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Health Care Financing Report

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Executive Summary

The Colorado legislature established the Health Care Cost Savings Act of 2019 (HB19-1176) to create a Task Force charged with, among other responsibilities, selecting and working closely with an analytic team to examine alternative approaches to health care financing. The analytic team was tasked with providing a detailed analysis of costs and other impacts of three systems to inform future policy decision making: (a) the current Colorado health care financing system in which residents receive health care coverage from private insurers and public programs or are uninsured; (b) a multi-payer universal health care system in which all residents of Colorado are covered, regardless of immigration or documentation status, under a plan with a mandated set of benefits that is publicly and privately funded and also paid for by employer and employee contributions; and (c) a publicly financed and privately delivered option that provides universal coverage again, regardless of immigration or documentation status.

The Colorado School of Public Health (CSPH) was chosen as the analytic team to conduct this health care reform cost analysis. Guided by HB19-1176, CSPH engaged in two core activities related to the three healthcare reform policy options: 1) summarizing the scientific literature on a range of topics outlined by HB19-1176 and deemed important by the Task Force and 2) modeling costs.

Literature Review

To describe how these different health care reform options might have economic implications for society related to high healthcare costs, we conducted a literature review of the most relevant research from the last two decades. Using a rapid review methodology, two independent reviewers synthesized findings of 283 articles and created fact sheets that summarize the available literature and discuss the implications within a health reform context. Specifically, the literature review examined evidence on how high healthcare costs impact our society through 1) inappropriate emergency department and urgent care use, 2) lost productivity and unemployment, and 3) medical bankruptcy and financial burden. Additionally, this literature review examined 1) medical costs caused by diversion of funds from other health determinants (such as education, safe food supply or safe water supply) and 2) workforce retention (by sector) for these different healthcare reform policy contexts.

The synthesis of the available literature suggests that high healthcare costs have numerous negative health and economic impacts on Colorado and the rest of the United States. To this end, reforms to Colorado's health care systems through the introduction of a partial or full publicly financed and privately delivered component could lead to 1) less frequent medical bankruptcy and financial hardship, 2) less frequent inappropriate emergency department visits, 3) changes in healthcare-related employment (dependent on reimbursement rates), 4) a likely decrease in the health insurance workforce (especially in the context of a fully publicly financed program), 5) an increase in overall employment and productivity, and 6) improved health outcomes and lower health care spending.

The primary mechanisms and the extent of the success of these health care reform policy options will be driven by the degree to which reforms can improve 1) rates of uninsured and under-insured, 2) decrease medical out of pocket costs, and 3) sustain, or ideally increase, social programming budgets to address social determinants of health.

Cost Modeling

The goal of the cost modeling is to estimate the total healthcare expenditures for the state of Colorado under the three systems specified above. The data and methods used to generate the estimates are described later in the report and more complete details are included as an appendix. Here we summarize our approach and final results.

To estimate the total healthcare expenditure for the state of Colorado under three insurance coverage plans, we use the data from the 2018 Medical Expenditure Panel Survey data (henceforth 'MEPS') and the 2018 American Community Survey data for Colorado (henceforth 'ACS') to estimate mean healthcare expenditures. We then extrapolate to the Colorado population to estimate total healthcare costs under each health care reform scenario. To further refine our model, we conduct a number of calibrations to account for Colorado-specific expenditure estimates, vary ranges of the percent of individuals who move into the publicly funded part of the multi-payer universal system, and ranges of provider reimbursement rates, and also include a price elasticity correction to account for potential cost-savings under different reimbursement rates.

The reform option used in our cost models for the partial and full publicly financed and privately delivered scenarios was benchmarked off the benefit generosity and out-of-pocket cost levels of the private market. As we discuss in greater detail later in this report, this gives the reform option a benefit generosity level that is aligned with the average benefit generosity level of the private market which is less generous than Medicaid. The same holds true for out-of-pocket cost levels which are aligned with the average out-of-pocket levels for ongoing utilization (e.g., deductibles, copays, and coinsurance) of the private market which is approximately 15%. Changes in the reform option benefit and out-of-pocket cost levels would have implications for the total healthcare costs associated with those reforms. In our cost models we only vary reimbursement levels. As policy discussions continue, the model created here could be used to generate cost estimates of different specific health policy reform proposals.

The Table below provides total cost estimates in Colorado for status quo and partial and full publicly financed and privately delivered reform options. The table also provides confidence intervals. These confidence intervals represent the uncertainty of our estimates given reform option specifics and assumptions which we detail later in this report. This uncertainty would likely affect all of our estimates in a similar way which gives us greater confidence in the relative position of our estimates to each other (i.e., comparing different cost estimates across health reform options).

We estimate the total cost of Colorado's current health care system to be $38.3 billion. Our estimate of the total cost in a partial publicly financed and privately delivered reform option ranges

from $38.6 billion to $39.34 billion depending on the amount of crossover from the private market and reimbursement rates for the reform option. Our estimates of the total costs ina full publicly financed and privately delivered reform option ranges from $34.62 billion to $37.78 billion depending on the reimbursement rates for the reform option.

In summary, compared to the current Colorado health care financing system:

Table: Estimates and 95% confidence intervals in billions of dollars for total healthcare expenditures in the state of Colorado under the various scenarios. Assuming a Colorado population of 5,773,714 (2020 census figure).

Overall population cost (in billions)	Reimburse 100%	Reimburse 150%	Reimburse 200%	Reimburse as private (250%)
Status quo (with cost calibration for uninsured)	-	-	-	38.30 (36.07, 40.75)
0% private crossover	39.13 (36.77, 41.65)	39.20 (36.83, 41.72)	39.27 (36.89, 41.79)	39.34 (36.95, 41.86)
10% private crossover	38.88 (36.53, 41.37)	39.03 (36.67, 41.54)	39.18 (36.81, 41.70)	39.34 (36.95, 41.86)
20% private crossover	38.60 (36.27, 41.08)	38.85 (36.50, 41.34)	39.09 (36.74, 41.60)	39.34 (36.95, 41.86)
Full publicly financed and privately delivered	34.62 (32.30, 37.00)	35.67 (33.27, 38.14)	36.73 (34.24, 39.27)	37.78 (35.22, 40.40)

(a) in a multi-payer universal health care system with the assumption that the publicly funded portion of this option further captures 10% of the privately insured market, **total healthcare expenditures would be 2%-3% higher compared to status quo depending on the level of provider reimbursement rates**. (Note: we provide cost estimates under a variety of provider reimbursement and plan uptake scenarios in the full report.)

(b) in a publicly financed and privately delivered universal health care system, **expenditures would be 3%-10% lower depending on the level of provider reimbursement rates.**

Conclusions

Healthcare reform in Colorado introducing universal health coverage that is either a multi-payer or single payer system has the potential to increase access to care, improve health outcomes, and possibly provide sector-specific employment benefits. Our cost estimates suggest that a multi-payer universal health care system will likely lead to small increases in the total cost of Colorado's health care system. Introduction of a full publicly financed and privately delivered

health care system could yield significant healthcare savings, particularly if pricing regulations are put in place to control cost growth in the future. The financial health of hospitals and clinics and clinician retention should all be carefully considered with any potential pricing regulations.

Disclaimer: The reform and coverage options in this report are not based on any past or current reform proposals in the Colorado State Legislature including HB21-1232. Instead, the cost modeling that we conduct in this report is based on reform and coverage options benchmarked against elements of our existing health care system and are detailed later in this report.

Here we touch on a range of topics including but not limited to the services provided, possible funding mechanisms, and the role active policy may play in potential reform options. These topics were specifically identified in HB19-1176 and for ease of identification we discuss them here. In some cases, these topics are also discussed in the subsequent literature review and cost modeling sections of this report which we note in the text.

Services Provided (1.2.2)

The partial publicly financed and privately delivered health reform option that we cost model leaves in place the major components of the current healthcare system such as Medicare, Medicaid, and the private employment based market. All requirements from Medicare, Medicaid, and the federal act (i.e. Affordable Care Act) are met in the same way that those requirements are met by those programs in our current system. In all of our models, individuals on Medicare maintain the same benefits and have the same reimbursement and cost profiles. Our models that estimate the costs of a partial or full publicly financed and privately delivered health reform option move some or all under-65 individuals into a new option that is based on the existing employment based private insurance market. This new option represents the average benefits provided in that segment of the market which are compliant with the federal act (i.e. Affordable Care Act) and provides all of the services listed below in the same way and at the same level asour current employment based system (dental coverage is not included).

- Coverage for women's health care and reproductive services
- Vision and hearing
- Access to primary specialty services in rural Colorado, and other underserved areas or populations
- Behavioral, mental health and substance use disorders services.

Our models that estimate the costs of a full publicly financed and privately delivered reform option move Medicaid recipients (including those who currently qualify for Medicaid through disability and who do not meet the asset or income qualifications) into the new reform option. This reform option does have out-of-pocket cost sharing components which Medicaid in Colorado in its current form does not have. Future policy recommendations could include a different out-of-pocket cost sharing profile or could include a variable cost sharing component that could be based on income.

Funding (1.2.4)

Health care reforms that introduce either a partial or full publicly funded and privately delivered option could be funded in a variety of ways. For a partial publicly funded and privately delivered option some combination of funds that come from the general fund and income or other taxes are the logical funding sources. For a full publicly funded and privately delivered option additional funding sources include federal funding for Medicare, Medicaid, and the ACA marketplaces. Federal waivers would be necessary in order for Colorado to use the funding in a reform option. We provide a detailed discussion of the Federal waivers that would be necessary in the Federal Waivers section of this report. In addition to these public sources of funding,

individual patients would in all likelihood also need to pay directly into the system in the form of taxes, fees, premiums, deductibles, coinsurance, and/or copays. The amounts and levels individuals would need to pay would likely need to vary based on income in order to make the payments realistic and feasible while also generating sufficient funding to support the given reform option.

Additional Considerations (1.2.5)

Competitive compensation for providers

Competitive compensation is a critical component to attracting and retaining the clinical providers, including doctors and nurses, needed to run Colorado's health care system. As our literature review section on economic impacts of health reform highlights, there is uncertainty surrounding the compensation levels that are needed to retain clinical providers. There is additional uncertainty as to how reimbursement rates translate into specific impacts on clinical provider salaries. This uncertainty prevents us from being able to specifically identify the clinical provider retention implications of given reimbursement levels. Instead, we have estimated the cost implications of a range of reimbursement levels that on the low-end match Medicare reimbursement rates and on the high-end match average private payer reimbursement rates (which are approximately 250% of Medicare reimbursement rates).

Benefits for Coloradans temporarily out of state

Reimbursement for medical care received by Coloradans who are temporarily out of state are factored into our cost modeling at various reimbursement rates.

Uninsured, underinsured, and at-risk insured individuals

We define uninsured as simply those individuals that do not have health insurance and we define underinsured and at-risk as those individuals whose level of health insurance coverage either places them at risk of undue financial burden or in an actual situation of undue financial burden due to health care costs. Our current status quo health system leaves approximately 6.5% of the population uninsured (estimate from the Colorado Health Institute). Both the partial and full publicly financed and privately delivered reform options we model theoretically provide universal coverage. However, in practice it is difficult to achieve universal coverage with a multi-payer system that has independent administrative systems such as our current status quo health care system. The same holds true for a reform option that includes a partial publicly financed and privately delivered component. An indication of the number of underinsured and at-risk individuals in Colorado is the estimated 18% of Coloradans (estimate from the Colorado Health Institute) who reported in 2019 that they had trouble paying a medical bill. The number ofunderinsured and at-risk individuals would likely not decrease significantly in a partial publicly financed and privately delivered reform option as the number of underinsured and at-risk individuals come largely from the existing elements of our healthcare system (primarily from the employment based and individual market). The introduction of a full publicly financed and

privately delivered reform option could significantly decrease the number of underinsured and at-risk individuals to the extent that the reform option decreases out of pocket spending by individuals.

Compliance with the Federal Act

The specifics of the benefit design for either a partial or a full publicly financed and privately delivered reform option are not yet determined, however, we based our cost models on the existing employment based private insurance market and our utilization cost estimates are a reflection of the average benefits provided in that segment of the market which are compliant with the federal act (i.e. Affordable Care Act).

Out-of-pocket charges including coinsurance, deductibles and copayments.

Health reform options we modeled were benchmarked against the private employer based market which, on average, leaves the insured responsible for 34% of total cost (including premium). We factor in premium subsidies for those individuals who would move from Medicaid or the uninsured category. Our cost models are robust to different premium subsidy levels as well as the substitution of taxes and/or fees for traditional premium payments.

When examining only out-of-pocket costs associated with utilization of services once insurance coverage has been obtained (i.e. coinsurance, deductibles, and copayments) insured responsibility on average is 15% of total cost. While these are the out-of-pocket charges associated with the reform options that we included in our cost models, policy reforms could choose to change the out-of-pocket costs which would have corresponding implications for the utilization and cost estimates of those reforms.

Active policy (2.3.6)

Colorado's health care system is complex and governed by a network of active policy that includes legislation from the state legislature, regulations from state agencies such as the Department of Health Care Policy and Financing and the Division of Insurance, and regulations from the Federal government. The health reform options that we examine in this report and the ultimate recommendations made by the Task Force will need to effectively navigate this networkof active policy in order to accomplish what the Task Force intends. Throughout this report we discuss aspects of active policy that would need to be considered in order to effectively introduce the reform options outlined in HB19-1176. For example, the section of Federal waivers discusses what waivers would be needed in order to implement reform options.

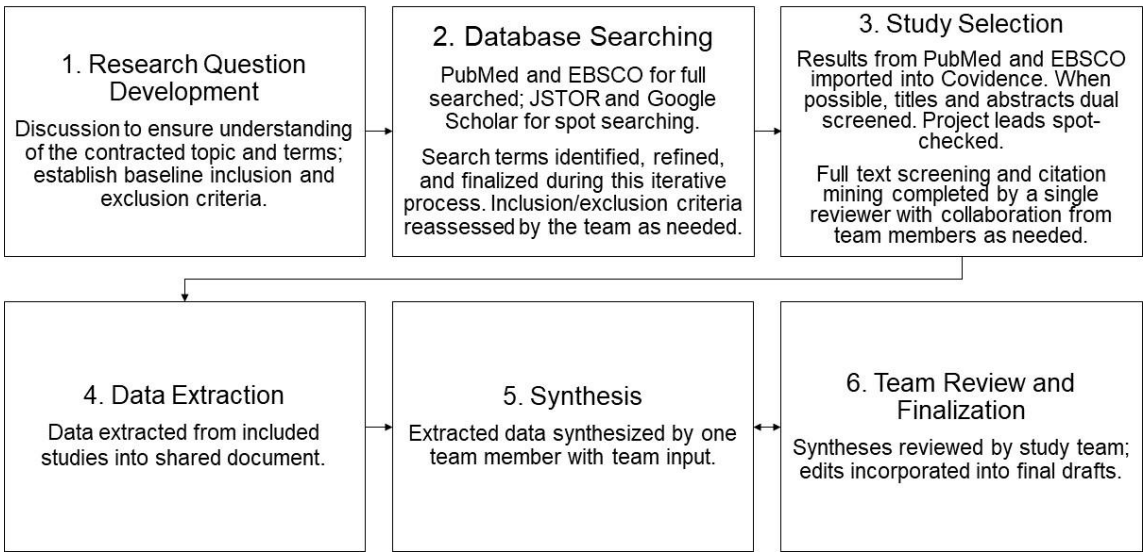
Literature Review (1.2.3)

This literature review describes the costs to society of high healthcare costs. Specifically, the literature review examined 1) inappropriate emergency department and urgent care use, 2) lost productivity and unemployment, and 3) medical bankruptcy and financial burden 4) medical costs caused by diversion of funds from other health determinants (such as education, safe foodsupply or safe water supply) and 5) workforce retention (by sector) for these different healthcarereform policy contexts. Finally, we discuss federal waivers and requirements for implementing the health reform options proposed in the legislation. Colorado is a geographically diverse state with dense metropolitan areas as well as rural and frontier areas. We attempted to highlight potential differential impacts on urban vs. rural areas in our summaries below.

Methods. To meet the deadline set forth in the inter-agency agreement, the literature review was conducted using rapid review methodology.[1] Two independent reviewers developed searchterms and searched PubMed and EBSCO for each topic separately. We restricted our search toarticles since 2000; although we made a few exceptions for especially consequential articles that were published before 2000. Reviewers also spot-checked for salient missing articles in JSTOR and Google Scholar, and obtained additional sources through citation mining. Titles andabstracts (when available) were imported into Covidence, a literature review screening tool. After initial screening, remaining articles received a full text review and relevant articles were incorporated in a narrative synthesis. Figure 1 gives a summary of our methodology. Each topic is briefly summarized with the anticipated implications for potential health care reform in a highlight box, followed by a more detailed synthesis. Overall, we synthesized findings from 283 articles and created reviews that summarize the available literature and discuss the implicationswithin the current healthcare reform context.

1. Garritty C, Gartlehner G, Nussbaumer-Streit B, et al. Cochrane Rapid Reviews Methods Group offers evidence-informed guidance to conduct rapid reviews. J Clin Epidemiol. 2021/02/01/ 2021;130:13-22. doi:https://doi.org/10.1016/j.jclinepi.2020.10.007

Figure 1. Literature Review Procedure



Cost of Emergency Care (1.2.3.1)

The aim of this review is to describe the scientific research and data pertaining to the costs of emergency department care, urgent care, and intensive care, particularly for individuals who are unable to afford preventive or primary care in lower-cost settings, and ways that healthcare reforms may impact these costs.

Summary of Findings

Shifting health care use for non-emergent issues from the emergency department to primary care and urgent care reduces overall healthcare costs. Increasing primary care access can prevent individuals from experiencing more serious health crises, which would reduce emergency care use and contribute to health care cost-savings over time, especially for uninsured individuals. However, Colorado data suggests that increases in preventive care use following the implementation of the Affordable Care Act have not yet decreased the state's rate of emergency care utilization. This may indicate that health insurance and primary care affordability are not the only factors in increasing preventive service utilization; convenience andaccessibility are also key.

Reforms to Colorado's healthcare system through the introduction of a partial or full publicly financed and privately delivered component may reduce emergency department utilization and therefore overall healthcare costs to the extent that reforms increase access to preventive and primary care. Additionally, the current scientific literature suggests that any cost savings would take one to three years to realize.

Utilization and Cost of Emergency, Urgent, and Primary Care Literature Summary

Total health care spending in the United States has continued to rise over the past 25 years.[1, 2] Emergency department care is a key contributor to these costs and is estimated to account for 5 to 10% of total health care spending.[2, 3] Use and expense of emergency services has increased over time; one study[2] found that between 2010 and 2016, emergency department visits increased by 7.26% while hospital charges for emergency department visits grew by 56%. A longitudinal study[4] tracked emergency department utilization for adult Medicaid beneficiaries in Maryland, Ohio, and West Virginia between 2006 and 2010 and found that the percentage of patients going to the emergency department for care did not increase over time; however, the number of emergency department visits increased over time for previous emergency department users. Patients with fragmented access to primary care and complex health care needs were more likely to be emergency department users. Notably, across the counties included in the study, those with a greater proportion of urgent care centers had lower overall emergency department visits. A study[5] in Texas found that overall expenditures and out-of-pocket payments for those privately insured were 10 times higher at emergency departments as compared to urgent care clinics, for the same diagnosis. While average total and out-of-pocket expenditures for primary care also increased for private insurance,[6] this growth is dwarfed by emergency care expenditures.[7] According to data from the Medical Expenditure Panel Survey (MEPS), the mean emergency department per-visit expenditure in

2015 for private insurance was $1,676, for Medicare was $892, for Medicaid was $504, and for patients with no insurance was $723.[7] Private insurance has the highest expenditure-to-charge ratio at 0.47, while Medicare, Medicaid, and patients with no insurance have an expenditure-to-charge ratio between 0.24 and 0.29.[7] As emergency care use continues to rise, visits to primary care providers have declined over the past two decades, especially for adults from low-income areas and for acute care visits.[8, 9]

Utilization and Cost of Emergency and Primary Care in Colorado

While the number of Coloradans who report at least one annual preventive care visit increased from 62.4% in 2017 to 74% in 2019, the percentage of Coloradans reporting emergency department utilization has remained around 20%.[10] Of those visits, 38% reported that they went for a non-emergent reason. According to the Colorado Hospital Association (CHA) Databank, in 2017 there were 1,818,616 emergency department visits; 240,455 of which resulted in inpatient admissions.[11] Data from the Colorado Hospital Price Report[12] shows that Medicaid patients have the highest number of total emergency department visits, followed by privately insured and Medicare patients, respectively. At 14.67%, Medicaid patients also have the highest percent of low-acuity visits, which could likely be addressed in a lower-cost setting, as compared to privately insured patients (8.46%) and Medicare patients (4.39%). Medicaid patients are also four times as likely to report that providers don't accept their insurance, most of which is sought for primary care.[13] For the lowest-acuity and least expensive emergency department visit in 2019, the average charge was $1,112; whereas the average allowed amount for such visits covered by private insurance was $665, by Medicaid was $239, and by Medicare Advantage was $128.[12] In comparison, for a 30-minute new patient office visit in 2019, the average charge was $247. The average allowed amount was $161 for privately insured patients, $220 for Medicaid patients, and $118 for Medicare Advantage patients.[12]

The Impact of Health Reform on Utilization and Cost

It is difficult to discern the direct effect of primary care visits in the reduction of emergency care use, and the resulting cost-savings. The Oregon Health Insurance Experiment, which examined health care utilization for low-income adult Medicaid lottery winners compared to controls, has often been cited as the sentinel research on how insurance coverage expansion increases health care utilization across outpatient, inpatient, and emergency department settings within a year of implementation. In this study, increased preventive care use in the newly enrolled Medicaid population did not immediately translate into decreased emergency department visits or hospitalizations, but it did yield improvements in self-reported physical and mental health.[14] Research from the Massachusetts health reform and the Affordable Care Act (ACA) has provided more comprehensive and mixed evidence on how insurance coverage expansion impacts preventive care and emergency department utilization. One study[15] that compared emergency department utilization in Massachusetts following health reform to that in the neighboring states of New Hampshire and Vermont found that emergency department visits increased by similar amounts across all three states, suggesting that insurance coverage expansion neither increased nor decreased emergency department utilization when analyzed within the context of neighboring states' trends. A more recent study[16] examining the Massachusetts health reform found that emergency department visits and inpatient encounters

decreased while ambulatory visits increased slightly post-reform, but the authors did not perform a cost analysis.

