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MEMORANDUM

May 30, 2014

To: Barbara Stillwater, AK Diabetes Prevention and Control, DHSS

Re: *Medicaid Claims Before and After Self-Management Training*—Deliverable 2

In February 2014, the Department of Health and Social Services (DHSS), together with the Alaska Diabetes Program, engaged Evergreen Economics (Evergreen) to provide technical assistance with assessing the positive and negative impacts on medical costs associated with diabetic patients who attend chronic disease self-management program (CDSMP) classes, diabetes self-management program (DSMP) classes, or diabetes self-management education (DSME) workshops.

This memorandum presents the results of Deliverable 2 of Evergreen's analysis of Medicaid Claims Before and After Self-Management Training. For this deliverable, we conducted statistical analysis to determine if there is a relationship between participation in self-management training and reduction in spending on Medicaid services. This memorandum is organized as follows:

A. Summary of Findings
B. Statistical Modeling
C. Potential Medicaid Cost Savings Associated with DSME Training
D. Caveats to this Analysis

To complete these tasks, Evergreen relied on data provided by DHSS, as well as data from the Alaska Behavioral Risk Factor Surveillance System (BRFSS) annual survey for 2008-2012, and historical claim-level spending by Alaska Medicaid beneficiaries. We also relied on results from published research, which we cite accordingly in this memo. For additional details regarding how these data were prepared and analyzed, please refer to the documentation provided in Deliverable 1 on March 26th, 2014.

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A. Summary of Findings

A study performed by Alaska's DHSS in 2013 found that diabetics who attend DSME or CSDMP classes show statistically significant improvement in their A1C measurements, body mass index, and blood pressure.[1] Based on these findings, one may also expect that these participants would experience reductions in their utilization and cost of healthcare services.

The focus of this study was to investigate if Medicaid beneficiaries who enrolled in DSME, CSDMP, or DSMP classes experienced reduced spending on Medicaid services after completion of the self-management classes. Due to the small number of Medicaid beneficiaries that participated in the CSDMP and DSMP training, we were not able to develop statistically meaningful estimates for CSDMP or DSMP. However, we did find statistically significantly reductions in Medicaid spending by DSME participants relative to non-participants, which suggest that offering DSME classes for diabetics on Medicaid could result in overall annual savings on Medicaid expenditures.

Specifically, we found that Medicaid recipients with diabetes who attended at least one DSME class experienced a 21.7% reduction in annual Medicaid spending relative to Medicaid recipients with diabetes that did not attend any DSME classes. For fiscal year 2014, we estimate the savings would be approximately $5,670 per Medicaid beneficiary.

Those who attended at least one DSME class also experienced reductions in annual spending on inpatient and outpatient hospital services, relative to those that did not attend any DSME classes. Decreased spending on inpatient and outpatient hospital services indicates a reduced need for critical care by those that participated in DSME training.

In order to extrapolate our findings to all diabetic adults on Medicaid, we analyzed beneficiary-level data used in the Long-Term Medicaid Spending in Alaska (MESA) Forecast, as well as data gathered through the Alaska Behavioral Risk Factor Surveillance System (BRFSS) Survey. We estimate that there are approximately 6,300 adult Medicaid beneficiaries that have diabetes. If all of these beneficiaries had participated in DSME training in the prior fiscal year, total savings to the Medicaid program could be as much as $36 million dollars for fiscal year 2014.

We believe that two of the caveats discussed in Section D deserve mention in this summary section: First, the statistical analysis we conducted was based on a small sample of Medicaid

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[1] Stillwater, B. & Farr, M. *Clinical Outcomes Associated with Self-Management Classes among Patients of an Urban Community Health Center.* Chronic Disease Prevention Health Promotion. Chronicles. July 2013, Vol. 5, No.. 2. http://dhss.alaska.gov/dph/Chronic/Documents/Publications/assets/ChroniclesV5-2.pdf

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beneficiaries (104 in total), of which only 21 had participated in DSME training. Second, those that participated in DSME training were not randomly assigned to participate, but rather were asked to participate based on indicators of poor health. The results of our analysis lack the statistical robustness on which policy decisions should be made. In the ideal study, the sample size would be several hundred or more beneficiaries with approximately half being randomly assigned to participate in DSME training. Nevertheless, we believe the findings of this study provide evidence that DSME training may lead to substantial cost savings for the Medicaid program. We also believe our findings provide support for a more robust study of the impact of DSME (and perhaps other forms of training) that follows a randomized controlled trial (RCT) approach.

