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The impact of Medicaid expansion in 2014 on prescription second-generation antidepressant utilization in Washington State:
An interrupted time series analysis

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Abstract

Background

Depressive disorders, specifically major depressive disorder (MDD), is predicted to become the leading cause of disease burden worldwide by 2030. In the United States, MDD is already the leading cause of disability. Yet, less than 50 percent of US adults diagnosed with a mental disorder seek treatment, often due to lack of health coverage or affordability. In 2014, the Affordable Care Act expanded Medicaid eligibility in select states to extend health and medication coverage to previously uninsured Americans. Medicaid expansion has been shown to increase medication use in expansion states, however, few studies have examined how Medicaid expansion has impacted a specific drug class such as second-generation antidepressants. This study looked at the impact of Medicaid expansion on antidepressant utilization in Washington State, a state that participated in expansion and reports one of the highest rates of depression in the U.S.

Objective

The objective of this study was to evaluate second-generation antidepressant utilization measured by number of prescriptions filled before and after Medicaid expansion in 2014, while also accounting for known increases in Medicaid enrollment.

Methods

An interrupted time series analysis was conducted using Medicaid state drug utilization data from 2011 to 2016. The primary outcome was changes in quarterly antidepressant use before and after Medicaid expansion in Washington. The secondary outcome was per-member-per-quarter (PMPQ) antidepressant utilization before and after expansion, which accounted for the increase in Medicaid enrollees.

Results

Washington experienced a significant trend increase in antidepressant utilization after Medicaid expansion. Specifically, total utilization increased by 14,912 prescriptions per quarter after expansion ($p < .001$) and PMPQ utilization increased by .008 ($p < .05$) after expansion compared to the pre-expansion utilization trend.

Conclusions

Study results suggest that prescription second-generation antidepressant use increased in Washington after full Medicaid expansion in 2014, partly due to the influx of new enrollees.

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1. Introduction

1.1 Background

For much of the 20th century, mental health and adequate mental health care were overshadowed by physical ailments and medical-surgical care. Only in recent years have mental health issues come to the forefront of public health concern. In the United States, health prioritization has long been shaped by mortality data and medical-surgical treatment coverage has dwarfed mental health treatment coverage.

Beginning in 1990, the Global Burden of Disease study (GBD) began a shift from reports highlighting only mortality data to quantifying health loss as well, reporting measures such as disability adjusted life years (DALYs). This shift in data reporting made it difficult for the world to ignore the burden of mental health disorders across the globe (1). The most recent GBD study in 2016 reported 1.1 billion people worldwide living with psychological, psychiatric or substance use disorders (2). Additionally, this report highlighted that among these mental disorders, major depressive disorder (MDD) ranked as one of the top ten leading causes of ill health in all but four countries (2). Since the first GBD report in 1990, MDD has been among the top 5 leading causes of disease and injury burden worldwide. According to World Health Organization (WHO) projections, it is expected to climb to the number one leading cause of disease and injury burden worldwide by 2030 (3).

In the United States, MDD is already the leading cause of disability among people ages 15-44, accounting for 3.7% of all U.S. DALYs (4, 5). In 2016, about 16.2 million American adults experienced at least one major depressive episode, representing 6.7% of all U.S. adults (6). MDD is a depressive disorder, also known as major depression or unipolar clinical depression. Depressive disorders are severe mood disorders that impair both cognitive and social functioning (7). These impairments stem from severe symptoms affecting how one handles daily activities, such as sleeping, eating, exercising and working (7). There are multiple forms of depressive disorders, each slightly different and arising from unique circumstances, including MDD, persistent depressive disorder, postpartum

depression, psychotic depression, seasonal affective disorder, bipolar disorder, disruptive mood dysregulation disorder and premenstrual dysphoric disorder.

The social and cognitive impairments associated with depressive disorders can have a considerable social and economic impact on not only the depressed individual, but also their family, employer and society. This often results in decreased productivity, increased workplace absenteeism, unemployment and subsequently, decreased income (3). Furthermore, depressed individuals have been found to be about 20 times more likely to commit suicide and twice as likely to die prematurely from all causes compared to the general-public (8). In 2010, the incremental economic burden of individuals with MDD in the U.S. was $210.5 billion which included direct costs of treatment, productivity loss and suicide-related costs (4). Though depressive disorders can lead to such dysfunction and economic burden, it is often manageable when treated properly. Medical management for persons with a depressive disorder is dominated by pharmacotherapy, predominantly involving the use of second-generation antidepressants since first-generation antidepressants typically have intolerable side effects and do not interact well in combination with other forms of medication (9). However, the proportion of treatment for mental disorders in the U.S. is still significantly lower than chronic psychical medical disorders (3).

In the U.S., roughly 50 percent of adults diagnosed with a mental disorder receive treatment, often citing an inability to access affordable care as a major barrier (10, 11). To enumerate, 1 in 5 adults with a mental disorder were uninsured between 2012 and 2013 reflecting the long standing higher uninsured rate of individuals with mental disorders compared to the general-public (10, 11). This poses a major public health issue regarding the treatment of individuals with depressive disorders in the U.S., as health insurance coverage is largely provided through full-time employers and individuals with a depressive disorder are more likely to be unemployed or only employed part-time compared to the general-public (4). This lack of health care coverage and treatment access for many vulnerable Americans in need of mental health care sheds light on a major health insurance gap that the Medicaid expansion

provision of the 2010 Patient Protection and Affordable Care Act (ACA) set out to narrow.

The fundamental goal of the ACA was to extend access to health care coverage to roughly 32 million Americans who were previously uninsured (12). A core component in achieving this objective was the expansion of Medicaid eligibility to up to 138% of the Federal Poverty Level (FPL) ($16,394 for a single person in 2016) for all non-elderly adults (13). Medicaid is a public health insurance program jointly funded by states and the federal U.S. government that provides coverage to the nation's most economically disadvantaged populations including low-income adults, children, pregnant women, elderly adults and people with disabilities (13, 14). Though Medicaid expansion was originally mandated for all states, a 2012 Supreme Court ruling deemed Medicaid expansion optional, leaving the decision to expand coverage up to each state. This resulted in 31 states, including the District of Columbia (D.C.), participating in expansion, 1 state considering and 19 states opting out upon the implementation of the ACA on January 1, 2014. This expansion of eligibility by participating states allowed an estimated 5% of the U.S. population the opportunity to gain access to health insurance coverage (15).

