SURTCOM 21-06

An Analysis of the Costs and Benefits of Providing Increased Mobility to Reduce Social Isolation Among America's Aging Population

Prepared for:

U.S. Department of Transportation

Prepared by:

Del Peterson
Antonio Molina

Small Urban and Rural Center on Mobility
Upper Great Plains Transportation Institute
North Dakota State University, Fargo, ND

May 2021

Acknowledgments

Funds for this study were provided by the Small Urban, Rural and Tribal Center on Mobility (SURTCOM), a partnership between the Western Transportation Institute at Montana State University and the Upper Great Plains Transportation Institute at North Dakota State University. The Center is funded through the U.S. Department of Transportation's Office of the Assistant Secretary of Research and Technology as a University Transportation Center. The Small Urban and Rural Center on Mobility within the Upper Great Plains Transportation Institute at North Dakota State University conducted the research.

ABSTRACT

The number of Americans age 65 and older is projected to nearly double from 52 million in 2018 to 95 million by 2060, and the 65-and-older age group's share of the total population will rise from 16% to 23% (US Census 2018). Also, average U.S. life expectancy increased from 68 years in 1950 to 78.6 years in 2017, in large part due to the reduction in mortality at older ages. This larger share of older adults also means that Social Security and Medicare expenditures will increase from a combined 8.7% of gross domestic product today to 11.8% by 2050 (Social Security Administration 2019).

These societal changes among aging Americans, along with the current COVID-19 pandemic, have led to isolation on a greater scale than in recent times. This is especially true in the rural area where small urban and rural communities continue to age as disproportionate shares of the younger population move to larger communities pursuing education, employment, and other opportunities.

The objective of this research was to quantify the cost of providing greater mobility through public transportation to aging adults in small urban and rural communities to lower social isolation. This was compared with the increased medical spending due to current levels of isolation. Effort was taken to quantify the costs in numerous states throughout different regions of the United States.

Results for the states studied showed that from three to 10 trips per month could be provided to an isolated individual at a lower cost than the extra medical costs due to isolation. Also, an extra 25 to approximately 80 miles of service can be provided to an isolated aging adult per month for the states studied. Finally, from two to six hours of service can be provided to an isolated aging adult per month at costs equal to or less than the monthly medical costs due to isolation. A marketing plan designed to target potential aging and isolated riders showed that the simulated cost of seven monthly trips per passenger would be feasible for small, medium, and large agencies at the median level, and that all simulations yielded cost-effective results for medium-sized agencies when added marketing and operating costs were included in the simulations.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

Many of us appreciate the occasional opportunity to disconnect, giving our minds and bodies a chance to recharge, but when isolation becomes long-term and turns into loneliness, the results can be detrimental and potentially devastating, particularly for aging adults. The number of Americans aged 65 and older is projected to nearly double from 52 million in 2018 to 95 million by 2060, and the 65-and-older age group's share of the total population will rise from 16% to 23% (US Census 2018). Also, average U.S. life expectancy increased from 68 years in 1950 to 78.6 years in 2017, in large part due to the reduction in mortality at older ages. This larger share of older adults also means that Social Security and Medicare expenditures will increase from a combined 8.7% of gross domestic product today to 11.8% by 2050 (Social Security Administration 2019).

These societal changes among aging Americans have led to isolation on a greater scale than in recent times. This is especially true in the rural Midwest, where small urban and rural communities continue to age as disproportionate shares of the younger population move to larger communities pursuing education, employment, and other opportunities. The current COVID-19 pandemic has also added to the level of social isolation among aging adults throughout the country. Improving mobility within the aging population in these smaller communities can aid in lessening isolation by allowing for greater opportunities to socialize and move around one's community, resulting in decreased healthcare costs.

Statistics related to the topic of aging in America leading to increased levels of social isolation are compelling:

- Loneliness increases the likelihood of mortality by 26%.
- Those who are socially isolated cost about $130 per month more in Medicare spending than their non- or less-isolated counterparts.
- Lacking social connections is as damaging to health as smoking 15 cigarettes a day.
- Coronary bypass patients who report feeling lonely have a mortality rate five times higher than other patients 30 days post-surgery.
- Lonely individuals have a 64% increased chance of developing clinical dementia.
- People who are lonely report 5% more severe symptoms of the common cold than those who are less lonely.

(Stonegate Senior Living 2018)

1.1 Objectives

The objective of this research was to quantify the cost of providing greater mobility through public transportation to aging adults in small urban and rural communities to lower social isolation. This was compared with the increased medical spending due to current levels of isolation. Effort was taken to quantify the costs in numerous states throughout different regions of the United States.

1.2 Organization of Content

The study begins with a literature review, including research papers and other applicable materials addressing social isolation issues among aging adults. Following the literature review is an overview of the research methodology used in this study. Next is the cost analysis chapter focusing on rural transit cost ratios compared with social isolation costs in 10 states throughout the country. Results and key findings are presented in the final chapter.

2. LITERATURE REVIEW

2.1 Social Isolation

Social isolation seeks to explain and address breakdowns in interactions between individuals and social groups within communities or societies. Breakdowns or shortcomings in these interactions are displayed by low participation in activities that give a sense of belonging and relevance regarding community involvement. For example, access to labor markets, the educational system, the healthcare system, and the possibility of accessing cultural activities constitute relevant examples that influence social isolation (Cloutier-Fisher et al. 2011)

The involvement of individuals in their community or society is subject to various factors, both internal and external. For an individual, participating in activities within the community allows their personal effort to be directly favored, develops membership ties, and establishes a relationship of interest within a community group, furthering the development and well-being of the individual (Murray 2015). For the community, the participation of its individuals is its most valuable asset, as it represents the making of resources, culture, cohesion, and overall allows for the development of community and promotes its general welfare.

Given this notion of social participation in which people are part of activities in their own community, the concept of social isolation arises to describe and encompass situations in which an individual fails to participate, does it partially, or participates without being able to reach their full potential, often due to unfamiliar situations and processes beyond their control (He et al. 2018).

The main characteristics of social isolation can be summarized in the following (Rajé 2007):

- An emphasis on how the individual manages to participate in activities that give a sense of belonging in a social context. This is the key difference from traditional notions of poverty that emphasize mainly material deficiencies.
- It is a multidimensional problem, where different factors may be the cause of exclusion situations, and where these factors can overlap and be maximized in complex processes to create states of isolation.
- Elements are subject to social, political, and economic environments. Different activities can be understood as binding or relevant from the point of view of participation, depending on the individual and the society or community in which they reside. At the same time, the participation standards are relative to each context of analysis.
- It is a gradual problem, in which different individuals can be affected by the same causal factors of exclusion, but these are manifested with different intensity and, therefore, they constitute different risk factors.
- It is a dynamic process since there are relationships of dependence between different risk factors, and these can maximize, overlap, and accumulate according to processes typical of human coexistence.
- It is a problem that fundamentally affects the individual on a daily basis. There are different visions regarding the basic unit of analysis in this problem, but they relate to practical limitations or disaggregated individual level analysis. This reveals that the emphasis must be focused on an individual reality.
- The relationships between the different social agents are emphasized (individuals, companies, government, organizations, and activities), and at the same time exposed in the weaknesses of the bonds of interaction between them, which finally limit the participation of individuals and creates various states of isolation.

2.2 Elder Life

Society often considers aging adults to be synonymous with unproductiveness, inactivity, or dependency. This relates to a stigma of social and budgetary burden for a group of people who, upon reaching the age of 60 or 65, are forced to finish their working life and "start old age" (Plazinić and Jović 2018). This prevailing social image has contributed to keep the stereotype of an “unproductive older adult” with whom society still recognizes or identifies as the elderly, without considering the potential of seniors who wish to continue carrying out productive activities contributing to their own well-being as well as to that of their family and society as a whole.

In its world report on aging, the World Health Organization (2015) considers avoiding the perception of getting older as a simple addition to the retirement age with policies that allow the elderly to live those years with the best possible health condition and quality of life. So, as life goes on, if the person believes that greater longevity can be lived with greater quality, it is possible that they can focus many of their activities to add to their own quality of life.

Hui et al. (2014) pointed out that, here in the United States, older adults are already looking for alternatives for this stage of life and that people who are close to traditional retirement age do not always want to retire, possibly because of the need to work; but there is also the interest of the elderly to remain active in society, as a demonstration of being productive in the community.

Wiles et al. (2011) indicated that, in 2011 and 2012, 23% of new entrepreneurs were in the age range of 55 to 64 years. In a similar case, van der Pas et al. (2015) report there are twice as many successful entrepreneurs over 50 years of age compared with individuals less than 25 years old. In this current framework of aging, it is considered that a rethinking of the relationship between aging and society is possible, so that older persons do not feel imprisoned in a system that associates them with loss, illness, and slow death, but rather perceive encouragement that allows them to achieve accomplishments through successful and productive aging.

Therefore, aging dynamically and successfully should reflect feeling socially productive more than economically productive; that is to say, feeling useful to society. Older adults should not only be considered recipients of social assistance, but also recognized as productive entities for themselves and for the community, based on their knowledge and experiences of a lifetime, without forgetting that aging is a unique dynamic process that generates an individual experience for each person.

2.3 Public Transportation and the Elderly

Public transportation, in both physical and economic terms, constitutes a key factor for active aging. It is a topic related with other areas of discussion regarding aging people's living conditions. Chudyk et al. (2015) found that the ability to move around the city determines the social and civic participation along with access to the community and health services.

Transportation systems constitute a specific way through which individuals access activities not within their immediate reach. The ability to access these activities is what determines the individual’s participation; therefore, it is essential to understand the factors that affect the ability of the transportation system to fulfill this role effectively for all the individuals that require it. On the other hand, a transportation system’s undesirable characteristics can negatively affect the most vulnerable individuals, who also lack the means to reverse this impact (Nordbakke 2013).

Public transit facilitates connectivity between territories and people, and is an instrument that promotes cohesion, integration, and identity. This is associated with the idea that basic goods and services linked to life quality, such as transportation, housing, adequate food, quality education, and health, are facilitating elements for the development of each individual. Thus, public transit has a role to fulfill in the processes of social inclusion.

With aging adults, public transportation often plays an important role in being the link to family, friends, and the rest of the community, allowing aging adults to keep a level of independence. Research has shown that a deficiency in mobility can keep older people from joining social activities and leads to low confidence, depression, and loneliness (Peterson and Rieck 2017).

Cass et al. (2005) state that as people get old it becomes more important for them to have contact with a "support network," rather than a "social network." These support networks may take the form of companionship, emotional support, instrumental help, and information on a daily basis. Most of the time, support networks will be founded within a few miles of one's residence and often include neighbors, family members, and friends who can provide formal and informal services.

Increasing the use of public transit has been shown to generate economic benefits through reductions in transportation-related costs. These include benefits such as spending less on vehicle fuel and maintenance. Also, with aging adults, there are wider social benefits associated with the use of public transportation, including the very important benefit of improved overall health of a local community (O´Hern and Oxley 2015).

As people age, they often outlive their ability to drive and experience a related loss of independence. Even where alternative travel options exist, a high percentage of aging adults may not be familiar or comfortable with these options. Mental and physical consequences of aging may make it more difficult for older adults to walk, bike, or use public transit to access activities. Restraint in mobility can result in isolation and difficulty getting to necessary activities like grocery shopping and medical appointments.

Aging adults perceive that the public transport system is often not designed according to their needs, so the physical environment can perform as a facilitator or restrainer of performance according to how their demands interact with personal abilities (Mackett 2015). For a satisfactory and safe performance of commuting, aging adults require that public spaces and modes of transportation be accessible considering the limitations that generally affect them (Ryan et al. 2015).

2.4 Travel Behavior

Banister and Bowling (2004) published research in Great Britain highlighting the differences by gender regarding the various forms of mobility. For example, men over 60 years of age often keep driving their own vehicle while women more often use other mobility options, such as taking the bus. People surveyed considered that public transportation is important as a mode for accessing local services and for participation in activities.

In Scotland, a study showed that women over 70 years of age tend to walk or travel as passengers in cars rather than driving their own vehicle. During the past few years, there has been an increase in driver's licenses issued to women, but men continue to lead, exceeding 70% among those over 70 years of age (Raeside et al. 2012). In Scotland, people over 60 years of age can travel free by bus, but it does not represent the most widely used type of service. The reasons for low use were examined. People interviewed commented that buses in Scotland were clean, on schedule, safe, comfortable, and cheap, but many men and women believed they do not need to use them because they have their own car. In addition, 31% of women and 20% of men replied that they do not use the bus because of their own health problems. Aging adults with lower incomes who live in less-favored areas have limited access to their own vehicle and were found more likely to use the local bus for daily activities.

Within the United States, aging adults prefer to drive their car, with the choices of public transit or walking being significantly less popular (Alsnih and Hensher 2003). The main issues identified as problems due to this intense use of private vehicles included environmental pollution and traffic congestion. The authors point out that there are many aging drivers who are highly dependent on their personal vehicles, and the National Highway Traffic Safety Administration (NHTSA) reported that in 2012, adults over 65 years were responsible for 17% of traffic fatalities and 20% of pedestrian mortalities. Fatality rates also increased as adults aged with individuals 80 to 84 having the highest rate of driving-related accidents.

After retirement, daily life changes, and these changes also include mobility habits. In general, overall mobility decreases in quantity. Aging men, when possible, usually continue to drive their own personal vehicles in the first years of retirement and decrease both their driving time and distance from their homes as they continue to age. Older women tend to use public transportation more often than men. Regarding the reasons for commuting, men usually travel for leisure and recreation while women often travel to perform tasks like shopping, visiting family, and accompanying others. This type of travel is often carried out in a linked manner depending on the activity. It is women who make the most daily trips for different purposes on average (Alsnih and Hensher 2003).

2.5 Aging in Place

Residing somewhere in a community means much more than simply satisfying a basic need for housing. The house, the neighborhood, and the community become the niche in which existence develops, especially as people age and commuting requires a bigger effort. Therefore, house and neighborhood gain a more powerful connotation. (Sixsmith and Sixsmith, 2008). They become the area in which the most personal and shared experiences with others occur and usually involve the same social group. As aging adults contribute within this community they often develop a sense of belonging and participation (Vanleerberghe et al. 2019). A survey by Mattson (2020) found that allowing seniors to age in place was one of the most important perceived benefits of rural transit. They found that transit not only supported independent living, but improved social connectedness kept people living within their local communities.

Journeys within the community may represent exhausting and unpleasant experiences that many aging adults avoid as much as possible. Their strategy includes trying to carry out all of their necessary activities within a convenient radius of action, depending on the ease of moving and personal health conditions (Dalmer 2019). In this context, it may be called segregation or inequality in the provision of services and activities as mobility becomes an important element that articulates a person's daily life. Although some communities' roads and modes of transportation have improved over the decades, commuting is far from comfortable, satisfactory, and pleasant for most aging adults.

Having their own car does not necessarily improve the quality of the trip. Many aging adults stop driving because they no longer feel safe or comfortable. (Frank et al. 2019). Traffic is too heavy for them; they think that people are driving too fast now and that traffic rules are generally not respected. Those who continue driving prefer to use public transport when they must travel to unfamiliar places far from their homes, or to very crowded locations. Some aging adults are afraid of getting lost because they no longer recognize many places due to their transformations (Frank et al. 2019).

2.6 The Cost of Isolation

A direct correlation between isolation and Medicare spending was studied by Shaw et al. (2017). This was the first known study to measure the association between isolation and health expenditures. A distinct difference was made in this research between objective isolation and loneliness. They defined loneliness as including qualitative factors that involved a person's personal sense of belonging and the quality of their relationships. Objective isolation was defined as a quantifiable disconnection from social networks. This included both the size and structure of an aging adult's social network along with the frequency of social interactions and social support systems for the individual. They linked retirement study data to Medicare claims in order to analyze objective isolation.

Results showed that objective isolation predicted greater Medicare spending by approximately $1,600 per person annually. Increased medical spending was even more pronounced for widowed aging adults. Medicare spending increased by more than $3,000 per person annually for those both widowed and isolated compared with their widowed peers who were not isolated. Shaw et al. (2017) concluded that policies supporting increased social connectedness among isolated aging adults could reap significant savings both qualitatively and quantitatively.

2.7 COVID-19 Pandemic and Isolation

The COVID-19 pandemic has increased the number of aging adults who are socially isolated, including both independently living aging adults and those living in assisted living and nursing home settings. Prior to the pandemic, the majority of independently living aging adults actively participated in social activities, such as attending senior centers, church activities, shopping trips, and many other social events within their own local communities. Other community-based long-term care services were also available, including adult day care, respite care, meals on wheels, and home health services, among others. However, due to partial and full lockdown policies throughout the pandemic, many of these services have either been canceled altogether or greatly restricted. These restrictions would certainly increase social isolation and loneliness among aging adults (Wu 2020).

The COVID-19 pandemic will have long-term and deep impacts on aging adults' physical health and mental well-being. Wu (2020) concluded that social isolation is likely to become a major risk factor that affects aging adults' health outcomes. Strategies suggested to address these issues included raising awareness of the health and medical impact of social isolation among health care workers as well as among members of the public, developing technology-based interventions to mobilize resources for aging adult family members, community-based resources that address social isolation in aging adults, and engaging the healthcare system to begin developing methods to identify social isolation and loneliness within health care settings (Wu 2020).

Gavin (2020) found that among adults over age 50, 56% said they sometimes or often felt isolated from others according to 2020 polling, compared with 27% who felt isolated just two years earlier. Social contacts have suffered as well with 46% of aging adults reporting in 2020 that they infrequently interact with friends, neighbors, or family outside of their household, doing so once a week or less, compared with 28% who responded similarly in 2018. These results come from a University of Michigan National Healthy Aging Poll done for the University of Michigan's Institute of Healthcare Policy (University of Michigan 2020).

They did find that technology has helped aging adults connect with each other, including the 59% who reported using social media on a weekly basis, and 31% who used video chat software once a week or more. Conclusions emphasized that prolonged isolation can have a profound negative effect on both physical and mental health. It also was not surprising the aging adults who live alone reported greater levels of isolation and loneliness since the pandemic began. As aging adults try to avoid coronavirus infection, they have available resources, including an AARP website tool that helps aging adults assess their level of isolation and connects them to resources and opportunities within their local communities (Gavin 2020).

Psychological risk factors for aging adults living in isolation during the pandemic were studied by Dispatch Health (2020). They found that while the combination of isolation and confusion can cause fear and anxiety in anyone, it is particularly concerning for aging adults during the COVID-19 crisis. Social isolation, while beneficial physically to mitigate infection, has also resulted in many psychological risk factors among aging adults. These hidden complications should be highlighted as a serious public health concern as they can intensify the risk of cardiovascular, autoimmune, neurocognitive, and psychological issues.