Research that compares utilization and cost before and after the ACA has also had mixed results. An Illinois study[17] indicated that emergency department visits increased across the statefollowing the implementation of the ACA, whereas a study[18] out of Maryland found that while emergency department utilization increased for new Medicaid adult beneficiaries, the total volume of emergency department visits remained constant. A study from a rural hospital in Georgia found that emergency department visits increased by 6% in 2011 and then decreased by 22% and 25% in 2012 and 2013, respectively, as compared to pre-ACA utilization.[19] In turn, one study[20] that examined the effects of expanded Medicaid or private insurance coverage afterthe ACA in Kentucky and Arkansas as compared to Texas, a non-expansion state, found that bythe second year of continuous coverage, primary care visits increased and emergency department visits decreased for patients in expansion states. Findings from a study[21] on Oregon's 2014 Medicaid expansion suggest that like utilization, outpatient expenditures increase initially after reform for new and returning insured adults due to pent up demand, compared to continuously insured adults, then stabilize by 24 months post reform. This held truefor emergency department visits as well, with the returning insured patients' expenditures stabilizing to a similar level to the continuously insured population, and the newly insured population's expenditures falling below the continuously insured. In line with Colorado's data, a national study[22] found that Medicaid expansion was associated with a higher likelihood ofvisiting a primary care provider; however, it was not associated with an increase in the yearly number of primary care visits per person or a subsequent decrease in total emergency department visits. Overall, the evidence tends to support the existence of a time lag between reform, increased primary care visits, and decreased emergency care usage.

Preventive Care Accessibility

There are multiple ways to encourage primary care usage outside of benefit generosity. A Virginia study[23] that enrolled uninsured patients into a community-based coordinated care program that included access to a nearby primary care provider found that between the first year and third year of continuous coverage, the average number of primary care visits increased, and the average number of emergency department visits decreased. This change contributed to a 46% decrease in annual health care costs by the third year. For patients with one or more comorbid conditions, total per patient costs were 81% lower in the third year than the first year. Another Virginia-based study[24] found that providing $25 and $50 cash incentives to low-income and uninsured adults to see primary care providers increased the odds of visiting a primary care provider by 36% and 56%, respectively. In turn, a primary care visit led to a 19% decrease in a patient's probability of visiting the emergency department for a non-emergent reason.[24]

Free primary care clinics and free 24-hour phone consultation service have been associated with a significant reduction in emergency department visits, especially among previous high-user patients who had three or more annual emergency department visits.[25] Paid sick leave among working adults has also been shown to significantly decrease the odds of using

emergency department services.[26] These study findings, among others, imply that affordability is not the only factor in increasing primary care usage; access must be increased as well. For example, most emergency department visits occur between 5pm-8am and on the weekends.[27] One study[27] found that patients who could contact a primary care provider outside of normal business hours had significantly fewer emergency department visits. Additionally, patients with a usual source of care who report experiencing barriers to timely primary care access are significantly more likely to visit the emergency department.[28] In 2019, 77.5% of Coloradans who visited an emergency room for a non-emergency reported that they did so because they needed care outside of normal hours, 52.9% could not get an appointment soon enough, and 41.6% said it was more convenient.[10] Another key component of preventive care accessibility is the number of primary care physicians, with one study finding a significant association between a higher proportion of primary care physicians and decreased emergency department visits, surgeries, and hospital admissions.[29] Overall, research does suggest that problems accessing primary care are associated with increased likelihood of utilizing emergency department services. In turn, delaying care can result in multiple visits.[30]

Section 1.2.3.1 References

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Lost Time, Productivity, and Unemployment (1.2.3.2)

The aim of this review is to describe the research and data on the cost in lost time from work, decreased productivity, or unemployment for individuals who, as a result of being unable to afford preventive or primary care, develop a more severe, urgent or disabling condition.

Summary of Findings

Barriers, like cost and insurance coverage, that impact access and utilization of physical and mental health care services are common in Colorado. Nationally, low-income, unemployed, and uninsured adults are more likely to experience both financial and nonfinancial barriers to health care. Barriers to care can lead to costly consequences, like late diagnosis and mismanagement of acute and chronic health conditions. Studies have found that decreased productivity and lost time from work due to chronic health conditions constitute the majority of health-related lost productivity costs to employers, employees, and society. Early intervention for acute and chronic health conditions, which occurs with regular utilization of preventive care services, is assumedto improve health, and decrease overall costs to society. Increases in insurance coverage, decreases in unemployment rates, and paid sick leave have been shown to improve access and utilization of preventive health care services.

Reforms to Colorado's health care systems through the introduction of a partial or full publicly financed and privately delivered component could lead to increased employment and increased worker productivity to the extent that reforms decrease the number of uninsured and underinsured individuals in the State. These effects may be greater in rural areas as rural areas tend to have higher uninsured and underinsured rates.

The Consequences of Barriers to Preventive Care Literature Summary

Barriers to care can result in unmet health needs, late diagnoses, delayed care, and compromised management of chronic health conditions.[1, 2] Affordability is a well-documented barrier to care. A 2012 study[2] analyzing the 2007 Health Tracking Household Survey found that 18.5% of American adults had unmet health care needs or delayed care due to affordability barriers. While important, affordability is not the only barrier to care. In fact, the study found that 21% of American adults experienced nonfinancial barriers to care, like accommodation, availability, accessibility, and acceptability barriers, and 66.8% of respondents with an affordability barrier said they also experienced nonfinancial barriers. This research indicates thatnonfinancial barriers may be even more prevalent than financial barriers, and the intersection of different kinds of barriers may amplify health care access issues.

Since 2012, with the passage of the Affordable Care Act (ACA), the percentage of American adults who skip needed medical care due to cost has decreased. Notably, the percent of low-income adults who forgo medical care due to cost fell from 16.8% in 2013 to 12.4% in 2015. However, 7.3% fewer adults living near or below the federal poverty level reported seeing a health care provider over the course of 2015, as compared to adults living at or above 200% of the federal poverty level.[3] Furthermore, uninsured adults report experiencing more barriers to

care than those insured by public or private insurance. In 2017, 50% of uninsured adults reported that they didn't have a usual source of care, 24% reported delaying care, 20% reportedgoing without care, and 19% reported postponing or not using needed medications due to cost.[4]The research shows that living at or below the federal poverty level, unemployment, and uninsurance are associated with experiencing barriers to care; while employment, increased insurance coverage, and paid sick leave are associated with improved access to needed health care services.[5-8]

Studies[9-11] on the impacts of Medicaid expansion show that increasing insurance coverage, especially for those who were formally uninsured or underinsured, decreases barriers to care. As a result, patients are more likely to seek and access medical care when they need it. Medicaid expansion was also shown to significantly increase the percentage of early-stage cancer diagnoses,[11] and significantly reduce mortality rates.[9, 10] Uninsurance rates in Colorado have decreased since the implementation of the ACA, from 15.8% in 2011 to 6.5% in 2018 and 2019.[12] For more information on health care avoidance due to cost, see the Financial Hardship section of this report.

Barriers to Mental Health Care in Colorado

According to the 2019 Colorado Health Access Survey, approximately one in six Coloradans reported experiencing poor mental health for eight or more days per month. Vitally, 13.5% of Coloradans reported not receiving needed mental health care services due to access barriers. Cost and insurance coverage were the most reported barriers to accessing needed mental health care. Of those who delayed or skipped needed mental health care, 83% were uninsured, 61.1% were concerned about the cost of treatment, and 53.8% did not think that their insurance would cover treatment. Specific to mental health care, nonfinancial barriers may be attributed to stigma. Almost half (47.3%) of Coloradans did not get needed care because they felt uncomfortable discussing personal issues and were worried that someone could find out.[12] Given that delayed care can lead to worsening and more costly conditions over time, this poses immediate and long-term health and economic consequences for Colorado residents, families, and employers.

Health and Unemployment

Research regarding workers' health and unemployment is well established, with a number of studies[13, 14] finding an association between poor mental and physical health and an increased risk of job loss or maintained unemployment. In particular, poor physical health, mental health problems, and chronic diseases have been associated with an increased risk of job loss.[15, 16] Within the United States, however, research on this topic is limited to a few studies that have looked at specific health risks. One study[17] found that increased levels of depression were associated with an increased probability of unemployment, especially for those with 10 or less years of education compared to those with 16 or more years of education. A study[18] on women with breast cancer found that low-income women had a lower rate of job retention after treatment as compared to higher-income women, perhaps linked to differences in the level of employer accommodation. In a 1996 systematic review[19] of unemployment and health, the list of unemployment-associated conditions included increased stress levels, unhealthy behaviors like alcohol and tobacco use, cardiovascular-renal disease mortality, infant mortality, low birthweight,

highway fatalities, ischemic health disease mortality, suicide and depression rates; however, the authors acknowledge that most reported associations between unemployment and specific health outcomes may be debatable because few studies had been replicated at the time. A more recent systematic review[20] of health outcomes associated with unemployment and job-insecurity synthesized the findings of 14 studies and found a significant association betweenunemployment and self-rated health, anxiety, depression, and mortality.

Unemployment and Health Insurance Coverage

State-level Medicaid expansion studies indicate that expanding insurance coverage improves overall health as well as chronic health condition management.[9] This may moderate health risks associated with unemployment and even increase overall employment rates. The Colorado Health Foundation estimates that Medicaid expansion has been directly responsible for 31,074 jobs in Colorado, or a 1.35% increase in total employment for the state.[21] Similar data has been found in other Medicaid expansion states. For example, Montana found a significant increase in their low-income adult workforce following Medicaid expansion.[22] Looking at trends across the United States, one study[23] found that in states with expanded Medicaid, there was a substantial increase of employment for people living with disabilities, as compared to states that did not expand Medicaid.

According to a 2012 National Center for Health Statistics report,[8] over half of unemployed Americans were uninsured, and regardless of insurance status, the unemployed experienced poorer physical and mental health outcomes than employed adults. Regardless of employment status, uninsured adults experienced the greatest financial barriers to care and were the most likely to delay or skip needed care. This illustrates that both employment and insurance coverage status are independently associated with a person's financial access to care.

Similar to the state's uninsurance rate, Colorado's unemployment rate has decreased from a high of 9.1% in 2011, after the 2008 Great Recession, to a low of 2.5% in November of 2019.[24] Over the same time period, Colorado's reliance on employer-sponsored health insurance has also decreased. The Colorado Health Institute found the percentage of Coloradans insured through their employer has decreased from 57.7% in 2009 to 49.4% in 2017.[25] The National rates of unemployment and uninsurance have followed similar downward trends as those in Colorado over the past decade, with a 3.5% rate of unemployment and an 8% rate of uninsurance in 2019.[26, 27] Furthermore, 55.4% of the U.S. population had employer-sponsored health insurance in 2019.[27] This data shows that unemployment rates, uninsurance rates and employer-sponsored insurance rates are higher nationally than in Colorado. That being said, during the SARS-CoV-2 pandemic, Colorado's unemployment rate spiked to 12.1% in April of 2020; subsequently decreased to 6.6% as of February 2021, and has yet to return back to the pre-pandemic rate.[24] Given the unemployment and economic shocks experienced across the country, the pandemic has illustrated the possible societal benefits of further disentangling health coverage from employment status.

Cost of Chronic Health Conditions

In the United States, six in ten adults live with a chronic disease, four in ten live with two or more chronic diseases, and one in five live with a mental illness.[28, 29] A systematic review[30] on presenteeism, or lost productive time, found that chronic health conditions like allergies, diabetes, arthritis, and depression, as well as health risks like obesity and physical inactivity have been associated with losses in productivity for employers. Within the United States workforce, one study[31] found a 9.4% prevalence of depressive disorders; employees with depression reported an average of 5.6 hours per week in lost productive time as compared to
1.5 hours per week for employees without depression. Another study[32] looked at the magnitude and impact of chronic health conditions on Dow full-time employees in Michigan and Texas. Of the surveyed employees, 65% reported living with one or more chronic health conditions. The most reported health conditions among the employees were allergies, arthritis, joint pain or stiffness, heart or circulatory problems, back or neck disorders, depression, diabetes, and breathing disorders. Work loss over a four-week period associated with these primary health conditions ranged from 0.9 hours lost due to allergies to 3.7 hours lost due to depression to 5.9 hours lost due to breathing disorders. In turn, self-reported lost productive time ranged from 17.8% for employees with diabetes to 36.4% for employees with depression. A more recent study[33] that assessed Health Risk Appraisal (HRA) data from employees of a large United States health care system over a 4-year period, also found that allergies were the most commonly reported health condition, followed by hypertension, migraines or severe headaches, and arthritis, while chronic back pain, mental illness, and general anxiety contributed the most toself-reported productivity losses with 16.7, 16.6, and 16.2 minutes, respectively, per day per employee.

Collins et al. (2005) estimated that the annual per employee cost was highest for those suffering from depression and lowest for those suffering from allergies. Overall, chronic conditions were estimated to account for 10.1% of Dow's total labor costs in 2002, with 6.8% due to presenteeism or productivity loss, 2.3% due to medical care costs, and 1.0% due to absenteeism or lost time from work.[32] Allen et al. (2018) estimated that the annual cost per person, in 2018 dollars, due to productivity losses were $2,100 for mental illness, $1,920 for chronic back pain and for general anxiety, $1,690 for migraines or severe headaches, $1,290 for neck pain, $1,150 for depression, $1,090 for autoimmune disease, $930 for arthritis, $710 for type I diabetes, and $716 for allergies. The most expensive health conditions based on the estimated annual cost to the company were allergies, migraines or severe headaches, general anxiety, and chronic back pain, costing the company $2.88 million, $2.02 million, $1.43 million, and $1.21 million, respectively.[33]

While these studies looked at the costs to specific employers, there is a limited amount of research on the cost of chronic health conditions to employees and it has been difficult to accurately estimate the total costs to society. Asthma is a health condition that is more common among people living in poverty or near the poverty line, and health care costs for people with asthma have been estimated to be over two times higher than those without asthma.[34, 35] According to Medical Expenditure Panel Survey (MEPS) data between 2008 and 2013, asthma caused 1.8 days of missed work for adults and 2.3 additional school day absences for children

annually. This resulted in an average per worker loss of $214 in annual earnings, a $207 annual cost per child, and an estimated total cost of $81.9 billion to society over the five-year period.[34] A systematic review[36] on common conditions that often require rehabilitative intervention estimated the prevalence and costs associated with stroke, spinal cord injury, traumatic brain injury, multiple sclerosis, osteoarthritis, rheumatoid arthritis, limb loss, and back pain. Among the conditions they analyzed, back pain and arthritis were the most common and costly conditions, costing society over $200 billion (in 2013 dollars) annually. The authors postulate that early intervention and improvements in care for chronic and disabling conditions would result in direct and indirect cost savings.

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Medical Bankruptcy (1.2.3.3)

The purpose of this section is to describe the scientific research and data pertaining to the costs of medical bankruptcy to patients and providers.

Summary of Findings

The consensus in the scientific literature, and society more broadly, around medical bankruptcy is that it is a tragedy, affecting many Americans each year. However the precise number of medical bankruptcies annually is unknown due to the nature of bankruptcy and the many factors contributing to any individual's financial situation. Health care reform has the potential to reduce medical bankruptcy over time as a function of health plan benefit generosity and consumer out-of-pocket cost limits. Reforms should be cautious of replacing uninsured with underinsured, as this could lead to little or no reduction in medical bankruptcy.

Reforms to Colorado's health care system through the introduction of a partial or full publicly financed and privately delivered component would likely decrease medical bankruptcies in Colorado through (1) decreasing the number of uninsured and (2) decreasing out of pocket costs for those that are insured (i.e., decreasing the number of underinsured). These effects may be greater in rural areas as rural areas tend to have higher uninsured and underinsured rates.

Medical Bankruptcy Literature Summary

Medical bankruptcy in the United States has been a topic of study and discussion in the literature most prominently since about 2005. Himmelstein et al published a study in 2005 titled "Illness and Injury as Contributors to Bankruptcy," which reported, of bankruptcy filers (n=1,771) in the year 2002 from 5 of 75 national districts, that 28% of filers reported illness or injury as a contributor to their bankruptcy filing.[1] In 2009, a study[2] by the same group reported that based on survey data (n=2,314) and interviews (n=1,032), 62% of all bankruptcies in the US were related to medical costs, while acknowledging that most bankruptcies involve several factors. Ten years later after the passage of the Affordable Care Act (ACA), Himmelstein et al conducted a follow-up study,[3] which found that 58.5% of their survey population (n=910) agreed that medical expenses contributed to their bankruptcy, and 44.3% cited illness-related work loss as acontributing factor. Combined, 66.5% cited at least one of these two medical contributors. If this were applied to the nation as a whole, medical costs were contributing factors for approximately 530,000 medical bankruptcies annually.[3]

These studies have come under great scrutiny since their release. The US Department of Justice was called upon to review the findings of the 2009 study as it was widely cited in supportof the ACA. After reviewing over 5,000 bankruptcy filings, the Department of Justice found that 54% of filers listed no medical debt, and 90% of those who listed medical debt had debts under $5,000.[4] However, this data may underestimate true medical debt if filers previously used credit cards or home equity to pay off medical costs.[5] The main critiques of the Himmelstein studies

are (1) a wide definition of medical bankruptcy inflates the actual effect of medical costs on bankruptcy, and (2) correlation being confused with causation (i.e., filers may have medical debt that did not necessarily cause them to file bankruptcy).[6, 7] One study re-analyzed the survey data of the 2005 Himmelstein study and calculated that only 17% of the bankruptcies included were attributable to medical costs.[7] The authors have responded to these criticisms to defend their methodology in various editorial letters.[8, 9]
Using a more limited definition of medical bankruptcy than the Himmelstein studies, another survey-based study (n=446) found that 26% of surveyed filers reported medical debt as causing their bankruptcy, while 61% reported having medical debt.[10] These findings are concurrent with an analysis[11] of national Current Population Survey data and publicly available bankruptcy data (1992-2004), which estimated that out-of-pocket medical costs are pivotal in 26% of personal bankruptcies among low-income households and another analysis[12] that used Panel Study of Income Dynamics data, who estimate that 27% of filings were primarily driven by medical debt, while in 36% of cases they were a contributing factor.

Other studies have used a different approach identifying groups that may be prone to experience medical bankruptcy. These found that among persons experiencing a catastrophic event or cancer, approximately 4% would later file bankruptcy.[6, 13] Childhood cancer survivors have also been found to be 6.6 times as likely as the general population to have considered filing for bankruptcy.[14] Another study using a similar causal approach found that cancer survivors were 2.65 times more likely to file for bankruptcy, this effect was especially true in nonelderly patients who did not have Medicare, which points to the attenuation of the effect when insurance coverage is more generous.[15] Various studies have examined financial toxicity and burden on cancer survivors and other special populations in great depth.[16-18] A deeper dive into high cost populations is beyond the scope of this review, however, we acknowledge that high cost populations drive overall health care costs, and we address this in our cost model by running and testing models both with and without truncation.

Medical Bankruptcy in Colorado

Chapter 7 (also known as straight bankruptcy) is by far the most common bankruptcy filing in the nation, Colorado being no exception. The number of Chapter 7 filings has been decreasing overall since 2005 with the passage of the Bankruptcy Abuse Prevention and Consumer Protection Act, with some fluctuation and economic changes between 2005 and 2010. To summarize, in Colorado over 40,000 people filed for Chapter 7 in 2005. In 2010, the total was 27,619; whereas in 2019 the total was 8,500 (unpublished data https://www.cob.uscourts.gov/stats/istat_graph.asp).[19] If the range found in the literature (26%-67%) is applied to Colorado, medical cost related bankruptcies may range approximately between 2,210 and 5,695 in Colorado in 2019 (2020 data not available yet). There are limitations to applying national survey data to the state of Colorado, especially when there is nota sense of agreement on the actual burden of medical bankruptcy in the United States; this is only a broad estimate. The Colorado Health Institute's Colorado Health Access Survey estimated that medical bankruptcies have decreased in Colorado over recent years. Among people who had trouble paying medical bills in the past year in Colorado (approximately 18% of

Coloradans), only 3.7% reported filing bankruptcy,[20] compared to 11.1% in 2013,[21] the first year the statistic was collected.

The Potential of Health Care Reform in Reducing Medical Bankruptcies

It can be safely said that in contrast to the United States, countries with nationalized health care or social insurance systems experience virtually no medical bankruptcy.[22] However, health care reform is not a guarantee that all medical bankruptcies will disappear, as the reduction in out-of-pocket consumer costs will vary with benefit generosity. In 2009, Himmelstein et al conducted a study in the state of Massachusetts showing that despite health care reforms in thestate pre-ACA, the percentage of medical cost-related bankruptcies did not decrease significantly, using the same methods as the 2007 study.[23] This finding was corroborated by a separate group that studied the same health care reform in Massachusetts and found a slight increase in overall bankruptcy filings, possibly due to the housing market and other economic conditions.[24] An economic study[25] of this reform, however, did find that bankruptcy was reduced among subprime borrowers. Reducing the number of uninsured in the population of a state cannot be assumed to completely solve the problem of medical cost-related bankruptcy, as some individuals may still be underinsured or experience gaps in coverage. It may also take time for the effects of health care reform to reduce costs to individuals that were incurred pre-reform.

