

Predictive Modeling



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Introduction

More than 2.4 million elderly and disabled people receive care each year from over 7,800 Medicare-certified home health agencies throughout the United States. Annual expenditures by Medicare and Medicaid for home healthcare were \$38.1 billion in 2003 and \$43.2 billion in 2004.¹ While home health represented only five percent of the Medicare and Medicaid expenditures in 2004, this segment of the healthcare industry is expected to grow substantially in the future due, in part, to the aging population and the increase in chronic medical conditions. According to the US Department of Labor, “the development of in-home medical technologies...and patients’ preference for care in the home have helped change this once-small segment of the industry into one of the fastest growing parts of the economy.”

A key quality focus for providers, payors and policy-makers is avoiding costly hospitalizations and emergent care visits for homecare patients. As a result, there has been a tremendous influx of new and innovative products, processes, and interventions designed to help home care providers improve outcomes and avoid unnecessary hospitalizations and emergent care. Examples of such innovations include telemedicine, disease management, point-of-care software, care pathways, care plans, advanced wound-care technologies, specialized therapies, advanced medication dispensers, and educational offerings.

Of course, these interventions do not come without a cost, and sometimes it is a significant one. In order to provide cost-effective care, homecare executives must determine how to strategically allocate resources, including these costly advancements in care. To do so, executives and caregivers must objectively ask and answer questions, such as:

- Which patients can benefit most from the use of this service or technology?
- Are there patients who have greater/less risk of a poor outcome?
- Can I use different interventions for different types of patients?
- Is the intervention achieving the desired goal?

One effective way to help answer these questions is through predictive modeling, a practice that utilizes the sophistication of statistical models and the wealth of information available in the home care industry to predict potential patient outcomes. This predictive capability can and will help direct agencies in incorporating technology, disease management, or clinical pathways into their care operations.

Predictive Model

A predictive model forecasts the likelihood of future events based on data from the past. For example, the score produced by a predictive model may indicate a patient's likelihood of hospitalization, death, or experiencing an unexpected response to a treatment. The model is made up of a number of predictors—variable factors that are likely to influence or be indicative of future behavior or results. In home health, for example, a patient's gender, age and medical history might predict the likelihood of a future outcome. To create a predictive model, data is collected for the relevant predictors and outcomes, a formula is created using statistical techniques, predictions are calculated, and the resulting model is tested and validated using additional data.

Predictive modeling is not new to healthcare. The first reports of using mathematical and statistical models to predict medical outcomes date from the 1940s. It is only in the last ten years, however, that predictive models of increasing accuracy have been developed and supported by numerous peer-reviewed publications. In addition, health insurance companies use predictive modeling for underwriting—predicting future costs for the design of benefit packages, such as premiums, deductibles, co-pays, and overall features—and paying physicians using specific quality measures.²

Predictive modeling in home care has its roots in the risk adjustment methodology created by the Center for Health Services Research in Denver, Colorado. Risk adjustment is focused on comparing outcomes for patient populations that are likely to be different. “The purpose of risk adjustment when comparing outcome rates (such as hospitalization rates) for two different patient samples is to statistically compensate (or adjust) for risk factor differences in the two samples so that the outcome rates can be compared legitimately despite the differences in risk factors.”³ The practical application of using a model to predict individual patient outcomes would take the risk adjustment methodology one step further.

How Does Predictive Modeling Apply To Home Health?

As homecare becomes a more integral part of healthcare delivery, the pressure on agencies to provide high quality, cost-effective care will increase. Achieving that cost-quality balance will become more critical, and more of a challenge. “Predictive modeling is a set of tools used to stratify a population according to its risk of nearly any outcome. Ideally, patients are risk-stratified to identify opportunities for intervention before the occurrence of adverse outcomes that result in increased medical costs.”⁴ Given the state of the healthcare environment, and the factors known to drive up costs, how can we translate this technique into a solution for some of the challenges faced in home care? Can we actually look at certain patient characteristics at the start of care and identify those who might be at a greater risk for a negative outcome?