The pandemic has not only caused physical complications for aging adults, it has also resulted in negative mental health effects due to mandated isolation and voluntary quarantine. Some of the most concerning psychological risk factors of isolation for aging adults include depression, anxiety, panic attacks, suicidal thoughts, and substance abuse. Dispatch Health (2020) contends that raising awareness regarding these psychological risk factors is very important, and aging adults should incorporate measures to lessen their impacts. Measures may include adding more structure to one's day while incorporating physical activity, and also establishing communication platforms to regularly connect aging adults with family and friends. They also caution all aging adults to continue to take care when leaving their homes as social distancing guidelines begin to lessen, offering alternatives to total social isolation. Everyone should continue to be vigilant by wearing face coverings, maintaining a six-foot distance from others, and washing hands regularly.

3. RESEARCH METHODOLOGY

This research compared the increased medical cost from isolation among older adults to the cost of providing greater mobility options through demand response rural public transportation designed to lessen isolation costs. For example, as the degree of isolation increases among aging adults, Medicare costs tend to rise as well (Shaw et al. 2017). By improving mobility options for isolated aging adults, this will lower their social isolation and also the medical costs due to decreased isolation levels. Comparing the costs associated with providing greater mobility to that of medical costs both with and without greater mobility will determine whether or not such action would make financial sense. Figure 3.1 shows this hypothesized scenario.

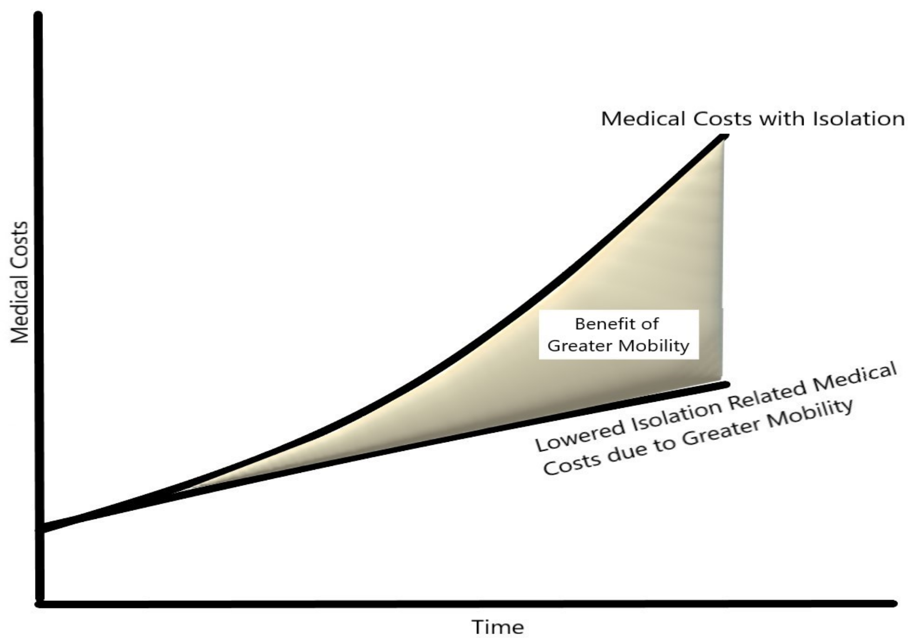


Figure 3.1 Medical Costs Associated with Isolation and Greater Mobility

Considerable uncertainty arises when comparing the costs involved with medical and mobility options. Individuals must make complex, dynamic decisions pertaining to the multiple choices available to them. Therefore, to explain some of the uncertainty that occurs, @Risk simulations were conducted. The following discussion focuses on the functionality of @Risk and how it applies to studying data that include variability. This methodology is similar to that developed in previous research (Peterson and Rieck 2017).

When someone is confronted with a problem that includes uncertainty, it becomes challenging to use an analytical model that will return accurate results. @Risk, a Microsoft Excel add-in program, contains functions that yield results generated from random variables. For example, entering RISKNORMAL (8,2) in a cell will produce an observation from a normal random variable with a mean of 8 and a standard deviation of 2. Once cell values that include uncertainty are replaced with @Risk functions, a simulation can be run based on the unique values within the @Risk cells. The simulation imitates a real-life situation. Within the model, an @Risk cell is simulated a set number of times, called iterations, to provide an outcome. Note that this answer is not exact, but rather a calculation based on the data variability included within the model. @Risk also permits the user to describe different probability distributions based on the variability of given variables. Therefore, decision makers have the option of using various probability distributions that best fit their data. Common distributions include logistic, triangular, and normal, among others. The technique of simulation can also be chosen. For this research, Monte Carlo simulations were used. This type of simulation was thought to best represent the available data. The use of random numbers for each iteration in a Monte Carlo simulation is similar to a spin on the roulette wheel at a casino. Similar to the spins on the roulette wheel, the numbers utilized to produce results within each iteration are independent from one another.

Variables that represented uncertainty for this research included those listed in Table 3.1. These variables were chosen to represent uncertainty in simulation models because they represent some of the most important costs considered by demand responsive rural transit agencies when developing service levels for their clientele. Also, they exhibited substantial variability within the datasets.

Table 3.1 @Risk Variables

Rural Public Transportation Variables
Operating Expenses
Passenger Trips
Vehicle Revenue Miles
Vehicle Revenue Hours
Passenger Fares

States studied included North Dakota, New Mexico, Arkansas, Alabama, Kentucky, Vermont, South Carolina, Nebraska, Idaho, and West Virginia. These 10 states were chosen because they represented different regions of the country with either large rural populations or a large percentage of rural residents compared with their overall state population. The following chapter focuses on simulation modeling and results for all 10 states highlighting the distinctive variability present within each location.

Data used in this research were collected from a combination of sources, including the U.S. Census (2018), Rural National Transit Database (2018), and AARP (2017). Medical cost data used in the analysis were collected from Shaw et al. (2017), which highlighted increased Medicare spending due to social isolation among older adults.

4. ISOLATION ANALYSIS AND SIMULATION RESULTS

Average cost analysis, simulations, and marketing of rural transit are the focus of this chapter. Increased medical costs due to isolation were compared to the costs of providing greater mobility through demand responsive public transportation in rural areas. Three main transit cost ratios were considered. These included operating expense per trip, operating expense per vehicle mile, and operating expense per vehicle hour. Increased Medicare costs due to isolation were quantified from an AARP (2017) study that found an annual increase of $1,608 in Medicare costs for each socially isolated older adult in 2012 dollars. Isolation levels were quantified using a composite score of responses to targeted questions related to social isolation. All analyses used monthly costs per individual, so $134 per month was used for the 100% level of increased Medicare costs due to isolation. This value was inflated to the 2018 dollar value to match cost data from the 2018 National Rural Transit Database using the Consumer Price Index (2020).

Ten states were studied individually and also grouped together within simulations (Figure 4.1). These included North Dakota, Idaho, New Mexico, Alabama, Arkansas, Kentucky, West Virginia, Vermont, South Carolina, and Nebraska. Individual state figures not included in the write-up section of this report can be found in the Appendix.

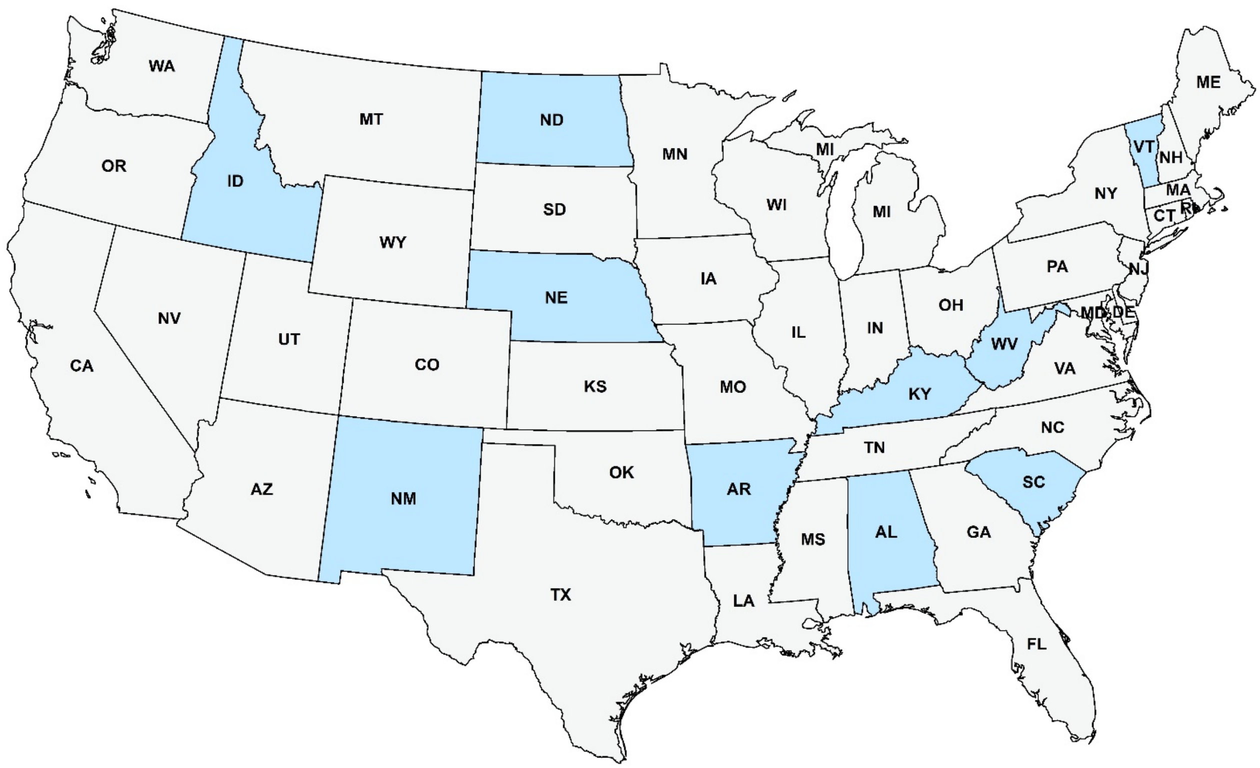


Figure 4.1 States Studied

States were chosen because they either had a large rural population or a large percentage of rural residents (Table 4.1). Also, states were chosen to provide a cross-section of specific results from various U.S. regions. Notice that the states of Vermont, West Virginia, Arkansas, Kentucky, Alabama, and North Dakota all rank within the top 11 among U.S. states in percentage of state population that live in rural areas, while South Carolina, Idaho, and Nebraska all rank within the top half of U.S. states in percentage of rural population.

Table 4.1 Rural State Statistics

State	State's Total Population	Rural Population	Percent Rural Population	Percent Rural Population Rank
Vermont	625,741	382,356	61%	2
West Virginia	1,852,994	950,184	51%	3
Arkansas	2,915,198	1,278,329	44%	6
Kentucky	4,339,367	1,806,024	42%	8
Alabama	4,779,736	1,957,932	41%	9
North Dakota	672,591	269,719	40%	11
South Carolina	4,625,364	1,557,555	34%	18
Idaho	1,567,582	461,212	29%	22
Nebraska	1,826,341	490,655	27%	24
New Mexico	2,059,179	464,818	23%	31

U.S. Census (2010)

4.1 State Level Operating Expenses per Trip Analysis

Table 4.2 shows the operating expenses, passenger trips, and the average operating expense per trip for rural demand-response trips by transit agencies in 2018 for the 10 states studied. Notice that operating expenses in Kentucky were more than twice the level compared with those in any other state at more than $50 million, and that Kentucky passenger trips were twice as high as any other state as well with over two million trips given. Arkansas had the second highest operating costs followed by Vermont and Alabama, respectively. Alabama had the second highest amount of passenger trips behind Kentucky at just over one million trips followed by Arkansas and Vermont. Considering average operating expenses by trip, Vermont had the largest cost at $26.59 per trip followed by West Virginia and Vermont. Alabama had the lowest operating expense per trip at $9.92 followed by New Mexico and Nebraska. The operating expense per trip ratio is quite easy to understand compared with either operating expenses calculated by mile or hour, as most understand that a trip consists of a rider boarding a vehicle at a given location and exiting the same vehicle at a different location. However, due to significant differences in both trip length and time, this measure has significant volatility as highlighted by Table 4.2.

Table 4.2 2018 State Operating Expenses per Trip

State	Total Operating Expenses	Total Passenger Trips	Operating Expense per Trip
Kentucky	$50,510,086	2,134,506	$23.66
Arkansas	$19,658,038	872,498	$22.53
Vermont	$16,917,921	636,293	$26.59
Alabama	$10,061,209	1,014,610	$9.92
Nebraska	$9,182,417	619,927	$14.81
North Dakota	$8,146,780	457,423	$17.81
South Carolina	$8,138,200	443,644	$18.34
West Virginia	$4,793,793	181,604	$26.40
New Mexico	$3,358,013	246,989	$13.60
Idaho	$1,260,230	72,645	$17.35

The North Dakota average operating expense per trip is compared to increased isolation-related Medicare costs per person in Figure 4.2. All costs are analyzed on a monthly per-person basis. Isolation Medicare costs were considered at three different levels, including 50%, 75%, and 100% of total isolation Medicare costs. These cost levels highlight the feasibility of increased mobility through greater rural demand-response transit use. For example, if an average potential isolated rider takes five transit trips in a month, the cost of providing these trips from a transit agency perspective will be approximately $80 and nearly equal to 50% of increased isolation-related Medicare costs. However, if the same rider was to take 10 trips or more per month, the cost of providing the trips would be greater than the overall isolation Medicare costs, and so it is not cost-effective to provide 10 or more trips per month based solely on Medicare costs. Therefore, as long as the total cost of providing trips per month, nine or fewer is this example, is less than the total increased isolation Medicare costs per month, it can be cost-effective to provide such service. Once the service provided becomes costlier than the Medicare cost it is designed to lessen, it becomes counterproductive financially based solely on isolation Medicare costs.

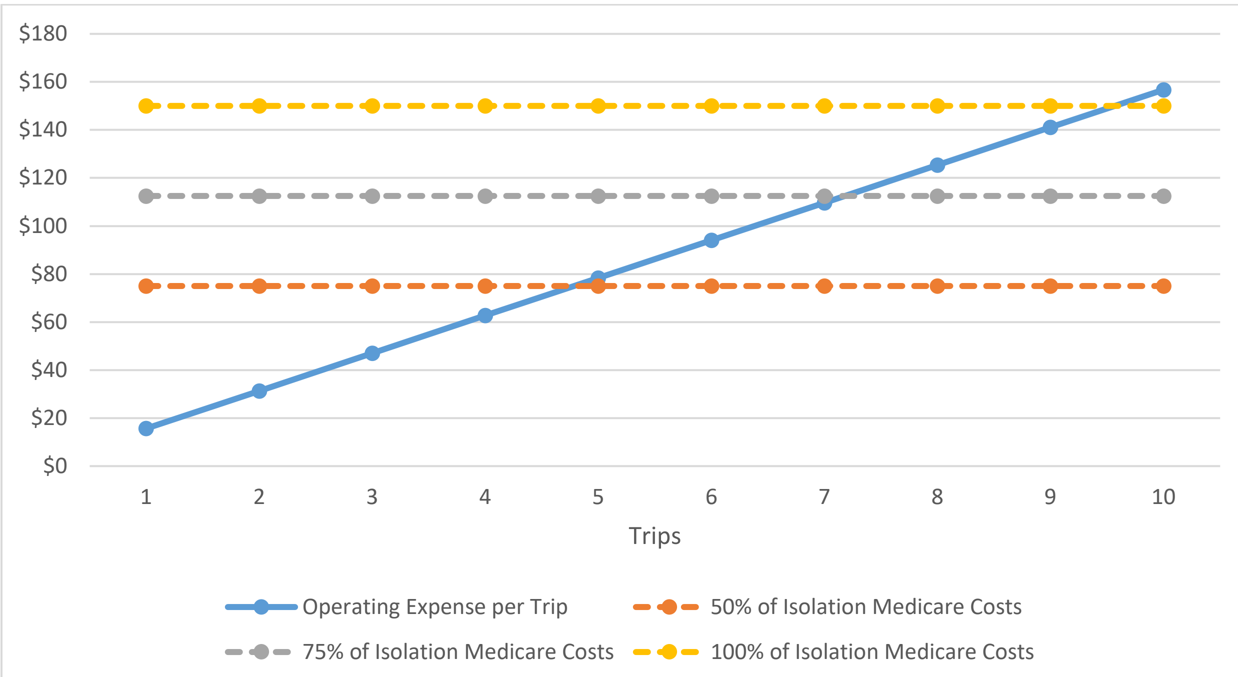


Figure 4.2 North Dakota Average Operating Expenses per Trip versus Isolation Medicare Costs

Figure 4.3 shows the state of Arkansas's average operating expense per trip versus isolation Medicare costs per person. Compared with North Dakota, their average costs per trip are higher and therefore they cannot provide as many trips to potential isolated riders and remain cost-effective. At the 50% Medicare cost level, for example, they can only provide three rides per month and no more than seven total rides per month at the 100% level of isolation Medicare costs where the service is no longer cost-effective based solely on total isolation-related Medicare costs per month.