An analysis based on national data from 1992-2004 estimated that a 10% increase in Medicaid eligibility could reduce personal bankruptcies by 8%.[11] More recently, an analysis comparing states who adopted Medicaid to those who did not under the ACA found similar results.[26] Several other econometric studies have leveraged health care reforms, including the Oregon Medicaid lottery[27] and optional state Medicaid expansion under the ACA,[28-30] to examine the effect of healthcare reform on population financial health, including bankruptcies. The Oregon study found no significant reduction in bankruptcies within the first year.[27] Examining Medicaid expansion, Caswell and Waidmann found a significant reduction in bankruptcies amongst other positive financial outcomes;[28] Brevoort et al estimate that the 19 states who expanded Medicaid prevented 50,000 bankruptcies over the course of 2 years, compared to states who did not adopt;[29] while Hu et al found reductions in overall consumer debt but not in bankruptcies.[30] A thorough literature review of the effect of the 2010 Medicaid expansion concluded that states who expanded Medicaid saw reduced costs in uncompensated care and increased hospital profitability compared to non-expansion states.[31]

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Medical Financial Hardship (1.2.3.4)

The aim of this review is to describe the research and data on the costs to and effects on individuals who do not file bankruptcies but are financially depleted due to medical costs, and how health policy may influence these outcomes. High financial burden of health care is generally defined as spending more than 10% of pre-tax income (for an individual or a family) on insurance premiums and health services.

Summary of Findings

Medical financial burden is fairly prevalent in the US, affecting more than half of the population, and is especially pervasive in vulnerable populations.[1] Medical debt and the fear of accruing medical debt has been associated with changes in health behavior, such as avoiding and delaying care. Historically in the United States, states that have expanded their public insuranceprograms have seen decreased financial hardship and higher health care utilization, and those that have decreased public coverage have seen the opposite.

Reforms to Colorado's health care systems through the introduction of a partial or full publicly financed and privately delivered component would likely decrease medical financial hardship in Colorado through (1) decreasing the number of uninsured and (2) decreasing out of pocket costs for those that are insured (i.e., decreasing the number of underinsured). These effects may be greater in rural areas as rural areas tend to have higher uninsured and underinsured rates.

Medical Financial Hardship Literature Summary

Although medical bankruptcy has gained traction as a topic of study in recent years, medical debt and medical financial hardship are much more common and may influence health consumer behavior, spending, and health cost to society.[2] Cancer survivors are an example of apopulation greatly burdened with health care costs; cancer treatment can leave survivors with financial burdens that influence their future life choices, this is commonly referred to in the literature as "financial toxicity."[3, 4] As of 2003, a Commonwealth Fund report estimated that 37%of Americans had difficulty paying medical bills, and/or have accrued medical debt.[5] In 2008, thesame group estimated the number had risen to 41%.[6] Between 2000 and 2009 (just before the ACA), the median medical financial burden grew an average of 2.7% each year and the proportion of households with high financial burdens increased significantly.[7] In 2019, Yabroff et al reported that approximately 56% of Americans were experiencing medical financial hardship of some kind; those under 65, those with chronic conditions and the uninsured were the most likely to report medical financial hardship.[1] In 2020, the Commonwealth Fund reported that approximately 21% of Americans between the ages of 19 and 64 were underinsured, 12% were uninsured, and 9.5% experienced a gap in coverage over the past year.[8] Having dependent children and earning middle-income levels (earning too much to qualify for Medicaid, but not enough to purchase a high-premium insurance plan) have been found to increase the likelihood of medical debt.[9] Similarly, medical financial burden for families with children have been found to be mitigated by public insurance more than private insurance.[10, 11] Enrollment in a

consumer-directed health plan[12] or a high deductible health plan[13] also increases the likelihood of financial hardship, especially among low-income individuals and those with chronic conditions. Medical bills that are sent to collections have been found to decrease in amount withage - that is, the average size of medical debt for 64 year olds was nearly 40% less than that of 27 year olds.[14] In general, Medicare beneficiaries are happy with their coverage, but those who are seriously ill and not dually covered under Medicaid can still face serious financial hardship especially when purchasing expensive prescriptions, as Medicare currently has no out of pocketspending cap.[15] The average Coloradoan spends slightly more out of pocket than the national average; 3.6% of non-elderly adult income (compared to 3.1% nationally) is spent on medical out of pocket expenses, including insurance premiums.[16]

The literature suggests that medical debt, and even fear of medical debt, is associated with behavior change. To cope with medical costs from adverse health events, households with low financial assets, the uninsured, and those with high out of pocket costs are more likely to borrow and create unsecured debt.[17] Avoiding or delaying health services is strongly correlated with high-deductible coverage,[8, 18, 19] uninsurance and underinsurance,[8] as well as depression, poverty and poor perceived health.[18] A study[20] of the state of Arizona found that having insurance did not significantly protect individuals from medical debt, and that medical debt and lack of coverage predict reduced access to care. Those in consumer directed health plans are more likely to experience financial burden if only their employer contributes to their plan (as opposed to employee only and employee-employer joint contributions); those who do make contributions report changes in their care-seeking behavior to avoid costs.[21] Among African American men, unmet medical need due to cost was associated with health self-efficacy in the context of financial hardship.[22] Among families with children, financial burden, discordant insurance, and a dependent child with an activity limitation are all associated with delaying or forgoing care.[23] The RAND Health Insurance Experiment found that adult participants enrolled in higher cost sharing insurance plans visited the doctor less than those in low cost sharing plans, for inpatient, outpatient, and emergency care visits.[24] Based on these findings, Keeler and Rolph (1988) estimated that a 10% increase in cost sharing yields a 2% decrease in utilization.[25] Before the RAND Health Insurance Experiment, economists assumed that the demand for health care was not price sensitive. In the decades following this formative experiment, cost sharing has been used to prevent over-utilization of health care services.[25] Premiums and deductibles have continued to increase significantly since 2010,[26] leading to greater cost sharing especially for low-wage earners.[27] A 2010 literature review[28] of cost-sharing and its effects on spending and outcomes concluded that cost-sharing shifts financial burden to patients, who maynot be able to make appropriate decisions about their care in response and that vulnerable populations have shown worse health outcomes with increased cost-sharing. The same finding has been corroborated by others in more recent years.[27] High medical financial burden has also been associated with mistrust in physicians.[29]

Medical Financial Hardship in Colorado

The Colorado Health Access Survey found that in 2019, 30% of Coloradans received an unexpected medical bill in the past year and that the percentage of Coloradans who had trouble paying a medical bill in the past year rose for the first time since the ACA was passed. Black

Coloradans are nearly twice as likely as white Coloradans to have had problems paying a medical bill. Of the 18% of Coloradans who had trouble paying medical bills, 54% took on credit card debt, and 33% were unable to afford essentials such as food and utility bills. About 1 in 5 Coloradans skipped care due to cost; and the number increases for those between 100 and 300% FPL,[30] and millennials.[31] Notably, Coloradans living at 138 to 400 percent of the federal poverty level do not qualify for Medicaid. This data suggests that Medicaid expansion has improved health care affordability for many of Colorado's lowest income residents; however, there is still a considerable portion of the population who either skip health care services due to cost, or receive care and have difficulty paying medical bills. Colorado is no exception to the national trend of rising deductibles, in fact, in 2017 the average Colorado family deductible was $3,700, which was 10% higher than the national average.[32]

Health Policy and Medical Financial Hardship Literature Summary

There is a substantial body of research around the effects of health policy on economic financial burden in the US. Optional Medicaid expansion in 2010 has been shown to reduce catastrophic financial hardship, out-of-pocket spending,[33] unpaid bills, and amounts sent to collections.[34, 35] In fact, the ACA Medicaid expansion provided a large-scale experiment, and a 2020 literature review of over 1,000 studies that examined its effects concluded that states who opted to expand Medicaid had improved health care affordability, financial security, state budgets (Medicaid expansion was 100% federally funded until 2016, then it gradually dropped to 90% by 2020), and reduced uncompensated care costs to hospitals and clinics.[36] In Colorado, uncompensated care costs were reduced by 56% during the first four years after Medicaid expansion.[37] A difference-in-difference study[38] examining changes in financial burden among families with children after the ACA found that the lowest-income families saw the greatest reduction in financial burden, followed by low-income and middle-income, although a substantialamount of children and families still face significant financial burden and out of pocket costs. Another study[39] similarly found that the lowest income families benefited the most from ACA marketplace subsidies. A Commonwealth Fund issue brief[40] described differences in implementation and outcomes of the ACA across California, Florida, New York and Texas. The brief found that the two states with lower uninsurance rates post-ACA (California and New York)also had fewer residents reporting problems getting care due to cost and lower percentages of residents having a problem paying a medical bill in the last 12 months or having accrued medical debt. Caregivers of children with special health care needs who live in states with more generous Medicaid and SCHIP programs also report less financial burden than those in other states.[41]

The Massachusetts health reform of 2006 also provides an example of the impact of health policy on financial burdens. By 2010, survey data showed that fewer families were spending more than 10% of their income on medical out of pocket expenses, and that low-income familieswere less likely to report having trouble paying for medical bills within the past year,[42] although another study found that about 25% of nonelderly adults in fair or poor health had still avoided care due to costs in the first years of the reform.[43] Additionally, some families purchasing insurance through the Massachusetts health insurance exchange before the ACA reported higher than expected out of pocket costs, especially families with high deductible plans, older

subscribers on the plan, more dependent children on the plan, and those in a low-income bracket.[44] In interviews with patients of an Emergency Department at a safety net hospital (n=976), 33% of survey respondents reported financial hardships and 22% reported concern about paying for the current visit.[45] However, Massachusetts hospitals had a 26% decrease in bad debt after the reform, which was even more pronounced in safety net hospitals.[46]

Other states have also made impactful health policy changes. For example, Iowa implemented a personal responsibility component when expanding their Medicaid program under the ACA, which involved an annual wellness and health risk assessment. Failure to comply resulted in a monthly premium, and failure to pay the premium resulted in disenrollment from Medicaid. A qualitative study interviewing disenrolled individuals found that gaps in coverage caused financial burden, health care utilization decrease, and inability to obtain prescriptions.[47] In 2018, Arkansas added a work requirement to Medicaid. In 2019 the requirement was suspended by a federal judge; however, approximately 18,000 adults had already lost coverage. A qualitative study interviewing disenrolled individuals found that employment did not increase during the time the order was in effect, 50% of those interviewed reported problems paying off medical debt, and 64% reported not taking medications due to cost.[48] Conversely, one year after the Oregon Medicaid lottery, a study found that enrollees had a decline in the probability of being sent to collections for medical bills.[49] The RAND assessment of the New York Health Act, a potential tax-funded single-payer system for the state of New York (aligned with the full publicly financed system in this report), estimated that households above 1,000% FPL would increase their health spending, while households below 1000% FPL would decrease their health spending, and that this redistribution would alleviate medical financial hardship among lower income households who are the most vulnerable to financial distress.[50]

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Health Determinants, Social Spending, and Healthcare Costs (1.2.3.5)

The purpose of this review is to summarize the literature and scientific evidence surrounding medical costs caused by diversion of funds from other health determinants (such as education, safe food supply or safe water supply). In this report we refer to spending on health determinants more generally as social spending.

Summary of Findings

There are numerous potential funding mechanisms for health care reform, as discussed in the funding section of this report. The choice of funding mechanism will inevitably impact social programs and services if funds are diverted from existing social spending initiatives. This phenomenon of greater health care spending crowding out social spending has been documented in states such as California,[1] although we found no research directly measuring theeffects of the change on health outcomes or additional costs incurred by those changes. In general, higher social spending has been shown to lead to improved health outcomes; however, there is international evidence that this does not necessarily reduce health care costs. Conversely, defunding social spending leads to worse health outcomes, and will most likely increase health care spending.

Reforms to Colorado's health care systems through the introduction of a partial or full publicly financed and privately delivered component could yield greater health outcomes and decreased health care-related spending. These aims are most likely to be achieved if social service program budgets remain constant or increase.

Social Spending and Health care Costs Literature Summary

In the literature, K-12 education and human services are usually considered social spending, and they appear to have a direct impact on health outcomes. A common data technique in this area of study is to analyze a ratio of social to health spending, as seen in several studies below. Previous studies have found that social spending alone is associated with improved health outcomes such as obesity,[2] HIV/AIDS,[3] teenage birth rates,[4] fatal mental and behavioral disorders,[5] and homicide.[6] There is also a pervasive argument in the literature that health care spending ceases to improve health outcomes when it reaches wasteful levels, and could be reallocated to social programs, which are usually more effective at improving several health outcomes.[7]

International Evidence. One of the most widely cited studies within this topic examined the effects of both health care and social spending on five health outcomes (life expectancy, infant mortality, low birth weight, maternal mortality and potential years of life lost) across 30 Organisation for Economic Co-operation and Development (OECD) countries (including the US). Bradley et al. (2011) found that higher *health care* spending as a percentage of GDP improved life expectancy and maternal mortality. They also found that higher *social* spending as a percentage of GDP was associated with better outcomes in life expectancy, infant mortality, and potential years of life lost. When analyzed as a ratio of social to health care spending, the

results remained largely the same although, curiously, they also found an association with increased rates of low birth weight.[8] These findings were corroborated by a more recent 2016 report[9] that reproduced Bradley et al.'s analysis but included additional countries and years of observation. The 2016 report also analyzed state level data in the US and found that social spending (per capita, rather than as a percent of GDP as in the cross-national study) was also associated with longer life expectancy and lower infant mortality.[9] Similarly, another study estimated that if the US raised its social spending in education and incapacity benefits (including disability, occupational injury and accident, and employee sickness benefits, and home-help and residential services for the working aged) to the same level as the highest OECD spender, it could eliminate the life expectancy gap[10] (life expectancy in the US is shorter than in other high-income countries[11]). Although one might think that countries who spend more on social benefits spend less on health care and vice versa, Papanicolas et al. (2019) found that OECD countries who spend more on health care also spend more on social services, perhaps due to societal values. A large portion of social spending in the US comes from private sources, which are concentrated on the elderly population. In fact, when private spending is taken into account, the US spends slightly more on social spending than the OECD average (19.7% vs 17.0%, respectively).[12] Some have argued that reallocating some of the funding spent on the elderly to other life stages may create more impact on long-term health outcomes.[13]

Domestic Evidence. Bradley et al. (2016) also analyzed data within the United States, and found that states with a higher ratio of social (social services and public health) to health (Medicare and Medicaid) spending had better health outcomes between 2000 and 2009. Health outcomes included adult obesity, asthma, mentally unhealthy days, days with activity limitations, and mortality rates for lung cancer, heart attack, and type 2 diabetes. They did not find a difference in postneonatal infant mortality rates.[14] This, along with the Bradley et al. (2011) international study,[8] is another prominent piece in the literature, cited by many who delve deeper into US social and health care expenditures and their effects on health outcomes. McCullough and Leider (2016) have leveraged the Robert Wood Johnson Foundation's County Health Rankings[15] to such a purpose. In 2016, they found that local (county-level) social expenditures across the US were moderately associated with higher County Health Rankings, although no particular area of spending was associated with especially notable gains. Some categories also had decreasing returns with additional spending, indicating the possibility that once a county reaches a certain threshold, "additional spending may yield fewer additional benefits from a health outcomes perspective."[16] Wealthier counties in the US tend to have better outcomes, but less wealthy counties can increase their odds of becoming "overperformers" in County Health Rankings by increasing their public health and social spending.[17]

A follow-up study by another group who included environmental and behavioral factors at the county level also found that better health outcomes were associated with higher spending in social services and welfare, although they found mixed results for higher spending on police and fire.[18] Using a typology approach, McCullough (2017) also grouped US counties into 5 expenditure groups. Two groups showed high social spending and strong health outcomes, and counties who spent more on social services and education tended to spend less on public hospitals, and vise versa.[19] Similarly, Medicaid expansion, which infused federal dollars into

state budgets, was shown to increase hospital profitability and decrease safety-net spending in California.[20] In 2019, McCullough and Leider analyzed Texas county spending on corrections, higher education, K-12 education, parks and recreation, fire and ambulance, housing and community development, police, community health care and public health, libraries, and public hospitals; they found that increased funding in four of these areas (fire and ambulance, community health care and public health, housing and community development, and libraries) were associated with improved health outcomes according to County Health Rankings over the course of six years.[21]

Social Spending in Colorado

The state of Colorado spends about 33% of its total budget on health care, over half of which comes from federal dollars to fund Medicaid, where a majority of this funding is directed. Nineteen percent of the state budget is used for kindergarten through 12th grade (K-12) education, and a little over 7% goes to human services, which oversees financial and food assistance, child welfare, rehabilitation, mental health and substance use treatment programs, and programs for the aging, among other things.[22] According to the Urban Institute, Colorado spends less per capita than most states on public welfare. They also report that the national average for K-12 education is 21%, slightly higher than Colorado's 19%, although the most recent data from the Census Bureau is from fiscal year 2017 and may not be comparable to Colorado's current budget.[23] Colorado also spends slightly less than the national average on personal health care expenditures.[24]

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Economic Impacts for Employers, Employees, and Households (2.3.5.1)

The aim of this review is to describe the research and data on anticipated employment changes in Colorado, by sector, related to changes in health care financing and anticipated economic impacts of the new system on employers and households.

Summary of Findings

The available evidence suggests that, in states where health care reforms have occurred, rates of employment in the healthcare industry remain approximately the same or eventually decrease if provider reimbursement rates decrease. Furthermore, evidence also suggests that expanded public healthcare options result in a decrease in insurance-related jobs (more so under a publicly financed option), and an increase in overall employment. Reforms will also need to take into account the funding options, which we discuss in the funding section of this report. Vermont's health care reform effort suggests that raising income taxes may have a negative impact on public perception and political feasibility. Prior literature suggests that when states expand coverage there is an increase in new businesses and self-employment among those with disabilities, those who have dependents, and those in advanced stages of life, depending on the business mandates for providing insurance to employees. Based upon the available literature, it is more difficult to discern what effect, if any, a reform would have on state competitiveness for goods and services compared to other states. It is clear that the US pays very high healthcare costs with relatively poor health outcomes. Any reform that would aim to increase Colorado's competitiveness on the national market would have to focus on controlling costs and appropriate financing for the program. Lastly, evidence from San Franscisco's health care reform indicates that reform efforts to achieve universal coverage would need to include people who are undocumented in order to be truly universal, and that this can be accomplished with deliberate planning and implementation. Most likely, the cost of insuring this population would increase their access to preventive care, decreasing overall costs in the long run (see Sections 1.2.3.1 and 1.2.3.2 for more details).

Reforms to Colorado's health care systems through the introduction of a partial or full publicly financed and privately delivered component would most likely result in the following economic changes: healthcare-related employment would either remain the same or eventually decrease (if provider reimbursementrates decrease); insurance-related jobs would likely decrease (moreso under a full publicly funded option), and Colorado would likely experience an increasein overall employment. These anticipated economic impacts would be highly influenced by the specific reimbursement, benefit design and funding mechanisms.

Employment and Health Reform Background

According to the Bureau of Labor Statistics, 89% of state and local government workers had access to medical care benefits in 2020.[1] State and local governments paid an average monthly premium of $576.34 for single coverage and $1,235.07 for family coverage.[1] Within the private

sector, 27% of workers in the 10th percentile for wage and 94% in the 90th percentile for wage had medical care benefits.[1, 2] According to the Kaiser Family Foundation 2020 Employer Health Benefits Survey, the average family premiums paid by private and non-federal employers have increased by 4% since 2019, 22% since 2015, and 55% since 2010.[3, 4] In 2020, private and non-federal employers paid an average annual premium of $7,470 for single coverage and $21,342 for family coverage, (or monthly premiums of $622.50 for single coverage and $1,778.50 for family coverage).[3] In 2019, 49.6% of Americans received health insurance through their own or a family member's employer.[5]

A key component of publicly financing services is the assumption that employers will redistribute money previously spent on medical care benefits to raise wages. These wages will then be subject to taxes, which will help cover the cost of the new health care system, ultimately placing the burden of cost back on taxpayers.[6] The savings associated with a single-payer health plan (consistent with the full publicly financed system in this report) generally arise from a reduction in administrative costs, lowering overall expenditures.[7] A systematic review[8] of economic analyses found that out of 22 studies projecting cost savings for a national single-payer plan in the United States, 20 predicted savings over several years, with the largest source of savings coming from reduced administration. The strongest predictors for savings were utilization increase, administrative savings, and reduced drug costs. Economists also generally assume that progressive plans which shift disposable income from high-income households to low-income households will increase consumption, and by effect employment, in the long run.[9] With a public option health system reform (consistent with the partially publicly financed system in this report), economists assume that publicly financed options will crowd-out private employer-based health insurance coverage, however; this is not often the case.[10] It may also beimportant to note that many health care reform predictive models do not include effects on employment, as it is very complicated and can be unpredictable.[8] Many studies focus largely either on overall savings or employment in a specific sector, rather than both.