Care professionals have used, and continue to use, predictive analysis every day to identify patients at higher risk of developing complications. This practice may be in the form of

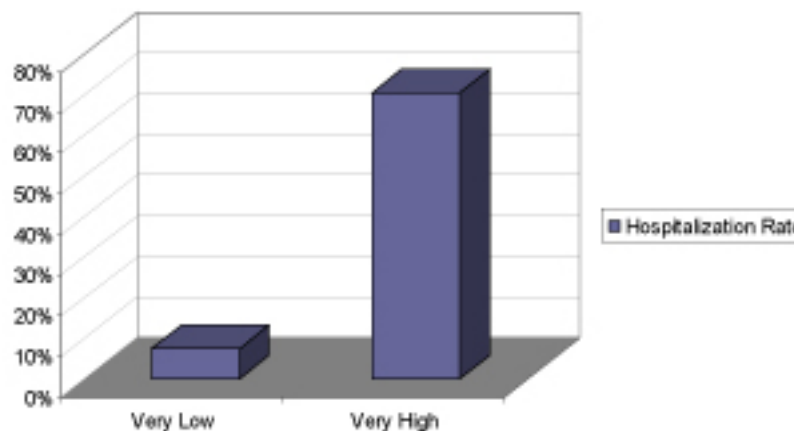
completing a checklist of high risk characteristics, or treating patients with certain conditions as inherently more likely to have specific problems due to the diagnosis (for example, treating diabetics as though they have a higher risk of hypo/hyperglycemia). While many of these practices fall into the category of common sense, others, such as the checklist approach, may have roots in clinical studies and practice research. Perhaps the most common form of predictive analysis in use today is intuition—a combination of years of clinical experience and “gut feel” to identify patients that may need a bit more care than others.

Where predictive modeling stands apart from intuition, common sense, and risk checklists is in the complex combination of multiple patient characteristics, considered independently and together, in a sophisticated model to identify the statistical probability of specific outcomes. With the wealth of patient information available in home health, the industry has the historical data available to create and test these models, ultimately providing a scientific estimation of potential patient outcomes.

For example, a recently-developed acute care hospitalization predictive model was applied to approximately 15 million patient records in the OCS data warehouse. The model grouped patients into categories based on their likelihood of hospitalization at start of care (SOC). The patients were categorized into five groups, ranging from Very Low Risk to Very High Risk. The patients’ episodes of care were then examined to determine which patients were ultimately hospitalized. Based on this analysis, within the group of patients who were categorized as Very Low Risk at SOC, only 7.6 percent were hospitalized. Meanwhile, the patients that were identified at SOC as Very High Risk experienced a hospitalization rate of over 70 percent (See **Figure 1**).

Armed with this type of information at the very beginning of a patient’s episode, home health agencies can develop targeted interventions to better manage high risk patients.

Figure 1: Hospitalization Rates for Patients Identified High or Low Risk at SOC



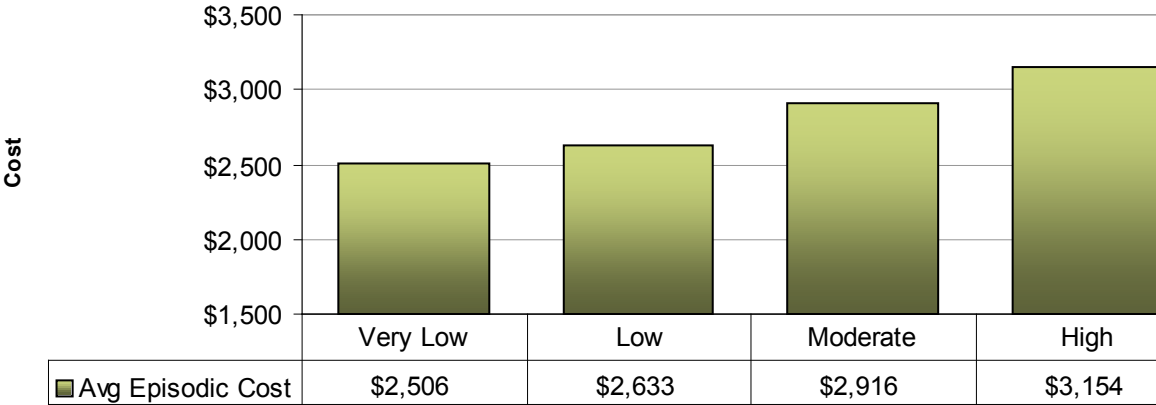
Source: OCS—Cases ended between 2003 and 2005