B. Statistical Modeling

Our preferred statistical model to estimate the impact of DSME classes is shown in Figure 1. The model regresses a beneficiary's average annual spending *after participating in DSME training* (the "post period") on the DSME indicator variable and the beneficiary's average annual spending *before participating in DSME training* (the "pre period").[2] The goal of this model is to predict spending in the post period based on a patient's historical spending patterns and whether or not they attended a DSME class.

Figure 1: Preferred Model for Estimating Impact of DSME Training

$$Ln(Cost_{i,Post}) = \beta_0 + \beta_1 DSME + \beta_2 Ln(Cost_{i,Pre}) + \varepsilon$$

Where:

$Ln(\,) =$ *"Natural log of"*

$Cost_{i,Post} =$ *Total annual medical costs of patient i during the post period*

$Cost_{i,Pre} =$ *Total annual medical costs of patient i during the pre period*

$\beta_0, \beta_1, \beta_2 =$ *Coefficients to be estimated in the regression model*

$DSME =$ *Indicator variable for participation in DSME classes (1 if attened class, 0 otherwise)*

$\varepsilon =$ *Random error, assumed to be normally distributed*

[2] We used the natural logarithm of pre-period and post-period spending in the regression model. By transforming the data using the natural log we are able to eliminate much of the person-to-person variability in Medicaid spending, allowing us to focus on the change in spending between the pre and post periods. In addition, "logging the data" allows us to estimate the percent change in Medicaid spending associated with DSME training rather than the dollar change, which tends to be noisy and difficult to estimate—especially in small samples.

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Statistical Results

Table 1 shows the results of the regression analysis, which is based on a sample of 104 Medicaid beneficiaries, 21 of whom participated in DSME training. The R-Square (0.79) indicates that 79 percent of the variation in the dependent variable (the natural log of average annual spending in the post-period) is explained by variation in the explanatory variables (the natural log of average annual spending in the pre-period and DSME participation). The F-statistic of 186 is highly statistically significant (P-value < 0.000) which indicates that the explanatory variables are useful in predicting the dependent variable.

Table 1: Regression Results for Preferred Model[3]

Explanatory Variables	Coefficient	St. Error	t-stat	P-Value
Constant	0.009	0.561	0.016	0.987
DSME	-0.244	0.109	-2.233	0.028
$Ln(Cost_{i,Pre})$	0.999	0.054	18.374	0.000
Summary Statistics				
Sample Size = 104		F-stat = 186	R-Square = 0.79	

The estimated coefficient on the variable $Ln(Cost_{k,Pre})$ is highly statistically significant, indicating that spending in the pre-period is a good predictor of spending the post-period.[4]

The coefficient on DSME is also statistically significantly different from 0 at the 0.05 level of significance. This is the coefficient of interest to us. The variable DSME is an indicator or "dummy" variable that is equal to 1 for those Medicaid beneficiaries that participated in DSME training and is equal to 0 for those that did not. The coefficient value for the DSME variable is an estimate of the effect that DSME training has on Medicaid spending relative to those beneficiaries that did not participate in the training. Specifically, the effect is computed as:

[3] The regression was estimated with unit weights. The unit weights were developed to ensure that the output represent the population of adult diabetics on Medicaid with respect to age (working-age adults: 21-64 years of age and elderly: 65+ years of age) and gender.

