

Maximizing Care Management Savings through Advanced Total Population Targeting

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ABSTRACT

The increasing burden of chronic disease in the United States and other industrialized nations continues to drive healthcare costs to new heights. To reverse current trends, organizations are employing care management programs that target individuals with chronic conditions. The goal is to reduce costs and morbidity through better condition management. The challenge is to identify individuals for whom intervention can make a difference and find intervention opportunities at the right time: before adverse health outcomes escalate medical costs.

The dynamics of medical spending within a population can be counterintuitive. Spending is not solely driven by specific diagnoses, diseases, and clinical risks, nor by the same individuals from year to year. The potential for reducing costs varies among high-cost individuals. To effectively identify the appropriate individuals for an intervention, predictive models must take these dynamics into account.

Five principal rules govern healthcare costs within a total population and should guide the targeting of care management interventions. This document reviews these rules and outlines how Healthways' predictive modeling strategies segment the population for the most effective targeting of interventions and the greatest impact on healthcare expenditures.

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THE FIVE RULES OF HEALTHCARE COSTS

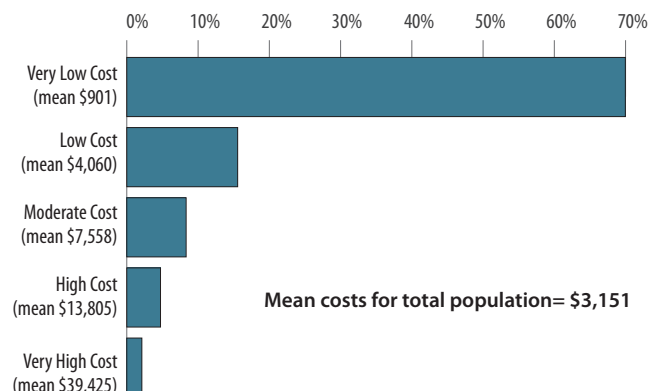
Cost Distribution Across a Population Is Static

Segmenting a population into spending brackets from year to year shows that the percent of the population within each

bracket remains relatively constant over time. Healthcare spending is low for the majority of individuals and high for relatively few. Healthcare costs for individuals are not normally distributed around the population mean, because individuals with exceedingly high costs—the outliers of the population—skew the average cost upward.

An analysis of healthcare spending within a population of 15,000 employees in 2002 (Figure 1) illustrates these points. The four highest quintiles of cost, accounting for 80% of the company's medical spending, contain only 30% of the population. The average annual cost for the total population is \$3,150; however, the average for 70% of the population is only \$901.¹

FIGURE 1: Distribution of employee healthcare costs.
Adapted from Lynch and Gardner, 2009.



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An analysis of Healthways data derived from a large commercial health plan in 2006 and 2007 further substantiates these observations. As Figure 2a shows, 50% of the population accounted for only 3% of costs, averaging \$150 per individual. At the other end of the spectrum, 5% of the population incurred 53% of total spending; this small group averaged approximately \$20,000 in annual claims costs.

A comparison of cost distribution from year to year indicates that the percentage of people in each cost bracket remained relatively static (Figure 2b).

FIGURE 2: Distribution of healthcare costs among commercial health plan members. 2a: The relationship between the percent of claims generated by a given percent of members and the average annual claims cost per person in the highest and lowest cost groups. **2b:** The number of members in 6 cost brackets in year 1 (teal) and year 2 (gray).

FIGURE 2a

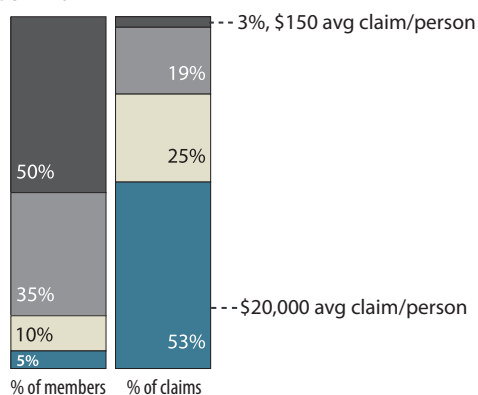
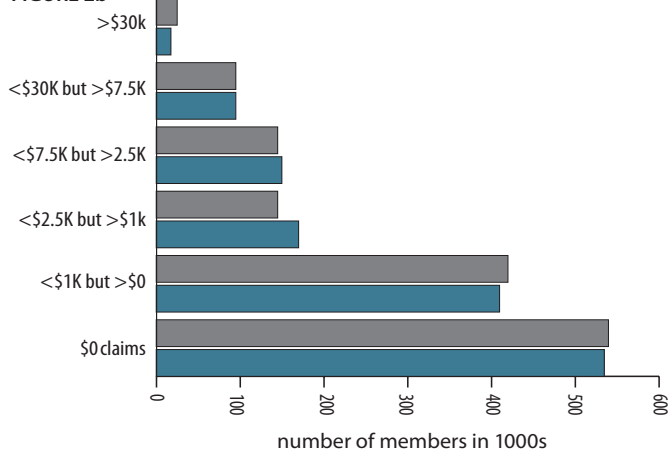


FIGURE 2b



Because most individuals within a population do not incur excessive healthcare costs, care-management interventions without sophisticated targeting are of limited value.