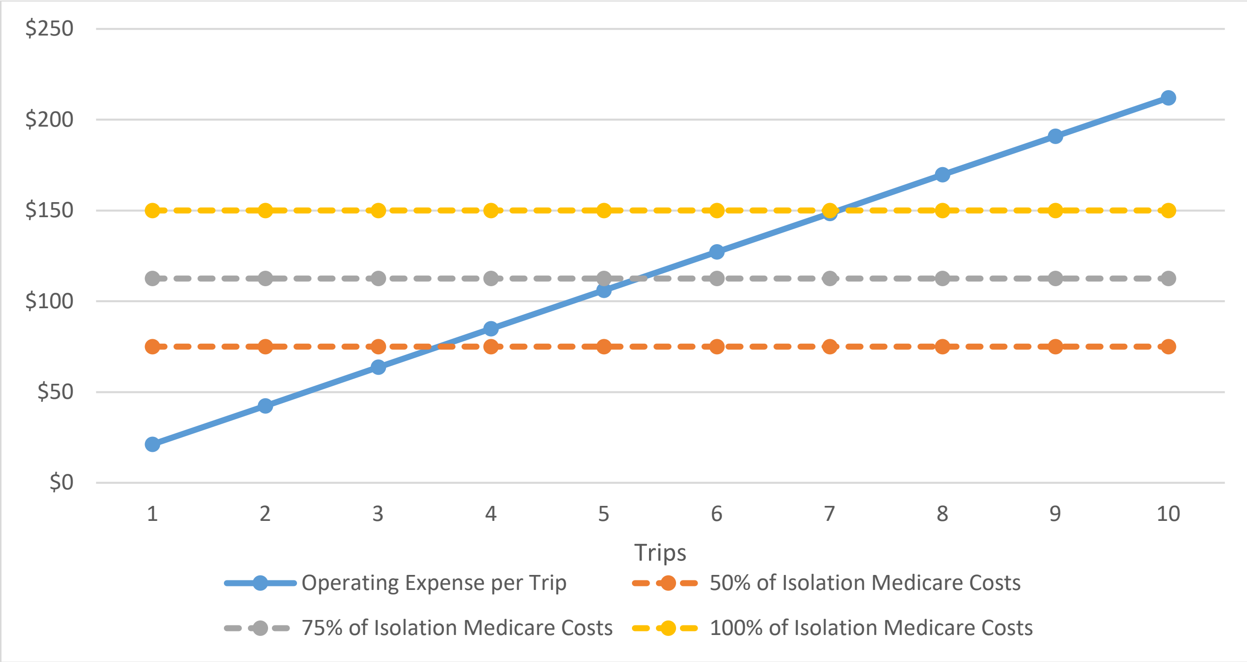


Figure 4.3 Arkansas Average Operating Expense per Trip versus Isolation Medicare Costs

Input data for @Risk simulations run on operating expense per trip data are defined in Table 4.3 and results are illustrated in Figure 4.4. These simulations assumed seven trips would be taken per individual each month for the three states of North Dakota, Idaho, and Arkansas. Seven monthly trips per rider was chosen as it represented the average cost equal to 75% of isolation-related Medicare costs, thus representing the midpoint for the estimates. Trip costs were calculated by subtracting the passenger fare from the total trip cost to show the total cost borne by the transit agency. The chosen probability distributions were based on best fit analysis within @Risk. Results show that 75% of the simulated operating expenses were at or below the 100% level of isolated Medicare costs for Idaho, while nearly 68% for North Dakota and approximately 50% for Arkansas were below this same level. Arkansas showed the most variability compared with both Idaho and North Dakota illustrated by the steeper line representing its costs. Idaho had the lowest level of variability among the three states, but showed higher costs at the median compared with North Dakota. North Dakota's costs were also lower than Idaho's at the 25% level, but higher at the 75% level due to its greater variability compared with Idaho overall. The variability is shown by the greater values of the standard deviations in Table 4.3.

Table 4.3 Trip Cost Simulation Inputs

	Operating Expense/Trip		Passenger Fare/Trip		
State	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**	**Probability Distribution**
North Dakota	$17.94	$12.73	$2.26	$1.16	Extreme Value
Idaho	$17.42	$6.49	$0.30	$0.25	Exponential
Arkansas	$22.53	$14.12	$1.33	$2.66	Logistic

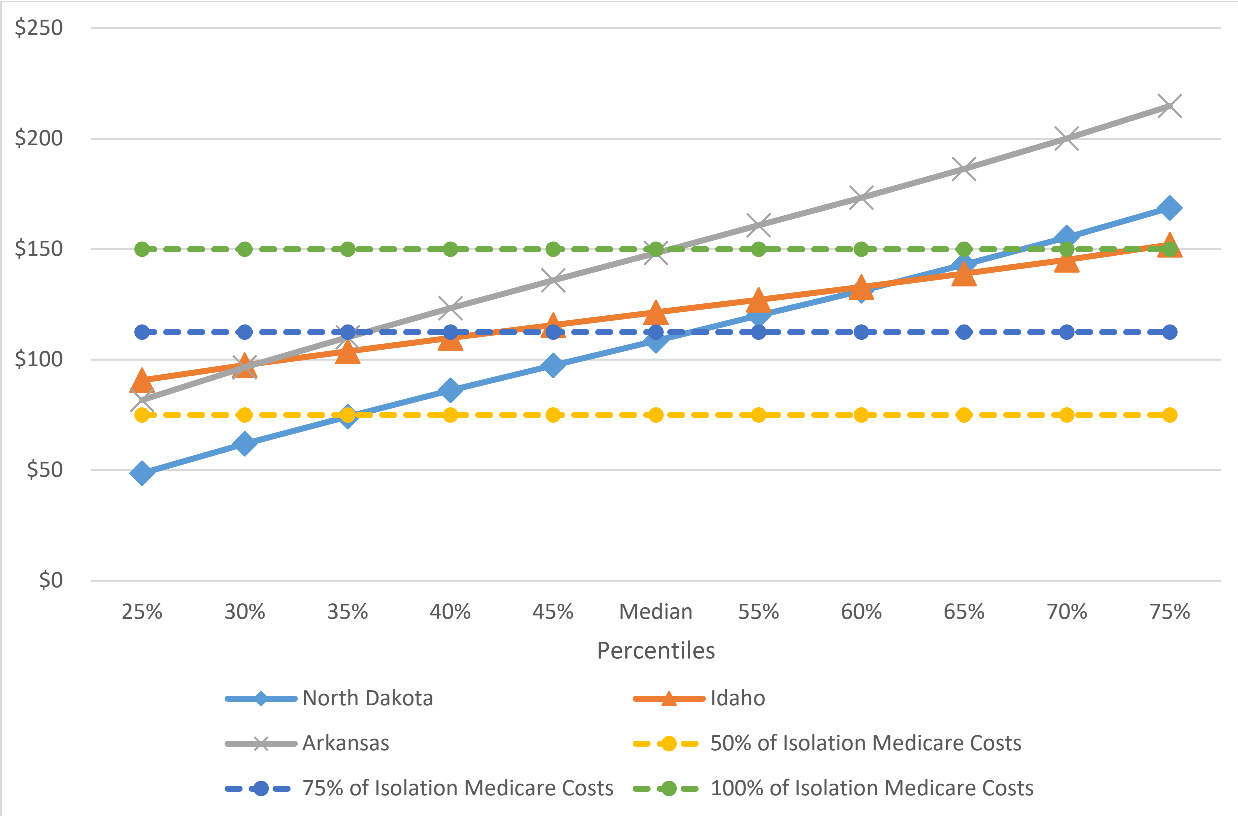


Figure 4.4 Simulation Costs for Seven Trips Compared to Isolation Medicare Costs

4.2 State Level Operating Expense per Vehicle Mile Analysis

Table 4.4 shows the operating expenses, vehicle revenue miles, and the average operating expense per vehicle revenue mile for rural demand-response trips by transit agencies in 2018 for the 10 states studied. Kentucky had more than twice the amount of vehicle revenue miles than any other state with 27,350,705 vehicle revenue miles. They were followed by Vermont and Arkansas with more than 12 million miles each. Idaho had the highest average operating expense per vehicle revenue mile at $4.30. New Mexico, North Dakota, and Nebraska all had average operating expenses per vehicle revenue mile greater than $3.00, while Vermont's ratio was the lowest at $1.35 per vehicle revenue mile.

Table 4.4 2018 State Operating Expenses per Vehicle Revenue Mile

State	Total Operating Expenses	Total Vehicle Revenue Miles	Operating Expense per Vehicle Revenue Mile
Kentucky	$50,510,086	27,350,705	$1.85
Arkansas	$19,658,038	12,108,146	$1.62
Vermont	$16,917,921	12,543,760	$1.35
Alabama	$10,061,209	3,584,417	$2.81
Nebraska	$9,182,417	2,982,030	$3.08
North Dakota	$8,146,780	2,606,498	$3.13
South Carolina	$8,138,200	4,816,594	$1.69
West Virginia	$4,793,793	1,679,294	$2.85
New Mexico	$3,358,013	984,928	$3.41
Idaho	$1,260,230	293,374	$4.30

The Nebraska average operating expense per vehicle mile is compared to isolation Medicare costs in Figure 4.5. Nebraska rural transit agencies can provide approximately 40 miles per passenger of additional monthly service equaling the 75% isolation Medicare cost level per person. Once agencies exceed the 55 miles per month threshold, it is no longer feasible for them to provide service based solely on isolation Medicare costs as transit costs would exceed monthly isolation Medicare costs. Figure 4.6 illustrates the same vehicle revenue mile measurement for the state of Kentucky. Notice that because Kentucky's average operating expense per vehicle revenue mile is considerably less than that of Nebraska, they can provide up to 60 miles of additional service per month on average for each isolated resident at the same 75% level. This is largely due to Kentucky's average vehicle miles per trip being nearly 13 miles while Nebraska's average vehicle miles per trip is less than five miles. Because of this, Kentucky's rural transit providers are able to lower their cost per mile by driving substantially more miles per trip on average and lowering the overall cost per vehicle mile as a result.

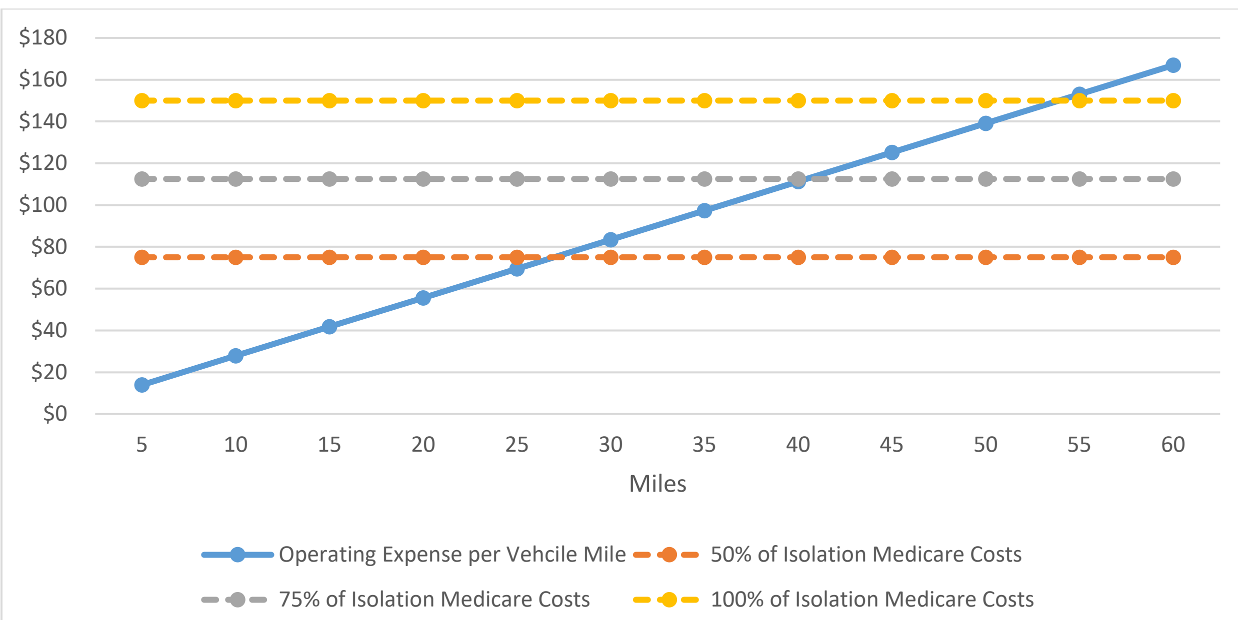


Figure 4.5 Nebraska Average Operating Expense per Vehicle Revenue Mile versus Isolation Medicare Costs

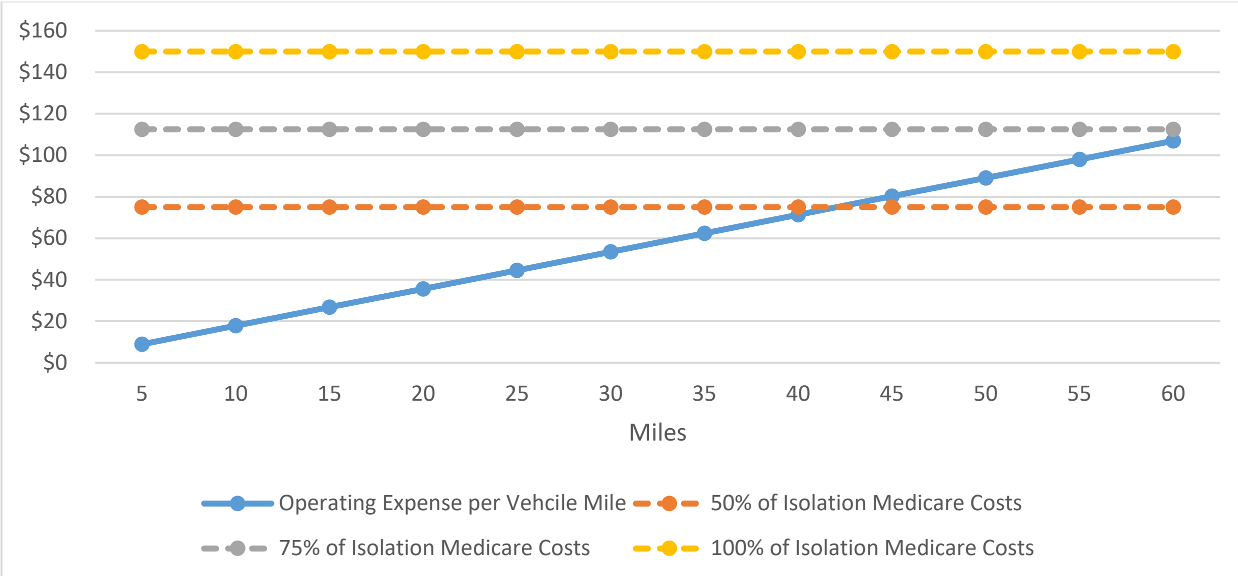


Figure 4.6 Kentucky Average Operating Expense per Vehicle Revenue Mile versus Isolation Medicare Costs

Table 4.5 shows the input data and Figure 4.7 shows operating expense per vehicle revenue mile @Risk Simulation results. These simulations assumed an additional 40 miles of service would be added monthly per isolated rider for the states of Kentucky, Vermont, and New Mexico. Forty miles was chosen as it represented the midpoint for average cost per vehicle revenue mile at the 75% isolation Medicare costs level for most states. Mileage costs were calculated by subtracting the passenger fares per mile from the operating expense per mile to show the total cost per mile borne by the transit agency. The chosen probability distributions were based on best fit analysis within @Risk. Results shown at the median level indicate that an increase of 40 vehicle revenue miles is feasible for rural transit agencies in Kentucky and Vermont, but not New Mexico, to remain below 75% of isolation related Medicare costs. This is because New Mexico's rural transit agencies' operating costs per vehicle revenue mile were two to nearly three times higher (Table 4.5) than those in Kentucky and Vermont. Using this measure, simulations showed that both Kentucky's and Vermont's costs per vehicle revenue mile would be less than the 75% level of isolation medical costs for all simulations illustrated in Figure 4.7. Operating expenses per vehicle revenue mile for both states being less than $2.00 per mile made this result possible.

Table 4.5 Mileage Simulation Inputs

	Operating Expense/Mile		**Passenger Fare/Mile**		
State	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**	**Probability Distribution**
Kentucky	$1.85	$0.64	$0.06	$0.14	Extreme Value
Vermont	$1.35	$0.48	$0.04	$0.06	Normal
New Mexico	$3.46	$1.10	$0.29	$0.87	Normal

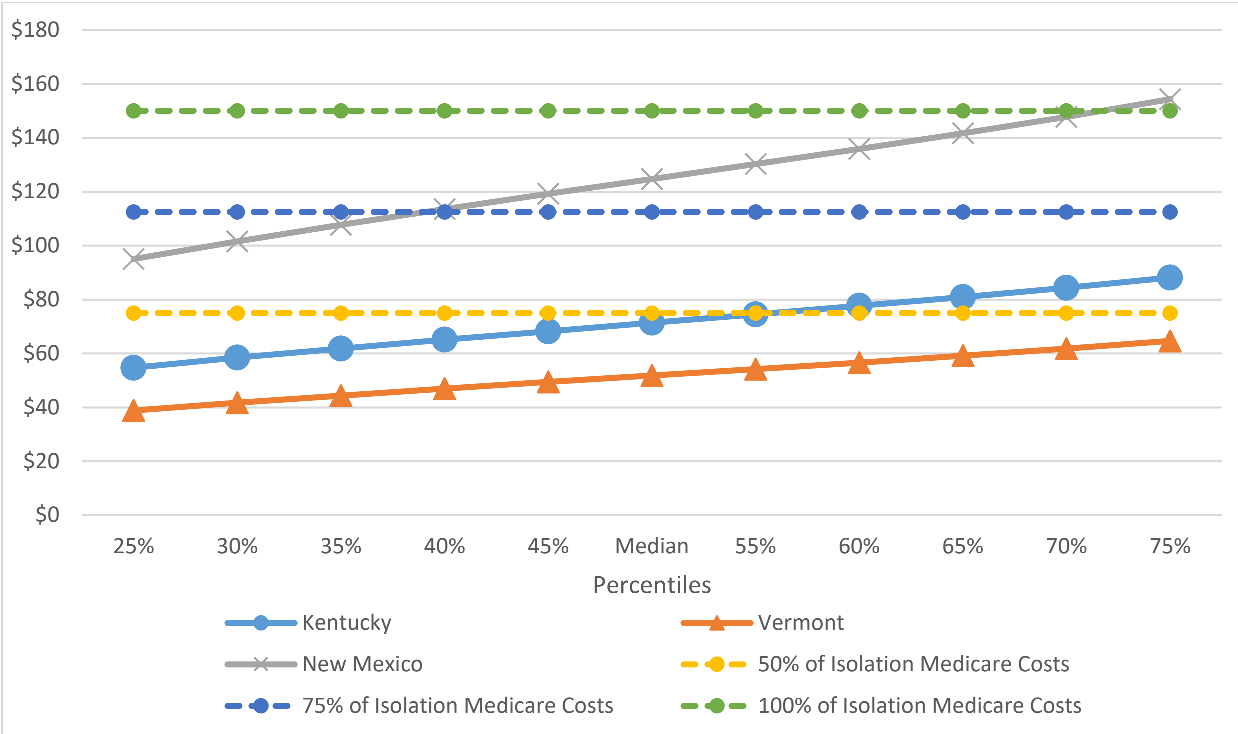


Figure 4.7 Simulation Costs for 40 Miles of Service Compared to Isolation Medicare Costs

4.3 State Level Operating Expense per Vehicle Hour Analysis

Table 4.4 shows the operating expenses, vehicle revenue hours, and the average operating expense per vehicle revenue hour for rural demand-response trips by transit agencies in 2018 for the 10 states studied. Notice Kentucky nearly tripled all the other states with 1,541,254 vehicle revenue hours. Arkansas and Vermont were again second and third with 632,466 and 395,201 vehicle revenue hours, respectively. Idaho had the highest average operating expense per vehicle revenue hour at $51.32 per hour followed by Alabama and New Mexico with $51.32 and $45.71 per vehicle revenue hour, respectively. The lowest average operating expense per vehicle revenue hour was from rural transit agencies in Arkansas at $31.08 per hour. They were followed by South Carolina and Kentucky, both showing operating expenses per vehicle revenue mile of less than $33.00 per hour.

