

## Evaluation of a Medicaid Asthma Disease Management Program

ARIEL LINDEN, DR.P.H., M.S.,<sup>1,2</sup> GREGORY D. BERG, PH.D.,<sup>3</sup>  
and SANDEEP WADHWA, M.D., M.B.A.<sup>3,4</sup>

### ABSTRACT

This study evaluates 1-year outcomes of an asthma disease management program implemented in an Oregon Medicaid population. A non-randomized pre-post study, a matched case-control study, and a “programmatic effects” analysis were conducted. Compared to matched controls, the treatment cohort had significantly fewer emergency room visits per thousand (7 vs. 28,  $P < 0.001$ ) and higher office visits per thousand (57 vs. 7,  $P < 0.0001$ ) but no significant difference in hospital admission rates. The programmatic effects model identified the participants’ initial severity levels and the number of various communications they received as the most important variables in explaining the change in asthma severity from baseline to 12 months. These findings are supportive of the DM design, which is to reduce acute services by improving coordination of care between patients and their providers. Additionally, it appears that there is a close association between the number of patient contacts and their subsequent change in health status. (*Disease Management* 2007;10:266–272)

### INTRODUCTION

WHILE ASTHMA AFFECTS PERSONS of all ages, it is especially prevalent in Medicaid populations.<sup>1</sup> The Medicaid population as a whole is poorer and sicker than the low-income privately insured population and has a higher prevalence of disability: approximately half of adults with Medicaid report cognitive or physical limitations, a rate exceeding 4 times that for low-income adults with private insurance.<sup>2</sup> Medicaid populations also tend to be less mobile and are less likely than other groups to have a home phone. Furthermore, this population is less trusting of providers and unsolicited

callers and has lower health literacy and a relatively high rate of chronic illnesses and disabilities.<sup>3</sup> Chronic or disabling conditions affect over 60% of the Medicaid population; these patients cost on average 15 times more than beneficiaries without similar conditions.<sup>4</sup> Nationwide, approximately half of the pediatric asthma hospitalizations in the United States are billed to Medicaid.<sup>5</sup>

The primary goals of disease management (DM) programs are to reduce, if not eliminate, unnecessary hospital and emergency department (ED) visits through patient self-management skills training, symptom recognition training, and the use of patient/provider de-

---

<sup>1</sup>Linden Consulting Group, Portland, Oregon.

<sup>2</sup>School of Medicine and School of Nursing, Oregon Health and Science University, Portland, Oregon.

<sup>3</sup>McKesson Health Solutions, Broomfield, Colorado.

<sup>4</sup>Division of Geriatrics, Department of Medicine, University of Colorado Health Sciences Center, Denver, Colorado.

financed care plans.<sup>6</sup> Other studies have shown the effectiveness of DM programs in commercial settings using 2 group-matched analyses with reductions in inpatient admissions between 35% and 66% and reductions in ED visits between 32% and 66%.<sup>7,8</sup> One publication for Medicaid managed care members showed inpatient reductions of 55% and reductions in ED visits of 24%,<sup>9</sup> with another state Medicaid evaluation not reporting inpatient and ED visits.<sup>10</sup>

This article describes the clinical and disease-specific utilization outcomes of an asthma DM program implemented in the Oregon State Medicaid population for participants and controls for whom there were at least 2 years of complete data.

More specifically, 3 analyses were conducted: (a) a non-randomized pre-post study in which outcomes for program participants were compared to eligible but non-participating controls, (b) a matched case-control study in which program participants were matched with controls on the propensity score, and (c) a programmatic effects analysis to identify predictors of the change in severity score for program participants from initial assessment to 1-year follow-up assessment.

## METHODS

### *Intervention*

In 2002, Oregon State initiated an asthma DM program for its fee-for-service Medicaid recipients. On a monthly basis, the state identifies subjects who have been diagnosed with asthma from their medical claims data. Registered nurses then call potential participants to determine their interest in program enrollment. For those who agree to enroll, the nurse conducts an initial risk assessment to determine the participant's severity level (classified as high, moderate, and low).

