State of North Carolina

Office of The State Auditor
Beth A. Wood, CPA

Department of Health and Human Services
Division of Medical Assistance

Community Care of North Carolina

Raleigh, North Carolina
Financial Related Audit
August 2015

NC OSA
The Taxpayers' Watchdog

EXECUTIVE SUMMARY

PURPOSE

As directed by the General Assembly, the purpose of this audit was to determine whether the Community Care of North Carolina (CCNC) model saved money and improved health outcomes within the Medicaid program at the Department of Health and Human Services, Division of Medical Assistance.

BACKGROUND

CCNC is a managed primary care program that served approximately 1.3 million of approximately 1.5 million Medicaid beneficiaries in the state as of December 31, 2012.

Under CCNC, eligible beneficiaries join "medical homes," which coordinate patients' healthcare services. Primary care services are managed through the medical home, and access to specialty care is coordinated through the primary care physician. Each patient has access to a case manager to ensure individualized care. CCNC also provides health education to its plan members and assists them in maximizing their own health care through self-management.

The study population is limited to non-elderly, non-dual Medicaid beneficiaries. Dual eligible beneficiaries are individuals who receive full Medicaid benefits but also receive assistance from Medicare. The majority of dual eligibles meet the Medicare eligibility requirement based on age (65 and older). For these members, Medicaid is the payer of last resort, paying for long-term care or other costs that Medicare does not cover. Dual eligible beneficiaries were eliminated from the study population because significant portions of Medicare claim payments and records were not available.

KEY FINDINGS

- The researcher's analysis, based on data from July 1, 2003, through December 31, 2012, suggests that the CCNC program saved money among non-elderly, non-dual Medicaid beneficiaries.
    - Savings of approximately $78 per quarter per beneficiary, approximately $312 a year in 2009 inflation-adjusted dollars (approximately a 9% savings)
    - Decreased spending in almost all spending categories, with the largest reduction in inpatient services

- The researcher's analysis suggests improved health outcomes for CCNC members.
    - Approximately a 20% increase in physician services (increased physician services is expected to prevent more expensive health care in the future)
    - Approximately a 25% reduction in inpatient admissions
    - Approximately a 10.7% decline in prescription drug use
    - Reduction in readmissions, inpatient admissions for diabetes, and emergency department visits for asthma (only the asthma results are statistically significant)
    - No statistically significant effect on overall emergency department use

The key findings in this summary may not be inclusive of all the findings in this report.

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AUDITOR'S TRANSMITTAL

August 20, 2015

The Honorable Pat McCrory, Governor
Members of the North Carolina General Assembly
Mr. Rick Brajer, Secretary, Department of Health and Human Services
Mr. Dave Richard, Director, Division of Medical Assistance
Dr. Tom Wroth, Chief Medical Officer and Acting President of Community Care of North Carolina Networks

Ladies and Gentlemen:

We are pleased to submit this financial related report titled Community Care of North Carolina. The audit objectives were to determine whether the Community Care of North Carolina model saves money and improves health outcomes within the North Carolina's Medicaid program.

The Department of Health and Human Services' Secretary Brajer and Community Care of North Carolina Networks' acting president Dr. Wroth reviewed a draft copy of this report. Their written comments are included starting on page 25 and page 26, respectively.

This audit was conducted in accordance with *North Carolina General Statute 147-64.7*. The General Assembly directed the Office of the State Auditor to "engage nationally recognized medical researchers to perform a scientifically valid study based upon actual data to determine whether the Community Care of North Carolina model saves money and improves health outcomes."

We appreciate the cooperation received from management and the employees of the Department of Health and Human Services and Community Care of North Carolina during our audit.

Respectfully submitted,

Beth A. Wood

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BACKGROUND

The North Carolina Department of Health and Human Services (DHHS) is the designated State Medicaid agency. Most of the responsibility for administering the Medicaid program is delegated to the Division of Medical Assistance (DMA).

In recent years, Medicaid budgets across the country have been growing. In North Carolina, Medicaid represents the second largest expenditure behind education. In response to the growing budgets, DHHS and DMA officials developed and implemented multiple strategies to control Medicaid costs, including Community Care of North Carolina (CCNC).

CCNC is a managed primary care program which serves approximately 1.3 million out of approximately 1.5 million of Medicaid beneficiaries in the state.[1]

Under the CCNC model, eligible beneficiaries join "medical homes"[2] which coordinate a patient's healthcare services. Primary care services are managed through the medical home. Access to specialty care is coordinated through the primary care physician. Each patient has access to a case manager to ensure individualized care. CCNC also provides health education to its plan members and assists them in maximizing their own health care through self-management.

CCNC's central office, 14 regional networks, and locally-based care managers work together with CCNC-affiliated primary care physician practices to deliver medical services to Medicaid eligible patients. CCNC asserts that the coordination of preventive care, such as health screenings and prescriptions, will prevent more expensive health care in the future, such as emergency room visits and expensive surgeries, and improve health care outcomes.

Medicaid pays an administrative fee[3] for each Medicaid recipient enrolled in CCNC for 'care coordination' and all medical services are billed as fee-for-service by the health providers. The administrative fee-per-month depends on the type of member (e.g. aged/blind/disabled vs. standard Medicaid beneficiary).

In a January 2013 audit report,[4] the Office of the State Auditor noted that savings attributed to the CCNC program were based on actuarial analysis and assumptions in other studies. Auditors recommended that North Carolina engage medical researchers to perform a scientifically valid study based on actual data to determine whether the CCNC model saves money and improves health outcomes.

In July 2013, the General Assembly directed the Office of the State Auditor to "engage nationally recognized medical researchers to perform a scientifically valid study based upon actual data to determine whether the Community Care of North Carolina (CCNC) model saves money and improves health outcomes."

As noted above, there are other studies of the CCNC model performed by various entities. See Appendix A for the researcher's discussion on key differences between this study and previous studies.

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[1] 1.3 million (85%) of Medicaid eligible participants as of December 31, 2012 as reported by DHHS.

[2] A team based health care delivery model led by a primary care physician that provides comprehensive and continuous medical care to patients with the goal of obtaining maximum health outcomes.

[3] Ranging from $2.50 to $13.72 from 2004 through 2012.

[4] PER-2013-7291 Department of Health and Human Services - Division of Medical Services - Medicaid

OBJECTIVE, SCOPE, AND METHODOLOGY

The objectives of this audit were to determine whether the Community Care of North Carolina (CCNC) model saves money and improves health outcomes within North Carolina's Medicaid program.

