0.062**	-0.052**	-0.046**	-0.052**
Expansion X Continuous Enrollment						
Expansion / 1-2 Years Continuous	0.043**	0.054**	0.036**	0.043**	0.036**	0.043**
Expansion / <1 Year Continuous	0.081**	0.100**	0.080**	0.081**	0.064**	0.081**
RUCA B X Continuous Enrollment						
Enrolled ≥1 yr < 2 yrs/Lg Rural	0.006**	0.005*	0.007**	0.006**	0.004*	0.006**
Enrolled < 1yr /Lg Rural	-0.002	-0.003	-0.002	-0.002	-0.004*	-0.002
Enrolled ≥1 yr < 2 yrs/Sm Rural	0.013**	0.013**	0.014**	0.015**	0.010**	0.013**
Enrolled < 1yr/Sm Rural	0.013**	0.016**	0.012**	0.009	0.010**	0.013**
Enrolled ≥1 yr < 2 yrs/Isolated Rural				0.011**		
Enrolled < 1yr/Isolated Rural				0.018**		

** $p < 0.01$ * $p < 0.05$

CHAPTER 5

DISCUSSION, IMPLICATIONS AND CONCLUSION

DISCUSSION

Summary of Findings

This study sought to understand whether utilization of preventive and behavioral health services among those newly enrolled in Medicaid differed across urban and rural residents in Oregon. Furthermore, this study examined whether continuity of coverage had differing effects on Medicaid enrollees' health service use across the rural-urban continuum. Two years after the implementation of the Affordable Care Act and Medicaid expansion, we found that Medicaid residents in rural parts of Oregon received quantitatively fewer preventive and behavioral health services than those living in urban areas. Furthermore, continuity of coverage had differing effects on the utilization of preventive services across the urban-rural continuum, but overall, continuity of coverage was found to be an important component of preventive and behavioral health service utilization. This study did find that rural residents had less variation in service use by expansion type than urban residents. Furthermore, rural residents had less variation in service use regardless of the length of time they were continuously enrolled in Medicaid as compared to urban residents.

The findings from this study suggest that factors other than the level of rurality may play a larger role in accessing and utilizing health care. Predisposing characteristics such as ones gender had a greater association with use of preventive and behavioral health care services than the level of rurality. Enabling factors such as enrollment in a CCO and being newly enrolled in Medicaid were also found to have a greater association with both preventive and behavioral health service use. Finally, need factors defined by

having a chronic disease diagnosis were found to have the greatest association with preventive and behavioral health service utilization.

Association Between Rurality and Health Service Utilization: Key Findings

This study found that rural Medicaid enrollees received quantitatively fewer preventive services, tobacco cessation services and substance abuse treatment services in a given month than those residing in more urban areas. However, larger differences in the predicted probability of preventive service use were found among those newly enrolled in Medicaid as compared to previous enrollees. Results from the count data models mirror those of the person-month linear probability models in that there were quantitatively small differences in the number of services in a year by level of rurality and larger differences between those newly enrolled in Medicaid from those previously enrolled.

Interestingly, we found less variation in health service use between previous enrollees and new enrollees in small rural towns than those in larger rural or urban towns. Similar patterns and differences in service utilization were found for cessation service use among smokers as well as alcohol and substance abuse treatment among those with a substance abuse diagnosis. While our results indicated those newly enrolleed in Medicaid may have had slightly increasing trends in service use over time, unadjusted rates by month (Figures 3-5) indicate that increase may have been due to a larger increase initialy, followed by a period where service use leveled off. However, findings from this study suggest that previous studies indicating decreases in preventive service use after Medicaid expansion among Oregon enrollees, may have been due to the lower rates of use among those newly enrolled.[131]

Our findings are similar to those of previous studies examining the effect of earlier Medicaid expansion efforts on rural populations' use of health services in Oregon[57,90] as well as other states.[30,122] Furthermore, our findings that those newly enrolled in health insurance used significantly fewer health care services than those previously enrolled are consistent with previous studies examining the effects of gaining insurance on preventive service use,[16,82,113] on tobacco cessation service utilization,[80] as well as substance use treatment among rural residents as compared to urban.[169,170] However, the effect of enrollment in health insurance and Medicaid expansion on receipt of substance abuse treatment services has been less consistent.[171-173] As suggested by one study, some of the barriers in accessing substance abuse treatment that those in rural areas face include availability of services, which includes shortages of providers and treatment facilities, transportation issues, lack of access to current technology, cost and stigma.[174]

Association Between Continuity of Enrollment and Health Service Utilization: Key Findings

This study found that continuity of coverage had very different effects on tobacco cessation service use and substance abuse treatment than it had on preventive service use. This finding was especially true among enrollees in small rural areas. While I found the use of cessation services and substance abuse treatment was lower among those continuously enrolled for less than one year than among those enrolled for the entire study period, almost no difference in behavioral health service use by length of enrollment among residents in small rural areas was found. Additionally, I found that those newly enrolled in Medicaid enrolled the entire study period used fewer behavioral

health services in a given month than those enrolled continuously for less than one year. This finding could be due to the potential for pent up demand among new enrollees for these services. While these patterns did not exist for those previously enrolled in Medicaid, they may have had more opportunity to receive behavioral health services prior to the start of the study period and over a longer period of time. Continuity of coverage was found to have a larger effect on preventive service use among urban enrollees as compared to rural enrollees. Larger differences in preventive service use by length of continuous enrollment in Medicaid were found among those living in urban parts of Oregon than those in more rural areas.

Findings from this study were similar to those of previous studies that found gaps in coverage were associated with decreased use of preventive care services.[36,99] One study found those who gained insurance took time to "catch up" to the same rate of utilization as those previously insured.[99] These results suggest it may take more than two years for those newly enrolled in Medicaid to reach the same rate as those who had previously been enrolled. Another study examining the effect of continuity of coverage on receipt of health services found that gaps in coverage were associated with delays in obtaining care patients felt was necessary as well as poorer quality of care.[103]

We hypothesized that smokers and substance abusers continuously enrolled for longer periods of time would utilize more services for tobacco cessation and substance abuse treatment, respectively. A possible explanation for why findings from this study did not match my hypothesis could be that persons with longer gaps in coverage may have had built up demand for care they were only able to utilize once they gained health insurance. However, one study found no evidence of pent-up demand for health care

among newly insured children compared to those who were continuously insured.[99] Similar to our study, that study also found a positively increasing time trend in service use among those newly insured. Additionally, the study found no variation in demand for services by level of rurality among those newly insured. Another study examining substance abuse treatment among Medicaid enrollees in Vermont found that more continuous enrollment in Medicaid was associated with reduced expenditures for among substance abusers.[175] The authors hypothesized this may have been due to increased demand for care when initially enrolled, but that demand tapered off over time.

Strengths and Limitations

Strengths

Our study had several strengths. I was able to utilize Medicaid claims and enrollment information for all enrollees in Oregon for the years 2012-2015. As such, I was not limited to a sub-sample of Oregon Medicaid enrollees. Additionally, I was able to utilize more than one year of post-expansion data. This allowed me to better determine how new enrollees are utilizing the health care system are so many changes were implemented.

One of the challenges in studying disparities in rural areas is the lack of data that provides an identifier for place of residence. Furthermore, more than one method is used to define rurality. In states like Oregon that have geographically large counties, using counties to differentiate between urban and rural areas may not provide an adequate representation and may underestimate differences.[64,66] By using RUCAs to identify the level of urbanization, I was able to explore finer gradients of rurality as well as account

for the fact that communities with a large proportion of the work population communiting to larger towns may have access to different types of services. Because my definition of rural was based upon geographic distance to an urban area as well as commuting flows it is not able to account for other factors that make rural communities different from urban communities. These include factors such as perceptions of the health care system, cultural differences in using the health care system or even fewer options in providers.[90,176] The differences in service use between urban and rural Medicaid enrollees that we found in this study could be the result of those differences. Because the Medicaid data available only included ZIP codes, I was not able to link to the Census tract level and instead had to collapse Census tracts to ZCTAs. Despite this fact, ZIP code-level covariates to define rurality have still been found to be as sensitive as Census level covariates.[177]

Limitations

Use of administrative data to assess health service use has some limitations because it is not collected for research purposes. The validity and accuracy of claims data to determine diagnoses may not always be complete.[178] However, administrative data provides a useful way to investigate population-level research from data that has already been collected. Because of the nature of Medicaid claims and eligibility data, it is free from non-response and drop-out bias.[179] Comparisons between administrative and clinical data have found similar prevalence for many diseases with the use of administrative sources.[180] While administrative data has been shown to be slightly more accurate in rural hospitals than urban, other factors such as hosptial teaching status and size were more important in predicting coding accuracy.[181] Because of this, underreporting of the outcomes of interest within this study were not expected to bias estimates.

The fact that National Drug Codes (NDCs) were not available to help calculate tobacco cessation services or alcohol or substance abuse treatment services received was another limiation. In addition, the utilization of the state tobacco Quit Line was also not available. This limitation could have resulted in under-estimating the probability of receiving services in a given month. Based on the fact that perceptions of tobacco QuitLines and use of cessation programs do not vary by the level of rurality[182,183] any under-estimation is not expected to have varied by ZIP code or RUCA level. I was further limited in the amount of information available about individual level factors and characteristics known to be associated with utilization of health care services such as education and individual income.[15,16] However, fixed effects models used to determine the potential for omitted variable bias found estimates were valid.