The presence of any high-risk factor placed patients into the high-risk category. High-risk factors include: severely fragmented speech; symptoms almost continuously every day for the last 2-3 months; peak expiratory flow (PEF) <50% predicted; continuous steroid use dur-

ing the last month; 2 or more asthma-related hospitalizations or ED visits during the last 12 months. Moderate-risk factors include: limited speech; nocturnal symptoms more than twice weekly over the last 2-3 months; PEF <80% and >50% predicted; 1 asthma-related ED visit or hospitalization in the previous 12 months; history of mechanical ventilation or intensive care unit admission at any time; current smoker; presence of allergic rhinitis/sinusitis. Low-risk factors include: unrestricted speech; symptoms less than 5 times a week during previous 2-3 months; nocturnal symptoms 2 times weekly or less; PEF >80% predicted. The absence of any risk factors placed patients in the low-risk category.

Patients with multiple risk factors were placed in the highest risk category containing the risk factor. For example, a current smoker with 2 asthma-related ED visits during the past year was placed in the high-risk category.

Upon completion of the risk stratification, nurses provide a self-management intervention plan that includes written materials, informal and formal education, on demand free 24-hour access to a nurse counseling telephone line, and instructions on how to contact the nurses about symptoms and concerns.

Once members are enrolled in the program, nurses conduct a quarterly telephonic re-assessment to determine each participant's knowledge, behavior, and health status related to his or her asthma. The improvement in patients' knowledge, behavior, and health status are expected to lead to changes in their medical service utilization.

### *Subjects*

Between 90,000 and 120,000 individuals become eligible for Oregon fee-for-service Medicaid on a monthly basis. Of these, roughly 6,000 new asthmatics are identified via medical claims. The analyses conducted herein are limited to those individuals who were continuously enrolled in Medicaid for a 24-month period between October 2002 and June 2006. In other words, individuals were required to have at least 2 years of complete data in order to be included in the study (ie, 1 baseline year and 1 program year). Analysis of overall program ef-

fectiveness was limited to the first program year to maximize the sample size<sup>11</sup> and account for seasonal components,<sup>12</sup> while mitigating the impact of external factors that may occur over a longer period, such as changes in regional variations in practice patterns or market forces.<sup>13</sup>

Baseline demographic and utilization characteristics for program participants were established by taking the date of their initial assessment and going back 365 days. First program year characteristics were established by going forward in time 365 days from the initial assessment date. Therefore, to be included in the outcomes analysis participants must have had a 12-month baseline (pre-program) and 12 months of continuous program participation. A total of 319 individuals met these criteria. Asthma-related utilization was determined using the primary diagnosis field on any medical claim and matching it to a list of International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes recommended by the Disease Management Association of America.<sup>14</sup>

Program non-participants are defined as Medicaid recipients who were identified as having an asthma diagnosis on a claim and who did not participate in the DM program during the same time period in which the program was available. These individuals may have either chosen not to participate in the program or had not responded to repeated telephonic and written communications. Given that non-participants do not have an "enrollment date," the program "referral date" was used as a proxy. The program referral date is the date a person was identified through administrative claims and then referred to the DM program by the state. Thus, the baseline was established as 365 days prior to the referral date and the "pseudo" program year was established as being 365 days following the referral date.

Using the propensity scoring technique described in Linden et al,<sup>15</sup> a large subset (66%) of the participation group was matched to controls meeting the criteria described above. Baseline variables used to create the propensity score were: age, gender, months enrolled in Medicaid prior to the individual's program start date (or referral date for controls), number of daily asthmatic controller drugs, num-

ber of short-acting asthma drugs, number of asthma-specific hospital admissions, number of asthma-specific office visits, number of asthma-specific ED visits, number of other asthma-specific outpatient services rendered, and number of flu and pneumococcal vaccinations provided.

#### *Outcome variables*

In both the unadjusted pre-post and matched-pairs analyses, the following outcome variables were evaluated: rate of daily asthma controller drugs, rate of short-acting asthma drugs, rate of asthma-specific hospital admissions, rate of asthma-specific office visits, rate of asthma-specific ED visits, rate of other asthma-specific outpatient services rendered, and rate of flu and pneumococcal vaccinations provided.

In the programmatic effects analysis, the change in severity score was used as the dependent variable and the following independent variables were evaluated: age, length of Medicaid eligibility, gender, number of monitoring calls, number of symptom calls, number of education calls, member inbound calls, number of physician alerts issued, number of case-management alerts issued, and initial severity level.