The audit scope included an analysis of state Medicaid claims data from July 1, 2003, through December 31, 2012.

To accomplish the audit objectives, the Office of the State Auditor (OSA) contracted with a nationally recognized medical researcher to develop the study methodology and determine if the CCNC model saves money and improves health outcomes

The researcher was selected based on his qualifications, experience, credentials, and proposed methodology. OSA vetted the researcher and his methodology with officials at the Department of Health and Human Services and CCNC as well as with the legislators that requested this study.

To evaluate the completeness of the claims used in the study, auditors reconciled the dollar value of the population to state accounting records.

As noted in Appendix B (page 8), this study excludes non-elderly, dual-eligible Medicaid beneficiaries. See Appendices B through E for detailed descriptions of the researcher's study methodology, data reconciliation and verification efforts, study limitations, and study results and tables.

We did not perform any tests of internal controls. As a result, our audit does not provide a basis for rendering an opinion on internal control, and consequently, we have not issued such an opinion.

We conducted this performance audit in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

FINDING AND RESPONSES

1. CCNC Model Saved Money and Improved Some Health Outcomes for Non-Elderly, Non-Dual Medicaid Beneficiaries

The researcher's analysis, based on data from July 1, 2003, through December 31, 2012, suggests that that the Community Care of North Carolina (CCNC) managed care program saved money and improved some health outcomes among non-elderly, non-dual[5] Medicaid beneficiaries.

Cost Savings

The researcher's analysis suggests savings of approximately $78 per quarter per beneficiary, approximately $312 a year in 2009 inflation-adjusted dollars (approximately a 9% savings). The estimate is relatively imprecise, with a 95% confidence interval ranging from $1 to $154 in savings per member per quarter.

The estimated savings are inclusive of administrative fees paid[6] to CCNC and primary care providers each month for each Medicaid recipient enrolled in CCNC.

The decreased spending reflects decreases in almost all spending categories, with the largest percentage reduction in spending (17.6%) on inpatient services. Spending on other services generally declined but those results were not statistically significant. See Table 2 in Appendix E for more details on the study results.

Without the CCNC program, Medicaid would have paid approximately $312 more per beneficiary per year. This estimate is based on the researcher's study methodology as detailed in Appendix B.

There is some uncertainty regarding the researcher's base estimate of a 9% savings and various sensitivity analyses (e.g. omitting the risk score or changing the functional form) suggests somewhat smaller savings (See Sensitivity Analyses in Exhibit B). Yet throughout the sensitivity analyses, the conclusion that CCNC saves money remained.

Health Outcomes

The results regarding the health outcome measures generally suggest improved health of Medicaid recipients enrolled in CCNC. The researcher's analysis estimates approximately a 25% reduction in inpatient admissions which is consistent with an overall improvement in beneficiary health (See Table 3 in Exhibit E).

[5] Dual eligible beneficiaries are individuals who receive full Medicaid benefits as well as those who only receive assistance with Medicare premiums or cost sharing. They were eliminated from the study population because significant portions of Medicare claim payments and records were not available.

[6] Ranging from $2.50 to $13.72 from 2004 through 2012.

The researcher's analysis also found a reduction in hospital readmissions, emergency department visits for asthma, and inpatient admissions for diabetes, though only the asthma results are statistically significant (See Table 5 in Appendix E).

Results are Not Applicable to Other Medicaid Strategies
The researcher's findings do not speak to the impact of CCNC relative to other possible money saving or patient care strategies.

AGENCY RESPONSES

See pages 25 and 26, respectively, for the Department of Human Services and Community Care of North Carolina responses.

Previous analyses of Community Care of North Carolina (CCNC) have typically addressed the issue by choosing a control group of enrollees in Medicaid that do not use CCNC services (Filmore, et al. is an exception). Other analyses generally used observable characteristics of enrollees to try to control for underlying health differences between participants in the Carolina Access 2 (CA2)[7] population and other Medicaid enrollees. These studies then compare the adjusted spending and health outcomes of CA2 enrollees to adjusted non-CA2 enrollees to infer the effect of CCNC. If people in CA2 spend less or are healthier, then these effects were attributed to CCNC services.

If all differences in the health of these populations are captured by the covariates (factors such as patient demographics or health status), then the approach outlined above gives an unbiased estimate of the program effect.

However, this assumption is unlikely to be realistic. Individuals will sort into and out of CA2 based on information that is available to them and not captured in the data, such as patients being at the onset of an illness that has not yet been recorded in claims data. Individuals with particularly complex care needs may have been preferentially enrolled into CA2 while others may apply to be exempt from CA2 if they are particularly ill. As a result, previous studies may overstate or understate the cost savings to CA2 if the health status of those in CA2 relative to those outside of the program differs in ways that the analyst cannot observe.

The key to an effective evaluation of the CCNC program is addressing these underlying differences. Our methods are designed to address this concern.

[7] Carolina Access 2 is the name for non-elderly (under 65), blind, or disabled beneficiaries participating in the CCNC program.

Statistical Approaches

Our basic strategy in carrying out this study used state Medicaid claims, eligibility files, and provider data to measure the impact of the Community Care of North Carolina (CCNC) model.

We did not rely on simple regression adjusters (though we included them because they mitigated a concern). In particular, we took advantage of the fact that there was an enormous expansion of Carolina Access 2 (CA2) in recent years. CCNC member months rose from 8.3 million in 2008 to 11.7 million in 2011. Much of this increase was due to the expansion of Medicaid rolls during the recent recession. However, a sizeable portion reflects shifts into CA2; non-CCNC member months fell by approximately 900,000 over this same period. This latter shift reflects both an expansion in the number of providers accepting CA2, a push to enroll aged, blind, and disabled enrollees into this program, and individuals whose participation was optional and who had not used primary care getting assigned to a medical home.

Our primary analytic strategy relied on variation in the rollout and acceptance of the program across counties.

Our model was:

(1) $Y_{it} = X_{it}*B_0 + CCNC\%_{ct}*B_1 + C_i + Q_t + e_{it}$

Where:

Y_{it} = outcome for subject 'i' in quarter 't'
X_{it} = covariates for subject 'i' in quarter 't' described more below
CCNC%ic = percentage of beneficiaries in the beneficiary's county enrolled in CCNC at time t.
C_i is a county fixed effect. This captures time invariant county traits (including average health status in the county or time invariant physician practice styles or delivery system infrastructure) and generates a model that identifies the effects of CCNC based on *changes* in CCNC enrollment penetration.
Q_t is a vector of quarter dummies (1 if observation is in quarter 't'.). These variables capture all common trends occurring over time, including general inflation and any underlying trends in practice patterns.
e_{it} = a random error term for subject 'i' in quarter 't'
B_0 is a vector of coefficients on covariates
B_1 is the coefficient of interest

We explored several other strategies, including a person fixed effect model and a physician fixed effect model. Both were rejected because they failed various diagnostics tests (described below).

