**1.1 Introduction**

United States health care spending reached $3.6 trillion, or $11,172 per person in 2018 while growth in retail prescription drug spending increased 2.5 percent to $335.0 billion (CMS, 2018) and prescription drugs represent one of the fastest-growing areas of healthcare spending (Martin et al., 2016). This rapid increase should concern everyone as many conditions requiring prescription drugs are very common. The Center for Disease Control (2019) estimates six in ten adults have at least one chronic disease, defined as “a condition that lasts one year or more and requires ongoing medical attention or limits activities of daily living or both” while 90% of the nation’s $3.6 trillion in annual health care expenditures are for people with chronic and mental health conditions.

Bertoff, Ruder, and Bauman (2017) researched data on chronic diseases from 2014 and determined the top 10 chronic diseases by prevalence: hypertension, high cholesterol, mood disorders, diabetes, anxiety disorders, upper respiratory disorders, inflammatory joint disorders, osteoarthritis, asthma and heart disease. Previous research has shown these conditions are commonly associated with negative lifestyle behaviors such as excessive alcohol use, tobacco use, poor nutrition or lack of physical activity. Simply avoiding these lifestyle behaviors can greatly reduce the likelihood one suffers from a chronic condition. However, it is inevitable some will suffer from these condition and seek treatment. Those suffering from a chronic disease typically treat with prescription drugs; nearly half of the United States population uses a prescription drug to treat a chronic disease condition (Kit et. al, 2012). To pay for these drugs, Societies around the world have developed many mechanisms to fund healthcare. In the United States, it is common to secure health insurance coverage through employment while public options such as Medicare or Medicaid are available to certain population segments. As a result, some individuals may lack adequate healthcare coverage and thus the ability to pay for prescription drugs. Properly identifying demand for prescription drugs can inform public policy analysis or allow a pharmaceutical company to target a certain market.

**1.2 Literature Review**

Previous literature has examined the characteristics of prescription drug users’ drugs in detail. International studies in countries where public healthcare is more comprehensive subsidized provide interesting results regarding the relationships between access to care, lifestyle factors, demographics and need-based factors when income is not a barrier to access. However, the United States public health care coverage is less comprehensive, and it is uncertain how their results translate. This literature is briefly reviewed.

Health and chronic disease conditions linked to obesity are associated with increased utilization of prescription drugs (Mueller et al., 1997; Vandegrift and Datta, 2006). Similarly, the adult percentage reporting smoking tends to correlate with greater prescription use because of its association with various chronic diseases (Nianogo et al., 2016). Nianogo et al. found an individual’s BHI, a constructed variable combining obesity and tobacco use, was significantly and positively correlated with prescription drug consumption. Their results are complemented by Wright and Prosser (2014) who evaluated the impact of obesity on pediatric expenditures and found obese adolescents had significantly more healthcare visits relative to normal weight adolescents. Keto et. al (2017) investigated health care utilization among Finnish tobacco smokers. They found male and female smokers are 28% and 21% more likely to use healthcare services than their non-smoking counterparts, respectively.

Demographics and socioeconomic status also play a significant role in the demand for prescription drugs. Leth-Petersen and Skipper (2014) evaluated income and drug demand of Danish individuals. They find a strong positive relationship between income and prescription drug demand, increasing significantly at age 50. Several studies have shown women have a higher absolute level of drug use than males due to higher life expectancy and fertility related care (Burtoff, 2017; Ghosh, Simon, Sommers, 2017; Nianogo et.al 2016). Nianogo et. al’s findings show minority and rural populations fill substantially less prescriptions than whites or urban people.