Providers per 1,000 population may underestimate the current rate of providers that accept Medicaid patients due to ACA payment increases. However, research found that this temporary increase in payments may have little impact on improving physicians acceptance of Medicaid patients.[184] Richards et al. (2016) also found no difference between urban and rural practices in their acceptance of new Medicaid patients.[185] It is also recognized that the number of providers within a ZIP code only provides an approximation of resource availability. It does not take into account persons or practitioners that may reside on the border of two or more ZIP codes. As Continelli et al. (2010) explained, this would, if anything attenuate the strength of any observed outcomes.[84] Finally, we were not able to account for the number of Community Health Workers or Health Navigators that were being used by many CCOs and may be more prevalent in certain parts of Oregon than others.

Finally, because safety net clinics often provide care to those uninsured and underinsured along with clinics that provide services on a sliding scale based on income, those newly enrolled in Medicaid were not necessarily without health care prior to being enrolled. Furthermore, they may have recently moved from another state or had a recent decrease in income. Based on our assumption of the newly enrolled population not having insurance prior to becoming enrolled in Medicaid, we would have underestimated the difference between those newly enrolled and previous enrollees. However, previous research indicates that most of those newly enrolled in Medicaid were previously uninsured, the majority for more than one year.[107]

IMPLICATIONS

Implication #1: Medicaid's Importance in Rural Communities

Medicaid covers a disproportionate number of persons living in rural towns in Oregon and the United States as compared to urban areas.[14,33] Those just gaining health insurance for the first time or eligible after a long gap in coverage are only beginning to learn to navigate the health care system and access both needed and recommended care. Medicaid expansion may be an important tool for reducing gaps in insurance coverage. As found by others, Medicaid expansion has improved access to and use of outpatient and preventive care.[122] This study found that continuity of enrollment had a significant effect on utilization of preventive health care services. These gaps may lead to use of more costly health care. The potential for many to lose the coverage they have only just gained could impact expansion enrollees. Additionally, because Medicaid covers a larger

percentage of rural residents than urban, elimination of state Medicaid expansions has the potential to also impact the health care system especially in rural areas where physicians relay more heavily on revenue from Medicaid than urban physicians.[186,187]

Implication #2: Impact of Hospital Closures on Rural Communities

Preventive care services are one important piece of the health care system, but not the only component. This study demonstrated that rural Medicaid enrollees use significantly fewer services in a given month and that provider density has a very small, yet significant assocation with health service utilization. The fact that many rural communities are now facing increasing numbers of hospital closures may further exacerbate the disparities in health among rural residents. A recent study found that Medicaid expansion was significantly associated with the reduced likelihood of hospital closures, especially in rural areas.[188] From 2010 through January 2018, 83 rural hospital have closed nationally and another 673 are at risk of closing.[189] These closures have the potential to significantly impact the health care system for rural residents and may overburden the few providers that remain.

A recent case study of several rural communities that had hospital closures found these closures resulted in providers of all types leaving the community.[190] The study also found that all the hospitals that closed were a major source of urgent and primary care, especially when other outpatient care was limited. Finally, the report found these closures were assocaited with increased gaps in specialty care, notably substance use disorder treatment. The 2016 Medicare Payment Advisory Council Report to Congress provided recommendations for alternative payment models that would allow rural hospitals at risk

of closing to continue to provide outpatient services and grant funding to help support emergency department services.[191] Ongoing research will need to monitor how these changes impact preventive and behavioral health service utilization and the potential for longer term implications to overall health and well-being.

Implication #3: CCO's Effect on Access to Care in Rural Areas

The final CCO Evaluation Report highlighted several key findings through the end of 2015.[131] Decreases in avoidable emergency department visits, but also slight decreases in access to primary and preventive care services among adults.[131] However, the evaluation did not examine difference between those newly enrolled after Medicaid expansion was established. The evaluation did find that financial incentives for meeting certain benchmarks were positively associated with better performance. CCOs are rewarded for benchmarks related to tobacco cessation and alcohol and substance abuse treatment. Those same incentives are not, however, available for preventive service visits for adults, only for children and teens.

Given that rural residents have higher smoking and substance abuse rates than those residing in more urban areas[6] in combination with the fact that 38% of Oregon adults on Medicaid use tobacco compared to just 12% of adults insured by other sources[192] may further exacerbate disparities in health outcomes if cessation and treatment options are not available or effective. Specific to Oregon's Medicaid program, our sensitivity analyses found that enrollment in a CCO was positively associated with the utilization of both preventive and behavioral health services. This finding was particularly true for those enrolled in a CCO who lived in more rural parts of Oregon as

compared to those living in urban areas. This difference could be due, in part to some of the more innovative ways CCOs are able to provide care and outreach to their patient population. Understanding what components of CCOs are most beneficial to rural communities will be important to help insure disparities in preventive care do not widen. The final CCO evaluation report did find that financial incentives were tied improved performance.[131] Currently, there are incentives and benchmarks tied to adolescent well care visits, enrollment in a patient centered primary care home, and provider access questions about payer case mix and whether primary care providers are accepting new Medicaid patients.[193] There is no metric directly tied to primary care visits for adults. There is, however, an incentive for meeting benchmarks for cigarette smoking prevalence and penalties tied to adult alcohol and substance misue screening. If these incentives are key to improving utilization, have a preventive service benchmark in place for adults may be necessary to improve rates of care.

Implication #4: Future Cost Savings

As found by others, increases in preventive and behavioral health services use may result in longer-term health and well being.[76,147] Additionaly, such increases could lead to longer-term savings for the health care system. Increasing access to these services will also require there be enough providers to see these new patients. Health insurance has been associated with primary care use and decreases in specialty care or unnecessary care.[76,147] Medicaid enrollees have smoking rates nearly two times the rate of those not on Medicaid.[117] About 5.2% of the annual healthcare spending in the United States can be attributed to smoking-related health services that are covered by public programs.[194] Increased access to coverage, in addition to more stable coverage for Medicaid enrollees,

could lead to higher quit rates, which could in turn lead to lower health care costs. However, while Medicaid enrollees have higher rates of substance abuse disorders they have also been shown to have lower rates of treatment.[195] A recent study examining the effect of the ACA on alcohol and substance use treatment post-expansion found no change in receipt of treatment among young adults.[196] The fact that rural areas have lower rates of specialists than urban areas, lack of proper care and treatment may for rural residents may only be exacerbated.[90]

Future Research

Our finding that new enrollees with shorter lengths of continuous enrollment utilized more preventive and behavioral health services than those enrolled for longer periods of time deserves more attention. Additionally, we do not actually know that those we defined as newly enrolled in Medicaid had been uninsured prior to their enrollment in OHP or how long their period of being uninsured lasted. Because state Medicaid programs are not identical, understanding how rural populations are utilizing health services after implementation of the ACA and Medicaid expansion will be important. Finally, we did not closely examine the effects of movement from one RUCA to another or even movement within a RUCA. Medicaid enrollees that move during the study period may provide a unique opportunity to better understand if disparities in use are a function of person-level characteristics or the characteristics of rural or urban areas.

CONCLUSION

Medicaid expansion has the potential to overwhelm the health care system, particularly in rural areas where the number of health care providers per population is much lower than in urban areas. Examination of the differing effects among those newly enrolled versus those who had previously been enrolled in use of preventive care services provides further evidence that new enrollees may require more time before they are able to navigate or use the health care system in the same way as those who have had health insurance within the past year. Althgough we found lower rates of service use in small and isolated small rural towns, we did find increasing trends in service use over time that may have been due to a large, inital increase followed by leveling off over time. Residents of large rural towns, with fewer providers per population than in urban areas, had the same if not higher rates of service use than in urban areas.

Many studies have examined the impact of Medicaid expansion on health service utilization, but only a few of those studies have focused on the effect among rural populations. In addition to the social and demographic differences between urban and rural residents,[6] rural residents also face additional challenges in accessing and receiving health care. These challenges include lower rates of primary care providers in rural areas, and even lower rates of specialty providers,[176] transportation issues,[90] greater distances to care including specialty care,[90] real and perceived lower quality of care,[176] lack of trust in the health care system or the quality of care provided among rural residents,[90] as well as differing cultural norms around using health care.[90]

The importance of primary care services on future health outcomes and health care costs has been well documented.[76,147,176] Because of the disparities in morbidity and

mortality between urban and rural residents, it will be important to continue to monitor whether disparities in utilization persist or even widen as a result of the ACA. Attention to these population sub-groups will help ensure that efforts and public health programs and policies will continue to focus on those areas and groups where greater improvements in health outcomes might be made.

The ACA brought about many changes to the health care system including a new focus on preventive medicine as well alternative payment structures that may move the health care system away from a strictly fee-for-service model. It remains to be seen, though, whether small changes in the utilization of preventive and behavioral health care will translate to longer-term outcomes such as improvements in population health outcomes. If rural Medicaid enrollees continue to utilize preventive and behavioral health care services at lower rates, understanding what changes are working and which are not could be beneficial to narrowing disparities. Furthermore, future evaluation of the impact of Medicaid expansion and increased access to health insurance should consider longer-term continuity of insurance coverage when estimating health service utilization.

As shown by this study as well as others, having health insurance alone does not guarantee access to or utilization of health services,[27,117,171] but it can influence a person's ability or willingness to use or receive needed or recommended care.[197] Medicaid expansion has lead to gains in the percent of the U.S. population now covered by health insurance, especially among rural populations.[105,112] However, some have not been able to easily access or have chosen not to use preventive or behavioral health services.[198,199]

While residents of rural areas have worse health behaviors and health outcomes,[6,9,15,69] there are a multitude of factors that contribute to these disparities.[14,16,60]

Health system reform is one tool that has been used to help decrease health disparities within the United States, it may take more than providing insurance to completely eliminate them. In addition to improving access to health care, improvements in education or reducing rates of poverty may also be necessary to truely eliminate these gaps in health outcomes.