Using Predictive Modeling to Manage Resource Use

Predictive modeling, or risk notification, can have an important impact on cost and profitability, as well as resource use planning. Agencies can now know within minutes of completing a start of care assessment the statistical probability of a patient requiring hospitalization or emergent care, or of a patient declining in functional or health status. This information can provide invaluable insight for the clinician or case manager who needs to decide how best to care for the patient.

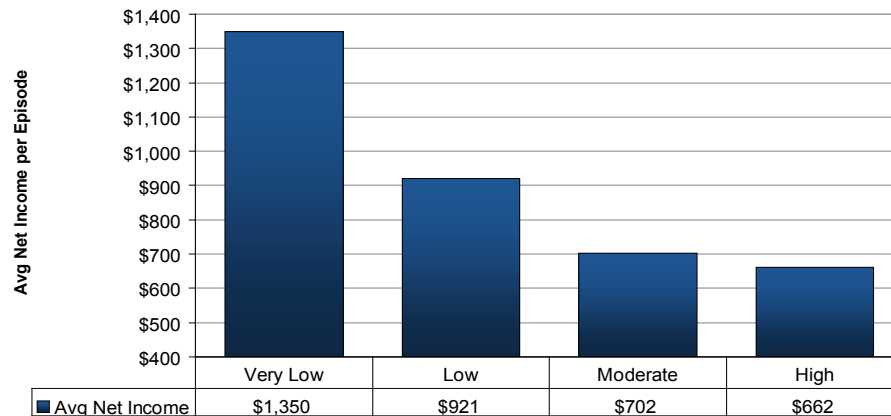
Although the predictive models were developed based on clinical criteria, from a financial perspective, patients with a higher probability of hospitalization or emergent care at start of care are also generally more costly within their home health episode than lower risk patients (see **Figures 2 and 3**). Thus identifying and carefully managing these patients proactively is an important financial strategy.

Figure 2: Actual Episodic Cost for Predicted Hospitalization Levels



Source: OCS Database—non-LUPA Medicare episodes ended in 2005 (about 168,000 episodes)
Excludes supply costs

Figure 3: Actual Episodic Profit for Predicted Hospitalization Levels



Source: OCS Database—non-LUPA Medicare episodes ended in 2005 (about 168,000 episodes)
Excludes supply costs

In a world of limited reimbursement through prospective pay, predictive modeling can play a critical role in making care decisions that are in the best interest of both the patient and the agency. Significant cost savings can be realized by identifying, upon admission, patients who have a high likelihood of experiencing an adverse event and of being high-cost to the agency. Such identification is possible through predictive modeling. The identification process can help focus and prioritize clinical outreach, and allows the agency to determine if a specific program or care protocol will prevent the expected undesirable results. A clinician can utilize evidence-based protocols, combined with experience, to create a more focused care plan that ultimately results in a better outcome for the patient.

For example, an agency could use predictive modeling to assess risk, and determine whether to use telemedicine, case management, disease management, or other means of educating and tracking the patient’s progress, all based on objective information. By tailoring interventions to patient needs, agencies can apply interventions to those who need them most, and, conversely, avoid using the most costly interventions for patients who may not need them. In addition, by systematically fine-tuning and targeting their care practices based on patient risk, agencies can provide more effective care and positively impact overall outcomes, which would likely result in an increased payment in a pay-for-performance environment.

Another benefit of using predictive information is that it gives an agency the ability to weigh the potential costs and benefits associated with utilizing and implementing specific plans of care and understanding how these plans affect efficiencies in financial and operational factors. Understanding which patients will require which resource mix at start of care allows more accurate resource forecasting, thereby allowing the agency to manage and plan staff levels appropriately.