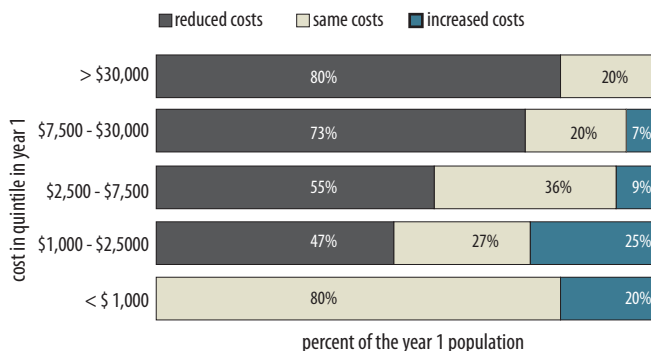
Individual Healthcare Costs Are Variable, Because High-Cost Events Are Episodic

Although a total population shows a consistent distribution of healthcare spending from one year to the next, people

move dynamically between cost brackets. High-cost brackets demonstrate particularly dramatic flux. For example, in a given year, 73% to 83% of people in the high-cost bracket are there for the first time, and only 12% to 18% of this group remains in the same bracket the following year. Across the total population, less than 1% of individuals remain in the high-cost bracket for two or more consecutive years.¹

The likelihood of remaining in the same cost bracket from year to year decreases with increasing costs. An analysis of cost data from 13,000 male employees (Figure 3) shows that, in this population, 80% of the lowest cost (<\$1,000) group in 2003 remained low cost in 2004, while only 20% of the highest-cost (>\$30,000) group remained high cost in 2004.¹

FIGURE 3: Change in healthcare costs among 13,000 male employees, year 1 to year 2. Lynch and Gardner, 2009.



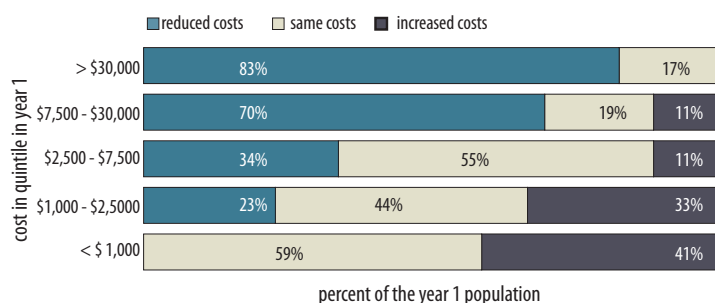
The dynamic nature of the high-cost segments of a population is due to the episodic nature of high-cost events. For example, in 2005, the United States had 1,413,000 hospital discharges attributed to acute coronary symptoms (ACS), including myocardial infarction and unstable angina.² The costs associated with an initial ACS hospitalization are approximately \$23,000 per patient.³ However, only 20% of individuals hospitalized for ACS are re-hospitalized within one year,⁴ demonstrating that the majority of high cost individuals in this group will not be expensive for two consecutive years.

Neither Chronic Disease Nor Clinical Risks Are Sufficient for Predicting Short-Term Costs

Most health conditions make a person more likely, but not certain, to experience a costly event. A large study of 200,000 employees in 2001 found that only 14% of diabetic employees, 11% of hypertensive employees, and 9% of hyperlipidemic employees had costs exceeding \$7,500. Although costs for individuals with chronic disease are higher on average than for others within the population, individuals with chronic disease typically do not incur high costs in consecutive years, as shown in Figure 4.¹

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FIGURE 4: Change in healthcare costs among 898 diabetic male employees, year 1 to year 2. Lynch and Gardner, 2009.



Individuals with clinical risk factors such as high cholesterol have a higher likelihood than those without these risks of developing a chronic disease and, over time, experiencing high medical costs.⁵ Targeting risk factors early may prevent the future accumulation of costs,⁶ and clinical risk factors should be taken into account in developing an overall risk profile. Yet like chronic health conditions, clinical risk factors alone are inadequate predictors of short-term medical expenditures. Other important cost influences include comorbidities, demographics, medications, prior utilization patterns, disease self-management, health behaviors and psychosocial factors.^{7, 8}

An analysis of risk factor prevalence in high-cost versus low-cost groups illustrates the limitations of clinical risks as sole predictors of individual costs (Table 1; CareGuide LLC).