REFERENCES

1. Kelly Ann Holder, Alison Fields, Daphne Lofquist. (2016) Rurality Matters. U.S. Census Bureau; February 9, 2017. https://http://www.census.gov/newsroom/blogs/random-samplings/2016/12/rurality_matters.html accessed Date
2. U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion. Healthy People 2020. Washington, DC January 27, 2017. https://http://www.healthypeople.gov, accessed Date
3. National Institutes of Health. NIH health disparities strategic plan and budget: Fiscal years 2009–2013. Washington DC, 2015.
4. Kathryn H. Dansky, Riad Dirani. (1998) The Use of Health Care Services by People with Diabetes in Rural Areas. *The Journal of Rural Health* 14(2):129-37.
5. Adam Drewnowski, Colin D. Rehm, David Solet. (2007) Disparities in obesity rates: Analysis by ZIP code area. *Social Science and Medicine* 65(12):2458-63.
6. Michael Meit, Alana Knudson, Tess Gilbert, Amanda Tzy-Chyi Yu, Erin Tanenbaum, Elizabeth Ormson, et al. (2014) The 2014 Update of the Rural-Urban Chartbook. Rural Health Reform Policy Research Center.
7. Thomas A. Arcury, Wilbert M. Gesler, John S. Preisser, Jill Sherman, John Spencer, Jamie Perin. (2005) The Effects of Geography and Spatial Behavior on Health Care Utilization among the Residents of a Rural Region. *Health Services Research* 40(1):135-55.
8. Macarena C. Garcia, Mark Faul, Greta Massetti, Cheryll C. Thomas, Yuling Hong, Ursula E. Bauer, et al. Reducing Potentially Excess Deaths from the Five Leading Causes of Death in the Rural United States. Atlanta, GA Centers for Disease Control and Prevention, ; 2017 p. 1-7.
9. Ernest Moy, Macarena C. Garcia, Bastian B, Lauren M. Rossen, Deborah D. Ingram, Mark Faul, et al. Leading Causes of Death in Nonmetropolitan and Metropolitan Areas — United States, 1999–2014. In: Centers for Disease Control and Prevention, editor. Atlanta, GA 2017. p. 1-8.
10. Christie A. Befort, Niaman Nazir, Michael G. Perri. (2012) Prevalence of Obesity Among Adults From Rural and Urban Areas of the United States: Findings From NHANES (2005–2008). *Journal of Rural Health* 28(4):392-7.
11. Karly B. Smith, John S. Humphreys, Murray G. A. Wilson. (2008) Addressing the health disadvantage of rural populations: How does epidemiological evidence inform rural health policies and research? *Australian Journal of Rural Health* 16:56-66.
12. Mark S. Eberhardt, Elsie R. Pamuk. (2004) The Importance of Place of Residence: Examining Health in Rural and Nonrural Areas. *The American Journal of Public Health* 94(10):1682-6.
13. JS McCall-Hosenfeld, CS Weisman. (2011) Receipt of preventive counseling among reproductive-aged women in rural and urban communities. *Rural Remote Health* 11(1):1617-27.
14. Vann Newkirk, Anthony Damico. (2014) The affordable care act and insurance coverage in rural areas. *The Kaiser Commission on Medicaid and the Uninsured, May* 29.
15. Carol Adaire Jones, Timothy S. Parker, Mary Ahearn, Ashok K. Mishra, Jayachandran N. Variyam. (2009) Health Status and Health Care Access of Farm and Rural Populations. USDA - Economic Research Service.
16. Catherine Hoffman, Anthony Damico, Rachel Garfield. (2011) Research Brief: Insurance Converage and Access to Care in Primary Care Shortage Areas. Washington, DC: Kaiser Family Foundation.
17. Kenneth E. Johnson. (2012) Rural Demographic Change in the New Century. University of New Hampshire: Carsey Institute.

18. Centers for Disease Control and Prevention. (2017) Persons who did not receive medical care or who delayed seeking medical care in the past year due to cost, by selected characteristics: United States, 2015. Altanta, GA; cited 2017 February 3, 2017. https://http://www.cdc.gov/nchs/nhis/SHS/tables.htm, accessed Date
19. Starfield B, Shi L, Macinko J. (2005) Contribution of primary care to health systems and health. *Milbank Quarterly* 83(3):457-502.
20. Joseph D. Freeman, Srikanth Kadiyala, Janice F. Bell, Diane P. Martin. (2008) The Causal Effect of Health Insurance on Utilization and Outcomes in Adults: A Systematic Review of US Studies. *Medical Care* 46:1023-32.
21. Rhode Island Department of Health. (2012) Impact of Primary Care on Healthcare Cost and Population Health: A Literature Review.
22. Bolin JN, Bellamy G. (2011) Rural healthy people 2020. *College Station: The Texas A&M Health Science Center, School of Rural Public Health, Southwest Rural Health Research Center*.
23. Ali H. Mokdad, James S. Marks, Donna F. Stroup, Julie L. Gerberding. (2004) Actual Causes of Death in the United States, 2000. *JAMA* 291(10):1238-45.
24. U.S. Preventive Services Task Force. (2017) USPSTF A and B Recommendations. https://http://www.uspreventiveservicestaskforce.org/Page/Name/uspstf-a-and-b-recommendations/, accessed Date
25. Birgit Babitsch, Daniela Gohl, Thomas von Lengerke. (2012) Re-revisiting Andersen's Behavioral Model of Health Services Use: a systematic review of studies from 1998–2011. *GMS Psycho-Social-Medicine* 9.
26. Jane Bolin, Larry Gramm. (2010) Access to Quality Health Services in Rural Areas-Insurance: A Literature Review. Rural Healthy People.
27. Michelle M. Casey, Kathleen Thiede Call, Jill M. Klingner. (2001) Are Rural Residents Less Likely to Obtain Recommended Preventive Healthcare Services. *American Journal of Preventive Medicine* 21(3):182-8.
28. Mark P. Doescher, Jackson JE. (2008) Trends in Cervical and Breast Cancer Screening Practices Among Women in Rural and Urban Areas of the United States. Seattle, WA: Rural Health Research Center.
29. Benjamin D. Sommers, Katherine Baicker, Arnold M. Epstein. (2012) Mortality and Access to Care among Adults after State Medicaid Expansions. *New England Journal of Medicine* 367(11):1025-34.
30. Marguerite Burns, Laura Dague, Thomas DeLeire, Mary Dorsch, Donna Friedsam, Lindsey Jeanne Leininger, et al. (2014) The Effects of Expanding Public Insurance to Rural Low-Income Childess Adults. *Health Services Research* 49(2):2173-87.
31. The Kaiser Commission on Medicaid and the Uninsured. (2016) Key Facts about the Uninsured Population: Fact Sheet. Menlo Park, CA: Kaiser Family Foundation.
32. Carmen DeNavas-Walt, Bernadette D. Proctor, Smith JC. (2010) Income, Poverty, and Health Insurance Coverage in the United States: 2009. Washington, DC: US Census Bureau.
33. Julia Foutz, Samantha Artiga, Rachel Garfield. (2017) Issue Brief: The Role of Medicaid in Rural America. Kaiser Family Foundation.
34. David M. Cutler, Alexander M. Gelber. (2009) Changes in the Incidence and Duration of Periods without Insurance. *New England Journal of Medicine* 360(17):1740-8.
35. Joseph J. Sudano Jr, David W. Baker. (2003) Intermittent Lack of Health Insurance Coverage and Use of Preventive Services. *American Journal of Public Health* 93(1):130-7.
36. Rachel Gold, Jennifer DeVoe, Amit Shah, Susan Chauvie. (2009) Insurance continuity and receipt of diabetes preventive care in a network of Federally Qualified Health Centers. *Medical Care* 47(4):431-9.