Table 4.6 2018 State Operating Expense per Vehicle Revenue Hour

State	Total Operating Expenses	Total Vehicle Revenue Hours	Operating Expense per Vehicle Revenue Hour
Kentucky	$50,510,086	1,541,254	$32.77
Arkansas	$19,658,038	632,466	$31.08
Vermont	$16,917,921	395,201	$42.81
Alabama	$10,061,209	197,317	$50.99
Nebraska	$9,182,417	205,387	$44.71
North Dakota	$8,146,780	184,423	$44.17
South Carolina	$8,138,200	257,541	$31.60
West Virginia	$4,793,793	108,143	$44.33
New Mexico	$3,358,013	73,465	$45.71
Idaho	$1,260,230	24,558	$51.32

Figure 4.8 shows the average operating expense per vehicle revenue hour compared with isolation Medicare costs for South Carolina. Rural transit agencies here can provide approximately four hours of additional transit service per month for an isolated aging adult at a cost equal to 75% of the Medicare costs that same aging adult would accrue due to isolation. Considering a lower level of additional isolation Medicare costs per aging adult, the average South Carolina rural transit agency could provide an additional two-and-a-half hours of service per month and still remain below the 50% isolation medical cost level. Figure 4.9 shows the same vehicle revenue hour ratio for the state of Vermont. Because average operating costs per vehicle revenue hour are more than $11 per hour higher in Vermont compared with South Carolina, rural transit agencies in Vermont will only be able to provide one-and-a-half to two hours of additional service per isolated aging adult at the 50% level and between two-and-a-half to three hours of service at the 75% level, respectively. This difference is due to total operating expenses in Vermont being more than double those in South Carolina, while their total vehicle revenue hours are approximately 50% more than those of South Carolina.

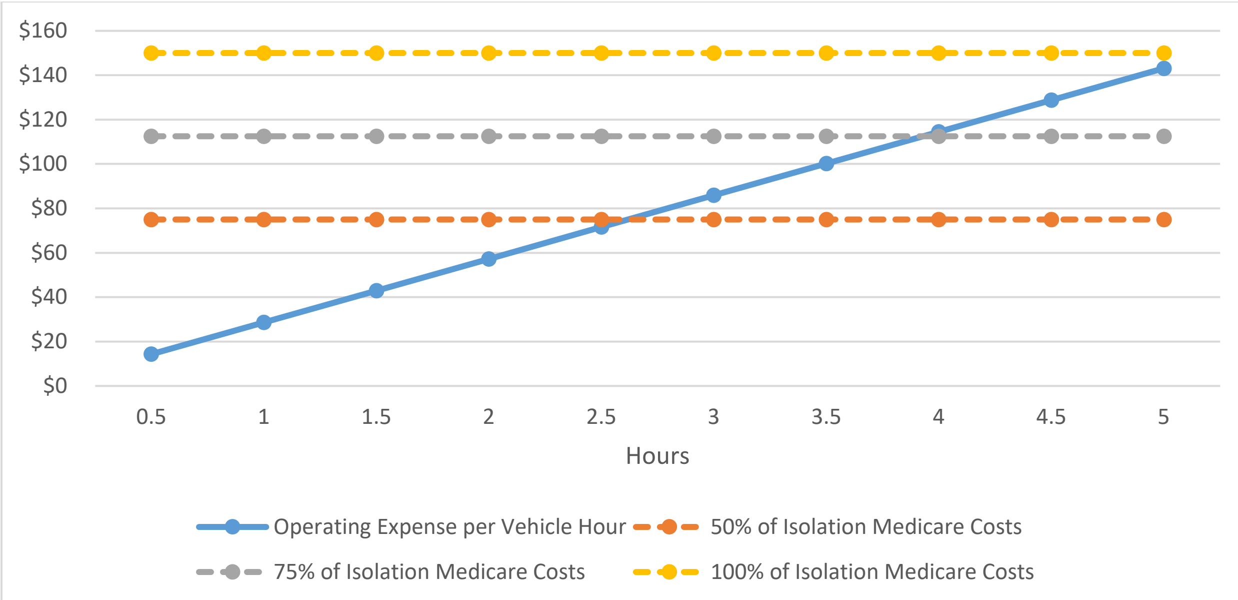


Figure 4.8 South Carolina Average Operating Expense per Vehicle Revenue Hour versus Isolation Medicare Costs

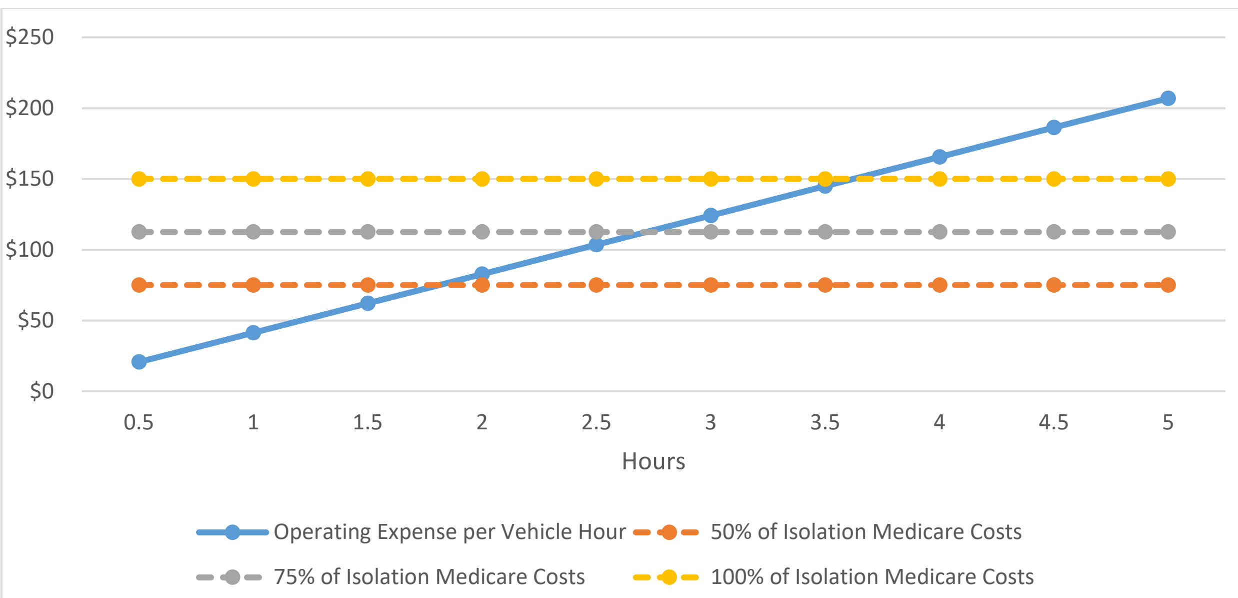


Figure 4.9 Vermont Average Operating Expense per Vehicle Revenue Hour versus Isolation Medicare Costs

Table 4.7 shows the input data, and Figure 4.10 shows operating expense per vehicle revenue hour @Risk simulation results. These simulations assumed an additional three hours of service would be added per isolated rider for the states of South Carolina, West Virginia, and Alabama. Three hours of additional service was chosen because it represented the mid-point for average costs per vehicle revenue hour at the 75% isolation Medicare costs for most states. Hourly costs were calculated by subtracting the passenger fare per hour from the operating expense per hour to show the total cost per hour borne by the transit agency. The chosen probability distributions were based on best fit analysis within @Risk. Results indicate that both South Carolina and West Virginia could remain below the 75% level of increased isolation Medicare costs at the median level, while Alabama could not. This was due to Alabama's operating cost per hour of vehicle revenue service being more than $6 higher than that of West Virginia and nearly $20 higher than that of South Carolina. Also, the variability of operating costs per vehicle revenue hour (shown by the standard deviations) was higher in both Alabama and South Carolina compared with West Virginia. This led to results at the 25% level being within $10 of each other when comparing Alabama with West Virginia, but more than $40 apart at the 75% level.

Table 4.7 Hourly Simulation Inputs

State	Operating Expense/Hour Mean	Operating Expense/Hour Standard Deviation	Passenger Fare/Hour Mean	Passenger Fare/Hour Standard Deviation	Probability Distribution
South Carolina	$31.66	$18.77	$2.97	$1.61	Exponential
Alabama	$51.15	$28.80	$3.92	$2.39	Extreme Value
West Virginia	$44.30	$11.53	$7.73	$4.52	Uniform

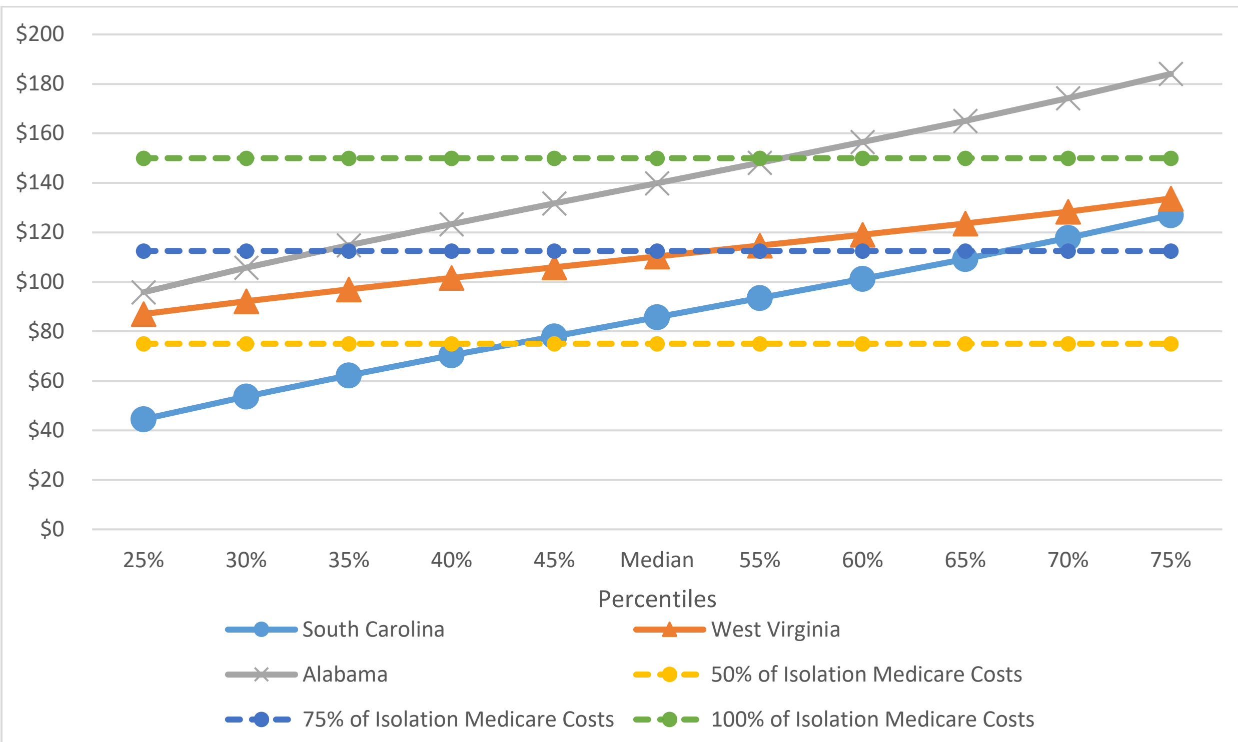


Figure 4.10 Simulation Costs for Three Hours of Additional Service Compared to Isolation Medicare Costs

4.4 Marketing to Attract Isolated Passengers

Increased marketing may be necessary to attract potential isolated passengers to their local rural demand responsive transit agency. The rule of thumb within rural transit is that a system should spend approximately 1% of its operating budget on marketing expenses, such as promotional materials and advertising. The goals and objectives of marketing should increase awareness of the service, educate the public regarding service and benefits, create a positive image, encourage ridership among new customers, and build support for the service within the local community (RTAP 2018).

Table 4.5 shows operating expenses, marketing expenses, and ridership goals based on data from rural agencies within the 10 states studied. For the purpose of this analysis, agencies with a $200,000 annual operating budget were classified as small, and agencies with a $1 million annual budget were classified as medium, while agencies with a $2 million annual budget were classified as large in terms of rural transit. Average annual ridership for agencies small, medium, and large was also based on similar agency ridership levels within the 10-state study region. The marketing budget increase is equal to 1% of the annual operating budget, thus doubling the marketing recommendation by RTAP (2018). This marketing increase focuses on aging adults 65 years old and older. The ridership increase goal was simulated to vary between a 5% to 10% increase while the isolated potential riders of this increase varied between 10% and 20%. This follows the AARP (2017) study, which found that approximately 14% of aging adults were socially isolated. These variables were allowed to fluctuate within the simulations representing the uncertainty of the increased marketing effort.

Table 4.8 Annual Operating Budget, Marketing Expenses, and Ridership Goals

Rural Agencies	Operating Budget	Average Annual Ridership	Marketing Budget Increase	Ridership Increase Goal (5%-10%)	Isolated Increase Goal (10%-20% of Ridership Goal)
Small	$200,000	11,900	$2,000	595-1,190	60-238
Medium	$1,000,000	68,200	$10,000	3,410-6,820	341-1,364
Large	$2,000,000	97,000	$20,000	4,850-9,700	485-1,940

Figure 4.11 illustrates the potential annual isolated ridership increases given the proposed marketing effort highlighted above. These ridership predictions were simulated to show their impact on isolated aging riders at various percentiles. Predictably, the large agency gained the greatest number of new isolated rides while the small agency gained the fewest new rides. The medium sized agency gained between 300 and 1,200 new isolated rides while the small agency gained between 30 and 250 isolated rides, respectively. The large agency's total isolated ride increases were between 400 and 1,700 rides.

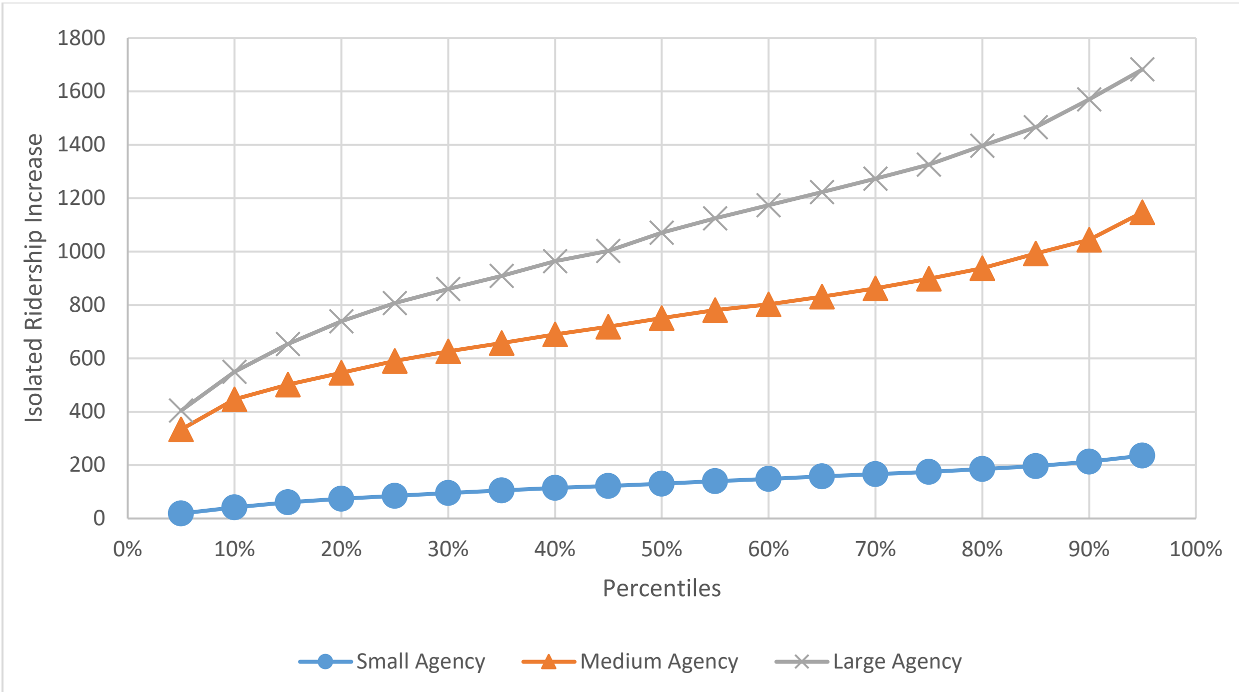


Figure 4.11 Potential Annual Isolated Ridership Increase from Marketing Effort

Simulations run for small, medium, and large agencies that include the increased marketing effort are shown in Figure 4.12. This illustrates the effect of the increased cost and ridership due to the potential marketing effort with respect to operating costs per trip. All simulations were run on a monthly basis to be consistent with previous analyses. The vertical axis shows operating costs and marketing costs together. Seven monthly trips per rider was chosen as it represented the closest average monthly cost per trip to 75% of isolation related medical costs per aging adult for most states, which represented the midpoint for the estimates. Results indicate that at the median level, both the small and medium sized agencies' costs are less than 75% of the isolation medical costs while the large agency falls between the 75% and 100% level. The small agency costs are more variable compared with the other two as they are almost equal to the medium agency at the 10% level and the large agency at the 100% level. This is represented by a steeper curve compared with the other two. The medium agency variability was the lowest among the three while the large agency variability was less than that of the small agency, but greater than the variability of the medium agency. At the 90% level, both the small and large agency costs are greater than the total isolation medical costs for the average isolated aging adult, showing that it is no longer cost effective for seven rides per month to be given to a potential isolated rider at this level. The medium sized agency simulation costs stayed approximately at or below the 75% level of isolated medical costs per aging adult for all simulations ran.