Variables

Outcome Variables

We examined a broad range of outcomes including:

1. Expenditures
   a. Total expenditures
   b. Inpatient spending
   c. Outpatient and Professional spending
   d. Emergency room spending
   e. Dental spending
   f. Prescription drug spending

2. Utilization
   a. Number of ambulatory encounters
   b. Number of inpatient hospitalizations
   c. Number of prescriptions and mix of prescription types (in particular branded vs. generic)

3. Quality
   a. Hospital re-admissions
   b. Emergency room utilization for asthma
   c. Inpatient Utilization for diabetes

4. Process measures that can be calculated from administrative data (claims and eligibility) were computed for the population and sub-populations of interest. Examples of these measures include:
   a. Well checkups (child and adolescents)
   b. Diabetic care (HbA1c, LDLc, eye exam)
   c. Asthma care (ER admissions for asthma)
   d. Breast cancer screening
   e. Cervical cancer screening
   f. Chlamydia screening

Covariates

We used a range of common covariates (in addition to the CCNC variables described above).

1. CCNC enrollment. We counted any subject with at least one quarter of CCNC enrollment in the quarter as a CCNC member.
2. Risk scores calculated for each enrollee by applying risk analysis algorithms (Chronic Illness and Disability Payment System Version 5.3, Medical and Prescription Drug Models) to all enrollees during the study period. This analysis quantified any changes in risk profile (positive and negative) over time. We explored both concurrent (C_Risk) and prospective risk scores

(P_Risk). Concurrent risk scores were based on claims in the year in question. They best captured concurrent health changes (e.g. births), but coding can be influenced by the program, so many researchers do not prefer concurrent measures. Prospective risk score based the score in time 't' on claims in 't-1' (in this case, "t" is defined annually). There is less coding concern, but it may be less accurate and scores for new enrollees (and in the first year) are based on age and gender alone.

3. Age. We used a non-linear approach, using indicator variables (defined as 0 or 1) for different age ranges).
4. Gender was included in final model
5. Disability status
6. Chemical dependency (vs. not) was included in final model
7. Serious mental illness was included in final model
8. Chronic conditions: In the final model we added dummy variables for 5 chronic conditions: Diabetes, asthma, chronic obstructive pulmonary disease, congestive heart failure, and high cholesterol. In each case the person was coded as having the condition once evidence is present in the claims data. Once the condition was present, it remained present throughout the study period.

Study Population

Our primary sample population was non-elderly, non-dual[8] CCNC enrollees between 2003 and 2012. In addition to measuring spending, utilization, and outcomes for the entire population, we also considered important sub-populations. We dropped any observation that had fewer than three months Medicaid eligibility in the quarter. We considered the heterogeneous impacts of CCNC across the following groups:

1. Children vs. adults
2. Disabled adults vs. other adults
3. Men vs. women
4. Years 2003-2008 vs. 2008-2012

Sensitivity Analysis

We conducted several sensitivity analyses. First, we dropped the quarter of enrollment. The transition period may be particularly prone to biases associated with changes in health status. By dropping this quarter, we mitigated those concerns.

[8] Dual eligible beneficiaries are individuals who receive full Medicaid benefits as well as those who only receive assistance with Medicare premiums or cost sharing. They were eliminated from the study population because significant portions of Medicare claim payments and records were not available.

Second, we explored models that use prospective, instead of concurrent, risk, and models that did not adjust for risk score.

Third, we estimated different functional forms, specifically Generalized Linear Models with log links and gamma distributions. These models could not estimate with clustered standard errors, so we focused on the Ordinary Least Squares models.

Diagnostics

We regressed risk score on our covariates, including the CCNC% to assess whether the CCNC% variable would not predict risk. If CCNC% does predict risk, it could be a sign of unmeasured covariates that influence our results (if CCNC% predicts observed risk, it is more likely to predict unobserved risk and unobserved risk could create a bias). The CCNC% variable is not statistically significant in this model. For this reason, and because we believe county variation in CCNC enrollment is less attributable to external factors than a person level model, we preferred the county fixed effects model.

Alternative Analytic Strategies Explored

We explored two alternative empirical strategies during this study. First, we used a person fixed effect method that compares CA2 enrollees to themselves before they joined CA2. That is, we studied how spending and health changes when enrollees transition into the CA2 program. In doing so, we hoped to control for unobserved illness that varies from person to person – by comparing the person to themselves in an earlier year, rather than to someone outside CA2 who might be quite different.

$$Y_{it} = X_{it}*B_0 + CCNC_{it}*B_1 + S_i + Q_t + e_{it}$$

To test this model, we regressed risk score on our covariates, including the CCNC indicator to assess whether the CCNC indicator variable would not predict risk because this could be a sign of residual confounding (if CCNC predicts observed risk, it is more likely to predict unobserved risk). The CCNC variable is statistically significant in this model.

Moreover, our patient fixed effect results suggested a different conclusion than our main model, with CCNC predicting a significant rise in spending. Based on our diagnostic work, we believe that this likely reflects unmeasured risk. Moreover, the inpatient savings were implausibly large, perhaps reflecting a regression to the mean (with people joining CCNC after a hospitalization). For these reasons, and because we believe county variation in CCNC enrollment is less endogenous than a person level model, we preferred the county fixed effects model.

The second estimation strategy we explored was based on physician switching to mitigate concerns about enrollee time varying selection. This strategy studied movements onto CA2 which are not based on the decision of the enrollee, but rather based on changes in provider participation. Enrollees in Medicaid are unlikely to have chosen their providers based on CA2 participation; rather, factors such as location and quality of care were foremost in their mind. If a given enrollee has a regular physician who is not participating in CA2, but who switches into CA2, then the enrollee is essentially assigned to CA2 unless they ask for an exemption. This allowed us to study the effect of being enrolled in CA2 independent of changes in individual health or tastes for medical care.