37. Leighton C. Ku, Patricia MacTaggart, Fouad Pervez, Rosenbaum SJ. (2009) Improving Medicaid's Continuity of Coverage and Quality of Care. Washington, DC: Association for Community Affiliated Plans.
38. Olveen Carrasquillo, David U. Himmelstein, Steffie Woolhandler, David H. Bor. (1998) Can Medicaid Managed Care Provide Continuity of Care to New Medicaid Enrollees? An Analysis of Tenure on Medicaid. *American Journal of Public Health* 88(3):464-6.
39. Robert A. Lowe, K. John McConnell, Molly E. Vogt, Jeanene A. Smith. (2008) Impact of Medicaid Cutbacks on Emergency Department Use: The Oregon Experience. *Annals of Emergency Medicine* 52(6):626-34.
40. Melinda K. Abrams, Michelle M. Doty, Jamie Ryan, Dominique Hall, Pamela Riley. (2014) Ready or Not? How Community Health Centers View Their Preparedness to Care for Newly Insured Patients: Issue Brief. The Commonwealth Fund.
41. Janice C. Probst, Charity G. Moore, Saundra H. Glover, Michael E. Samuels. (2004) Person and Place: The Compounding Effects of Race/Ethnicity and Rurality on Health. *American Journal of Public Health* 94(10):1695-703.
42. Meredith A. Fordyce, Frederick M. Chen, Mark P. Doescher, L. Gary Hart. (2007) 2005 Physician Supply and Distribution in Rural Areas of the United States. Seattle, WA: WWAMI Rural Health Research Center.
43. Patient Protection and Affordable Care Act. Sect. 18001 (2010).
44. Oregon Health Plan. OHP Data and Reports. Portland, OR March 22, 2017. https://http://www.oregon.gov/oha/healthplan/Pages/reports.aspx, accessed Date
45. Oregon Health Authority. (2016) Oregon's Health System Transformation Quarterly Legislative Report: Q1 2016. Portland, OR.
46. Molly Frean, Jonathan Gruber, Benjamin D. Sommers. (2016) Disentangling the ACA's Coverage Effects — Lessons for Policymakers. *The New England Journal of Medicine* 375(17):1605-8.
47. Enrolled House Bill 3650, (2011).
48. Oregon Health Authority. (2012) Oregon's Health System Transformation Legislation: A Summary of OR House Bill 3650. Portland, OR.
49. Oregon Health Policy Board. (2012) Coordinated Care Organizations Implementation Proposal: House Bill 3650 Health System Transformation. Oregon Health Authority.
50. Howard SW, Bernell SL, Yoon J, Luck J, Ranit CM. (2015) Oregon's Experiment in Health Care Delivery and Payment Reform: Coordinated Care Organizations Replacing Managed Care. *Journal of Health Politics, Policy and Law* 40(1):245-55.
51. Patient-Centered Primary Care Home Program, OAR 409-055-0000 to 409-055-0090 (2009).
52. Recognized Patient-Centered Primary Care Homes. March 23, 2017. http://www.oregon.gov/oha/pcpch/Pages/recognized-clinics.aspx, accessed Date
53. (2015) Patient-Centered Primary Care Home Program. Oregon Health Authority; March 23, 2017. http://www.oregon.gov/oha/pcpch/Pages/index.aspx accessed Date
54. Hartley D. (2004) Rural Health Disparities, Population Health, and Rural Culture. *American Journal of Public Health* 94(10):1675-8.
55. Joseph A. Benitez, Liza Creel, J'Aime Jennings. (2016) Kentucky's Medicaid Expansion Showing Early Promise On Coverage And Access To Care. *Health Affairs* 35(3).
56. Randall D. Cebul, Thomas E. Love, Douglas Einstadter, Alice S. Petrulis, John R. Corlett. (2015) MetroHealth Care Plus: Effects Of A Prepared Safety Net On Quality Of Care In A Medicaid Expansion Population. *Health Affairs* 34(7):1121-30.

57. Katherine Baicker, Sarah L. Taubman, Heidi L. Allen, Mira Bernstein, Jonathan H. Gruber, Joseph P. Newhouse, et al. (2013) The Oregon Experiment — Effects of Medicaid on Clinical Outcomes. *New England Journal of Medicine* 368(18):1713-22.
58. Sophie C. Miller, Bianca K. Frogner, Laura M. Saganic, Allison M. Cole, Roger Rosenblatt. (2016) Affordable Care Act Impact on Community Health Center Staffing and Enrollment: A Cross-Sectional Study. *The Journal of Ambulatory Care Management* 39(4):299-307.
59. Paula A.M. Weigel, Fred Ullrich, Dan M. Shane, Keith J. Mueller. (2016) Variation in Primary Care Service Patterns by Rural-Urban Location. *Journal of Rural Health* 32(2):196-203.
60. James D. Reschovsky, Andrea B. Staiti. (2005) Access And Quality: Does Rural America Lag Behind? *Health Affairs* 24(4):1128-39.
61. Daniel Polsky, Molly Candon, Brendan Saloner, DouglasWissoker, Katherine Hempstead, GenevieveM. Kenney, et al. (2017) Changes in Primary Care Access Between 2012 and 2016 for New Patients With Medicaid and Private Coverage. *JAMA Internal Medicine*. Epub February 27ß, 2017.
62. Sarah Miller, Laura R Wherry. (2017) Health and Access to Care during the First 2 Years of the ACA Medicaid Expansions. *New England Journal of Medicine* 376(10):947-56.
63. K. John McConnell, Stephanie Renfro, Richard C. Lindrooth, Deborah J. Cohen, Neal T. Wallace, Chernew ME. (2017) Oregon's Medicaid Reform And Transition To Global Budgets Were Associated With Reductions In Expenditures. *Health Affairs* 36(3):451-9.
64. Susan A. Hall, Jay S. Kaufman, Thomas C. Ricketts. (2006) Defining Urban and Rural Areas in U.S. Epidemiologic Studies. *Journal of Urban Health: Bulletin of the New York Academy of Medicine* 83(2):162-75.
65. Hart LG, Larson EH, Lishner DM. (2005) Rural definitions for health policy and research. *American Journal of Public Health* 95(7):1149-55.
66. Eric H. Larson, L. Gary Hart. Rural health workforces methods and analysis. In: Eric H. Larson, Karin E. Johnson, Thomas E. Norris, Denis M. Lishner, Roger A. Rosenblatt, L. Gary Hart, editors. State of the Health Workforce in Rural American: State Profiles and Comparisons. Seattle, WA: WWAMI Rural Health Research Center, University of Washington; 2003. p. 15-22.
67. Rural Health Information Hub. (2015) What is Rural? May 4, 2017. https://http://www.ruralhealthinfo.org/topics/what-is-rural, accessed Date
68. Andrew F. Coburn, A. Clinton MacKinney, Timothy D. McBride, Keith J. Mueller, Rebecca T. Slifkin, Mary K. Wakefield. (2007) Choosing Rural Definitions: Implications for Health Policy Issue Brief. Rural Policy Research Institute.
69. Arthur G. Cosby, Tonya T. Neaves, Ronald E. Cossman, Jeralynn S. Cossman, Wesley L. James, Neal Feierabend, et al. (2008) Preliminary Evidence for an Emerging Nonmetropolitan Mortality Penalty in the United States. *American Journal of Public Health* 98(8):1470-2.
70. McGinnis JM, Foege WH. (1993) Actual causes of death in the United States. *Jama* 270(18):2207-12.
71. Services. USDoHaH. (2014) The Health Consequences of Smoking - 50 Years of Progess: A Report to the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health,.
72. Mandy Stahre, Jim Roeber, Dafna Kanny, Robert D. Brewer, Xingyou Zhang. (2014) Contribution of Excessive Alcohol Consumption to Deaths and Years of Potential Life Lost in the United States. *Preventing Chronic Disease* 11.
73. Kai H. Young, Melissa Ehman, Randall Reves, Brandy L. Peterson Maddox, Awal Khan, Terence L. Chorba, et al. (2016) Increases in Drug and Opioid Overdose Deaths — United States, 2000–2014. *Morbidity & Mortality Weekly Report* 64(50-51):1378-82.

74. Paulozzi LJ, Yongli Xi. (2008) Recent changes in drug poisoning mortality in the United States by urban–rural status and by drug type. *Pharmacoepidemiology and Drug Safety* 17(10):997-1005.
75. (2012) CDC Grand Rounds: Prescription Drug Overdoses — a U.S. Epidemic. *Morbidity & Mortality Weekly Report* 61(1):10-3.
76. Barbara Starfield, Leiyu Shi, James Macinko. (2005) Contribution of Primary Care to Health Systems and Health. *Milbank quarterly* 83(3):457–502.
77. Gostin LO, Jacobson PD, Record KL, Hardcastle LE. (2011) Restoring health to health reform: integrating medicine and public health to advance the population's well-being. *University of Pennsylvania Law Review*:1777-823.
78. Kringos DS, Boerma W, Zee Jvd, Groenewegen P. (2013) Europe's Strong Primary Care Systems Are Linked To Better Population Health but Also to Higher Health Spending. *Health Affairs* 32(4).
79. Stead LF, Gillian Bergson, Tim Lancaster. (2008) Physician advice for smoking cessation. *The Cochrane Library*.
80. Steffani R. Bailey, Megan J. Hoopes, MiguelMarino, John Heintzman, Jean P. O'Malley, Brigit Hatch, et al. (2016) Effect of Gaining Insurance Coverage on Smoking Cessation in Community Health Centers: A Cohort Study. *Jounral of General Internal Medicine* 31(10):1198-205.
81. James B. Kirby, Toshiko Kaneda. (2005) Neighborhood Socioeconomic Disadvantage and Access to Health Care. *Journal of Health and Social Behavior* 46(1):15–31.
82. Reza Rezayatmand, Milena Pavlova, Wim Groot. (2013) The impact of out-of-pocket payments on prevention and health-related lifestyle: a systematic literature review. *European Journal of Public Health* 23(1):74-9.
83. Samina T. Syed, Ben S. Gerber, Lisa S. Sharp. (2013) Traveling Towards Disease: Transportation Barriers to Health Care Access. *Journal of Community Health* 38(5):976-93.
84. Tracey Continelli, SandraMcGinnis, Timothy Holmes. (2010) The Effect of Local Primary Care Physician Supply on the Utilization of Preventive Health Services in the United States. *Health & Place* 16(5):942-51.
85. Asheley Cockrell Skinner, Rebecca T. Slifkin. (2007) Rural/Urban Differences in Barriers to and Burden of Care for Children With Special Health Care Needs. *Journal of Rural Health* 23(2):150-7.
86. Jean A. Talbot, Erika C. Ziller, Jennifer Lenardson, David Hartley. (2014) Implications of Rurality and Psychiatric Status for Diabetic Preventive Care Use among Adults with Diabetes - Research & Policy Brief. Portland, ME: Maine Rural Health Research Center.
87. The Kaiser Commission on Medicaid and Uninsured. (2015) Key Facts about the Uninsured Population. Kaiser Family Foundation; September 5, 2016. http://kff.org/uninsured/fact-sheet/key-facts-about-the-uninsured-population/, accessed Date
88. Elizabeth M. Allen, Kathleen T. Call, Timothy J. Beebe, Donna D. McAlpine, Pamela Jo Johnson. (2017) Barriers to Care and Health Care Utilization Among the Publicly Insured. *Medical Care* 55(3):207-14.
89. Heidi Allen, Bill J. Wright, Katherine Baicker. (2014) New Medicaid Enrollees In Oregon Report Health Care Successes And Challenges. *Health Affairs* 33(2):292-9.
90. Heidi Allen, Bill Wright, Lauren Broffman. (2017) The Impacts of Medicaid Expansion on Rural Low- Income Adults: Lessons From the Oregon Health Insurance Experiment. *Medical Care Research and Review*.