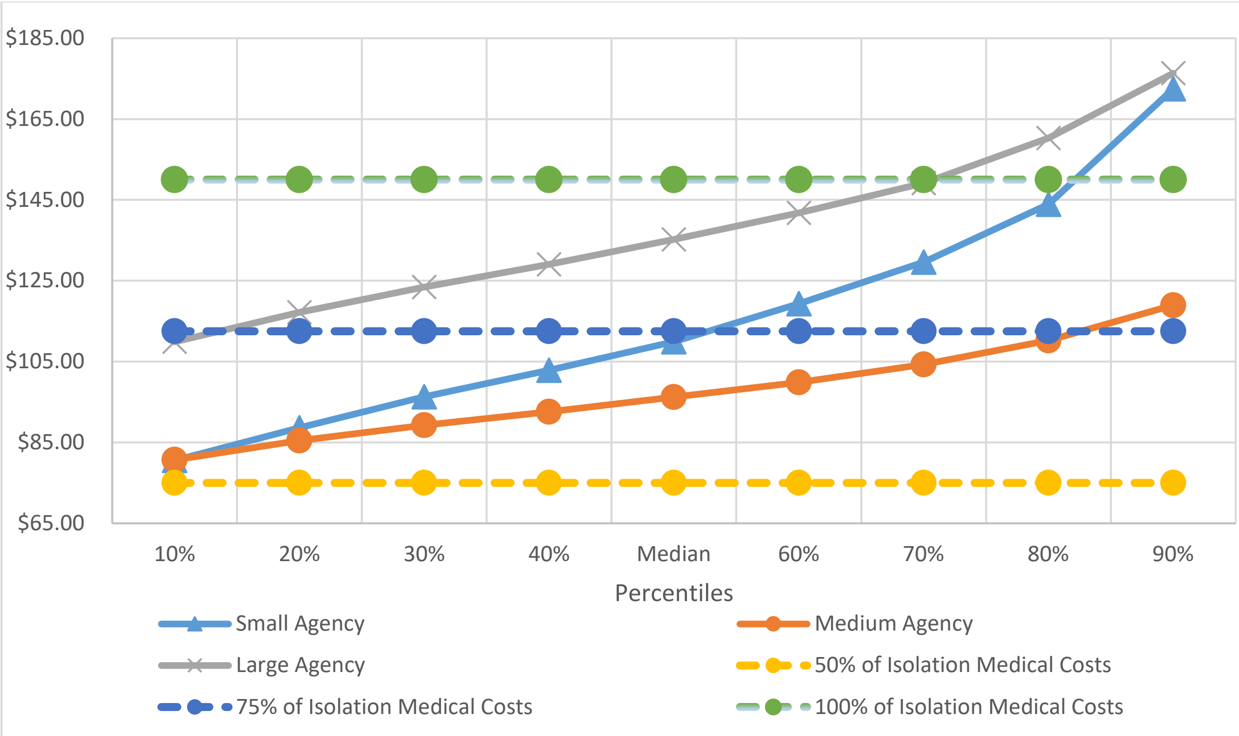


Figure 4.12 Increased Marketing Simulation Costs for Seven Trips versus Isolation Medical Costs

4.5 Summary

The main objective of this chapter was to compare the cost of increased Medicare expenses among aging adults in rural areas due to isolation to the cost of added mobility to lessen isolation by local rural transit agencies. Results for the states studied showed that from three to 10 trips per month could be provided to an isolated individual at a cost less than the extra Medicare costs due to isolation. Also, an extra 25 to approximately 80 miles of service can be provided to an isolated aging adult per month for the states studied. Finally, from two to six hours of service can be provided to an isolated aging adult per month at costs equal to or less than the monthly Medicare costs due to isolation. A marketing plan designed to target potential aging and isolated riders showed that the simulated cost of seven monthly trips per passenger would be feasible for small, medium, and large agencies at the median level, and that all simulations yielded cost-effective results for medium sized agencies when added marketing and operating costs were included in the simulations.

5. SUMMARY AND KEY FINDINGS

The objectives of this study were to quantify the added Medicare costs due to isolation among aging adults, and to compare those to the cost of added mobility to lessen isolation by local rural transit agencies. Average cost analysis from a transit perspective was conducted using three ratios, including operating costs per trip, operating costs per vehicle revenue mile, and operating costs per vehicle revenue hour. Simulation allowed these three cost ratios to vary, which yielded a range of outcomes. This gives rural transit agencies the ability to compare their unique circumstances to a range of results rather than a single scenario or value.

Key Finding #1: Rural transit agencies can cost effectively provide service to lower isolation-related Medicare costs among aging adults. For example, based on the isolation benefit alone, rural North Dakota transit agencies can provide up to nine demand response transit rides per month to an isolated aging adult for less than the added Medicare cost of being isolated. These rides would allow the aging adult to visit friends and family, attend local functions, or participate in a variety of other activities within their local community each month, leading to lower isolation and lessened medical costs.

Key Finding #2: The current COVID pandemic has increased isolation among aging adults, which will lead to greater isolation medical costs in the future. Wu (2020) found that social isolation is likely to become a major risk factor that affects adults' health outcomes. Rural transit can lessen this increased isolation by increasing ridership among isolated aging adults. For example, based on the marketing to aging adults' simulations in this study, the average small, medium, and large rural transit agency within the study's 10-state region can cost effectively provide an additional seven trips per month per isolated aging adult at the median level.

Key Finding #3: Rural transit's role to help lower Medicare costs through lessening isolation needs to be considered as Americans live longer and demand greater mobility options. Average U.S. life expectancy increased from 68 years in 1950 to 78.6 years in 2017, in large part due to the reduction in mortality at older ages. This larger share of older adults also means that Social Security and Medicare expenditures will increase from a combined 8.7% of gross domestic product today to 11.8% by 2050 (Social Security Administration 2019). Rural transit will continue to play a considerable role in lessening these costs through added service as long as they are properly funded.

Key Finding #4: Increased funding for rural transit will be necessary as rural communities continue to age disproportionately with the younger population moving to larger communities. Transit will need to serve as a transportation lifeline for many aging adults whose support networks of friends and family no longer reside in their local community (Stonegate Senior Living 2018).

BIBLIOGRAPHY

AARP. (2017). "Medicare Spends More on Socially Isolated Older Adults." AARP Public Policy Institute. Insight on the Issues No. 125.

Alsnih, R., and Hensher, D. A. (2003). "The mobility and accessibility expectations of seniors in an aging population." *Transportation Research Part A: Policy and Practice*. Volume 37, Issue 10, 903-916.

Banister, D., and Bowling, A. (2004). "Quality of life for the elderly: the transport dimension." *Transport Policy*. Volume 11, Issue 2, pp. 105-115.

Cass, N., Shove, E., and Urry, J. (2005). "Social Exclusion, Mobility and Access." *The Sociological Review*, 53(3), pp. 539-555.

Chudyk, A. M., Winters, M., Moniruzzaman, M., Ashe, M. C., Sims-Gould, J., and McKay, H. (2015). "Destinations matter: The association between where older adults live and their travel behavior." *Journal of Transport and Health*. Volume 2, Issue 1, pp. 50-57.

Cloutier-Fisher, D., Kobayashi, and K., Smith, A. (2011). "The subjective dimension of social isolation: A qualitative investigation of older adults' experiences in small social support networks." *Journal of Ageing Studies*. Volume 25, Issue 4, pp. 407-414.

Consumer Price Index. (2020). U.S. Bureau of Labor Statistics, Division of Consumer Prices and Price Indexes, Accessed December, 2020. https://www.bls.gov/cpi/.

Dalmer, N. K. (2019). "A logic of choice: Problematizing the documentary reality of Canadian aging in place policies." *Journal of Aging Studies*. Volume 48, pp. 40-49.

Frank, S., Berk, S., Hernandez, L., Hogarth, P., Shill, H. A., Siddiqi, B., and Simon, D. K. (2019). "Transportation innovation to aid Parkinson disease trial recruitment." *Contemporary Clinical Trials Communications*. Volume 16.

Gavin, Kara. (2020). "Loneliness Doubled for Older Adults in First Months of COVID-19." University of Michigan Health Lab. Accessed December, 2020. https://labblog.uofmhealth.org/rounds/loneliness-doubled-for-older-adults-first-months-of-covid-19.

He, S. Y., Cheung, Y. H. Y., and Tao, S. (2018). "Travel mobility and social participation among older people in a transit metropolis: A socio-spatial-temporal perspective." *Transportation Research Part A: Policy and Practice*. Volume 118, pp. 608-626.

Hui, E. C. M., Wong, F. K. W., Chung, K. W., and Lau, K. Y. (2014). "Housing affordability, preferences and expectations of elderly with government intervention." *Habitat International*. Volume 43, pp. 11-21.

Mackett, R. (2015). "Improving accessibility for older people – Investing in a valuable asset." *Journal of Transportation and Health*. Volume 2, Issue 1, pp. 5-13.

Mattson, Jeremy. (2020). "Measuring the Economic Benefits of Rural and Small Urban Transit Services in Greater Minnesota." Minnesota Department of Transportation, Report 2020-10.

Murray, L. (2015). "Age-friendly mobilities: A transdisciplinary and intergenerational perspective." *Journal of Transport and Health*. Volume 2, Issue 2, pp. 302-307.

Nordbakke, S. (2013). "Capabilities for mobility among urban older women: barriers, strategies, and options." *Journal of Transport Geography*. Volume 26, pp. 166-174.

O´Hern, S., and Oxley, J. (2015). "Understanding travel patterns to support safe active transport for older adults." *Journal of Transport and Health*, Volume 2, Issue 1, pp. 79-85.

Plazinić, B. R., and Jović, J. (2018). "Mobility and transport potential of elderly in differently accessible rural areas." *Journal of Transport Geography*. Volume 68, pp. 169-180.

Peterson, Del, and Ted Rieck. (2017). "Aging in Place in Small Urban and Rural Communities." SURLC 17-006. Montana State University, Bozeman: Small Urban and Rural Livability Center.

Raeside, R., Li, H., Chen, T., and McQuaid, R. W. (2012). "Population ageing, gender and the transportation system." *Research in Transportation Economics*. Volume 34, Issue 1, pp. 39-47.

Rajé, F. (2007). *Negotiating the Transport System. User Contexts, Experiences and Needs.*

Ryan, J., Wretstrand, A., and Schmidt, S. M. (2015). "Exploring public transport as an element of older persons´ mobility: A Capability Approach perspective." *Journal of Transport Geography*. Volume 48, pp. 105-114.

RTAP. (2018). Developing a Marketing Plan. Rural Transit Assistance Program, Federal Transit Administration, U.S. Department of Transportation. Washington, D.C.

Rural Transit Database. (2018). Rural Transit Database, The National Transit Database, Federal Transit Administration. Washington, D.C. https://www.transit.dot.gov/ntd.

Shaw, Jonathan, Monica Farid, Claire Noel-Miller, Neesha Joseph, Ari Houser, Steven M. Asch, Jay Bhattacharya, and Lynda Flowers. (2017). "Social Isolation and Medicare Spending: Among Older Adults, Objective Social Isolation Increases Expenditures while Loneliness Does Not." *Journal of Aging Health*, Volume 29, Issue 7, pp. 1119-1143.

Sixsmith, A., and Sixsmith, J. (2008). "Ageing in Place in the United Kingdom." *Ageing Int*. 32, pp. 219-235.

Social Security Administration. (2019). Research, Statistics, and Policy Analysis. Social Security Administration, Washington, D.C. https://www.ssa.gov/policy/index.html.

Stonegate Senior Living. (2018). "One is the Loneliest Number: Combating Senior Isolation." Stonegate Senior Living, LLC. https://stonegatesl.com/one-is-the-loneliest-number-combating-senior-isolation/.

University of Michigan. (2020). National Poll on Healthy Aging. University of Michigan. Accessed December, 2020. https://www.healthyagingpoll.org/.

U.S. Census (2018). State Population by Characteristics. U.S. Census Bureau, Washington, D.C. https://www.census.gov/data/tables/time-series/demo/popest/2010s-state-detail.html.

Van der Pas, S., Ramklass, S., O´Leary, B., Anderson, S., Keating, N., Cassim, B. (2015). Features of Home and Neighborhood and the Liveability of Older South Africans. European Journal of Ageing. Volume 12, pp. 215-227.

Vanleerberghe, P., De Witte, N., Claes, C., Verté, D. (2019). The association between frailty and quality of life when aging in place. Archives of Gerontology and Geriatrics. Volume 85.

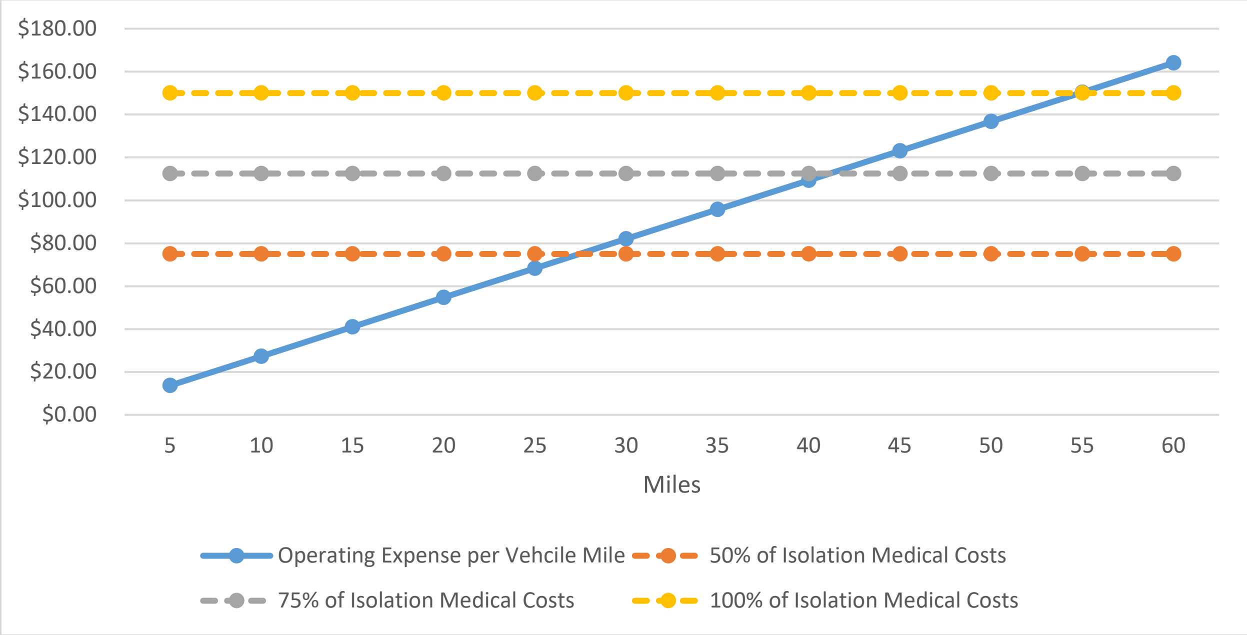
WHO. (2015). World Report on Ageing and Health. World Health Organization. Available at: https://www.who.int/publications/i/item/world-report-on-ageing-and-health.

Wiles, J. L., Leibing, A., Guberman, N., Reeve, J., Allen, R. E. S. (2011). The Meaning of "Aging in Place" to Older People. The Gerontologist. Volume 52, No. 3, pp. 357-366.

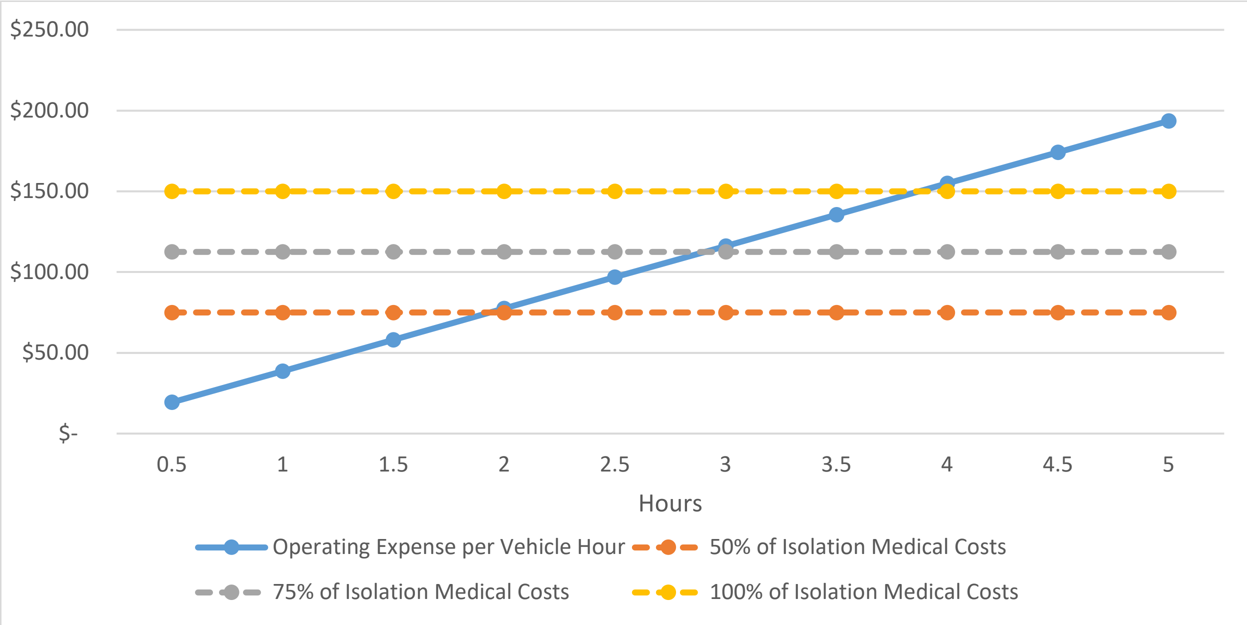
Wu, Bei. (2020). Social Isolation and Loneliness Among Older Adults in the Context of COVID-19: a Global Challenge. Global Health Research and Policy. Volume 5, No. 27.

