Integrated, Accountable Care For Medicaid Expansion Enrollees

A Comparative Evaluation of Hennepin Health

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Abstract:

Hennepin Health, a Medicaid accountable care organization, began serving early expansion enrollees (very low-income childless adults) in 2012. It uses an integrated care model to address social and behavioral needs. We compared health care utilization in Hennepin Health versus other Medicaid managed care in the same area from 2012-2014, controlling for demographics, chronic conditions, and enrollment patterns. Homelessness and substance use were higher in Hennepin Health. Overall adjusted results showed Hennepin Health had 52% more emergency department visits and 11% more primary care visits than comparators. Over time, modeling a six-month exposure to Hennepin Health, emergency department and primary care visits decreased and dental visits increased; hospitalizations decreased non-significantly but increased among comparators. Subgroup analysis of high utilizers showed lower hospitalizations in Hennepin Health. Integrated, accountable care under Medicaid expansion showed some desirable trends and subgroup benefits, but overall did not reduce acute health care utilization versus other managed care.

Key words: Medicaid expansion, accountable care organization, integrated care models, social determinants of health, marginal structural models

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Introduction:

The Patient Protection and Affordable Care Act (ACA, 2010) allowed states to expand Medicaid to cover low-income, working age adults without dependent children, a subset of the population previously ineligible for consistent public insurance coverage. The impact of Medicaid expansion on the health status, mortality, and financial stability of low income populations has been widely examined (Sommers, Gunja, Finegold, & Musco, 2015; Wherry & Miller, 2016). Medicaid expansion has been associated with increases in outpatient clinic visits, with mixed evidence regarding emergency department (ED) visits and inpatient stays depending on length of observation period (e.g., one year or multiple years) and setting or design (e.g., different states; survey versus experiment) (DeLeire, Dague, Leininger, Voskuil, & Friedsam, 2013; Finkelstein et al., 2012; Sommers et al., 2015; Wherry & Miller, 2016). Yet, little is known about how insurance structures might serve as a vehicle to integrate services for adults with complex needs and if such integrated models would improve health or stabilize health care utilization. This is particularly important given the high rates of acute and chronic health conditions and high patterns of health care use among the Medicaid expansion population (DeLeire et al., 2013). Specifically, these low-income adults had high rates of homelessness (Vickery et al., 2016), and mental illness and substance use (Mark, Wier, Malone, Penne, & Cowell, 2015). Significant evidence supports the impact of programs tailored to meet the needs of high-risk populations with housing, case management, and integration of care (Hwang & Burns, 2014). Some of these programs have been delivered within Medicaid to high-risk patients (Bell et al., 2015). It is unknown, however, if such programs can attenuate patterns of high usage of acute care seen under Medicaid expansion.

Increasing movement in the US health care system toward accountability and population
health presents new opportunities to address social and behavioral health determinants, especially within accountable care organizations (ACOs). ACOs are networks, or groups, of health care providers, clinics, and hospitals that agree to provide coordinated care to an identified group of patients (Fisher & Shortell, 2010; Gold, 2015). Although Medicare ACOs were formalized under the ACA, the ACO construct is similar under Medicaid (Center for Health Care Strategies, Inc., 2017), with slightly greater variation due to state-level differences in Medicaid administration and state legislative actions (Kaiser Commission on the Uninsured, 2012). ACOs were formed to reduce costs and incentivize high value, efficient care delivery. They replaced fee-for-service payment for health care with arrangements to share per capita costs in caring for a population with partners throughout the health care delivery system. Depending on the ACO, partners can either agree to share any savings generated, or can agree to also share losses (two-sided risk), with the possibility of greater financial rewards. ACOs, and other ACO-like value-based payments, are projected to remain a key strategy to incentivize efficient delivery of health care under current and future reforms of the U.S. health care system (Antos & Capretta, 2017). States and local leaders have taken specific interest in building ACOs within Medicaid and have been granted the freedom to experiment with program designs that may better address the specific needs of their Medicaid populations (Kocot, Dang-Vu, White, & McClellan, 2013; Lewis, Larson, McClurg, Boswell, & Fisher, 2012). However, ACO adoption in Medicaid has been slow, with just 16 states having active or planned Medicaid ACOs in 2016 (Center for Health Care Strategies, Inc., 2016). Early evidence of ACOs’ impact in Medicaid suggests minimal reductions in total per member per month expenditures over two years in two early adopting states. Over time, there were small reductions in use of primary care and inpatient hospitalizations and mixed impact on ED visits (McConnell et al., 2017). We are aware of no
studies comparing ACO-enrolled Medicaid expansion patients to those not enrolled in an ACO.

New Contribution

This paper examines a novel Medicaid ACO, Hennepin Health (HH), which began as a Medicaid demonstration project in 2012. HH has been cited as a unique Medicaid ACO due to its managed care structure, broad scope of services, and high degree of financial risk/accountability (two-sided risk) (Somers & McGinnis, 2014). Run by Hennepin County, HH was initially designed to meet the specific needs of the early Medicaid expansion population—adults without dependent children living at or below 75% of the federal poverty level. As described previously, the HH payment component operates as a managed care organization (MCO), while its health care and service provider components incorporate multiple approaches to improving the health of its population including: (1) assignment of specific staff to connect patients to primary care and other necessary services (care coordination), (2) increased access to care for mental illness and substance use (behavioral health) including integration within primary care, (3) increased access to services to meet social needs (e.g., housing, employment), and (4) improved access to dental services (due to the observed connection between dental health and use of the ED (Cohen, Manski, Magder, & Mullins, 2002)). Much of this work occurs within a defined provider network that coordinates with outreach staff at sites including the county jail, homeless shelters, and the ED (Sandberg et al., 2014).