[4] The coefficient value of 0.999 indicates that for each additional dollar of spending in the pre-period, spending in the post period will increase by an estimated 99.9¢. The lower and upper 90 percent confidence interval on the true effect is that each additional dollar spent in the pre-period will lead to an additional $0.91 to $1.09 spending in the post-period.

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$$DSME\ Effect = (e^{\beta_{DSME}} - 1) \times 100$$

Where:

$DSME\ Effect$ = Percent change in annual spending relative to non-DSME participants

β_{DSME} = Estimated coefficient on the variable DSME

e = Exponential function operator (inverse of the natural log)

Plugging our coefficient into the formula for the percent change, we find

$$DSME\ Effect = (e^{\beta_{DSME}} - 1) \times 100 = (e^{(-0.244)} - 1) \times 100 = (0.783 - 1) \times 100 = -21.7\%$$

The resulting parameter is interpreted the following way: Medicaid recipients with diabetes that attended at least one DSME class experienced a 21.7 percent reduction in annual Medicaid spending, relative to Medicaid recipients with diabetes that did not attend any DSME classes (i.e. the control group).[5] It is important to note that this is not stating that the annual spending necessarily decreased in the post period, only that the change from pre to post was 21.7 percent less for those that attended DSME classes. Nevertheless, the 21.7 percent does represent our estimate of the savings in Medicaid spending associated with DSME training.

C. Potential Medicaid Cost Savings Associated with DSME Training

Estimating the Number of Medicaid Beneficiaries with Diabetes

As a first step to estimating the number of beneficiaries with Diabetes, Evergreen analyzed historical beneficiary-level enrollment and spending records for the Alaska Medicaid program. These are the same data the Medicaid Budget Group has used since 2005 to develop the annual Long-Term Medicaid Enrollment and Spending Forecast. We define our population of interest as adult beneficiaries (ages 20 and older) who are not pregnant or postpartum.[6]

We analyzed data from the Alaska Behavioral Risk Factor Surveillance System (BRFSS) annual survey for 2008-2012 to estimate the proportion of adult Medicaid beneficiaries

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[5] The lower and upper 90 percent confidence interval on the true effect is that Medicaid recipients with diabetes that attended at least one DSME class experienced a 6.4 to 34.4 percent reduction in annual Medicaid spending, relative to Medicaid recipients with diabetes that did not attend any DSME classes.

[6] While some women do develop diabetes during pregnancy (often referred to as gestational diabetes), most of these women will not continue to be diabetic after delivery. Since Medicaid beneficiaries with gestational diabetes are not part of the population of interest for this study, we excluded women enrolled through the pregnant/postpartum eligibility category from our analysis. We recognize that some pregnant women will receive ongoing treatment for Type 1 or Type 2 diabetes, however the costs associated with their diabetes treatment is confounded with the costs associated with pregnancy and so we believe the more "conservative" approach is to exclude them from our analysis.

who are diabetic.[7] In all four survey-years, respondents were asked whether they had ever been told they had diabetes.[8] They were able to select one of the following responses:

A. Yes
B. Yes, but only during pregnancy
C. No, but was told I had pre-diabetes or borderline diabetes
D. No

Table 2 shows the distribution of responses by Medicaid-eligible adults for each year analyzed. Some of the year-to-year variation in the proportion with diabetes may be due to the survey weighting method rather than actual changes in the population characteristics. We used the average over the five survey years (14 percent) as an estimate of the proportion of Medicaid beneficiaries with diabetes.

Table 2: Prevalence of Diabetes among Medicaid-Eligible Adults

Year	Diabetes	Gestational Diabetes	Borderline / Pre-Diabetes	No Diabetes
2008	18.1%	0.7%	2.5%	78.7%
2009	11.1%	2.1%	2.2%	84.6%
2010	19.9%	1.6%	1.3%	77.3%
2011	11.5%	3.1%	1.4%	84.1%
2012	9.4%	1.1%	1.4%	88.1%
Average	**14.0%**	**1.7%**	**1.8%**	**82.5%**

Source: Analysis of BRFSS data by Evergreen Economics

Applying the assumption that approximately 14% of adult Medicaid enrollees are diabetic to the total count of adult enrollees provided in the MESA data, we were able to estimate the number of diabetic enrollees for each fiscal year. Table 3 shows estimated counts of Medicaid beneficiaries 20 years of age and older that are not are not enrolled under the pregnant/postpartum eligibility category.

