Lessons Learned? What New Hampshire can Learn from Vermont in "Hub and Spoke" Model of Opioid Treatment

Nick Bergeron

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Advisor: Fr. Richard McGowan S.J.

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ABSTRACT

Vermont had 13.9 overdose deaths per 100,000 people in 2014, almost 2.5 times less than New Hampshire in the same year (Rudd 2016). Much of this has been attributed to the framework Vermont has in place for treatment of Opioid Use Disorder (OUD), specifically the "Hub and Spoke" model of treatment. This model has been highly praised due to the continuity of care waivered spoke physicians are able to provide, and the overall success the program has had in reducing overdoses and addiction as a whole, typically through the "gold standard" of Medication Assisted Treatment (MAT). "The Doorway" as the hub and spoke system is called in New Hampshire, is realistically a referral framework that links people seeking treatment with OUD to a provider, which is very different from the structure in Vermont. Vermont is predicted to spend about $85 million of Medicaid money on treatment for people with OUD in 2019 (Table 1). Meanwhile, New Hampshire, a state with over double the population, is projected to spend $52 million in 2019 (Table 2). This is likely due to differences in Medicaid payment structure and MAT-waivered physician availability; Vermont has a larger rate of MAT providers per 10000 population of 2.71 compared to 2.05 in New Hampshire. New Hampshire Medicaid reimburses behavioral health providers poorly, providing an indexed reimbursement rate of 0.83 in comparison to 1.11 in Vermont (Kaiser Family Foundation 2019). To initiate change and create a treatment utilization rate equivalent to Vermont, it is estimated New Hampshire would have to spend $133 million to $150 million in 2019, which is not possible given the taxation structure in place.

INTRODUCTION

On January 27th 2017, recently sworn-in President Donald Trump told Mexican President Enrique Peña Nieto "I won New Hampshire because New Hampshire is a drug-infested

den…where drugs are being sold for less money than candy." Residents took umbrage with this statement, pointing to other states with similar drug problems. New Hampshire, like much of the United States, is in the midst of an opioid epidemic. From the period of 1999-2011, the consumption of opioids increased significantly. For example, hydrocodone consumption grew by almost 200 percent and oxycodone consumption increased by 500 percent (Jones 2013). The rapid rise in semisynthetic opioid consumption has proved to be problematic and coincides with increases in street drugs such as heroin and fentanyl. According to the Center for Behavioral Health Statistics and Quality, over 4 out of 5 people who are addicted to heroin started out abusing semisynthetic opioids prescribed by a physician. Furthermore, most of these individuals cited the cheaper cost of the alternative opioids (Muhirir 2013).

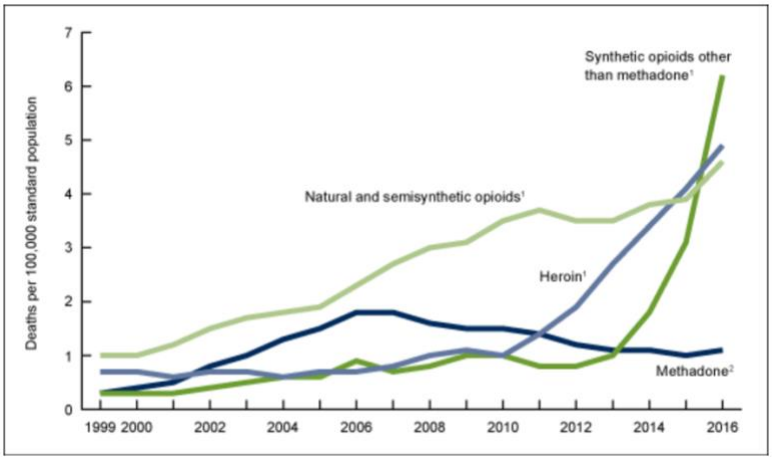


Figure 1: Overdose Deaths by Drug in the United States from 1999-2016 (Hedegaard 2017)

The CDC has tracked overdoses in the US, separating overdose death causes into four distinct categories: heroin, methadone, natural and semisynthetic opioids, and synthetic opioids (Hedegaard 2017). Heroin is an illegally derived opioid sold at the street level and typically injected by needle into the veins. Methadone is a synthetic opioid often used to treat heroin and opioid addiction in rehab and other anti-addiction clinics. Because of the specific, recovery-focused usage of methadone, it is listed in a separate category from synthetic opioids. A

semisynthetic opioid is a drug prescribed by a healthcare provider such as oxycodone, codeine, or morphine. Synthetic opioids are meant to mimic semisynthetic opioids, and can be significantly more potent than traditional opioids. This includes fentanyl and analogs such as acetyl fentanyl, carfentanil, and tramadol (Hedegaard 2017). Of synthetic opioids, fentanyl is the most widely abused.

New Hampshire specifically has had significant issues with the rise in synthetic opioids. New Hampshire was second in per capita overdose deaths per 100,000 people with 34 deaths, second only to West Virginia at approximately 43 deaths (Rudd 2016). The national average over this time period was 16 deaths per 100,000 people. The crisis in New Hampshire is magnified by the greatest magnitude increase in synthetic opioid overdoses. Synthetic opioid overdoses have increased dramatically over the past 5 years in New Hampshire; the year over year increase from 2014-2015 showed a 95 percent increase in synthetic opioid deaths (Rudd 2016). The opioid crisis has affected high income and low income states alike; income and opioid overdose deaths are not necessarily correlated.

While opioid overdose deaths have increased in New Hampshire over the past 5 years, the economy has improved to be one of the leading states in the nation in terms of unemployment and skilled labor. New Hampshire has the fourth-lowest Gini coefficient of the individual states, at about 0.43 compared to the national average of 0.47 (Boyce 2016). This indicates there is moderate income inequality between residents within the state, but it is less unequal than most other states in the US. New Hampshire has a large supply of educated workers, as workers have an average of 14.6 years compared to the national average of 13.1 years (Atkinson 2014). New Hampshire is noted for workers' ability to use technology to maximize their business, holding the fifth most patents per 1000 workers (Atkinson 2014). New

Hampshire historically has one of the lowest unemployment rates in the country, currently about 2.7% as of August 2018. This is the lowest rate in New England and the third-lowest in the nation (NHES 2018). However, two of the epicenters of opioid overdoses in the state are also the economic engines that employ a large portion of the state. Nashua and Manchester, both located in Hillsborough county, have had the most overdose deaths in the past 3 years (New Hampshire Drug Monitoring Initiative 2018).

These two cities have taken the unique step of creating a "Safe Station" program out of all fire stations within the city limits. These firemen and emergency personnel have been trained to administer Narcan (naloxone) to individuals in distress, but typically counsel people who are going through withdrawal or are seeking resources for rehabilitation. Narcan blocks the effects of opioids within 5 minutes of intravenous injection, but people typically need multiple injections as the effects only last about 30 minutes to an hour. People who seek help at the Safe Stations are not arrested and have no legal ramifications, but can seek counseling with firefighters for free (New Hampshire Drug Monitoring Initiative 2018). The firefighters dispose of any illegal substances without criminal charges and can point individuals towards recovery programs. The station in Manchester was the pilot Safe Station program, but its success has led people from around the country to institute similar programs. Because of the cost of hospital detox is about $2000 per day, state officials believe that the Safe Station program saves the state government a significant amount of money on a per patient basis.

Opioid overdose deaths have been problematic in geographically neighboring Vermont, albeit at smaller level, even lower than the national average. Vermont had 13.9 overdose deaths per 100,000 people in 2014, almost 2.5 times less than New Hampshire in the same year (Rudd 2016). Much of this has been attributed to the framework Vermont has in place for treatment of

Opioid Use Disorder (OUD), specifically the "Hub and Spoke" model of treatment. Through improved continuity of care, access to physicians, and the reduction if not elimination of waitlists to be admitted into a treatment program, Vermont has succeeded in significantly reducing overdose deaths by getting people into treatment at faster pace (Brooklyn 2017). The challenges New Hampshire faces in implementing its own treatment infrastructure on par with that of Vermont are complex and varied. The cost of creating hub and spoke and the underlying economics of reimbursements and physician behavior in responding to incentives is critical in comparing these different yet similar states.

LITERATURE REVIEW

Medically prescribed opioid abuse has traditionally been viewed as the precursor to the current opioid crisis in the United States. Opioid prescriptions per capita in the United States are among the highest in the world, but have dropped significantly in the past few years from a rate of 81.3 per 100 people in 2012 to 58.7 per 100 in 2017 (CDC 2018). People addicted to heroin or other injectable drugs are classified as either "pill-initiates" or "inject-initiates" (Mars 2013). According to a qualitative study of heroin addicts in Philadelphia and San Francisco, the majority were described as pill initiates. Of pill initiates, it differed in how older and younger individuals became addicted. Younger initiates cited the lower stigma of Oxycodone or Vicodin as why they became addicted to pills, and typically received or stole them from family members or friends who had legitimate prescriptions (Mars 2013). In contrast, the older addicts were typically over-prescribed medications from physicians and became addicted to the pills after the therapeutic benefits wore out (Mars 2013). The transition to injectable drugs such as heroin took place when these people ran out of money, especially on the East Coast where low cost-high purity heroin is highly prevalent. A respondent in the study said $40 dollars of heroin would last

him two days where as the equivalent amount of oxycodone would last him 25 minutes (Mars 2013). Thus, opioids in pill form such as Oxycodone are often considered to be a gateway drug for heroin and fentanyl.