To date, HH has managed its enrolled population for less than its per-member-per-month payment amounts each year and produced shared savings. However, since other MCOs also enrolled early Medicaid expansion adults at the same time and in the same geographic area, HH presents a unique opportunity to comparatively test the impact of the HH care model, and the financial arrangements that stimulated it, in comparison to other expansion options. Rather than a
test of the pre/post impact of Medicaid expansion itself, the objective of this paper is to compare the health care utilization over time of Medicaid early expansion enrollees exposed to the HH care/payment model versus other, non-HH, MCOs in the same urban area.

Conceptual Framework

Our study is guided by a conceptual framework (Supplemental Figure 1) based on the Behavioral Model for vulnerable populations, the socio-ecological framework, and the cumulative complexity model (CuCoM).

The Behavioral Model for vulnerable populations describes how predisposing and enabling characteristics combine to produce perceived needs which lead to health behaviors including utilization of health care (Gelberg, Andersen, & Leake, 2000). Domains with specific impact for vulnerable populations include individual-level factors not included in traditional health services research such as experience of homelessness and historic use of safety net health care – variables we included in our analysis. As noted in the socio-ecological model, neighborhood characteristics (i.e., proximity to a safety net hospital) can also impact health care use and enrollment into the HH ACO or another Medicaid expansion plan, and, therefore, were included in our models (Centers for Disease Control and Prevention, 2015).

The CuCoM details how and why enabling factors and perceived need lead to different patterns of health care utilization (Shippee, Shah, May, Mair, & Montori, 2012). Specifically, such factors reflect balances or imbalances between the work patients must manage (the tasks and responsibilities of life and of caring for their conditions) and their capacity to manage that work. When workload and capacity are out of balance (as in low-resource individuals who must manage multiple health conditions), regular access to primary or preventive care may be problematic, whereas acute utilization in the emergency department or hospital may be
especially frequent. Better integration of services, outside of insurance alone, may reduce the work required to access care and/or increase capacity with additional supports and stability.

**Methods**

**Data Source**

Enrollment and claims data on eligible enrollees from March 1, 2011 (initial Medicaid eligibility for this population) through December 31, 2014 were obtained from the MN Department of Human Services (DHS). Specific permission was obtained from MN DHS to include treatment and payment records for behavioral health conditions. Linkage was completed using state-assigned unique beneficiary identification numbers.

Institutional Review Board approval was granted from the Minneapolis Medical Research Foundation, University of Minnesota, and Minnesota Department of Human Services.

**Study Population**

Data were collected on all adults (aged 21-64) without dependent children living at or below 75% of the federal poverty-level in Medicaid (early expansion) whose county of financial responsibility (based on reported address at time of initial registration) was one of seven counties surrounding the Minneapolis-St. Paul (MN) metropolitan area.

Inclusion criteria were any assignment of Hennepin or Ramsey County as county of financial responsibility during the study period, limiting the cohort to uniformly low-income Medicaid expansion enrollees in Minnesota’s two neighboring, urban counties (the “Twin Cities”). We included individuals with any (one or more) months of enrollment under early Medicaid expansion for multiple reasons. These included maximizing our use of available data and sample; the ability to address varying months of enrollment using our censoring approach (see Statistical Analyses below); and a focus on not omitting from our analyses those individuals...
who might have the most trouble with navigating enrollment and accessing services. Including individuals with any months of enrollment also aligned with programmatic reality, in that HH and other plans were responsible for individuals during any months enrolled. See analysis description below for further details. Exclusion criteria removed individuals systematically different than HH enrollees: those younger than 21 years (as of 2011); older than 64 (as of 2014); and those with initial enrollment after December 31, 2013 (when the higher income limit of the federal Medicaid expansion took effect).

Study Variables

The primary independent variable was enrollment in HH, one of four MCO choices available to expansion-eligible adults (aged 21-64) in Hennepin County. During the study period, all Minnesota Medicaid enrollees had to select a MCO within 90 days of enrollment. Enrollees who did not elect a MCO but whose address was located within urban zip codes centered around downtown Minneapolis were automatically enrolled into HH. This auto-enrollment area was home to the region’s largest concentration of homeless shelters and housing service providers, as well as some of the lowest income neighborhoods in the Twin Cities metropolitan area, biasing HH enrollment toward harder-to-reach and more socially complex people.

Other variables collected for comparison and as potential confounders were selected based on a conceptual model (Supplemental Figure 1) developed by the research team. Specifically we collected data on age; gender; race/ethnicity; education; primary language; history of care in a safety net setting; zip code near the largest safety net hospitals in Hennepin or Ramsey county; homelessness using an address-based tool we developed in previous work (Vickery et al., 2017); and risk scores estimating future health care expenditures (hierarchical condition category [HCC]) calculated monthly as a time-varying covariate using all available
data from the prior 12 months (Pope et al., 2000). We chose the HCC risk score to capture cost-relevant risk adjustment in our model, and to reflect programmatic realities of Hennepin Health. However, HCC was not our only approach to capturing health conditions. We also used a count of chronic conditions, also as a time-varying covariate with a 12-month lookback at the person-month level, based on Clinical Classification Software (CCS) definitions (Healthcare Cost and Utilization Project, 2016; Magnan, 2015). Additionally, we created flags for any mental health disorder and any substance use disorder using HCC and CCS categories. We also included presence of chronic pain/fatigue based on the Chronic Condition Data Warehouse definitions (Centers for Medicare and Medicaid Services, 2017) and near/term pregnancy based on CCS definitions (Supplemental Table 1). We also created an additional measure of verifiable, expensive, predictive conditions (VEPS) (Dudley et al., 2003) to compare the presence of key conditions which might drive health care utilization.

Primary outcome variables included monthly counts of inpatient hospital admissions, admitted days per month, and ED, primary care (Weiner & Abrams, 2011), and dental visits (Supplemental Table 2).

