Evaluation of Wisconsin's BadgerCare Plus Core Plan for Adults without Dependent Children

Report #2

The Utility of the Health Needs Assessment (HNA)

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EXECUTIVE SUMMARY

This report is the second of two that presents findings from an evaluation of Wisconsin's BadgerCare Plus Core Plan -- a 2009 expansion of coverage to low-income adults without dependent children (hereafter referred as "childless adults"). The Core Plan launched with an automatic enrollment of approximately 12,000 very low-income uninsured childless adults from Milwaukee County's previous General Assistance Medical Program (GAMP). In July 2009, enrollment was opened statewide to low-income uninsured childless adults. Enrollment quickly surpassed state projections and, on October 9, 2009, enrollment was closed; applications made after that date were placed on a waiting list. Total enrollment with this cap reached a peak of 65,057 and then steadily declined with attrition.

This evaluation uses administrative claims to compare the medical care utilization of 9,619 GAMP-enrolled childless adults both prior to and one year following their transition into the Core Plan. It also assesses the experience of 53,103 other Core Plan members whose effective date was in July and December of 2009.

Non-GAMP enrollees, who entered in the open enrollment period, were required to complete a Health Needs Assessment (HNA) as part of the application process for the Core Plan. This evaluation assesses the utility of the HNA in identifying the presence of chronic conditions and other health needs, and of identifying likely future resource utilization.

Report #1 presents the evaluation of the service utilization of Core Plan members and compares the experience of those members who entered from prior GAMP enrollment to those who entered through later open enrollment. Report #2 presents the evaluation the utility of the HNA.

Summary of Findings, Report #2

Accuracy of HNA Member Self-Report Relative to Claims Diagnoses
- Overall, the HNA accurately reports diagnoses, relative to what is observed on medical claims in the year following enrollment. However, this accuracy varies by condition. There is a notable amount of misreporting, which suggests the importance of the provider visit within the first year of enrollment.

- The level of "confirmed positives" ranges from very high (>97% correspondence) for diabetes to very low (about 23%) for emphysema. The confirmed positive level for a given condition is defined as follows: the percent of enrollees reporting the presence of the condition on the HNA who have a claim with a corresponding diagnosis within a year of Core Plan enrollment. For example, if 1,000 enrollees reported having asthma on the HNA and 800 of them had a claim on which asthma was listed as a diagnosis during their first year on the Core plan, the confirmed positive level would be 80%. A high level of confirmed positives is reflective of a strong correlation between the HNA and intended Core Plan health care utilization process.

- The converse – an "unconfirmed positive" – occurs when a member reports the presence of a condition on the HNA, but no associated diagnosis is present on any claim within a year of Core Plan enrollment. The data show very high levels of unconfirmed positive for emphysema (about 77%) to relatively low levels for diabetes (<3%) and high blood pressure (about 14%), with notable levels for all other conditions studied. Unconfirmed positives might indicate 1) that the member who reported the condition did not receive related medical services in the time period, 2) that the provider did not detect or document the condition, despite the member's report or 3) that the condition was erroneously reported in the HNA.

- Most conditions show a very high level of "consistent negative" – HNA responses reporting the absence of a condition, and no diagnosis of that condition appearing in a claim. High blood pressure and depression are the two conditions that fall below the level of 90% correspondence.

- The "false negative" levels for high blood pressure, depression, range from about 12 to 15%, while cancer and asthma show false negative rates less than 5%. Heart problems, diabetes, and COPD each approach a false negative level of 10%. A false negative occurs when a member reports the absence of a condition, but that condition appears as a diagnosis within the claims. False negatives may occur 1) if a condition develops and is newly diagnosed after the member enters the Core Plan, 2) the member is unaware of the presence of the condition prior to receiving Core Plan-sponsored health services, or 3) the member is aware of, but did not wish to report, the condition in the HNA. False negatives would be expected given that this population, coming from the previously uninsured, would likely have had gaps and inadequacies in prior health care. The presence of such false negative responses in the HNA suggests the potential importance of the required provider visit within the first year of enrollment.

HNA for Assessing Condition/Disease Prevalence

- The HNA effectively detects the prevalence of asthma, depression, and emphysema within the Core Plan population in that the population prevalence in the HNA corresponds closely to the population prevalence in claims-based diagnoses.

- Many conditions, however, are significantly under-reported by the HNA: cancer, COPD, diabetes, heart problems, high blood pressure, and stroke. That is, the population prevalence in the claims-based diagnosis rate substantially exceeds the population prevalence in the HNA.

- HNA under-reporting may occur because the condition(s) developed after the members entered the Core Plan. Or, the conditions may have been present upon enrollment but not known to the members. In the latter case, the coverage and access to health care provided by the Core Plan would have facilitated detection of conditions that might otherwise have continued undiagnosed until more advanced stages.

- There is a fairly strong correspondence between the prevalence of comorbidities as indicated by claims data and as indicated by HNA responses. Persons with a combination of asthma and depression show the highest level of correspondence in reporting and claims diagnosis.

HNA Predictive Value Relative to Basic Demographic Information

- Overall, the addition of measures reflecting the HNA responses significantly increases the accuracy of a model predicting future utilization relative to a model including age and sex alone.
- The overall level of the HNA's predictive accuracy, however, remains low; and it is less precise than other commonly employed modeling techniques. Nonetheless, the commercially-available models require considerably more time and resource investment both to administer and to analyze.
- While their joint predictive accuracy of the overall variation in utilization is low, it remains the case that each of the HNA measures, taken separately, correlates highly with utilization.
- The use of the HNA adds significant predictive value over the use of demographics alone to predict utilization at the upper 70th and 90th percentiles.

List of Tables

I.   Background

The State of Wisconsin in 2009 launched the BadgerCare Plus Core Plan for adults without dependent children ("childless adults"). Eligible individuals have incomes up to 200% of the Federal Poverty Line (FPL) and do not have access to other forms of health insurance. The Core plan's program offers a pared down version of those benefits available through the state's existing Medicaid/CHIP program (BadgerCare Plus). Enrollment for Core Plan opened in July 2009 and was ultimately capped at approximately 65,000 enrollees. In January 2009, prior to opening enrollment to all eligible persons, the State automatically transitioned twelve thousand low-income childless adults from Milwaukee County's General Assistance Medical Program (GAMP) to the Core Plan.

All enrolled GAMP members as of December 26, 2008 were automatically transitioned to the BadgerCare Plus Core plan on January 1, 2009, at which point GAMP ceased to exist. General Core Plan enrollment opened on July 15, 2009.[1] Table 1a provides summary demographic characteristics of the former GAMP members who enrolled in the Core Plan and Table 1b provides the same information for other Core enrollees. In the GAMP sample, forty-two percent is female. The average age is 43.5 with 26.5% being less than age 35, 55% being between 35 and 55, and 18% being age 55 or older. As the race and ethnicity of a public health program member is not relevant to program eligibility, it is often not reported in the administrative file. Race / ethnicity is missing for 41% of the sample. 23% of the sample is reported as White, 36% as Black, and 7% as Hispanic. The main difference between the two samples: a smaller proportion of the GAMP sample is white and the GAMP sample is somewhat older than the Core sample.