Many studies examining the initial short-term effects of expansion have in fact shown significant increases in Medicaid enrollment, suggesting that millions of Americans gained health insurance because of coverage expansion provisions of the ACA (16, 17). Though these initial effects of Medicaid expansion on details such as enrollment rates have been studied and reported on extensively, there is limited research on expansion's impacts on specific health care utilization trends. As an increased amount of post-implementation data has become available since 2014, more recent studies have begun to delve into these specifics. One early study analyzing individual level data indicated that those who gained Medicaid coverage after expansion had significant increases in prescription fill rates and reductions in out-of-pocket spending (17). Another study, looking at prescription drug utilization at the population level, demonstrated that compared to non-expansion states, expansion states provided previously vulnerable, uninsured Americans increased

access to prescription drugs covered under the Medicaid Drug Rebate Program (18). Studies such as these present stepping stones into assessing drug utilization trends before and after Medicaid expansion, further highlighting that expanding health insurance coverage improves access to care and increases use of health care services. However, various limitations in these studies calls for further research in this area, including a lack of a breakdown by varying drug classes, a post-expansion period limited to 2014 and the exclusion of multiple states. Washington is one such state that has been excluded from some studies due to its unique health care landscape. This gap in research on the impact of Medicaid expansion on prescription drug utilization, namely second-generation antidepressants in Washington State, warrants further study.

Washington, home to roughly 6.8 million people, reports some of the highest rates of mental health disorders compared to the U.S. national average. Notably, Washington was ranked 47th out of 51 states and D.C. in 2016 national rankings for mental health indicators such as number of individuals with mental health issues, access to insurance, access to adequate insurance and barriers to accessing mental health care (10). Prior to the implementation of the ACA, 948,000 or 16% of non-elderly Washingtonians were uninsured, similar to the 15% national average, and the average monthly Medicaid enrollment was just over 1.1 million (19). Furthermore, after the economic downturn of 2008, Washington's state-funded managed care program, known as the Basic Health Plan (BHP) was to be phased out due to subsequent budget cuts. In 2008, the BHP covered about 100,000 low-income residents up to 200% FPL who were at that time ineligible for Medicaid. However, the BHP still did not cover all those who were eligible. Due to funding limits, there was an enrollment cap and by 2011 the waiting list of eligible low-income Washingtonians was over 150,000 individuals. Washington had a clear need for an alternative plan to provide health insurance to its low-income residents. Thus, when the ACA was enacted in 2010, Washington along with 6 other states including D.C. chose to participate in Medicaid early expansion. Through the Centers for Medicare and Medicaid Services (CMS), Washington received a Section 1115 "Transitional Bridge" Medicaid Demonstration Waiver, effective

from January 1, 2011 to December 31, 2013. This waiver allowed Washington to transition coverage for non-elderly adults up to 133% FPL who were previously uninsured or enrolled in the BHP or the State Alcohol and Drug Addiction Treatment Support Act programs to Medicaid before full expansion to 138% FPL beginning on January 1, 2014 (19). From 2011 to 2013, Washington had an average of roughly 1.1 million Medicaid enrollees, which jumped to about 1.6 million after full Medicaid expansion by the end of 2014 and then continued to increase to about 1.8 million by December 2016 (20).

This previous state-level health care reform and Washington's participation in early Medicaid expansion has classified Washington State's health care landscape as unique. This uniqueness has previously limited Washington from being included in studies comparing the effects of Medicaid expansion across both expansion and non-expansion states. With a high burden of mental health disorders, including depressive disorders, and little previous prescription drug utilization research conducted, Washington presents an important case to analyze the impact of Medicaid expansion on prescription antidepressant drug utilization.

1.2 Research Question

This study poses the question, did the number of outpatient prescription second-generation antidepressant medications increase in Washington State after full Medicaid expansion in 2014?

1.3 Study Aim and Hypothesis

The primary aim of this study is to compare access to outpatient prescription second-generation antidepressant medications, measured by number of prescriptions filled, covered under Washington State's Medicaid program before and after full Medicaid expansion in 2014. Specifically, total and per-member-per-quarter (PMPQ) utilization are estimated to identify both overall and per member impacts of Medicaid expansion on second-generation antidepressant utilization. It is hypothesized that after full Medicaid expansion in 2014, there was a significant

trend increase in second-generation antidepressant utilization in Washington's Medicaid population.

2. Study Design

2.1 Data

This study used a retrospective, observational design using register data from CMS reporting quarterly drug utilization. More specifically, an interrupted time series (ITS) method was used for this study. Recognized as one of three types of study designs to evaluate policies (21), ITS has emerged as the most commonly used quasi-experimental design for assessing the impact of policies (22). This design uses time series data, data collected repeatedly at equally spaced intervals of time, before and after a specified 'interruption' (policy change) date. This establishes a long term underlying pre-policy trend, any immediate effect at the time of the policy change and a post-policy trend (23). Furthermore, a control group or site is not necessarily required for this study design, presenting a robust method for measuring the effect of a policy when randomization and selection of a control group or comparison may be impractical (21). In this single group analysis, the pre-policy trend projected into the post-expansion period serves as the estimate of what would have happened if Medicaid expansion had not occurred, known as the counterfactual (24).

2.2 Statistical Method

Medicaid state drug utilization data was used for this study. Washington State drug utilization files from 2011 to 2016 were downloaded from the CMS government data website. Since 1992 after the establishment of the Medicaid Drug Rebate Program, all states have been required to submit quarterly drug utilization data to CMS. These data sets are comprised of population level information regarding drug utilization of all covered outpatient prescription medications paid for by state Medicaid agencies and include details such as quarter, drug name, National Drug

Code, number of prescriptions filled and dollars reimbursed for all 50 states and D.C (25).