The period of study that we proposed included an enormous expansion of provider participation in the CA2 program. For example, the CA2 program in 2008 made a major push to expand to Blind, Aged & Disabled adults, through increases in the additional reimbursement for primary care providers in CA2 for that population. We expected that many adults in this category were moved to CA2 because their providers decided to participate. Moreover, many people whose enrollment was optional and who had not used primary care services previously were being enrolled in primary care medical homes.

To implement this strategy, we hoped to estimate a model similar to our main model but replace the CCNC% variable with $CCNC\%_{pt}$ which measures the percent of a physician's patients in CCNC and we would replace county dummies with physician dummies, P_i. Thus our estimating equation becomes:

(2) $Y_{it} = X_{it}*B_0 + CCNC\%_{pt}*B_1 + P_i + Q_t + e_{it}$

Physician assignment

While it is conceptually easy to assign CCNC beneficiaries to physicians, because of the management fee, an assignment algorithm is needed for non- CCNC patients.

We assigned patients using the plurality of evaluation and management services in a quarter. If there were none, we took the most recent assignment up to 2 years before the quarter in question.

The assignment was imperfect because patients see multiple physicians and some patients have no visits, particularly soon after enrollment and early in the data.

Because symmetry is important for CCNC and non-CCNC patients we used assigned physicians for both CCNC and non-CCNC patients. To do this we needed an algorithm to assign non-CCNC beneficiaries.

To test our algorithm we examined how well we could identify the physician for CCNC enrollees (where we know the physician).

Unfortunately, our algorithm was only able to assign approximately 25% of CCNC patients to the physician of record based on the physician collecting the CCNC fee. This may be because the fee was paid to the practice site and beneficiaries may see different providers at the site which complicated our assignment process.

As a result, we did not find these results credible and did not report them.

Data Reconciliation and Verification Process

Beginning in April 2014, the validation process of the claims, enrollment, and provider files supplied by the Division of Medical Assistance (DMA) was started. Data were provided in SAS dataset format for the following record types:

- Enrollment (All spans from January 1, 2003, to December 31, 2012
- Claims (Dates of service from January 1, 2003, to December 31, 2012) for medical and pharmacy services.
- Providers (all providers enrolled with DMA during the study period)

The initial reconciliation process was performed in several steps:

1. Claim totals and utilization statistics were generated and shared with both DMA and the Office of the State Auditor (OSA). These statistics were generated using sum functions and without any merge or join with eligibility or providers.
2. Enrollment statistics were generated and shared with DMA and OSA.
3. Claim totals were generated by month that were the result of joining the medical and pharmacy claims with the enrollment data. The merge condition was a comparison of data warehouse member ID and date of service with enrollment dates.
4. Validation of key data elements (procedure codes, diagnosis codes, financials, patient, and provider elements).

Initial analysis revealed the following issues:

1. Data for the period of January 1, 2003, to June 30, 2003, were missing and are not available.
2. Paid data from August 2003 to March 2004 were missing but eventually supplied.
3. Member ID joins did not function correctly for both medical and pharmacy data. Joins from claims to enrollment were revised to be based on a different variable (the legacy Medicaid ID). Once changed, the non-match rate on claims joined to eligibility decreased from 32.18% to 2.03%. The match rate was further improved by making logic adjustment for account for relocated Hurricane Katrina members who became Medicaid eligible in January and February 2006.
4. Discrepancies of between 2% and 9% (annual basis) were observed when comparing project datasets to DMA control reports on an unmerged claim total basis. Once identified as an issue, DMA corrected the logic in control reports and the variances were alleviated.

Parallel to the activities described above, the cost data were compared to state accounting records. Several issues were identified in this reconciliation:

1. DMA had created the extract using the last state of the claim. For the claims exported to the dataset, the financial data elements represented net expenses of all corrections and adjustments that had been applied to the claim. While the resulting dataset had fewer transactions, it was not possible to compare on a monthly basis to state accounting records. To correct for this issue, revised claim files were created and reprocessed by the project team. Monthly claim totals were regenerated and supplied to OSA.
2. The reconciliation process revealed several months with larger than expected differences between the project datasets and state accounting records. On September 8, 2014, replacement files were supplied for 2006 and the differences were by in large, reconciled. DMA provided replacement files for several months of 2004. It was thought that remediation of the 2004 claims will bring the total variance between state accounting records and the project database to approximately 1% but it did not.

In summary, the final remaining data issues were:

1. The DMA replacement details files for January 2006 to March 2006 are not linkable based on either member or claim number.
2. The provider ID contained on the claim transaction is not linkable to the provider file.
3. Reconciliation with state accounting records within a reasonable tolerance could not be achieved.

Because of the remaining data issues, the following extracts were created:

1. Source claims data from the legacy data warehouse for the months (July 2003 to June 2004 and January 2006 to March 2006) that were outside of tolerance with respect to differences between analysis paid claims and state accounting records.
2. A crosswalk to Transaction Control Number (TCN) to billing taxonomy provider ID, legacy provider ID, provider location, and provider taxonomy code. This crosswalk / mapping file was required because of the various formats of provider ID that were being used across the four formats of datasets.
3. A crosswalk of legacy provider IDs to provider IDs that were used to populate a subset of months on the legacy and replacement datasets.

The additional datasets and crosswalks were uploaded to the secure FTP server on September 26, 2014. Work began on the integration of these files with the previously received files. During the integration process, an issue was discovered with the replacement prescription drug data. Revised pharmacy data were received on October 30, 2014, and were integrated into the analysis dataset.

To complete the validation of the final integrated database, the following tests were conducted:

1. Comparison of total claims paid (medical and pharmacy) by paid month. This table (included as an attachment) compares the database to state accounting record. The report was generated using ANSI SQL to sum paid claims by month (expressed as the claim processed date in yyyy-mm format) without any joins to eligibility or provider data. This validation was conducted using a blinded approach - the integrated database was used to generate the included report of processed claims totals by month and OSA and DMA conducted the actual comparison of records. Observed differences were less than 1%.
2. Comparison of total claims paid (medical) by incurred month to provider file. This table (generated using ANSI SQL and provided to OSA) compares the total paid claims by incurred month (expressed as the beginning date of service in yyyy-mm format) present in the database to total claims in the database using a join condition from the medical claims to the provider table using the provider ID. No outer join was utilized. Overall the difference was well less than 1%.
3. Comparison of total claims paid (medical) by incurred month to eligibility file. This table (generated using ANSI SQL and provided to OSA) compares the total paid claims by incurred month (expressed as the beginning date of service in yyyy-mm format) present in the database to total claims in the database using a join condition from the medical claims to the eligibility table using the alternative member ID and date of service on the line item to alternative member ID and eligibility start and eligibility end. No outer join was utilized. Overall the difference was slightly more than 2%.
4. Comparison of total claims paid (prescription drugs) by dispense month to eligibility file. This table (generated using ANSI SQL and provided to OSA) compares the total paid claims by dispensed month (expressed as the dispense date in yyyy-mm format) present in the database to total claims in the database using a join condition from the medical claims to the eligibility table using the alternative member ID and date of service on the line item to alternative member ID and eligibility start and eligibility end. No outer join was utilized. Overall the difference was slightly less than 1%.