The Wisconsin Department of Health Services completed a waiver application to the federal Centers for Medicaid and Medicare Services to launch the Core Plan as a demonstration initiative. The waiver application describes that childless adults enrolling in BadgerCare Plus will be required to complete a Health Needs Assessment (HNA) as a condition of enrollment.

> The HNA is a short survey of basic health conditions and health history that the State will use to help match enrollees with HMOs and providers that meet the individual's specific needs. The HNA is designed for individuals to self-report basic health information and to capture the immediate health needs of members. The HNA data is important for three reasons:
> 1. The childless adult population is a new coverage population for BadgerCare Plus and we lack sufficient information about their health needs. The HNA (and the physical examination) will allow us to begin to fill in the blanks in this knowledge.
> 2. We will be using information provided in the HNA to recommend an HMO to the individual or couple applying for BadgerCare Plus for childless adults and will use HNA data as part of our automatic assignment of an HMO when the individual or couple does not select one on their own. For example, if an individual says that he has been diagnosed with diabetes, we will want to alert the individual if one of the HMOs in his service area has an excellent track record for providing quality health care for diabetic patients.
> 3. By using the HNA data, combined with encounter and claims data that we might have on file, we can alert the HMO to serious health conditions that require immediate intervention.
>
> Wisconsin Department of Health Services,
> Health Insurance for Childless Adults,
> Waiver Proposal, page 22, July 1, 2008

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[1]Application levels for the Core Plan immediately exceeded projections and program budget. Total program enrollment reached a high of 65,057. As a result of this unanticipated demand for the program, an enrollment cap was imposed on October 9, 2009. Applications received after that date were placed on a waiting list and (with a few exceptions for cancer and heart disease patients) none of the waiting list applicants have been enrolled into coverage.

The HNA elements are listed in the Appendix to this report.

Table 1a: Demographic Characteristics of the Transitional (Former GAMP) Core Population			
	All	Men	Women
Number of Enrollees	9,619	5,581	4,038
Female	41.98%	--	--
Age (Mean)	43.50	42.11	45.42
Age < 35	26.50%	29.48%	22.39%
Age>=35 & Age < 55	55.17%	56.30%	53.62%
Age>=55	18.33%	14.23%	24.00%
White	23.28%	21.45%	26.00%
Black	35.54%	33.6%	38.24%
Hispanic	6.74%	5.61%	8.30%
Race / Ethnicity Missing	41.48%	45.15%	36.40%
Source: BadgerCare Plus Core Plan Enrollment File			

Table 1b: Demographic Characteristics of the Non-GAMP Core BadgerCare Populaiton			
	All	Men	Women
Number of Enrollees	56,103	28,578	27,525
Female	49.06%	--	--
Age (Mean)	40.57	39.24	41.95
Age < 35	38.35%	41.82%	34.74%
Age>=35 & Age < 55	41.42%	41.89%	40.93%
Age>=55	20.23%	16.29%	24.33%
White	77.30%	74.06%	80.66%
Black	14.51%	17.43%	11.47%
Hispanic	3.97%	4.23%	3.71%
Race / Ethnicity Missing	6.12%	6.57%	5.66%
Source: BadgerCare Plus Core Plan Enrollment File			

II. Evaluation Approach

State administrative enrollment and claims data were used to assess the effectiveness of the Wisconsin CORE plan in 1) delivering appropriate care to its members, 2) achieving DHS' goals for members' efficiency of service utilization and 3) promoting members' progress toward improved health outcomes.

A. Research Questions

The UW Population Health Institute, in collaboration with DHS, identified the following research questions for the evaluation of the HNA.

How predictive is the HNA/how useful is the tool in assessing member prevalence of chronic conditions in the non-GAMP Core population?
1. *What is the prevalence of reported chronic conditions?*
2. *Are chronic conditions accurately self-reported by the HNA in this population? What conditions are most/least likely to be reported accurately (HNA to claim/encounter outcomes)?*
3. *How much more predictive of service utilization is the HNA compared with using only the basic demographic information available for other BadgerCare Plus populations (age, sex, income)?*

B. Data and Outcome Measures

The data for all analyses were drawn from the State's administrative claims database (called the InterChange system) and from the State's eligibility system (called the CARES database). The analyses consider two different samples of Core Plan enrollees. The first is the former-GAMP members who were automatically enrolled in the Core Plan in January 2009. The second is other voluntary enrollees to the Core Plan who enrolled between July 1 and October 9, 2009. As mentioned above, the former-GAMP members were not administered the HNA and, therefore, are excluded from many of the analyses presented in this report.

For the former GAMP sample, claims data were drawn from January 1, 2009 (the beginning of coverage under the Core Plan for former-GAMP members) through September 2010. For the Core sample, claims data were drawn from July 15, 2009 (the beginning of coverage under the Core Plan for non-GAMP enrollees) through September 2010. Claims data provided information on diagnoses and utilization by category, while the CARES data provided demographic and income information.

The utilization outcomes examined include four categories of utilization based on claims data: all outpatient visits, mental health service visits, emergency department (ED) visits, and inpatient hospitalizations. For each person in each year, a "visits per month" measure of utilization is constructed as the total number of visits in that year divided by the number of months the person was enrolled in the program. Annual number of visits were also used a measure of utilization in some of the analyses. ED visits are measured as a day with an ED claim, identified using procedure billing codes.

Hospitalizations were measured as the number of hospital stays, using bed day revenue codes to identify them in the claims. This analysis is careful to distinguish between new admissions and transfers between hospitals, as transfers should not be considered new hospitalizations. Since transfers cannot be observed directly, this study infers that any gap of less than two days between an admission and a discharge or last bed day is a transfer. Outpatient visits were measured as the number of provider-day visits. Total outpatient visits are defined using a procedure code that is used only for outpatient visits (which includes skilled nursing visits).

The HNA analysis used the Core sample, described above, which consists of the non-GAMP enrollees into the Core Plan between July 1 and October 9, 2009. Only the non-GAMP Core Plan enrollees were required by the State to complete an HNA upon their enrollment into the Core Plan. The analysis is restricted to those enrollees that had a completed HNA. (The HNA elements are listed in Appendix A.) In addition, the Wisconsin Department of Health Service has informed the study team that some invalid HNA data may have been submitted by the enrollment broker, due to time constraints and caseload backup between August 1-October 9, 2009. The research team, in order to sort out a group of valid HNA cases for study, set inclusion criteria based on input from DHS. This study assesses only HNAs submitted in 2009, but does not include those submitted between the dates August 1st, 2009 – October 9th, 2009. The study sample, therefore, includes a total of 14,752 individuals with completed HNAs whose effective dates fell between July 1 and December 31, 2009.