The data sets were downloaded in chronological order and organized individually, beginning with 2011. Drug name inclusion criteria was established using Washington Medicaid preferred drug lists, known as Apple Health Medicaid Fee for Services Preferred Drug Lists. These lists are a cost containment strategy that are updated and expanded on periodically throughout each year and include all preferred and non-preferred prescription medications covered by Apple Health. All Apple Health Medicaid Fee for Service Preferred Drug Lists that were in effect from 2011 to 2016 were obtained from the Washington State Health Care Authority. Apple Health defines prescription second-generation antidepressant medications as both serotonin reuptake inhibitors (SSRIs) and selective norepinephrine reuptake inhibitors (SNRIs). Each preferred drug list was examined to compile a cumulative list of all second-generation antidepressants listed by year, which served as the drug name inclusion criteria for this study (See Appendix 1). All other prescription drugs listed in each data set (i.e. all other drug classes except second-generation antidepressants) were excluded from this study.

Each data set was then split by quarter, creating a separate data file for each quarter of every year included in this study, spanning quarter 1 of 2011 to quarter 4 of 2016. A cumulative sum of the number of prescriptions filled variable was created to establish the total number of antidepressant prescriptions filled in each quarter. The data for each quarter was then transferred to a new file for the entire study period from 2011 to 2016 which included year, quarter and total number of prescriptions filled (i.e. the cumulative sum of number of prescriptions filled per quarter).

To calculate PMPQ utilization for the secondary outcome in this study, quarterly state Medicaid enrollment data was retrieved from the Henry J. Kaiser Family Foundation (KFF) since these numbers are not included in the Medicaid state drug utilization data sets. Collecting and reporting of Medicaid enrollment data was different before and after the ACA. Prior to the ACA, KFF contracted with Health

Management Associates to collect state-level Medicaid enrollment data twice yearly, every June and December, reporting to the Kaiser Commission on Medicaid and the Uninsured (26, 27). Thus, in this study, quarterly enrollment numbers prior to 2014 were created by assuming June enrollment numbers reflected the first two quarters of each year and December enrollment numbers reflected the last two quarters. Then, starting in 2014, CMS began collecting as well as publicly reporting monthly state-level Medicaid enrollment data (28). Subsequently, from 2014 to 2016, this study defined quarterly enrollment numbers by averaging monthly enrollment numbers according to corresponding quarters. PMPQ antidepressant utilization was calculated by dividing total quarterly prescriptions filled by quarterly enrollment numbers and was then added to the final cumulative data file with year, quarter and total number of prescriptions filled variables.

The primary outcome of this study, model 1, was changes in quarterly second-generation antidepressant utilization as measured by total number of prescriptions filled from 2011 to 2016 in Washington. The secondary outcome of interest, model 2, was changes in quarterly PMPQ utilization of second-generation antidepressant medications from 2011 to 2016 in Washington to account for the changes in Medicaid enrollment due to the expansion of eligibility after implementation of the ACA.

An interrupted time series analysis, most commonly known as segmented linear regression or ITSA, was conducted to assess the impact of Medicaid expansion in 2014 on the number of antidepressant prescriptions filled within the Medicaid population in Washington. Segmented linear regression analysis directly tests the underlying time trend in the data and the change in trend related to a policy change. This is done by creating independent variables representing time elapsed, pre- and post-interruption, and a post-interruption slope, as presented in the segmented regression equation in Table 1 (29). The specific interruption point used in this study was the implementation date of the ACA, January 1, 2014, as this is when full Medicaid expansion went into effect. Subsequently, the pre-expansion period was defined as quarter 1 in 2011 through quarter 4 in 2013 and the post-expansion

period as quarter 1 in 2014 through quarter 4 in 2016. This study added three segmented regression variables to the final cumulative data file. First, a time indicator variable coded 1 through 24, representing each quarter in the study period. Second, an ACA indicator variable where the pre-expansion time points were coded 0 and the post-expansion time points were coded 1. Third, a post-slope trend or interaction variable (time variable X ACA variable) where time points 1-12 were coded 0 and time points 13-24 were coded 1-12.

A significance level of 0.05 was used in model 1 and model 2. Autocorrelation, also known as serial correlation of the error terms, was assessed by visually checking the plot of unstandardized residuals against time as well as using the Durbin-Watson statistic. Autocorrelation was adjusted for in model 1 and model 2 using the Prais-Winsten method of adjusting a linear model for autocorrelation. Seasonality was assessed by visually analyzing quarterly box and whisker plots as well as the time series plots of both total prescription utilization and PMPQ utilization for seasonal variability. For both model 1 and model 2, seasonality was adjusted for by stratification, using seasonal indicator variables for quarter 1, 2 and 3. SPSS version 25 statistical software (30) was used to conduct this analysis.

2.3 Ethical Considerations

The collection of Medicaid state drug utilization data is approved by CMS and under the Federal Privacy Act, 5 U.S.C. Section 552a and the HIPAA Privacy Rule, 45 C.F.R Parts 160 and 164, CMS is obligated to protect the privacy of individual beneficiaries and other persons (25). The use of this data is open to the public and does not require special ethical approval (25).

3. Results

3.1 Descriptive Statistics

Changes in the coding for antidepressant prescription names occurred for some prescriptions throughout the 6 years included in this study. These changes were highlighted in each Apple Health Fee for Service Preferred Drug List and accounted

for during the data inclusion process. Missing values were found for certain prescriptions throughout the study period as well. These missing values were operationalized by CMS as cases of suppression. A case of suppression was defined as an instance where there were less than 11 counts of prescriptions filled. This process is required under U.S. law to protect the privacy of individual beneficiaries and other persons (25). Cases of suppression were excluded from quarterly cumulative prescription counts.

3.2 Total Antidepressant Utilization

First, total antidepressant utilization was analyzed to estimate the magnitude of the impact of Medicaid expansion. Before model adjustments, the pre-expansion period had an average of 121,391 antidepressant prescriptions filled per quarter, compared to an average of 240,189 filled in the post-expansion period (See Table 2). Figure 1 shows the spike in number of prescriptions filled following the implementation of Medicaid expansion as well as the trend increase in the post-expansion period compared to the pre-expansion period for both the unadjusted data and the model prediction.

Estimates from the interrupted times series model first indicate a negative pre-expansion trend, though this was not a significant finding (See Table 3). Second, Medicaid expansion is shown to have had a significant immediate level increase of second-generation antidepressant utilization of approximately 75,469 more prescriptions filled than the predicted counterfactual value for quarter 1 of 2014 (p < .05). Third, after Medicaid expansion, Washington experienced a significant trend increase in quarterly antidepressant utilization. The difference in the period trend was about 14,912 prescriptions higher per quarter in the post-expansion period compared to the pre-expansion period (p < .001).