[7] In 2011 and 2012 the BRFSS did not explicitly ask respondents whether they were enrolled in Medicaid. Instead, we used responses to other survey questions (age, income, household size, disabilities, and children in home) to determine if a respondent would have been eligible for Medicaid coverage based on our estimate of their household's income as a percent of the federal poverty level (FPL). If the respondent met the criteria for any type of Medicaid eligibility and reported having some type of medical insurance coverage (i.e. not uninsured), we considered them to be part of the Medicaid eligible population.

[8] From 2008 to 2010 the question specified whether *a doctor* had ever told them that they had diabetes.

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Table 3: Estimated Count of Medicaid Beneficiaries in Alaska 20 Years of Age and Older that are not Pregnant/Postpartum

Fiscal Year	Beneficiaries	With Diabetes
2008	30,106	4,215
2009	31,505	4,411
2010	34,443	4,822
2011	39,076	5,471
2012	42,415	5,938
2013	43,417	6,078
2014	44,973	6,296

Sources: ADHSS Medicaid Budget Group; Analysis of BRFSS data by Evergreen Economics

Estimating the Annual Cost per Enrollee

In order to estimate the difference in Medicaid expenditures of diabetics and non-diabetics, we reviewed relevant literature to find reported annual costs of care for each group. Using the reported dollar costs of care in each study, we calculated the annual cost of care for a diabetic adult as a percentage of the cost of care for a non-diabetic adult. By computing the difference in spending between diabetic and non-diabetic care in this way, we were able to remove the effect of changes in prices over time (inflation). This allows us to directly compare the differences in cost across many years; see Table 4 below. Across the five studies we examined, the average cost of care for a diabetic adult as a percentage of the cost of care for a non-diabetic adult is 240.3 percent.

Table 4: Published Estimates of the Annual Cost of Care for Adult Diabetics

Study Sample		Annual Cost of Care		Diabetic Cost as % of Non-Diabetic Cost
Year	Group	Diabetic	Non-Diabetic	
2003	US Medicaid	$6,481	$3,367	192.5%
2007	US Population	$11,744	$5,872	200.0%
2009	US Medicaid	$13,490	$5,133	262.8%
2010	US Medicaid	$14,229	$4,568	311.5%
2012	US Population	$13,741	$5,853	234.8%
			Average	**240.3%**

Sources: Kaiser Family Foundation[9,10], PubMed[11], Freedom Benefits[12], and American Diabetes Association[13]

[9] Cohen, Mindy. *An Overview of Medicaid Enrollees with Diabetes in 2003*. Kaiser Commission on Medicaid and the Uninsured: Issue Paper. October 2007. http://kaiserfamilyfoundation.files.wordpress.com/2013/01/7700.pdf

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Total Estimated Spending on Adult Beneficiaries with Diabetes

Using the relative cost information shown in Table 4, the counts of Medicaid beneficiaries shown in Table 3, and total incurred Medicaid expenditures by fiscal year from the Medicaid Budget Group, we estimated the average cost per beneficiary and the total cost for all beneficiaries with diabetes. We estimate that for fiscal year 2014, adult beneficiaries with diabetes will incur about $166 million in Medicaid costs (see Table 5).