91. Kate E Pickett, Michelle Pearl. (2001) Multilevel Analyses of Neighbourhood Socioeconomic Context and Health Outcomes: A Critical Review. *Journal of Epidemiology and Community Health* 55(2):111–22.
92. Andrew F. Beck, Jeffrey M. Simmons, Bin Huang, Robert S. Kahn. (2012) Geomedicine: Area-Based Socioeconomic Measures for Assessing Risk of Hospital Reutilization Among Children Admitted for Asthma. *American Journal of Public Health* 102(12):2308-14.
93. Alexandra M. Yip, George Kephart, Paul J. Veugelers. (2002) Individual and Neighbourhood Determinants of Health Care Utilization Implications for Health Policy and Resource Allocation. *Canadian Journal of Public Health* 93(4):303-7.
94. Chyke A. Doubeni, Guruprasad D. Jambaulikar, Hassan Fouayzi, Scott B. Robinson, Margaret J. Gunter, Terry S. Field, et al. (2012) Neighborhood Socioeconomic Status and Use of Colonoscopy in an Insured Population – A Retrospective Cohort Study. *PLOS One* 7(5):e36392.
95. Jill Amlong MacKinnon, Robert C. Duncan, Youjie Huang, David J. Lee, Lora E. Fleming, Lydia Voti, et al. (2007) Detecting an Association between Socioeconomic Status and Late Stage Breast Cancer Using Spatial Analysis and Area-Based Measures. *Cancer Epidemiology, Biomarkers & Prevention* 16(4):756-62.
96. Mario Schootman, Donna B Jeffe, Elizabeth A Baker, Walker MS. (2006) Effect of Area Poverty Rate on Cancer Screening Across US Communities. *Journal of Epidemiology and Community Health* 60:2002-207.
97. Centers for Disease Control and Prevention. (2010) Vital Signs: Health Insurance Coverage and Health Care Utilization - United States, 2006-2009 and January-March 2010. Atlanta, GA.
98. Cathy Schoen, Catherine DesRoches. (2000) Role of Insurance in Promoting Access to Care Uninsured and Unstably Insured: The Importance of Continuous Insurance Coverage. *Health Services Research* 35(1):187-206.
99. Karen Goldsteen, Raymond L. Goldsteen. (2002) Demand for Medical Services Among Previously Uninsured Children: The Roles of Race and Rurality. Columbia, SC: South Carolina Rural Health Research Center.
100. Sandra L. Decker, Jalpa A. Doshi, Amy E. Knaup, Daniel Polsky. (2012) Health Service Use among the Previously Uninsured: Is Subsidized Health Insurance Enough? *Health Economics* 21(10):1155-68.
101. Social Security Act, S. 1925, codified at 42 U.S.C. § 1396r-6.
102. Report to Congress on Medicaid and CHIP, March 2014. Washington, DC: Medicaid and CHIP Payment Access Commission.
103. Benjamin D. Sommers, Rebecca Gourevitch, Bethany Maylone, Robert J. Blendon, Arnold M. Epstein. (2017) Insurance Churning Rates For Low-Income Adults Under Health Reform: Lower Than Expected But Still Harmful For Many. *Health Affairs* 35(10):1816-24.
104. Aparna Soni, Michael Hendryx, Kosali Simon. (2017) Medicaid Expansion Under the Affordable Care Act and Insurance Coverage in Rural and Urban Areas. *The Journal of Rural Health*:1-10.
105. Uberoi N, Finegold K, Gee E. (2016) Health Insurance Coverage and the Affordable Care Act, 2010–2016. Washington, DC: US Department of Health and Human Services: Office of the Assistant Secretary for Planning and Evaluation.
106. Patient Protection and Affordable Care Act, Law 111-148, 23 (2010).
107. Sara R. Collins, Munira Gunja, Michelle M. Doty, Sophie Beutel. (2016) Americans' Experiences with ACA Marketplace and Medicaid Coverage: Access to Care and Satisfaction. The Commonwealth Fund.
108. Frean M, Gruber J, Sommers BD. (2016) Disentangling the ACA's Coverage Effects — Lessons for Policymakers. *New England Journal of Medicine* 375(17):1605-8.

109. Tim McAfee, Stephen Babb, Simon McNabb, Michael C. Fiore. (2015) Helping Smokers Quit — Opportunities Created by the Affordable Care Act. *New England Journal of Medicine* 372(1):5-7.
110. Kaiser Family Foundation. (2015) Preventive Services Covered by Private Health Plans under the Affordable Care Act. October 21, 2016. http://kff.org/health-reform/fact-sheet/preventive-services-covered-by-private-health-plans/, accessed Date
111. Buck JA. (2011) The Looming Expansion And Transformation Of Public Substance Abuse Treatment Under The Affordable Care Act. *Health Affairs* 30(8):1402-10.
112. Larisa Antonisse, Rachel Garfield, Robin Rudowitz, Samantha Artiga. (2017) Issue Brief: The Effects of Medicaid Expansion under the ACA: Updated Findings from a Literature Review. Menlo Park, CA: Kaiser Family Foundation
113. James B. Kirby, Jessica P. Vistnes. (2016) Access To Care Improved For People Who Gained Medicaid Or Marketplace Coverage in 2014. *Health Affairs* 35(10):1830-4.
114. Adele Shartzer, Sharon K. Long, Nathaniel Anderson. (2016) Access To Care And Affordability Have Improved Following Affordable Care Act Implementation; Problems Remain. *Health Affairs* 35(1):161-8.
115. Benjamin D. Sommers, Thomas Buchmueller, Sandra L. Decker, Colleen Carey, Richard Kronick. (2013) The Affordable Care Act Has Led To Significant Gains In Health Insurance And Access to Care for Young Adults. *Health Affairs* 32(1):165-74.
116. Erika C. Ziller, Jennifer D. Lenardson, Andrew F. Coburn. (2015) Rural Adults Delay, Forego, and Strategize to Afford Their Pre-ACA Health Care. Portland, ME: Maine Rural Health Research Center.
117. Kelly C. Young-Wolff, Daniella Klebaner, Cynthia I. Campbell, Constance Weisner, Derek D. Satre, Alyce S. Adams. (2017) Association of the Affordable Care Act With Smoking and Tobacco Treatment Utilization Among Adults Newly Enrolled in Health Care. *Medical Care*. Epub March 10, 2017.
118. Jean P. O'Malley, Maureen O'Keeffe-Rosetti, Robert A. Lowe, Heather Angier, Rachel Gold, Miguel Marino, et al. (2016) Health Care Utilization Rates After Oregon's 2008 Medicaid Expansion Within-Group and Between-Group Differences Over Time Among New, Returning, and Continuously Insured Enrollees. *Medical Care* 54(11):984-91.
119. Josh Gray, Iyue Sung, Stewart Richardson. (2014) ACAview Tracking the Impact of Health Care Reform: Observations on the Affordable Care Act: 2014. Princeton, NJ: athenahealth & Robert Wood Johnson Foundation.
120. Karin V. Rhodes, Simon Basseyn, Ari B. Friedman, Genevieve M. Kenney, Douglas Wissoker, Daniel Polsky. (2017) Access to Primary Care Appointments Following 2014 Insurance Expansions. *Annals of Family Medicine* 15(2):107-12.
121. Laura R. Wherry, Sarah Miller. (2016) Early Coverage, Access, Utilization, and Health Effects Associated With the Affordable Care Act Medicaid Expansions: A Quasi-experimental Study. *Annals of Internal Medicine* 164:795-803.
122. Benjamin D. Sommers, Robert J. Blendon, E. John Orav, Arnold M. Epstein. (2016) Changes in Utilization and Health Among Low-Income Adults After Medicaid Expansion or Expanded Private Insurance. *JAMA Internal Medicine* 176(10):1501-9.
123. Roger A. Rosenblatt, L. Gary Hart. (2000) Physicians and Rural America. *The Western Journal of Medicine* 173(5):348-51.
124. Coordinated care organizations, ORS 414.625 (2015).
125. K. John McConnell, Anna Marie Chang, Deborah J. Cohen, Wallacem N, Michael E. Chernew, Glenn Kautz, et al. (2014) Oregon's Medicaid Transformation: An Innovative Approach To Holding A Health System Accountable For Spending Growth. *Healthcare* 2(3):163-7.