3.3 PMPQ Antidepressant Utilization

PMPQ utilization was also examined to more thoroughly analyze the effect of Medicaid expansion on second-generation antidepressant utilization given the

influx of new individuals enrolled in Medicaid. In general, Medicaid enrollment in Washington increased after full expansion in 2014. During the pre-expansion period Medicaid had an average enrollment of about 1.1 million individuals per quarter, compared to an average of approximately 1.7 million Medicaid enrollees per quarter in the post-expansion period (See Table 2). More specifically, one year after Medicaid expansion there was about a 46% increase in Medicaid enrollment compared to the quarter prior to expansion, an estimated increase of over 520,000 individuals. This increase continued into quarter 4 of 2016, 3 years after Medicaid expansion, with about a 62% increase in enrollment compared to quarter 4 of 2013 resulting in an estimated increase of over 705,000 enrollees.

Before model adjustments, the pre-expansion period had an average of about 0.108 second-generation antidepressant prescriptions filled PMPQ, compared to an average of approximately 0.138 prescriptions filled PMPQ in the post-expansion period (See Table 2). Figure 2 shows the more stationary model that indicates a less noticeable spike in the number of prescriptions filled immediately following the implementation of Medicaid expansion as well as a trend increase in the post-expansion period compared to the pre-expansion period for both the unadjusted data and the model prediction.

Estimates from the interrupted time series model first indicate a significant negative utilization trend during the pre-expansion period, showing that PMPQ utilization was decreasing by .004 prescriptions per quarter ($p < .05$). Second, no significant immediate effect of Medicaid expansion on antidepressant prescription utilization was found when controlling for the influx of new enrollees. After Medicaid expansion, however, a significant increase in the quarterly utilization trend was still found compared to the pre-expansion quarterly utilization trend. Specifically, the difference in period trend was .008 prescriptions higher per quarter in the post-expansion period compared to the pre-expansion period ($p < .05$).

3.4 Absolute and Relative Effects of Medicaid Expansion

Without adjusting for increased enrollment, using results from the model prediction, one year after Medicaid expansion went into effect an estimated 245,788 second-generation antidepressant prescriptions were filled, compared to 113,337 filled the quarter preceding expansion. This translates into an increase of about 132,451 prescriptions filled, a 117% increase in antidepressant utilization one year post expansion. By quarter 4 of 2016, 3 years after Medicaid expansion went into effect, Washington Medicaid enrollees filled an estimated 320,952 antidepressant prescriptions. Compared to the quarter before expansion, this indicates an increase of about 207,615 prescriptions, a 183% increase in utilization.

After adjusting for increased Medicaid enrollment, using results from the model prediction, it was estimated that enrollees used 0.154 antidepressant prescriptions per-member one year after Medicaid expansion compared to 0.095 antidepressant prescriptions filled per-member in the quarter prior to expansion. This translates into an increase of about 0.059 prescriptions filled per-member, a 62% increase in antidepressant utilization one year post expansion. By quarter 4 of 2016, Medicaid enrollees used an estimated 0.175 prescriptions per-member. Compared to the quarter prior to expansion, this indicates an increase of about 0.08 antidepressant prescriptions filled per-member, an 84% increase in utilization.

3.5 Sensitivity Analysis

The final total and PMPQ utilization models presented in this study were chosen after careful examination of best fit and consideration of ITS methodological issues and the multiple ways to control for these potential biases. First, both Prais-Winsten and Cochrane-Orcutt procedures for adjusting for autocorrelation of autoregressive type 1 were performed. For the final models, a Prais-Winsten feasible generalized least squares regression was used as this regression made the Durbin Watson statistic nearest to 2 and the upper value of the Durbin Watson significance limit of 1.944 for the model parameters, indicating no autocorrelation in the error terms. The Durbin Watson statistic of the Prais-Winsten method was 1.857 for model 1

and 1.825 for model 2, while the Cochrane-Orcutt method was 1.814 for model 1 and 1.764 for model 2. Furthermore, the Prais-Winsten method is a modification of the Cochrane-Orcutt method that is more efficient, as it does not lose the first observation in its iterations. Second, seasonality was controlled for using stratification by a seasonal dummy variable rather than a more complicated method such as the U.S. Bureau of the Census X-11 seasonal adjustment program. The stratification method was chosen for the final models in this study because similar studies examining the impact of Medicaid expansion on prescription drug utilization also used stratification as their method for seasonal adjustment. Furthermore, the Census X-11 method is more often used for time series data with more time points when forecasting and working with ARIMA models, rather than segmented regression models. Third, though stationarity, the absence of a natural trend in the data, is an important issue to consider when it comes to time series data, ordinary differencing was not conducted to the data in this study to stabilize the mean. As the purpose of this study was to conduct a segmented regression rather than forecasting, the fact that Washington's total antidepressant prescription utilization exhibited a rather non-stationary tendency was not an area of major concern. Furthermore, the time variable in a segmented linear regression model estimates any underlying time trend in the data, adjusting the model for a secular trend.

4. Discussion

4.1 Main Findings

The results support the hypothesis that full Medicaid expansion in 2014 was associated with a quarterly utilization trend increase in outpatient second-generation antidepressant prescriptions in Washington. First, looking at total utilization before the increase in Medicaid enrollment was accounted for, the positive immediate level change in utilization within the first quarter of implementation indicates an immediate policy effect. Second, one year following Medicaid expansion, total antidepressant utilization had an estimated increase of

just over 132,000 prescriptions filled compared to the quarter preceding expansion, a 117% increase in utilization. This increasing trend continued into quarter 4 of 2016 with an estimated increase of just over 207,000 prescriptions compared to the quarter prior to expansion, about a 183% increase in utilization. These findings of a significant immediate impact of Medicaid expansion as well as an increased trend in antidepressant use per quarter following the ACA indicates that Medicaid expansion offered increased access to antidepressant medications to new, vulnerable Washingtonians, who were previously uninsured.

