

## Selection of Medicaid Beneficiaries for Chronic Care Management Programs: Overview and Uses of Predictive Modeling

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### Abstract

Effective use of care management techniques may help Medicaid agencies reduce costs and improve health care quality. However, identifying members at highest risk of costly, preventable service utilization remains a challenge. Even choosing from the many software models designed to predict health risk can be difficult.

In order to make it easier for Medicaid programs to select appropriate software, UMass Medical School's Center for Health Policy and Research evaluated the strengths and weaknesses of three widely-available solutions. Using Medicaid claims data from the State of Vermont, we compared these pre-existing health risk predictive models in terms of their capacity to predict the most costly

Medicaid members with chronic conditions. All three models – Chronic Illness and Disability Payment System (CDPS), Diagnostic Cost Groups (DCG), and Adjusted Clinical Groups Predictive Model (ACG-PM) – were designed specifically to analyze Medicaid populations.

For predicting the very highest-cost members (i.e., the 99th percentile), the DCG model is most effective. However, our research showed that the ACG-PM model performed best overall for the Office of Vermont Health Access, the Vermont Medicaid program. Since ACG-PM is free for Medicaid agencies, it presents the most cost-effective solution.

## Selecting Medicaid Beneficiaries for Care Management

As the cost of health care increases, state Medicaid programs face the challenge of providing appropriate health services for vulnerable populations while simultaneously controlling expenditures. One way to address these issues is to identify high-cost patients and enroll them in enhanced care management programs. These programs help patients access needed care, equip them to self-manage their chronic conditions, and encourage doctors to adhere to guidelines for evidence-based care. Enhanced care management does not guarantee cost savings, but it does encourage preventive efforts that may yield better health outcomes while reducing the need for expensive care.

The state of Vermont offers care management to all eligible Medicaid beneficiaries with at least one of the following chronic conditions: asthma, diabetes, chronic obstructive pulmonary disease, low back pain, congestive heart failure, ischemic heart disease, arthritis, hypertension, lipid metabolism disorders, chronic renal failure, or depression. Of those members with chronic conditions, the 5 to 10 percent with the most expensive care requirements are offered enhanced care management (Maxwell, 2007; Office of Vermont Health Access, 2007). However, it is difficult to determine which members are likely to need the most intensive level of intervention.

In the early stages of the state's care management program, patients were selected based upon their prior use of health care (mainly through hospital and emergency department referral systems), as well as the cost of that care (Office of Vermont Health Access: Identification, Verification, and Stratification, personal communication, 2007). While this initially served as a convenient way to select members, prior cost and utilization do not always indicate high future cost. Accounting for all prior diagnoses allows for better accuracy in estimating future health care costs (Ash et al., 2001). Moreover, since members are often identified when in crisis, the member referral system can be both inefficient and inequitable. Many of those who might benefit from care management are not identified until they need costly emergency care.

To help Vermont select members for enhanced care management, UMass Medical School's Center for Health Policy and Research proposed using health risk predictive modeling. Since the state has a relatively small population and limited budget, it was not feasible to create a custom model for Vermont Medicaid. Instead, we investigated the ability of currently available models to identify the highest cost cases and therefore the members eligible for enhanced care management.

## Health Risk Predictive Modeling — What It Is and How It Can Be Used

Health risk predictive modeling uses diagnoses to predict how much an individual's health care will cost in the future. This method provides an efficient way to evaluate all eligible individuals instead of relying primarily on referral programs to select patients. This may allow for early intervention for at-risk patients, particularly those without effective physician advocates. Such intervention may help reduce the need for emergency care and hospitalizations.

Referral programs are likely to always have some role in selecting patients, but predictive modeling is preferable because of its efficiency and fairness. Health risk predictive modeling estimates current illness burden and future cost by efficiently evaluating all eligible members and distinguishing chronic conditions from transitory ones. This method is more accurate than using prior cost alone as an indicator of future cost.