One of the more common ways both state and federal government officials have attempted to crack down on over prescription of Oxycodone and other medically prescribed opioids is through "Pill Mill" laws. The term "Pill Mill" is slang for a physician or medical professional who frequently over-prescribes opioids with little medical consideration (Chang 2015). Florida is probably the most infamous state for high volume opioid prescription providers. A study examining high risk "Pill Mill" providers in Florida found that before the institution of "Pill Mill" laws, approximately 4% of the healthcare providers in the state were responsible for 67% of the total opioid volume prescribed (Chang 2015). Large amounts of drugs prescribed by these providers was reduced after the enactment of laws in October of 2011: regression-based analysis demonstrated that these providers lost an average of 536 opioid patients a month over the ensuing 6 month period (Chang 2015). The low risk providers saw no statistically significant change in prescribing behavior in response to the enactment of the laws. While the behavior of the high-risk providers did change, they still held a disproportionate amount of the opioid prescriptions overall (Chang 2015). One of the main ways state governments attempted to combat patients "double-dipping" in opioid scripts from multiple providers was through Prescription Drug Monitoring Programs (PDMPs). Vermont created an online PDMP in 2006 while New Hampshire created theirs in 2012. These online databases state whether patients have been receiving opioids from another provider and ensure that there is a low propensity for abuse for those who are prescribed. Providers and pharmacists are required to check these databases before prescribing or filling opioids, respectively.

While the number of pills on the street has lessened, fentanyl and heroin have filled the void left by stringent prescription practices. According to the Minnesota Department of Health, a kilogram of either heroin or fentanyl can be purchased by a dealer for about $6000 dollars, but heroin retails for $80,000 dollars on the street while fentanyl is up to $1.6 million dollars because of differences in potency. Heroin is often cut with fentanyl, allowing dealers to produce more intense highs for users at a fraction of the cost (Rudd 2017). As a result, toxicology reports often find heroin and fentanyl in the system of a user that has died of an overdose. In New Hampshire specifically, few of the overdoses are from heroin alone, but instead from a combination of heroin and a fentanyl analog or just a fentanyl analog alone (New Hampshire Drug Monitoring Initiative 2018). Because of the strength of fentanyl (about 100 times more potent than heroin), the risk of overdose is significantly greater. Synthetic opioid overdoses almost doubled in the United States over the period of 2013 to 2014, increasing from 1.0 deaths per 100,000 to 1.8 deaths (Rudd 2017).

Little academic work has been performed to examine the economy of the state of New Hampshire, however many news articles have examined the low unemployment rate coupled with a high median income. New Hampshire has had three main economic industries emerge in the wake of the Great Recession: high technology manufacturing, tourism, and health care (Bird 2017). Because of the vast economic and lifestyle differences within different areas of the state, the New Hampshire Center for Public Policy considers there to be “Two New Hampshires” (Bird 2017). The first is Urban New Hampshire, which is made up of Rockingham, Strafford, Hillsborough, and Merrimack counties; this is essentially the southern and eastern parts of the state. These counties rely on white collar work: technology, finance, education, and health care constitute the main economic sectors within these counties. In contrast, Rural New Hampshire is

made up of Coos, Grafton, Belknap, Cheshire, Sullivan, and Carroll counties. These counties rely upon the tourism industry and are experiencing population declines while Urban New Hampshire is experiencing high levels of growth (Bird 2017). The labor market in Urban New Hampshire is very tight with levels of unemployment steadily below 3 percent in all counties; many job openings stay vacant for an extended period of time for structural reasons. New Hampshire has a large population of so-called "Baby Boomers" as 1 in 3 residents are a part of this generation. To prevent a labor shortage, many companies are currently trying to incentivize laborers to stay in their job instead of retiring (Bird 2017).

The demographic shift in Vermont is similar to New Hampshire but the economy differs in a few ways such as in the size of government. Vermont is more similar to parts of Rural New Hampshire in the sense that much of the population is aging and many younger individuals are moving out of the state to seek other employment opportunities (Vermont Department of Labor 2018). Similarities between the two economies include a largely service-based economy in Vermont, specifically restaurants (which take up 5.1% of GSP), real estate (14.7%), and healthcare (10.7%). Another large industry is manufacturing, which takes up about 8.7% of the GSP. The largest difference between the two states comes with the largest employing sector. Vermont's greatest sector by is the government which takes up 14.8% of GSP (Vermont Department of Labor 2018). On a legislative level, New Hampshire is a tax-averse state while Vermont places a priority on public services. This is exemplified through state expenditures; according to the Kaiser Family Foundation, Vermont spent $5.56 billion in Financial Year 2016 compared to $5.83 billion to New Hampshire. Accounting for the population of 623 thousand people in Vermont compared to 1.34 million people in New Hampshire, Vermont spends and

taxes a significantly greater amount per capita ($8925 vs. $4350). Thus, Vermont is better able to support a large government labor force with extensive social programming.

Since New Hampshire has significantly less financial resources than Vermont, it has utilized some creative approaches to combat rising overdose levels. The New Hampshire Governor's Commission on Alcohol and Drug Abuse Prevention, Treatment, and Recovery was expanded in 2012 to include an Opioid Task Force to build upon the Prevention and Treatment Task Forces, respectively (New Hampshire Center for Excellence 2018). The Opioid Task Force combines a multitude of experts and stakeholders from the community including education, business, health care, and government leaders to try to reduce the number of individuals misusing opioids, reduce the harm associated with opioids, and increase the availability of treatment options for people struggling with opioid addiction (New Hampshire Center of Excellence 2018). The Opioid Task Force released goals for the time period of 2017 to 2020. Most of the goals are centered around community education and understanding of the opioid crisis as well as significant Narcan training for people in the community. However, the way that the task force has constructed their recommendations is unique in the multidiscipline approach they take for the community to act against opioids. The task force recommends education and adjustment for health care professionals, the at-large public, education professionals, law enforcement, as well as changes to the health care system, pharmacy practices, and undertaking harm reduction practices on the local level (New Hampshire Department of Health and Human Services 2017). These programs have been implemented slowly due to a lack of money allotted specifically for committee recommendations.

While New Hampshire has been focused on some specific goals and policies to pull the state out of the opioid crisis, it has been slow to adopt the “Hub and Spoke” model of care that

has been very successful in Vermont. The "Hub and Spoke" model divides Vermont into 5 regions, each with their own "hub" clinic (Brooklyn 2017). At the hub, the staff will provide a consultation to the person with opioid addiction and place them in the appropriate setting such as an opioid treatment center such as rehab or schedule outpatient care such as medication-assisted treatment (MAT) with their primary care physician. The "spokes" are how patients are referred into the hubs of care; spokes include law enforcement, inpatient physicians, residential homes, mental health centers, and other outreach mechanisms that facilitate patient contact (Brooklyn 2017). Hubs are typically used in patients with higher levels of comorbidities or require more supervised treatment plans. This model has been highly praised due to the continuity of care waivered spoke physicians are able to provide, and the overall success the program has had in reducing overdoses and addiction as a whole. The Hub and Spoke model has been credited with the increase in capacity of Opioid Addiction Treatment (OAT) facilities and increasing the amount of people treated for their addiction by medical professionals (Brooklyn 2017).

Vermont has been highly successful in combating the opioid crisis because of a significant capacity for MAT using buprenorphine. Typically, MAT involves outpatient visits with a provider such as a primary care physician (PCP) or psychiatrist. These providers will often refer people within their service to get cognitive behavioral therapy and other resources while seeing patients once a week in their clinic. When the opioid crisis began to be an epidemic in 2012, Vermont the highest per capita MAT capacity in the country of 13.8 people per 1000 while having an opioid misuse rate of 9.9 per 1000 (Jones 2015). Vermont actually had more treatment beds than necessary which allowed it to flex up as overdoses and opioid misuse rates increased over the following years. New Hampshire was not nearly as well prepared for the opioid crisis. New Hampshire had only 4.2 opioid treatment slots per 1000 people despite an

opioid misuse rate of 11.2 per 1000 (Jones 2015). According to the Substance Abuse and Mental Health Administration (SAMHSA), as of July 2018, Vermont had a population of 7 thousand people with OUD, with 4 thousand receiving no treatment. Meanwhile, New Hampshire had a population if 17 thousand with OUD but 14 thousand not receiving treatment. New Hampshire was ill-prepared from a treatment capacity perspective to deal with the opioid crisis as they did not have a cohesive system to get people into treatment facilities, especially regarding MAT.

MAT is seen as the "gold-standard" for OUD treatment, typically using methadone, buprenorphine, or naltrexone (US Surgeon General Report 2016). Methadone must be dispensed in specific, controlled clinics and not by a typical PCP or psychiatrist, which makes it less often used than buprenorphine. Perhaps the most common or recognizable drug for MAT is Suboxone, which is buprenorphine combined with naltrexone which can be prescribed by any MAT waivered physician. The treatment process using MAT has proven to be effective for a majority of patients. In a study that followed people with OUD over the course of years of treatment, it was found that after 42 months, 31.7% of patients were not on any opioid agonist therapy and were not using illicit drugs (Weiss 2015). Another 29.4% were on treatment such as buprenorphine or naltrexone but did not meet the criteria for opioid dependence (Weiss 2015). Of the other participants, 7.5% were using illicit opioids while on agonist therapy and 31.4% were using illicit opioids without any other treatments. However, of people abusing opioid pills before undergoing opioid agonist therapy, 10.1% reported using heroin for the first time after stopping agonist therapy (Weiss 2015). However, MAT is seen as overwhelmingly positive and the most effective method for OUD treatment.