126. K. John McConnell. (2016) Oregon's Medicaid Coordinated Care Organizations. *JAMA* 315(9):869-70.
127. Office of Health Analytics. (2017) Technical Specifications and Guidance Documents for CCO Incentive Measures. March 28, 2017.
http://www.oregon.gov/oha/analytics/Pages/CCO-Baseline-Data.aspx, accessed Date
128. Oregon Health Authority. (2017) Oregon's Health System Transformation: CCO Metrics 2016 Mid-Year Report. Portland, OR: Office of Health Analytics.
129. Oregon Health Authority. (2017) Primary Care Spending in Oregon: A Report to the Oregon State Legislature. Portland, OR.
130. Carol V. Irvin, JudyAnn Bigby, Vivian Byrd, Michael Barna, Suzie Witmer, Maureen Higgins. (2015) Midpoint Evaluation of Oregon's Medicaid Section 1115 Demonstration: Mid-2012 through mid-2014. Salem, OR: Mathematica Policy Research.
131. Jonah Kushner, Kyle Tracy, Bonnie Lind, Stephanie Renfro, Ruth Rowland, John McConnell. (2017) Evaluation of Oregon's 2012-2017 Medicaid Waiver, Final Report. OHSU, Center for Health Systems Effectiveness.
132. AAFP, AAP, ACP, AOA. Joint Principles of the Patient-Centered Medical Home. March 2007.
133. Erin Fries Taylor, Stacy Dale, Deborah Peikes, Randall Brown, Arkadipta Ghosh, Jesse Crosson, et al. (2015) Evaluation of the Comprehensive Primary Care Initiative: First Annual Report. Princeton, NJ: Mathematica Policy Research.
134. Marci Nielsen, Barbara Langner, Carla Zema, Tara Hacker, Paul Grundy. (2012) Benefits of Implementing the Primary Care Patient- Centered Medical Home: A Review of Cost & Quality Results, 2012. Patient-Centered Primary Care Collaborative.
135. Sherril Gelmon, Neal Wallace, BIllie Sandberg, Shauna Petchel, Nicole Bouranis. (2016) Implementation of Oregon's PCPCH Program: Exemplary Practice and Program Findings. Portland, OR: OHSU & PSU School of Public Health and Mark O. Hatfield School of Government.
136. Deborah Peikes, Arkadipta Ghosh, Aparajita Zutshi, Erin Fries Taylor, Grace Anglin, Lara Converse, et al. (April 2016) Evaluation of the Comprehensive Primary Care Initiative: Second Annual Report. Princeton, NJ: Mathematica Policy Research.
137. Health Policy Brief: The Relative Contribution of Multiple Determinants to Health Outcomes. *Health Affairs*. Epub August 21, 2014.
138. Booske B, Athens J, Kindig D, Park H, Remington P. (2010) Different Perspectives for Assigning Weights to Determinants of Health. *University of Wisconsin Population Health Institute, County Health Rankings Working Paper*.
139. R. Douglas Scott II, Steven L. Solomon, John E. McGowan J. (2001) Applying Economic Principles to Health Care. *Emerging Infectious Diseases* 7(2):282-5.
140. Thomas Rice. (2013) The Behavioral Economics of Health and Health Care. *Annual Review of Public Health* 34(431-447).
141. Jeffrey Liebman, Richard Zeckhauser. (2008) Simple Humans, Complaex Insurance, Subtle Subsidies. Cambridge, MA: National Bureau of Economic Research
142. Lu Ann Aday, Ronald Andersen. (1974) A Framework for the Study of Access to Medical Care. *Health Services Research* 9(3):208-20.
143. Ronald Andersen. (1995) Revisiting the Behavioral Model and Access to Medical Care: Does it Matter? *Journal of Health and Social Behavior* 36(1):1-10.
144. Ronald Andersen. Families' Use of Health Services: A Behavioral Model of Predisposing, Enabling, and Need Components. Chicago, IL: University of Chicago; 1968.

145. Benjamin D. Sommers, Richard Kronick. (2016) Measuring Medicaid Physician Participation Rates and Implications for Policy. *Journal of Health Politics, Policy and Law* 41(2):211-24.
146. Craig D. Holden, Jie Chen, Rada K. Dagher. (2015) Preventive Care Utilization Among the Uninsured by Race/Ethnicity and Income. *American Journal of Preventive Medicine* 48(1):13-21.
147. Leiyu Shi, James Macinko, Barbara Starfield, Robert Politzer, John Wulu, Jiahong Xu. (2005) Primary Care, Social Inequalities, and All-Cause, Heart Disease, and Cancer Mortality in US Counties, 1990. *American Journal of Public Health* 95(4):674-80.
148. Seth A Berkowitz, Carine Y Traore, Daniel E Singer, Steven J Atlas. (2015) Evaluating Area-Based Socioeconomic Status Indicators for Monitoring Disparities within Health Care Systems: Results from a Primary Care Network. *Health Services Research* 50(2):398-417.
149. Medicaid Claims and Eligibility. OHA/DHS DSSURS data warehouse.
150. Rural Health Research Center. (2017) RUCA Data. Seattle, WA January 21, 2017. http://depts.washington.edu/uwruca/ruca-data.php, accessed Date
151. Poverty Status in the Past 12 Months, 5 Yr-Estimates. American Community Survey / US Census; 2010-2014.
152. Median Income in the Past 12 Months (in 2014 Inflation-Adjusted Dollars). American Community Survey / US Census; 2010-2014.
153. Financial Charateristics for Housing Units with a Mortage. S2506 ed: American Community Survey / US Census; 2010-2014.
154. Health Resources & Services Administration: Data Warehouse. Primary Care Service Area Data Download – 2010 (Census Tract Basis). March 30, 2017. https://datawarehouse.hrsa.gov/data/datadownload/pcsa2010download.aspx, accessed Date
155. U.S. Department of Health and Human Services. Federal Office of Rural Health. Defining Rural Population. September 1, 2016. http://www.hrsa.gov/ruralhealth/aboutus/definition.html, accessed Date
156. Oregon Health & Sciences University. Office of Rural Health. Rural Definitions. September 1, 2016. http://www.ohsu.edu/xd/outreach/oregon-rural-health/data/rural-definitions/index.cfm, accessed Date
157. University of Washington School of Medicine. RUCA Data: Travel Distance and Time, Remote, Isolated, and Frontier. Septmber 1, 2016. http://depts.washington.edu/uwruca/, accessed Date
158. James N.Laditka, Sarah B. Laditka, Janice C. Probst. (2009) Health care access in rural areas: Evidence that hospitalization for ambulatory care-sensitive conditions in the United States may increase with the level of rurality. *Health & Place* 15:761–70.
159. Christine Buttorff, Teague Ruder, Melissa Bauman. (2017) Multiple Chronic Conditions in the United States. Santa Monica, CA: Rand Corporation.
160. US Census Bureau. (2017) Geographic Terms and Concepts - Census Tract. March 15, 2017. https://http://www.census.gov/geo/reference/gtc/gtc_ct.html, accessed Date
161. U.S. Census Bureau. ZIP Code Tabulation Areas (ZCTAs). March 30, 2017. https://http://www.census.gov/geo/reference/zctas.html, accessed Date
162. Nancy Krieger, Jarvis T. Chen, Pamela D. Waterman, David H. Rehkopf, S.V. Subramanian. (2003) Race/Ethnicity, Gender, and Monitoring Socioeconomic Gradients in Health: A Comparison of Area-Based Socioeconomic Measures—The Public Health Disparities Geocoding Project. *American Journal of Public Health* 93(10):1655-71.

163. James Macinko, Barbara Starfield, Leiyu Shi. (2007) Is Primary Care Effective? Quantifying the Health Benefits of Primary Care Physician Supply in the United States. *International Journal of Health Services* 37(1):111-26.
164. StataCorp. Stata statistical software. 12 ed. College Station, TX: StataCorp; 2011.
165. Chunrong Ai, Edward C. Norton. (2003) Interaction Terms in Logit and Probit Models. *Economics Letters* 80(1):123-9.
166. Maarten L. Buis. (2010) Stata tip 87: Interpretation of interactions in nonlinear models. *Stata Journal* 10(2):305–8.
167. Ottar Hellevik. (2009) Linear versus logistic regression when the dependent variable is a dichotomy. *Quality and Quantity* 43(59):59-74.
168. Paul D. Allison. Fixed Effects Regression Methods for Longitudinal Data using SAS. Cary, NC: SAS Institute; 2005.
169. Tyrone F. Borders, Booth BM. (2007) Research on Rural Residence and Access to Drug Abuse Services: Where are we and Where Do We Go? *Journal of Rural Health* 23(s1):79-83.
170. Tyrone F. Borders, Brenda M. Booth, Katharine E. Stewart, Ann M. Cheney, Geoffrey M. Curran. (2015) Rural/Urban Residence, Acces, and Perceived Need for Treatment Among African American Cocaine Users. *Journal of Rural Health* 31(1):98–107.
171. Jennifer R. Havens HKK, Michelle R. Lofwall, Sharon L. Walsh. (2017) Insurance is not enough: Significant increases in insurance coverage do not increase substance abuse treatment entry among rural Appalachian drug users. *Drug and Alcohol Dependence* 171:e85.
172. Brendan Saloner, Sachini Bandara, Marcus Bachhuber, Colleen L. Barry. (2017) Insurance Coverage and Treatment Use Under the Affordable Care Act Among Adults With Mental and Substance Use Disorders. *Psychiatric Services* 68(6):542-8.
173. Mir M. Ali, Judith L. Teich, Ryan Mutter. (2015) The Role of Perceived Need and Health Insurance in Substance Use Treatment: Implications for the Affordable Care Act. *Journal of Substance Abuse Treatment* 54:14-20.
174. Teri Browne, Mary Ann Priester, Stephanie Clone, Aidyn Iachini. (2015) Barriers and Facilitators to Substance Use Treatment in the Rural South: A Qualitative Study. *Journal of Rural Health* 00:1-10.
175. Mary Kate Mohlman, Beth Tanzman, Karl Finison, Melanie Pinette, Craig Jones. (2016) Impact of Medication-Assisted Treatment for Opioid Addiction on Medicaid Expenditures and Health Services Utilization Rates in Vermont. *Journal of Substance Abuse Treatment* 67:9-14.
176. Bronwyn E. Fields, Jeri L. Bigbee, Janice F. Bell. (2015) Associations of Provider−to−Population Ratios and Population Health by County−Level Rurality. *Journal of Rural Health* 32(3):235-44.
177. Avis J. Thomas, Lynn E. Eberly, George Davey Smith, James D. Neaton. (2006) ZIP-Code-based versus Tract-based Income Measures as Long-Term Risk-adjusted Mortality Predictors. *American Journal of Epidemiology* 164(6):586-90.
178. Roselie A. Bright, Jerry Avorn, Daniel E. Everitt. (1989) Medicaid data as a resource for epidemiologic studies: Strengths and limitations. *Journal of Clinical Epidemiology* 42(10):937-45.
179. John A Baron, Elisabete Weiderpass. (2000) An Introduction to Epidemiological Research with Medical Databases. *Annals of Epideiology* 10:200-4.
180. Patrick S. Romano, Leslie L. Roos, Harold S. Luft, Janmes G. Jollis, Katherine Doliszny. (1994) A comparison of administrative versus clinical data: coronary artery bypass surgery as an example. *Journal of Clinical Epidemiology* 47(3):249-60.
181. Pavani Ragngachari. (2007) Coding for Quality Measurement: the Relationship between Hospital Structural Characteristics and Coding Accuracy from the Perspective of Quality Measurement. *Perspectives in Health Information Management* 4(3).