### Overview of Predictive Models

Predictive models use health care claims information, such as prior cost, demographics, and diagnoses, to estimate the current burden of illness and future health care costs. A number of well-established predictive models are available for Medicaid applications. Different models use varying techniques and combinations of data.

Using statistical techniques, the models distinguish between conditions that are likely to be short-lived and those that may be chronic. Conditions that are more likely to persist are weighted more heavily than transitory ones as the models predict future cost. Information on prior diagnoses enables the models to rank individual members of a population in terms of expected future cost risk and assign them into low-, medium-, and high-risk categories.

### Predictive Models Tested

We chose to test three predictive modeling tools that were developed for Medicaid populations (though not with Vermont-specific data) using clinically-meaningful and transparent methods. Each model is currently used in one or more states. Diagnostic data for the models were derived from claims using the International Classification of Disease, 9th Edition, Clinical Modification (ICD-9-CM). The three health risk predictive models tested were the Adjusted Clinical Groups Predictive Model (ACG-PM), Chronic Illness and Disability Payment System (CDPS), and Diagnostic Cost Groups (DCG) models.

## ACG-PM Model

The ACG-PM software, developed at Johns Hopkins University, predicts future health care costs by evaluating pharmacy expenses, diagnoses, and demographics. A two-stage process is used. First, patients are sorted into clusters based on age, sex, and diagnosis combinations. Each cluster is assigned a cost score based on the average costs of similar, previously-evaluated patients. Second, statistical methods are used to create risk scores while factoring in signs of frailty, specific chronic diseases, and hospital dominant conditions – conditions which result in hospitalization for a high proportion of those affected. Past pharmacy costs can also be factored into the model (Weiner, 2005).

One version of the ACG-PM software is available to state Medicaid agencies at no cost. (Ordering information can be found at [http://www.acg.jhsph.edu/html/OrderACGProducts\\_Medicaid.htm#cons](http://www.acg.jhsph.edu/html/OrderACGProducts_Medicaid.htm#cons)).

## CDPS Model

Developed at the University of California, San Diego (UCSD), the CDPS model is available without charge at <http://cdps.ucsd.edu/>. The model uses diagnostic and demographic data to predict cost, based on the principle that an individual's risk score tends to increase with each additional condition that the individual has. In other words, the costs are additive. Potential benefits include the fact that CDPS classification codes were developed with the Medicaid population in mind, placing specific emphasis on substance use disorders and mental health (Kronick and Dreyfus, 1996; Kronick et al., 2000). However, since it is a free download, CDPS is offered as is. There is no customer support, and the software is not updated regularly.

## DCG Model

Boston University researchers created the Diagnostic Cost Groups–Hierarchical Condition Category (DCG-HCC) model, which also uses the assumption of additive costs (Pope et al., 2004). Updated in 2007 and now offered by Verisk Health Care, the DCG Medicaid model was developed using Massachusetts Medicaid data. Risk scores can be calculated separately for fee-for-service and managed care programs. Most ICD-9-CM diagnoses are categorized into disease and condition categories that are clinically meaningful. The DCG model is available for an annual license fee based on population size. (Ordering information can be found at <http://www.veriskhealthcare.com>).

## Methods

To determine each health risk predictive model's accuracy in selecting high-cost members, two years of past Vermont Medicaid claims data were obtained from the Office of Vermont Health Access (OVHA).

The three software applications – ACG-PM, CDPS, and DCG – were used to generate relative risk scores. Based on these scores, which were computed using Year 1 diagnosis data, individuals were assigned to the top 10 percent (high-cost) and top 1 percent (very high-cost) risk groups. Each model's results were compared with the actual individuals comprising the top 10 percent and top 1 percent during Year 2.

Each model's sensitivity, or ability to accurately identify the high-cost members, was calculated. Specificity, or the ability to omit low-cost members, was also calculated. Sensitivity and specificity are inversely related, but the best model will exhibit the highest degree of both.

Positive predictive value (PPV) was also determined, since it provides practical information for planning care management programs. PPV gives the estimated proportion of high-cost members to all selected members. In this instance, PPV is the ratio of cases correctly identified in Year 1 (i.e., those that are indeed high-cost by Year 2) to all members selected in Year 1.