Vermont has paid for the hub and spoke model of MAT using a combination of federal funds with and influx of state Medicaid money. The reimbursement rates to providers are

separated by hub versus spoke. The reimbursement for the hub is mostly paid for by Vermont Medicaid (Brooklyn 2017). Section 2703 provides 90% matching federal funds to create home health programs for the first 8 quarters from the inception of the program, and then reverts back to typical federal Medicaid matching. The hub receives a monthly bundled rate of $493.37 for one standard clinical service and one medical service (Brooklyn 2017). The spoke also receives funding, but it is paid out separately. The spoke receives $163.75 per month per patient receiving buprenorphine (Brooklyn 2017). Spokes can be any different type of clinic, and are supported by a Medication Assisted Treatment (MAT) team which is paid for by the state. Every MAT team is assigned to serve 100 Medicaid patients, and consists of a Registered Nurse and a licensed behavioral health provider with at least a Master's degree (Brooklyn 2017). The funding for this program is a 90/10 split between money from the Affordable Care Act and Centers for Medicare and Medicaid (Brooklyn 2017). Because Vermont initiated an All-Payer ACO test model, which was the first of its kind in the United States, the federal government agreed to continue to pay for expanded Medicaid until 2022 under the initial Affordable Care Act expansion (Department of Vermont Health Access 2019).

The majority of all patients entered into Vermont's hub and spoke system of MAT treatment are covered using Medicaid money. Of the 3637 people receiving hub MAT services in November of 2018, 2899 were Medicaid beneficiaries; this means that 79.7% of all patients in the hubs have their insurance paid for by a mix of federal and state funds (Department of Vermont Health Access 2019). A study on Vermont Medicaid MAT recipients found that the cost to put someone through intensive MAT for a year was lower than detoxification and abstinence rehabilitation techniques. People who did not receive MAT had higher rates of emergency department visits and inpatient admissions (Mohlman 2016). Thus, there was a $412

difference in Medicaid expenditures between both groups, which was a significant difference at a 90% confidence level (Mohlman 2016). This was especially surprising as MAT courses were often given to those with the highest expected healthcare costs such as pregnant mothers or other vulnerable people with pre-existing conditions and comorbidities. The MAT group's greatest cost was on buprenorphine and other pharmaceuticals associated with their treatment plan, as well as more visits to a primary care physician to ensure they were following up with their recovery plan (Mohlman 2016). Opioid addiction costs a significant amount of money to combat, however it is beneficial to the public as a whole as it prevents more costs downstream from other services, while also reducing the number of relapses (Mohlman 2016).

There is a significant overall economic cost associated with OUD borne by the public. When someone with OUD does not access treatment, there are significant costs associated with their disease. There are many private sector losses such as in productivity or fatalities, but over 25% of all losses are public (Florence 2016). This amounted to over 28.9 billion dollars in costs to the state and federal governments annually based off of the year 2013 (Florence 2016). The total cost was estimated to be 78.5 billion (Florence 2016). For the state of Vermont to treat someone with OUD for a year using MAT, the cost is about $17122 per year to Medicaid (Department of Vermont Health Access 2019). For other OUD treatment, such as therapy or detoxification without the use of medication, the cost is slightly lower at $16256 (Department of Vermont Health Access 2019). However, the typical enrollee of Vermont Medicaid has the state pay out about $9000 per year, making MAT or other OUD treatment more palatable politically (Department of Vermont Health Access 2019). For people undergoing MAT in the spokes, the cost in 2016 was about $18126 per participant (Vermont Department of Health 2016). Vermont Medicaid covered about 80% of people receiving MAT in the hubs compared to 68% in the

spokes (Vermont Blueprint for Health 2016). New Hampshire spent about $7096 per enrollee in in FY2014, a sizeable difference when compared to Vermont (The Henry J. Kaiser Family Foundation 2019).

One of the most important aspects to Vermont's plan to combat the opioid crisis using hub and spoke is with its robust Medicaid system. About 27.1% of Vermont's population receives their insurance through Medicaid for a total of 159238 enrollees (UNH Institute for Health Policy & Practice 2017). Vermont expanded Medicaid under the Affordable Care Act and now has its payor mix of Medicaid of using about 41.1% state funds and 58.9% federal money (The Henry J. Kaiser Family Foundation 2019). Vermont has been progressive in ensuring that all citizens are covered by health insurance. Current legislation mandates all citizens up to 300% of the federal poverty level to be eligible for Medicaid or heavily subsidized private alternatives through either MVP Health or Blue Cross Blue Shield (UNH Institute for Health Policy & Practice 2017). All patients in either the Medicaid or private system are arranged into the same Accountable Care Organization (ACO) for cost-sharing and outcome-based compensation in the state of Vermont (UNH Institute for Health Policy & Practice 2017). Vermont also has a very low share of people uninsured, where only 3% of the population stated that they did not have any policy whatsoever (Vermont Department of Health 2018). There was no statistical difference between the percentages of people uninsured when stratified by income, meaning the highest income bracket had no statistical difference of being uninsured from the lowest bracket. Often times healthcare providers and health systems lament that Medicaid does not reimburse professionals such as doctors on par with other plans. However, Vermont compensates their Medicaid-accepting providers better than most other states in the country, as their indexed

reimbursements were 1.11 compared to the baseline average of 1 (Henry J. Kaiser Family Foundation 2019).

New Hampshire does not provide nearly as much public health insurance to its general population. New Hampshire has 13% of its citizens covered under Medicaid for a total of 180,324 enrollees, even under an expanded Medicaid program under the provisions of the Affordable Care Act (The Henry J. Kaiser Family Foundation 2018). New Hampshire does not have the same subsidization process for people who are slightly above the income cutoffs as Vermont does, and the result is a higher uninsured rate. The Medicaid payor mix for New Hampshire is 59.5% federal and 40.5% state funded (The Henry J. Kaiser Family Foundation 2019). New Hampshire has a 7% uninsured rate which is double that of Vermont albeit below the national average of 9% (The Henry J. Kaiser Family Foundation 2018). New Hampshire does not payout as well as Vermont to provider for services performed for Medicaid patients. New Hampshire pays out an indexed value of 0.83 compared to the national average of 1 (The Henry J. Kaiser Family Foundation 2019). New Hampshire has also mandated work requirements for Medicaid, however this has recently been challenged in the courts.

New Hampshire has attempted to put the hub and spoke model into play using federal grants to combat the opioid crisis. Governor Chris Sununu announced the hub and spoke model with 9 regions throughout New Hampshire, with most of the centers located in the south of the state. Sununu intended to have hospitals in each hub region volunteer to run the hubs (Wickham 2018). Sununu said that the model would be up and running when the federal grant money, $22.9 million a year for the next two years, started to flow as of September 30. However, as of October 16, hospitals from 7 of the 9 regions had signed up to serve as the hubs for their region, with the exceptions being Manchester and Nashua. Manchester has two hospitals, Catholic Medical

Center (CMC) and Elliot Hospital while Nashua is served by St. Joseph's Hospital and Southern New Hampshire Medical Center, none of which wanted to participate in the new care model. The state plans on this gap in Manchester and Nashua being filled by Granite Pathways, a local subsidiary of FEDCAP, a federal recovery program (Rogers 2018).

One of the largest questions about the New Hampshire Hub and Spoke model regards the funding of care at the hubs. The New Hampshire government has set aside $7.7 million dollars to be spread out over the 9 hubs on a per capita and usage basis (DeWitt 2018). Many hospitals have stated the funding will likely not be enough to cover the cost of running both the hub and spoke system. Concord Hospital stated the funding they received from the state would dictate what services and level of coverage they are able to provide to patients in the system (DeWitt 2018). The funding does not come immediately to the hospitals, meaning they will have to operate at a loss until the entirety of the funding is transferred to them over time. Another issue for the hub hospitals is that federal funds necessitate the tracking of progress of the system, forcing the hospitals to keep and submit 80 percent of the data within the first year of operation. (DeWitt 2018). A further complication for the hubs in New Hampshire is staffing. Hubs are required to operate a 24/7 call center staffed by addiction counselors, social workers, and other addiction specialists (DeWitt 2018). With a shortage in these professionals throughout the state, hospitals will likely be competing with one another for a limited pool of applicants. Hubs also must be ready to accept patients into the program by the beginning of the 2019 calendar year (DeWitt 2019). The entirety of these factors complicates the decision of whether or not a hospital should join the Hub and Spoke program.

While the introduction of the Hub and Spoke model into New Hampshire has been the most recent intervention in the opioid crisis, the cities of Manchester and Nashua used the Safe

Station program to trim down the number of overdoses and the burden on the emergency rooms. The Safe Station program was started in Manchester in May of 2016, and has served over 4000 individuals seeking treatment for opioid addiction (Solomon 2016). The program is run out of the 10 firehouses in Manchester and 7 firehouses in Nashua. These are staffed 24/7 for people to consult with firefighters, who often then guide patrons to treatment facilities. The Safe Station program in Nashua was started in November of 2016 and has been used over 2000 times as an access point for care (Feely 2018). Firefighters will dispose of any drugs without alerting law enforcement, essentially providing an access point into the system. However, with the new hub and spoke model being introduced in November, local officials do not know if the Safe Station will survive due to cost constraints (Feely 2018).

The New Hampshire Hub and Spoke model is organized to build out an infrastructure for treatment that has not previously existed. Thus, unlike the Vermont hubs, the New Hampshire hubs are used as referral centers to spokes, which are where MAT and other OUD treatments take place (Plenda 2019). However, this has proved to be somewhat problematic as staffing issues and reimbursement by the state have caused the program to be ineffective. New Hampshire Medicaid reimburses behavioral professionals to 56% of private insurance payment, causing psychiatrists and other addiction professionals to be a scarce resource (Plenda 2019). The New Hampshire Department of Health and Human Services did not base the structure of the hub and spoke program on Vermont, and did not look at the data or reimbursement structure Vermont had in place. Because the New Hampshire system was so disorganized and lacked a cohesive structure, the federal funds were used to create a barebones system for officials to build upon (Plenda 2019).