Although these findings could benefit from future research, these results align with previous studies and reports that have concluded that Medicaid expansion has led to increased access to coverage and care. Specific to prescription utilization, a report on shifts in U.S. medicine use estimated that expansion states filled 25.4% more prescriptions in 2014 compared to 2013 (31). Another study comparing drug utilization in expansion and non-expansion states one year after Medicaid expansion found similar results, estimating that overall prescription drug utilization increased by 17% in expansion states compared to the year prior to implementation of the ACA (18). This report and study considered all prescription drugs covered under the Medicaid Drug Rebate Program, concluding that these observed increases in outpatient drug utilization in the year following Medicaid expansion were largely due to the influx of new Medicaid enrollees. In addition, they similarly reported that Medicaid expansion led to early increases in prescription drug utilization in participating states.

It is important to note that though this study has similar conclusions to previous reports and studies on the impact of Medicaid expansion on prescription drug utilization, the absolute and relative effects found in this study were much higher. For example, one year after Medicaid expansion, the findings from this study show about 90-100% more of an increase in prescription drug utilization compared to the previous results mentioned. It is crucial to consider that these previous findings looked at all prescription drug classes covered under the Medicaid Drug Rebate Program and included multiple states. Furthermore, Washington was excluded

from one of these studies due to its state-level health reform and participation in early Medicaid expansion. Nonetheless, the steep increase in prescription second-generation antidepressant drug utilization after Medicaid expansion compared to the quarter prior to expansion may suggest the real need for increased access to mental health treatment in Washington. This suggestion aligns with prevalence reports of a high burden of depressive disorders in Washington, as well as a high number of individuals with mental illness not receiving treatment and adults with severe mental illness reporting an unmet need for care (10, 32). Furthermore, these higher rates of increases in antidepressant prescriptions are in line with larger projections that were made prior to expansion that estimated an increase in outpatient mental health prescription utilization of about 67% within the newly eligible Medicaid population in the U.S (33).

Examining PMPQ utilization in model 2 revealed that though Medicaid expansion was associated with a significant post-expansion trend increase in the number of prescription antidepressants filled, this growth in utilization cannot be fully explained by expansion alone. Even when controlling for the influx of Medicaid enrollees between 2014 and 2016 a significant post-expansion increase was found. Specifically, one year following Medicaid expansion, the number of antidepressant prescriptions filled increased by .061 per-member compared to the quarter preceding expansion, about a 68.5% increase in utilization. Like findings in model 1, this increase in utilization continued into quarter 4 of 2016, with an estimated increase of about .081 antidepressant prescriptions filled per-member compared to the quarter preceding expansion, about a 91% increase in utilization. These results suggest that increased Medicaid enrollment was not the only factor contributing to the growth in antidepressant utilization seen in Washington's Medicaid population from 2014 to 2016.

Again, although these findings could benefit from future research, the conclusions drawn from these results are similar to other studies in this limited body of literature on the impact of Medicaid expansion on prescription drug utilization. The same study that reported a total utilization increase of 17% in expansion states one year

after Medicaid expansion also reported PMPQ utilization. This study found that by the end of 2014, PMPQ prescription drug utilization was significantly increasing in states that participated in expansion. Specifically, the difference in period trend reported was .075 prescriptions higher per-member in the post-expansion period compared to the pre-expansion period (18). This study also concluded that due to this significant finding of an increasing post-expansion trend in prescription drug utilization even after controlling for Medicaid enrollment suggests that Medicaid expansion cannot be the only contributing factor (18).

In this study specifically, there are several other factors that could have contributed to the reported increase in antidepressant use after controlling for increased enrollment. First, the ACA included several provisions other than Medicaid expansion specific to decreasing barriers to mental health treatment. For example, federal parity requirements, most recently updated by the 2008 Mental Health Parity and Addiction Equity Act (MHPAEA) and amended by the ACA for the commercial health insurance market, made mental health coverage comparable to medical-surgical coverage. In other words, mental health coverage could be no more restrictive than medical-surgical coverage when it came to copays, coinsurance, treatment limitations, etc. As Medicaid is not part of the commercial insurance market, and therefore not subject to the MHPAEA, a separate final parity rule was enacted that applied certain MHPAEA requirements to Medicaid, differing slightly depending on enrollment in managed care organizations, alternative benefit plans or the Children's Health Insurance Program (34). Essentially, after implementation of the ACA, most Medicaid enrollees, not just newly eligible Washingtonians, were covered under insurance plans that complied with most MHPAEA parity regulations. This decreased previous barriers to mental health treatment and could have possibly played a role in the reported increase in antidepressant utilization after adjusting for the influx of new Medicaid enrollees. The ACA also included a stipulation for Medicaid to include preventive health services in their coverage plans (35). Specific to MDD, Medicaid now covers depression screenings. This stipulation of the ACA sought to decrease barriers to mental health diagnostics and could have also played a role in the significant trend

increase in antidepressant utilization reported in the PMPQ model. Second, more second-generation antidepressant prescriptions gained coverage under Washington's Apple Health Preferred Drug List between 2011 and 2016. These lists are developed by Washington's Health Care Authority and Labor and Industries Department based on clinical evidence of drug safety, efficacy and effectiveness and are updated multiple times throughout each year. In 2011, a total of 26 different second-generation antidepressant drugs were listed throughout the year, while by 2016 a total of 54 were listed (See Appendix 1). The increased number and coverage of antidepressant drugs may have also contributed to the increase in antidepressant utilization beyond Medicaid expansion. Third, though there is much more work to be done, efforts to raise mental health awareness and decrease stigmatization of mental illness in recent years may have also contributed to a growth in individuals seeking mental health services and using pharmacotherapy treatment in the form of prescription second-generation antidepressants. Evaluating these other possible factors contributing to increased antidepressant use in Washington are important topics for future study.

These results add to this growing field of research on the impact of Medicaid expansion on prescription drug utilization. By focusing on one state and one class of drugs, this study gains a better understanding of the impact of Medicaid expansion on prescription drug utilization on a more specific and micro level than previous research. Though states must follow general federal guidelines, Medicaid programs vary state to state with differing eligibility criteria, benefits packages, provider payment policies and administrative structures (13), which often makes it difficult to get a detailed understanding of specific Medicaid impacts on individual states from studies including multiple states or analyzing national data. Furthermore, this study increased the post-expansion period up to 2016, capturing a longer term post-expansion trend than previous research that were only able to include data up until 2014.