## RESULTS

### *Unadjusted pre-post analysis*

Table 1 presents baseline characteristics and asthma-specific outcomes for all program participants and non-participants who were continuously enrolled in Medicaid over a 24-month period and eligible for participation in the asthma DM program. As indicated, 319 individuals participated in the program for at least 1 year, and 940 individuals met the program eligibility criteria but did not participate.

Compared to non-participants, program participants tended to be older, female, and have a longer term of enrollment in Medicaid. Fifty-four percent of participants were younger than 18 years of age compared to 62% of the non-participant population (data not shown). Additionally, the participation group had higher baseline rates of daily controller and short-acting drug usage, office visits, and ED visits.

TABLE 1. BASELINE CHARACTERISTICS AND ASTHMA-SPECIFIC OUTCOMES FOR ALL PROGRAM PARTICIPANTS AND NON-PARTICIPANTS CONTINUOUSLY ENROLLED IN MEDICAID OVER A 24-MONTH PERIOD AND ELIGIBLE FOR PARTICIPATION IN THE ASTHMA DM PROGRAM\*

	Participants	SE	Non-participants	SE	95% CI (for difference)	P value
Baseline characteristics						
Group size (N)	319		940			
Age	24.5	1.20	18.80	0.61	(-8.23, -3.06)	0.0001
Female (%)	0.64	0.03	0.58	0.02	(0.0002, 0.1233)	0.05
Months enrolled in Medicaid	96.9	2.70	89.0	1.50	(1.80, 14.01)	0.01
Baseline utilization						
Daily controller drugs	0.34	0.12	0.10	0.03	(0.002, 0.477)	0.05
Short-acting drugs	0.46	0.16	0.14	0.04	(-0.000, 0.649)	0.05
Admissions	0.04	0.01	0.02	0.01	(-0.0121, 0.0406)	0.29
Office visits	1.13	0.10	0.11	0.01	(0.8281, 1.2181)	0.0001
Emergency department visits	0.14	0.03	0.84	0.04	(-0.7987, -0.6043)	0.0001
Other professional services	0.27	0.12	0.20	0.05	(-0.184, 0.332)	0.57
Flu and pneumococcal vaccination	0.30	0.04	0.24	0.02	(-0.1402, 0.0213)	0.15
Outcome utilization						
Daily controller drugs	0.30	0.09	0.07	0.03	(0.0428, 0.4039)	0.02
Short-acting drugs	0.34	0.11	0.09	0.02	(0.033, 0.478)	0.02
Admissions	0.01	0.01	0.01	0.00	(-0.01360, 0.01953)	0.73
Office visits	0.87	0.09	0.05	0.01	(0.6579, 0.9934)	0.0001
Emergency department visits	0.06	0.02	0.44	0.04	(-0.4493, -0.2955)	0.0001
Other professional services	0.12	0.02	0.05	0.02	(-0.0057, 0.1566)	0.07
Flu and pneumococcal vaccination	0.39	0.04	0.20	0.02	(-0.2783, -0.1118)	0.0001

\*Unless otherwise noted, all baseline characteristics are presented as means and standard errors [SE], and utilization is presented as rates per thousand.

There was no statistically significant difference between groups in baseline admission rates or utilization of other outpatient professional services or flu and pneumococcal vaccination rates. After the first program year, participants had higher rates of asthma medication usage, office visits, other professional services, and flu and pneumococcal vaccination rates compared to non-participants. While there was no significant difference between groups in hospital admission rates, participants visited the ED at a much lower rate than non-participants.

#### Case-control analysis

The statistically significant differences found in nearly all baseline characteristics between participants and non-participants strongly suggest the existence of self-selection bias. Therefore, we limited confidence in the validity of the results of the unadjusted pre-post analysis. To control for observed variation between the 2 groups, a subset of participants was matched to controls based on their propensity scores.

Table 2 presents baseline characteristics and outcomes for all cases and matched controls continuously enrolled in Medicaid over a 24-

month period and eligible for participation in the asthma DM program. As shown, the 209 pairs were similar on every baseline characteristic and utilization measure.