APPENDIX

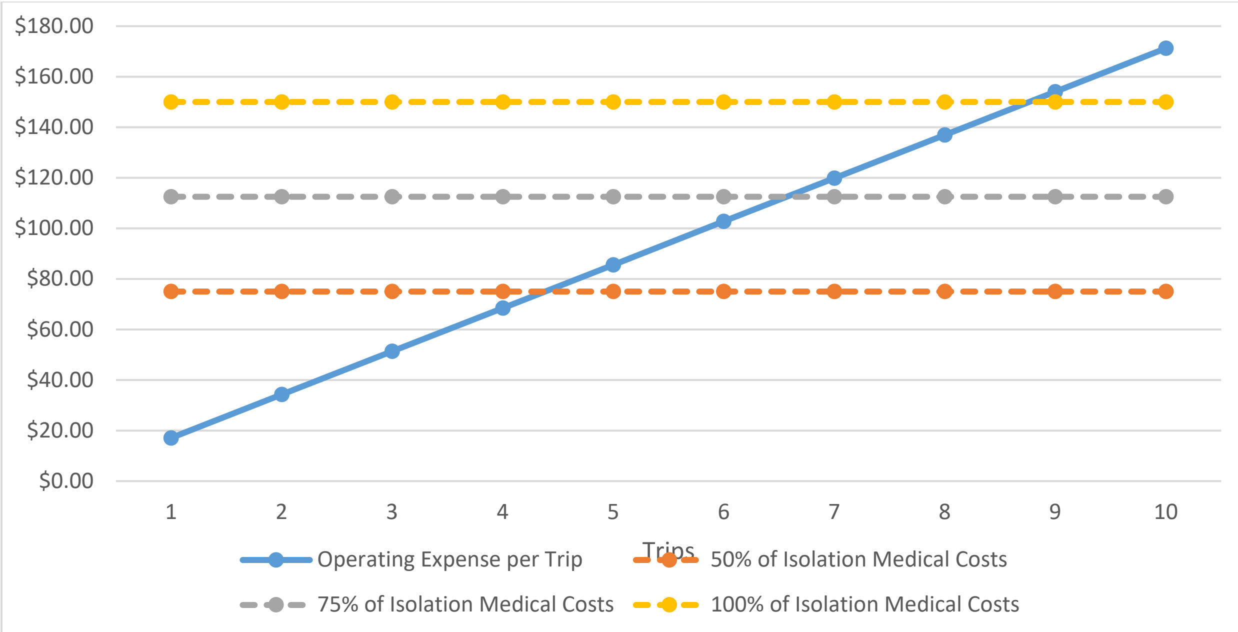
Cost Ratios by State Compared to Isolation Medicare Costs



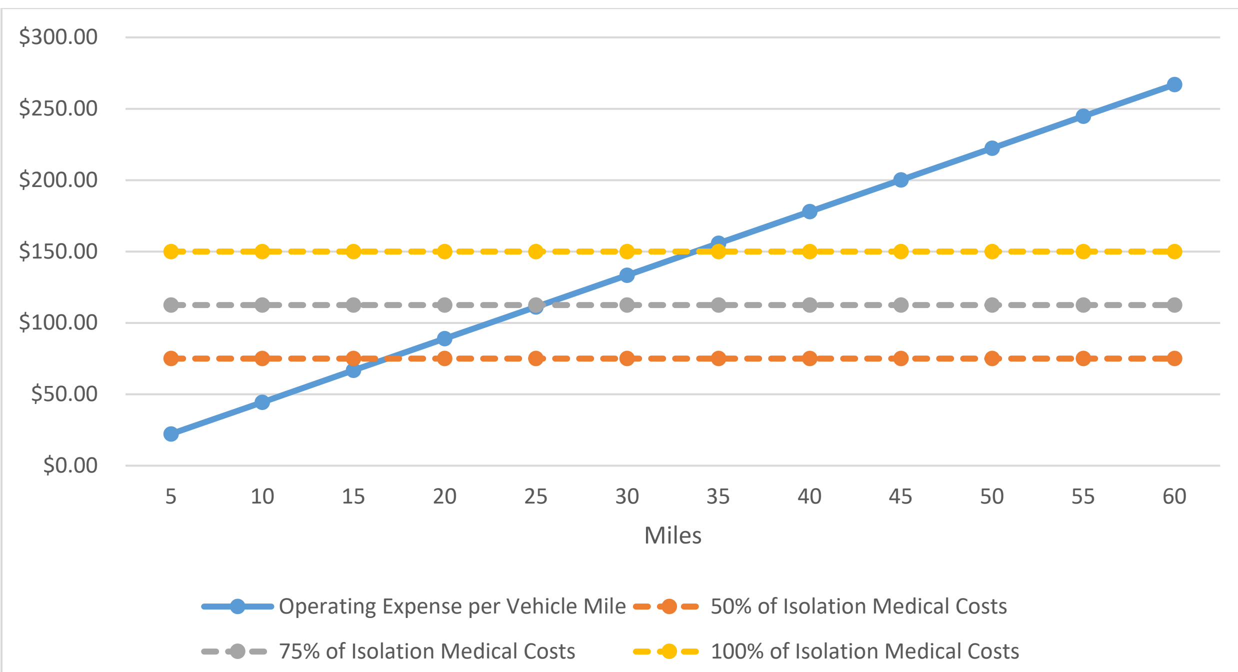
North Dakota Average Operating Expense per Vehicle Revenue Mile Compared to Isolation Medicare Costs



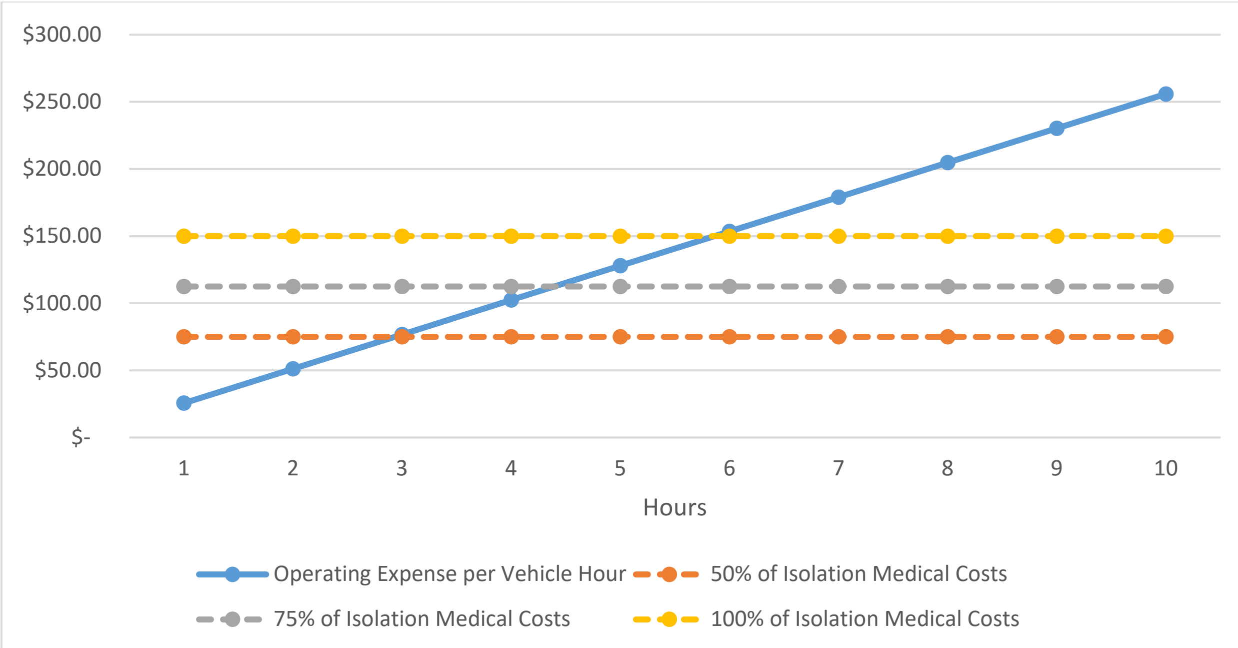
North Dakota Average Operating Expense per Vehicle Revenue Hour Compared to Isolation Medicare Costs



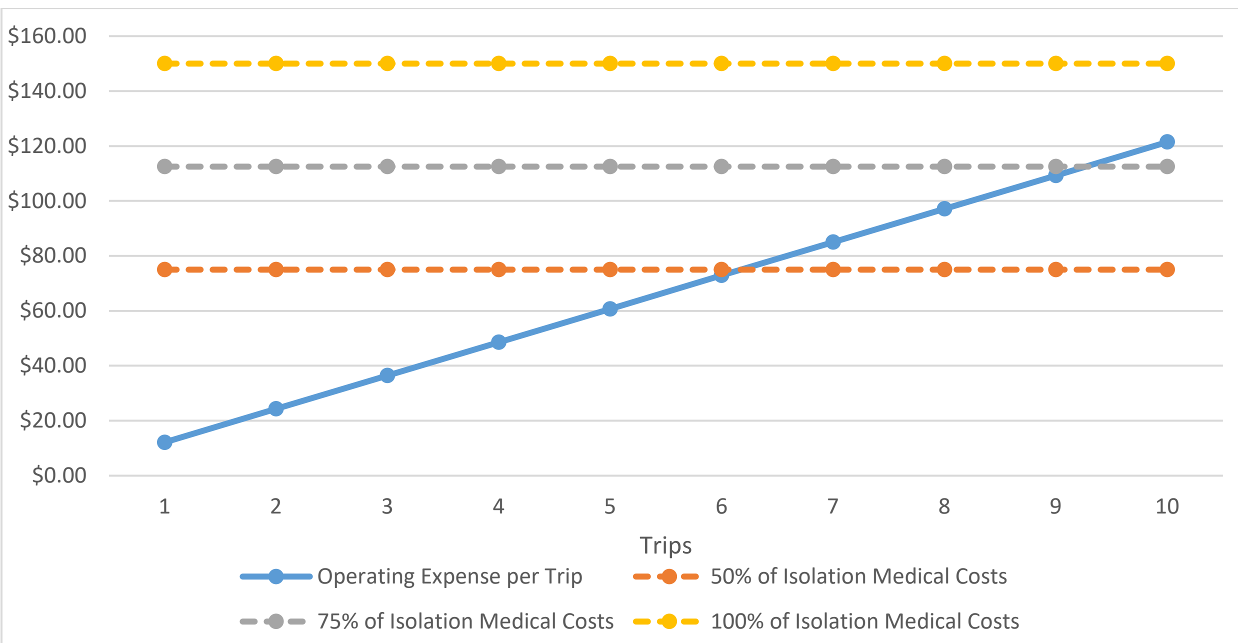
Idaho Average Operating Expense per Trip Compared to Isolation Medicare Costs



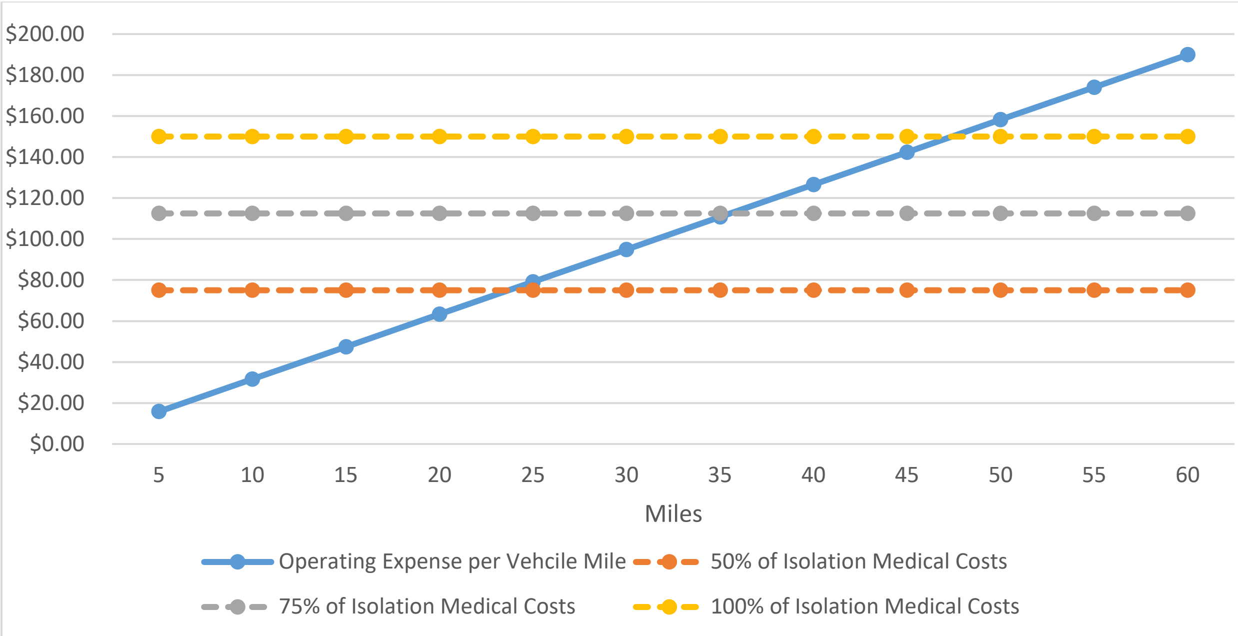
Idaho Average Operating Expense per Vehicle Revenue Mile Compared to Isolation Medicare Costs



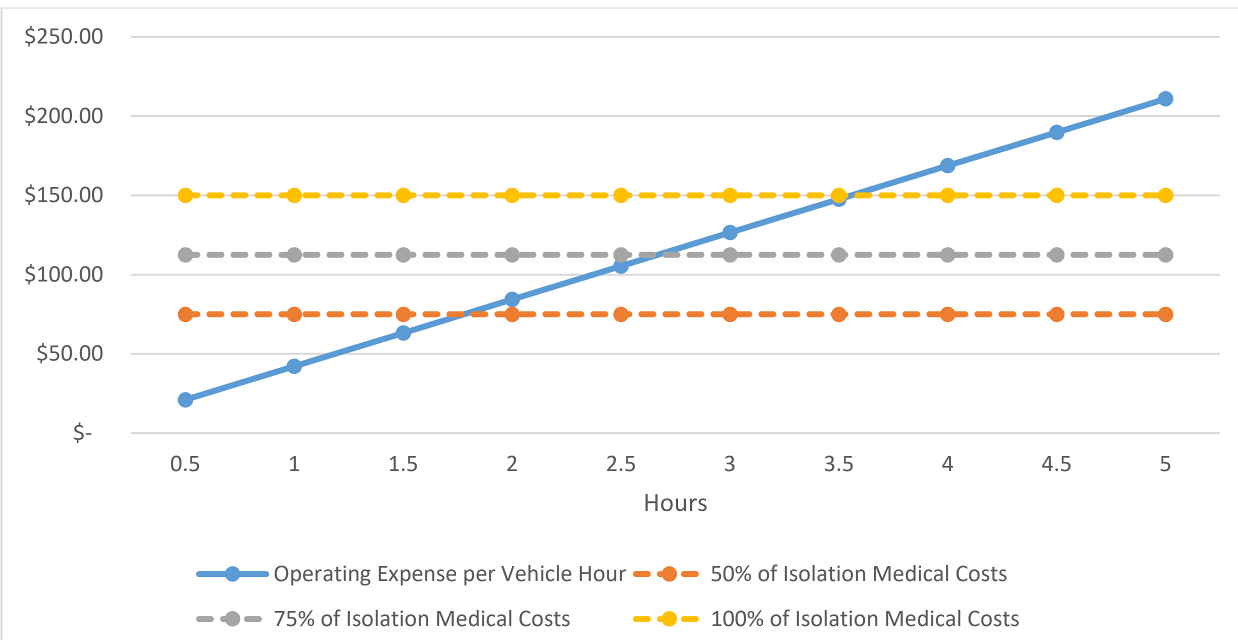
Idaho Average Operating Expense per Vehicle Revenue Hour Compared to Isolation Medicare Costs



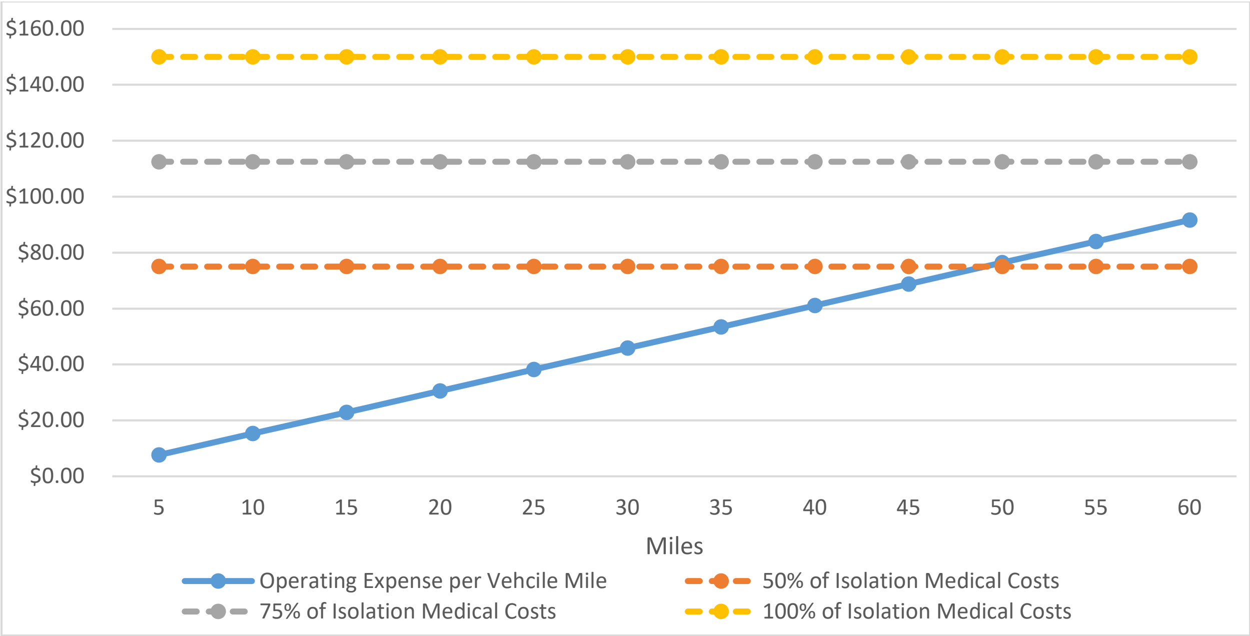
New Mexico Average Operating Expense per Trip Compared to Isolation Medicare Costs



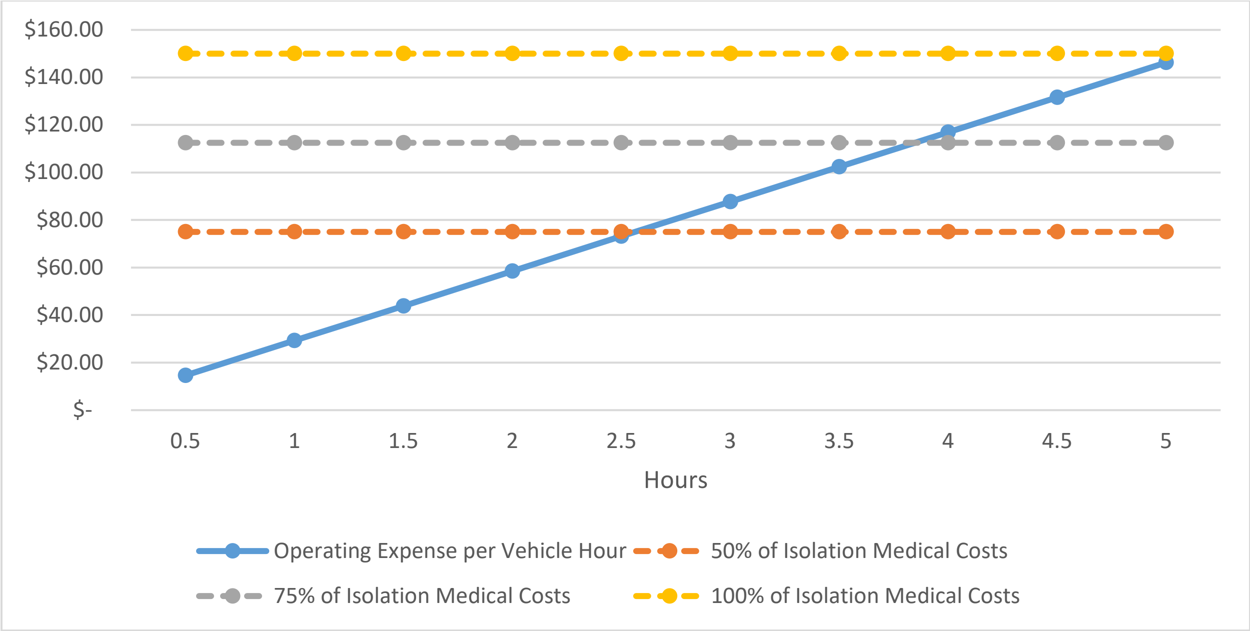
New Mexico Average Operating Expense per Vehicle Revenue Mile Compared to Isolation Medicare Costs