Access to care was found by Nianogo et. al to be the primary determinant associated with prescription drug consumption. In their model, an additional primary care provider accounts for an additional 252.28 count units of prescription drugs filled in high-utilization states. Similarly, Gosh, Simon and Sommers (2017) studied the impact of the Affordable Care Act’s 2014 Medicaid expansion on prescription drug use among low-income non-elderly adults among states that expanded Medicaid coverage with those that did not. The ACA provided U.S states with the option, but not the requirement, to expand Medicaid coverage to populations above the federal poverty level. They found Medicaid expansion resulted in sizable and statistically significant increases in Medicaid prescription drug use, particularly in expansions states with a higher share of Hispanic or black populations. Wang et al. (2014) complement these findings in their examination of the impacts of a mandatory universal prescription drug insurance program in Ontario on health care utilization and outcomes. Their study shows the introduction of a mandatory drug program in Canada substantially increased drug coverage among the general population and substantially improved access to care for the uninsured representing a 33 percent increase in utilization relative to pre-policy coverage in Quebec.

This area of work has a large body of prior research however gaps remain. Nianogo et al’s results are at the county-level and do not provide information on granular data such as the specific conditions the prescriptions were for. The data set used by Ghosh et. al. did not include patient-level information on demographic and socioeconomic characteristics to allow them to estimate results by age, gender or income. Studies on income or demand responses to healthcare may not translate as readily due to the differences in the healthcare economies. This gap shows clear a need for research investigating demand for prescription drugs in the United States at the individual level. Using individual level data on households in the United States obtained from the 2017 National Health Interview Survey, I attempt to define the characteristics of the population sample who are most likely to be prescribed prescription drugs and additionally those forgoing treatment due to the costs of the medication. Negative lifestyle behaviors such as smoking, excessive alcohol use or obesity are expected to be positively associated with prescription drug use. Further, I suspect cost is a significant deterrent to treatment and therefore the uninsured and low-income populations are more likely to forego prescription medications due to cost. Finally, I hypothesize chronic conditions are positively associated with foregoing medication as the costs for continuous treatment can be costly.

This research will be useful for pharmaceutical companies looking to invest in the development of novel medications or for policy analysis regarding public subsidy expansion on healthcare. The remainder of the paper is organized as follows: Section 2 provides background information on the data and empirical model. Section 3 presents the regression results and analysis. In section 4, I provide concluding remarks and suggestions for future research.

**2. Empirical Model**

**2.1 Data**

Data on individual level characteristics were obtained from the CDC’s 2017 National Health Interview Survey. The survey monitors the health of the nation and covers the civilian non institutionalized population residing in the United States at the time of the interview and consists of two parts: 1) a set of basic health and demographic items and 2) one or more questions on current health topics. I utilize the Sample Adult file augmented with the Person Data file. The main dependent variables are 1) An individual prescribed medication in the last year and 2) Whether an individual has forgone medication in the past year. The independent variables are categorized into five groups: life-style variables, healthcare access factors, socioeconomic, demographic and chronic illnesses. The data set used is comprised of 12,771 total observations. Table 1 in the appendix provides descriptive statistics of the data set. A brief description of the variables follows.

**2.1.1 Life-Style Variables**

The life-style behavior measures include obesity, smoking and excessive alcohol use. A BMI greater than or equal to 30 is considered obese (CDC). A person is recorded as a tobacco user if they report currently smoking at least some days. Likewise, a person is considered an excessive user of alcohol if they report consuming alcohol on a weekly frequency.

**2.1.2 Healthcare access factors**

Nianogo et al. show a strong positive relationship between access to care and prescriptions filled while Ghosh, Simon and Sommers find public subsidy expansion results in significant increases in utilization for chronic conditions. In this instance, a positive relationship between insurance coverage and being prescribed medication and affordability of the medication is expected. A person is determined to have access to care if they had insurance coverage over the last year, whether public or private.

**2.1.3 Socioeconomic and demographic factors**

Income has direct and indirect effects on prescription drug use. Directly, wealthier individuals have greater concerns for their health status and more contact with the healthcare system. Indirectly, wealthier individuals are linked to better insurance coverage for pharmaceutical care (Leibowitz et, al. 1985). I expect a positive relationship between income and drugs prescribed and a negative relationship between income and inability to pay for prescription medicine.