During the program year, cases visited the ED 76% fewer times than controls ( $P = 0.001$ ) and visited their physician 87% more ( $P = 0.0001$ ). There was no significant difference between groups in admissions, or use of other professional services, asthma medication usage, or flu and pneumococcal vaccination rates.

#### Programmatic effect analysis

In the third analysis, individual components of the DM intervention were assessed to determine their impact on the change in a participant's severity score from the initial assessment (performed during the enrollment call) to the end of the first program year (12-month severity score minus initial severity score). All program participants completing at least 1 year of the DM program were included in this analysis. Given that non-participants do not receive a severity rating (as this is established during the initial call with a nurse), this analysis is limited to participants only. As length of enroll-

TABLE 2. BASELINE CHARACTERISTICS AND ASTHMA-SPECIFIC OUTCOMES FOR CASE-CONTROL MATCHED PAIRS CONTINUOUSLY ENROLLED IN MEDICAID OVER A 24-MONTH PERIOD AND ELIGIBLE FOR PARTICIPATION IN THE ASTHMA DM PROGRAM\*

	Cases	SE	Controls	SE	95% CI (for difference)	P value
Baseline characteristics						
Group size (N)	209		209			
Propensity score	0.33	0.01	0.33	0.01	(-0.0375, 0.0379)	0.99
Age	23.1	1.40	22.25	1.36	(-3.17, 4.89)	0.68
Female (%)	0.61	0.03	0.62	0.03	(-0.1078, 0.0887)	0.85
Months enrolled in Medicaid	94.7	3.32	94.9	3.29	(-9.40, 8.87)	0.96
Baseline utilization						
Daily controller drugs	0.21	0.13	0.10	0.06	(-0.160, 0.389)	0.41
Short-acting drugs	0.33	0.17	0.19	0.12	(-0.276, 0.553)	0.51
Admissions	0.02	0.01	0.02	0.01	(-0.0299, 0.0299)	1.00
Office visits	0.33	0.04	0.31	0.04	(-0.0905, 0.1192)	0.79
Emergency department visits	0.16	0.04	0.13	0.03	(-0.0731, 0.1305)	0.58
Other professional services	0.22	0.15	0.09	0.03	(-0.181, 0.440)	0.41
Flu and pneumococcal vaccination	0.25	0.04	0.19	0.04	(-0.0513, 0.1707)	0.29
Outcome utilization						
Daily controller drugs	0.16	0.09	0.17	0.11	(-0.279, 0.260)	0.94
Short-acting drugs	0.24	0.12	0.1	0.08	(-0.189, 0.390)	0.49
Admissions	0.01	0.01	0.01	0.01	(v.0202, 0.0298)	0.71
Office visits	0.57	0.07	0.07	0.02	(0.3439, 0.6513)	0.0001
Emergency department visits	0.07	0.03	0.28	0.06	(-0.3376, -0.0834)	0.001
Other professional services	0.08	0.04	0.02	0.02	(-0.0257, 0.1406)	0.18
Flu and pneumococcal vaccination	0.34	0.05	0.23	0.04	(-0.0202, 0.2292)	0.10

\*Unless otherwise noted, all baseline characteristics are presented as means and standard errors [SE], and utilization is presented as rates per thousand.

ment in Medicaid was not used as an analytic criterion here, the total sample size increased to 481 (from the 319 participants meeting the 24-month enrollment criteria).

Participants' initial severity levels were determined by program nurses using a 3-point rating scale: 1 = low (N = 137), 2 = medium (N = 262), and 3 = high (N = 82). The Wilcoxon Signed Ranks Test indicated a statistically significant decrease ( $z = -2.430$ ,  $P = 0.015$ ) in severity from pre- to post-1st year program measurements. Overall, 131 participants (27%) decreased their severity level, 259 par-

ticipants (54%) maintained their severity level, and 91 participants (19%) increased their severity level. These changes were similarly noted in the subset of participants used as cases in the case-control analysis.