The hub in New Hampshire functions very differently from its counterpart in Vermont. In New Hampshire, dialing 211 on a phone at any time of the day will connect people to a licensed addiction counselor at the hub nearest to them (Plenda 2019). Another option is for people to walk directly into a hub to access resources. Either way, the staff at the hub will assess what interventions are necessary and refer the person out to a spoke. If there is a waiting period of time between for a person to access treatment at a spoke, the hub will offer clinical interventions if necessary to ensure patients are safe (Plenda 2019). However, not all of the hubs currently have MAT waivered physicians on their staffs. This has been one of the difficulties for the hubs, as they do not serve as high-intensity MAT facilities like Vermont has constructed. When the hub does refer someone out to a spoke provider, the hub checks in with the individual at 30, 60, and 90 day intervals to obtain information as is required by the federal grant (Plenda 2019). The data tracking system is not required in Vermont, however Vermont has set up tracking initiatives such as The Vermont Blueprint for Health to report to legislators and other stakeholders.

The number of healthcare professionals licensed to provide MAT using buprenorphine has stalled in New Hampshire due to regulation. In New Hampshire, 405 providers have been waivered for MAT, but are unevenly distributed as only 4 are located in rural Coos county (Plenda 2019). These providers are also generally limited in the number of patients they can attend to, with the majority only certified to provide care to a maximum of 30 patients. Vermont, a state with almost half of the population, has 283 buprenorphine waiver physicians, and the majority of these are allowed to have 100 patients under their service. Additionally, there are issues with rural access to care. In northern parts of New Hampshire, people would have to drive well over an hour to access a hub, such as the distance from Pittsburg to Berlin in Coos county. Vermont, a more rural state, does not have these levels of distance to reach a hub for care.

For a physician to become MAT waivered, they must take eight hours of training to prescribe buprenorphine to patients. Patients that require naltrexone or methadone should be referred to a provider that specializes in addiction care (New Hampshire Department of Health and Human Services 2018). For a physician assistant or nurse practitioner to become MAT waivered, they must have 24 hours of training, including the 8 hour course physicians are required to complete (New Hampshire Department of Health and Human Services 2018). This class is free for all providers to complete and can count towards continuing medical education credits (CMEs) physicians are required to complete. After completing the required coursework and education, a physician, NP, or PA can then provide MAT to up to 30 patients for a year (New Hampshire Department of Health and Human Services 2018). Following the successful prescribing over the course of the year, a provider can then petition the DEA to allow them to provide MAT to up to 100 patients. After another year, a provider can petition for up to 275 patients (New Hampshire Department of Health and Human Services 2018). While it is not difficult to become waivered to be a MAT provider, few physicians have gone through the process due to the lack of financial incentive to prescribe buprenorphine.

There is no typical profile for a participant in a MAT program through a hub or spoke in Vermont. The average age of a participant was about 34 years old with about 54% of all participants being female (Vermont Blueprint for Health 2019). Of the women, about 15% were pregnant. About 62% of all participants had a non-substance abuse diagnosed mental health condition and 25.6% had a chronic pain condition. Over 32% were diagnosed with depression and 15.9% were Hepatitis C positive (Vermont Blueprint for Health 2019). There are a variety of underlying causes for a person to be in MAT, however it is unknown if this is somewhat of a

self-selecting population as not all people with OUD have access to treatment. Additionally, MAT is typically a course of care for people with significant comorbidities to their condition.

DATA

To look into a Vermont versus New Hampshire comparison, data on Vermont's hub and spoke model and usage were taken from Vermont's Department of Health and Human Services. Information about the per capita cost of both the spoke and hub was taken from The Vermont Blueprint for Health. Census data for the hub and spoke was extracted from the Vermont Blueprint for Health final 2018 report. Vermont provides the public with a robust dataset through the Vermont Blueprint for Health specifically detailing Vermont's response to the opioid crisis. The Blueprint for Health writes a public report annually to the state government that is then published for public viewing. The 2018 report includes hub and spoke utilization, including the share of all people under care who were Medicaid enrollees. Vermont publishes a wealth of aggregate statistics of their enrolled Medicaid population. Since the states have different structures of payment for the hub and spoke intervention model, the cost in Vermont was used to estimate a projected cost for New Hampshire through Medicaid. Using the forecasted values in New Hampshire with the Vermont cost structure and usage rate, the cost of hub and spoke in New Hampshire will be estimated.

New Hampshire data was gathered from the New Hampshire Drug Monitoring Initiative (NHDMI). The NHDMI has significantly less and different data tracked than what the Vermont Blueprint for Health. Information collected from the NHDMI includes Emergency Department visits, treatment admissions, overdose deaths, and naloxone (Narcan) administrations. This data is collected monthly with about a 1 month lag. The NHDMI publishes a report annually combining the county figures and adding additional observations of out-of-state residents or

people of unknown residence into the data. The data utilized is from the 2018 final report is the treatment admissions data, while information on ED visits and overdoses was taken from the interactive viewer as of March 2019. There are a multitude of limitations presented by the NHDMI data. There are no numbers of the amount of people undergoing MAT or other OUD treatment. There are no figures about the number of people on Medicaid undergoing treatment nor is there robust publicly available Medicaid data on costs of procedures or reimbursement structures to physicians or treatment homes.

To understand the federal and state shares of Medicaid, information from the Kaiser Family Foundation (KFF) was extracted. Additionally, the average Medicaid spending per enrollee data was used from the KFF. The KFF also provided data on the indexed Medicaid reimbursement per provider. All of the KFF data were collected using 2017 as a base year. This information was used to find a baseline as well as projected cost for the overall hub and spoke program. Detailed information on MAT providers in both states was taken from the Substance Abuse and Mental Health Services Administration (SAMHSA). SAMHSA provided data on the number of physicians newly waivered on an analyzed basis. SAMHSA provided data recent as 2019, however this data was not collected and prorated due to perceived inaccuracies and incompleteness in the data. The SAMHSA database had multiple providers duplicated with different addresses. In these situations, the location the provider stated they spent the largest share at was kept. The SAMHSA database veracity is questionable as it relies on providers to update or remove themselves if they choose to no longer provide MAT treatment.

METHODOLOGY

The hub and spoke model of Vermont was used to calculate the theoretical cost of a similar adaptation in New Hampshire. Because of the lack of complete data available for New

Hampshire, and the lack of data stratification by county in Vermont, no panel regression was run. Instead, analysis was performed to look at some of the costs via Medicaid to each state. While New Hampshire does not have the same hub and spoke model as Vermont, the cost of treatment if it did was examined to the state budget through Medicaid. Using the Vermont Blueprint for Health 2018 report, the monthly census for the hubs was determined from January 2017 until December 2018. The number of people in the spokes was performed quarterly, in the months of March, June, September, and December for the period of time of March 2017 to June 2018. Since the hub census and the spoke census were highly correlated, a SLR model to predict the missing spoke values was utilized. Using the spoke values generated for the missing data points within the spoke census data set and the known values of the hub census, univariate forecasting techniques were utilized to predict values for 2019. Both the hub and spoke census were found to be best expressed by a Winters Additive exponential smoothing model. Since the data for the spoke data set is informed by the hub census values, it makes logical sense for both data sets to be best explained by the same forecasting model. The lack of monthly spoke census values is one of the limitations of the study, but unfortunately the data does not exist publically.

With the forecasted 2019 data points for the Vermont hub and spoke censuses respectively, calculations were performed to summarize the overall cost to Vermont Medicaid. According to the Vermont Blueprint for Health 2018 final annual report, 80% of people within the hubs were enrollees of Medicaid compared to 68% of people receiving treatment in the spokes (Department of Vermont Health Access 2019). Thus, the values for the hub and spoke census were multiplied by .8 and .68, respectively. The amount it cost Medicaid annually on a per capita basis for both hub and spoke care was detailed in a Vermont Blueprint for Health brief published in 2015. This number was found to be $18,126 for care annually in a spoke, while the

cost was $14,626 for a hub (Vermont Blueprint for Health 2016). These numbers were converted into a monthly amount and multiplied by the number of Medicaid recipients calculated to be under the care of a hub or spoke, respectively. The value for 2019 was then summed up using the forecasted hub and spoke values generated from the Winters Additive exponential smoothing forecasting model. Predicted values on each side of the 95% confidence interval were also calculated so as to get a better idea of the range.

Because New Hampshire does not publicly publish the number of people undergoing MAT or any other type of OUD treatment, the number of people undergoing treatment was estimated using one of the prior studies. This number is another limitation of the study as the number of people on MAT was estimated using the Jones study from 2015. In this study, based off of 2012 information, New Hampshire was found to have a MAT capacity of 4.2 people per 1000 of population (Jones 2015). Since this was the best estimate of New Hampshire treatment capacity in the current period of time, this number was used to generate a sample population undergoing treatment in New Hampshire. The spoke Medicaid enrollment share (68%) was multiplied into the total number of people expected to be in some sort of treatment therapy. This was then calculated using the hub Medicaid enrollee percentage (80%) to determine the range in which the cost likely falls. A combined rate, averaging the hub and spoke cost was also calculated to give a third estimate of the cost. The per capita Medicaid expenditure rates from Vermont for both the hub, spoke, and the combined cost were then adjusted using the KFF Medicaid reimbursement indices of 1.11 for Vermont and 0.83 for New Hampshire. Using the rates adjusted to monthly payments and the projected Medicaid census, the predicted cost of the current New Hampshire program for the 2019 year was calculated.

The second part of the analysis centered around the costs New Hampshire could see with an improved treatment capacity and framework. Using the average projected 2019 census for both hub and spoke combined, the per capita utilization for Vermont's treatment system was found. This rate was then translated into to the number of people that would be undergoing treatment in New Hampshire if the state improved its capacity. This number was again translated into predicted Medicaid beneficiaries, and multiplied into a monthly adjusted reimbursement rate. The hub, spoke, and combined rates were all used to determine a predicted range of the cost. Included in all tables of predicted costs is the base Medicaid expenditure per capita for people who are not going under treatment annually. This is used to demonstrate the additional cost of MAT and other opioid treatment to demonstrate the "treatment premium" of a person with OUD compared to a typical Medicaid enrollee.