Women have higher life expectancy and use health services for gender-specific reasons. (Xu et al., 2010). A female is expected to be positively associated with prescription drug use compared to males. Ageing is associated with greater susceptibility to illness and the need for more medical services and also expected to be positively associated with drugs prescribed. Race is comprised of three groups: Hispanics, Whites, and Other (including blacks, Asians and other minority groups). Lack of access to care could explain comparatively weak results among minorities. Income is grouped into quartiles based off in individuals earnings in the previous year: poverty, $0-$15,000, low, $15,000-$45,000, middle, $45,000-$75,000 and high, $75,000 or higher. Those groupings approximates to Bureau of Labor Statistics data for the first, second and third quartile of wage earners were $24,972, $47,788, $76,024 annually representative of low, middle- or high-income levels as of October, 2019. A poverty grouping is included to represent those below the federal poverty level of $12,490(HHS, 2019). Individuals below this threshold qualify for Medicaid coverage which provides a mechanism to pay for prescription drugs potentially making the income group just above the federal poverty level the most at risk for inability to afford prescription drugs

**3. Empirical Model**

I construct a model to estimate the characteristics of individual demand for medication and the characteristics of individuals who express an inability to afford medication. The model(s) take(s) the form:

where is an individual i’s likelihood of being prescribed medication, (j = 1…3) are the life-style behavior, access to care, and economic factors. are the independent and normally distributed residuals with constant variance. In addition, a similar model is estimated where is an individuals likelihood to forego medication due to cost. Table 2 in the appendix summarizes these regression results. Tables 3 & 4 provide a summary of the marginal effects. The results are explored below.

**3. Analysis**

The R-squared from OLS shows the model captures relevant information in explaining the independent variables A summary of the logit model shows several variables are not insignificant in explaining the likelihood of being prescribed a medication or the inability to afford the medication. Thus, the logit model developed here captures statistically significant portions of the variation in characteristics for drug demand or the inability to afford drugs. A Breusch-Pagan test confirms residuals have constant variance and the functional form of variables has not been mis-specified for each model. Results are provided in the appendix.

**3.1 Lifestyle Behaviors**

Obesity and smoking are positively associated with causing limitations in daily activity while alcohol is negatively associated, as shown in table 5 & 6. An individual is 15.37% more likely to experience a limitation if they are obese and 11.3% if they are a smoker while a weekly drinker is 4% less likely. Additionally, an obese individual is 12.3% more likely to be prescribed medication than a non-obese person. Obesity results largely complement existing literature and conventional thought. However, although smokers are much more likely to experience limitations there is no statistical evidence they are prescribed medications to treat their limitations. One explanation could be smokers forgo treatment due to higher cost of treatment. Health insurance premiums are typically higher for individuals who smoke and health issues surrounding smoking are well known. Smokers may misrepresent their health status on insurability questionnaires for lower upfront costs or may simply be predisposed to avoid treatment. Further research could explore smokers and prescription drug usage in more detail. Smoking is also positively associated with being unable to afford prescription medication, with a probability the smoker 9.7 percentage points higher than non-smokers, all else equal, in the Logit model, confirming smokers have difficulty affording drugs.

**3.2 Demographics**

Males are 12.62% less likely to be prescribed a drug and 2.78 more likely to be able to afford medication, supporting previous research finding females more likely to use healthcare services. Age is positively associated with being prescribed a medication but the marginal effect is not large. Compared to whites, Hispanics and other minorities are 11.65% and 8.28% less likely to be prescribed medication than other races, all else equal. Hispanics or minorities may lack adequate access to insurance coverage or have lower overall income relative to whites which prevents them from appropriate treatment. Only low-income individuals were statistically less likely than high-income earners to be prescribed medication. Research could investigate if this is due to a coverage gap. In general, compared to the high-income earners, the marginal effect was inverse to the level of income. This supports previous research that suggests wealthier individuals are more aware of their own health and transform health information into better health outcomes more effectively. Individuals who are covered by some form of insurance are 13.95% more likely to be prescribed medication and 5.12% less likely to forego medication due to cost. This result lends support to the Gosh, Wang and Nianogo’ s studies which all determined access to care was a primary determinant of drug utilization and produces a result supporting public investment in health care access.