Next, an ordinary least squares regression model was estimated to identify which components of the intervention had a significant impact on the change in severity from pre- to post-1st program year. A best subset analysis was performed to identify the most parsimonious model based on  $R^2$  and the Mallows'  $C_p$  statistic. Table 3 presents the model parameters for the best fit-

TABLE 3. REGRESSION MODEL PARAMETERS FOR DETERMINING PROGRAMMATIC ELEMENTS ASSOCIATED WITH THE CHANGE IN SEVERITY SCORES

Predictor	Coefficient	Correlation	T Value	P value
Intercept	-0.392		-7.180	<0.0001
Case management alerts	-0.129	-0.227	-5.070	<0.0001
Initial severity—level 2	0.851	0.524	13.407	<0.0001
Initial severity—level 3	1.695	0.660	19.150	<0.0001
Follow-up calls on symptoms	-0.213	-0.149	-3.294	0.0011
Educational calls	-0.068	-0.177	-3.926	<0.0001
F-tested	79.393			<0.0001
Adjusted $R^2$	44.95%			

ting model. Overall the model was significant and explained approximately 45% of the variation in the change in severity scores from pre- to post-1st program year (a change from a higher severity to a lower severity level is represented as a negative value and vice versa).

Communications with or on behalf of participants had a strong inverse association with the change in their severity level, meaning that the improvement in health status of participants was related to more phone calls for follow-up on symptoms, more educational calls, and more alerts about the participant's condition sent to case management.

The initial severity level of the participants was directly associated with their change in severity after 1 year. In other words, participants initially classified as being of low or moderate severity had a higher probability of improving their health status after 1 year than those of a high initial severity.

## DISCUSSION

The results of this study indicate that the asthma DM program was effective in reducing asthma-specific ED visits while concomitantly increasing the use of physician office visits. These findings are supportive of the general mission of DM, which is to reduce unnecessary use of acute services by improving coordination of care between patients and their primary health care providers thereby, in effect, creating a "medical home."

There was no statistically significant difference in asthma-specific hospitalization rates between cases and controls. This is most likely explained by the initial low occurrence rate in this population (ie, 20 admits per thousand asthmatics), suggesting that there was little opportunity to make a significant impact on this measure.<sup>16</sup>

There were no significant changes in asthma medication or flu and pneumococcal vaccination utilization. From the review of the data, it appears that asthmatics who have historically used the appropriate medications or received annual immunizations will continue to do so, while asthmatics who have not used these medications or received immunizations in the past will continue not to use them, even after

being educated about their effectiveness. This assumption was confirmed by regressing program year utilization on baseline year utilization. The resulting  $R^2$  values were 0.85 and 0.51 for medications and immunizations respectively, while admissions and ED visits elicited  $R^2$  values of only 0.04 and 0.06, respectively.

Initial severity level was directly associated with the potential for reducing or maintaining that severity over time. Those with low initial severity were most likely to remain low, while those with higher severity were most likely to get worse as their chronic illness progressed. Given that there were only 3 severity levels used for classification, it appears that moderately severe participants signify the level with the most opportunity for change. In these data, this group also represented the largest initial cohort. The importance of this variable could be more telling with larger subgroup sizes and a more even distribution between levels.

The relationship found between the number of programmatic elements, such as patient calls or coordination with case-management, and a change in severity is very enlightening. It appears that in the case of asthma DM, more is better. These data should prove helpful in determining the appropriate number and type of contacts participants receive as part of a DM program intervention.

This study has several limitations. First, in Oregon Medicaid 47% of recipients lose their eligibility within 12 months (personal communication from Charles A. Gallia, Ph.D., of the Office of Medical Assistance Programs, Department of Human Services, State of Oregon; August 30, 2006). Not only does this high turnover restrict the potential to systematically change health-related behaviors in the intervention group, but it also limits the number of subjects available for a longitudinal evaluation. This is evident in the current analysis in which only 319 program participants met the 24-month eligibility criteria.

Second, selection bias is always a threat to validity in non-experimental study designs.<sup>17</sup> This was addressed by using a propensity score matched case-control design, however this technique only controls for observed sources of variation. Therefore it is still possible that unknown sources of bias were present.