Higher Quality Of Care And Quality Outcomes

In addition to streamlining resource use, predictive modeling clearly has great potential in improving patient outcomes. Understanding which patients are at higher risk of negative outcomes, and treating them appropriately, can result in avoiding unnecessary hospitalizations, use of emergent care, and declines in patient status. Ultimately, this means a better outcome of care for each individual patient.

Quality patient outcomes have always been a focus for home health providers. The public reporting of agency-specific outcomes on Home Health Compare has placed outcome rates in the spotlight in terms of assessing an agency from the perspective of surveyors, referral sources, and consumers. At the same time, highlighting outcome data as a tool to differentiate themselves in their market has become an important marketing strategy for many agencies as the industry has become more competitive in the past few years. Within the next several years, this focus on outcomes will most likely be rewarded by CMS through a pay-for-performance (P4P) model—providing bonuses to agencies that achieve higher outcomes.

There are two primary components of improving quality of care:

- Understanding and improving the mechanics of care; and
- Applying appropriate interventions to appropriate patients.

Predictive modeling allows agencies and individual practitioners to do the latter more effectively and efficiently. By using predictive modeling to identify high risk patients at the start of care, and employing evidenced-based practices to address the patient needs, agencies can have a direct impact on patient outcomes by decreasing hospitalizations, emergent care rates, and other adverse events, as well as by increasing rates in improvement measures. With these outcome improvements, agencies can make themselves more competitive for P4P bonuses and referrals.

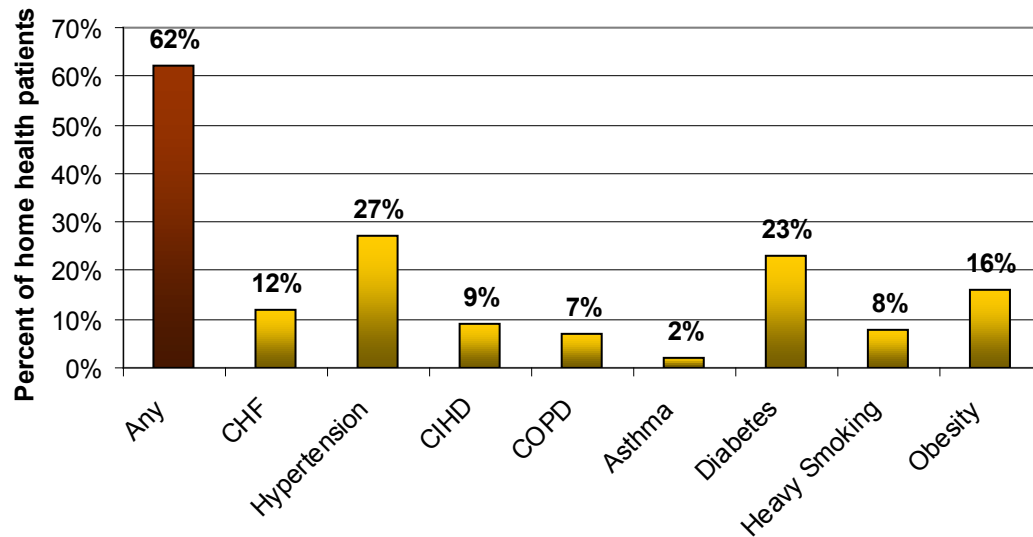
Predictive Modeling In Disease Management

In addition to the traditional care provided by home health agencies, predictive modeling has value in some of the potential future directions of home health—in particular, disease management (DM). Disease management refers to a process by which patients with specific chronic conditions receive differentiated, evidence-based care and education focused on teaching them about managing their condition and following-up with them on a regular basis to ensure compliance with DM-recommended activities. The goal of DM is to prevent acute exacerbations of conditions and avoid preventable high cost care.

Historically, DM programs have been funded by self-insured employers, managed care, and other payors. More recently, CMS has become involved in sponsoring a number of disease management demonstration programs, aimed at reducing the skyrocketing costs of the chronic care population. While disease management services are offered by a myriad of provider types, including disease management companies, many home health providers see an opportunity for their entry into this market. The types of health problems predominately seen in home care patients are conditions targeted in many disease

management programs across the country: diabetes, CHF, COPD, smoking, and obesity. These conditions affect more than 60 percent of home care patients across the country (see Figure 4). Including other potential disease management target groups, such as pain management patients or frail elderly, the vast majority of home care patients live with or experience some disease management-appropriate health issue.