Table 5: Estimated Count and Incurred Cost of Medicaid Beneficiaries with Diabetes that are 20 Years of Age and Older and are not Pregnant/Postpartum

Fiscal Year	Beneficiaries With Diabetes	Incurred Cost Per Diabetic Beneficiary	Total Cost of Diabetic Beneficiaries
2008	4,215	$24,784	$104,465,856
2009	4,411	$26,038	$114,854,914
2010	4,822	$27,838	$134,234,369
2011	5,471	$27,992	$153,142,559
2012	5,938	$26,468	$157,167,553
2013	6,078	$25,940	$157,670,122
2014	6,296	$26,310	$165,655,028

Sources: Analysis of Medicaid Budget Group and other data by Evergreen Economics

Potential Savings Associated with DMSE

Based on the results of our statistical analysis of participants in DSME classes and the control group, we found that Medicaid beneficiaries with diabetes who attended at least the first DSME class experienced a 21.7% reduction in annual Medicaid spending relative to Medicaid beneficiaries with diabetes that did not attend any DSME classes. Applying this parameter estimate to the estimates of Medicaid cost incurred by diabetic beneficiaries shown in Table 5, we can estimate the potential savings associated with the DSME program if all Medicaid beneficiaries were to attend at least one DSME class.

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[10] Kaiser Commission on Key Facts. *The Role of Medicaid for People with Diabetes.* November 2012. http://kaiserfamilyfoundation.files.wordpress.com/2013/01/8383_d.pdf

[11] Damico, A. & Garfield, R.L. *Medicaid Expansion Under Health Reform May Increase Service Use and Improve Access For Low Income Adults With Diabetes.* January 2012. Health Aff (Milwood); 31(1): 159-67. http://www.ncbi.nlm.nih.gov/pubmed/22232106?dopt=Abstract

[12] Novak, T. *Empowering Diabetics to Take Control of Their Health.* February 2013. FreedomBenefits.net. http://www.freedombenefits.net/affordable-health-insurance-articles/health-insurance-for-diabetics.html

[13] American Diabetes Association. *Economic Costs of Diabetes in the U.S. in 2012.* April 2013. Diabetes Care; Vol. 36; No.4 1033-1046. http://care.diabetesjournals.org/content/36/4/1033.full

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Table 6 shows the count of adult beneficiaries with diabetes, our estimate of the potential savings per beneficiary, and the total potential savings if all adult beneficiaries attended at least one DSME class for fiscal years 2008 through 2011. Based on our analysis of the pre-post data provided by the Division of Public Health and other sources of data, we estimate that for the current fiscal year (FY2014), adult beneficiaries with diabetes would have incurred almost $36 million less in Medicaid costs if all of these beneficiaries had participated in the DSME program.

Table 6: Potential Savings if all Medicaid Beneficiaries with Diabetes that are 20 Years of Age and Older and are not Pregnant/Postpartum participated in DSME

Fiscal Year	Beneficiaries With Diabetes	Potential Savings Per Diabetic Beneficiary	Potential Savings for All Diabetic Beneficiaries
2008	4,215	$5,366	$22,618,150
2009	4,411	$5,638	$24,867,509
2010	4,822	$6,027	$29,063,401
2011	5,471	$6,061	$33,157,258
2012	5,938	$5,731	$34,028,719
2013	6,078	$5,616	$34,137,531
2014	6,296	$5,696	$35,866,362

Sources: Analysis of Medicaid Budget Group and other data by Evergreen Economics

D. Caveats to this Analysis

The focus of this study was to investigate the impact that participation in DSME had on a beneficiary's use of Medicaid services. We were able to show a statistically significant reduction in annual Medicaid spending among diabetics who attended DSME classes, as well as estimate the potential savings on Medicaid expenditures if DSME classes were made available to all diabetics on Medicaid in Alaska. However, there were inherent limitations in our analysis caused by the experimental design and available data.

The study did not follow a randomized experimental design. Instead of being randomly assigned to a Case and Control group, participants were invited to participate in the diabetes management programs and they self-selected to do so. There may be unobservable difference (self-selection bias) between those that chose to participate and those that did not.

The DSME participants are not expected to be representative of all diabetics on Medicaid. The DSME population was deterministically selected by healthcare professionals and is composed of diabetic patients with especially severe and quickly deteriorating health situations. These individuals may have greater potential for savings than the average

diabetic. It would be advantageous to analyze the relationship between Medicaid expenditures and the participants' health status. Modeling health status along with DSME participation would make it possible to estimate the potential savings for a diabetic whose health status better reflects the population of diabetics on Medicaid.