Third, the program effects model was lim-

ited to DM program participants only, as non-participants never received a periodic severity classification. Thus, outcomes from this particular analysis may be subject to some level of regression to the mean and/or mathematical coupling.<sup>18</sup>

## CONCLUSIONS

This study adds to the body of literature on DM-related outcomes. Most notably, these findings are supportive of the general mission of DM, which is to reduce unnecessary acute services by improving coordination of care between patients and their primary health care providers thereby, in effect, creating a "medical home." Additionally, it appears that there is a close association between the number of times patients are contacted for follow-up, education, or care coordination, and their subsequent change in health status. Similar analyses conducted in future studies should attempt to include severity indices from the control cohort or population in order to further clarify the causal role of the DM intervention.

## FINANCIAL SUPPORT

McKesson Health Solutions.

## REFERENCES

- Merrick NJ, Houchens R, Tillisch S, Berlow B, Landon C. Quality of hospital care of children with asthma: Medicaid versus privately insured patients. *J Health Care Poor Underserved*. 2001;12:192-207.
- Hadley J, Holahan J. Is health care spending higher under Medicaid or private insurance? *Inquiry*. 2003/2004;40:323-342.
- White C, Fisher C, Mendelson, D, Schulman K. The Health Strategies Consultancy LLC with Duke University. State Medicaid disease management: lessons learned from Florida. March 2005. Available at: <[www.avalerehealth.net/research/docs/Duke\\_DM-Florida.pdf](http://www.avalerehealth.net/research/docs/Duke_DM-Florida.pdf)>.
- Allen SM, Croke A. *The Faces of Medicaid: The Complexities of Caring for People with Chronic Illnesses and Disabilities*. Hamilton, NJ: Center for Health Care Strategies; 2000.
- Owens PL, Thompson J, Elixhauser A, et al. *Care of Children and Adolescents in U.S. Hospitals*. Rockville, MD: Agency for Healthcare Research and Quality; 2003. HCUP Fact Book No. 4. AHRQ Publication No. 04-0004.
- Weaving Disease Management into the Fabric of Patient Care*. In: Grosel C, Hamilton M, Koyano J, Eastwood S, eds. *Health and Health Care 2010: The Forecast, The Challenge*. 2<sup>nd</sup> ed. Princeton, NJ: Jossey-Bass; 2003:299.
- Berg GD, Johnson A, Fleegler E. Clinical and utilization outcomes for a pediatric and adolescent telephonic asthma care support program: A propensity score-matched cohort study. *Dis Manage and Health Outc*. 2003;11:737-743.
- Johnson A, Berg GD, Fleegler E, Sauerbrun M. A matched-cohort study of selected clinical and utilization outcomes for an asthma care support program. *Dis Manag*. 2005;8:144-154.
- Johnson AE, Yin M, Berg G. Utilization and financial outcomes of an asthma disease management program delivered to Medicaid members: Results of a three-group comparison study. *Dis Manage and Health Outc*. 2003;11:455-465.
- Lind A, Kaplan L, Berg GD. Evaluation of an asthma disease management program in a Medicaid population. *Dis Manage and Health Outc*. 2006;14:151-161.
- Linden A, Adams J, Roberts N. Using an empirical method for establishing clinical outcome targets in disease management programs. *Dis Manag*. 2004;7:93-101.
- Linden A, Adams J, Roberts N. Evaluating disease management program effectiveness: An introduction to time series analysis. *Dis Manag*. 2003;6:243-255.
- Linden A, Adams J, Roberts N. The generalizability of disease management program results: getting from here to there. *Manage Care Interface*. 2004;17:38-45.
- Disease Management Association of America. *Outcomes Guidelines Report*. Washington DC: DMAA; 2006.
- Linden A, Adams J, Roberts N. Using propensity scores to construct comparable control groups for disease management program evaluation. *Dis Manage and Health Outc*. 2005;13:107-127.
- Linden A. What will it take for disease management to demonstrate a return on investment? New perspectives on an old theme. *Am J Manage Care*. 2006;12:217-222.
- Linden A, Adams J, Roberts N. An assessment of the total population approach for evaluating disease management program effectiveness. *Dis Manag*. 2003;6:93-102.
- Archie JP. Mathematical coupling: a common source of error. *Ann Surg* 1981;193:296-303.

Address reprint requests to:  
Ariel Linden, Dr.PH., M.S.  
Linden Consulting Group  
6208 NE Chestnut Street  
Hillsboro, OR 97124

E-mail: [alinden@lindenconsulting.org](mailto:alinden@lindenconsulting.org)