Effects on Employment by Sector

Overall Employment. The estimates for changes in overall employment after health care reform mostly predict increased employment with increased coverage. White et al. (2017) predicted that there would be the highest increase in employment in Oregon under the Health Care Ingenuity Plan, and to a lesser extent under a single-payer plan (the proposed system was funded similarly to the full publicly financed option in this report). Interestingly, they predicted a decrease in overall employment under the public option plan (similar to the partially publicly financed option in this report).[9] Liu et al. (2018) estimated that under New York's proposed single-payer health reform plan (the proposed system was funded similarly to the full publicly financed option in this report), New York Health Act (NYHA), there could be a 1.9% increase in overall employment compared to the status quo. In turn, workers in households living at or below 1000% of FPL, particularly those who receive employer-sponsored medical care benefits in the status quo, would see an increase in wages with NYHA. On the other hand, wages may decrease for workers making above 1000% of FPL because of the increases in payroll taxes.[11] Gruber & Hanratty (1995) studied non-health sector employment and wage changes in Canadian provinces as they transitioned to national health insurance (NHI) at different times

between 1961 and 1975. Based on economic modeling and survey results, they found that NHI was associated with an estimated 1.3 to 2.6% rise in employment and a 1.4 to 4% increase in wages. Employment and wages did not rise as much in provinces that financed NHI with general revenues as compared to provinces that used lump-sum premiums. Wages also showed slower growth rates in provinces with high private health care coverage before transitioning to NHI. The authors hypothesized that the positive changes associated with NHI may be due to increased job mobility and improved overall health of workers.[12]

Insurance and Administrative Employment. Following the Massachusetts health reform in 2006, administrative health care employment (management, finance, administrative support, etc.) grew significantly faster than in the rest of the nation, while physician and nurse employment growth kept approximately the same pace. Patient care support also grew more than in the rest of the US, though not by a statistically significant amount. This may indicate an increase in utilization due to the number of newly insured individuals, and the relative ease of training new administrative and patient care support positions, relative to training new physicians and nurses.[13] Sheils & Cole (2012) predicted that a single-payer system (using a consistent mechanism with the full publicly financed option in this report) in Minnesota would reduce administrative costs by 84%, which would decrease insurance-related employment to a much greater extent than health-related employment. White et al. (2017) similarly predicted that insurance-related employment in Oregon would decrease the most under a single-payer system (which is consistent with the full publicly financed system in this report in that Oregon's potential single payer system would also pay through a single channel), but it would also decrease under the Health Care Ingenuity Plan and the public option plan (consistent with the partially publicly financed option in this report in that Oregon's potential public option would have put a government health plan on the insurance exchange).[14]

Employment in the Health Care Sector. Other states that have considered single-payer or public option reform have conducted studies to estimate the potential impact on the healthcare workforce; however, none of these states ended up enacting such systems. Therefore the evidence is mainly based on predictive models. Sheils & Cole (2012) predicted that a full publicly funded system in Minnesota would reduce non-physician employment in both physician practices and hospitals as compared to the current employment numbers under the Affordable Care Act (ACA).[14] Liu et al. (2018) estimated that adopting New York's proposed NYHA would lead to an increase in employment for health care workers by 2022 in line with increases in demand for health care services, but may decrease over the subsequent decade due to lower provider payment rates as compared to the status quo.[11] White et al. (2017) estimated macroeconomic effects of three options for health care reform in Oregon. Specifically, they compared predicted employment changes within health-related professions, insurance-related professions, and all other professions if they were to adopt a single-payer system (which is consistent with the full publicly financed system in this report), a Health Care Ingenuity Plan, or a public option (which is consistent with the partial publicly financed system in this report), as compared with the status quo. They found that there would be a decrease in employment for health-related professions under the single payer option and the public option, but there would

be an increase in employment for health-related professions under the Health Care Ingenuity Plan.[9]

On that note, there is a substantial amount of evidence more generally surrounding health care employee retention, which may be informative in considering health reform and health policy. Specifically, single-payer countries tend to pay their health workforce lower salaries than the US. If Colorado adopts a single-payer system, health care salaries may drop, and it would be reasonable to think that some people may leave the state in search of better pay. For the purpose of simplicity, we have narrowed our focus on salary-based retention to physicians and nurses in this literature review.

Physicians. Physician burnout (a state of mental exhaustion caused by professional life) is a focal point of physician retention literature. Burnout is generally related to stress, and has been linked to reduced reimbursement, increased pressure to produce, and changing rules of insurance and reimbursement systems, among many other non-financial factors.[15] Physician dissatisfaction with salary is associated with lower job satisfaction.[16] A 2004 literature review of physician turnover concluded that financial issues, characteristics of the physician's practice, and personal issues were the most salient factors in physician turnover.[17] Some groups of physicians seem to experience salary dissatisfaction more keenly than others. That is, physicians with better revenues tend to stay in patient-centered medical homes longer, and financial incentives play a core role in physician retention in the public (vs. private) sector.[18, 19] Studies have also found that specialist providers relocate to areas with lower HMO prevalence, although the effect does not appear in the primary care physician pool and is moderated by the environment of the local economy.[20] Nurse Practitioners, who have stepped up to fill physician shortages in some areas, tend to stay longer in a position and have lower odds of intending to leave their current position when they have higher salaries. [21] On the other hand, pay mattered less than training, personal elements, and practice in a systematic review[22] of rural physician retention, suggesting that rural physicians have different priorities. Gray and Grefer (2011) estimated that early career military physicians place more weight on earnings than those in later career stages. Specifically, compensation has a large impact on the decision to remain in the military during a physician's first unobligated year of service, and a small impact on retention every year after that.[23] The Medicaid shutdown in Mississippi in 2005 had little to no effect on physician job satisfaction in the state; however, a particularly high rate of malpractice lawsuits in2002, which made insurance very expensive for physicians in Mississippi, resulted in physiciansleaving the state and retiring early.[24, 25] A university-associated practice in Wisconsin was able to increase physician satisfaction with salary amount and compensation structure by implementinga population health focused scale system and moving away from relative value units (RVU).[26]

It should be noted that intention to leave practice and actually leaving are measured differently and are not equal. A survey of German physicians found that physicians who wished to emigrate were less satisfied with their jobs, listing salary among many other factors. The German system has a lower paying structure for physicians. Approximately 30% of survey participants had a desire to emigrate from Germany to another country either temporarily or permanently at the time of the survey, although the most recent physician emigration rates wereclose to 0.5% in the previous year.[27] In the United States, an analysis of the American Medical

Association Masterfile also showed that intention to leave is more highly associated with physician dissatisfaction than with actual departure from practice.[28]

Nurses. Due to a global nursing shortage that has emerged over the past decade, there is a fairly large body of literature surrounding nurse retention. International literature reviews on the subject have concluded that organizational and individual factors both play a role in nurses' decisions to stay or leave clinical practice.[29] In addition, nursing faces an ageing workforce and increased workload, which has led to burnout and a general sense of undervaluation.[30] Underfunding of certain sectors, such as long-term care facilities, has particularly contributed to nurse burnout and turnover.[31] In a survey of nurses who work at University of Colorado Hospital in Aurora, 53% reported that they experience financial stress. When asked about effective ways to retain staff, 32% suggested better pay, and 58% made a recommendation generally related to salaries or benefits (including better pay).[32] Salary and benefits were also identified by a group of mid-career Canadian nurses as a major factor in retention in a mixed methods study,[33] second only to a positive work environment among reasons to stay. A literature review[34] in 2008found that financial incentives were effective at retaining older nurses in the workforce; in the case of set salary scales, fringe benefits were also effective. In a national survey of registered nurses who currently work in a position other than nursing (i.e., those who left the profession), 35% cited better salaries in their new field as a reason for leaving nursing. The proportion was nearly 70% for men, and 33% for women.[35] In a survey[36] of 500 recently graduated nurses, 90%reported that salary, reward and benefit were important factors in retention, and another survey[37] of future nursing graduates ranked pay rate as the number one factor in choosing employment. However, other studies have found that salary is less important for retention than other factors such as self-concept, communicative leadership, network centrality, and organizational commitment.[38-40] Indeed, a high turnover NICU in Pennsylvania was able to reduce their turnover rate by 91% through a series of interventions that did not involve raising nurses' salaries.[41] According to an umbrella review[42] of evidence on nurse retention in rural areas, financial incentive programs were highly effective, as well as supportive relationships in nursing,information and communication technologies, and rural health career pathways. England's National Health Service (NHS), which is a single-payer, tax funded health care system (similar to the full publicly financed system in this report in that all payments come through a single channel), offers nurses a cost of living stipend in some areas. Metropolitan hospitals compete for nurse retention through work environment and career progression offerings, as well as remuneration for high cost of living areas and achievements/certifications.[43] A British study estimated that raising NHS nursing wages would have a very small impact on nurse retention.[44] Following the Massachusetts health reform of 2006, one study found that while hospital admissions increased post-reform, there was no change in nurse employment rates as compared to New York state, and nurses were hired at a lower rate than in California.[45]

Health Care Provider Employment in Colorado. Physician compensation reports from 2019 and 2020 found that the average physician salary in Denver has increased from $303,454 to $352,073.[46, 47] However, this average salary places Denver within the bottom ten metro areas in the country for physician compensation. This may indicate that Denver has an easier time retaining physicians due to factors outside of salary, like quality of life and the desirability of

living in Colorado.[48] To that end, Colorado was within the top ten states for retaining graduating residents between 2010 and 2019, with 59.7% of residents who trained in Colorado staying within the state to practice medicine.[49] According to the 2020 Bureau of Labor Statistics report, Colorado is home to 52,330 registered nurses that make an average annual salary of $77,860, 3,080 nurse practitioners that make an average annual salary of $109,760, and 3,020 family medicine physicians that make an average annual salary of $199,190.[50-52] Current research shows that Colorado is one among many states currently experiencing a physician shortage, and that shortage is expected to increase between now and 2030 as the population increases.[53]

Economic Impacts; Employers, Households, and Society

There are innumerable considerations to include when discussing the economic impact of healthcare reform on households and employers. The following is a general summary of some of the most prominent and prolific issues in the literature. One such topic is the use of payroll taxes to fund universal coverage. Haislmaier and Hall (2019) estimate that the increase in payroll taxes needed to finance a federally run "Medicare for All" system, without changes or regulations to current health care costs (provider payments, pharmaceutical costs, administrative costs), would result in an 11% decrease (or $5,671) in the average household's annual disposable income. They further estimate that households with employer-sponsored insurance would be impacted the most negatively by health reform, with 87.2% of those households experiencing a decrease in disposable income.[54] Indeed, Vermont was successful in passing a single-payer health plan (similar to the full publicly financed system in this report in that all payments come through a single channel) through state legislation in 2011. Although estimates predicted savings of up to 25% in state health care spending, the creation of 3,800 jobs, and an increased economic output,[55] the plan was abandoned in 2014 as the financing options relied heavily on increased taxation that was economically unsustainable, particularly forsmall businesses and low-wage earners.[56] However, on a national level, Bichay (2020) compared health care expenditures between OECD countries with single-payer and multi-payer health systems and found that single-payer systems were associated with significantly lower overall health care expenditures, approximately 0.75% of their National gross domestic product (GDP) lower compared to countries with multi-payer systems.[57] This is strikingly close to Vermont's estimate of $200 million in expenditure savings if they were to adopt a single-payer system, which Hsiao (2020) calculated to represent 0.74% of their gross state product in 2011.[55,57]

Employer mandates are one example of a major impact that health reform might have on employers. Employer mandates usually require employers of a certain size to either offer insurance to their employees or pay a penalty fee. A mixed-methods study examining mandated employer-based coverage implementation in Hawaii concluded that mandating coverage resulted in lower premiums and a lower rate of uninsured in the population, however, it did not slow the overall rise in the cost of health care.[58] Two years after the Massachusetts health reform in 2006 (a reform that also included employer mandates), a survey showed that businessowners had positive views of the reform, and that there was an increase in employers with 3 or more employees offering coverage. Employers were also less likely (compared to national data)to indicate plans to terminate or restrict coverage.[59]

The ACA provided another natural experiment for the effects of health reform on households. For the purposes of this review, we exclude predictions about the ACA and focus on analysis of its real-world effects thus far. The ACA encouraged employee wellness programs by providing funding for expanded health services to employers, which has been shown to promote wellness among employees, [60] potentially leading to reduced costs of care. It also may have pushed more employers to offer high-deductible plans, which shift more cost to the employee and are affordable for large employers.[61] There is also evidence that the ACA shifted the burden of health care costs to a more even distribution across income levels. Namely, in 2005, households in the bottom 20% of income paid 26.8% of their income compared to roughly half that amount for those with income in the top 1 percent. By 2016, health care financing had become approximately proportional, that is, the same percentage was being paid out across all income levels. [62] In the state of Colorado, the Colorado Health Foundation estimates that Colorado's economy, as measured by state gross domestic product, was $3.82 billion (1.14%) larger as a result of ACA Medicaid expansion in 2016.[63] We also acknowledge that Colorado is a state with distinct geographic regions that affect health care utilization and cost - for example, households on the Eastern Plains, the Denver metro area, the Western Slope, and the Front Range differ in demographics and health care expenditures.

Economic Impacts for Employers, Employees, and Households, contd. (2.3.5.1)

There are a few more well-known and well researched economic topics in the literature that may be of interest to the Task Force, which we include here. These topics are job lock, competitiveness of goods, and the undocumented population.

Job Lock and the Labor Pool

A common topic in the literature surrounding employment and health care is that of job lock, which is the idea that if one receives health insurance through their employer, they are less likely to take a chance on an entrepreneurial venture and lose that coverage. The reasoning is that universal or near universal coverage would encourage entrepreneurship by removing the barrier of health insurance acquisition from the process of starting a business. In studies pertaining to job-lock, coverage through a family member or Medicare is sometimes used as a proxy for universal coverage, yet is not the same as universal coverage, which may cost more to the individual. That being said, the evidence tends to solidify the claim that health care coverage options influence entrepreneurial and self-employment decisions within certain populations. A pre-ACA review of the literature on this topic in the US concluded that individuals with employer-provided health insurance stay on the job 16% longer and are 60% less likely to voluntarily leave their jobs than those with insurance that is not provided by their employers.[64] Conversely, any reform plan that mandates small businesses to provide insurance to employeesmust weigh the counter-entrepreneur effect in the balance. For example, the 2006 Massachusetts health reform required businesses with 11 employees or more to provide group insurance; a 2010 analysis showed that new entrepreneurial endeavors in Massachusetts decreased post-reform, and that small businesses may have attempted to avoid the mandate by reducing their number of employees or hiring more part-time employees, despite the fact that overall fewer people were uninsured in the state.[65]

While the health care climate has undoubtedly changed since the ACA in 2010, generally it is agreed that coverage through a spouse increases the odds of entrepreneurship,[66-68] and that self-employment spikes at age 65 when Medicare is available.[66] The connection seems less clear amongst the younger population. Leveraging the ACA passage in 2010, early studies found that increasing dependent coverage (allowing those under 26 to remain on parents' insurance) may have caused a shift in young adults from full to part time work,[69, 70] and that self-employment among this population increased especially among women.[71] Two more recentstudies, however, found that the ACA did not significantly impact job mobility for young adults, suggesting that job lock is minimal for this population.[72, 73] Finally, another study found no link between dependent coverage and likelihood of self-employment except among young adults living with disabilities, who were 19-23% more likely to be self-employed.[74] To summarize, the evidence supports the idea that job lock does occur in more at-risk populations, such as those who are supporting a family, living with a health concern or disability, or in advanced life stages; whereas young, healthy individuals seem less likely to consider losing health insurance a major concern when starting a business venture.[75-78]

Tax deductions for the self-employed have demonstrated limited effects on the decision to exit self-employment (especially for men without coverage through a spouse), but no significant effect on the decision to enter it.[67] Although there is evidence that the ACA increased the number of insured self-employed individuals, especially in states that opted to open their own marketplace,[79] self-employed individuals are still less likely to have health insurance than the traditionally employed, and self-employed females are less likely than their male counterparts to carry insurance.[80] There is also evidence that after subsidies and taxes are taken into account, premiums are lower for the self-employed after the implementation of the ACA.[81]

Literature surrounding the ACA's overall effect on the labor market has shown that the ACA did not decrease the working-age adult labor pool,[82] even in states with Medicaid expansion.[83-85] In fact, a study by the Colorado Health Foundation estimated that Colorado added over 31,000 jobs because of Medicaid expansion as of 2016, and predicted that number would continue to grow.[63] Additionally, analysis of employment trends in the 50-64 year old population found that the ACA did not change the probability of retirement or part-time work, and there was also no effect in states that opted for Medicaid expansion,[86] although another study concluded that low-educated women aged 55-64 were more likely to retire early in Medicaid expansion states.[87]This would indicate that generally, although coverage is more available/accessible, the labor pool is not reduced among this population. Similarly, an analysis of low-income workers showedthat states who chose to expand Medicaid with the ACA did not experience significant changes in employment, job switching, or full- versus part-time status.[88] A separate study examining low-wage female workers found that before the ACA, a new full-time position actually increased the risk of becoming uninsured.[89] Overall, there is little evidence that increasing coverage leads to a decreased labor pool.

Competitiveness of Goods

There is also a small body of research concerning the global competitiveness of American goods and their connection to the cost of healthcare and insurance; that is, the idea that companies pay more for employee coverage in the United States than other corporations pay in countries where universal or public insurance is available, which leads to less competitive pricesfor American goods on the international market. In 2006 the CEOs of the Big Three automotive companies (Ford, DaimlerChrysler and General Motors) met with then-president George W. Bush to voice their concern that rising health care costs in the US were affecting automotive competitiveness globally.[90] In 2003, the three companies estimated that in comparison to Canada, they spent $1200-$1400 more per midsize car entirely due to health care costs.[91] General Motors again estimated in 2004 that health care costs added about $1,500 to the cost of each vehicle they produced, a figure influenced greatly by the legacy costs General Motors pays to support the health care of its retirees.[92] In 2010, the CEO of Starbucks said that the company spends $300 million on health care coverage for employees annually, which is more than it spends on coffee annually.[93] Although it is well established that in general, the US spends a high percentage of its GDP on health care with somewhat worse health outcomes relative to other developed nations,[94, 95] it is less clear how this trickles down to global competitiveness. Indeed, the Global Competitiveness Index, a measure released by the World Economic Forum, ranked the US as number 2 out of 141 countries for productivity in 2019.[96] One study conductedpre-ACA suggested that although employers in foreign countries with universal coverage do not directly pay for health insurance on the private market as in the US, they either pay into a public fund or are taxed in order to compensate for universal health care, and the difference in rates may be equal, or partially or completely offset by other factors such as lower taxes and higher productivity in the US (depending on the comparison country in question).[97] A 2009 report concluded that the impact of the inefficiencies in the US health care system on the global competitiveness of employers and workers in the US was largely attributable to higher expenditures in the US on maintaining the same level of workforce health and care as in comparable countries.[98] A 2012 literature review of the subject acknowledged that the inefficiencies of the US healthcare system have an impact on the general well-being of Americans, but concluded that the evidence around its effects on global competitiveness are conflicting, and suggests a “relatively tenuous link between the U.S. healthcare system and international competitiveness.”[99]

Undocumented Households

An issue brief[100] on the topic of undocumented immigrants and access to care summarized that health care spending for the undocumented is lower than for citizen adults, and most commonly includes childbirth, serious injury, or poisoning. It is also noted that the undocumented use fewer services and face barriers in attaining care for themselves and their children (whether those children are US-born or not), due to fear of being detected, low levels of insurance, and language barriers. A 2016 study showed that in Los Angeles county, undocumented children were less likely than mixed-status and native families to have insurance and a usual source of care, while US-born children of undocumented parents rely heavily on public insurance.[101] The current ACA policy does not allow undocumented immigrants to be covered by Medicaid or purchase insurance through the Marketplace, although they can purchase private insurance.[102]

This population remains a large portion of the uninsured living in the United States, which continues to grow as the ACA provides coverage for more legal residents.[103, 104] Undocumented, uninsured individuals often lean on charity care, usually provided through safety net hospitals.[105] There is also evidence that the combination of being barred from ACA coverage but allowed emergency care access (no emergency room can turn away a patient in critical condition, regardless of their ability to pay), has led to unethical practices such as patient dumping, leaving safety net hospitals overburdened with care and cost.[106] Some states, including Vermont, Massachusetts, and California, provide some form of coverage for any resident, regardless of citizenship, using non-federal funds.[107] San Francisco currently covers their uninsured population (including the undocumented) through a city-wide program that employers pay into. Enrollment dropped after the ACA was introduced, but the program continues to insure the undocumented.[108] Previous literature and policy reviews have concluded that covering undocumented individuals may lower costs through a few mechanisms, including lower insurance premiums (due to a larger and healthier risk pool) and an uptick in cost-effective preventative and ambulatory care, rather than more expensive emergency and late-stage treatment.[109-112] Results of a qualitative study conducted among mixed-status families in a border town concluded with the recommendation that successful health care reform should address broader issues related to immigration status, especially anxieties regarding future chances of regularization, which impact mixed-status family decisions to enroll in healthcare programs and had unintended consequences for US-born children.[113] Regarding public support for including the undocumented in healthcare reform, a state level study of New Mexico found that the public was more in support of providing coverage to undocumented children than to undocumented adults. Liberal ideology and perceptions of commonalities with Latinos were associated with increased support for reforms that included coverage for the undocumented. The majority of respondents did not support such policies.[114] Internationally, similar policies to the ACA implemented in the UK and Germany that exclude undocumented immigrants from coverage have been met with disapproval from physicians who feel pressured to identify and exclude potential patients from treatment, and lead to fear and confusion amongst immigrants around the medical system.[115] An issue brief from the Commonwealth Fund summarized that European countries have found success in three strategies for improving access to health care for the undocumented by focusing on: specific populations such as pregnant women and children; specific types of services, such as prevention or infectious disease control; and specific funding policies such as allowing the undocumented to purchase insurance.[116]

In the state of Colorado, undocumented immigrants contributed approximately $134,582,000 in state and local taxes in 2015.[117] The Congressional Budget Office's 2007 report,[118] "The Impact of Unauthorized Immigrants on the Budgets of State and Local Governments" concluded, based on existing literature, that state and local tax revenues from undocumented immigrants do not offset the total cost of services (education, health care and law enforcement) provided to those immigrants, although these costs are a small percentage of what state and local governments spend to provide the same services to residents. While it is difficult to estimate the exact impact, it is likely "modest." The report also concluded that federal aid programs did not fully cover the costs of state and local governments in providing these services.[118]

Section 2.3.5.1 References

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Federal and Legal Constraints to Healthcare Reform in Colorado (1.2.4.2)

The purpose of this review is to describe federal and legal constraints to healthcare reform in Colorado and provide a broad overview of strategies to address these constraints. In this report we use single payer option and single channel payment system interchangeably.