To assess how well the HNA identified chronic conditions, this study focused on the set of conditions listed in the HNA, which are the following: any condition, asthma, any cancer, COPD, depression, diabetes, emphysema, heart problem, high blood pressure, and stroke. These are referred to here as HNA1-chronic conditions. The HNA also asked individuals to report whether they had an ED visit or a hospitalization for each of these conditions. If yes, these are referred to here as an HNA2-chronic condition. It was also determined, for this sample, whether the same chronic condition was seen in the claims data for any visit during the 12 month period following enrollment, which is referred to here as claims-chronic conditions.

Question 1. *What is the prevalence of reported chronic conditions?*

The proportion of the sample that indicated the presence of a chronic condition on the HNA (HNA1-chronic condition) was calculated, as was the proportion that indicated they had an ED visit or were hospitalized for a chronic condition (HNA2-chronic condition).

Separately, the frequency of specific diagnoses among members was calculated using the claims data (claims-chronic condition). To attain population level prevalence, a condition-specific diagnosis code was counted only once for any specific member, even if the individual had multiple claims with the same code. The study then compared the prevalence of HNA-reported conditions with the prevalence appearing within the claims in the study time period.

Finally, the top comorbidities reported by the HNA are calculated and compared to comorbidities present in the claims data.

Question 2. *Are chronic conditions accurately self-reported by the HNA in this population?*
What conditions are most/least likely to be reported accurately (HNA to claim/encounter outcomes)?

To address this question, the proportion of the sample was calculated with both an HNA1-chronic condition along with a corresponding claims-chronic condition and the proportion of the sample with an HNA2-chronic condition along with a corresponding claims-chronic condition. The proportion was also calculated for the sample with a claims-chronic condition who have a corresponding HNA1-chronic condition and the proportion of the sample with a claims-chronic condition who have a corresponding HNA2-chronic condition.

Responses were categorized in four ways: "confirmed positive", "unconfirmed positive", "consistent negative", and "false negative". Please note that it is not obvious that the diagnoses in the claims are more valid than those reported by individuals on the HNA. However, since utilization and care decisions will

be made based on those diagnoses, they are the most relevant ones for policymaking and for potential reference to disease management.

In particular, a set of responses are categorized as a "<u>confirmed positive</u>" if an HNA response was followed by a corresponding diagnosis present in the claims data within a year of Core Plan enrollment. A high level of confirmed positives indicates that the HNA does a good job at predicting likely future utilization. An "<u>unconfirmed positive</u>" occurs when a member reports the presence of a condition on the HNA, but it is not present as a diagnosis in the claims data within a year of Core Plan enrollment. Unconfirmed positives might indicate 1) that the member who reported the condition did not require medical services for that condition in the following year, 2) that the provider did not detect or document the condition, despite the member's report or 3) that the condition was erroneously reported in the HNA.

A "<u>consistent negative</u>" would occur if the HNA response reporting the absence of a condition and no diagnosis of that condition appears in any claim over the following year. A high rate of consistent negatives would be expected, as each individual condition is not present for a large majority of the population. However, consistent negatives may occur if a member did not have a visit during the enrollment year, or if the member did have a visit but the provider failed to detect or document the presence of a condition. A "<u>false negative</u>" occurs when a member reports the absence (or lack of awareness) of a condition, but that condition appears as a diagnosis in a claim within the following year. False negatives may occur 1) if a condition develops and is newly diagnosed after the member enters the Core Plan, 2) the member is unaware of the presence of the condition prior to receiving Core Plan-sponsored health services, or 3) the member is aware of, but does not want to report on the HNA, his or her health conditions. False negatives would be expected given that this population, coming from the previously uninsured, would likely have had gaps and inadequacies in prior health care (see Figure 1). These percentages were also calculated for subgroups of the sample defined by age, and gender.

> **Question 3.** *How much more predictive of service utilization is the HNA compared with using only the basic demographic information available for other BadgerCare Plus populations (age, sex, income)?*

An alternate test of the utility of the HNA is the extent to which its presence in the Core plan application improved the ability to forecast enrollees' healthcare utilization relative to the use of demographic measures available in the traditional BadgerCare Plus application alone. Assessing the incremental predictive ability of the HNA involves comparing the amount of variation in healthcare utilization explained by a multiple regression model containing both the demographic and HNA measures to the amount of variation in healthcare utilization explained by a multiple regression model containing only socio-demographic measures (age, gender, and income).

The amount of variation explained by a regression model is reflected in the "r-square" statistic, which ranges from 0 to 1. A value of zero would indicate that the model explains *none* of the variation in healthcare utilization among Core plan members and a value of 1 would indicate that the model explains *all* of the variation in utilization among members. To assess their relative predictive value, the values of the r-squared are calculated and compared for regression models with and without the HNA measures.

Logit models were also run and, using a split-sample approach, used to test the strength of the HNA for predicting utilization at or above the 70th and 90th percentiles. HNA performance was compared against the predictive value of models using basic demographic data of age, sex, and income (below and above 138% FPL) alone (see Yu and Dick 2010[2] for a recent Medicaid-related example of cross-validation methods).

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[2] Yu H and Dick AW. "Risk-adjusted capitation rates for children: How useful are the survey-based measures?" Health Services Research 2010 Dec; 45(6 Pt 2); 1948-62.

Figure 1. Correspondence between HNA Responses and Condition Documentation in Claims
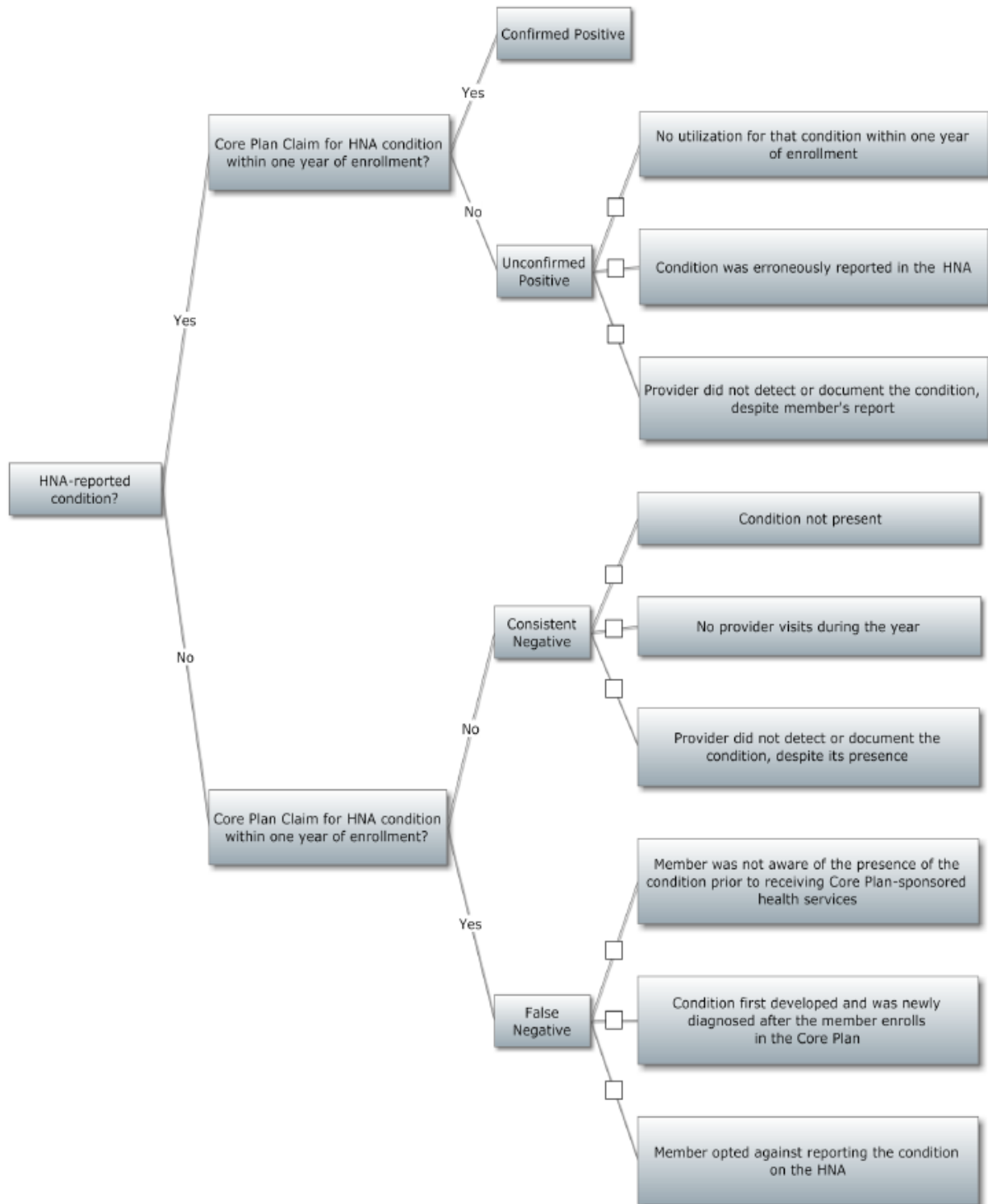
III.   Results