Assignment to intervention and comparison groups was at the person-month level in order to capture and model dynamic enrollment patterns and their association with utilization over time. Assignment at the person-month level also aligned with the programmatic and financial reality for HH and other MCOs—i.e., enrollment in its untransformed state was a time-varying variable. The intervention was defined as HH enrollment; the comparator was enrollment in non-HH Medicaid MCOs in Hennepin and Ramsey counties (Figure 1). Months of fee-for-service and non-enrollment were not considered in this analysis.

The analysis compared outcomes from January 1, 2012, the date when HH was initiated,
to December 31, 2014. For variables requiring lookback (e.g., to identify chronic conditions), we used data from March-December 2011 when available for individuals who enrolled prior to 2012.

**Statistical Analyses**

Variables that were constant over time were summarized at the person-level, while items that varied (e.g. monthly count of chronic conditions) were summarized at the person-month level. We modeled outcomes at the person-month level in alignment with the person-month measurement of HH/comparison enrollment and multiple time-varying covariates. This also allowed us to focus primarily on programmatic enrollment as the exposure and to mimic the financial realities of the ACO which held responsibility for members during each month of enrollment.

To account for time-varying confounding and most closely simulate the conditions of a randomized controlled trial, a marginal structural model (MSM) was fit using inverse probability weighting (Héroux et al., 2014). The MSM approach is intended to achieve the same end as other approaches for confounding, such as propensity score matching—namely to eliminate bias due to confounding. However, in longitudinal data with multiple observations per person, confounding can vary over time with changing values of the confounding variables and the exposure over time. As opposed to single-time matching techniques, MSMs are designed expressly to address this time-varying confounding by using inverse probability of treatment weights (based on the probability of being in a particular treatment group) that vary over time. In addition, MSMs may also incorporate a censoring weight to account for differences in the probability of being observed/censored over time. This is vital given that “churn” on and off enrollment in HH and other plans creates the potential for censoring.
As with any statistical model, MSMs have multiple assumptions. First, similar to other models for observational data, MSMs assume no unmeasured confounders. While this is not testable, our use of unique covariates such as derived indicators for homelessness, history of safety net health care use, zip code near safety net hospital, and others listed above, we are confident that we have done as much as possible to meet this assumption. Second, MSMs assume that there are no combinations of covariates for which either treatment condition (HH or non-HH) is not possible; as noted, all individuals in the study were all eligible for some early expansion plan based on age, income, lack of otherwise qualifying disability, and lack of dependents, and all lived in the same metropolitan area. Third, MSMs require a properly specified censoring weight be incorporated into the weighting scheme; as noted, we have incorporated such a censoring weight to account for differences in unobserved months.

To conduct the analysis, two-part models using MSMs were computed to estimate utilization for HH versus non-HH on all outcomes. The two-part MSMs used generalized linear models to estimate the probability of any use (versus none), and the conditional rate, or amount of use among users, for each utilization outcome. This approach was used due to the high proportion of months with no (zero) use of health care (zero-inflation). We present overall expected rates, which are the product of the probability of any use multiplied by the conditional rate of use among users (see Appendix A). For interpretation, we also present differences in those expected rates and their 95% confidence intervals. Two separate two-part MSMs were computed, first, with an indicator term for current enrollment in HH for overall estimates (encompassing thirty-six months). Second, to estimate linear trends over time, a separate model analyzed the interaction of current enrollment in HH with calendar time (as a continuous term) including significance testing of the interaction. The effect of a standard six-month exposure was
estimated using parameters from the model. Inverse probability of treatment weights for the
MSMs were estimated based on logistic regression models for enrollment in a MCO and
enrollment in HH given enrollment in a MCO. These models included other time-varying
covariates (Appendix A). Because subjects contributed multiple person-months to the analysis,
robust standard errors were used from generalized estimating equations. The Delta Method was
used to compute standard errors of the transformed outcomes (Casella & Berger, 2002).

Subgroup analyses

We conducted two subgroup analyses: First, to evaluate HH’s targeted attempts to
intervene with enrollees with the highest use of health care services, and second, to examine the
effects of censoring on measures and estimates. In the first, planned a priori, we analyzed overall
effects, as described above, limited to high utilizers, defined as individuals having more than
four ED visits or two inpatient hospital visits in their first 12 months of enrollment. These cut
points were chosen based on internal population management guidelines in HH for care
coordination and referral to intensive primary care. In the second subgroup analysis (post-hoc, in
response to peer review), we limited analyses to individuals with six months of continuous
enrollment in the same plan. This was chosen based on six months being the intended default
enrollment period for Hennepin Health and other MCOs. While these analyses address a specific
set of important questions and issues, we remain focused on our main analyses as most able to
capture dynamic enrollment patterns and maximize use of available data, as well as most
reflective of the overall programmatic reality of HH.

Results

Main findings

There were 19,433 unique Medicaid enrollees in HH for at least one month from 2012-
2014, and 73,458 enrollees without any HH exposure (non-HH). Analyses were conducted on the 3,022,808 person-months of enrollment of these individuals during the study period. However, for clarity of description, we present characteristics at the person-level in Table 1. Enrollees in HH were more likely to be male, Black, and homeless than those without any HH enrollment. HH enrollees had lower counts of chronic conditions and slightly lower risk scores (HCC) than non-HH enrollees while rates of expensive conditions (VEPS) were similar. HH enrollees demonstrated slightly lower rates of mental illness, but slightly higher rates of substance use disorders. HH enrollees had more total months unenrolled in Medicaid during the study period than non-HH enrollees (Table 1).

Raw (i.e., unweighted) counts of utilization demonstrated slightly higher rates of admission per month and longer length of stay in HH vs. non-HH enrolled person-months. There were lower rates of intensive care unit (ICU) encounters in HH versus non-HH. Similarly, HH had higher rates of ED and primary care visits and fewer dental visits than non-HH (Table 2).