It should be noted that any data that is used for micro-economic research of this type has some error rate. A modest error rate (such as 1% to 2%) does not have a material impact on the estimated effects of policy interventions, for several reasons:

1. All models include an error term which absorbs random error in the dependent variable.
2. Because there is sufficient uncertainty in the estimation procedure itself that it swamps modest underlying variation in the data in terms of empirical importance.
3. From a practical perspective, marginal differences (such as those described above) are to be expected when using administrative data for such exercises. It is the researcher's experience that any difference of less than several percentage points is an outstanding result.

There are a number of limitations associated with our analysis. Most importantly, the lack of randomization requires us to rely on a quasi-experimental design, which may be subject to biases due to unmeasured beneficiary characteristics. In fact, we find that beneficiaries join Community Care of North Carolina (CCNC) as their health status deteriorates, suggesting that there may be significant differences between CCNC and non-CCNC enrollees. We address this by using variation in the rate of change in penetration of CCNC across counties to minimize the role of individual traits in the key analysis. Diagnostic analysis suggests that this is a reasonable strategy, yet unobserved traits may still influence the results somewhat. Other strategies that might rely on data from other states were not feasible.

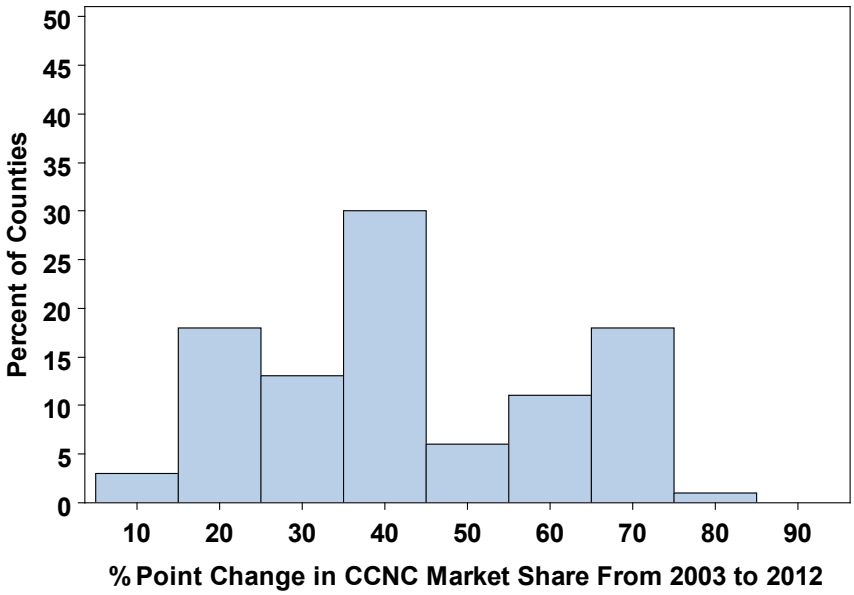
A related concern is that we have no perfect way to control for health status. The results are insensitive to the use of concurrent or prospective risk scores, but when we drop risk score completely, the magnitude of the effect drops considerably. This could reflect failure to account for greater risk burden of CCNC beneficiaries or elimination of a coding effect that causes us to erroneously overstate the CCNC effect. Yet even in the models without risk score, the conclusion that CCNC saves money remains.

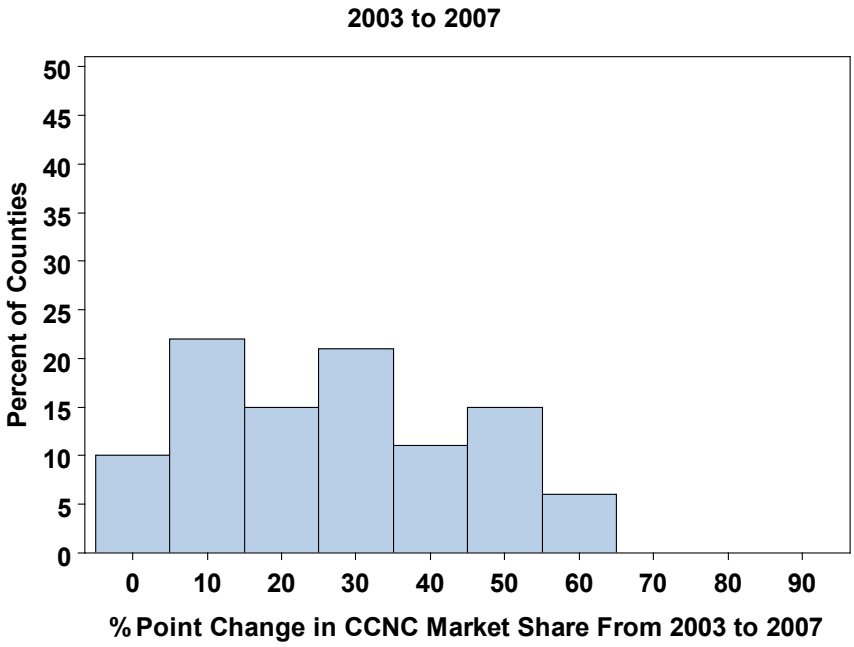
Another set of limitations relates to statistical power. All statistical analyses have a range of imprecision. In our base model, this imprecision is quite large. Moreover, when we examine the most recent period, the variation in our key variable diminishes, making it even harder to assess the impact of CCNC. There are several related limitations. For example, we examine 13 quality measures (though several may be related). Whenever there are multiple outcome variables, the likelihood of an erroneous conclusion rises (for example, if one examined 20 independent outcome variables, one would expect one statistically significant finding at the .05% level by chance, even if there was truly no effect.) Separately, in our sensitivity analysis that used Generalized Linear Models, we were not able to cluster the standard errors due to memory limitations. This may inflate the statistical significance of the findings.