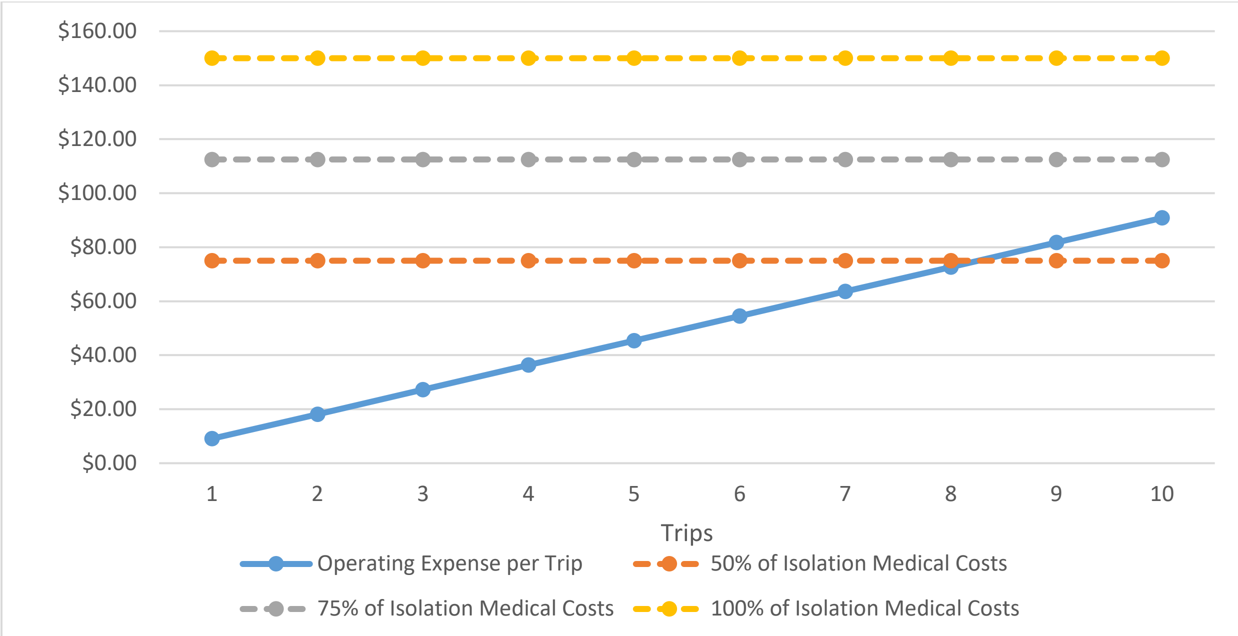
New Mexico Average Operating Expense per Vehicle Revenue Hour Compared to Isolation Medicare Costs



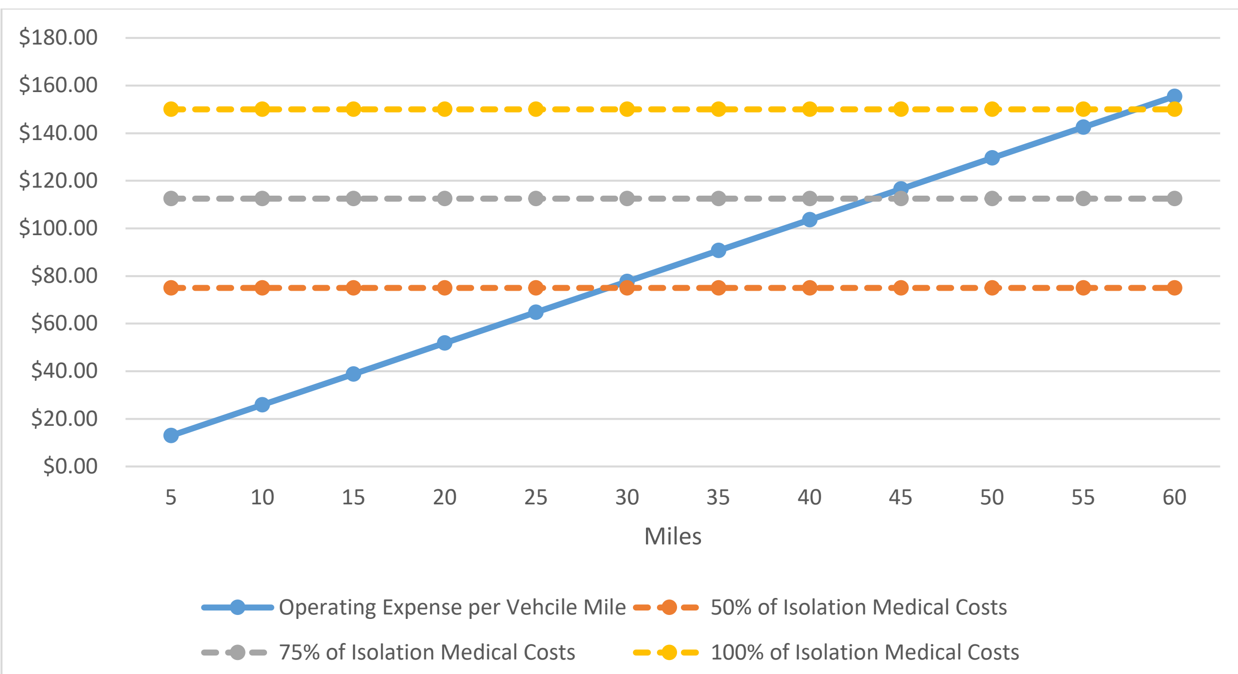
Arkansas Average Operating Expense per Vehicle Revenue Mile Compared to Isolation Medicare Costs



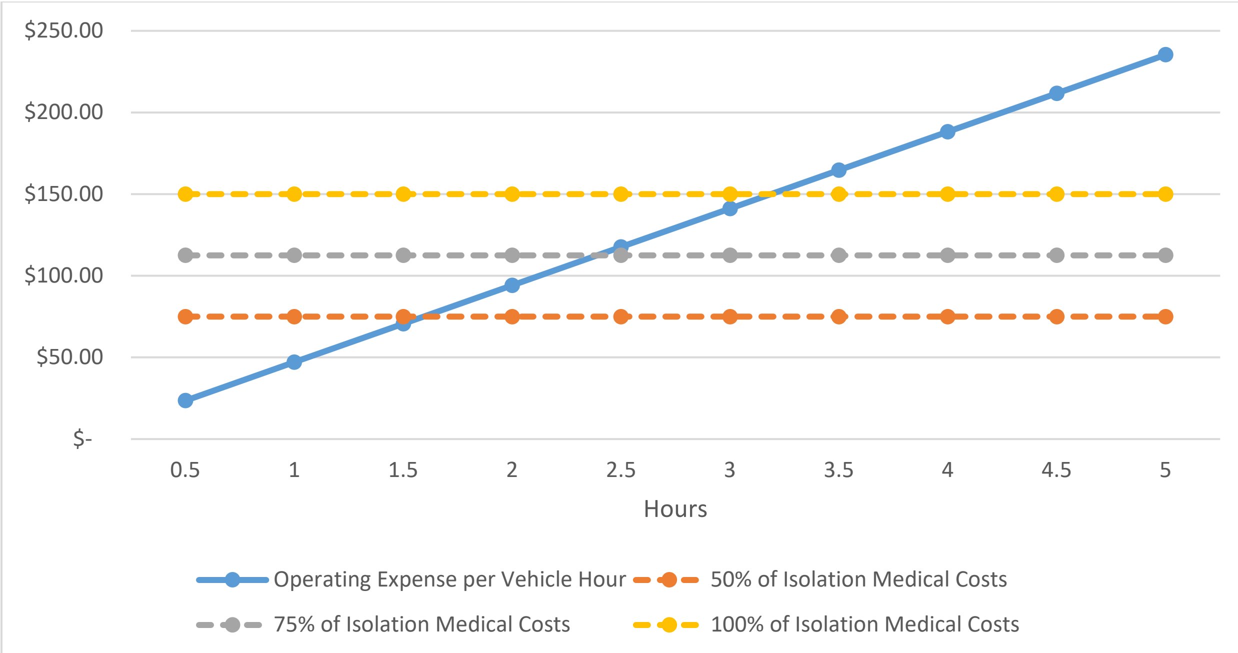
Arkansas Average Operating Expense per Vehicle Revenue Hour Compared to Isolation Medicare Costs



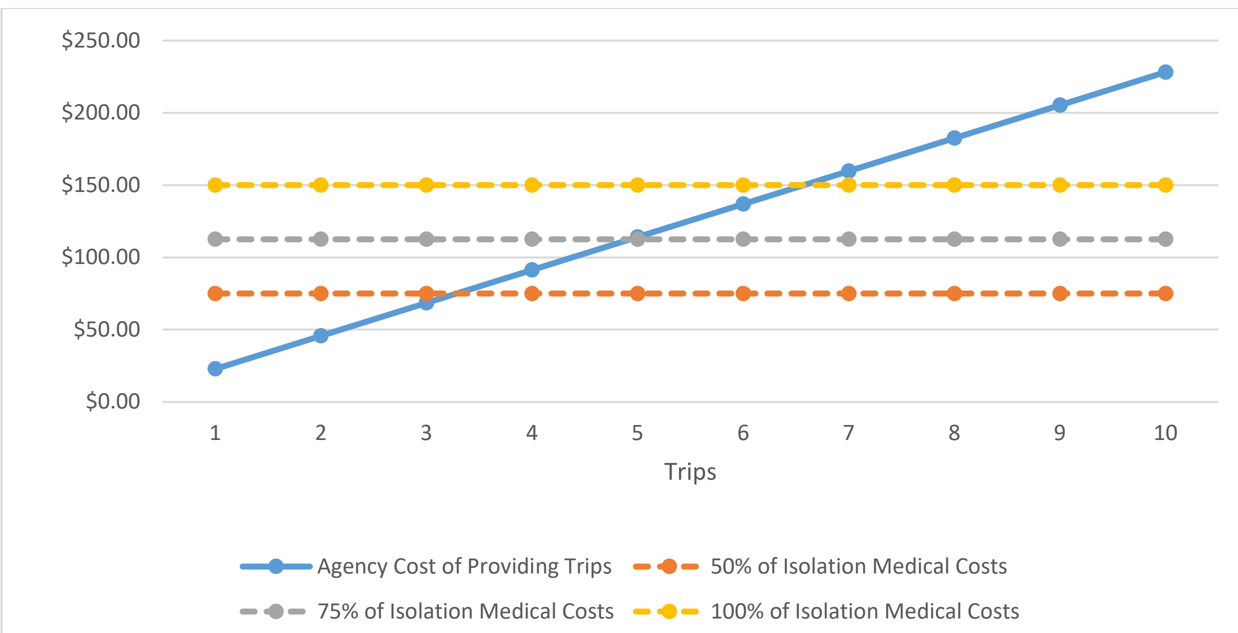
Alabama Average Operating Expense per Trip Compared to Isolation Medicare Costs



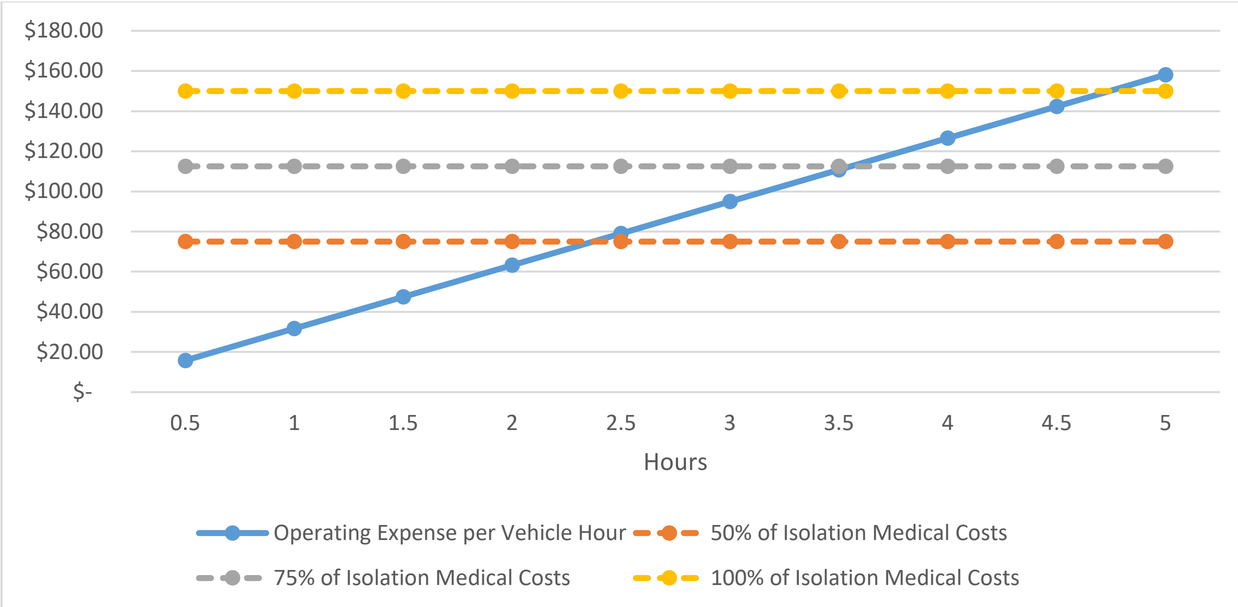
Alabama Average Operating Expense per Vehicle Revenue Mile Compared to Isolation Medicare Costs



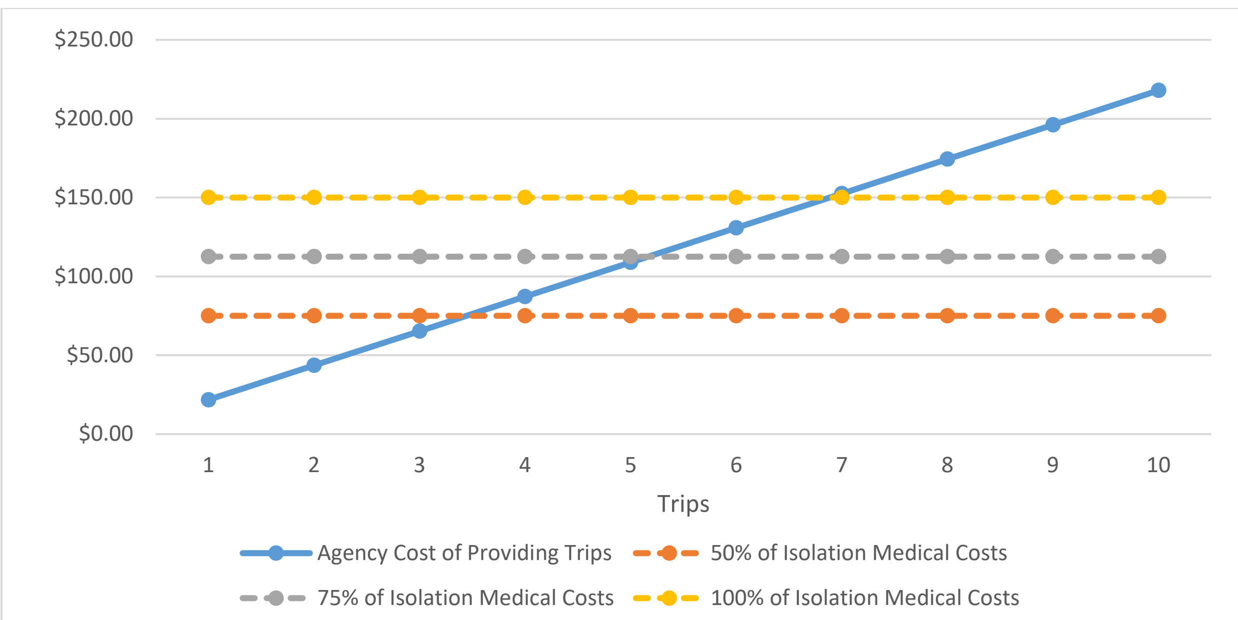
Alabama Average Operating Expense per Vehicle Revenue Hour Compared to Isolation Medicare Costs



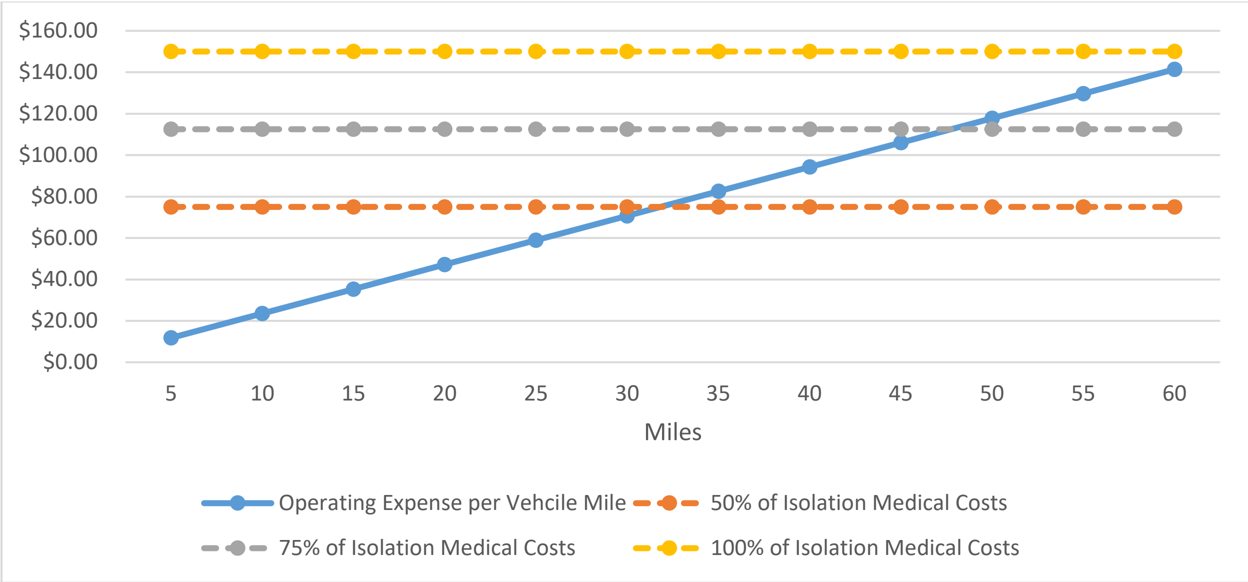
Kentucky Average Operating Expense per Trip Compared to Isolation Medicare Costs