The results of the MSMs comparing HH to non-HH (as estimates of overall effects and differences between them) are described in Table 3, with additional detail from the two-part models in Supplemental Figure 2 and Supplemental Table 3. There were no statistically significant differences between HH and non-HH in overall expected rates of inpatient admissions and admitted days. There were small, non-significant patterns of fewer hospital admissions but slightly longer length of stay in HH. HH was associated with slightly more use of the ICU, with borderline significance (difference=0.2, 95% CI: 0.01-0.34). In two-part model results, this was driven by a slightly higher probability of any ICU visit per month. The overall expected rate of ED use for HH was 52% higher compared to non-HH due to both a higher probability of any ED use for HH and a higher rate of use among ED-users. The overall expected rate of primary care
visits per month was 11% higher for HH compared to non-HH, driven by a higher rate of primary care use among users of primary care for HH versus non-HH. Overall expected rates of dental use for HH were lower than non-HH.

Estimates of the effect of HH and non-HH over time, based on the fitted MSMs modeling interactions between exposure and calendar month, are shown in Figure 2, with further detail in Supplemental Table 4. Predicted estimates of six months of HH enrollment were associated with decreases in visits to the ED and primary care, increased visits to dental care, and a non-significant trend toward fewer hospital admissions. Similar estimates for non-HH enrollment were associated with increased hospitalizations and decreased ED, primary care, and dental visits. When compared, the expected rate of dental use increased more over time for HH than non-HH enrollment (8.2 more visits/1,000 persons over 6 months, 95% CI: 7.2 – 9.2). By comparison, trends in the expected rates of hospital, ED, and primary care use for HH versus non-HH over time were not statistically significant.

Subgroup analyses

Our first subgroup analysis of results for high utilizers, presented as overall expected rates for simplicity, indicated that among historic high utilizers, the rate of inpatient admissions was lower in HH than non-HH MCOs (Table 4). Echoing the main analyses, overall expected rates of dental visits were also lower among high utilizers enrolled in HH versus non-HH.

Admitted days and ED, ICU, and primary care visits did not significantly differ based on confidence intervals of their differences crossing zero.

The second subgroup analysis, including only those with at least six months of continuous enrollment in a given plan (Table 5), indicated few substantial differences from the main results: overall ED and primary care visits were higher, and dental visits were lower, for
HH versus non-HH enrollment. At the same time, findings for admitted days and ICU differed marginally from the main findings: as with the main results, they were nominally higher in HH, but here, the confidence intervals of their differences slightly missed zero, indicating minimal difference in this subgroup. However, confidence intervals of HH and non-HH point estimates (a slightly more conservative comparison) overlapped, indicating minimal difference.

**Discussion**

In this study, we examined the impact of enrollment in a risk-sharing ACO, compared to enrollment in other Medicaid MCO programs, on the health care use of very low-income urban adults in a Medicaid expansion population. HH offered a multi-faceted care model to address the specific needs of this population and demonstrated that payment reform can support implementation of care coordination and integration across delivery systems designed to address physical, behavioral, and social needs. Default enrollment policies resulted in significantly higher rates of substance use disorder, homelessness, and unstable enrollment among HH versus non-HH. Our study attempted to overcome these differences by fitting MSMs with inverse probability weights.

In our main analyses, including all expansion enrollees in Medicaid MCOs in the same urban area, we found slightly higher overall use of primary care with HH enrollment. Overall rates of ED use were also higher, but overall hospitalizations were comparable in HH versus non-HH. When assessing changes over time with six-months of exposure, HH enrollment demonstrated consistent reductions in the use of ED and primary care, a trend toward decreased hospitalizations, and increased dental visits. Over the same time period, hospitalizations significantly increased in non-HH while dental visits decreased. When compared, only the increase in dental use over time in HH was statistically distinguishable from the non-HH trends.
Our subgroup results among high utilizers differed in some ways, notably finding that hospitalizations were significantly lower overall for HH while ED and primary care visits did not differ significantly from non-HH. However, our second subgroup analysis among those with six months of continuous enrollment produced findings substantively similar to main results with only two marginal differences, supporting the utility of censoring weights in our main analyses.

We conclude that the impact of an integrated, accountable care model for Medicaid expansion enrollees on health care utilization was multifaceted and reduced some types of care. However, overall, health care utilization did not differ significantly from non-ACO managed care comparators in most respects across the entire enrolled population.

Our findings are consistent with some past observations finding initially high rates of health care use, especially in the ED, among new health insurance enrollees, especially within Medicaid (DeLeire et al., 2013; Finkelstein et al., 2012). Similarly, our findings align with evidence suggesting that high initial health care use among the newly insured Medicaid population declines over time (Fertig, Carlin, Ode, & Long, 2017). Obtaining new health insurance often means that people have not had access to necessary health care, sometimes for an extended period. It may be natural, and even beneficial, for these groups to initially seek out more health care. However, there is also evidence that new coverage does not necessarily lead to ready access to primary care. Low-income populations with Medicaid insurance also often seek out care in ED settings likely related to non-insurance barriers to primary care including lack of transportation and fear of high co-pays at the site of care (Cheung, Wiler, Lowe, & Ginde, 2012; Shippee, Shippee, Hess, & Beebe, 2014). Our analysis of HH suggests that integrated care models alone, even when involving partners across the county, may not overcome these ED patterns compared to other Medicaid MCOs across an enrolled population, although both
enrolled populations had decreasing rates of ED use when assessed over time. However, high primary care use for HH overall, combined with progressive decreases in hospitalizations, do align well with some studies which suggest that primary care use is associated with lowered rates of inpatient hospitalization (Starfield, Shi, & Macinko, 2005). Findings from our subgroup analysis of high utilizers support nuance in this pattern, however—benefit may be mainly derived among those with the highest acute use. The greater increase in dental visits compared to non-HH enrollment in the main analysis, by contrast, may reflect a programmatic focus on connecting individuals with dental services access within HH. However, high initial levels of dental visits among the non-HH enrollees, combined with low initial levels of dental visits among HH enrollees, left HH with lower estimated rates overall in main and subgroup analyses.