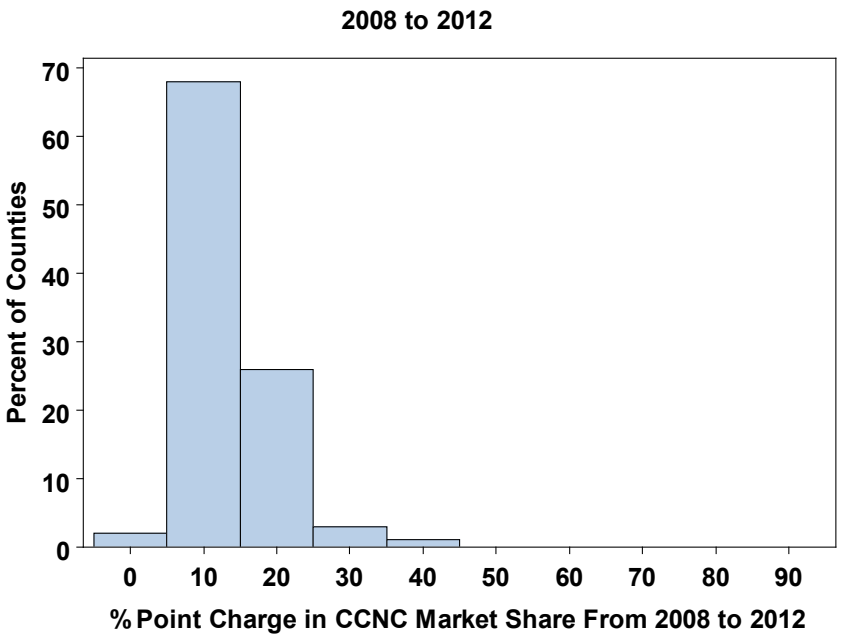
Our findings do not speak to the impact of CCNC relative to other possible strategies. Our comparison, and hence savings, is relative to North Carolina Medicaid outside of CCNC.

Figure 1 (below) examines the variation, across counties, in the change in CCNC%. This is the variation we use to infer the effect of the CCNC program. The histograms categorize counties based on the percentage point change in CCNC penetration over the relevant study period. It is computed as the penetration in the most recent period minus the penetration in the initial period. The horizontal axis represents this change. For example, 10 on the horizontal axis represents a 10 percentage point change in CCNC% over the relevant period. The vertical axis represents the percent of the 100 of counties in North Carolina in that bin. For the entire study period (top panel) we see a wide variation in the change in penetration. The earlier period also has reasonable variation. Yet by 2008, most of the diffusion of CCNC has occurred and therefore in the bottom panel we see less variation between 2008 and 2012.

Figure 1: Histogram of CCNC% by county 2003 to 2012







Tables 1a and 1b (below) report descriptive statistics. They show that at baseline, Community Care of North Carolina (CCNC) beneficiaries were younger, less likely to be female or disabled, with somewhat greater disease burden, as measured by risk score and chronic conditions, including serious mental illness. These patterns generally strengthened over time with CCNC enrollees becoming relatively younger, relatively less likely to be female or disabled, and overall relatively less healthy. These relative changes were often largely driven by changes in the comparison population as opposed to the CCNC population. For example, the average age of the CCNC population was relatively stable, but the average age of the comparison population rose quite a bit.

Table 1a: Descriptive Statistics: Outcome Variables

All Quarters (3 months exposure in quarter)

	Total	CCNC	Other
Total Paid (PMPQ)	1053.50	1037.68	1078.48
Inpatient (PMPQ)	148.69	111.85	206.85
ER (PMPQ)	8.14	8.02	8.34
Physician and Outpatient (PMPQ)	668.85	659.31	683.90
Drug (PMPQ)	187.59	206.87	157.14
Dental (PMPQ)	46.82	59.56	26.71
Admissions (PMPQ)	0.035	0.025	0.051
Physician Encounters (PMPQ)	5.627	6.774	3.818

2012 (3 months exposure in quarter)

	Total	CCNC	Other
N (Quarters)	1217977	909326	308651
Total Paid (PMPQ)	1027.27	1082.56	864.39
Inpatient (PMPQ)	121.40	101.12	181.15
ER (PMPQ)	6.56	7.08	5.02
Physician and Outpatient (PMPQ)	660.85	693.79	563.83
Drug (PMPQ)	205.64	237.04	113.15
Dental (PMPQ)	50.07	61.68	15.88
Admissions (PMPQ)	0.03	0.02	0.05
Physician Encounters (PMPQ)	7.99	9.55	3.39

% change (2004 to 2012) Annualized

	Total	CCNC	Other
N (Quarters)	3.5%	11.2%	-6.6%
Total Paid (PMPQ)	2.1%	4.0%	-0.9%
Inpatient (PMPQ)	-2.1%	-0.3%	0.6%
ER (PMPQ)	-6.0%	-5.9%	-8.4%
Physician and Outpatient (PMPQ)	2.7%	4.8%	-0.3%
Drug (PMPQ)	4.2%	5.5%	-2.8%
Dental (PMPQ)	5.0%	4.5%	-6.5%
Admissions (PMPQ)	-1.7%	0.4%	1.3%
Physician Encounters (PMPQ)	4.8%	5.3%	-4.5%

The lack of comparability of the populations, and, more importantly, given the study design, the differential change, poses a challenge for any evaluation. We controlled for observed changes in patient traits, but those changes may suggest there are changes in unobserved features as well. However, the pattern of compositional changes presents a mixed picture of potential bias. Specifically, the CCNC population is getting younger but with a growing disease burden. This might reflect the growth in enrollment from mandatory program categories (such as children) occurring at the same time that the sickest of the aged/ blind and disabled are joining CCNC (which is intentional). It may also be a sign of coding issues. For example, if CCNC led to more accurate coding (or coding just happened to be getting more accurate in counties with rapidly growing CCNC populations, CCNC enrollees would appear to have a greater illness burden. On a risk adjusted basis CCNC would then appear to save money not because spending is rising more slowly, but because illness burden is, artificially, rising more rapidly. Our sensitivity analysis with different (or no) risk adjustment allows us to assess the potential for coding differences to affect results.