Using an adaptation of the PPV test, all selected Medicaid members, based on Year 1 data, are assigned to one of four categories based on actual Year 2 costs. The four cost categories for Year 2 are as follows:

1. Low-cost – below the 50th percentile (\$4,061)
2. Moderate-cost – between the 50th and 90th percentiles (\$4,061–\$24,567)
3. High-cost – between the 90th and 99th percentiles (\$24,567–\$96,632)
4. Very high-cost – at or above the 99th percentile (\$96,632)

## Results

Overall, the ACG-PM model performs best, exceeding the other models in the areas of sensitivity, specificity, and positive predictive value for the top 10 percent of cases. This model also yielded the best results when accounting for hospitalizations among both the top 10 and top 1 percent groups.

The DCG model is preferred, however, when predicting the very high-cost members (top 1 percent). Vermont chose to use the ACG-PM model, because of its comparative performance and the fact that the model is available to the state at no cost.

## Study Limitations

This study could evaluate only currently-available technology, although there is ongoing development of new tools and improvement to existing models. The study was also limited by the fact that it focused only on the state of Vermont. There remains the possibility that the Vermont-specific findings may not hold true for other state Medicaid programs, some of which have health systems that are substantially different from that of Vermont.

## General Implications

These findings may prove useful to other state Medicaid programs faced with the challenge of selecting individuals for enhanced care management programs through the use of available health risk predictive modeling tools.

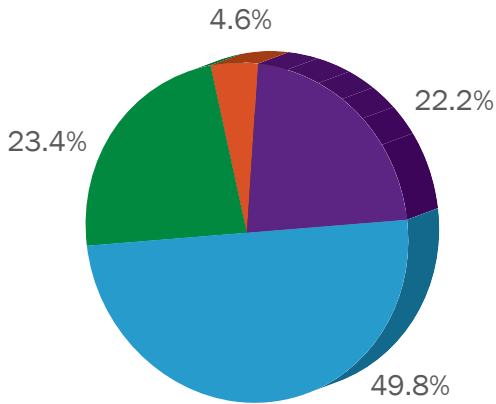
While the majority of cases identified by these three models exceeded the median cost of care, none of the models was able to predict the very highest cost members – those with Year 2 costs above \$96,000 – with substantial accuracy. The best, DCG, was only able to identify approximately 50 percent of the highest cost members. Two potential barriers to accuracy include the fact that the model is not customized to Vermont's population, as well as the unpredictable nature of serious injuries and illnesses that require expensive care. The relatively small differences in model performance for the most costly cases indicate that states with limited resources may be able to rely on models that are available for free.

Further research is needed to examine whether selecting individuals for enhanced care management through the use of health risk predictive models is more accurate than relying solely on a referral system. While predictive models' lack of information on immediacy, individual detail, and social factors may present issues for care managers, the models do offer efficiency and equity that can have far-reaching effects.

The inclusion of clinical diagnostic information enables the models to distinguish effectively between patients with transitory and chronic needs, unlike methods that use less reliable indicators of future resource use, such as prior cost and utilization. By basing initial case selection on health risk predictive modeling output, Medicaid programs are better able to efficiently evaluate all eligible members. In addition to identifying at-risk patients who do not have effective physician advocates, this technology can also provide timely assessment of risk, which, when accompanied by early medical intervention, can help avoid costly emergency department visits and inpatient hospital care.