Further analysis examined MAT waivering in both Vermont and New Hampshire. Using data from SAMHSA, the number of providers in both Vermont and New Hampshire were used to breakdown the number of providers by county. Using population data from the 2017 census projection for all counties in each state and the number of MAT providers in each, the number of MAT providers per 10000 people was calculated. This data was used to look at the similarities and difference in the organization of rural and urban counties throughout each state and the overall MAT infrastructure each state has put into place.

DISCUSSION

The results demonstrate that Vermont has devoted significant resources towards combating the opioid crisis through the hub and spoke treatment model. Vermont is predicted to spend about 85 million dollars of Medicaid money on treatment for people with OUD in 2019 (Table 1). This strategy has worked, however, and likely justifies the cost. Since Vermont is not

a tax averse state and is willing to spend a large amount per capita on healthcare and enroll a large percentage of its population on Medicaid, more people are willing to seek treatment since it does not cost them as much money out of pocket. While this costs the state significant money upfront, the state has proven the societal benefits significantly outweigh the costs. For every dollar the state spends on OUD treatment, the state, taxpayers, and the average private individual all receive between $1.12 and $1.18 in benefit (Vermont Department of Public Safety 2017). Thus, the deviation from the average Medicaid expenditure is worth the investment for the state of Vermont because of the returns. Additionally, since 70% of all people treated in the hub and spokes on buprenorphine remain off opioids after treatment, the number of people at risk of overdosing decreases significantly with every person Vermont puts into treatment (Vermont Department of Public Safety 2017). Vermont has demonstrated that hub and spoke when implemented correctly is effective at reducing the population afflicted by OUD, and actually saves the state money in the long run.

	Forecasted Vermont Medicaid Costs for 2019			
	Spoke Cost	Hub Cost	Total Cost	Average Medicaid Cost
Forecasted	$38,126,409.66	$46,944,584.67	$85,070,994.33	$ 53,083,945.33
Lower Bound	$36,501,474.18	$43,683,961.73	$80,185,435.91	$ 50,017,099.83
Upper Bound	$39,752,372.28	$50,198,382.13	$89,950,754.41	$ 56,147,055.33

Table 1: Forecasted 2019 Hub and Spoke Costs to Medicaid Compared to Average Enrollee

New Hampshire has organized their hub and spoke system in an entirely different way. To state that New Hampshire has instituted hub and spoke resembling that of Vermont is incorrect. “The Doorway” as the system is called in New Hampshire, is realistically a referral framework that links people seeking treatment with OUD to a provider who is able to treat the patient in an inpatient or more likely outpatient setting. This does not increase the overall MAT capacity for providers and does not necessarily make care significantly more accessible since

many of the walk-in "hub" clinics are more than an hour away in more rural areas of the state. The Doorway also does not increase capacity at recovery clinics or create new residential substance abuse treatment facilities to treat the numerous people with OUD. This proves problematic, as the $6 million devoted to the hub hospitals and clinics is supposed to support access for people suffering OUD throughout the state. A limitation on the study is that there is no data on hub utilization in New Hampshire as the plan went into effect on January 1st, 2019 and no data has been realized to the public as of this writing.

One of the benefits of "The Doorway" grant is the 211 hotline New Hampshire expanded as a part of The Doorway program. The 211 program was initially created in 2008 by the New Hampshire Department of Health and Human Services to provide information and referral services to any individual within the state, specifically to help with taxes (Granite United Way, 2019). It was then expanded in 2019 to be include a referral to a licensed addiction counselors 24/7, which will in turn provide people access to care at any time or refer them to treatment centers. Especially in rural parts of the state where distance can create a barrier to access care, the 211 hotline can be utilized and likely will be effective in placing people into treatment centers. In a state where it is difficult to find and retain licensed addiction counselors due to the low pay relative to other locations in New England, the hotline could serve as a remote referral center and a low-cost option when compared to opening a physical location with staffers. Since there is no data on the "hub" utilization, this will be up for debate until the data are collected.

One of the opportunities for New Hampshire to trim costs but improve access to care would be the expansion of the Safe Station program. The Safe Station program in Manchester and Nashua has been considered a success, with over 6000 people triaged and brought into treatment since its inception in May 2016 (Solomon 2016). Since fire departments in each

municipality are a fixed cost, they could be useful in creating a referral network, especially in more rural areas of the state. Almost every house in New Hampshire has a fire department within a 20 minute drive from their residence, which could be utilized much more effectively than some of the current Doorway hubs. While these centers are not staffed with licensed addiction counselors like the current New Hampshire "Doorway" hubs are, they could be trained similarly to firefighters in Manchester or Nashua. This certainly has a cost associated with it, but the money used to set up the doorway hubs could be utilized by training these professionals who already have experience responding to similar crises in lieu of the hubs at hospitals.

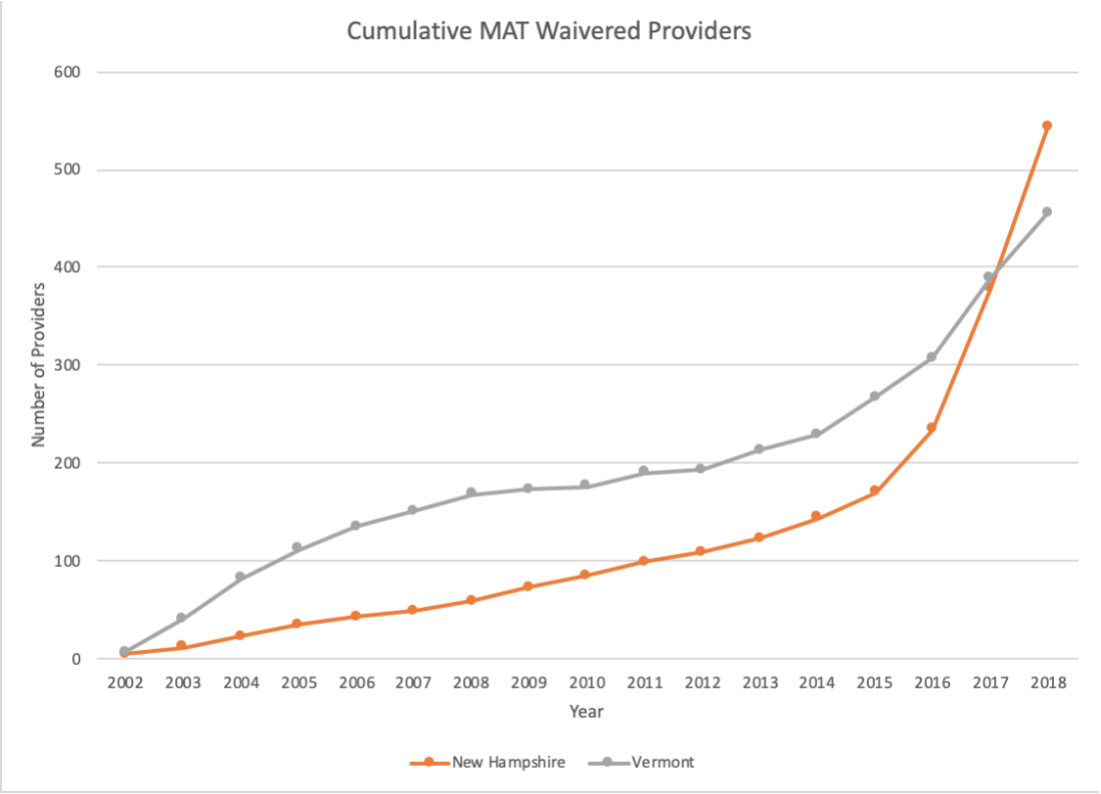


Figure 2: Cumulative MAT Waivered providers in New Hampshire and Vermont 2002-2018

One of the most important aspects for any interventions in New Hampshire remains access to treatment providers, especially MAT providers. New Hampshire historically has had

less providers waivered to prescribe buprenorphine to patients over time, as New Hampshire only surpassed Vermont in 2017 (Figure 1). New Hampshire likely has not had many waivered providers because of the low reimbursement rates for psychiatrists in comparison to other states such as Massachusetts or Vermont (Plenda 2019). Since New Hampshire providers billing a behavioral health visit for Medicaid enrollees only get 56% of private patients, there is little incentive to go through the waiver process to obtain little financial reward (Plenda 2019). The large spike in providers becoming waivered is due to a change in the law that allowed for mid-level providers such as Nurse Practitioners and Physician Assistants to become waivered as of July 2016 through the federal Comprehensive Addiction and Recovery Act. This significantly changed the number of providers able to prescribe buprenorphine, as data as of September 2017 stated there were only 49 active buprenorphine waivered physicians for the entire state (Hinde 2017). The lack of providers continues to the current day and led to long waitlists for treatment; the state government conceded they have not kept track of how many unique names are in the queue for treatment or how many have been deterred by the lengthy waitlist (Hinde 2017). Thus, New Hampshire needs to better incentivize providers to become MAT providers through better reimbursement structures, performance-based compensation, or providing fairly-paying salaried positions to some state-employed providers to improve access to care.