Summary of Findings

A viable model for health care reform at the state level must overcome a number of legal and federal constraints. The primary legal constraint is the Employee Retirement Income Security Act of 1974 (ERISA). Federal constraints include stipulations of Medicare, Medicaid, and the Affordable Care Act (ACA). Deliberately crafted legislation can avoid the legal constraints associated with ERISA. Federal constraints can be addressed using waivers. States can apply for waivers from the US Department of Health and Human Services requesting exemptions from certain federal requirements in order to develop innovative methods of health care delivery at the state level. The number and types of waivers required depend heavily on the proposed legislation.

The process of identifying and applying for appropriate federal waivers is time consuming and complex. However, there is reason to believe that the current administration will be supportive of states looking to develop innovative health care systems. The types of waivers that are approved often depend on the policy leanings of the administration and the current Department of Health and Human services secretary, Xavier Becerra, recently confirmed Health and Human Services secretary, oversees the waivers that states use to customize health care delivery. Both President Biden and Becerra have expressed support for expanding health insurance coverage.[1] At the state level, Colorado Governor Jared Polis cited increasing access to affordable health care and innovative approaches to meet health care needs as top priorities.[2]

Any legislation to reform Colorado's health care system must be in compliance with the federal Employee Retirement Income Security Act (ERISA) in order to avoid legal challenges. Depending on the proposed legislation, federal waivers may be required to navigate constraints posed by Medicare, Medicaid, and the Affordable Care Act. Reform efforts in other states have established a precedent for obtaining federal waivers for state healthcare innovation.

Legal Constraints: ERISA

Summary. The Employee Retirement Income Security Act (ERISA) is a federal law regulating employer benefit plans. It supersedes state laws regarding health insurance and thus complicates enactment of a state level system with a single channel for payment. While states cannot prohibit employer-sponsored plans as part of single payer legislation without violating ERISA, states can enact legislation that creates an optional alternative to employer-sponsored plans. This allows for the creation of a state-sponsored health system that is in compliance with ERISA.

Detailed Overview. In 1974, Congress enacted the Employee Retirement Income Security Act (ERISA) to regulate employer benefit plans, including health coverage. In order to encourage employers to sponsor benefits plans and to allow these plans to operate independently from varying state laws, ERISA supersedes state laws that relate to employee benefit plans. Thus, ERISA has the potential to complicate plans for states to implement a single payer health care system, as the adoption of a single payer model would impact employee-sponsored health plans. It is worth noting that at the time ERISA was enacted, there were active discussions of a national health care program underway. As a result, the possibility of state health care expansion was not a prominent consideration.

Understanding the potential impact of ERISA on state health care reform is complicated by the fact that its clauses appear contradictory, therefore much of our knowledge on the limitations imposed by ERISA come from prior U.S. Supreme Court and Circuit Court decisions.[3] Court decisions suggest that ERISA does not necessarily prevent enactment of a single payer health care system. While ERISA would likely prevent a state from enacting a law that prohibits self-insured employer-sponsored benefit plans, states may be able to enact legislation creating an optional alternative to employer-sponsored benefit plans. Such an alternative would influencethe behavior of employers without violating ERISA, and subsequently allow for a universal state health system. In addition, ERISA may allow the state to align other aspects of the health care delivery system, such as claims payment rules, through a single channel. The “single channel” approach falls short of a single payer option, but allows the state to streamline health care administration while maintaining a system of multiple payer and benefit plans.
In short, while the state must pay close attention to the limitations imposed by ERISA on health care reform, there is some legal precedent for designing a single payer or single channel state system that is compliant with ERISA.

Federal Constraints

To enact a single payer system, states must apply for exemptions, or waivers, from certain requirements imposed by Medicare, Medicaid, and the Affordable Care Act (ACA) Health Insurance Marketplace. A single-payer model requires waivers from specific requirements in Medicare, Medicaid, and the Affordable Care Act (ACA) health insurance exchange. The purpose of the waivers is threefold:[3,4]

1. To allow the state to obtain federal funds for eligible residents and reinvest savings accrued from providing higher value care into the healthcare system;
2. To provide the state flexibility to integrate and align federal claims processing and billing requirements for different funding sources; and
3. Align benefits with a standard benefit package to ensure an integrated health care delivery system.

Two federal waiver mechanisms allow states considerable latitude in customizing an innovative health care delivery plan. Section 1332 of the ACA offers state governments the opportunity to waive portions of the ACA in order to optimize health care delivery. Further, Section 1115 of the Social Security Act allows for states to develop innovative strategies for Medicaid delivery.

Extensive research into specific federal waiver requirements within these two mechanisms has been conducted by other states proposing systemic health care reform. In particular, we draw heavily from research conducted in Vermont to inform proposed single-payer and public option legislation in the state of Colorado.[3]

Waiver Requirements for a Single-Payer System

Medicare Waivers

Summary. Three federal waiver options exist to include Medicare in a state-created single-payer system. The most flexible of these options is a waiver from the Center for Innovation at the Centers for Medicare and Medicaid Services (CMS). Securing this waiver would allow for the state to take over the administration of Medicare and incorporate Medicare administration into a state-based single-payer system.

Detailed Overview. Medicare is the federal health insurance program for individuals 65 or over, certain younger people with disabilities, and those with End-Stage Renal Disease.[5] It is governed by federal law; therefore, states traditionally have a limited role in administering Medicare. However, federal waivers offer opportunities to include Medicare in a state-created single-payer system. The waiver opportunities are discussed in depth below.

1. Waiver from Center for Innovation at the Centers for Medicare and Medicaid Services (CMS) (42 USC §1315a)

   Context: The ACA created the Center for Innovation within CMS to allow opportunities for innovation in Medicare and Medicaid. The goal of the waiver provision is to encourage innovative methods to reduce program expenditures and improve quality of care. This waiver does not require budget neutrality for theinitial 5-year waiver term, which allows states more flexibility in designing a program and allows a period of time to achieve cost savings.

   Relevance: This type of waiver can be used to align Medicare payment and delivery requirements with Medicaid and create the basis for a streamlined payment system. Aligning and simplifying the administration of Medicare would ensure that there is one set of administrative requirements in the single-payer system. Request to administer (or contract administration of) Medicare payment and claims as part of the waiver would ensure that the claims and billing process will also flow through the single payer. In addition, if the state pursued an all-payer rate process whereby a uniform payment and single rate is established for all public and private insurers,[6] Medicare should be included in this.

2. Traditional Medicare waiver (42 USC §1395b-1)

   Context and Relevance: CMS has the authority to allow flexibility in payment mechanisms in order to improve quality or efficiency in Medicare. This provision is more limited in scope and alone would be insufficient to merge Medicare with a new, single-payer system.

3. Administering Medicare as allowed under 42 USC §1395kk

Context: The state has the authority to administer Medicare benefits provided specified minimum requirements are met. The state must have demonstrated capability to carry out the functions of Medicare, it must comply with conflict of interest standards, and it must have sufficient assets to financially support the functions of Medicare.

Relevance: If the state is able to fulfill minimum requirements, it is then able to determine and make payments for Medicare services, provide beneficiary education, and communicate necessary information to providers. This option is more limited in scope than the Center for Innovation waiver, and it alone is insufficient to merge Medicare into a single-payer system. However, it can allow for additional models to be considered in the system design.

Medicaid Waivers

Summary. Colorado can apply for a waiver through Section 1115 of the Social Security Act that allows the state substantial flexibility to incorporate Medicaid into a single-payer system. The Global Commitment to Health waiver approved for Vermont serves as a precedent for how states can restructure their Medicaid programs.

Detailed overview. Medicaid is the public health insurance program for individuals with low income. It is structured as a federal-state partnership whereby states administer Medicaid programs and have the flexibility to determine covered populations and services, all subject to federal standards.[7] States are guaranteed federal matching dollars for qualified services provided to eligible enrollees.

Context: Section 1115 of the Social Security Act allows states flexibility in the administration of Medicaid. To include Medicaid in a single-payer system, the state can adopt a model similar to the Global Commitment to Health waiver approved for the state of Vermont in 2005. This waiver allowed the state of Vermont to fundamentally restructure its Medicaid program and can serve as a template for restructuring Medicaid in Colorado to allow incorporation into a single payer system. Under the Global Commitment to Health Waiver in Vermont, the amount of federal Medicaid funding available to the state is capped. The state is considered a managed care entity, meaningthat it pays itself (with the assistance of federal matching funds) a premium for each beneficiary. In exchange for taking on the risk of operating under a capped funding arrangement, the waiver allows Vermont to use federal Medicaid funds to refinance an array of its non-Medicaid health programs. The goals of the waiver are to provide the state with financial and administrative license to help maintain its broad public health care coverage and provide more effective services, explore new ways to reduce the number of uninsured citizens, and encourage innovation in health care by focusing on health care outcomes.[8]

Relevance: The state can pursue a waiver modeled after the Global Commitment for Health waiver approved for Vermont to incorporate Medicaid into a single-payer model.

Affordable Care Act Health Care Marketplace Waivers

Summary. States can apply to waive the requirements of the ACA Health Care Marketplace as long as they have passed legislation that provides benefit coverage equal to or more comprehensive than the marketplace.

Detailed overview.

Context: The Health Insurance Marketplace is "a shopping and enrollment service for medical insurance" created by the ACA.[9] Section 1332 of the ACA gives the federal Department of Health and Human Services (HHS) the authority to waive the federal requirements for the qualified health benefits plans, the health insurance exchanges, the cost-sharing in qualified health benefit plans, and the premium subsidies. States seeking a waiver will need to have passed legislation and to have a proposal providing benefit coverage equal to or more comprehensive than the exchange, provide cost-sharing protections against excessive out-of-pocket spending, and cover at least as many residents as would have received coverage via the exchanges.

Relevance: Section 1332 allows the state to obtain federal premium and cost-sharing subsidies to fund a single-payer system. The state could use this waiver to align the benefit packages and administration.

Waiver Requirements for a Publicly Funded / Privately Delivered Plan or Publicly Funded / Publicly Delivered Plan

Waiver requirements for a plan that involves public funding / private delivery or public funding / public delivery are more straightforward than for a single payer plan. If the plan becomes a state licensed insurance product, it could be offered through the Colorado state health care marketplace. This would obviate the need to pursue the ACA Health Care Marketplace waiveras described above. However, if the state pursues a single channel system of payment that includes a publicly funded plan, the state would still need to seek waivers from federal law regarding Medicare and Medicaid as detailed above.

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Cost Models

Here we detail the data and methods used to generate estimates of total healthcare expenditure for the state of Colorado under three policy scenarios. First, we outline the role of cost modeling in the scope of the project. We then describe the data that we used, our modeling approach, and our results. Additional details on modeling, exploratory data analysis, and model diagnostics are located in the statistical appendix. In addition, a visual representation of our approach is included as Figure 2.

The goal of the cost modeling is to estimate the total healthcare expenditure for the state of Colorado under three policy scenarios. Statistically, this is accomplished by estimating the mean healthcare expenditure for individuals in our sample and extrapolating this mean estimate to the entirety of Colorado's population. We generate a point estimate and a confidence interval for the average healthcare expenditure for an individual in Colorado under each insurance type. Because we use a representative sample from the American Community Survey to estimate thismean (details in the Data section), we can multiply this mean estimate and the confidence bounds by the population of Colorado to get a point estimate and confidence bounds for thetotal cost under each insurance type. These three policy scenarios are defined as: status quo, partial publicly financed and privately delivered, and full publicly financed and privately delivered.

We use the Medical Expenditure Panel Survey data (henceforth 'MEPS') and the American Community Survey data for Colorado (henceforth 'ACS') to estimate mean healthcare expenditure. We use MEPS and ACS data from 2018, as that is the most recent year for which both datasets are available. MEPS is a nationwide sample of 14,541 individuals for which we have detailed information on healthcare expenditure, insurance coverage, and various demographic and health related variables. The ACS data is a Colorado-specific sample of 55,928 individuals for which we have information on a variety of demographic and insurance related variables, but we crucially do not have information on healthcare expenditures for ACS participants. More detail on the data is in the Data section.

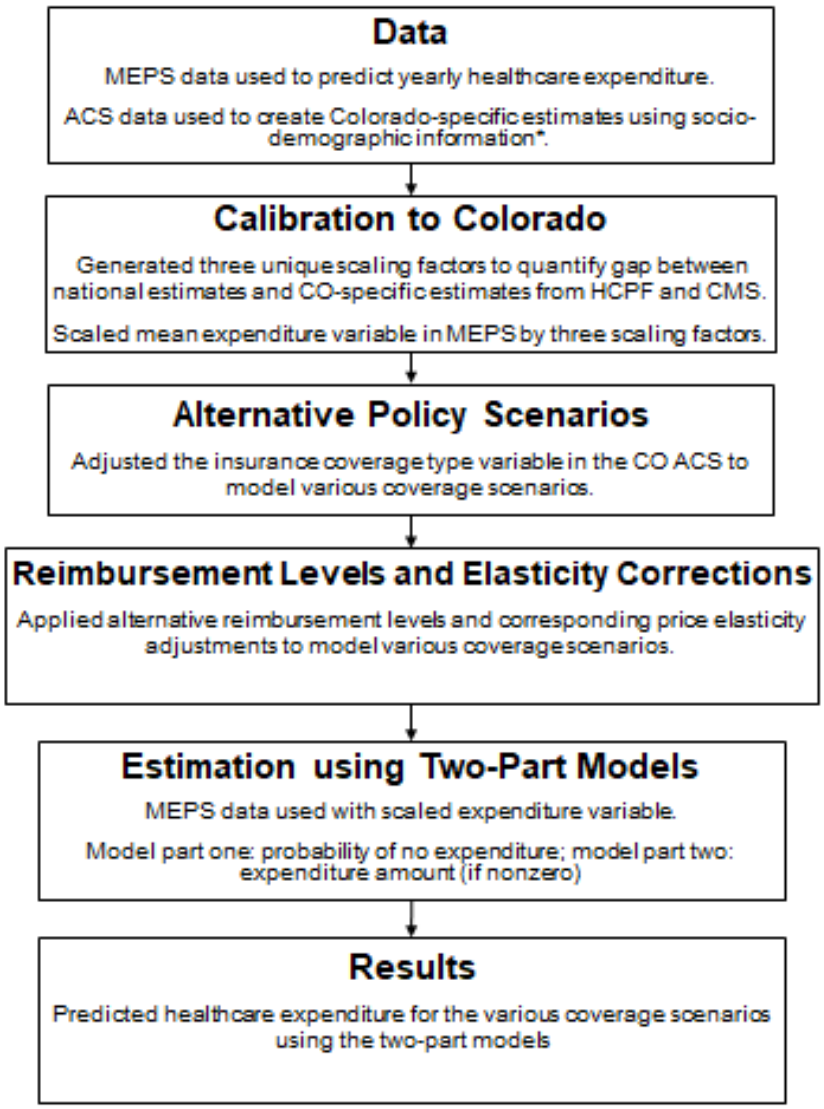
Our modeling approach is as follows. We build a model using the MEPS data to predict healthcare expenditure using a set of demographic and insurance coverage related variables that are present in both the MEPS and the ACS data. We then use the model to predict yearly healthcare expenditure for individuals in the Colorado ACS data. This allows us to estimate the mean healthcare expenditure and a confidence interval for that mean for individuals in the Colorado ACS data, whom we take to be representative of the population of Colorado. More details on the modeling are in the Methods section.

We want to estimate the total cost under the three coverage scenarios: status quo, partial publicly financed and privately delivered, and full publicly financed and privately delivered. We also adjust the reimbursement rate for the two reform options and adjust the rate of public adoption for the partial publicly financed and privately delivered scenario (which is linked to plangenerosity). The three coverage scenarios are modeled via adjustment of the insurance coverage variable in the Colorado ACS sample. Adjustments to the reimbursement rate and the

plan generosity are modeled by scaling the predicted expenditure and varying the proportion of individuals who switch to the new public option, respectively. Details are in the Methods section.

The remainder of this report details the data and the modeling approach that we used, and the estimation of the total costs for the state of Colorado and 95% confidence intervals for those costs. Additional details on the statistical methods used, exploratory data analysis, and model diagnostics are contained in the statistical appendix.

Figure 2. Cost Modeling Procedure



*CO specific socio-demographic information included family income, insurance coverage type, education level, ethnicity, race, sex, and age.

MEPS: Medical Expenditure Panel Survey
ACS: American Community Survey
CO: Colorado

Data

This section discusses the MEPS and ACS data and details some information on the variables that are included in the model. We also discuss data cleaning and missing data. As framing for the following description of the data and the cleaning process, it is useful to consider that the following variables (in some form) are included in our model: yearly healthcare expenditure, insurance coverage type, family income, sex, age, education level, race, and ethnicity. The choice of these covariates was based in part on literature, in particular the work of Deb and Norton.[1]

MEPS data for the years 2017 and 2018 were downloaded from the MEPS website. Yearly expenditure for the year 2018 was taken to be the variable TOTEXPY2. TOTEXPY2 is defined to be the total healthcare expenditure for the year 2018. Other variables used as independent variables in the cost model from MEPS include family income for the year 2018 (FAMINCY2), insurance type for the year 2018 (INSURCY2), age (defined as age as of December 31, 2018 using DOBYY), education (EDUCYR), race (RACEV1X), and ethnicity (HISPANX). A table of variables used in our analysis is included in the statistical appendix.

We adjust some of the variables described above for our analysis. For the variable INSURCY2, which measures insurance coverage type, we merge category `4' (corresponding to `Medicare Only') and category `6' (corresponding to `Medicare and Other Public Only') into a single category, corresponding to `Medicare, no private insurance'. The variable `EDUCYR', which measures years of education, is transformed into a categorical variable with four categories. These categories correspond to <12 years of education, exactly 12 years of education, less than 16 years of education, and 16 or more years of education. For most scenarios we considered total expenditure as measured by the TOTEXPY2 variable was calibrated to match expenditure in the state of Colorado. Details on this calibration are in the Methods section.

We next perform an exclusion based on missingness or nonsensical entries for our covariates of interest. We exclude 154 subjects with TOTEXPY2 equal to -1, which denotes `Inapplicable' according to the MEPS codebook. We exclude 7 additional subjects with negative values of the FAMINCY2 variable. We exclude an additional 1,311 subjects with missing education data. This brings the size of our MEPS sample to 13,069 subjects. This is the sample used for subsequent modeling.

ACS data from Colorado for the year 2018 was downloaded from the ACS website. Relevant variables from the ACS data are as follows: RAC1P (used to define the race covariate), HISP (used to define ethnicity), SCHL (used to define years of education), AGEP (used to defineage), and SEX (used to define sex). The following variables were used to define insurance coverage status: HICOV, PUBCOV, PRIVCOV, and HINS3.

Where there were differences in form between these variables in ACS and MEPS, we adjusted the variables in the ACS data to match the coding described for the MEPS data. Such ‘adjustment,' also known as mapping, is done for the race variable, the insurance coverage variable, and the years of education variable.

From the ACS data, we exclude 12,463 subjects with negative or missing family income. we exclude a further 1,697 subjects with missing education status. We exclude a further 1,107 subjects with missing race. This brings the size of our ACS sample to 40,661 subjects. This is the sample used for subsequent exploratory data analysis and modeling.

Methods

There are two broad methodological concerns in this project. The first is how we operationalize the scenarios described in the introduction, i.e. different insurance types, different reimbursement rate and plan generosity scenarios therin, and calibration of the expenditure variable in MEPS to be better representative of Colorado. Second is the statistical modeling used to predict healthcare expenditure from the set of independent variables discussed in the Data section.

Calibration to Colorado

After data cleaning and preprocessing, there is healthcare expenditure, demographic, and insurance related data for 13,069 individuals in MEPS. MEPS is not a Colorado-specific sample, and as healthcare spending patterns vary by region, it is of interest to calibrate the healthcare expenditure variable to better reflect patterns of healthcare spending in Colorado. To this end, we perform calibration of the total expenditure variable before modeling. This was done by scaling the TOTEXPY2 variable in the MEPS data, where a unique scaling factor is applied to individuals in accordance with their insurance coverage status as measured by INSURCY2. Theprocedure was as follows. First, a naïve model is fit to the data without any calibration (details on modeling approach to follow). Then, the mean predicted expenditure in the Colorado ACS data for individuals with Medicaid, Medicare, and private insurance was calculated. We generate the 'expected' mean yearly expenditure for Medicare, Medicaid, and private insurance from separate data as follows. We take the average yearly expenditure estimate for individuals on Medicare and private insurance from the CMS 2014 data[4] and extrapolate it to the year 2018 based on the estimated growth rate. We generate the expected mean yearly expenditure for Medicaid based on the HCPF annual report for the year 2018.[5] We compare the predicted means from our naïve model to these expected means and calculate the ratio of the expected mean to the predicted mean for individuals on Medicare, Medicaid, and private insurance. A unique ratio is generated for individuals on Medicare, Medicaid, and private insurance. The TOTEXPY2 variable in MEPS is then multiplied by the ratio corresponding to the observed insurance coverage status. Exact values for these ratios are in the statistical appendix. Costs for uninsured individuals were increased by 20% in accordance with a calibration to healthcare expenditure in Colorado, thus the TOTEXPY2 variable in MEPS was multiplied by 1.2 for individuals who are classified as uninsured according to the INSURCY2 variable.