The study was based on a small sample. Small samples are concerning because they inherently contain less information than larger samples. A larger sample would improve the precision of the DSME estimate and could make it possible to detect statistically significant changes in annual expenditure by CDSMP and DSMP participants.

The study's limited time frame was unable to determine whether or not Medicaid savings would persist over time. Beneficiaries who do make positive changes in their self-management of diabetes may eventually "snapback", reverting to unhealthy lifestyle choices similar to those followed before the self-management training. A study with an extended time frame would be able to determine if this type of "snapback" is likely to occur, and establish a more reliable long-term savings estimate for DSME participation.

The number of adult Medicaid beneficiaries with diabetes and their cost of Medicaid services were estimated. While our estimates were based on respected sources including the Alaska Behavioral Risk Factor Surveillance System annual survey, the DHSS Medicaid Budget Group's enrollment forecasts, they are only estimates. We believe the estimates used in the analysis reasonable, but they are certainly not exact.

Our estimates for the potential savings from DSME do not consider the cost of providing these classes. Ideally our analysis would include estimates of net savings to the Medicaid program by factoring in the cost of administering and providing the DSME classes.

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E. Appendix

Filtering: A series of filters were established so that people who had insufficient data or are not typical of the target population (adult diabetics on Medicaid) would be excluded from the regression analysis.

Ideally, the minimum duration of the pre and post periods should be one year each; by considering an entire year for each of the pre and post periods, we could eliminate the possibility that seasonal factors affect the analysis. However, 55 beneficiaries in the study (26 percent of all case and control records) had less than one year of pre period data. Because of this, we only excluded those beneficiaries that had less than 0.5 years of pre period data.

Total annual cost incurred by adult Medicaid beneficiaries averaged $12,339 in 2008 (the first year of the study) and $13,178 in 2011 (the last year of the study).[14] In order to limit our study to patients whose spending patterns were somewhat typical of the target population of Medicaid enrollees, those who had annual spending of less than $5,000 in the pre period were excluded.

We also excluded those people whose change in annual spending from the pre period to the post period was greater than a 300 percent change (i.e., increase or decrease) in spending. because this magnitude of change in expenditure is too extreme to be considered realistic for most of the target population. This type of filter should not bias the results because those with extremely high and those with extremely low changes in annual spending were removed.

There were 104 people (51.5%) who met all of these criteria, including 21 people who participated in DSME training (Case) and 76 persons in the Control.

Gender, Race, and Age: Gender and race were not included in any of the final models. While these types of demographic characteristics have a significant impact on dollar value of Medicaid expenditures as well as the prevalence of diabetes and other health conditions, these characteristics their impact on the *percent change* in Medicaid expenditures after DSME classes is uncertain. We consider various demographic explanatory variables in the regression models, but none were statistically significant. It is possible that with a larger data set one or more demographic variable would provided explanatory power in the model.

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[14] Long-Term Medicaid Spending in Alaska (MESA) Forecast, annual average spending

Number of Classes: In order to determine the effect of repeated DSME attendance on spending, we tried two different approaches in our preliminary models. With such a small sample, it was not possible to determine the incremental value of attended additional DSME classes with either of these approaches.

The first approach was to include the number of DSME classes attended (values ranging from 0 to 9) as an explanatory variable. The coefficient on this variable was not statistically significant. Our second modeling approach was to include the DSME indicator variable (1 if attended at least one class) along with an indicator for those who attended additional DSME classes (1 if attended two or more classes). In the filtered dataset, there were 10 people who had only taken one DSME class and 11 who took between 2 and 9 DSME classes. Including both variables allows the regression to isolate the impact of the first class from the impacts of any additional classes attended. The impact of the first DSME class was statistically significant and negative, but the impact of additional classes was not significant. Neither of these approaches was able to determine how repeated DSME attendance impacts annual spending, so the final models simply consider the impact of attending any number of DSME classes.