182. Brian G Danaher, L Gary Hart, H Garth McKay, Herbert H Severson. (2007) Measuring participant rurality in Web-based interventions. *BMC Public Health* 7(228).
183. Julie E Maher, Kristen Rohde, Clyde W Dent, Michael J Stark, Barbara Pizacani, Michael J Boysun, et al. (2007) Is a statewide tobacco quitline an appropriate service for specific populations? *Tobacco Control* 16(Supplement 1):i65-i70.
184. Sharon K. Long. (2013) Physicians May Need More Than Higher Reimbursements To Expand Medicaid Participation: Findings From Washington State. *Health Affairs* 32(9):1560-7.
185. Michael R. Richards, Brendan Saloner, Genevieve M. Kenney, Karin V. Rhodes, Daniel Polsky. (2016) Availability of New Medicaid Patient Appointments and the Role of Rural Health Clinics. *Health Services Research* 51(2):570–91.
186. Keith J. Mueller, Andrew F. Coburn, A. Clinton MacKinney, Timothy D. McBride, Rebecca T. Slifkin, Mary Wakefield. (2006) Medicaid and Its Importance to Rural Health. Columbus, MO: Issue Brief Rural Policy Research Institute Health Panel.
187. Pam Silberman, Matthew Rudolf, Cammie D'Alpe, Randy Randolph, Rebecca Slifkin. (2003) The Impact of the Medicaid Budgetary Crisis on Rural Communities. Chapel Hill, NC: North Carolina Rural Health Research and Policy Analysis Center.
188. Richard C. Lindrooth, Marcelo C. Perraillon, Rose Y. Hardy, Gregory J. Tung. (2018) Understanding The Relationship Between Medicaid Expansions And Hospital Closures. *Health Affairs* 37(111-120).
189. NC Rural Health Research and Policy Analysis. Rural Hospital Closures. UNC - Chapel Hill, NC March 20, 2018. http://www.shepscenter.unc.edu/programs-projects/rural-health/rural-hospital-closures/, accessed Date
190. Jane Wishner, Patricia Solleveld, Robin Rudowitz, Julia Paradise, Larisa Antonisse. (2016) A Look at Rural Hospital Closures and Implications for Access to Care: Three Case Studies. Issue Brief. Menlo Park, CA: The Kaiser Family Foundation, Uninsured TKCoMat.
191. Report to the Congress: Medicare and the Health Care Delivery System. Washington , DC: Medicare Payment Advisory Commission, Contract No.: June 2016.
192. Oregon Health Authority. (2014) Tobacco Cessation Services: 2014 Survey Report.
193. (2016) Oregon's Health System Transformation: CCO Metrics 2015 Final Report. Oregon Health Authority.
194. Xin Xu, Ellen E. Bishop, Sara M. Kennedy, Sean A. Simpson, Terry F. Pechacek. (2015) Annual Healthcare Spending Attributable to Cigarette Smoking: An Update. *American Journal of Preventive Medicine* 48(3):326-33.
195. Tami L. Mark, Lauren M. Wier, Kevin Malone, Michael Penne, Alexander J. Cowell. (2015) National Estimates of Behavioral Health Conditions and Their Treatment Among Adults Newly Insured Under the ACA. *Psychiatric Services* 66(4):426-9.
196. Laura J. Chavez, Kelly J. Kelleher, Steven C. Matson, Thomas M. Wickizer, Deena J. Chisolm. (2018) Mental Health and Substance Use Care Among Young Adults Before and After Affordable Care Act (ACA) Implementation: A Rural and Urban Comparison. *Journal of Rural Health* 34:42-7.
197. John Heintzman, Miguel Marino, Megan Hoopes, Steffani Bailey, Rachel Gold, Courtney Crawford, et al. (2014) Using Electronic Health Record Data to Evaluate Preventive Service Utilization Among Uninsured Safety Net Patients. *Preventive Medicine* 67:306-10.
198. Dahai Yue, Petra W. Rasmussen, Ninez A. Pnce. (2018) Racial/Ethnic Differential Effects of Medicaid Expansion on Health Care Access. *Health Services Research*.
199. Benjamin D. Sommers, Caitlin L. McMurtry, Riobert J. Blendon, John M. Benson, Justin M. Sayde. (2018) Beyond Health Insurance: Remaining Disparities in US Health Care in the Post-ACA Era. *Milbank Quarterly* 95(1):43-69.

200. Marcello Tonelli, Natasha Wiebe, Martin Fortin, Bruce Guthrie, Brenda R Hemmelgarn, Matthew T James, et al. (2015) Methods for identifying 30 chronic conditions: application to administrative data. *BMC Medical Informatics and Decision Making* 15(31).

APPENDICES

Appendix A: Count Model - Preventive Service Use

RUCA Level	Non-Expansion Marginal Effects (S.E.)	Expansion Marginal Effects (S.E.)
Urban	2.94**	2.00**
	0.006	0.004
Large Rural	2.91**	2.06**
	0.013	0.009
Small, Isolated Small Rural	2.74**	2.06**
	0.022	0.016

** p < 0.01 * p < 0.05

Appendix A: Count Model – Tobacco Cessation Service Use

RUCA Level	Non-Expansion Marginal Effects (S.E.)	Expansion Marginal Effects (S.E.)
Urban	3.00**	2.47**
	0.0057	0.0045277
Large Rural	3.04**	2.55**
	0.0130	0.0104
Small, Isolated Small Rural	2.81**	2.47**
	0.0223	0.0182

** p < 0.01 * p < 0.05

Appendix A: Count Model – ETOH Treatment

RUCA Level	Non-Expansion Marginal Effects (S.E.)	Expansion Marginal Effects (S.E.)
Urban	3.26**	2.64**
	0.006	0.005
Large Rural	3.25**	2.70**
	0.014	0.011
Small, Isolated Small Rural	3.04**	2.61**
	0.024	0.019

** p < 0.01 * p < 0.05

Appendix B: OHP List of Prioritized Services ICD-9, ICD-10 and CPT Codes

Preventive Care:

*ICD-9:*V01.0-V01.2,V01.4-V01.6,V01.71,V01.79,V01.81-V01.84, V01.89-V02.4,V02.51-V02.54,V02.59,V02.60-V02.62,V02.69,V02.7-V02.9,V03.2,V03.5-V03.7,V03.81,V03.82, V03.89-V04.0,V04.2,V04.3,V04.6,V04.81,V04.82,V04.89,V05.0,V05.1,V05.3,V05.4,V05.8, V06.1,V06.3-V06.6,V06.8,V07.0,V07.2,V15.88,V16.3,V16.41,V20.0-V20.2,V20.31,V20.32, V24.1,V65.3,V65.41-V65.45,V70.0,V71.09,V72.0, V72.11,V72.12, V72.19,V72.31,V72.32, V73.0-V73.6,V73.81,V73.88,V73.89,V73.98,V73.99,V74.0-V76.0,V76.11,V76.12,V76.2, V76.3,V76.45,V76.46,V76.49,V76.50, V76.51,V76.52,V76.81,V76.89,V76.9,V77.0-V77.8, V77.91,V77.99,V78.0,V78.1- V78.3, V78.8V78.9,V79.0- V79.3,V79.8,V79.9,V80.01, V80.09,V80.1-V80.3,V81.0-V81.6,V82.0-V82.6,V82.81,V82.89,V82.9

ICD-10: Z00.00-Z00.01,Z00.110-Z00.129,Z00.5,Z01.00-Z01.10,Z01.110-Z01.118,Z01.411-Z01.42,Z08,Z11.1-Z11.4,Z11.51,Z12.11,Z12.2,Z12.31,Z12.4,Z13.1,Z13.220,Z13.4, Z13.820, Z13.88,Z20.1-Z20.7,Z20.810-Z20.828,Z23,Z39.1,Z71.41,Z71.7,Z76.1-Z76.2,Z80.0,Z80.41, Z91.81