Alternative Policy Scenarios

The three health policy scenarios, those being status quo, partial and full publicly financed and privately delivered, were modeled as follows. Individuals in the ACS data under the age of 65

are categorized as being either uninsured, on public insurance, or on private insurance. There is a variable in the ACS data, the so-called 'insurance' variable, that records this status.

There are two tools used to model the different healthcare coverage scenarios, those being: manually adjusting the value of the insurance coverage covariate in accordance with the given scenario, and adjusting the predicted expenditure in accordance with reimbursement rate and elasticity. Note that individuals over the age of 65 do not undergo adjustment in any scenario but are included in the estimation of total cost as Medicare recipients. We decided to benchmark the new publicly financed and privately delivered option, whether it be partial or full, against the private insurance market. This means that individuals who move to the new public option in a given scenario have the value of their insurance coverage variable set to the category denoting private insurance. Additionally, individuals who move to the new public option have their predicted cost scaled by a factor that depends on reimbursement rates and elasticity (details to follow). Take, for example, an individual who moves from the uninsured category to the new public option. The value of the insurance coverage variable for that individual is changed from the category denoting 'uninsured' to the category denoting 'private insurance'. Additionally, the predicted cost is scaled by a factor that depends on reimbursement rate. If an individual moves from private insurance to the new publicly financed and privately delivered option, the value of the insurance coverage variable stays the same, while the predicted price is scaled by the reimbursement rate factor. If an individual stays on private insurance and does not switch in a given scenario, the value of their insurance coverage variable stays the same, and the predictedcost is not scaled.

The exact adjustment of the insurance coverage variable in accordance with the different scenarios is as follows. Note that all of these adjustments are made for individuals in the ACS data, and not for individuals in the MEPS data. For the status quo scenario, the insurance coverage variable is not adjusted. For the partial publicly financed privately delivered scenario, all uninsured individuals under the age of 65 are moved to the 'private insurance' category. A varying proportion of individuals move from private insurance to the new option – however this change is only reflected in a scaling of their predicted cost (details to follow) and *not* in a changeof their insurance coverage status variable. In particular, we model the case where 0%, 10%, and 20% of individuals on private insurance switch to the new option in the partial publicly financed and privately delivered option scenario. Individuals on Medicaid only have their insurance coverage status variable adjusted in the case of the full publicly financed and privately delivered option, where all uninsured individuals and all publicly insured individuals have their insurance coverage covariate changed to the private insurance category.

Reimbursement Levels and Elasticity Corrections

In addition to adjusting the insurance coverage variable to model the different scenarios, we also adjust the predicted expenditure for individuals on the new option. In brief, we consider four reimbursement rates, which each map to a change in predicted expenditure in accordance with known theory around the elasticity of demand for healthcare.[6,7] In the case where the new option reimburses the same as private insurance (i.e. 250% of Medicare), we do not change thepredicted expenditure for individuals in the new option. In the case where the new option

reimburses at 200% of Medicare, we decrease the predicted expenditure by 4%. In the case where the new option reimburses at 150% of Medicare, we decrease the predicted expenditure by 8%. In the case where the new public option reimburses at 100% of Medicare, we decrease expenditure by 12%.

Estimation Using Two-Part Models

Our approach to predicting healthcare expenditure based on the set of covariates discussed in the data section is as follows. To estimate mean healthcare expenditure, we implement a two-part model. Two-part models estimate the probability of nonzero expenditure and the magnitude of expenditure separately. This approach has many beneficial properties, namely enabling distinct estimation of the extensive and intensive effects and meeting the assumptions of semicontinuous cost data. It has substantial support in the literature,[1,2] and is supported by our statistical diagnostics (Appendix).

The first part of the model has a binary response variable denoting whether or not yearly healthcare expenditure was nonzero. The second part of the model estimates the magnitude of yearly expenditure, conditional on the fact that yearly expenditure is nonzero. The independent variables included in the model are as follows: family income, insurance status, sex, age, age squared, interactions of sex and age, interactions of sex and age squared, education, race, and ethnicity. The first part of the two-part model was estimated via logistic regression. The second part of the two-part model was estimated via a generalized linear model with a gamma distribution and a log link function. Additional details on model specification are contained in the statistical appendix.

An issue in the estimation of average cost is the presence of extreme outliers. It is well established that individual healthcare expenditure data is very right-skewed.[3] We believe that the outliers are part of the true distribution of costs, thus they must be directly modeled and not treated via exclusion or truncation. This presents issues with model fitting, diagnostics, and standard errors; these are covered extensively in the statistical appendix. In brief, the existence of these outliers does not make the estimation of the total cost particularly statistically difficult, but it does make it challenging to estimate reliable confidence intervals. We present evidence in the statistical appendix that bootstrapping the MEPS data is the most important element in the estimation of confidence intervals, thus this is the approach we have implemented to estimate the confidence intervals quoted in the main body of this report. In addition, reported mean and total cost point estimates are based on the means of bootstrap distributions of cost. This bootstrapping approach allows us to estimate the frequency and magnitude of outliers from the observed data and propagates this uncertainty into our estimation of total healthcare expenditure. Experimentation shows that accounting for the uncertainty in the MEPS data via bootstrapping is crucial for drawing confidence intervals, while additionally accounting for the uncertainty in the ACS data via a second bootstrap is negligible. Crucially, all confidence intervals assume the validity of our model. We present evidence from statistical diagnostics and literature that our two-part modeling is appropriate, and we believe that it is.

Results

Table 1 displays the mean cost and confidence intervals for the mean for individuals in Colorado. Table 2 displays total cost and confidence intervals for the total cost. Table 3 displaystotal cost as a percentage of the cost under the status quo. Note that all tables display cost for all individuals in the state of Colorado and not just individuals on publicly funded health insurance. The tables also provide confidence intervals. These confidence intervals represent the uncertainty of our estimates given reform option specifics and assumptions which we detailed earlier. This uncertainty would likely affect all of our estimates in a similar way which gives us greater confidence in the relative position of our estimates to each other (i.e., comparing different cost estimates across health reform options).

Table 1: Estimates and 95% confidence intervals in dollars for mean healthcare expenditure for an individual in Colorado under the various scenarios.

Overall per-person cost	Reimburse 100%	Reimburse 150%	Reimburse 200%	Reimburse as private (250%)
Status quo – no uninsured adj.	-	-	-	6616 (6230, 7037)
Status quo – 20% uninsured increase	-	-	-	6634 (6248, 7057)
0% private crossover	6778 (6368, 7214)	6790 (6378, 7226)	6801 (6389, 7238)	6813 (6400, 7250)
10% private crossover	6734 (6327, 7166)	6760 (6351, 7194)	6786 (6376, 7222)	6813 (6400, 7250)
20% private crossover	6686 (6283, 7115)	6728 (6322, 7160)	6771 (6361, 7205)	6813 (6400, 7250)
Full publicly financed and privately delivered	5996 (5594, 6409)	6178 (5762, 6605)	6361 (5931, 6802)	6544 (6100, 6998)

Table 2: Estimates and 95% confidence intervals in billions of dollars for total healthcare expenditure in the state of Colorado under the various scenarios. Assuming Colorado population of 5,773,714 (2020 census figure).				
Overall population cost (in billions)	Reimburse 100%	Reimburse 150%	Reimburse 200%	Reimburse as private (250%)
Status quo – no uninsured adj.	-	-	-	38.20 (35.97, 40.63)
Status quo – 20% uninsured increase	-	-	-	38.30 (36.07, 40.75)
0% private crossover	39.13 (36.77, 41.65)	39.20 (36.83, 41.72)	39.27 (36.89, 41.79)	39.34 (36.95, 41.86)
10% private crossover	38.88 (36.53, 41.37)	39.03 (36.67, 41.54)	39.18 (36.81, 41.70)	39.34 (36.95, 41.86)
20% private crossover	38.60 (36.27, 41.08)	38.85 (36.50, 41.34)	39.09 (36.74, 41.60)	39.34 (36.95, 41.86)
Full publicly financed and privately delivered	34.62 (32.30, 37.00)	35.67 (33.27, 38.14)	36.73 (34.24, 39.27)	37.78 (35.22, 40.40)

Table 3: Estimates comparing the total cost of each scenario as a percent of status quo.				
Overall cost as % of status quo	Reimburse 100%	Reimburse 150%	Reimburse 200%	Reimburse as private (250%)
Status quo – no uninsured adj.	-	-	-	99.73%
Status quo – 20% uninsured increase	-	-	-	**100% ($38.3B)**
0% private crossover	102.17%	102.35%	102.52%	102.70%
10% private crossover	101.51%	101.90%	102.29%	102.70%
20% private crossover	100.78%	101.42%	102.07%	102.70%
Full publicly financed and privately delivered	90.38%	93.13%	95.88%	98.64%

Note that rows 2 and 3 of the tables are slight permutations on the status quo – row 2 does not calibrate the expenditure of the uninsured while row 3 does. This does not have a substantial effect on the estimates. Rows 4-6 correspond to the partial public financed and privately delivered option and the percentage crossover describes the proportion of individuals who switch from private insurance to the new public option. All expanded public option scenarios assume the entire uninsured population joins the new public option and no currently publicly insured individuals under 65 (Medicaid recipients) switch to the new public option. Row 7 corresponds to a full publicly financed and privately delivered option, where all individuals underthe age of 65 switch to the new option.

Tables 4-6 display our estimates for the total cost for years 2, 5, and 10. These are calculated based on Table 2 assuming CMS' Colorado specific growth rate of 4.5%

Table 4: Estimates and 95% confidence intervals in billions of dollars for total healthcare expenditure in the state of Colorado under the various scenarios for year 2 assuming a 4.5% annual growth rate. Assuming Colorado population of 5,773,714 (2020 census figure).

Overall population cost (in billions)	Reimburse 100%	Reimburse 150%	Reimburse 200%	Reimburse as private (250%)
Status quo – no uninsured adj.	-	-	-	39.92 (37.59, 42.46)
Status quo – 20% uninsured increase	-	-	-	40.02 (37.69, 42.58)
0% private crossover	40.89 (38.42, 43.52)	40.96 (38.49, 43.60)	41.03 (38.55, 43.67)	41.11 (38.61, 43.74)
10% private crossover	40.63 (37.23, 43.23)	40.79 (38.32, 43.41)	40.94 (38.47, 43.58)	41.11 (38.61, 43.74)
20% private crossover	40.34 (37.90, 42.93)	40.60 (38.14, 43.20)	40.85 (38.39, 43.47)	41.11 (38.61, 41.86)
Full publicly financed and privately delivered	36.17 (33.75, 38.67)	37.28 (34.77, 39.86)	38.38 (35.78, 41.03)	39.48 (36.80, 43.74)

Table 5: Estimates and 95% confidence intervals in billions of dollars for total healthcare expenditure in the state of Colorado under the various scenarios for year 5 assuming a 4.5% annual growth rate. Assuming Colorado population of 5,773,714 (2020 census figure).

Overall population cost (in billions)	Reimburse 100%	Reimburse 150%	Reimburse 200%	Reimburse as private (250%)
Status quo – no uninsured adj.	-	-	-	45.55 (42.89, 48.45)
Status quo – 20% uninsured increase	-	-	-	45.67 (43.01, 48.60)
0% private crossover	46.66 (43.85, 49.67)	46.75 (43.92, 49.75)	46.83 (43.99, 49.84)	46.91 (44.06, 49.92)
10% private crossover	46.37 (42.49, 49.33)	46.54 (43.73, 49.54)	46.72 (43.90, 49.73)	46.91 (44.06, 49.92)
20% private crossover	46.03 (43.25, 48.99)	46.32 (43.53, 49.30)	46.62 (43.81, 49.61)	46.91 (44.06, 49.92)
Full publicly financed and privately delivered	41.28 (38.51, 44.12)	42.53 (39.68, 45.48)	43.80 (40.83, 46.83)	45.05 (42.00, 48.18)

Table 6: Estimates and 95% confidence intervals in billions of dollars for total healthcare expenditure in the state of Colorado under the various scenarios for year 10 assuming a 4.5% annual growth rate. Assuming Colorado population of 5,773,714 (2020 census figure).

Overall population cost (in billions)	Reimburse 100%	Reimburse 150%	Reimburse 200%	Reimburse as private (250%)
Status quo – no uninsured adj.	-	-	-	56.77 (53.45, 60.38)
Status quo – 20% uninsured increase	-	-	-	56.92 (53.60, 60.56)
0% private crossover	58.15 (54.64, 61.90)	58.25 (54.73, 62.00)	58.35 (54.82, 62.10)	58.46 (54.91, 62.21)
10% private crossover	57.78 (52.95, 61.48)	58.00 (54.50, 61.73)	58.23 (54.70, 61.97)	58.46 (54.91, 62.21)
20% private crossover	57.36 (53.90, 61.05)	57.73 (54.24, 61.44)	58.09 (54.60, 61.82)	58.46 (54.91, 62.21)
Full publicly financed and privately delivered	51.45 (48.00, 54.99)	53.01 (49.44, 56.68)	54.58 (50.88, 58.36)	56.14 (52.34, 60.04)

Cost Model References

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Appendix

Literature Review Appendix

Search Terms and Exclusion Criteria

Topic	Search Terms	Exclusion Criteria
1.2.3.1 Cost of emergency room, urgent care and intensive care treatment for individuals who are unable to afford preventive or primary care in lower-cost settings	("cost" OR "expense" OR "expenditure" OR “charge”) AND ("emergency care" OR "emergency department" OR "urgent care" OR "intensive care") AND ("primary care" OR "prevention" OR "preventive") AND ("income" OR "low-income" OR "affordable" OR "unaffordable") AND ("United States" OR "Colorado")	non-English, not in US, published before 2000, did not include utilization or cost of emergency care, urgent care, intensive care, primary care, or preventive care
1.2.3.2 Cost in lost time from work, decreased productivity or unemployment for individuals who, as a result of being unable to afford preventive or primary care, develop a more severe, urgent or disabling condition	(unemployment OR “sick days” OR “lost time” OR “decreased productivity” OR “lost productive work time”) AND (unaffordable OR affordable) AND (“primary care” OR preventive OR “delayed care”) AND (severe OR urgent OR disabling) AND (“health condition” OR condition OR illness) cost AND (afford OR unaffordable OR "unable to afford") AND ("delayed care" OR "preventive care" OR "primary care" OR "access to care") AND ("sick days" OR "unemployment" OR "decreased productivity")	non-English, studies that did not include the US, published before 2000
1.2.3.3 Cost of bankruptcies – cost to the individual and the providers not paid	bankrupt* AND ("medical expenses" OR "medical cost*"OR "medical bankrupt*")	non-English, not in US, published before 2001, did not include medical bankruptcy

1.2.3.4 Costs to and effects on individuals who do not file bankruptcies but are financially depleted due to medical costs	medical AND ("financial distress" OR “financial stress” OR “financial debt” OR “medical debt” OR “financial burden” OR “financial wellbeing” OR “financial hardship” OR "personal finance" OR "consumer finance" OR "Financial Stress"[Mesh]) AND (("Insurance, Health"[Mesh]) OR “health insurance” OR ("Medicaid"[Mesh]) OR ("Health Policy/economics"[Mesh] OR "Health Policy/statistics and numerical data"[Mesh]) OR “Medicaid expansion”) medical AND (“financial stress” OR “debt” OR “financial burden” OR “financial wellbeing” OR “financial hardship”) AND (“health insurance” OR "Health Policy" OR “Medicaid expansion”)	non-English, not in US, published before 2000
1.2.3.5 Medical costs caused by diversion of funds from other health determinants (such as education, safe food supply or safe water supply)	((("health determinants" OR "social determinants of health" OR "social spending" OR "social service spending") OR (social work/economics [MeSH Terms])) OR (social work/statistics and numerical data[MeSH Terms])) AND (("health spending" OR "healthcare spending" OR "healthcare reform" OR ("health expenditures"[MeSH Terms])))	non-English, studies that did not include the US, published before 2000, books, studies from developing countries
2.3.5.1 Anticipated employment changes in Colorado by sector related to changes in health care financing and anticipated economic impacts of the new system on employers and households	(“healthcare reform” OR “healthcare finance*” OR "single payor" OR "single payer" OR "public option") AND (“economic impact” OR “employ*” OR “household*”) AND ("United States" OR "Colorado") healthcare OR “healthcare cost*” AND “global competitiveness” ("healthcare reform" OR "single payer" OR "public option") AND ("undocumented") "physician retention" OR "physician attrition" OR "physician turnover"	non-English, published before 2000, predictive studies about the ACA

	"nurse retention" AND (reimbursement or salary or salaries)	

Glossary of Terms and Commonly Used Acronyms

2006 Massachusetts Health Care Reform: Often referred to as the model for the Affordable Care Act, the 2006 Massachusetts Health Care Reform enacted structures and requirements to promote health insurance coverage to near universal levels. The reform created an insurance exchange, called the Commonwealth Health Insurance Connector, on which residents can purchase health insurance (with subsidies if they qualify). It also established regulations for insurance companies, such as not being allowed to deny an individual coverage due to their health status, and giving a definition for minimal coverage and maximum premiums. Employers with 11 or more employees were required to offer and contribute towards an employee health plan, or pay a "Fair Share" penalty of up to $295 per employee per year. It also set up an individual mandate similar to the ACA, where people choosing not to maintain coverage would be fined, with some exceptions.

ACA; Affordable Care Act: Also known as the Patient Protection and Affordable Care Act, or "Obamacare," this refers to the national health reform enacted in the US in March of 2010. In short, the law provides rights and protections when it comes to purchasing health insurance, such as insurance companies no longer being able to deny an individual coverage because of an existing health condition. It also established health insurance Exchanges, on which any citizen of the US can purchase health insurance; low-income families may qualify for tax credits or subsidies when purchasing insurance to make it more affordable. In addition, the law enacted penalties for not maintaining essential minimal coverage with a few exceptions. Originally the law intended to expand Medicaid eligibility in all states; however, the Supreme Court ruled that states could not be forced to do so. Therefore, states were given the option to expand Medicaid with the federal government funding 100% of the cost through 2016, and gradually dropping to 90% in 2020 and beyond. Thirty-nine states so far (including the District of Columbia) opted to expand their Medicaid programs.

Charge: the amount the hospital or medical care provider bills for medical services.

CHP+; Child Health Plan Plus: federally referred to as State Children's Health Insurance Program (SCHIP), is Colorado's public low-cost health insurance program for pregnant women and children who do not qualify for Medicaid. For more information visit https://hcpf.colorado.gov/child-health-plan-plus

Consumer-directed health plan: health insurance plans that combine high deductible coverage with a tax-free savings account such as a Health Savings Account (HSA) or a Flexible Spending Account (FSA)

Crowd out (also known as substitution): happens when public funds substitute private funds that were previously spent on health care (i.e. in the case of a publicly funded, privately delivered

healthcare option). From an employer's perspective, crowding out can cause employers to stop offering health insurance or limit the coverage they offer. From an individual perspective, crowding out can cause individuals to drop their employer-sponsored or dependent health care insurance coverage in favor of a publicly funded, privately delivered plan.

Employee Retirement Income Security Act (ERISA): federal law that regulates employer benefit plans, including health coverage. In order to encourage employers to sponsor benefits plans and to allow these plans to operate independently from varying state laws, ERISA supersedes state laws that relate to employee benefit plans.

Expenditure: the cost of medical services that the payer(s) (i.e., the insurance company and patient) are responsible for paying based on negotiated amounts.

FPL; Federal Poverty Level: The Department of Health and Human Services defines the Federal Poverty Level each year; it is a measure of annual cash income before taxes. Federal Poverty Level is used in determining eligibility for certain social and welfare programs, including Marketplace subsidies and the Children's Health Insurance Program. The Federal Poverty Level for an individual in 2021 is $12,880, and increases with the number of persons in a household.

Financial toxicity: Issues or negative impacts to patients as a result of burdensome medical expenses.

HCIP; Health Care Ingenuity Plan: A managed competition health reform option proposed in the state of Oregon. HCIP would provide basic automatic coverage to all Oregon residents, except those enrolled in federal health plans, like Medicare, the Federal Employees Health Benefits Program, the Veterans Health Administrations, and the Indian Health Service. More generous health plans can be purchased by the individual or employers through the competitive marketplace, with cost-sharing based on income level.{Chapin White, 2017 #8}

Job lock: the inability of an individual to exit a position they are employed in due to the inevitable loss of benefits associated with that job.

Medicaid Expansion: See definition for Affordable Care Act (ACA).

OECD; Organization for Economic Co-operation and Development: an international organization that works to promote equitable policies. From the OECD website: "Together with governments, policy makers and citizens, we work on establishing evidence-based international standards and finding solutions to a range of social, economic and environmental challenges. From improving economic performance and creating jobs to fostering strong education and fighting international tax evasion, we provide a unique forum and knowledge hub for data and analysis, exchange of experiences, best-practice sharing, and advice on public policies and international standard-setting." For more information, go to https://www.oecd.org/about/.

Oregon Medicaid Lottery: In 2008, Oregon implemented a health insurance experiment in which low-income individuals who were uninsured and did not qualify for Medicaid based on eligibility requirements at the time were selected by lottery for a chance to apply for Medicaid, providing a randomized experiment for Medicaid eligibility in the real world.