There are several possible explanations for our main findings. First, ACOs are complex, heterogeneous organizations whose implementation was gradual during our study period (Shortell, 2016). The HH ACO model may lead to gradual improvements in health and health care use which require more than three years to fully manifest. This is supported by our findings of lowering rates of hospital use over time and similar trends for ED use. This may be especially true within HH since it began as a demonstration project and implemented its care model across several different clinical care delivery sites over time. At the beginning of the study, many care model interventions were immature or absent.

Second, our methods may not have fully adjusted for the social and medical differences between HH and non-HH enrollees. While default enrollment policies increased HH enrollment, it also presented a strong selection bias towards more people who are homeless and others unreachable by mail who demonstrated more unstable enrollment patterns (Table 1). While we attempted to overcome these factors in our weighted models with variables to measure some
social factors (e.g., address-based homeless indicator, history of care seeking in the safety net, zip code near safety net hospital), bias due to selection may be refractory to sufficient adjustment using health care claims data, and residual bias may remain. It is possible that our homeless indicator, for example, failed to fully represent the known influence of unstable housing on preferential use of the ED and inpatient hospital settings of care (Larimer et al., 2009). There are also a number of key social domains known to influence health care use still absent in the study data, e.g., corrections involvement, social isolation, and food insecurity. There were also consistently fewer enrolled months among HH enrollees. Although crossover occurred, and was accounted for in analyses conducted at the person-month level, patterns of enrollment and disenrollment (“churn”) have been associated with higher use of ED and inpatient health care (Sommers et al., 2015). While we conducted a subgroup analysis with six months of continuous enrollment and found few differences from the main results, it is possible that with longer continuous enrollment, the estimated influence of the ACO on health care use might be different. Furthermore, we created a rigorous comparison with enrollment in other Medicaid managed care programs within the same urban area in Minnesota where the health care system ranks second in the US for overall performance (Radley, McCarthy, & Hayes, 2017). If compared to other programs, such as fee-for-service Medicaid in this or other regions, the HH model may demonstrate different comparative influences on health care use patterns.

Third, it is possible that more use of health care, for this high-risk population, may be appropriate and may result in improved health outcomes in the long-term. This is especially likely given this group’s historic barriers to accessing comprehensive health insurance and the health care system. The HH care model made explicit efforts to draw members into care with outreach workers placed at a variety of sites where high-risk enrollees might be found including
county jails and work houses, the county’s mental health center, the health plan’s waiting room, the hospital ED, and various shelters in the region. It is possible that these efforts drove the increased use of primary care. It is also possible that such efforts drew people into health care settings who previously may not have sought care. While it is not ideal that some of this care happened in the ED and hospital, to some extent these utilization patterns may reflect appropriate health care-seeking behavior. Decreases in hospital use over time in the main analysis and lower overall hospital use in high utilizer subgroup analysis suggest some benefit of enrollment. Further work using well-designed measures of “avoidable” health care use may be able to address such a question.

Fourth, our findings align with the mixed results produced to date in studies of other ACO payment models. Most widely studied are the Medicare Pioneer ACOs which have been associated with modest financial savings especially in areas with high health care spending (McWilliams, Chernew, Landon, & Schwartz, 2015). Pioneer ACOs in the upper Midwest saw less consistent savings than ACOs in Boston or California (Nyweide et al., 2015). While there has been much enthusiasm about the potential impact of Medicaid ACOs (Lewis et al., 2012), we found few comparative, data-driven evaluations. McConnell et al. compared Medicaid ACO models in Oregon with those in Colorado but offers little insight about ACO to non-ACO comparisons (McConnell et al., 2017). Furthermore, part of the HH care model focuses on connecting enrollees with primary care medical homes (PCMH) as a mechanism to deliver accountable care (Edwards et al., 2014). Research findings about the association of PCMHs on health care utilization have been mixed with some showing no consistent reductions in use of ED or inpatient care (Friedberg, Schneider, Rosenthal, Volpp, & Werner, 2014; Rosenthal et al., 2013) while others have shown significant reductions (Higgins, Chawla, Colombo, Snyder, &
Overall, our study highlights the differences which can exist between administrative shared savings calculations and comparative research on program impact (DeLia, 2016). During the same study period, HH delivered coordinated and integrated care that met the needs of the enrolled population each year for under the risk-adjusted per-member-per-month payment rate. By program standards, this resulted in shared savings which were circulated among partners and reinvested into improvements in the delivery system. Our findings suggest that HH enrollees used more health care than their peers in non-HH managed care programs in the same urban area although their use of the ED, and possibly the hospital, were dropping over time. This highlights the heterogeneity of approaches to define program success and the need to pair administrative and research approaches to fully evaluate complex new approaches to health care delivery system innovations.

The U.S. health care system has struggled to operationalize approaches to address social and behavioral needs at the population level. The HH ACO demonstrates that ACOs serving Medicaid enrollees with high levels of financial risk may incent locally-driven efforts to link services with primary care to meet the broader needs of low-income patients. This was especially true in HH which began by serving only the narrow segment of very low-income early Medicaid expansion enrollees. Furthermore, HH represents a unique partnership between a county-affiliated safety net health system and county social services and public health. The heavy behavioral health burden (43%) of the Medicaid early expansion population in the study region likely incentivized an operational plan to address social and behavioral factors to a greater degree than Medicare ACOs (perhaps not surprising given the lower prevalence of mental illness in Medicare populations) (Fullerton, Henke, Crable, Hohlbauch, & Cummings, 2016). While the
results of this study do not support major changes in health care utilization over the first three
years of HH, our exploratory, qualitative study of HH members, done in parallel to these
quantitative analyses, suggest that linkage to primary care and mental health care within the
ACO care model are associated with self-reported improvements in quality of life (cite QCA
paper in MCRR).