CPT: 64505-64530,90471,90472,90630-90636,90645-90651,90654-90662,90669,90670,90673, 90680-90688,90696-90710,90713-90716,90719-90723,90732-90734,90736,90740-90748, 92002-92014,92551,92552,92567,96110, 99051,99060,99070,99173,99188,99281-99285,99341-99355,99358-99378,99381-99404,99408-99412,99429-99440

Tobacco Use Diagnosis:

ICD-9: 305.1,649.00-649.04

ICD-10: F17.200-F17.228,F17.290-F17.299,Z71.6

Tobacco Cessation Services:

CPT: 96127-96154,97810-97814,98966-98969,99078,99201-99215,99224,99324-99350, 99366,99406,99407,99441-99449,99487-99498,99605-99607

Alcohol or Substance Abuse Diagnosis:

ICD-9: 303.90,303.91,303.92,303.93,304.00,304.01,304.02,304.03,304.10,304.11,304.12,304.13 304.20,304.21,304.22,304.23,304.30,304.31,304.32,304.33,304.40,304.41,304.42,304.43,304.50, 304.51,304.52,304.53,304.60,304.61,304.62,304.63,304.70,304.71,304.72,304.73,304.80,304.81, 304.82,304.83,304.90,304.91,304.92,304.93,305.00,305.01,305.02,305.03,305.20,305.21,305.22, 305.23,305.30,305.31,305.32,305.33,305.40,305.41,305.42,305.43,305.50,305.51,305.52,305.53, 305.60,305.61,305.62,305.63,305.70,305.71,305.72,305.73,305.80,305.81,305.82,305.83

ICD-10: F10.10,F10.20-F10.21,F11.10,F11.20-F11.21,F12.10,F12.20-F12.21,F13.10,F13.20-F13.21,F14.10,F14.20-F14.21,F15.10,F15.20-F15.21,F16.10,F16.20-F16.21,F18.10,F18.20-F18.21, F19.10,F19.20-F19.21

CPT: 90785,90832-90840,90846-90853,90882,90887,96101,96150-96154,97810-97814,98966-98969,99051,99060,99184,99201-99239,99324-99350,99366,99408,99409,99441-99449,99487 99498,99605-99607

Appendix C: RUCA B Codes

RUCA B DEFINITIONS BY CODE

Urban Codes–
1.0 Metropolitan area core: primary flow within an Urbanized Area (UA)
1.1 Secondary flow (30-49%) to a larger UA
2.0 Metropolitan area high commuting: primary flow (≥30%) to a UA
2.1 Secondary flow (30-49%) to a larger UA
3.0 Metropolitan area low commuting: primary flow (10-30%) to a UA
4.1 Micropolitan area core: primary flow within an UC of 10,000-49,999 (large UC) with secondary flow (30-49%) to a UA
5.1 Micropolitan high commuting: primary flow 30% or more to a large UC with secondary flow (30-49%) to a UA
7.1 Small town core: primary flow within an UC of 2,500-9,999 (small UC) with secondary flow (30-49%) to a UA
8.1 Small town high commuting: primary flow 30% or more to a small UC with secondary flow (30-49%) to a UA
10.1 Rural areas: primary flow to a tract outside a UA or UC (including self) with secondary flow (30-49%) to a UA

Large Rural City/Town (Micropolitan)-
4.0 Micropolitan area core: primary flow within an UC of 10,000-49,999 (large UC)
4.2 Micropolitan area core: primary flow within an UC of 10,000-49,999 with secondary flow (10-29%) to a UA
5.0 Micropolitan high commuting: primary flow 30% or more to a large UC
5.2 Micropolitan high commuting: primary flow 30% or more to a large UC with secondary flow (10-29%) to a UA
6.0 Micropolitan low commuting: primary flow (10-30%) to a large UC
6.1 Micropolitan with low commuting: primary flow (10-30%) to a large UC with secondary flow (10-29%) to a UA

Small and Isolated Small Rural Town-
7.0 Small town core: primary flow within an UC of 2,500-9,999 (small UC)
7.2 Small town core: primary flow within an UC of 2,500-9,999 with secondary flow (30-49%) to a large UC
7.3 Small town core: primary flow within an UC of 2,500-9,999 with secondary flow (10-29%) to a UA
7.4 Small town core: primary flow within an UC of 2,500-9,999 with secondary flow (10-29%) to a large UC
8.0 Small town high commuting: primary flow (≥30%) to a small UC
8.2 Small town high commuting: primary flow (≥30%) to a small UC with secondary flow (30-49%) to a large UC
8.3 Small town high commuting: primary flow (≥30%) to a small UC with secondary flow (10-29%) to a UA

8.4 Small town high commuting: primary flow (≥30%) to a small UC with secondary flow (10-29%) to a large UC
9.0 Small town low commuting: primary flow (10-29%) to a small UC
9.1 Small town low commuting: primary flow (10-29%) to a small UC with secondary flow (10-29%) to a UA
9.2 Small town low commuting: primary flow (10-29%) to a small UC with secondary flow (10-29%) to a large UC
10.0 Rural areas: primary flow to a tract outside a UA or UC (including self)
10.2 Rural areas: primary flow to a tract outside a UA or UC (including self) with secondary flow (30-49%) to a large UC
10.3 Rural areas: primary flow to a tract outside a UA or UC (including self) with secondary flow (30-49%) to a small UC
10.4 Rural areas: primary flow to a tract outside a UA or UC (including self) with secondary flow (10-29%) to a UA
10.5 Rural areas: primary flow to a tract outside a UA or UC (including self) with secondary flow (10-29%) to a large UC
10.6 Rural areas: primary flow to a tract outside a UA or UC (including self) with secondary flow (10-29%) to a small UC

Appendix D: OHP Medicaid Eligibility Codes

OHP Eligibility Categories	OHP Eligibility Codes	Study Category
TANF Medical Clients		
TANF-M	E2, V2, XE, 2, 82, KA	Pregnant
Poverty Level Medical (PLM) Adults		
PLM: Adults < FPL	L2	Pregnant
PLM: Adults >= FPL	L6, L8	Pregnant
MAGI Pregnant Women		
Pregnant Women	LA, LB, LC, LD	Pregnant
Old Age Assistance/Blind, Disabled, and General Assistance		
AB/AD with Medicare	3, 4, B3, D4	Expansion/Standard
AB/AD without Medicare	3, 4, B3, D4	Expansion/Standard
General Assistance	5	Expansion/Standard
OAA with Medicare Part B	1, A1	Expansion/Standard
OAA with Medicare Part A or Part A & B	1, A1	Expansion/Standard
OAA without Medicare	1, A1	Expansion/Standard
MAGI Blind, Disabled		
MAGI Adult w/child w/o Medicare	M2	Expansion/Standard
MAGI Adult w/o child w/o Medicare	M4	Expansion/Standard
ACA Expansion population		
ACA: Families	M1, M5	Expansion/Standard
ACA: Adults/Couples	M3, M6	Expansion/Standard
Standard Benefit Package		
OHP: Families	W0, W1, W2, W3, W4, 1W	Expansion/Standard
OHP: Adults/Couples	Y0, Y1, Y2, Y3, Y4, 1Y	Expansion/Standard
Medicaid only/Non-OHP benefit package		
Non-OHP: Medicare Beneficiaries	QB, QS, NP	CAWEM/Uncategorized
CAWEM	CW, CS, CT, CU, CV, CX	CAWEM/Uncategorized
Breast & Cervical Cancer	BC	CAWEM/Uncategorized

Appendix E: List of Chronic Conditions and ICD Codes[200]

Asthma
ICD-9: 493.00-493.92

ICD-10: J45.20-J45.52,J45.901-J45.998

Respiratory
*ICD-9:*416.8,416.9,490-492,494-505,506.4,508.1,508.8

ICD-10: I278,I279,J40-J44,J46,J47,J60-J67,J68.4,J70.1,J70.3

Diabetes
*ICD-9:*249.00,249.01,249.10,249.11,249.20,249.21,249.30,249.31,249.40,249.41,249.50,249.51, 249.60,249.61,249.70,249.71,249.80,249.81,249.90,249.91,250.00,250.02,250.10,250.12,250.20, 250.22,250.30,250.32,250.40,250.42,250.50,250.52,250.60,250.62,250.70,250.72,250.80,250.82, 250.90,250.92,251.4,251.5,251.8,251.9,V53.51

ICD-10: E08.00-E08.29,E08.311-E08.9,E09.00-E09.29,E09.311-E09.9,E11.00-E11.29,E11.311-E11.9,E13.00-E13.29,E13.311-E13.9,E16.1,Z46.51

Hypertension
ICD-9: 401.0-401.9,402.00-402.91,405.09,405.19,405.99,437.2,V57.1,V57.21-V57.3,V57.81-V57.89

ICD-10: I10,I11.0-I11.9,I15.2-I15.9

Cardiac Conditions
ICD-9: 398.91,402.01,402.11,402.91,404.01.404.03,404.11,404.13,404.91,404.93,410,425.4-425.9,427.3,428,440.2

ICD-10: I09.9,I21,I22,I25.5,I42.0,I42.5-I42.9,I43,I48.0,I50,I70.2

Arthritis
ICD-9: 446.5,710.0-710.4,714.0-714.2,714.8,725

ICD-10: M05,M06,M315,M32-M34,M35.1,M35.3,M36.0