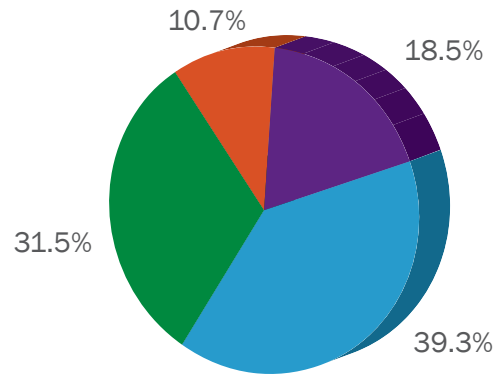
# Charts

**Top 10 percent risk group**

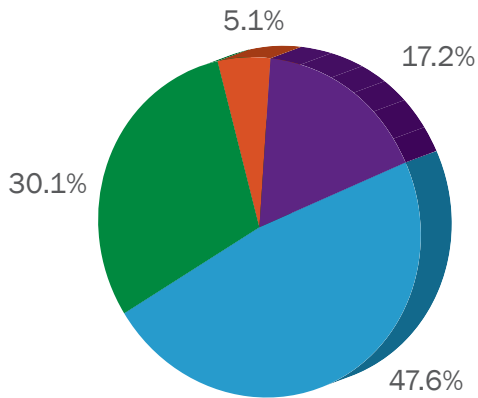


**CDPS**

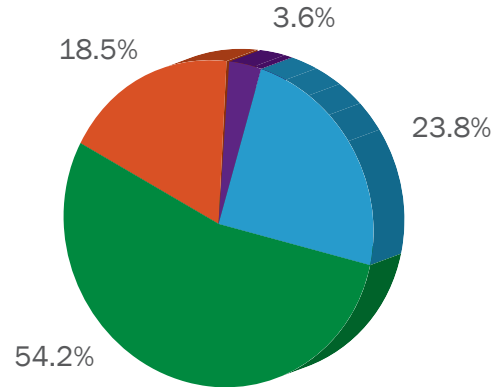
**Top 1 percent risk group**



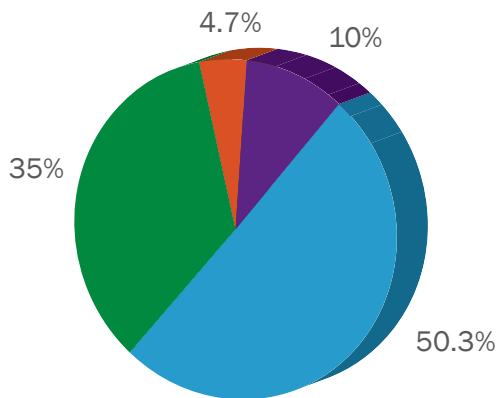
**CDPS**



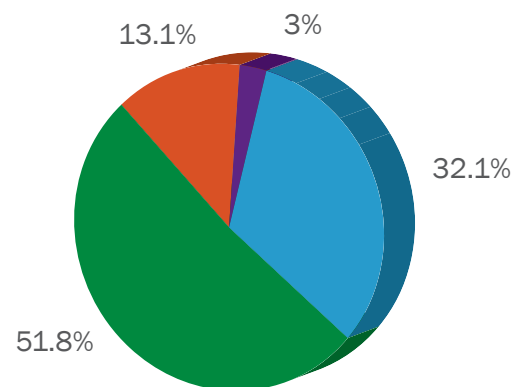
**DCG**



**DCG**



**ACG-PM**



**ACG-PM**

● Low-Cost (<50th Percentile)  
● Moderate-Cost (≥50th- $<$ 90th Percentile)

● High-cost (≥90th- $<$ 99th Percentile)  
● Very high-cost (≥99th Percentile)

## References

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## About the authors

**Sharada Weir, D.Phil.**, is an Assistant Professor of Family Medicine and Community Health and a senior project director in the Research Unit of UMass Medical School's Center for Health Policy and Research.

**Whitney C. Jones, B.A.**, is a research associate in the Office of the Deputy Chancellor in UMass Medical School's Commonwealth Medicine division. She is a graduate student in public policy at the UMass Boston McCormack Graduate School of Policy Studies.

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## Contact Information

### Sharada Weir

Center for Health Policy and Research  
University of Massachusetts Medical School  
333 South Street  
Shrewsbury, MA 01545

(508) 856-7852

[Sharada.Weir@umassmed.edu](mailto:Sharada.Weir@umassmed.edu)