Interpretation of our results must be made with acknowledgement of several limitations.
First, Hennepin Health is a heterogeneous care model with multiple components, and not all
were delivered to all enrollees. No reliable variables were available in the data to estimate the
varied care model components received by each enrollee. We instead treated any month of
enrollment as receipt of the HH care model. Second, while our MSMSs, fitted using inverse
probability weights, attempt to overcome selection bias and time-varying confounding, this may
not have addressed all sources of confounding especially related to unmeasured variables. This
includes default enrollment versus personally selecting a plan, which could have had a role in
selection processes but is unavailable in our data. We believe we have included many key
confounders that are often not included in claims analyses, including homelessness and history of
safety net health care use. However, unmeasured variables remain a limitation, as with any non-
randomized study. Third, concurrent with HH implementation, other payment reform efforts
occurred (Wholey et al., 2014). While these should not have been systematically different
between HH and non-HH enrollees, they may limit representativeness of this setting, or may
attenuate any differences between intervention and comparator. Fourth, while our MSMSs
preserved the maximum amount of observations per enrollee, our project is hindered by
interrupted enrollment (Table 1) with the disproportionally high rates of
enrollment/disenrollment (Sommers, Gourevitch, Maylone, Blendon, & Epstein, 2016) in HH
members. Despite adjustments in our weights for censoring, we are unable to determine if unenrolled months represented positive events (such as employment leading to increased income and private insurance), or more challenging events (such as extended time spent in jail/prison, difficulty filling out renewal paperwork). Additionally, as with any analysis of claims data, any utilization that might occur during unenrolled months would be unobserved; our models thus assume that no unenrolled utilization occurred. While health systems would be incentivized to connect unenrolled, eligible individuals with coverage to ensure they receive reimbursement, such an assumption is untestable. Additionally, these records contain no measures of health outcomes.

Likewise, both our person-month level and our person-level covariates require sufficient observation months to capture certain phenomena, such as the accumulation of chronic conditions. Therefore, our models used censoring weights that accounted for the probability of enrollment over time and past intervention history as an attempt to create unbiased comparisons between the intervention and control groups (Appendix A). Beyond the censoring weights, we attempted to further address this question using subgroup analyses among those with at least six months of continuous coverage to assess the impact of observation time on our findings. These subgroup analyses revealed substantively similar findings to the main results with only two marginal differences, suggesting support for the main results. However, to the extent that one group had greater social or behavioral complexity, greater severity of conditions, or more unmeasured health conditions, such differences could remain a limitation. For example, such unmeasured differences could, in part, explain higher ED use in HH enrollees found in the main analysis. Fifth and finally, estimating costs from managed care Medicaid data is challenging, requiring extensive assumptions and imputation and thus is not reported in the analyses shown
Conclusion

The case of HH demonstrates that an ACO structure within Medicaid, sharing substantial financial risk, offers powerful incentives to design and implement a care model to meet the specific needs of complex patients by linking delivery of social services, behavioral health, and medical care. Our study found that six-months of enrollment in such a care model was associated with less use of the ED/hospital and more use of primary and dental care over time among the enrolled cohort of very low-income adults. HH appeared to have the clearest benefit versus non-HH for high-utilizing patients, with lower hospitalizations overall among this subgroup. However, when compared overall to other Medicaid expansion managed care plans, HH ACO enrollees used the ED more often than their non-HH peers and had no significant differences in hospitalizations. Additional work is needed to study the impact of integrated care models between health care and social service systems within ACO and other shared savings models on patient outcomes. Such studies should use rigorous, experimental designs whenever possible to avoid the need for extensive statistical adjustment and include measures of patient-level health and social outcomes. ACOs promote flexibility and provide opportunity to develop models of care to efficiently address the broad health needs of low-income populations in Medicaid. More work is needed to harness this opportunity and develop approaches to rigorously evaluate such programs’ abilities to improve health and use of health care.
References


{ Vickery, K.D., Shippee, N. D., Guzman-Corrales, L. M., Cain C., Manser, S. T., Walton, T., Richards, J., Linzer, M., “Changes in quality of life among enrollees in Hennepin Health, a Medicaid expansion ACO.” *SAGE Production to complete the citation entry for this forthcoming article in MCRR.*}


Figure 1. Derivation of person-level intervention and comparison groups for Hennepin Health evaluation

MN Department of Human Services
Medicaid Data:
N=191,920
- \geq 1\text{ month of expansion eligibility between 3/1/2011 and 12/31/2014}
- County of financial responsibility in 7 county metropolitan region

Excluded:
n= 99,471
- Never in Hennepin or Ramsey counties, \(n=46,136\)
- Age < 21 yrs. on 1/1/2012, \(n=13,665\)
- Age \geq 65 yrs. before 12/31/2014, \(n=898\)
- New enrollees after 12/31/2013, \(n=28,739\)

Intervention group HH ever:
n=19,433
\geq 1\text{ month of enrollment in Hennepin Health (HH)}

Comparison group HH never:
n=73,458
No enrollment in Hennepin Health (non-HH)
Figure 2. Expected rates of health care use over time among in Hennepin Health (HH) versus non-Hennepin Health (non-HH) based on marginal structural model
Table 1. Socio-demographic characteristics of early Medicaid expansion enrollees exposed and not exposed to the Hennepin Health Accountable Care Organization at the person level