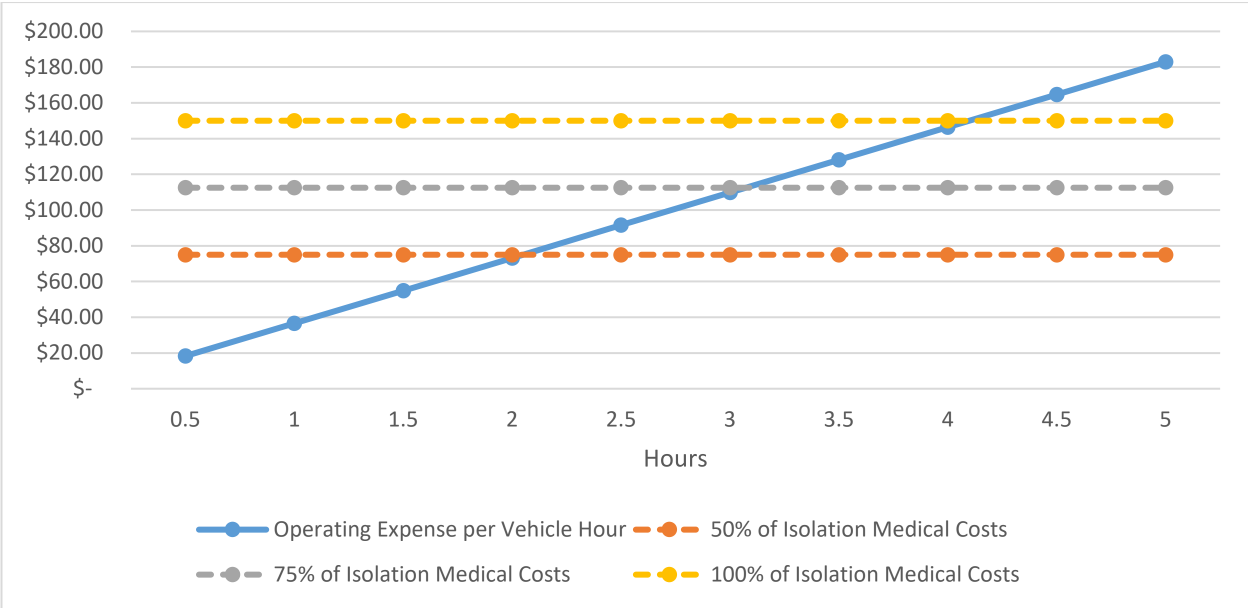
Kentucky Average Operating Expense per Vehicle Revenue Hour Compared to Isolation Medicare Costs



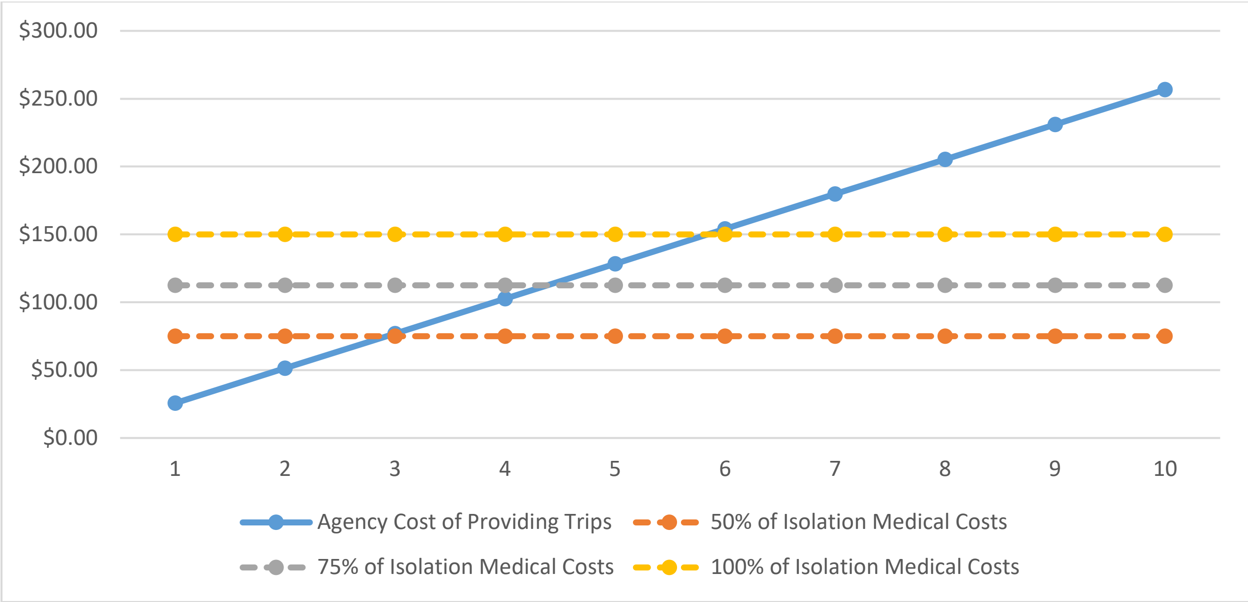
West Virginia Average Operating Expense per Trip Compared to Isolation Medicare Costs



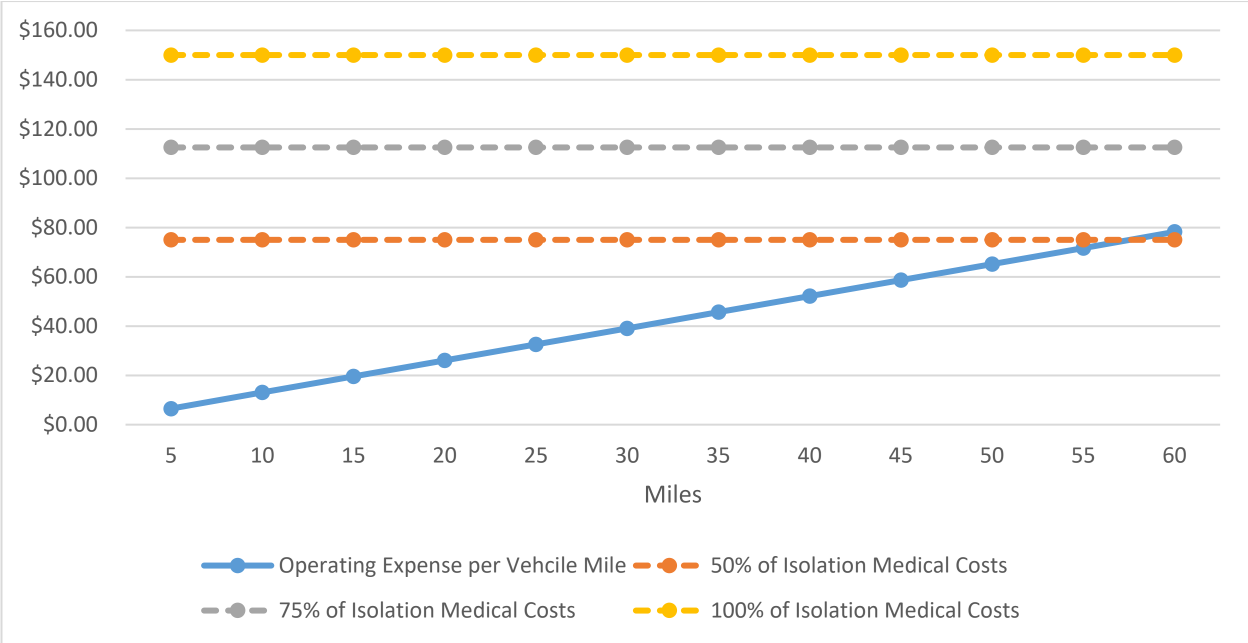
West Virginia Average Operating Expense per Vehicle Revenue Mile Compared to Isolation Medicare Costs



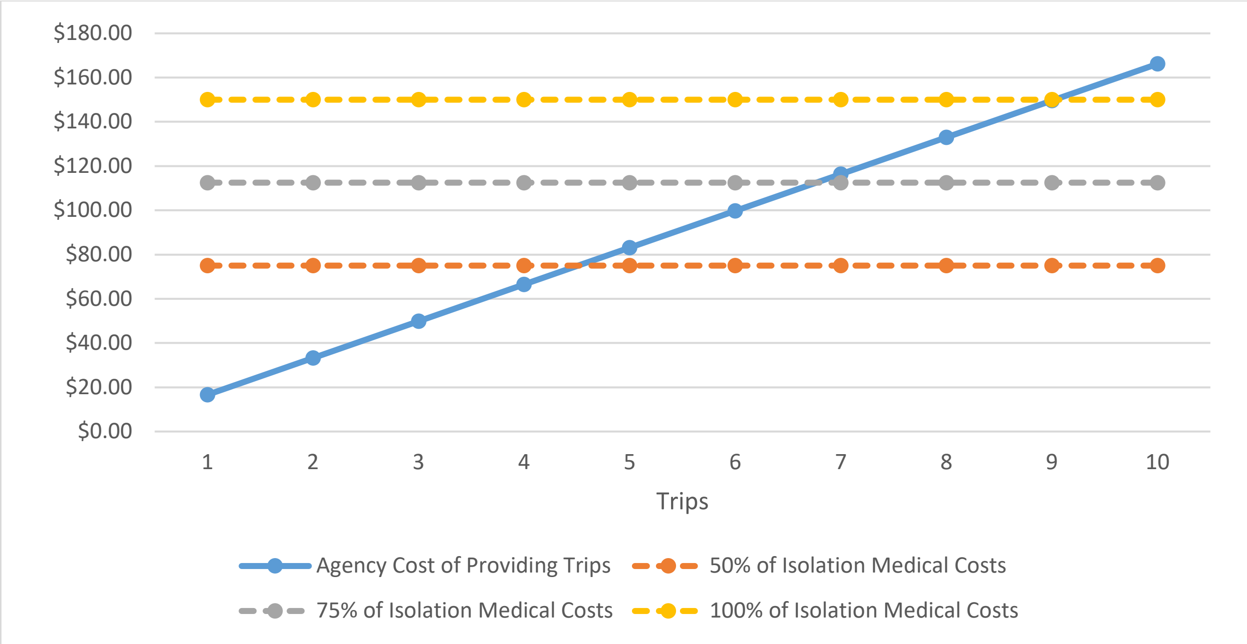
West Virginia Average Operating Expense per Vehicle Revenue Hour Compared to Isolation Medicare Costs



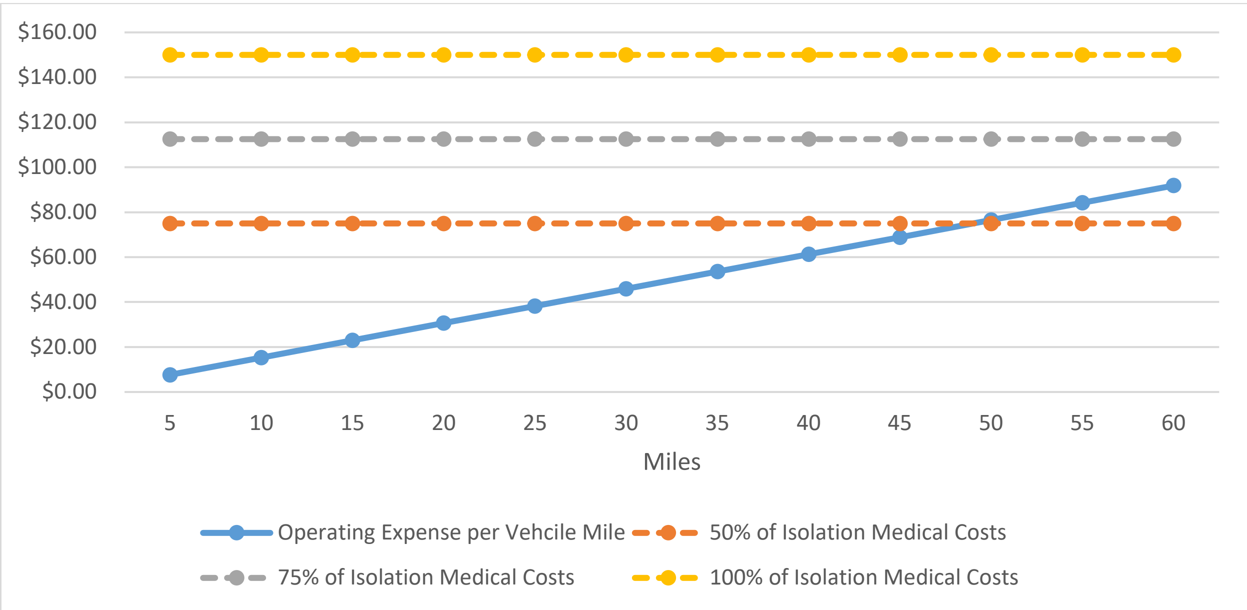
Vermont Average Operating Expense per Trip Compared to Isolation Medicare Costs



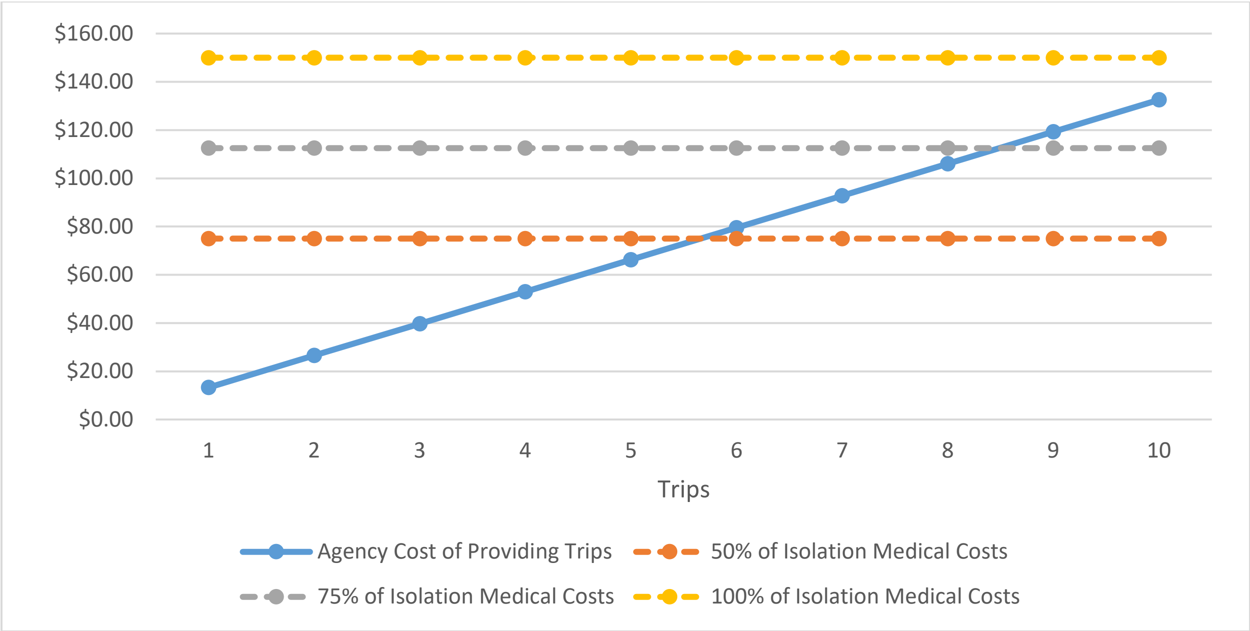
Vermont Average Operating Expense per Vehicle Revenue Mile Compared to Isolation Medicare Costs



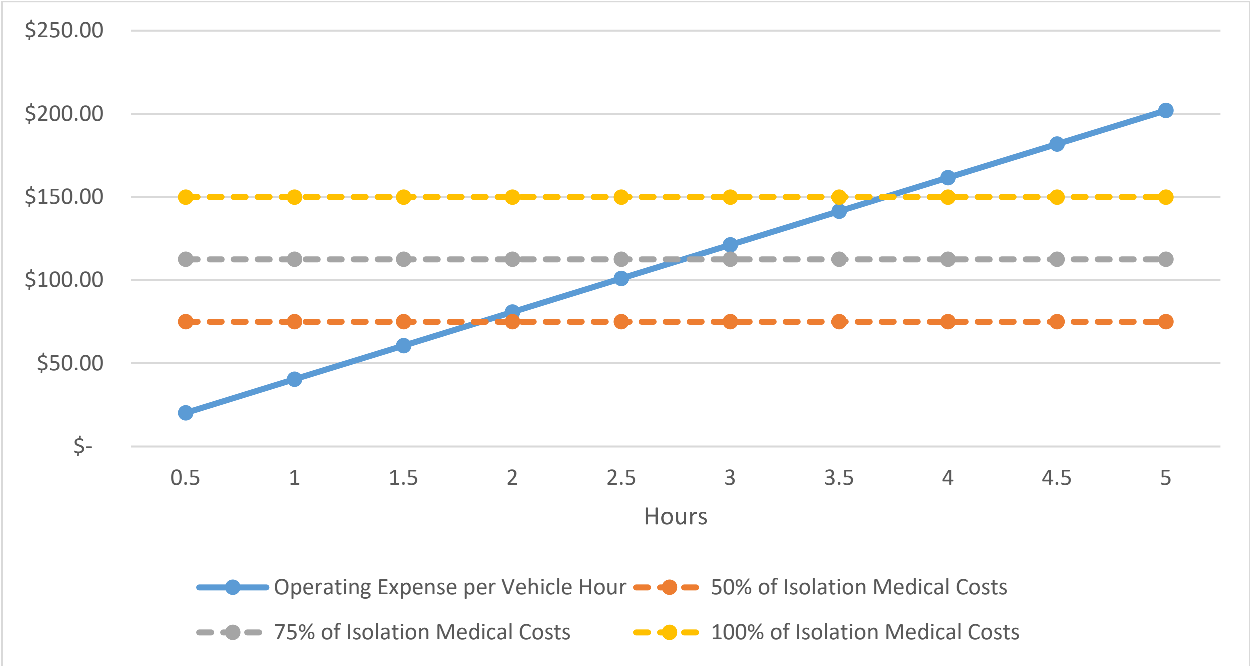
South Carolina Average Operating Expense per Trip Compared to Isolation Medicare Costs



South Carolina Average Operating Expense per Vehicle Revenue Mile Compared to Isolation Medicare Costs



Nebraska Average Operating Expense per Trip Compared to Isolation Medicare Costs



Nebraska Average Operating Expense per Vehicle Revenue Hour Compared to Isolation Medicare Costs