**3.3 Perception of one’s own health**

Unsurprisingly, the perception of one’s health appears to play a prominent role in drug demand. In general, the less well one perceives their health the more likely they are to be prescribed medication. Compared to those in excellent health, a person who sees their health as very good is 5.85% more likely to be prescribed medication and one in poor health is 27.7% more likely to be prescribed a prescription drug. These results support the findings of Saez and Val-Illrosa who found an individual seeks out health services based on the perception of their own need. Those who perceive their health as excellent are 15.2% less likely to be unable to afford medication while those who see their health as poor are 10% more likely to forego medication due to cost. These results suggest an individual accurately perceives their own health or an individual’s demand for drugs is determined significantly by their health perception.

**3.5 Utilization and chronic conditions**

An individual experiencing a limitation is 16.19% more likely to be prescribed medication and 4.45% more likely to forego medication due to cost compared to an individual who is not. When examining the relationship between type of limitation and prescription drug use, the model finds statistically significant evidence for depression, asthma, cancer, diabetes and arthritis are more likely to be prescribed medication than health individuals and depression, asthma, diabetes and arthritis individuals are less likely to be able to afford medication. Depressed individuals had a 24.08% more likely of being prescribed medication while a 6.94% more likely to forego medication due to cost. Similarly, asthmatics and diabetics were 24.23% and 52.3% more likely to be prescribed medication and 6.3% and 9% more likely forego medication due to cost.

The results suggest diabetics, asthmatics, and individuals with depression or cancer have the largest demand for prescription drugs. These conditions are deadly without medication and individuals do not have the option to forego treatment. Public policy aimed at reducing drug expenditures could incentive low-cost treatment options for these conditions. Asthmatic’s, diabetics and individuals with heart conditions are more likely to forego treatment due to cost. Pharmaceutical companies could research and develop affordable treatments aimed at this population. From a public policy perspective, expanding access to these segments would surely be a benefit to society.

**Section 4. Concluding Remarks**

**4.1 Study Limitations**

A major limitation of my model is the form of questions asked by the survey regularly only applied to the last 12 months i.e. “Have you been prescribed medication in the past 12 months?”. This could introduce bias in the model depending on how the survey participants interpreted the question. This model also only utilizes data from 2017. Incorporating additional cross-sectional NHIS interviews could provide better data for inference.

**4.2 Summary**

**S**moking is positively associated with prescription drug utilization and negatively associated with affordability of prescriptions. Smokers may forego treatment and policies could be developed to incentivize smokers to seek out health care services before their condition deteriorates. Further research could explore whether smoker’s inability to pay is due to an association with lower earnings, insurance coverage or their personal decision to seek health services. Results from racial groupings indicate Hispanics are likely to have issues with obtaining prescription medications. Therefore, research could also be directed towards positive impacts towards Hispanics and healthcare utilization. Insurance coverage is highly significant with being prescribed medication and negatively associated with being unable to pay for prescription drugs. This result supports other studies that show increasing access to care does lead to higher utilization.

For four of the most prevalent chronic health conditions, depression, asthma, diabetes and heart issues, there was statistically significant evidence that an individual experiencing some limitation in their daily activities is currently prescribed medication. Further, there was statistically significant evidence those with diabetes, heart issues, urinary system issues and depression have difficulty paying for medication. Pharmaceutical companies could investigate developing drugs for individuals with asthma as an individual with limitations resulting from asthma are more likely to be prescribed medication and, unlike the other limitations that were statistically significant, the individuals can afford the treatment. More morbidly, pharmaceutical companies could avoid bringing drugs to market for conditions associated with diabetes, heart issues, urinary system and depression as individuals may be more likely to be unable to afford prescription drugs. New entrants to pharmaceutical markets could explore developing affordable treatment or access options towards Hispanics or other minorities as these populations suffer from in access to health services. Drugs catering to the population that smokes would have a very high demand. Public subsidy expansion should focus on increasing access to minority groups and depressed individuals.

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