<table>
<thead>
<tr>
<th></th>
<th>Ever Hennepin Health</th>
<th>Never Hennepin Health</th>
</tr>
</thead>
<tbody>
<tr>
<td>N (%)</td>
<td>19,433 (20.9)</td>
<td>73,458 (79.1)</td>
</tr>
<tr>
<td>Age Mean (SD)</td>
<td>39.3 (11.5)</td>
<td>40.7 (12.2)</td>
</tr>
<tr>
<td>Sex, N (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>5,731 (29.5)</td>
<td>29,749 (40.5)</td>
</tr>
<tr>
<td>Male</td>
<td>13,702 (70.5)</td>
<td>43,709 (59.5)</td>
</tr>
<tr>
<td>Race/ethnicity, N (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>521 (2.7)</td>
<td>3,461 (7.6)</td>
</tr>
<tr>
<td>Black</td>
<td>10,240 (52.7)</td>
<td>18,251 (39.8)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>536 (2.8)</td>
<td>1,751 (3.8)</td>
</tr>
<tr>
<td>Native American</td>
<td>1,124 (5.8)</td>
<td>1,949 (4.3)</td>
</tr>
<tr>
<td>White</td>
<td>6,007 (30.9)</td>
<td>17,956 (39.2)</td>
</tr>
<tr>
<td>Unknown</td>
<td>1,005 (5.2)</td>
<td>2,446 (5.3)</td>
</tr>
<tr>
<td>Any Homelessness, N (%)</td>
<td>9,590 (49.3)</td>
<td>22,468 (30.6)</td>
</tr>
<tr>
<td>Not English Speaking, N (%)</td>
<td>17,702 (91.1)</td>
<td>64,405 (87.7)</td>
</tr>
<tr>
<td>Education Level, N (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than high school</td>
<td>2,897 (14.9)</td>
<td>13,594 (18.5)</td>
</tr>
<tr>
<td>High School or GED</td>
<td>13,762 (70.8)</td>
<td>48,597 (66.2)</td>
</tr>
<tr>
<td>More than high school</td>
<td>2,583 (13.3)</td>
<td>10,493 (14.3)</td>
</tr>
<tr>
<td>Missing</td>
<td>191 (1.0)</td>
<td>774 (1.1)</td>
</tr>
<tr>
<td>Pregnancy, a N (%)</td>
<td>459 (2.4)</td>
<td>3,392 (4.6)</td>
</tr>
<tr>
<td>Count of Clinical Classification Software (CCS) Categories Mean (SD)</td>
<td>4.59 (5.69)</td>
<td>5.58 (5.84)</td>
</tr>
<tr>
<td>Hierarchical Condition Category (HCC) Risk Score Mean (SD)</td>
<td>0.65 (0.54)</td>
<td>0.68 (0.57)</td>
</tr>
<tr>
<td>Number of verifiable, expensive, predictive conditions (VEPS) Mean (SD)</td>
<td>0.85 (1.04)</td>
<td>0.85 (1.04)</td>
</tr>
<tr>
<td>Any Mental Illness (CCS &amp; HCC), b N (%)</td>
<td>7,782 (40.0)</td>
<td>31,889 (43.4)</td>
</tr>
<tr>
<td>Substance Use Disorder (CCS &amp; HCC), c N (%)</td>
<td>7,061 (36.3)</td>
<td>23,193 (31.6)</td>
</tr>
<tr>
<td>Total months without any Medicaid enrollment (out of 46 possible months of data) Mean (SD)</td>
<td>21.15 (12.94)</td>
<td>17.38 (13.39)</td>
</tr>
<tr>
<td>Any generation of a claim, d N (%)</td>
<td>15,830 (81.5)</td>
<td>63,154 (86.0)</td>
</tr>
<tr>
<td>Died, N (%)</td>
<td>205 (1.1)</td>
<td>911 (1.2)</td>
</tr>
</tbody>
</table>

a Pregnancy was defined as having a CCS category of: Other pregnancy and delivery including normal (196), Other complications of pregnancy (181), Early or threatened labor (184), Forceps delivery (194) (“CCS Category Names,” n.d.)
Mental illness included diagnoses in Hierarchical Condition Category (HCC) 57 (Schizophrenia), 58 (Major Depressive, Bipolar, and Paranoid Disorders), or Clinical Classification Software mental health categories 650 (Adjustment disorders), 651 (Anxiety disorders), 652 (Attention-deficit, conduct, and disruptive behavior disorders), 653 (Delirium, dementia, and amnestic and other cognitive disorders), 654 (Developmental disorders), 655 (Disorders usually diagnosed in infancy, childhood, or adolescence), 657 (Mood disorders), 658 (Personality disorders), 659 (Schizophrenia and other psychotic disorders), 662 (Suicide and intentional self-inflicted injury), and 670 (Miscellaneous mental health disorders).

HCC 54 (Drug/Alcohol Psychosis) or 55 (Drug/Alcohol Dependence) and Clinical Classification Software substance use categories 660 (Alcohol-related disorders) and 661 (Substance-related disorders)

Any generation of inpatient, outpatient, or professional claim during study period
Table 2. Unweighted rates of health care utilization in Hennepin Health versus non-Health Hennepin by person-months

<table>
<thead>
<tr>
<th></th>
<th>Hennepin Health n=601,262 (19.9%)</th>
<th>Non-Hennepin Health n=2,421,546 (80.1%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean rate per 1,000 person-months</td>
<td>Mean rate per 1,000 person-months</td>
</tr>
<tr>
<td>Inpatient Admissions&lt;sup&gt;a&lt;/sup&gt;</td>
<td>23.1</td>
<td>22.1</td>
</tr>
<tr>
<td>Admitted days</td>
<td>190.5</td>
<td>166.7</td>
</tr>
<tr>
<td>Intensive care unit visits</td>
<td>0.1</td>
<td>0.5</td>
</tr>
<tr>
<td>Emergency Department visits&lt;sup&gt;b&lt;/sup&gt;</td>
<td>162.5</td>
<td>117.9</td>
</tr>
<tr>
<td>Primary Care visits&lt;sup&gt;c&lt;/sup&gt;</td>
<td>402.6</td>
<td>363.0</td>
</tr>
<tr>
<td>Dental visits</td>
<td>76.8</td>
<td>86.1</td>
</tr>
</tbody>
</table>