Q1. *What is the prevalence of HNA1- and HNA2-chronic conditions?*

Table 2 reports prevalence of a condition as measured by HNA responses relative to the percent of Core Plan members for whom there are claims with an associated diagnosis code. Tables 2a, b, c, and d show these comparisons by sex, age group, and income (below and above 138% FPL) respectively. The results show that the HNA effectively detects the prevalence of asthma, depression, and emphysema within the Core Plan population in that the population prevalence in the HNA corresponds closely to the population prevalence in claims-based diagnoses. Many conditions, however, are significantly under-reported by the HNA: cancer, COPD, diabetes, heart problems, high blood pressure, and stroke. That is, the population prevalence in the claims-based diagnosis rate substantially exceeds the population prevalence in the HNA.

HNA under-reporting may occur because the condition(s) developed after the members entered the Core Plan. Or, the conditions may have been present upon enrollment but not known to the members. In the latter case, the coverage and access to health care provided by the Core Plan would have facilitated detection of conditions that might otherwise have continued undiagnosed until more advanced stages.

Table 2.   Prevalence of Condition as Reported by HNA and
**   Prevalence of Condition by Frequency of Diagnosis in Members' Claims**

All HNA completions	% Reported in HNA N=22,971	% of members for whom claims include diagnosis code (1,448 with no claims)
Asthma	11.74%	10.39%
Cancer	1.26%	5.00%
COPD	2.00%	8.96%
Emphysema	1.45%	1.09%
Depression	21.04%	21.74%
Diabetes	9.83%	18.78%
Heart Problems	6.65%	13.84%
High Blood Pressure	23.12%	32.33%
Stroke	1.28%	2.43%

Table 2a. Condition Prevalence, by HNA Report and Claims Diagnosis, by Sex

Male	% Reported in HNA N=10,997	% of members for whom claims include diagnosis code (1,002 with no claims)
Asthma	9.22%	8.02%
Cancer	1.01%	3.85%
COPD	1.56%	7.94%
Emphysema	1.25%	1.12%
Depression	17.53%	17.42%
Diabetes	9.71%	18.57%
Heart Problems	7.30%	15.21%
High Blood Pressure	22.48%	32.47%
Stroke	1.21%	2.28%

Table 2b. Condition Prevalence, by HNA Report and Claims Diagnosis, by Sex

Female	% Reported in HNA N=11,974	% of members for whom claims include diagnosis code (446 with no claims)
Asthma	14.05%	12.44%
Cancer	1.49%	5.99%
COPD	2.41%	9.84%
Emphysema	1.62%	1.07%
Depression	24.27%	25.49%
Diabetes	9.93%	18.95%
Heart Problems	6.05%	12.65%
High Blood Pressure	23.72%	32.22%
Stroke	1.34%	2.57%

Table 2c. Condition Prevalence, by HNA Report and Claims Diagnosis, by Age

Age 19-34	% Reported in HNA N=7,449	% of members for whom claims include diagnosis code (718 with no claims)
Asthma	12.91%	10.66%
Cancer	0.28%	1.50%
COPD	0.11%	3.78%
Emphysema	0.07%	0.09%
Depression	17.14%	18.80%
Diabetes	2.83%	6.13%
Heart Problems	1.71%	4.44%
High Blood Pressure	5.03%	7.93%
Stroke	0.15%	0.35%

Age 35-44	% Reported in HNA N=3,180	% of members for whom claims include diagnosis code (197 with no claims)
Asthma	13.43%	12.40%
Cancer	0.82%	3.75%
COPD	1.26%	8.15%
Emphysema	0.91%	0.84%
Depression	25.41%	26.65%
Diabetes	9.50%	17.23%
Heart Problems	4.34%	10.46%
High Blood Pressure	19.47%	28.70%
Stroke	0.97%	1.34%

Table 2c, continued. Condition Prevalence, by HNA Report and Claims Diagnosis, by Age

Age 45-64	% Reported in HNA N=12,288	% of members for whom claims include diagnosis code (532 with no claims)
Asthma	10.58%	9.72%
Cancer	1.97%	7.32%
COPD	3.35%	12.16%
Emphysema	2.43%	1.74%
Depression	22.30%	22.19%
Diabetes	14.18%	26.46%
Heart Problems	10.26%	20.12%
High Blood Pressure	35.11%	47.32%
Stroke	2.05%	3.90%

Table 2d. Condition Prevalence, by HNA Report and Claims Diagnosis, by Income

Income <138% FPL	% Reported in HNA N=18,272	% of members for whom claims include diagnosis code (1,187 with no claims)
Asthma	12.39%	10.83%
Cancer	1.23%	4.83%
COPD	1.99%	9.05%
Emphysema	1.52%	1.05%
Depression	22.36%	22.58%
Diabetes	9.54%	18.44%
Heart Problems	6.51%	13.59%
High Blood Pressure	22.35%	31.28%
Stroke	1.32%	2.42%

Income > 138% FPL	% Reported in HNA N=4,353	% of members for whom claims include diagnosis code (245 with no claims)
Asthma	8.96%	8.57%
Cancer	1.40%	5.74%
COPD	2.09%	8.67%
Emphysema	1.19%	1.29%
Depression	15.83%	18.26%
Diabetes	11.03%	20.20%
Heart Problems	7.31%	14.92%
High Blood Pressure	26.60%	37.07%
Stroke	1.10%	2.53%

There is a fairly strong correspondence between the overall prevalence of comorbidities indicated by claims data and as reported in the HNA. Table 3 shows that eight of the top ten claims-based co-morbidities are shared with the HNA-based top ten.