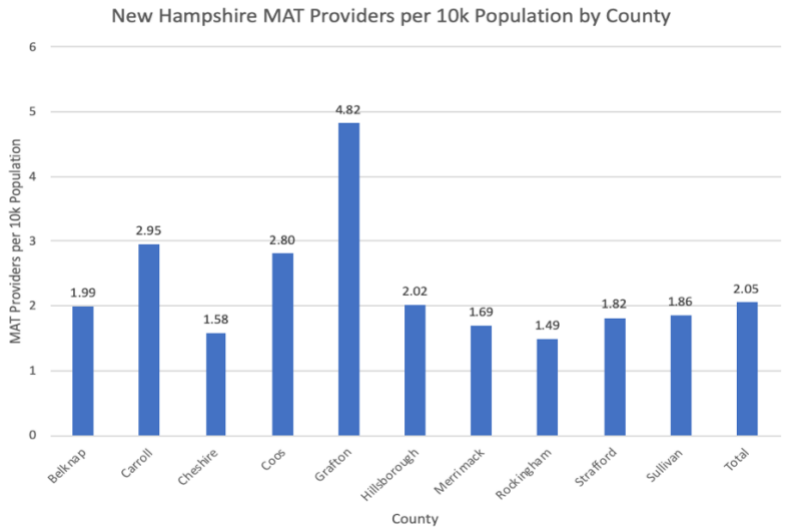


Figure 3: New Hampshire MAT Providers per 10,000 Population

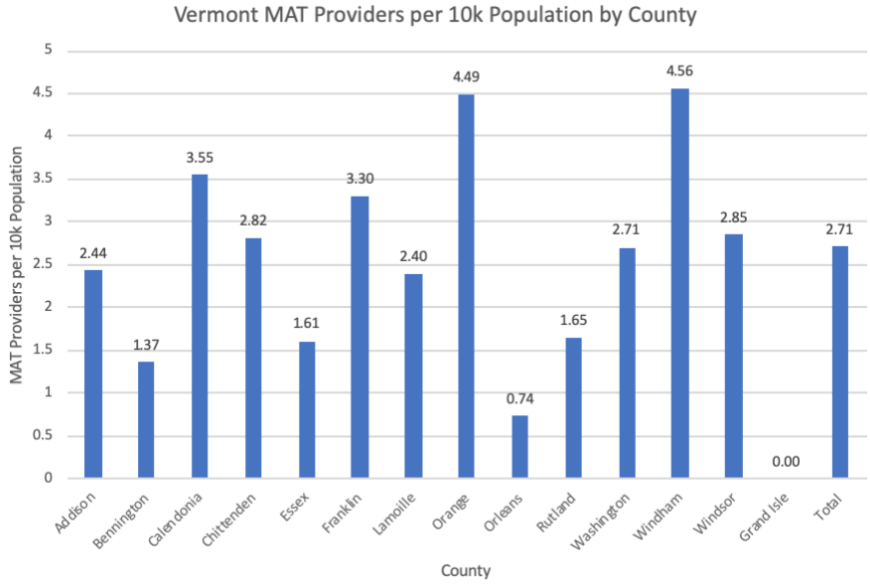


Figure 4: Vermont MAT Providers per 10,000 Population

Access to a MAT waivered physician is not identical around the counties of both states. Surprisingly, the lowest ratios of MAT providers in New Hampshire are in more urban counties such as Rockingham, Strafford and Merrimack counties, but the shortage also exists in rural counties such as Cheshire and Sullivan counties (Figure 3). Grafton county has a significant

number of waivered providers due to the presence of Dartmouth-Hitchcock Medical Center and Geisel College of Medicine at Dartmouth College, which has an addiction research center and significant analysis into the opioid epidemic. The Dartmouth effect in Grafton county is different than the effect of the University of Vermont Medical Center and the Larner College of Medicine at the University of Vermont because Chittenden county in Vermont is the largest population center in Vermont while Grafton county has a relatively low population. For this reason, it is unsurprising that Chittenden county has 2.82 providers compared to the state average of 2.71 and is not a significant outlier (Figure 4). Vermont's inflated numbers of providers in some counties and reduced numbers in others is likely due to the effective hub and spoke structure they have created. The hub and spoke clinics located in more urban counties draw patients from surrounding areas to see providers in these settings. This structure is successful because Vermont has built the backbone of the treatment infrastructure with a referral network proven to be effective. Vermont has a larger rate of MAT providers per 10000 population of 2.71 compared to 2.05 in New Hampshire. Lacking the proper incentivization structure for physicians to become MAT waivered, there is no economic reason for a physician in New Hampshire to prescribe buprenorphine.

Even in the rural counties such as Coos or Carroll that theoretically have a higher number of MAT providers to population than average, there are certainly problems with MAT accessibility. None of the 3 physicians in Coos county who are MAT waivered are currently accepting new patients, causing the waitlist for treatment to continue to grow. The 4 physicians listed as waivered in Carroll county include 2 who specialize in obstetrics and gynecology, 1 who moved out of the area, and 1 who is no longer in practice. In Sullivan county, there are 4 physicians listed on the SAMHSA database, but only 2 are actively prescribing buprenorphine to

patients as the other 2 are emergency room physicians who likely went through the process for CMEs. These inaccuracies within the SAMHSA database demonstrate that is a flawed resource and thus analysis using the database should be scrutinized. However, the overall trends should still be analyzed. There are not enough resources dedicated towards MAT treatment in these rural counties. The state needs to incentivize more physicians in these counties to become MAT providers. Likely, the burden falls on primary care physicians (PCPs) which are already in short supply in rural counties.

Instead of focusing on hub and spoke models as a top-down solution of creating an overarching support hotline to get people connected to treatment centers, New Hampshire would be better served focusing on the capacity of treatment. Since most individuals have a primary care physician, and the CDC guidelines are for adults to meet with their PCP at least once a year, this could be a logical place for people to be treated and triaged. Furthermore, while only 24.5% of people with a substance abuse disorder say they would be willing to be treated in a specialty home, 37.2% would be willing to go through treatment with their primary care physician (Bachhuber 2016). This large difference demonstrates the promise of expanding MAT treatment to primary care physicians. One of the largest barriers for this would be cost, especially in a very tax-averse state like New Hampshire. Since the reimbursement rates for MAT care are low but the documentation and number of visits is high, primary care providers are not properly incentivized to be the resource for MAT care. Perhaps a bonus-based structure for providers and practices caring for MAT patients could be useful to incentivize waivering and care. The bonus could increase with the number of patients served while also accounting for the outcome of the patient after treatment to ensure providers are properly caring for their patients.

Projected New Hampshire Medicaid Cost with Vermont Utilization Rate

Scenario		Spoke Rate	Hub Rate	Average Medicaid User
Current NH		$ 52,507,536.58	$ 42,368,709.59	$ 27,490,216.56
Vermont Utilization Rate	Forecasted	$ 141,770,348.77	$ 114,395,515.89	$ 74,223,584.72
	Lower Bound	$ 133,644,182.39	$ 107,838,453.69	$ 69,969,146.45
	Upper Bound	$ 150,009,031.29	$ 121,043,368.18	$ 78,536,930.61

Table 2: Forecasted New Hampshire Medicaid Costs with Vermont Utilization Rate vs. Baseline

Under the current model of care, New Hampshire is not spending nearly enough money to combat the opioid crisis. Using the predicted New Hampshire MAT utilization of 4.2 per 1000, New Hampshire will be on track to spend a 15 to 20 million dollar premium on baseline Medicaid for treatment (Table 2). This premium is used to demonstrate what New Hampshire typically spends on an average Medicaid patient when compared to the cost of a patient undergoing MAT. Using the Vermont 95 percent confidence interval of the per 1000 utilization rate lying between 10.66 to 11.99, New Hampshire would be expected to pay a 40 to 72 million premium annually based off of baseline Medicaid payments. This far surpasses the 23 million dollar annual grant the federal government gave to New Hampshire, and since the grant had specific rules about how it could be used, it is not a feasible option to cover the shortfall. New Hampshire therefore must find a different way to cover the shortfall, likely through taxes, which is likely not politically feasible in the state government. However, legislators are well aware of the opioid crisis taking place within the state, so an increase on “sin taxes” on items such as cigarettes or alcohol might garner some support. Federal aid could also make up some of the shortfall, as decreasing opioid overdoses likely has political value.

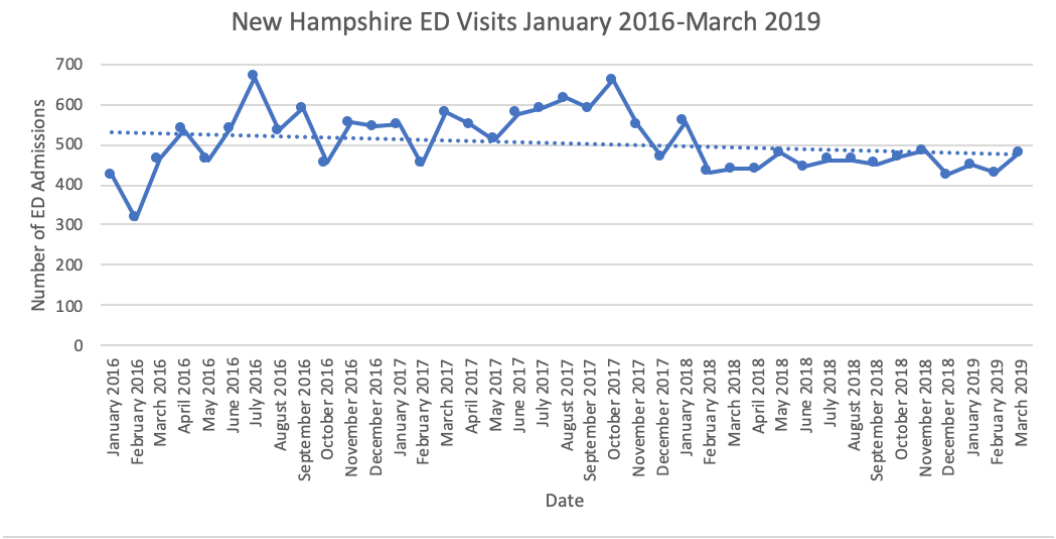


Figure 5: NH Opioid Emergency Department Visits January 2016 to March 2019

Aside from levels of taxation, the governments in Vermont and New Hampshire differ significantly in proactive versus reactive treatment in the opioid crisis. As can be seen In Figure 5, opioid-related emergency department visits have gradually dropped, with the peak number of visits occurring in October 2017. Since New Hampshire has not made significant, tangible policy changes other than the Safe Station program in this time period, it could be theorized that the worst of the opioid crisis has passed. However, the correlation between opioid overdoses and emergency department visits is 0.06, signifying that there is no relationship between visits and deaths. Overdose deaths, like opioid ED visits, have decreased in the past year, further emphasizing that the worst of the crisis may have passed (Figure 6). The general trend in both graphs, is a decrease, albeit it gradual. This reactive approach is a cheaper alternative for a state devoted to saving money for taxpayers. With a decentralized infrastructure and lack of complex data analysis, New Hampshire is poised to wait out the opioid crisis instead of fixing the underlying problems that lead to one of the highest overdose death rates in the nation.