4.2 Limitations

Though an ITS design is a robust method for examining the effects of a policy change, there are limitations within this study to consider. First, no comparison group was used. A comparison group would have allowed for a separation of the policy effect from other events that may have occurred around the same time. In other words, the use of a comparison state or national averages would have provided a more thorough analysis of the data. A comparison would tease apart any underlying trend in antidepressant utilization that may be connected to something other than time or the utilization trend connected to Medicaid expansion, providing a more comprehensive counterfactual scenario. Second, the scope of this study only included the impact of full Medicaid expansion in 2014 on antidepressant utilization. To get the whole picture of the impact of Medicaid expansion in Washington, years prior to 2011 would also need to be included in the study period to account for participation in early expansion. Evaluating the impact of Medicaid expansion in Washington with the addition of a comparison and the inclusion of an early expansion interruption are important topics for future research. Third, causality cannot necessarily be inferred from an ITS study, as standard regression analysis indicates a model estimate of the slope over time, but cannot completely distinguish the policy change from the underlying secular trend (37, 36). Though causal claims regarding a policy change cannot be determined, ITS is one of the few accepted ways to analyze the impact of a policy when a randomized control trial and the selection of a control is impractical or unfeasible (21).

4.3 Mental Health Treatment and Policy Implications

Expanding eligibility requirements for health insurance coverage is one way to increase access to prescription drugs. By extending Medicaid eligibility to 138% FPL, the Medicaid expansion provision of the ACA aimed at greatly decreasing the number of uninsured Americans and increasing access to health care services. Prior to the implementation of the ACA, in 2012, almost 948,000 or 16% of Washington's nonelderly adults and children were uninsured (19). By the end of

2016, 3 years after full Medicaid expansion, Washington's Medicaid enrollment had increased by just over 705,000 low-income Americans, significantly narrowing the uninsured rate in the state. The results from this study corroborate with other findings indicating that increased access to health coverage leads to increased use of health care services, specifically prescription drugs (18, 31). This increase in health care coverage for previously uninsured and vulnerable Washingtonians and subsequent increased access to and use of prescription antidepressants will likely have a positive impact in the treatment of individuals with MDD and other depressive disorders.

As the burden of MDD is projected to rise in the U.S. and worldwide, access to prescription antidepressant drugs will be hugely important in achieving better population health outcomes and downstream cost savings in other health services. Continued effort to achieve access to adequate mental health coverage and services needs to occur for individuals to receive the treatment they need and deserve (36). The results from this study and previous studies looking at the impact of Medicaid expansion on prescription drug utilization indicate that there was, and may still be, a large gap in health care coverage for low-income Americans who are in need of mental health care services, such as access to prescription drugs. In fact, a report on shifts in U.S. medicine use showed that by the end of 2015, Medicaid enrollees used significantly more prescription drugs than any other group of covered Americans (31). This increase in utilization post-expansion was enough to raise the overall prescription demand nationally, indicating that new enrollees were sicker than the existing Medicaid population (31).

Access to second-generation antidepressant prescriptions is crucial for the treatment of MDD and all other depressive disorders. This study's findings indicate that Washington has moved in a positive direction to increase access to antidepressant medications to its citizens, in part by participating in Medicaid expansion. Though the ACA, with its Medicaid expansion and other provisions to increase access to diagnostics, care and treatment to Americans are important policies that narrowed the uninsured gap and reduced some barriers to care in

Washington and the rest of the U.S., much more work needs to be done to further mitigate challenges to receiving affordable, adequate mental health care. As the burden of MDD is predicted to continue to rise dramatically in the next decade (3), it will be vital for public health policies to consider preventive, diagnostic and treatment measures for depressive disorders.

5. Conclusions

Medicaid expansion in Washington State led to a significant increase in second-generation antidepressant utilization. These results suggest that Medicaid expansion extended mental health care coverage and prescription drug services to previously vulnerable Washingtonians who needed access to mental health care services. These findings corroborate with mental health indicator reports showing that the Medicaid population in Washington was, and may still be in need of increased access to mental health care services and that Medicaid expansion, as well as other contributing factors, have decreased some barriers to much needed access to prescription antidepressant medications. As the burden of MDD and other depressive disorders are expected to rise in the coming decade, it will be important to continue this effort to increase access to mental health treatment services. Future research on this topic should also include a comparison state or states and years prior to 2011 to get a more comprehensive picture of the impact of full and early Medicaid expansion in Washington.

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Table 1. An interrupted time series model comparing outcomes before and after Medicaid expansion in 2014 in Washington State

Segmented Linear Regression Equation: $Y_t = \beta_0 + \beta_1 time_t + \beta_2 intervention_t + \beta_3 time\_after\_intervention_t + \beta_4 quarter1 + \beta_5 quarter2 + \beta_6 quarter3 + E_t$	
Coefficient	**Description**
Baseline Intercept (β_0)	Baseline level of the outcome variable at time 0
Pre-expansion Trend (β_1)	Pre-expansion trend, estimates the structural trend or growth rate in utilization independently from the policy change
Expansion (β_2)	Expansion effect, estimates the immediate impact of the intervention or the change in level of the outcome of interest after the policy change
Post-expansion Trend (β_3)	Expansion trend, the change in trend, or growth rate in outcome variable, after the policy change
Seasonality (reference category: quarter 4 (October – December)	
Quarter 1 (β_4)	January – March
Quarter 2 (β_5)	April – June
Quarter 3 (β_6)	July – September

Table 2. Descriptive statistics of total and per-member-per-quarter (PMPQ) outpatient second-generation antidepressant prescription utilization and Medicaid enrollment before and after Medicaid expansion in 2014 in Washington State

|	Number of Prescriptions Filled		
	Minimum	**Maximum**	**Mean**
Total Utilization	80,952	290,721	180,790
Pre-expansion	80,952	195,624	121,391
Post-expansion	116,225	290,721	240,189
PMPQ Utilization	0.07	0.17	0.1230
Pre-expansion	0.07	0.17	0.1076
Post-expansion	0.08	0.17	0.1384
Medicaid Enrollment	Number of Enrollees		
Total Enrollment	1,114,500	1,838,411	1,424,396
Pre-expansion	1,114,500	1,132,800	1,128,472
Post-expansion	1,476,742	1,838,411	1,720,320