Table 3: **Prevalence of Top 10 Comorbidities Computed Two Ways: Using HNA Responses and Using Claims Data**

Depression	High BP	Heart Problem	Diabetes	Asthma	% Diagnosed in Claims	% HNA Reported
X	x				2.36	2.84
	x		X		4.74	2.74
	x	X			1.95	1.21
X	x	X			0.68	0.58
X	x		X		1.23	0.88
X				X	1.01	2.17
	x	X	X		1.65	0.57
X		X			0.62	
	x			X	0.67	1.00
X	x			X		0.70
X			X		0.83	0.57

While this correspondence is high, it does vary somewhat across comorbidities. Another way of showing high rate of correspondence between the HNA and claims data is to report the proportion of Core Plan members reporting one of 10 most common co-morbidities in HNA that also have these co-morbidities diagnosed in their claims (see Table 4). There is again some variability in this correspondence across conditions. For example, persons with a combination of asthma and depression show the highest level of correspondence in reporting and claims diagnosis (> 77%) while only 40% of those reporting both heart problem and high blood pressure together in the HNA have both diagnoses in claims.

Table 4. **Proportion of Core Plan members with 10 most prevalent comorbidities in the HNA that also have the same comorbidity reported in claims within one year of enrollment**

	Frequency	Percent with match to claims
1. Asthma + Depression	180	77.58
2. Asthma + High BP	107	69.93
3. Asthma, Depression + High BP	47	68.11
4. Depression + High BP	310	57.09
5. Diabetes + High BP	557	50.91
6. Heart Problem + High BP	175	39.14
7. Depression + Diabetes	72	37.69
8. Depression, Diabetes + High BP	91	32.15
9. Depression, Heart Problem + High BP	43	27.56
10. Diabetes, Heart Problem + High BP	93	24.60

> *Q2. Are chronic conditions accurately self-reported by the HNA in this population?*
> *What conditions are most/least likely to be reported accurately (HNA to claim/encounter outcomes)?*

Table 5a reports the correspondence between HNA responses and whether the diagnosis for a specific condition appears in the diagnosis codes reported in claims in the twelve-month period following enrollment. For each condition, it reports the rates of confirmed positives, unconfirmed positives, consistent negatives, and false negatives (as defined in the previous section) for the entire sample. Table 5b provides detail for subgroups by sex, age, and income.

The level of confirmed positives ranges from very high (>90% correspondence) for diabetes to very low for emphysema.

The data show a very high level of unconfirmed positives for emphysema to quite low levels for diabetes and high blood pressure, with appreciable levels for all other conditions studied.

Most conditions show a very high level of consistent negatives. High blood pressure and depression are the two conditions that fall slightly below the level of 90% correspondence.

Indeed, false negatives for high blood pressure and depression fall in the 10-15% range, with heart problems, diabetes, or COPD approaching 10% false negatives. Cancer and asthma show false negative rates approaching 5%.   The presence of such false negative responses in the HNA demonstrates the importance of the first year health care visit with a provider.

The HNA does appear to provide significant information about condition-specific prevalence of certain conditions. The tables below show the percent of persons reporting within the HNA that they have a specific condition, and the percent of Core Plan members that have that diagnosis appearing within a claim. The data are provided for All HNA completions (N=22,971), and by age, sex, and income above and below 138% of the federal poverty level.

- The HNA appears to effectively detect the presence of cancer in individual enrollees.
- Here again, most conditions are significantly under-reported by the HNA: COPD, depression, heart problems.
- While very high percentage of persons reporting diabetes or high blood pressure are confirmed to have those conditions, those conditions also show high rates of under-reporting.
- As noted earlier, this under-reporting may occur because 1) the condition(s) developed once the member entered the Core Plan 2) the member may have omitted reporting this personal health information on the HNA, or 3) the condition(s) may have been present upon enrollment but not known to the member. In the latter case, the coverage and access to health care provided by the Core Plan would have facilitated detection of conditions that might otherwise have continued undiagnosed to more advanced stages.

Table 5a. **Correspondence between HNA answer and Diagnosis (Dx) in Claims Within One Year of Enrollment**

Diagnosis/Group All with a valid 2009 HNA = 22,971	Confirmed positive: Yes on HNA and *did have* the Dx appear in the claims	Unconfirmed positive: Yes on HNA and *did not* have the Dx appear in the claims	Consistent negative: No on HNA and *did not* have the Dx appear in the claims	False negative: No on HNA but *did have* the Dx appear in the claims
Asthma	56.98%	43.02%	95.96%	4.04%
Cancer	79.23%	20.77%	95.99%	4.01%
COPD	69.84%	30.16%	92.35%	7.65%
Emphysema	23.05%	76.95%	99.24%	0.76%
Depression	56.32%	43.68%	87.78%	12.22%
Diabetes	97.01%	2.99%	90.18%	9.82%
Heart Problems	67.79%	32.21%	90.18%	9.82%
High Blood Pressure	86.16%	13.84%	84.54%	15.46%
Stroke	36.65%	63.35%	98.02%	1.98%

Table 5b. **Correspondence between HNA answer and Condition-Related ED or Hospitalization Episode in Claims Within One Year of Enrollment**

Diagnosis/Group	Confirmed positive: Yes on HNA and *did have* the Dx appear in the claims*	Unconfirmed positive: Yes on HNA and *did not* have the Dx appear in the claims*	Consistent negative: No on HNA and *did not* have the Dx appear in the claims*	False negative: No on HNA but *did have* the Dx appear in the claims*
ED or Hosp for Asthma	76.09%	23.91%	90.75%	9.25%
ED or Hosp for COPD	79.17%	20.83%	91.44%	8.56%
ED or Hosp for Emphysema	27.87%	72.13%	98.98%	1.02%
ED or Hosp for Depression	64.82%	35.18%	79.41%	20.59%
ED or Hosp for Diabetes	99.10%	0.90%	82.49%	17.51%
ED or Hosp for Heart Problems	80.31%	19.69%	87.77%	12.23%

*Does not include those with no medical claims one year after effective date.