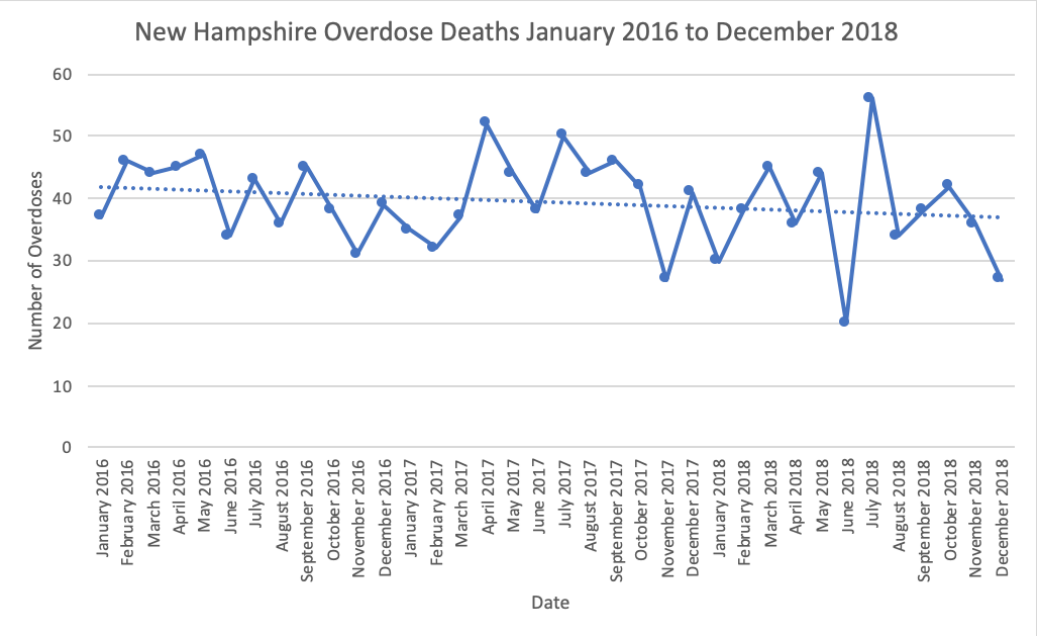


Figure 6: New Hampshire Overdose Deaths January 2016 to December 2018

The results of this analysis prove what many stakeholders in the community already knew: Vermont has been able to decrease the opioid addiction epidemic through a proactive approach to care, while New Hampshire has lagged behind with a lack of innovative, data-centric programs. Further analysis is predicated upon better data and better access to Medicaid data from both New Hampshire in Vermont. Since no research has been published on the cost of a person enrolled in Medicaid but not under any sort of detoxification or MAT care, this was a flaw in the creation of a synthetic New Hampshire. This analysis could be done using the year preceding illness coding with OUD in the data. This would provide a better baseline for state to outline costs, and make it more politically feasible to devote significant resources to MAT treatment, by both incentivizing providers to become waivered and perform at a high level when providing MAT treatment to their patients. The lack of standardized data between these two states was a

significant limitation of the study which did not allow for regressions. Further analysis would require more of this data to be available for more thorough analysis.

REFERENCES

Hedegaard H, Warner M, Miniño AM. *Drug overdose deaths in the United States, 1999–2015*. NCHS data brief, no 273. Hyattsville, MD: National Center for Health Statistics. 2017.

Rudd RA, Seth P, David F, Scholl L. *Increases in Drug and Opioid-Involved Overdose Deaths — United States, 2010–2015.* MMWR Morb Mortal Wkly Rep 2016;65:1445–1452.

Jones CM. *Trends in the distribution of selected opioids by state, US, 1999–2011*. Presented at Natl. Meet. Safe States Alliance, June 6, Baltimore, MD. 2013.

Muhirir, Pradip K, et al. "Associations of Nonmedical Pain Reliever Use and Initiation of Heroin Use in the United States." *CBHSQ Periodic Review*, Aug. 2013.

Boyce, James K. "Inequality And Environmental Protection." *Inequality, Cooperation, and Environmental Sustainability*, Jan. 2016, pp. 314–348.

Atkinson, Robert D. and Nager, Adams, The 2014 State New Economy Index (June 11, 2014). Information Technology & Innovation Foundation, June 11, 2014.

2018 New Hampshire Local Area Unemployment Statistics. New Hampshire Employment Security, 23 Aug. 2018.

New Hampshire Drug Monitoring Initiative. "July 2018 Drug Environment Report." 4 Sept. 2018, pp. 1–14.

Fischer, Benedikt, et al. "Differences and over-Time Changes in Levels of Prescription Opioid Analgesic Dispensing from Retail Pharmacies in Canada, 2005-2010." *Pharmacoepidemiology and Drug Safety*, vol. 20, no. 12, 13 July 2011, pp. 1269–1277., doi:10.1002/pds.2190.

Mars, Sarah G., et al. "'Every 'Never' I Ever Said Came True': Transitions from Opioid Pills to Heroin Injecting." *International Journal of Drug Policy*, vol. 25, no. 2, 8 Oct. 2013, pp. 257–266., doi:10.1016/j.drugpo.2013.10.004.

Chang, Hsien-Yen, et al. “Impact of Prescription Drug Monitoring Programs and Pill Mill Laws on High-Risk Opioid Prescribers: A Comparative Interrupted Time Series Analysis.” *Drug and Alcohol Dependence*, Elsevier, 2 June 2016.

Rudd, R A, et al. “Morbidity and Mortality Weekly Report (MMWR).” *Centers for Disease Control and Prevention*, Centers for Disease Control and Prevention, 14 Aug. 2017.

Bird, Greg. *New Hampshire Center for Public Policy*. 2017, *New Hampshire Center for Public Policy*, www.nhpolicy.org/UploadedFiles/Reports/NH_Economic_Outlook_2018.pdf.

“NH Governor's Commission – New Hampshire Center for Excellence.” *New Hampshire Center for Excellence*, Oct. 2018, nhcenterforexcellence.org/governors-commission/.

“Recommended Strategies to Address Opioid Related Harm in New Hampshire 2017-2020.” New Hampshire Department of Health and Human Services, 8 June 2017, 1viuw040k2mx3a7mwz1lwva5-wpengine.netdna-ssl.com/wp-content/uploads/2018/02/NHGovComm_AOD-OpioidTF_Priorities_2017-20.pdf.

Brooklyn, John R., and Stacey C. Sigmon. “Vermont Hub-and-Spoke Model of Care for Opioid Use Disorder.” *Journal of Addiction Medicine*, vol. 11, no. 4, July 2017, pp. 286–292., doi:10.1097/adm.0000000000000310.

Wickham, Shawne K. “NH Plans 9 Hubs Making Use of Federal Money for Opioid Crisis.” *New Hampshire Union Leader*, 15 Aug. 2018, www.unionleader.com/beyond-the-stigma/NH-plans-9-hubs-making-use-of-federal-money-for-opioid-crisis-08162018.

Rogers, Josh. “N.H. Hospitals to Run Most Substance Abuse Treatment 'Hubs'.” *New Hampshire Public Radio*, 16 Oct. 2018, www.nhpr.org/post/nh-hospitals-run-most-substance-abuse-treatment-hubs#stream/0.

Solomon, Dave. “Firefighters Reach out to Addicts with 'Safe Station'.” *New Hampshire Union Leader*, 4 May 2016, www.unionleader.com/Firefighters-reach-out-to-addicts-with-Safe-Station.

Feely, Paul. “Safe Station Program Sets Manchester Record for Intakes in a Month.” *New Hampshire Union Leader*, 4 Oct. 2018, www.unionleader.com/article/20181004/NEWS12/181009768/1016/NEWS07.

DeWitt, Ethan. “Capital Beat: Opioid Program Isn’t Easy Money.” *Concord Monitor*, 29 Sept. 2018, www.concordmonitor.com/Capital-Beat-hospitals-race-to-fill-governor-s-hub-and-spoke-proposal-20431659.

“2018 Vermont Economic-Demographic Profile.” Vermont Department of Labor, 21 Sept. 2018, www.vtlmi.info/profile2018.pdf.

UNH Institute for Health Policy and Practice. *Vermont Medicaid Overview*. 2017, *Vermont Medicaid Overview*, chhs.unh.edu/sites/default/files/vermont-medicaid-overview-05252017.pdf. Accessed 25 Mar. 2019.

The Henry J. Kaiser Family Foundation. (2019). *Medicaid Physician Fee Index*. [online] Available at: https://www.kff.org/medicaid/state-indicator/medicaid-fee-index/?currentTimeframe=0&sortModel=%7B%22colId%22:%22Location%22,%22sort%22:%22asc%22%7D [Accessed 25 Mar. 2019].

Vermont Department of Health. *Vermont Household Health Insurance Survey*. Vermont Department of Health, Dec. 2018, www.healthvermont.gov/sites/default/files/documents/pdf/VHHIS_Report_2018.pdf.

The Henry J. Kaiser Family Foundation. *Medicaid in New Hampshire*. The Henry J. Kaiser Family Foundation, Nov. 2018, files.kff.org/attachment/fact-sheet-medicaid-state-NH.