Table 1b: Descriptive Statistics: Subject Characteristics

Total	Total	CCNC	Other	Difference	Diff in Diff*
N (Quarters)	58304038	32721774	25582264	7139510	3395431
AGE	17.0	13.3	21.8	-8.5	-5.4
% < 19 years old	64.5%	78.5%	46.7%	31.8%	23.6%
% Female	59.5%	54.7%	65.7%	-11.0%	-7.8%
% disable	14.7%	10.7%	19.7%	-9.0%	-1.9%
C_RISK	1.68	2.91	1.63	1.29	0.90
P_RISK	1.61	2.58	1.57	1.01	0.73
% serious mental illness	4.8%	5.3%	4.2%	1.1%	-0.2%
% chemical dependency	0.2%	0.2%	0.2%	0.0%	0.0%
% chronic illness	12.5%	11.2%	14.0%	-2.8%	0.5%
2004					
N (Quarters)	5344467	2259881	3084586	-824705	
AGE	17.1	13.4	19.8	-6.4	
% < 19 years old	65.5%	77.7%	56.6%	21.1%	
% Female	59.9%	55.7%	63.0%	-7.4%	
% disable	14.6%	10.1%	17.9%	-7.8%	
C_RISK	1.58	1.89	1.40	0.49	
P_RISK	1.52	1.75	1.37	0.37	
% serious mental illness	5.2%	6.1%	4.6%	1.5%	
% chemical dependency	0.3%	0.3%	0.3%	0.0%	
% chronic illness	5.9%	7.1%	5.0%	2.2%	

2012				
N (Quarters)	6976472	4773599	2202873	2570726
AGE	17.4	13.7	25.5	-11.8
% < 19 years old	64.1%	78.2%	33.6%	44.6%
% Female	58.8%	54.0%	69.1%	-15.2%
% disable	14.8%	11.7%	21.5%	-9.7%
C_RISK	2.41	2.95	1.55	1.40
P_RISK	2.18	2.60	1.49	1.11
% serious mental illness	4.1%	4.5%	3.2%	1.4%
% chemical dependency	0.2%	0.2%	0.2%	0.0%
% chronic illness	5.5%	6.3%	3.6%	2.7%

* Diff in Diff measures the relative change in CCNC vs other over time. For example, the -5.4 in the age row denotes that the CCNC population was becoming *relatively* younger compared to the other population. It is computed as the -11.8 year difference in the CCNC age vs other in 2012 minus the -6.4 year age difference in the CCNC age vs others in 2004. The CCNC population barely aged over the study period while the comparison group aged over 5 years.

Table 2 (below) reports the results from our base model (the county fixed effects model). The county fixed effects model suggests a savings of approximately $78 quarter both when we use concurrent and prospective risk scores. This represents approximately 9% of spending, which is slightly greater than the Filmore et al. result. This savings reflects a large, statistically significant drop (roughly 17%) in inpatient spending, which was hypothesized. However, contrary to expectations, we also observed meaningful reductions in spending on ambulatory services (6.2%) and pharmacy services (10.7%), though they are not statistically significant. Declines in ER and dental spending were small and not statistically significant.

The standard error around the spending estimate is large with the 95% confidence interval ranging from approximately $1 to $154 (see table 4).

Table 2: Spending results: Impact of CCNC

		County Fixed Effect			
		$ per Quarter		Percentage	
	Means	C Risk	P Risk	C Risk	P Risk
Total	866.64	-77.98*	-81.62*	-9.0%	-9.4%
Inpatient	154.53	-27.25*	-27.26*	-17.6%	-17.6%
ER	6.45	1.45	1.43	22.5%	22.1%
Ambulatory	530.55	-32.67	-35.35	-6.2%	-6.7%
Pharmacy	143.16	-15.30	-16.19	-10.7%	-11.3%
Dental	38.50	-4.27	-4.30	-11.1%	-11.2%

All models include an intercept, age, disability status, risk score, county fixed effects and quarter fixed effects. . These fixed effects control for the time invariant traits at the county level.
* Denotes significant at P<.05

Table 3 (below) reports the results regarding utilization. These results confirm the inpatient result, estimating approximately a 25% reduction in admissions. This suggests the lower price admissions were the ones avoided because the inpatient spending results are smaller in percentage terms than the utilization results. We find a comparably large increase (approximately 20%) in physician services. This seemingly contradicts our observed decrease in ambulatory spending. To reconcile the ambulatory spending and physician services results, one would have to believe there was a strong shift in the mix of ambulatory services away from expensive services and sites of care. There is some evidence that this is the case, because when we examine only physician spending (as opposed to all ambulatory spending which includes hospital outpatient spending), we find a positive (albeit not statistically significant) impact of CCNC. Moreover, the emphasis on primary care and requirement of primary care physician prior authorization for specialist visits may disproportionately reduce high cost ambulatory visits, though we do not observe this directly because data issues prevent us from separating primary care and specialist visits on a consistent basis. Overall CCNC was associated with fewer physician visits (including primary care and specialist visits combined). Prescription drug use experienced only a small decline. This suggests that the observed savings were likely due to a shift towards less expensive medications.

Table 3: Utilization results

		County Fixed Effects	
	Means	Coef	Percentage
Inpatient	0.04	-0.01*	-25.6%
ER	0.02	0.00	11.5%
Ambulatory[1]	5.46	1.06*	19.4%
Pharmacy	43.71	-1.73	-3.9%
Dental	0.21	-0.01	-3.7%

All models include all relevant covariates, concurrent risk score and drop the quarter of transition.

[1] Physician services

* = significant at p<.05

Table 4 (below) reports a wide range of subgroup analysis and other sensitivity analysis. All of the models, with the exception of the 2008 through 2012 period suggest a savings. We do not put much faith in the estimates of the more recent period because the variation in the CCNC percent is considerably lower than for the entire period (see Figure 1). For example the ratio of the 75th percentile of change CCNC percent to the 25th percentile over the whole period is 2.18. In the early period the ratio is 3.77. Yet in the most recent period that ratio is only 1.58. It is simply harder to detect an effect in this more recent period. Note that the 95% confidence interval (CI) around the result in the most recent period is very wide (-88.22 to 193.45) and includes the potential for significant savings. In fact, this range includes our point estimate from the base model.