**Gender was missing for three people in the enrollment file.

***Age is calculated as of first effective date. Birthdate was missing for four people in the enrollment file.

Table 5c.   **Detail by Sex, Age, and Income above and below 138% FPL:**
Correspondence between HNA answer and Diagnosis (Dx) in Claims
Within One Year of Enrollment

Diagnosis/Group	Confirmed positive: Yes on HNA and *did have* the Dx appear in the claims	Unconfirmed positive: Yes on HNA and *did not* have the Dx appear in the claims	Consistent negative: No on HNA and did not have the Dx appear in the claims	False negative: No on HNA but *did have* the Dx appear in the claims
Asthma				
Males = 7,663	52.35%	47.65%	96.57%	3.43%
Females = 7,086	59.62%	40.38%	95.40%	4.60%
All People 19-34 = 7,499	53.79%	46.21%	95.92%	4.08%
All People 35-44 = 3,180	60.05%	39.95%	95.15%	4.85%
All People 45-64 = 12,288	58.24%	41.76%	96.17%	3.83%
Income <138% FPL = 18,272	57.28%	42.72%	95.91%	4.09%
Income >138% FPL =4,353	55.35%	44.65%	96.12%	3.88%
Cancer				
Males = 7,663	83.33%	16.67%	97.02%	2.98%
Females = 7,086	76.70%	23.30%	95.10%	4.90%
All People 19-34 = 7,499	75.00%	25.00%	98.71%	1.29%
All People 35-44 = 3,180	76.00%	24.00%	96.86%	3.14%
All People 45-64 = 12,288	79.92%	20.08%	94.18%	5.82%
Income <138% FPL = 18,272	77.38%	22.62%	96.12%	3.88%
Income >138% FPL =4,353	86.44%	13.56%	95.43%	4.57%
COPD				
Males = 7,663	66.67%	33.33%	93.06%	6.94%
Females = 7,086	71.73%	28.27%	91.72%	8.28%
All People 19-34 = 7,499	25.00%	75.00%	96.25%	3.75%
All People 35-44 = 3,180	57.50%	42.50%	92.52%	7.48%
All People 45-64 = 12,288	71.96%	28.04%	89.97%	10.03%
Income <138% FPL = 18,272	70.03%	29.97%	92.25%	7.75%
Income >138% FPL =4,353	67.42%	32.58%	92.63%	7.37%
Emphysema				
Males = 7,663	24.03%	75.97%	99.18%	0.82%
Females = 7,086	22.40%	77.60%	99.29%	0.71%
All People 19-34 = 7,499	0.00%	100%	99.91%	0.09%
All People 35-44 = 3,180	25.00%	75.00%	99.39%	0.61%
All People 45-64 = 12,288	23.02%	76.98%	98.81%	1.19%
Income <138% FPL = 18,272	21.27%	78.73%	99.27%	0.73%
Income >138% FPL =4,353	34.00%	66.00%	99.11%	0.89%

Table 5c, continued				
Diagnosis/Group	Confirmed positive	Unconfirmed positive	Consistent negative	False negative
Depression				
Males = 7,663	49.00%	51.00%	89.52%	10.48%
Females = 7,086	60.94%	39.06%	86.14%	13.86%
All People 19-34 = 7,499	53.32%	46.68%	88.66%	11.34%
All People 35-44 = 3,180	57.76%	42.44%	84.43%	15.57%
All People 45-64 = 12,288	57.33%	42.67%	88.05%	11.95%
Income <138% FPL = 18,272	56.49%	43.51%	87.51%	12.49%
Income > 138% FPL =4,353	55.16%	44.84%	88.92%	11.08%
Diabetes				
Males = 7,663	96.83%	3.17%	90.53%	9.47%
Females = 7,086	97.18%	2.82%	89.87%	10.13%
All People 19-34 = 7,499	94.79%	5.21%	96.71%	3.29%
All People 35-44 = 3,180	97.29%	2.71%	91.56%	8.44%
All People 45-64 = 12,288	97.24%	2.76%	85.54%	14.46%
Income <138% FPL = 18,272	96.96%	3.04%	90.28%	9.72%
Income >138% FPL =4,353	97.22%	2.78%	89.70%	10.30%
Heart Problems				
Males = 7,663	73.45%	26.55%	89.70%	10.30%
Females = 7,086	61.62%	38.38%	90.59%	9.41%
All People 19-34 = 7,499	40.98%	59.02%	96.23%	3.77%
All People 35-44 = 3,180	61.83%	38.17%	91.90%	8.10%
All People 45-64 = 12,288	71.06%	28.94%	85.87%	14.13%
Income <138% FPL = 18,272	66.07%	33.93%	90.25%	9.75%
Income >138% FPL =4,353	75.00%	25.00%	89.95%	10.05%
High Blood Pressure				
Males = 7,663	83.69%	16.31%	83.38%	16.62%
Females = 7,086	88.26%	11.74%	85.56%	14.44%
All People 19-34 = 7,499	66.67%	33.33%	95.30%	4.70%
All People 35-44 = 3,180	82.36%	17.64%	84.84%	15.16%
All People 45-64 = 12,288	88.35%	11.65%	75.32%	24.68%
Income <138% FPL = 18,272	85.36%	14.64%	84.93%	15.07%
Income >138% FPL =4,353	88.81%	11.19%	82.46%	17.54%
Stroke				
Males = 7,663	36.80%	63.20%	98.16%	1.84%
Females = 7,086	36.54%	63.46%	97.90%	2.10%
All People 19-34 = 7,499	10.00%	90.00%	99.66%	0.34%
All People 35-44 = 3,180	16.13%	83.87%	98.81%	1.19%
All People 45-64 = 12,288	40.42%	59.58%	96.86%	3.14%
Income <138% FPL = 18,272	37.50%	62.50%	98.06%	1.94%
Income >138% FPL =4,353	36.36%	63.64%	97.83%	2.17%

Table 5d. Correspondence between HNA answer and Condition-Related ED or Hospitalization Episode in Claims Within One Year of Enrollment