Mohlman, Mary Kate, et al. “Impact of Medication-Assisted Treatment for Opioid Addiction on Medicaid Expenditures and Health Services Utilization Rates in Vermont.” *Journal of Substance Abuse Treatment*, vol. 67, 4 May 2016, pp. 9–14., doi:10.1016/j.jsat.2016.05.002.

Department of Vermont Health Access, et al. *Annual Report on the Vermont Blueprint for Health*, Vermont Department of Health, 31 Jan. 2019. blueprintforhealth.vermont.gov/sites/bfh/files/2018_Blueprint_for_Health_Annual_Report_final.pdf.

Jones, Christopher M., et al. “National and State Treatment Need and Capacity for Opioid Agonist Medication-Assisted Treatment.” *American Journal of Public Health*, vol. 105, no. 8, Aug. 2015, pp. 55–63., doi:10.2105/ajph.2015.302664.

Florence, Curtis S., et al. “The Economic Burden of Prescription Opioid Overdose, Abuse, and Dependence in the United States, 2013.” *Medical Care*, vol. 54, no. 10, Oct. 2016, pp. 901–906., doi:10.1097/mlr.0000000000000625.

Plenda, Melanie, et al. “NH’s Hub and Spoke System: Traction or Just Spinning Wheels?” *New Hampshire Business Review*, 1 Mar. 2019, www.nhbr.com/nhs-hub-and-spoke-system-traction-or-just-spinning-wheels/.

Vermont Blueprint for Health. *Medication Assisted Treatment Profile*. Vermont Department of Health, Dec. 2016, blueprintforhealth.vermont.gov/sites/bfh/files/Blueprint Medication Assisted Treatment Profile (2016).pdf.

Weiss, Roger, et al. “Long-Term Outcomes from the National Drug Abuse Treatment Clinical Trials Network Prescription Opioid Addiction Treatment Study.” *Drug and Alcohol Dependence*, vol. 156, 1 May 2015, doi:10.1016/j.drugalcdep.2015.07.637.

New Hampshire Department of Health and Human Services, Bureau of Drug and Alcohol Services. Guidance Document on Best Practices: Key Components for Delivering Community-Based

"Vermont Results First Inventory and Benefit-Cost Analysis." The Vermont Department of Public Safety and The Joint Fiscal Office, Dec. 2017, blueprintforhealth.vermont.gov/sites/bfh/files/VT Results First Inventory and Benefit-Cost Analysis for the Hub and Spoke Model 2017.pdf.

Medication Assisted Treatment for Opioid Use Disorders in New Hampshire. Second Edition, April 2018.

Hinde, Jesse, et al. "State and Local Policy Levers for Increasing Treatment and Recovery Capacity to Address the Opioid Epidemic: Final Report." *RTI International*, 29 Sept. 2017, aspe.hhs.gov/basic-report/state-and-local-policy-levers-increasing-treatment-and-recovery-capacity-address-opioid-epidemic-final-report.

Bachhuber, Marcus, et al. "Primary Care: On the Front Lines of the Opioid Crisis." *Leonard Davis Institute for Health Economics*, University of Pennsylvania, 9 Aug. 2016, ldi.upenn.edu/brief/primary-care-front-lines-opioid-crisis.

"Opioid Overdose." *Centers for Disease Control and Prevention*, US Department of Health and Human Services, 3 Oct. 2018, www.cdc.gov/drugoverdose/maps/rxrate-maps.html.

Office of the Surgeon General. Facing Addiction in America: The Surgeon General's Report on Alcohol, Drugs, and Health. Washington: US Dept of Health and Human Services; 2016.

Granite United Way. "About Us." *211 New Hampshire*, Granite United Way, 2019, www.211nh.org/about-us/.

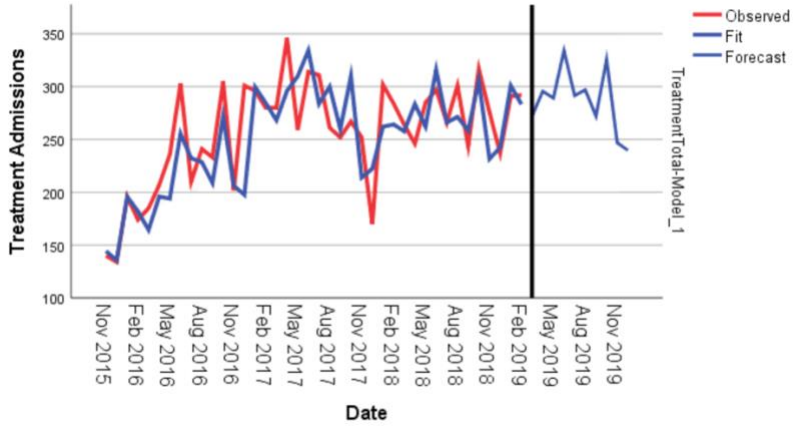
APPENDIX

```
. reg spokecensus hubcensus
```

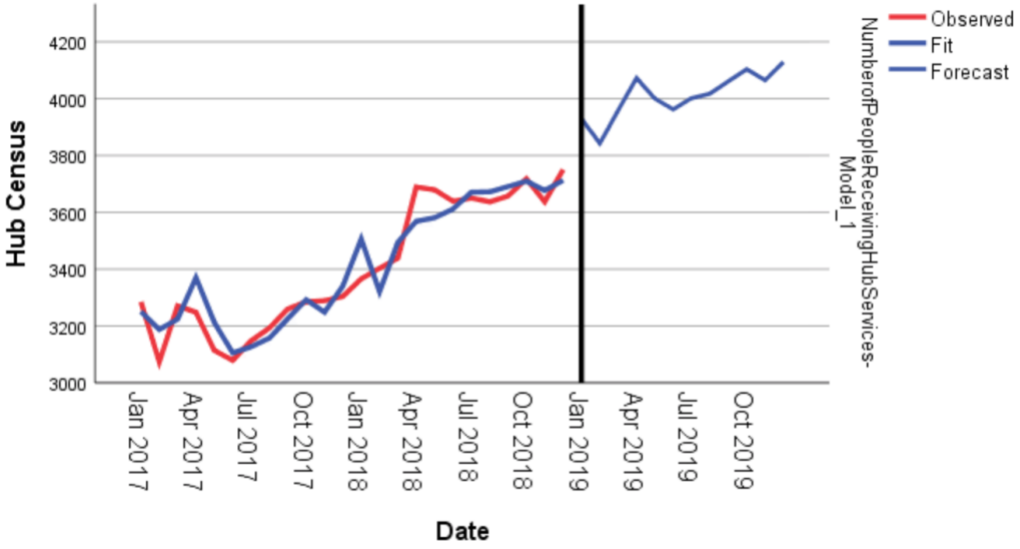
Source	SS	df	MS	Number of obs	=	6
				F(1, 4)	=	10.86
Model	57310.9301	1	57310.9301	Prob > F	=	0.0301
Residual	21108.5699	4	5277.14249	R-squared	=	0.7308
				Adj R-squared	=	0.6635
Total	78419.5	5	15683.9	Root MSE	=	72.644

spokecensus	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
hubcensus	.5652133	.1715114	3.30	0.030	.0890212	1.041405
_cons	808.2094	572.245	1.41	0.231	-780.5976	2397.016

Appendix 1: Prediction of Spoke Census using Hub Census Values



Appendix 2: New Hampshire Treatment Admissions using Simple Seasonal Exponential Smoothing Model



Appendix 3: Vermont Hub Census Prediction using Winters Additive Exponential Smoothing

Model Statistics

Model	Number of Predictors	Model Fit statistics: Stationary R-squared	Model Fit statistics: R-squared	Model Fit statistics: RMSE	Ljung-Box Q(18): Statistics	Ljung-Box Q(18): DF	Ljung-Box Q(18): Sig.	Number of Outliers
Treatment Total-Model_1	0	.793	.601	32.186	34.659	16	.004	0

Forecast

Model		Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019	Sep 2019	Oct 2019	Nov 2019	Dec 2019
Treatment Total-Model_1	Forecast	272	296	289	334	292	297	272	326	247	240
	UCL	337	366	364	413	375	384	363	420	345	342
	LCL	207	225	214	255	208	209	181	231	148	138

For each model, forecasts start after the last non-missing in the range of the requested estimation period, and end at the last period for which non-missing values of all the predictors are available or at the end date of the requested forecast period, whichever is earlier.

Appendix 4: Forecasted NH Treatment Values through 2019 (95% Confidence Interval)

Model Statistics

	Number of Predictors	Model Fit statistics: Stationary R-squared	Model Fit statistics: R-squared	Model Fit statistics: RMSE	Ljung-Box Q(18): Statistics	Ljung-Box Q(18): DF	Ljung-Box Q(18): Sig.	Number of Outliers
s-	0	.789	.909	71.632	23.372	15	.077	0

Forecast

		Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019	Sep 2019	Oct 2019	Nov 2019	Dec 2019
s-	Forecast	3930	3843	3959	4072	4000	3962	4002	4018	4061	4104	4065	4129
	UCL	4079	4024	4169	4306	4257	4239	4298	4332	4392	4451	4428	4507
	LCL	3781	3661	3749	3838	3743	3685	3705	3703	3729	3756	3701	3750

Appendix 5: Vermont Hub Census forecasted values through 2019 (95% Confidence Interval)

Forecast

Model		Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019	Sep 2019	Oct 2019	Nov 2019	Dec 2019
Number of People Receiving Treatment at a Spoke-Model_1	Forecast	3047	2997	3110	3127	3086	3092	3087	3096	3064	3145	3123	3145
	UCL	3134	3095	3216	3242	3209	3223	3225	3241	3215	3302	3286	3314
	LCL	2960	2900	3003	3012	2963	2961	2950	2952	2913	2988	2960	2975

Appendix 6: Vermont Spoke Census forecasted values through 2019 (95% CI)