Table 3. Parameter estimates, *p*-values from the full and PMPQ segmented regression models predicting mean quarterly numbers of antidepressant prescriptions filled in Washington State before and after Medicaid expansion in 2014

	[a] Total Utilization	*p*-value	[b] PMPQ Utilization	*p*-value
Baseline intercept	173373.147	<.001	.151	<.001
Pre-expansion trend	-4338.577	.088	-.004	.026
Medicaid expansion effect	75469.463	.006	.029	.093
Post-expansion trend	14911.781	<.001	.008	.003
Quarter 1	-43919.423	.071	-.034	.081
Quarter 2	-18864.603	.337	-.014	.314
Quarter 3	-33125.995	.159	-.024	.203

[a] *Quarterly indicators included to adjust for seasonality. Model estimates were generated using interrupted time series segmented regression with the Prais-Winsten method to account for autocorrelation.*
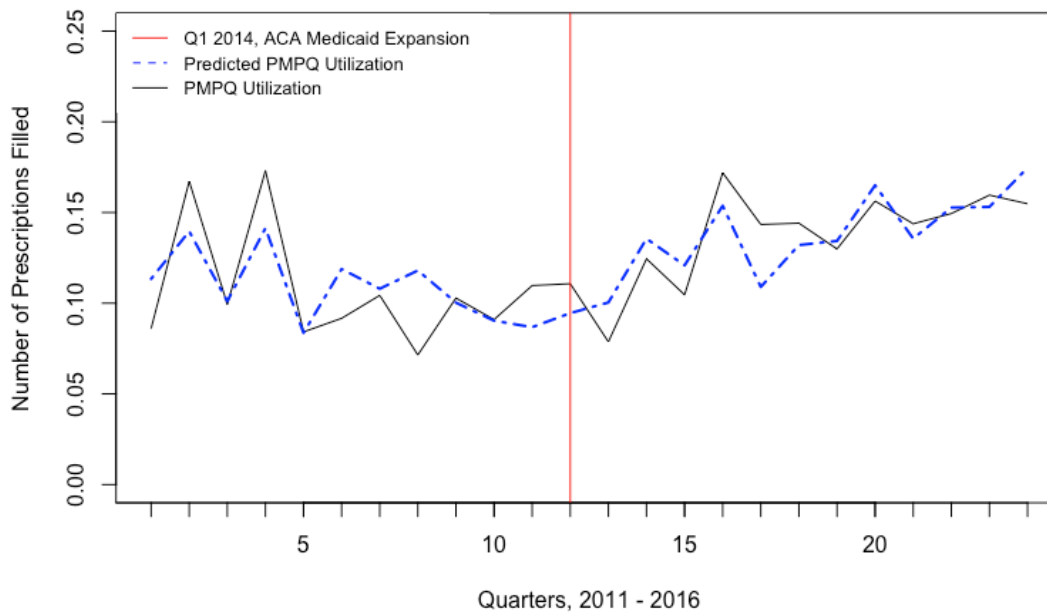[b] *PMPQ = per-member-per-quarter*

Figure 1. Washington State quarterly trends in total outpatient second-generation antidepressant prescription utilization before and after Medicaid expansion in 2014
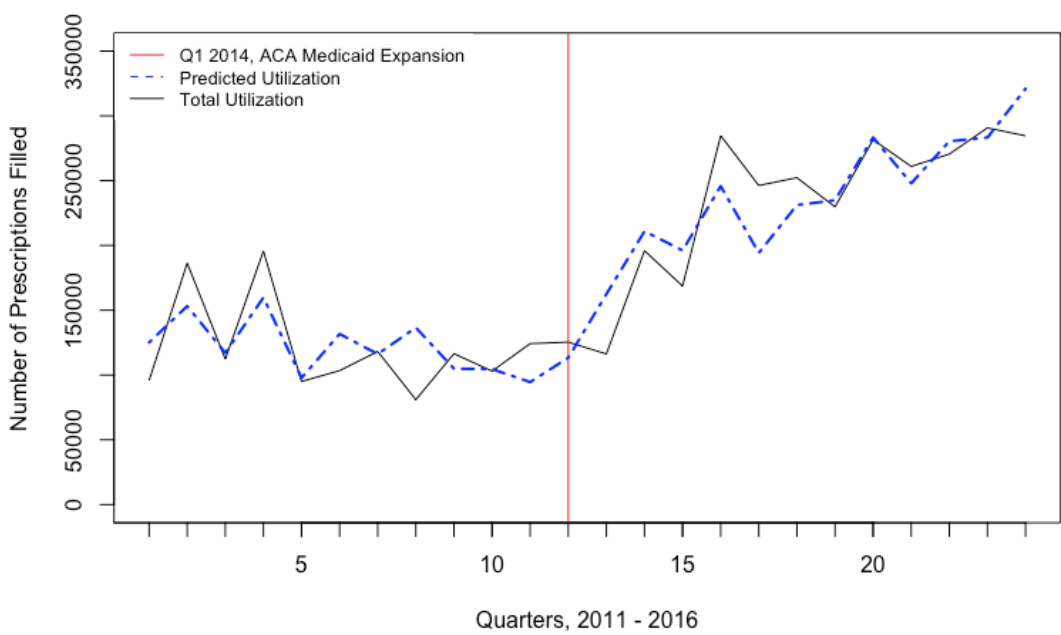
[a] *Prediction is adjusted for autocorrelation and seasonality.*

Figure 2. Washington State quarterly trends in PMPQ second-generation antidepressant prescription utilization before and after Medicaid expansion in 2014

[a] *Prediction is adjusted for autocorrelation and seasonality.*
[b] *PMPQ = per-member-per-quarter*

Appendix 1. List of All Outpatient Second-generation Antidepressant Prescriptions Included on Apple Health's Preferred Drug Lists From 2011-2016

2011 (26 total)

Generic
bupropion HC1/SR/XL
citalopram
fluoxetine HC1
fluvoxamine
mirtazapine/soltab
paroxetine HC1/CR
sertraline
venlafaxine HC1
Venlafaxine ER tablets