Diagnosis/Group	Confirmed positive *	Unconfirmed positive*	Consistent negative*	False negative *
ER or Hosp for Asthma				
Males = 7,663	71.53%	28.47%	92.90%	7.10%
Females = 7,086	79.02%	20.98%	88.88%	11.12%
All People 19-34 = 7,499	78.13%	21.88%	90.64%	9.36%
All People 35-44 = 3,180	73.68%	26.32%	89.20%	10.80%
All People 45-64 = 12,288	75.61%	24.39%	91.21%	8.79%
Income <138% FPL = 18,272	76.45%	23.55%	90.45%	9.55%
Income >138% FPL =4,353	71.79%	28.21%	92.04%	7.96%
ER or Hosp for COPD				
Males = 7,663	76.19%	23.81%	92.34%	7.66%
Females = 7,086	80.77%	19.23%	90.65%	9.35%
All People 19-34 = 7,499	50.00%	50.00%	96.25%	3.75%
All People 35-44 = 3,180	78.57%	21.43%	92.19%	7.81%
All People 45-64 = 12,288	80.39%	19.61%	88.44%	11.56%
Income <138% FPL = 18,272	78.00%	22.00%	91.35%	8.65%
Income >138% FPL =4,353	84.21%	15.79%	91.69%	8.31%
ER or Hosp for Emphysema				
Males = 7,663	33.33%	66.67%	98.94%	1.06%
Females = 7,086	25.58%	74.42%	99.02%	0.98%
All People 19-34 = 7,499	0.00%	0.00%	99.91%	0.09%
All People 35-44 = 3,180	37.50%	62.50%	99.26%	0.74%
All People 45-64 = 12,288	26.42%	73.58%	98.38%	1.62%
Income <138% FPL = 18,272	25.86%	74.14%	99.03%	0.97%
Income >138% FPL =4,353	66.67%	33.33%	98.76%	1.24%
ER or Hosp for Depression				
Males = 7,663	57.36%	42.64%	83.64%	16.36%
Females = 7,086	71.19%	28.81%	75.74%	24.26%
All People 19-34 = 7,499	58.99%	41.01%	82.53%	17.47%
All People 35-44 = 3,180	62.93%	37.07%	74.82%	25.18%
All People 45-64 = 12,288	71.37%	28.63%	78.78%	21.22%
Income <138% FPL = 18,272	63.53%	36.47%	78.65%	21.35%
Income >138% FPL =4,353	75.86%	24.14%	82.57%	17.43%
ER or Hosp for Diabetes				
Males = 7,663	98.92%	1.08%	82.95%	17.05%
Females = 7,086	99.33%	0.67%	82.10%	17.90%
All People 19-34 = 7,499	98.63%	1.37%	94.87%	5.13%
All People 35-44 = 3,180	100%	0.00%	84.67%	15.33%
All People 45-64 = 12,288	98.97%	1.03%	74.76%	25.24%
Income <138% FPL = 18,272	99.32%	0.68%	82.97%	17.03%
Income >138% FPL =4,353	97.50%	2.50%	80.56%	19.44%
ER or Hosp for Heart Probs				
Males = 7,663	83.75%	16.25%	86.79%	13.21%
Females = 7,086	76.00%	24.00%	88.61%	11.39%
All People 19-34 = 7,499	54.29%	45.71%	95.82%	4.18%
All People 35-44 = 3,180	72.73%	27.27%	90.71%	9.29%
All People 45-64 = 12,288	83.49%	16.51%	82.22%	17.78%
Income <138% FPL = 18,272	77.92%	22.08%	87.97%	12.03%
Income >138% FPL =4,353	90.20%	9.80%	86.99%	13.01%

Q3. *How much more predictive of service utilization is the HNA compared with using only the basic demographic information available for other BadgerCare Plus populations (age, sex, income)?*

Table 6 details mean utilization for the entire sample as well as mean utilization broken out by demographics and HNA responses.

- Those who answered Yes to any of the conditions had a significantly higher level of all visits than those who answered No.
- Significantly higher rates of hospitalization were observed for those who answered Yes to any of the conditions than for those who answered No.
- Relative to those who answered No, significantly higher rates of ER utilization were observed for those who answered Yes for all conditions except cancer.

Table 6. Average Utilization by HNA Answer, Sex, Age, and Income

		Mean Monthly Visit Rate		
	All Visits	Mental Health	Hospitalizations	ED Visits
All =22,971	0.821	0.057	0.012	0.069
Men = 10,997	0.671	0.047	0.012	0.068
Women = 11,974	0.958	0.067	0.012	0.070
p-value Gender	<.0001*	0.1745	0.6599	0.4964
All People 19-34 = 7,499	0.667	0.082	0.007	0.084
All People 35-44 = 3,180	0.885	0.055	0.013	0.097
All People 45-64 = 12,288	0.898	0.043	0.015	0.053
p-value Age categories equal	<.0001*	0.0550	<.0001*	<.0001*
Income <138% FPL = 18,272	0.821	0.057	0.012	0.077
Income >138% FPL = 4,353	0.810	0.059	0.010	0.037
p-value Income	0.7808	0.9575	0.0016*	<.0001*
Asthma = 2,696	1.078	0.072	0.014	0.117
p-value Yes vs. No	<.0001*	0.1450	0.0061*	<.0001*
Cancer = 289	1.320	0.031	0.043	0.099
p-value Yes vs. No	<.0001*	0.0756	<.0001*	0.0756
COPD = 460	1.227	0.071	0.032	0.127
p-value Yes vs. No	<.0001*	0.2772	<.0001*	.0001*
Emphysema = 332	1.283	0.094	0.032	0.117
p-value Yes vs. No	<.0001*	0.0972	<.0001*	0.0110*
Depression = 4,834	1.193	0.164	0.018	0.120
p-value Yes vs. No	<.0001*	<.0001*	<.0001*	<.0001*
Diabetes = 2,257	1.130	0.035	0.024	0.091
p-value Yes vs. No	<.0001*	0.0054*	<.0001*	<.0001*
Heart Problems = 1,527	1.160	0.045	0.029	0.100
p-value Yes vs. No	<.0001*	0.1527	<.0001*	<.0001*
High Blood Pressure = 5,312	1.018	0.052	0.019	0.078
p-value Yes vs. No	<.0001*	0.5350	<.0001*	0.0005*
Stroke = 294	1.258	0.052	0.034	0.141
p-value Yes vs. No	<.0001*	0.7192	<.0001*	0.0075*

*statistically significant at the p<.05 level

Table 7 shows the r-square from regression models of monthly measures of the following: all provider visits, mental health visits, hospitalizations, and emergency department visits. As outlined above, two regression models are estimated for each outcome measure, one using only age, sex and income as explanatory variables and one that augments these factors with measures created from HNA responses.

The percent of variation explained by age, sex, and income ranges from a high of 2.13% for overall utilization and a low of 0.15% for mental health utilization.

The joint addition of a dummy variable reflecting the response to each HNA measure adds a statistically significant amount of predictive power for each outcome. The r-square statistic more than doubles for overall visits, and increases by even greater multiples for mental health visits, ED visits, and hospitalizations. The overall r-square statistic, however, remains quite low in the augmented models, demonstrating that together the demographic variables and simply constructed measures reflecting individual HNA responses explain very little of the total variation in healthcare utilization.

Table 7. Predictive Value of HNA Responses Above that of Age, Sex. And Income Alone

	All Visits Per month	Mental Health visits per month	Hospitalization per month	ED visits per month
Age 18-34 F	-0.1293	0.0035	-0.0067	0.0033
Age 18-34 M	-0.4523	0.0219	-0.0074	-0.0101
Age 35-44 F	*Comparison category*	*Comparison category*	-0.0015	*Comparison category*
Age 35-44 M	-0.3338	0.0001	*Comparison category*	-0.0004
Age 45-64 F	-0.0768	-0.0150	-0.0037	-0.0488
Age 45-64 M	-0.2497	-0.0128	0.0001	-0.0371
Income <= 138% FPL	0.0697	0.0164	0.0030	0.0341
Asthma	0.1403	0.0049	0.0004	0.0232
Cancer	0.4714	-0.0009	0.0348	0.0620
COPD	-0.0011	-0.0147	0.0091	0.0412
Emphysema	0.1589	0.0355	0.0127	0.0096
Depression	0.3703	0.1229	0.0052	0.0593
Diabetes	0.2120	-0.0063	0.0070	0.0189
Heart Problem	0.2081	-0.0089	0.0120	0.0139
High blood pressure	0.0847	-0.0146	0.0032	0.0096
Stroke	0.0027	-0.0005	0.0047	0.1036
P-value from F-test	<0.00001	<0.00001	<0.00001	<0.00001
r-square, age, sex and income only	.0213	.0015	.0069	.0138
r-square, age, sex income and HNA factors*	.0504	.0132	.0261	.0421

*HNA factors: Asthma, Cancer, COPD, Emphysema, Depression, Diabetes, Heart Problems, High Blood Pressure, Stroke

This finding is consistent with those reported results for other predictive models. Ellis and McGuire[3], summarizing the predictive accuracy of various combinations of independent predictors and estimation methodologies in a Medicare sample, find that models including age and gender explain roughly 1% of the variation in charges, while models including age and gender combined with a single variable of

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[3] Ellis RP, McGuire TG. Predictability and predictiveness in health care spending. Journal of Health Economics 26 (2007) 25–48.

lagged total covered charges explain about 9% of the total variation, and models incorporating age, gender, and 183 diagnostic dummy variables explain 10.4 % of the variation.