Out-of-pocket cost: the amount of the total expenditure that the patient is responsible for, which varies by insurance and visit type.

Patient Dumping: the practice of transferring patients from one hospital to another (usually a safety net hospital), before they are medically stable or have received complete care, due to their inability to pay for services

Single Payer System: technically defined as a health plan that relies on a limited number of revenue sources and systems

Underinsured: the state of having health insurance coverage yet still paying burdensome amounts out of pocket; usually under a high deductible or consumer-directed health plan.

Statistical Appendix

HCPF Cost Modeling: Statistical Appendix

Jack Pattee and Colin Hensen

April 29, 2021

This appendix details the statistical analysis undertaken to generate the healthcare cost estimates for the state of Colorado. This appendix provides information on the statistical methods, the exploratory data analysis, some results that were not included in the higher-level report and are useful *only* internally within the project to justify other modeling decisions, and model diagnostics. Data cleaning and processing is described fully in the higher level report and so are not duplicated here.

1 Methods

As discussed in the higher level report, there are two broad methodological categories. The first can be thought of as 'calibration, reimbursement, plan generosity, and counterfactual scenarios', and this is covered extensively in the intermediate report and so is not covered here to great detail. Covered in great detail here is the second methodological category, which is the statistical modeling used to predict yearly healthcare expenditures for individuals in the state of Colorado. The calibration ratios mentioned in the higher level report are displayed in table 1.

Insurance Category	Expected Cost	Naive predicted Cost	Ratio
Private	5858.49	5488.05	1.067
Medicare	11,288.41	13,363.77	.845
Medicaid	6132	4107.57	1.54
Uninsured	-	-	1.2

Table 1: Calibration ratios for the MEPS data.

To estimate mean healthcare expenditure, we implement a two-part model. Two part models estimate the probability of nonzero expenditure and the magnitude of expenditure separately. This approach has many beneficial properties, namely enabling distinct estimation of the extensive and intensive effects and meeting the assumptions of semicontinuous cost data. It has substantial support in literature (Deb and Norton 2018; Mihaylova et al. 2011). The first part of the model has a binary response variable denoting whether or not yearly healthcare expenditure was nonzero. The second part of the model estimates the magnitude of yearly expenditure, conditional on the fact that yearly expenditure is nonzero. The independent variables included in the model are as follows: family income, insurance status, sex, age, age squared, interactions of sex and age, interactions of sex and age squared, education, race, and ethnicity. The first part of the two-part model was estimated via logistic regression. The second part of the two-part model was estimated via a generalized linear model with a gamma distribution and a log link function. Model specification is as below.

$$logit\{p(EXPY > 0)\} = \beta_0 + \beta_1 Income + \beta_2 Insurance + \beta_3 Education + \beta_4 Ethnicity + \beta_5 Race + \beta_6 Sex + \beta_7 Age + \beta_8 Age^2 + \beta_9 Sex \times Age + \beta_{10} Sex \times Age^2 \quad (1)$$

$$log(EXPY | EXPY > 0) = \beta_0 + \beta_1 Income + \beta_2 Insurance + \beta_3 Education + \beta_4 Ethnicity + \beta_5 Race + \beta_6 Sex + \beta_7 Age + \beta_8 Age^2 + \beta_9 Sex \times Age + \beta_{10} Sex \times Age^2 \quad (2)$$

These models are estimated using the MEPS data (where we have data on yearly healthcare expenditure, i.e. 'EXPY' in the above model). Model (1) is estimatd for all 13,069 subjects in the MEPS data. Model (2) is

estimated only on the subset of individuals who have nonzero healthcare expenditure, which is 11,070. The model is then used to predict healthcare expenditure for the ACS data (where we don't have expenditure data). Given that $E(EXPY) = E(EXPY \mid EXPY > 0) \quad p(EXPY > 0)$, we can multiply the predicted output from models (1) and (2) to get the expected healthcare expenditure for an individual in the MEPS data.

A substantial issue in the estimation of average cost is the presence of extreme outliers. Additional characterization of these outliers is described in section 2. It is well established that individual healthcare expendure data is very right-skewed (OHagan and Stevens 2003). Some papers (Deb and Norton 2018) use a 'topcoding' or truncation procedure to reduce the skewness of healthcare expenditure by truncating all observed cost values at some value, i.e. 50,000 dollars. Some review articles (Mihaylova et al. 2011) recommend against truncation, as the outliers are part of the 'true' distribution of costs. We agree with this conceptualization. Because our goal is to estimate total healthcare expenditure for the state of Colorado and it is established that a small number of individuals spend an exorbitant amount (well over 100,000 dollars) on healthcare in a given year, we do not believe any topcoding or truncation is appropriate for our purposes.

The existence of these outliers makes the process of drawing confidence intervals more difficult, as a single extreme outlier can appreciably shift the mean cost upwards for even a fairly large sample. A related concern is that we do not have an analytical solution to calculating the confidence interval for the mean cost as predicted from a two-part model described by equations (1) and (2). These two concerns lead us to the bootstrap approach for the calculation of confidence intervals. Given that we have a 'two-stage' approach, by which the model is estimated on stage 1 data (i.e. MEPS) and inference is drawn based on the application of the model to stage 2 data (i.e. the Colorado-specific ACS sample), it is logical for us to account for uncertainty in both the stage 1 and the stage 2 model in our boostrapping procedure. Bootstrapping the MEPS data is conducted as follows. Say the MEPS data has sample size n. For each of B bootstrap replications, we resample the rows the MEPS data n times with replacement. We then estimate a two-part model on this resample. Thus, after bootstrapping the MEPS data, we have B two-part regression models. By approximating the distribution of extreme outliers with the empirically observed distribution in the MEPS data, our resampling approach allows us to approximate the frequency and severity of extreme outliers and leverage this when estimating confidence intervals for the predicted mean. Boostrapping the ACS data is conducted as follows: assuming sample size N, draw a sample of size N with replacement from the rows of the ACS data. We explore some different approaches for bootstrapping the stage 1 and stage 2 data in sections 3 and 4. Our results show that bootstrapping the stage 1 data is crucial, and that bootstrapping the stage 2 data does not account for meaningful additional variability in the data. Thus, our approach implemented in our final cost estimates is to only bootstrap the MEPS data. That is, reported point estimates are means of a bootstrap distribution, and reported confidence intervals are the 2.5% quantile and the 97.5% quantile of a bootstrap distribution. Note, crucially, that this bootstrapping approach assumes the validity of our two-part model as specified by (1) and (2). The presence of the extreme outliers is a moderate violation of the assumptions of the two-part model and in particular of the log-link gamma GLM (2). We provide some evidence for the appropriateness of our modeling approach in section 4; the evidence is encouraging but the extreme outliers make any parametric model fit difficult. We stipulate here that all confidence intervals stated in this report are conditional on the suitability of the model, and that the true uncertainty is difficult to quantify exactly due to the existence of severe outliers.

2 Exploratory Data Analysis

This section details some exploratory analysis of the MEPS data. This furthers our understanding of the MEPS data and provides justification and framing for our modeling approach.

Table 2 shows the distribution of the relevant variables for the MEPS data.

	Overall (N=13069)
Expenditure	
Mean (SD)	6670 (19500)
Median [Min, Max]	1330 [0, 808000]
Family_Income	
Mean (SD)	75200 (68200)
Median [Min, Max]	56100 [0, 508000]
Insurance	
Private	6704 (51.3%)
Public	2770 (21.2%)
Uninsured	1023 (7.8%)
Medicare and Private	1228 (9.4%)
Medicare Only	1305 (10.0%)
No Medicare	39 (0.3%)
Years_Of_Education	
Less than 12	4281 (32.8%)
12	3352 (25.6%)
More than 12, Less than 16	2381 (18.2%)
16 or more	3055 (23.4%)
Ethnicity	
Hispanic	3113 (23.8%)
Not Hispanic	9956 (76.2%)
Race	
White Alone	9693 (74.2%)
Black Alone	2074 (15.9%)
AIAN Alone	67 (0.5%)
AA-NHOPI Alone	724 (5.5%)
Multiple Races	511 (3.9%)
Sex	
Male	6185 (47.3%)
Female	6884 (52.7%)
Age	
Mean (SD)	42.5 (22.1)
Median [Min, Max]	42.0 [6.00, 85.0]

Table 2: Distribution of relevant variables in the MEPS data.

First we characterize the distribution of the expenditure data. Figure 1 is a boxplot of the yearly expenditure data in MEPS with outliers colored red. Figure 2 is a histogram of yearly expenditure in the MEPS data with values truncated at 50,000. These plots demonstrate the substantial right skew of the data;the majority of the points fall at or near zero, while a substantial minority of points have very large value. Figure 1 characterizes all expenditures larger than 1.5 times the interquartile range above the upper limit ofthe interquartile range as outliers. The interquartile rnage is 229 to 5489, thus all expenditures larger than 13,379 points are labeled as outliers. There are 1,585 subjects in MEPS who meet this definition.

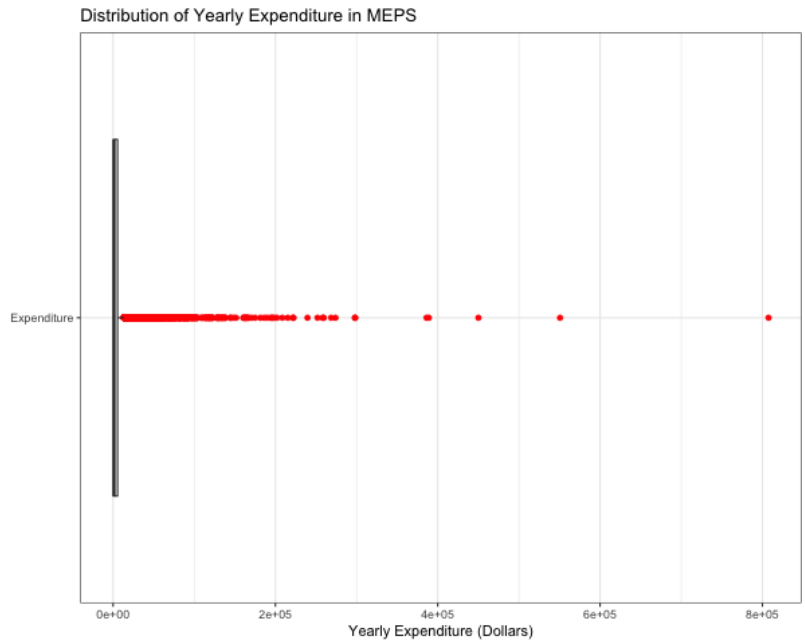

Figure 1: Boxplot of the distribution of yearly expenditure for the year 2018 in the MEPS data. Outliers in red.

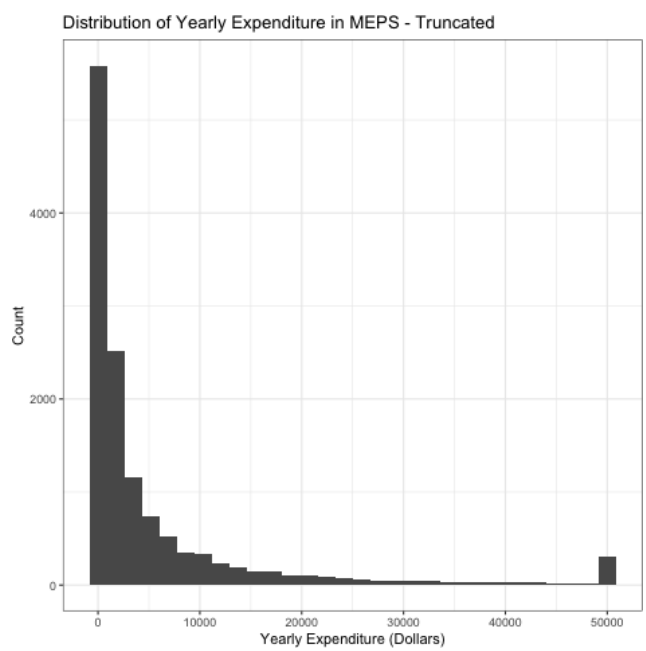

Figure 2: Histogram of the distribution of yearly expenditure for the year 2018 in the MEPS data with expenditure truncated at 50,000.

Next we characterize the distribution of yearly expenditure as stratified by insurance coverage status. As the basis of our approach to modeling different coverage scenarios involves manipulation of the insurance coverage variable, it is important for us to establish that yearly healthcare expenditure depends on insurance coverage status. As figure 3 shows, the the central tendency and interquartile range of the distribution of yearly expenditure clearly depends on insurance coverage status. Figure 4 accentuates outlier behavior; insurance coverage plausibly plays a role in the distribution of outliers, although it is difficult to test for or definitively prove.

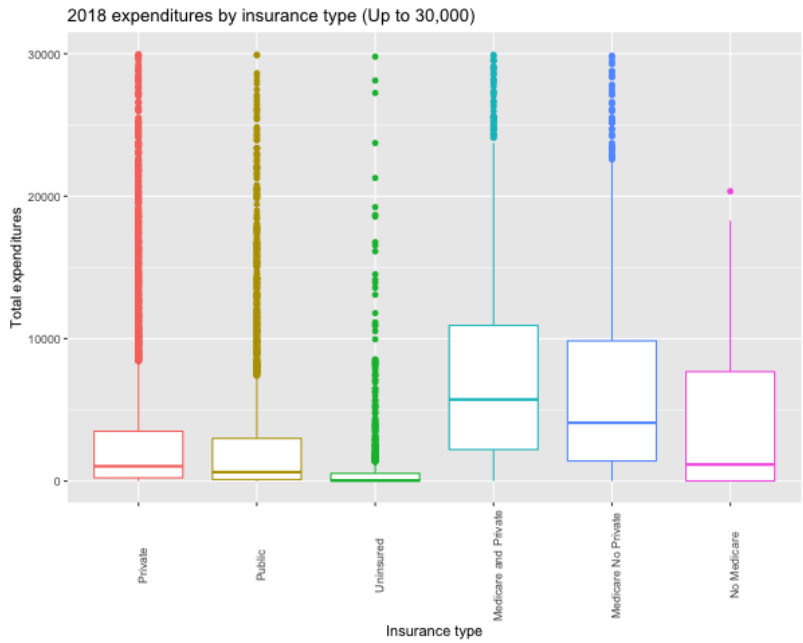

Figure 3: Distribution of yearly expenditure for the year 2018 in the MEPS data, stratified by insurance coverage type. Expenditures over 30,000 are omitted.

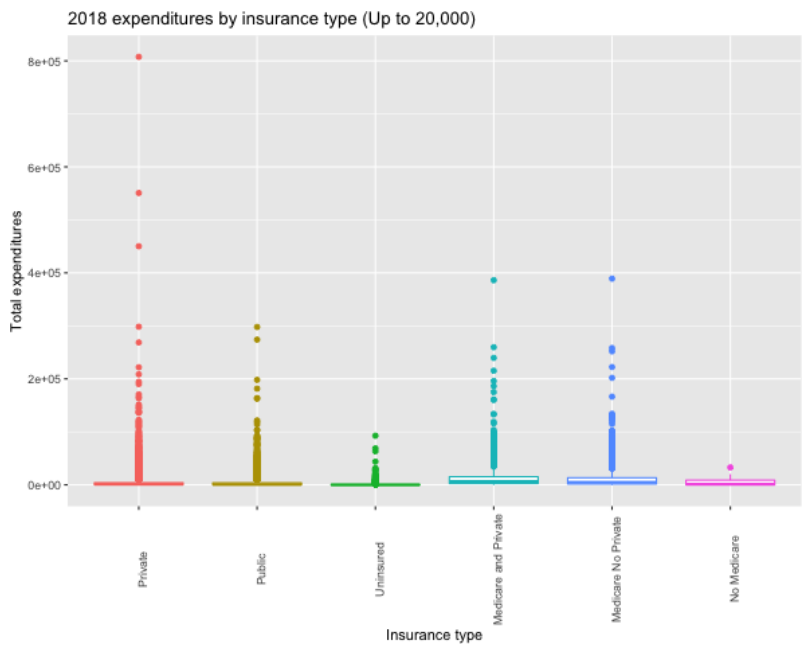

Figure 4: Distribution of yearly expenditure for the year 2018 in the MEPS data, stratified by insurance coverage type. All expenditures plotted.

We investigate the distribution of some of the variables of interest below. In particular, we investigate how the distribution of nonzero cost (treated as an indicator variable) depends on insurance coverage status. We also investigate the distribution of income alone and income stratified by insurance status. Lastly, we investigate the relationship between insurance type and race separately for subjects 65 and older and subjects under the age of 65.

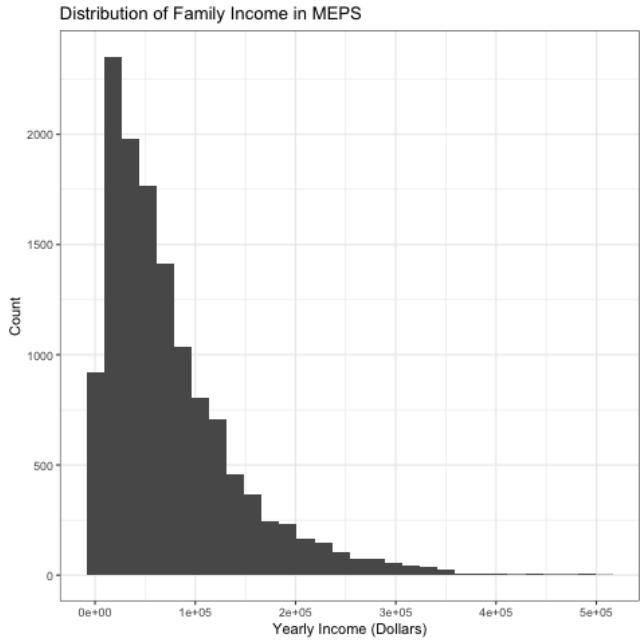

Figure 5: Distribution of family income for the year 2018 in the MEPS data.

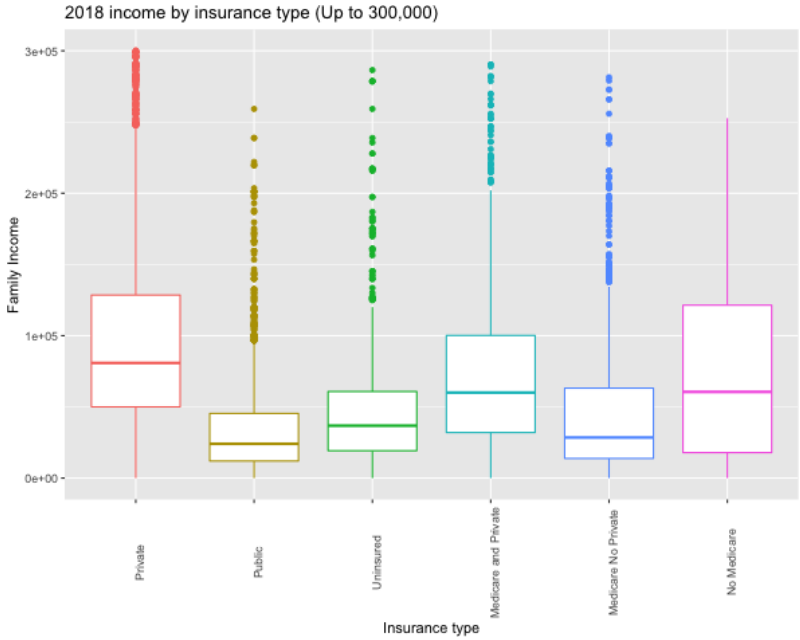

Figure 6: Distribution of family income stratified by insurance coverage type for the year 2018 in the MEPS data. Incomes over 300,000 not plotted.

	Private (N=6704)	Public (N=2770)	Uninsured (N=1023)	Medicare and Private (N=1228)	Medicare Only (N=1305)	No Medicare (N=39)
Nonzero_Cost						
No	926 (13.8%)	488 (17.6%)	491 (48.0%)	24 (2.0%)	61 (4.7%)	9 (23.1%)
Yes	5778 (86.2%)	2282 (82.4%)	532 (52.0%)	1204 (98.0%)	1244 (95.3%)	30 (76.9%)

Table 3: Proportion of subjects with nonzero yearly healthcare expenditure in the 2018 MEPS data stratified by insurance coverage status.

	White Alone (N=7654)	Black Alone (N=1727)	AIAN Alone (N=60)	AA-NHOPI Alone (N=604)	Multiple Races (N=452)	Overall (N=10497)
insurance_coded						
Private	5029 (65.7%)	959 (55.5%)	28 (46.7%)	433 (71.7%)	255 (56.4%)	6704 (63.9%)
Public	1847 (24.1%)	610 (35.3%)	23 (38.3%)	130 (21.5%)	160 (35.4%)	2770 (26.4%)
Uninsured	778 (10.2%)	158 (9.1%)	9 (15.0%)	41 (6.8%)	37 (8.2%)	1023 (9.7%)

Table 4: Distribution of insurance coverage type in the 2018 MEPS data stratified by race for subjects under the age of 65.

	White Alone (N=2039)	Black Alone (N=347)	AIAN Alone (N=7)	AA-NHOPI Alone (N=120)	Multiple Races (N=59)	Overall (N=2572)
insurance_coded						
Medicare and Private	1035 (50.8%)	117 (33.7%)	1 (14.3%)	48 (40.0%)	27 (45.8%)	1228 (47.7%)
Medicare Only	972 (47.7%)	228 (65.7%)	6 (85.7%)	69 (57.5%)	30 (50.8%)	1305 (50.7%)
No Medicare	32 (1.6%)	2 (0.6%)	0 (0%)	3 (2.5%)	2 (3.4%)	39 (1.5%)

Table 5: Distribution of insurance coverage type in the 2018 MEPS data stratified by race for subjects 65 and older.