Brand
nefazodone
paroxetine CR
venlafaxine ER capsules
Aplenzin
Celexa
Cymbalta
Effexor/XR
Lexapro
Luvox CR
Paxil/CR
Pexeva
Pristiq
Prozac/Prozac Weekly
Remeron/SolTab
Viibryd
Wellbutrin/SR/XL
Zoloft

2012 (29 total)

Generic
bupropion HC1/SR/XL
citalopram
fluoxetine HC1
fluvoxamine
mirtazapine/soltab
paroxetine HC1/ER
sertraline
venlafaxine ER capsules
venlafaxine HC1
Venlafaxine ER tablets

Brand
escitalopram
nefazodone
venlafaxine ER capsules
venlafaxine ER tablets
Aplenzin
Celexa
Cymbalta
Effexor XR
Lexapro
Luvox CR
Paxil/CR
Pexeva
Pristiq
Prozac/Prozac Weekly
Remeron/SolTab
Venlafaxine ER tablets
Viibryd
Wellbutrin/SR/XL
Zoloft

2013 (28 total)

Generic
bupropion HC1/SR/XL
citalopram
fluoxetine HC1
fluvoxamine
mirtazapine/soltab
paroxetine HC1/ER
sertraline
venlafaxine ER capsules
venlafaxine HC1

Brand
escitalopram
nefazodone
venlafaxine ER tablets
Aplenzin
Celexa
Cymbalta
Effexor XR
Lexapro
Luvox CR
Paxil/CR
Pexeva
Pristiq
Prozac/Prozac Weekly
Remeron/SolTab
Serzone
Venlafaxine ER tablets
Viibryd
Wellbutrin/SR/XL
Zoloft

2014 (45 total)

Generic
budeprion SR
bupropion HC1
bupropion SR
bupropion XL
bupropion HC1/ER/SR/XL
bupropion HC1/SR/XL
citalopram
escitalopram
fluoxetine HC1
fluvoxamine
mirtazapine/ODT/soltab
mirtazapine/soltab
paroxetine HC1/ER
sertraline
venlafaxine ER capsules
venlafaxine ER capsules/tablets
venlafaxine HC1

Brand
duloxetine
escitalopram
desvenlafaxine ER

nefazodone
venlafaxine ER tablets
Aplenzin
Brintellix
Brisdelle
Celexa
Cymbalta
Desvenlafaxine ER
Effexor XR
Fetzima
Forfivo
Lexapro
Luvox CR
Paxil/CR
Pexeva
Pristiq
Prozac/Prozac Weekly
Remeron/SolTab
Sarafem
Serzone
Venlafaxine ER tablets
Viibryd
Wellbutrin
Wellbutrin/SR/XL
Zoloft

2015 (41 total)

Generic
budeprion SR
bupropion HC1
bupropion SR
bupropion XL
citalopram
escitalopram
fluoxetine HC1
fluvoxamine
mirtazapine/ODT/soltab
paroxetine HC1/ER
sertraline
venlafaxine ER capsules/tablets
venlafaxine HC1

Brand
duloxetine
duloxetine EC

fluvoxamine ER
nefazodone
Aplenzin
Brintellix
Brisdelle
Celexa
Cymbalta
Desvenlafaxine ER
Effexor XR
Fetzima
Fetzima Titration Pack
Forfivo XL
Irenka
Khedezla
Lexapro
Luvox CR
Paxil/CR
Pexeva
Pristiq
Prozac/Prozac Weekly
Remeron/SolTab
Sarafem
Viibryd
Wellbutrin
Wellbutrin/SR/XL
Zoloft

2016 (54 total)

Generic
budeprion SR
bupropion HC1
bupropion SR
bupropion XL
citalopram
citalopram tablet
escitalopram
escitalopram tablet
fluoxetine HC1
fluoxetine HC1 capsule/solution
fluvoxamine
fluvoxamine tablet
mirtazapine/ODT/soltab

paroxetine HC1/ER
sertraline
sertraline tablet
venlafaxine ER capsules/tablets
venlafaxine ER capsules
venlafaxine HC1

Brand
citalopram HBR solution
desvenlafaxine ER
duloxetine
duloxetine EC
escitalopram solution
fluoxetine HC1 tablet
fluvoxamine ER
nefazodone
sertraline HC1 solution
venlafaxine ER tablets
Aplenzin
Brintellix
Brisdelle
Celexa
Cymbalta
Desvenlafaxine ER
Effexor XR
Fetzima
Fetzima Titration Pack
Forfivo XL
Irenka
Khedezla
Lexapro
Luvox CR
Paxil/CR
Pexeva
Pristiq
Prozac/Prozac Weekly
Remeron/SolTab
Sarafem
Trintellix
Viibryd
Wellbutrin
Wellbutrin/SR/XL
Zoloft

Appendix 2. Popular Science Summary

Full Medicaid Expansion in 2014 Increased Outpatient Prescription Second-Generation Antidepressant Use in Washington State

Major depressive disorder is the leading cause of disability in the United States and is predicted to rise to the leading cause of disease burden worldwide by 2030. Though the social, familial and economic impacts of depression are a rising cause for public health concern, many American's with mental health disorders lack health coverage and access to affordable treatment. Within the U.S., Washington State has some of the highest rates of depression and has been rated poorly for access to mental health treatment. When Washington decided to participate in the Medicaid expansion provision of the Affordable Care Act (ACA) that was implemented on January 1, 2014, it aimed at decreasing the uninsured rate and some barriers to health care. This study looked at the impact of Medicaid expansion in 2014 on prescription antidepressant utilization as measured by number of prescriptions filled from 2011 to 2016.

This study found that Medicaid expansion was associated with an increase in antidepressant use in Washington. These findings indicate that Medicaid expansion extended access to antidepressant drug services to previously uninsured, low-income Washington residents. However, additional increases in antidepressant utilization was found beyond what could be expected because of increased enrollment alone. This added increase suggests that other factors may have also played a role in the increase of antidepressant utilization within the entire Medicaid population between 2014 and 2016. For instance, other stipulations included in the ACA, increasing public awareness of mental health disorders and an increase in available antidepressant medications covered under Washington's Medicaid program may have also contributed to increased antidepressant use. Future studies should consider these other factors as well as including a comparison state or states and years prior to early Medicaid expansion to gain a more comprehensive understanding of the impact of Medicaid expansion on antidepressant utilization in Washington.