The Society of Actuaries in 2007 evaluated the predictive accuracy of commercially available claims-based risk assessment tools under different sets of conditions and with different sets of available information.[4] The analysis finds an r-square range of approximately 12-36% for expenditure-related models, dependent on assessment tool, use of offered vs. calibrated model, level of claims truncation and lagged versus non-lagged analysis.

It appears that the Core Plan HNA has a predictive accuracy weaker than claims-based prediction models, but it is important to note that the implementation of the HNA requires considerably less time and resource investment than do the commercially available risk assessment tools. As well, the HNA prediction model incorporates information that is readily collectable at point of enrollment. This is in contrast to prospective claims-based prediction tools, which require historical claims information that may not be accessible to the State in the case of newly enrolling members.

Predictive Value of the HNA for Upper Deciles of Utilization

Individuals populating the highest deciles of utilization account for a disproportionate amount of overall resource use; accordingly, the value of a given predictive tool is largely driven by its performance at the top end of the distribution. As such, the models predicting use in upper deciles were subjected to a more detailed series of specification checks than the models predicting overall visit counts. The preferred specification for modeling top deciles of utilization employed a more complicated treatment of the HNA measures, including the reporting of prior ED and hospitalization use, as well as the addition of household income.

Logistic regression was used to model annual utilization above the 70th and 90th percentile of visits. The predictive accuracy of models incorporating HNA covariates was compared against the predictive accuracy of basic demographic data of age and sex alone and age, sex, and income (below and above 138% FPL). Table 8 shows the predictive value for outpatient visits, mental health visits, ED visits, and hospitalizations of cases within two models:

Model A. Demographics age and sex only
      Case 1. No HNA (demographic data only),
      Case 2. Case 1 + HNA-reported conditions
      Case 3. Case 2 + reported prior episodes (diagnosis-related ED and hospitalizations)
      .

Model B. Demographics age, sex, and income
      Case 1. No HNA (demographic data only),
      Case 2. Case 1 + HNA-reported conditions
      Case 3. Case 2 + HNA-reported conditions and reported prior episodes (diagnosis-related ED and hospitalizations)

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[4] Winkelman R, Mehmud S. A Comparative Analysis of Claims-Based Tools for Health Risk Assessment Society of Actuaries. April 20, 2007.

For both types of models and most utilization types, the case that includes HNA conditions (A2 or B2) dramatically increases the predictive value over the use of demographics alone (A1 or B1).   The addition of HNA-reported diagnosis-related ED or hospitalization episodes (moving from A2 to A3 or B2 to B3) provides only marginal increase in predictive value over the use of HNA-reported conditions.

The HNA bolsters prediction of utilization at or above the 70th percentile of outpatient visits to a much greater degree in the model for which only age and sex are included in the demographic information (Model A, moving from 9% to 45% prediction value), compared to the model that includes income in the demographics (Model B, moving from 39% to 46% predictive value).   However, in the other percentiles and across the other utilization types (mental health, ED, hospitalizations), the HNA adds equally significant predictive value over simple demographics regardless of whether income is included.

Overall, the HNA tool provides information that can be useful in identifying plan entrants with a greater likelihood of incurring a large number of visits. Relative to prediction models with no income covariate, models incorporating HNA variables have considerably greater predictive capacity.

Table 8: Percent of Utilization in Upper Deciles Predicted by Model*

	70th Percentile of Outpatient Visits	90th Percentile of Outpatient Visits	70th Percentile of Mental Health Visits	90th Percentile of Mental Health Visits	70th Percentile of ED Visits	90th Percentile of ED Visits	**70th Percentile of Hospit-alizations
Model A							
Case A1. Base Model (Age + Gender)	8.81%	10.29%	36.38%	9.14%	38.63%	0.00%	36.10%
Case A2. Base Model + HNA conditions	45.35%	20.96%	69.78%	36.29%	40.18%	25.41%	46.08%
Case A3. Base Model + HNA conditions + HNA ED or Hospital stay	44.71%	22.70%	69.78%	36.10%	48.93%	28.54%	48.32%
Model B							
Case B1. Base Model (Age + Gender + Income)	39.12%	10.66%	33.30%	9.61%	35.45%	0.93%	31.05%
Case B2. Base Model + HNA conditions	45.81%	24.45%	68.84%	34.51%	48.67%	27.38%	49.33%
Case B3. Base Model + HNA conditions + HNA ED or Hospital stay	45.20%	22.70%	68.94%	39.83%	51.33%	30.28%	47.98%

Due to fragmentation in the predicted likelihood of visits in the upper decile(s), particularly in the case for which utilization is predicted using the base model, the fraction of the sample belonging to the predicted high utilizer group (e.g. upper 10%, upper 30%) may be substantially smaller than 10% or 30% of the sample. Generally, identification of the upper 10% and 30% of visits and predicted visits is imprecise due to fragmentation of the visits and predicted visits variable.

**Predicting the 90th percentile was not possible for Hospitalizations due to low numbers

Appendix: Health Needs Assessment

The questions indicate presence of the following: asthma, any cancer, COPD, depression, diabetes, emphysema, heart problem high blood pressure, stroke.

Also asks for additional information:
- Asthma
  - Emergency room visit in the past 12 months
  - Hospitalized in the past 12 months
- Cancer
  - Type of cancer that needs current treatment
- COPD (Chronic Obstructive Pulmonary Disease)
  - Emergency room visit in the past 12 months
  - Hospitalized in the past 12 months
- Depression
  - Emergency room visit in the past 12 months
  - Hospitalized in the past 12 months
- Diabetes
  - Emergency room visit in the past 12 months
  - Hospitalized in the past 12 months
- Emphysema
  - Emergency room visit in the past 12 months
  - Hospitalized in the past 12 months
- Heart Problem
  - Emergency room visit in the past 12 months
  - Hospitalized in the past 12 months

The applicant will be able to answer these questions by choosing the appropriate radio buttons for their yes or no responses.

The section on cancer will display various types of cancer based on the sex of the individual which will be pulled from Apply From Benefits. The types of cancer are as follows:
1. Male
   A. Colon
   B. Lung
   C. Testicular
   D. Prostate
   E. Other
2. Female
   A. Colon
   B. Lung
   C. Cervical
   D. Breast
   E. Ovarian
   F. Other

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