TABLE 1: Percent of high- and low-cost groups also at high clinical risk.

Clinical Risk Factor	% High Cost	% Low Cost	Difference
Systolic BP	12.5	11.1	1.4
Diastolic BP	14.3	10.0	4.3
Total Cholesterol	14.3	14.0	0.3
HDL	44.4	43.1	1.3
LDL	15.7	16.7	-1.0
Triglycerides	30.4	25.4	5.0
Glucose	12.5	2.5	10.0
BMI	59.6	35.0	24.6
Overall	77.2	70.0	7.2

Comorbidity is a Key Indicator of Future Cost

The presence of multiple chronic conditions is more predictive of high medical costs in a coming year than the presence of a single chronic condition. A study of Medicare beneficiaries found that the odds of having a preventable hospitalization in a given year increased by 7.5% for those with one chronic condition and climbed to 98.5% for individuals with four or more chronic conditions—a group that experienced costs more than 66 times that of individuals without chronic disease.⁹

The impact of comorbidity on hospitalization is not unique to the Medicare population. A Canadian study encompassing all age groups found that in a single year, the group with three or more chronic conditions was approximately three times as likely to stay overnight in a hospital.¹⁰

The prevalence of chronic conditions increases both with time and with age. In 2005, 63 million Americans (21%) had multiple chronic conditions, a number that is predicted to grow to 81 million by 2020. These numbers are more dramatic among older Americans—some 62% of those age 65 and above have more than one chronic disease, and 23% have five or more conditions.¹¹ These numbers emphasize the importance of early prevention strategies to reduce costs that are attributable to the accumulation of chronic conditions.

Prediction Does Not Guarantee Prevention

Unfortunately, the accurate prediction of high-cost health events cannot guarantee their prevention. Some high-risk individuals have extensive disease progression. Little can be done to stop or prevent imminent medical spending.

The key to generating value through a health management program is identifying those members with risks that can be mitigated, preventing individuals from moving into a high-cost bracket in the near future. Healthcare savings can be generated through interventions that reverse the trajectory of these individuals, whether or not they have a pre-existing chronic condition. The success of this strategy depends on accurate targeting of the right individuals at a time when prevention is possible.

PREDICTIVE MODELING FOR ACCURATE POPULATION TARGETING

Predictive modeling can improve the targeting of care management programs by mathematically determining the likelihood of defined outcomes. Healthways uses multiple models to:

- Predict which individuals are likely to incur high costs.
- Determine those within this group who have avoidable costs.
- Identify specific gaps in care that can be addressed to reduce disease progression and medical spending.

These models direct precise care management interventions to the specific individuals with the highest opportunities to avoid spending.

Advanced Methodology, Focused Models

Healthways uses a combination of neural network predictive models and clinical risk predictive models. Both draw on information that can include demographic, utilization, pharmaceutical, financial, and member self-reported data.

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Neural networks are non-linear, statistical data modeling tools that capture complex relationships between inputs and outputs and find patterns in data. Such networks mimic the human brain, in that they adapt and change structure based on the flow of external or internal information. The predictive power of a neural network is enhanced with greater exposure to data, since experience trains the model to recognize interrelated variables. Healthways uses extensive historical data to train neural network models to accurately predict what is likely to occur in the future based on input-output patterns of the past.¹² Healthways neural network models predict:

- **Future High Costs** – Identifies individuals most likely to incur high costs in the next 12 months.
- **Cost De-Escalation** – Identifies historically high-cost individuals who will most likely incur reduced costs in the absence of intervention.

For predicting specific clinical risk, a third-party expert system leverages Healthways data to identify and assess trends in financial, utilization, and clinical care gaps, and to compare the results against normative benchmarks (Verisk Health, Waltham, MA). This process reveals gaps in care that represent opportunities for intervention.

Targeted Interventions

The information gained from predictive modeling allows each member of a population to be targeted for the appropriate type and intensity of intervention. Healthways interventions are broadly categorized as Intensive Care Management (ICM), for those at high risk of cost escalation and who typically have several chronic conditions; Active Care Management (ACM), for those with high-to-moderate risk of cost escalation and who fall below the threshold for ICM; and Health Maintenance Interventions, to help improve or sustain health for the remainder of the population. To reflect individual health changes that may merit different care strategies, Healthways typically runs predictive models on a quarterly basis.