3 Preliminary Results

Table 6 displays the bootstrap means and confidence intervals for each pairwise combination of the four bootstrap approaches and five coverage scenarios. Here, we experimented with moving individuals over 65 to the new public option and resampling the ACS data (corresponding to the columns of table 6). In the final cost modeling, we did not shift individuals over 65 from their observed insurance coverage plans, andwe did not resample the ACS data. Additionally, the status quo versus partial publicly financed versus full publicly financed was operationalized differently in this preliminary analysis than the final analysis. The sole usefulness of this analysis for informing our cost modeling is that columns 1 compared to 2 and 3 comparedto 4 are nearly identical. This means that bootstrapping the ACS data is not necessary, which explains our decision to forego bootstrapping the ACS in the final cost estimates. The decision not to shift individuals over the age of 65 from their observed insurance plan was a conceptual policy decision and not a statisticalone.

	True ACS, 65+ crossover	Resample ACS, 65+ crossover	True ACS, 65+ no change	Resample ACS, 65+ no change
Status Quo	6459 (6057, 6885)	6457 (6055, 6871)	6459 (6057, 6885)	6457 (6055, 6871)
Sensitivity - 20%	6533 (6142, 6977)	6535 (6139, 6979)	6545 (6155, 6982)	6547 (6145, 6987)
Sensitivity - targeted	6596 (6205, 7045)	6596 (6200, 7047)	6606 (6212, 7045)	6606 (6206, 7051)
Sensitivity - 50%	6649 (6195, 7156)	6650 (6198, 7170)	6679 (6256, 7173)	6680 (6246, 7184)
Full publicly financed	6842 (6211, 7550)	6841 (6208, 7564)	6901 (6320, 7554)	6900 (6322, 7566)

Table 6: Bootstrap means and confidence intervals for the average yearly expenditure for an individual in Colorado. Means and confidence intervals are for each pairwise comparison of the four bootstrap approaches and the five coverage scenarios.

4 Diagnostics

This section describes some diagnostics for and justification of our modeling approaches.

The first part of the two part model, i.e. predicting the probability of nonzero cost as per equation (1), is fairly straightforward to specify. Different specifications of the binary model (i.e. logistic, probit, etc.) yield nearly identical results (Deb and Norton 2018), thus we proceed with the logistic. The choice of the second part of the model, i.e. estimating the magnitude of expenditure given nonzero expenditure, is sensitive to modeling assumptions and thus this choice must be carefully interrogated. Our argument for the choice of the log link function and the gamma distributional assumption is as follows, cohering to the argument laid out by Deb and Norton (Deb and Norton 2018). We use the Box Cox transformation to demonstrate that the choice of the log link function is correct, as shown in figure 7. We use a modified version of the park test (Park 1966) to demonstrate that the choice of the gamma distribution assumption is correct, as shown in figure 8 and described in subsequent text.

First, a review of the Box Cox transformation and it's purpose in this context. The Box Cox transformation is expressed as follows, for some value of λ:

$$y(\lambda) = \begin{cases} \frac{y^{\lambda-1}}{\lambda}, \lambda \quad 0 \\ log(y), \lambda = 0 \end{cases}$$

λ is chosen such that the resulting distribution of $y(\lambda)$ is the most symmetric. We estimated the optimal value of lambda for model (2) applied to all subjects in MEPS with nonzero yearly expenditure. The results are in plot 1. As shown in figure 7, the optimal value of λ is very close to zero. This indicates that a natural log transform model will produce the most nearly symmetric distribution, which motivates our choice of the log link function.

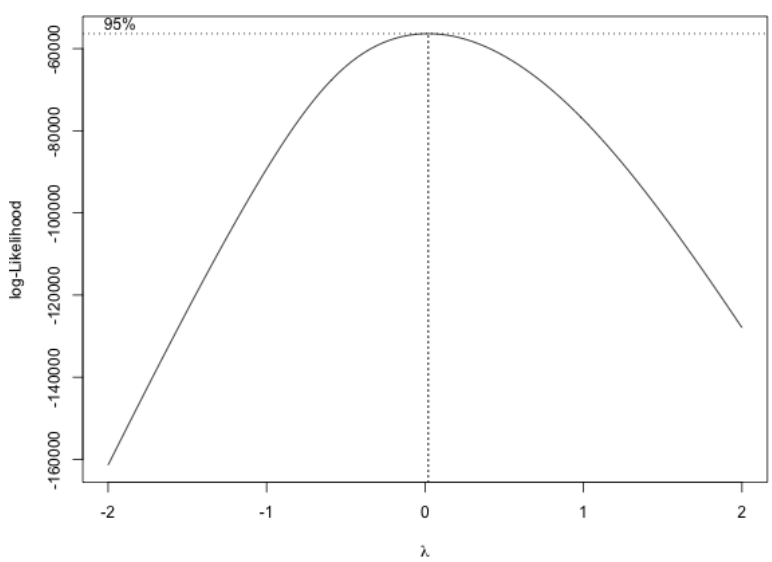

Figure 7: Log likelihood for λ in the Box Cox transformation.

We conduct a modified form of the Park test to justify our use of the Gamma distributional assumption. Our methodology for this application of the Park test matches the application in Deb and Norton (Deb and Norton 2018). Briefly, the Park test (Park 1966) was developed to test whether the response in a linear regression is heteroskedastic with respect to a particular covariate. This can logically be extended to the case where we replace a particular covariate with the predicted value from the regression model, and test whether the response is heteroskedastic with respect to the predicted value. In this way we can test the degree to which heteroskedasticitiy is present in the model, and use this to inform our distributional assumption.

Concretely, we assume the following functional relationship between the residual variance and the predicted output:

$$log(\sigma_i^2) = \gamma log(\hat{Y}_i) + \upsilon_i$$

where υ_i is some error term. We first estimate a generalized linear model (on subjects in MEPS with nonzero cost) with a log link and a gamma distribution. We use this to compute $\hat{\mathbf{Y}}$ and $\hat{\boldsymbol{\varepsilon}}$, the latter of which we treat as an estimator for the residual variance $\boldsymbol{\sigma}^2 = (\sigma_1^2, \ldots, \sigma_n^2)$. We then estimate the following model:

$$log(\hat{\boldsymbol{\varepsilon}}) = \gamma log(\hat{\mathbf{Y}}) + \upsilon_i$$

. As described in Deb and Norton, a value of $\gamma = 0$ implies that a normal distribution is appropriate, whereas $\gamma = 1$ implies Poisson, $\gamma = 2$ implies gamma, and $\gamma = 3$ implies inverse normal. We calculate that $\gamma = 1.87$ for the MEPS data, indicating that the choice of the gamma distribution is appropriate here.

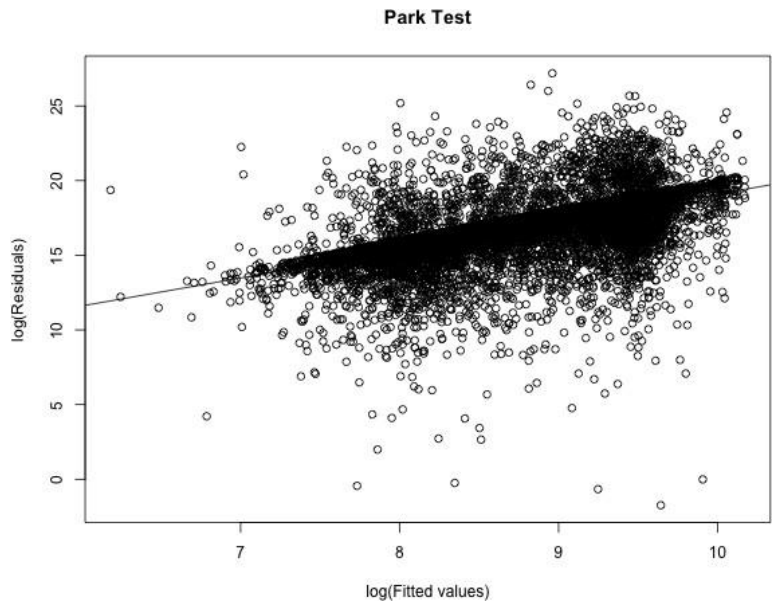

Figure 8: Plot of the log of the residuals (y axis) versus the log of the predicted values from the gamma regression with log link (x axis). Slope of the line of best fit is 1.87.

Figure 9 displays some diagnostic plots for the fit of the gamma GLM with log link for the nonzero expenditure data. This figure displays (right-left, top to bottom): a plot of deviance residuals against the linear predictor, a quantile-quantile plot of the deviance residuals against normal quantiles, a plot of Cook distance against the ratio of leverage / (1 - leverage), and a case plot of the Cook statistic. The quantile quantile plot is somewhat concave; this is somewhat to be expected as the outliers are dragging the distribution upwards. This is evidence that including the outilers in the modeling is putting moderate stress on the model and is not perfectly faithful to the modeling assumptions, but in the authors' opinion there is not substantial evidence against the use of the gamma GLM with log link here. We base our choice of the distribution and link function on the Box Cox transformation and the Park test as above, while acknowledging here that the outliers in the data make any modeling fit somewhat fraught, and that these diagnostics provide some evidence of substandard fit.

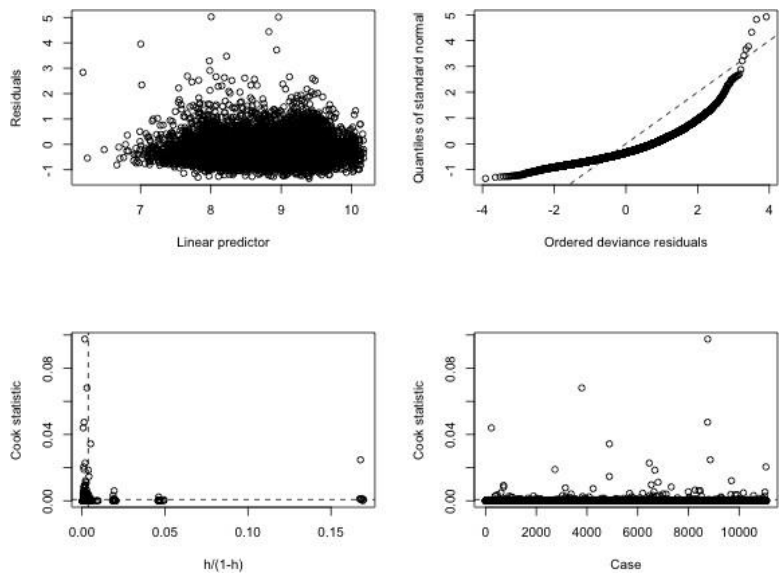

Figure 9: Diagnostic plots for the gamma GLM with log link on MEPS subject with nonzero healthcare expenditure. Right-left, top to bottom: a plot of deviance residuals against the linear predictor, a quantile-quantile plot of the deviance residuals against normal quantiles, a plot of Cook distance against the ratio of leverage / (1 - leverage), and a case plot of the Cook statistic.

Here, we provide some justification for the use of our bootstrapping approach. We conducted some real-data analyses that provide support for our approach, but not conclusive evidence.

As we do not have expenditure data in ACS, it is not straightforward to test whether our bootstrapping procedure is generating standard errors that cover the true mean cost with the specified type I error. One feasible approach is to split the MEPS data (where we do have information on expenditure) into a 'stage 1' and a 'stage 2' dataset. In this case, the stage 1 portion of MEPS data is used to estimate the two-part model, and this two-part model is used to predict the distribution of expenditure and thus the mean expenditure in the stage 2 data. We bootstrap the stage 1 data to get a bootstrap distribution of the mean yearly expenditure for the stage 2 data. Then we can observe whether the true mean expenditure data falls within the confidence bounds of the bootstrap distribution.

We clarify some notation here, then describe the approach in detail. Say we make s random splits, where proportion p of rows of the MEPS data is treated as stage 1 data, and proportion $1-p$ is treated as the stage2 data. Say also that, for each split, we conduct B bootstrap resamples of the stage 1 data. The procedure is as follows.

For each of s random splits, do the following: randomly split the MEPS data into stage 1 data of size np and stage 2 data of size $(1-p)n$. Generate B bootstrap resamples of rows of the stage 1 data. For each of these bootstrap resamples, estimate a the two-part model for healthcare expenditure specified by equations (1) and (2). Thus, we have B two-part models. Apply each of these B models to the stage 2 data and calculate the mean predicted cost. We have B mean predicted costs for the stage 2 data, thus we have a sampling distribution for the mean predicted cost. Then observe whether the true mean cost lies within the95% bootstrap confidence interval for the mean predicted cost, which is defined as the range from the 2.5% quantile to the 97.5% quantile.

In our application, we set s = 100 and B = 1000. We experimented with different values of p, namely 1/2, 2/3, and 4/5. We found that the value of p substantially influences the coverage percentage, with values of p closer to 1/2 having a larger coverage percentage. This is likely because values of p closer to 1/2 entail a larger size of the stage 2 data, meaning that there is less likely to be a substantial discrepancy in the severity and frequency of outliers between the stage 1 and the stage 2 data. We additionally experimented with bootstrapping the rows of the stage 2 data. This approach allows us to account for the uncertainty in the stage 2 data when calculating confidence intervals. We found that bootstrapping the rows of the stage 2data did not have a substantial effect.

Table 7 shows the coverage percentages for the four approaches. Figures 10-13 graphically display the bootstrap confidence interval in relation to the true value for each of the 100 random splits for each of the four approaches. The four approaches are defined as follows:

1. $p = 1/2$, bootstrap stage 1 data only.
2. $p = 2/3$, bootstrap stage 1 data only.
3. $p = 2/3$, bootstrap stage 1 and stage 2 data.
4. $p = 4/5$, bootstrap stage 1 data only.

Table 7 shows the coverage proportion across 100 random splits, where the mean is 'covered' for a given split if the true mean falls within the 95% bootstrap confidence interval.

Method	Coverage Proportion
1	.81
2	.73
3	.71
4	.56

Table 7: Proportion of random splits where the true mean is covered by the 95% bootstrap confidence interval.

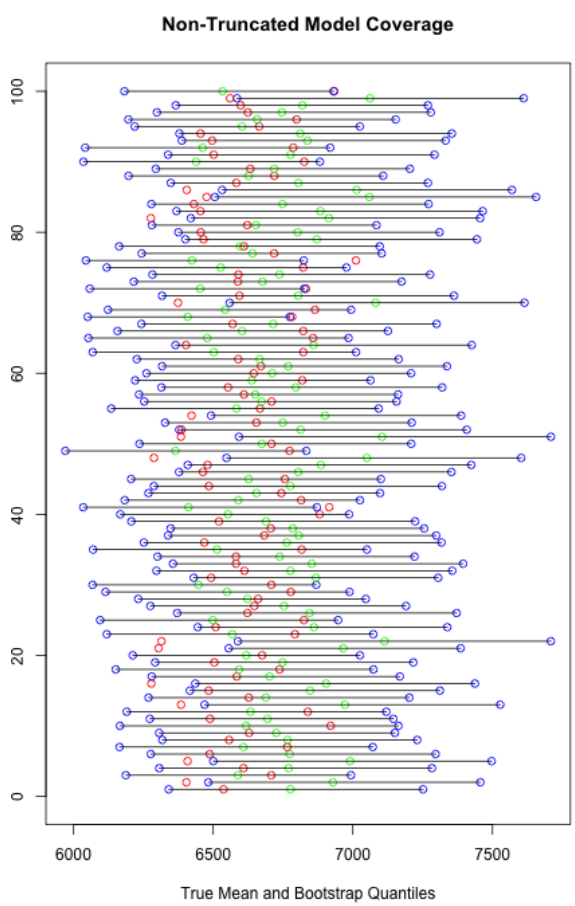

Figure 10: Plot of the 95% bootstrap confidence interval (in blue) and the median bootstrap value (in green) versus the true expenditure mean for the stage 2 data (in red) for method 1.

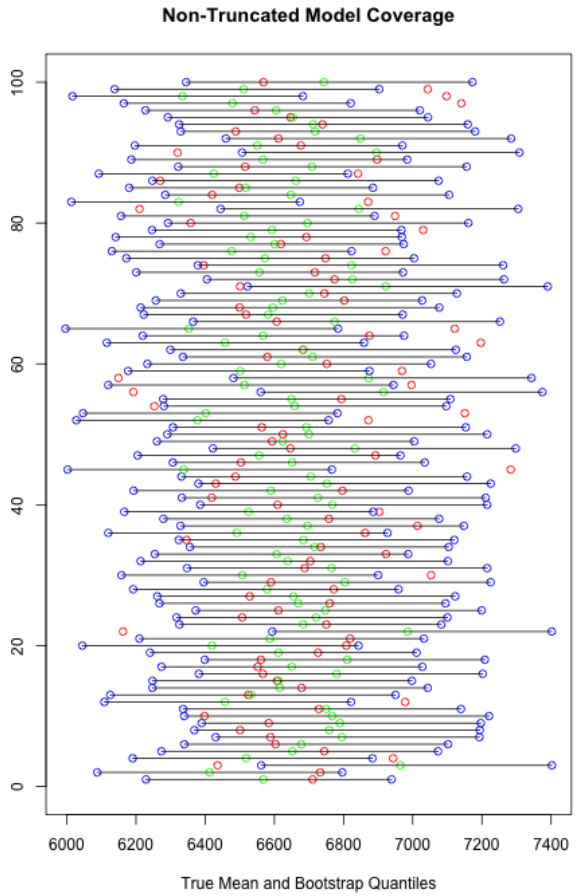

Figure 11: Plot of the 95% bootstrap confidence interval (in blue) and the median bootstrap value (in green) versus the true expenditure mean for the stage 2 data (in red) for method 2.

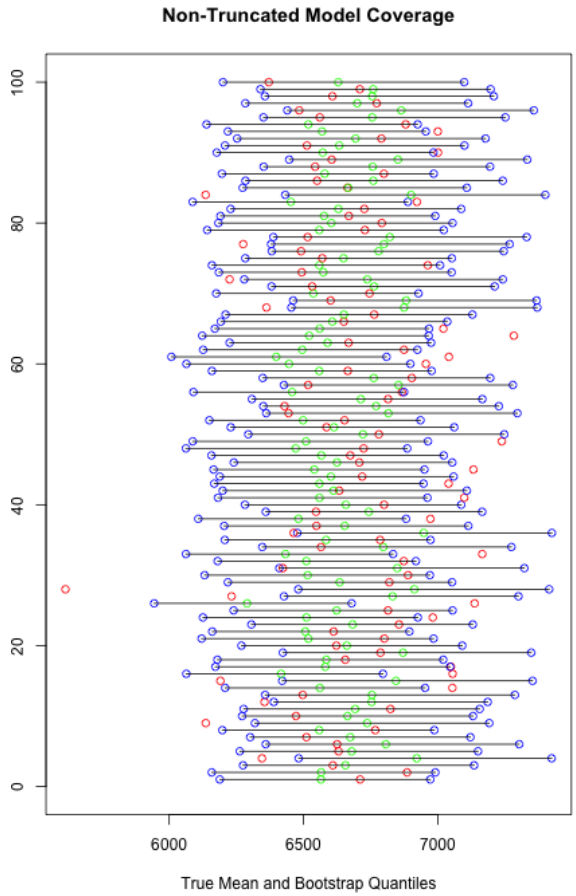

Figure 12: Plot of the 95% bootstrap confidence interval (in blue) and the median bootstrap value (in green) versus the true expenditure mean for the stage 2 data (in red) for method 3.

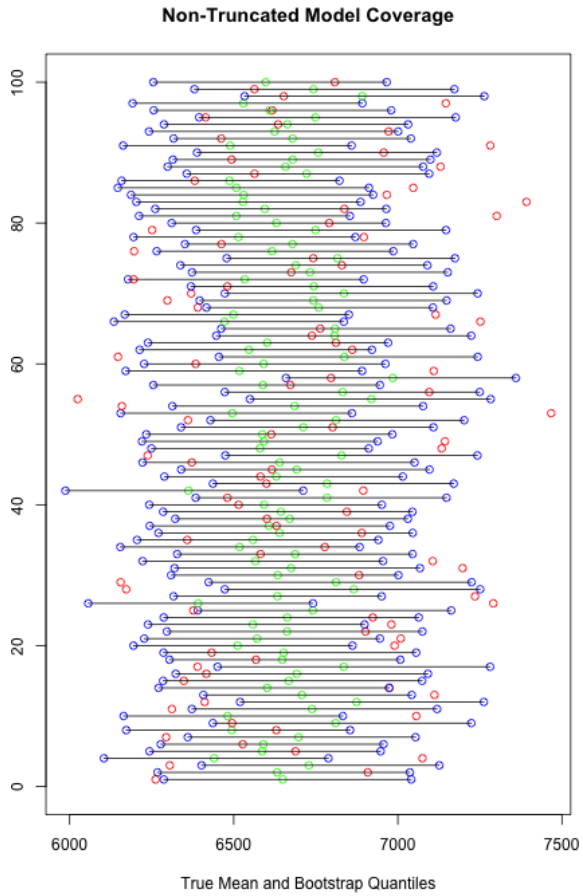

Figure 13: Plot of the 95% bootstrap confidence interval (in blue) and the median bootstrap value (in green) versus the true expenditure mean for the stage 2 data (in red) for method 4.

This provides evidence that the coverage percentage increases as the sample size of the testing data increases. Even in method 1, the sample size of the testing data is roughly 6500, which is substantially smaller than the ACS data (roughly 40,000). Thus, we expect better performance when the method is applied to the MEPS and ACS data.

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