<sup>a</sup> Includes regular and observation status admissions

<sup>b</sup> Algorithm for counting ED visits allowed maximum of 1 visit per calendar day

<sup>c</sup> Evaluation & Management CPT code on given date indicating a visit with a generalist provider (by National Provider Index directory) including Family Medicine, Internal Medicine, Geriatricians, Pediatricians, Preventive Medicine, Nurse Practitioners, or Obstetrics and Gynecology; following ACG approach (Weiner & Abrams, 2011).
Table 3. Estimated overall expected rates of health care utilization in Hennepin Health versus non-Health Hennepin by person-months based on the fitted marginal structural models

<table>
<thead>
<tr>
<th></th>
<th>Hennepin Health</th>
<th>Non-Hennepin Health</th>
<th>Difference (HH-nonHH)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate per 1,000 person-months</td>
<td>95% CI</td>
<td>Estimate per 1,000 person-months</td>
</tr>
<tr>
<td>Inpatient admissions</td>
<td>17.1</td>
<td>15.5-18.7</td>
<td>18.5</td>
</tr>
<tr>
<td>Admitted days</td>
<td>94.2</td>
<td>77.5-111.0</td>
<td>90.0</td>
</tr>
<tr>
<td>Intensive care unit visits</td>
<td>0.64</td>
<td>0.48-0.80</td>
<td>0.47</td>
</tr>
<tr>
<td>Emergency department visits</td>
<td>139.9</td>
<td>128.4-151.4</td>
<td>92.1</td>
</tr>
<tr>
<td>Primary care visits</td>
<td>401.5</td>
<td>389.2-413.7</td>
<td>363.0</td>
</tr>
<tr>
<td>Dental visits</td>
<td>70.1</td>
<td>67.1-73.0</td>
<td>96.6</td>
</tr>
</tbody>
</table>

*Bold text indicates significant difference between HH and non-HH with non-overlapping confidence intervals of estimates, or confidence interval of difference not crossing zero.*
Table 4. Sub-group analyses for high utilizers: Estimated overall expected rates of health care utilization in Hennepin Health versus non-Health Hennepin by person-months based on the fitted marginal structural models\textsuperscript{a}

<table>
<thead>
<tr>
<th></th>
<th>Hennepin Health</th>
<th></th>
<th>Non-Hennepin Health</th>
<th></th>
<th>Difference (HH-nonHH)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate per 1,000 person-months</td>
<td>95% CI</td>
<td>Estimate per 1,000 person-months</td>
<td>95% CI</td>
<td>Estimate per 1,000 person-months</td>
<td>95% CI</td>
</tr>
<tr>
<td>Inpatient admissions</td>
<td>67.7</td>
<td>58.4-76.9</td>
<td>93.75</td>
<td>89.9-97.6</td>
<td>-26.11</td>
<td>-35.9- -16.3</td>
</tr>
<tr>
<td>Admitted days</td>
<td>343.6</td>
<td>-164.8-852.0</td>
<td>563.4</td>
<td>459.4-667.4</td>
<td>-219.7</td>
<td>-826.0-386.6</td>
</tr>
<tr>
<td>Intensive care unit visits</td>
<td>1.8</td>
<td>1.1-2.6</td>
<td>1.7</td>
<td>1.4-2.0</td>
<td>0.1</td>
<td>-0.7-0.9</td>
</tr>
<tr>
<td>Emergency department visits</td>
<td>561.9</td>
<td>495.6-628.3</td>
<td>527.7</td>
<td>472.4-583.0</td>
<td>34.22</td>
<td>-10.9-79.3</td>
</tr>
<tr>
<td>Primary care visits</td>
<td>678.0</td>
<td>634.6-721.4</td>
<td>672.0</td>
<td>657.0-687.0</td>
<td>6.0</td>
<td>-39.3-51.4</td>
</tr>
<tr>
<td>Dental visits</td>
<td>87.1</td>
<td>77.5-96.8</td>
<td>117.8</td>
<td>113.8-121.8</td>
<td>-30.7</td>
<td>-41.0- -20.3</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Notes: High utilizers are defined based on internal standards used to trigger higher levels of care, specifically those with >4 emergency department or >2 inpatient hospital visits over their first enrolled 12 months of estimates, or confidence interval of difference not crossing zero.
Table 5. Sub-group analyses for enrollees with six months of continuous enrollment: Estimated overall expected rates of health care utilization in Hennepin Health versus non-Health Hennepin by person-months based on the fitted marginal structural models

<table>
<thead>
<tr>
<th>Service</th>
<th>Hennepin Health</th>
<th>Non-Hennepin Health</th>
<th>Difference (HH-nonHH)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate per 1,000 person-months</td>
<td>95%CI</td>
<td>Estimate per 1,000 person-months</td>
</tr>
<tr>
<td>Inpatient admissions</td>
<td>15.6</td>
<td>13.3-17.9</td>
<td>14.0</td>
</tr>
<tr>
<td>Admitted days</td>
<td>80.6</td>
<td>63.8-97.4</td>
<td>62.7</td>
</tr>
<tr>
<td>Intensive care unit visits</td>
<td>0.87</td>
<td>0.55-1.19</td>
<td>0.52</td>
</tr>
<tr>
<td>Emergency department visits</td>
<td><strong>166.6</strong></td>
<td><strong>155.9-177.3</strong></td>
<td><strong>99.7</strong></td>
</tr>
<tr>
<td>Primary care visits</td>
<td><strong>426.3</strong></td>
<td><strong>407.9-444.7</strong></td>
<td><strong>387.0</strong></td>
</tr>
<tr>
<td>Dental visits</td>
<td><strong>80.5</strong></td>
<td><strong>75.6-85.4</strong></td>
<td><strong>98.0</strong></td>
</tr>
</tbody>
</table>

*Notes: Bold text indicates significant difference between HH and non-HH with non-overlapping confidence intervals of estimates, or confidence interval of difference not crossing zero.*