Testing and Validation

Healthways tests the accuracy of predictive models before deploying them within a particular population. Steps include:

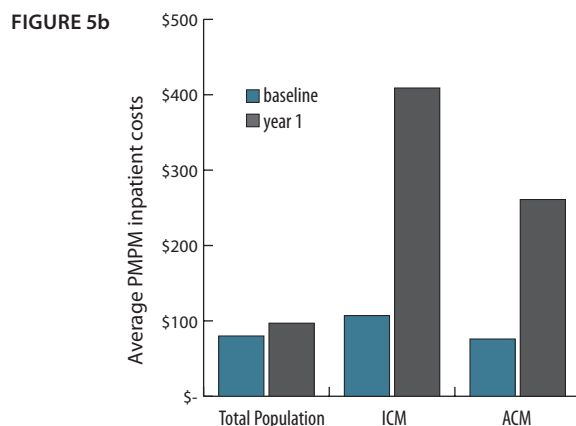
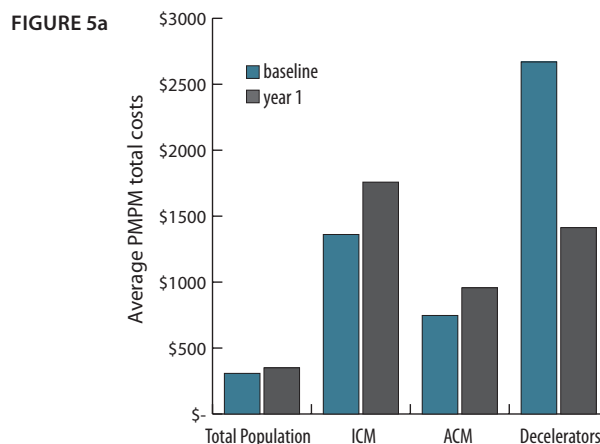
- Dividing the population into three groups: training, testing, and validation.
- Running training group data through neural network models, enabling models to learn from the data and suggesting model refinements for improved performance within the population.
- Comparing the targeting results of different model variations using the testing group.
- Running a year of historical data from the validation group through the chosen models and assessing predictive accuracy—for example, a group that hypothetically would have been targeted for Intensive Care Management should show increased costs in the second year.

Figures 5a and 5b illustrate the results of a validation test. Healthways entered a year of cost data from more than 60,000 members of a health plan into its predictive models (Baseline). The models hypothetically targeted members for ACM or ICM interventions. Healthways then compared the actual spending one year later for members in each category (Year 1) to determine whether the models accurately predicted which members would have increased costs.

Figure 5a data demonstrate a 29.2% and 28.3% increase in monthly spending for the ICM and ACM groups, compared to a 13.4 % increase in spending for the total population. Members predicted to experience decelerating costs without interventions, via the Cost De-Escalation model, did in fact experience a 47.1% decrease in costs from Baseline to Year 1.

Figure 5b demonstrates the particularly strong opportunity for preventing hospital inpatient charges using Healthways predictive models. Inpatient expenditures increased 289.6% and 244.8% for the hypothetical ICM and ACM groups, respectively—more than 10 times that of the total population.

FIGURE 5: Average per member per month (PMPM) total costs (5a) and inpatient costs (5b) for the total population and for individuals identified by predictive modeling for intensive care management (ICM), active care management (ACM), or as cost decelerators for two consecutive years, Baseline and Year 1.



CONCLUSION

The purpose of a total population approach to health management is to reduce and contain costs by preventing avoidable high-cost health events and by supporting and sustaining health within the total population. Essential to this purpose is the accurate and timely identification of individuals who are most likely to experience high costs in the near future and who have addressable risk factors or gaps in care. Healthways predictive models have proven highly effective in identifying the members of a population with near term spending increases, providing the opportunity to intervene prior to cost escalation. As a result, Healthways total population solutions provide a highly effective and efficient way to reduce healthcare spending across a population.

ABOUT HEALTHWAYS

For three decades, Healthways has been dedicated to improving the human condition. Each year, we learn more and do more for the millions of individuals who count on us to make a difference in their health and well-being. Healthways solutions deliver clear value. We are enhancing well-being, improving business performance and reducing healthcare costs. We have a long history of adapting to the customers we serve and honing our solutions for improved impact. Our approach is straightforward. Our solutions are complete, flexible, precise and personal.

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The Center for Health Research performs advanced analytics with data collected from millions of participants over twenty-five years of Healthways programming. Currently, Healthways houses six times the volume of data contained in the Library of Congress. That depth and breadth of information allows the team to conduct a vast range of research, and it is used to advance their thinking in all levels of healthcare. For access to our Virtual Research Library, and the reports published by the team at the Healthways Center for Health Research, go to www.healthways.com/research.

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