Table 4: Subsample and sensitivity analysis: CCNC impact on spending per quarter

	$/ quarter	%	95% CI Low	95% CI High
Base model	-77.98*	-9.0%*	-154.91	-1.06
2003-2007	-88.05	-8.6%	-201.35	25.25
2008-2012	52.62	4.9%	-88.22	193.45
Children	-54.50	-7.2%	-152.75	43.75
Adults	-95.99	-6.0%	-215.52	23.55
Disabled	-175.17	-18.0%	-390.33	39.99
Non-disabled	-42.61	-5.6%	-106.52	21.30
Males	-75.38	-6.4%	-178.42	27.65
Females	-80.71*	-8.3%	-159.38	-2.04
No risk score	-47.01	-5.4%	-126.08	37.10
GLM model with risk score	-55.64*	-6.4%*	-63.43	-47.80
GLM model w/o risk score	-28.43*	-3.1%*	-53.37	-3.47

All models include all relevant covariates, concurrent risk score and drop the quarter of transition.
* = significant at p<.05

Table 5 (below) reports health outcome and process measures. The results regarding the outcome measures generally suggest improved performance associated with CCNC. For the outcome measures we use logit models, designed for data whose outcomes are zero or 1 and where the outcome is very rare. Effect sizes are measured by the odds ratios, which capture the odds of a 1 (e.g. a readmission) relative to a zero (e.g. no readmission). If the odds ratio is 1 then there is no effect. An odds ratio less than 1 implies the variable reduces the likelihood of the outcome (e.g. reduces the likelihood of a readmission). In this case, the odds ratio for the outcome variables (readmissions, ER visits for asthma, and inpatient admissions for diabetes) are all less than 1, though only the asthma results are statistically significant. This implies CCNC reduces readmissions ER visits for asthma and inpatient stays for diabetes.

The results for process measures are mixed. For example, breast cancer screening rate rises, but cervical cancer screening rate falls. These results are generally hard to interpret because many of the screening services in question are not indicated each year. For example, cervical cancer screening is indicated every 3-5 years. Our measurement does not include the HEDIS specified look back period, so we do not know if the test was conducted earlier and therefore not indicated. Therefore there will inherently be noise in the results, because we did not observe if the test was indicated. Moreover, we considered the outcome measures a better measure of the quality of care.

Overall, we place more weight on the outcome than process measures and generally conclude CCNC likely had similar or better outcomes.

Table 5: Outcome and Process Results

	County Model	
Outcome Measures	Odds ratio	P-Value
Readmissions	.88	.160
ER visits for Asthma	.91	.053
Inpatient admits for Diabetes	.76*	.046
Process Measures	Coefficient	Percent
Well Child Visits	-0.1003*	-15.5%
Well Adolescent Visits	0.0001	0.1%
Chlamydia screening	-0.0414*	-24.7%
Breast Cancer Screening	0.0187*	43.6%
Cervical Cancer Screening	-0.0152*	-23.0%
Colon Cancer Screening	0.0001	0.9%
Diabetes Care – A1c	0.0028	0.6%
Diabetes Care LDLC	0.0026	0.9%
Diabetes Care – Eye Exam	0.1232	10.3%

* = significant at p<.05; not adjusted for multiple comparisons.

North Carolina Department of Health and Human Services

Pat McCrory
Governor

Richard O. Brajer
Secretary

August 19, 2015

The Honorable Beth A. Wood, State Auditor
Office of the State Auditor
2 South Salisbury Street
20601 Mail Service Center
Raleigh, NC 27699-0601

Dear Auditor Wood:

The Department appreciates the State Auditor's thoroughness in conducting a review of the work of Community Care of North Carolina (CCNC) in providing case management services to Medicaid beneficiaries. The State Auditor's staff and external health economist have provided valuable analyses and results based on an independent review supported by academic rigor. Based thereon, the Department is confident in the results presented.

The State Auditor has confirmed that CCNC's primary care "medical home" model has saved money for North Carolina's Medicaid Program and improved health outcomes for its Medicaid beneficiaries.

Sincerely,

Richard O. Brajer

RB:jet

cc: Sherry Bradsher, Deputy Secretary, Human Services
Rod Davis, Chief Financial Officer
Matt McKillip, Senior Policy Advisor
Laketha M. Miller, Controller
Emery E. Milliken, General Counsel
Mark Payne, Chief of Staff
Dave Richard, Deputy Secretary, Medical Assistance
Chet Spruill, Director, Office of Internal Audit
John E. Thompson, Manager, Risk Mitigation and Audit Monitoring
Randall Williams, Deputy Secretary, Health Services

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August 14, 2015

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The Honorable Beth A. Wood, CPA, State Auditor
Office of the State Auditor
2 South Salisbury Street
20601 Mail Service Center
Raleigh, North Carolina 27699-0601

Dear Ms. Wood:

We are pleased to have this opportunity to review the final report of findings from the study of Community Care of North Carolina conducted by Dr. Chernew and his team. The researchers have deployed a novel and scientifically rigorous methodological approach to evaluating the impact of Community Care of North Carolina on cost and outcomes for the NC Medicaid program. It is reassuring to see that their findings are well in line with prior evaluations, further solidifying the large body of evidence demonstrating CCNC's impact in reducing preventable hospitalizations, improving outcomes, and generating substantial cost savings that accrue to the state of North Carolina.

As implemented through CCNC, the NC Medicaid PCCM-model managed care approach emphasizes establishing access to a primary care medical home for Medicaid enrollees, equipping those medical homes with the multidisciplinary support needed to assure comprehensive, coordinated, high-quality care; and developing community-based infrastructure to support better local systems of care. In general, the primary care medical home model emphasizes quality and improved access to comprehensive, longitudinal care; and anticipates that savings will accrue through reductions in ED and inpatient utilization. CCNC's approach to population health management goes "above and beyond" many of the primary care medical home initiatives that that been implemented elsewhere, by:

1) establishing a community-level infrastructure for care coordination across settings of care, with multidisciplinary care team support of complex patients,
2) active facilitation of quality improvement work in practices and local systems of care,
3) utilization management of specialty care referrals, and
4) advanced analytic and informatics capabilities, utilizing data from multiple sources to support quality improvement activities, and a statewide care management information system for intelligent targeting of care management interventions to maximize return on investment.

Under the CCNC model, increased utilization of primary care services and improved adherence to treatment recommendations should be expected. These costs, in addition to the direct costs of the care management and practice support infrastructure that are captured in CCNC's monthly per-member, per month management fees, are expected to be more than offset by savings through reductions in hospital utilization and other potentially preventable services (such as overuse of specialty care), as members receive improved access to primary care and appropriate care of acute and chronic conditions. Dr. Chernew's findings are exactly in line with those expectations.

Sincerely,

Tom Wroth, MD, MPH
Acting President and Chief Medical Officer
North Carolina Community Care Networks, Inc.

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NC OSA
The Taxpayers' Watchdog

This audit required 940 hours of auditor effort at an approximate cost of $79,457. The cost of the specialist's effort was $200,000. The total cost of this audit was $279,457.