Figure 4: Prevalence Of Conditions Appropriate For Disease Management In Home Health Patients

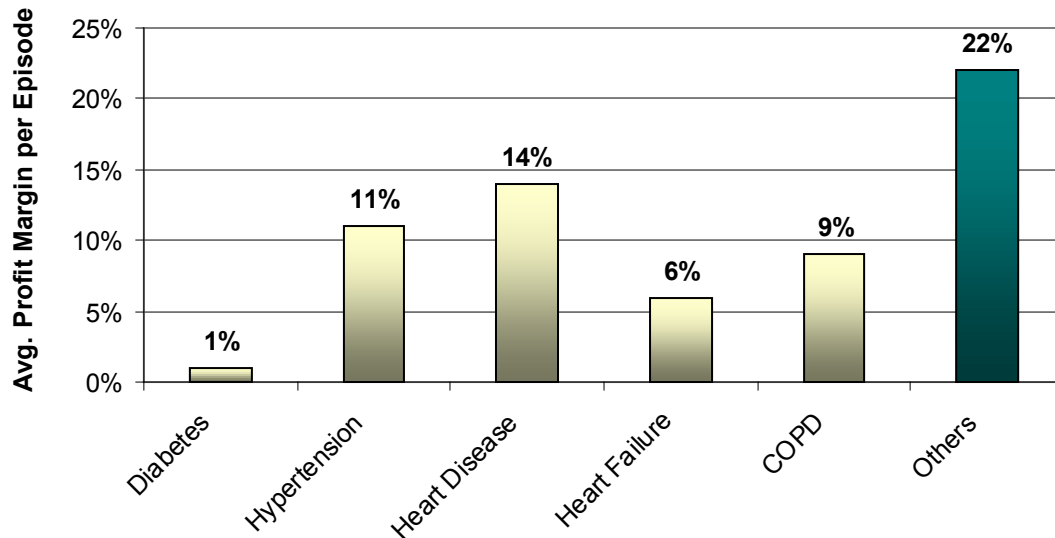


Source: OCS Database—patients admitted in the first quarter of 2006 (more than 250,000)

In addition to the prevalence of DM conditions within home health, another impetus for providers to proactively address these patients is the financial impact of the chronic conditions. According to current data, patient episodes with chronic conditions present, such as CHF and diabetes, tend to be less profitable than other types of patients (see Figure 5). The goals and challenges of most disease management programs mirror those of the home care industry. Patient education, encouraging patient involvement in care, and addressing problems associated with non-compliance are common to home care and disease management programs alike. Furthermore, both home care and disease management programs seek to minimize unnecessary hospital admissions and emergency room visits.

Additionally, Goetzel, et al found that from a purely financial perspective, DM programs directed at patients suffering from CHF, and programs which targeted multiple health and disease conditions, may save more money than they cost. These programs produced a positive ROI, even in the short run (within 1 to 2 years).⁵

Figure 5: Average profit margin per episode, by primary diagnosis at start of care



Source: OCS Database—non-LUPA Medicare episodes ended in 2005 (about 168,000 episodes)
Excludes supply costs

In this arena, predictive modeling could help to proactively separate DM patients into separate tracks, based on their likelihood of health problems or high healthcare costs. Providers could then design tracks with the appropriate level and types of education, training, and follow up. This differentiation could be the standard that gives disease management patients enough care to prevent acute exacerbations of their conditions (thereby saving healthcare costs), without providing more than necessary (thereby making disease management itself more affordable and available).

Conclusion

Home health agencies must continuously manage the delicate relationship between the cost of providing care and the quality of service delivered. While agencies have negotiated this challenging relationship for some time, emerging market dynamics make this balancing act increasingly difficult. With changes in the market, including a greater reliance on homecare, more financial pressure, increasing competition, and the likely introduction of pay-for-performance, it is now more critical and more of a challenge for agencies to achieve optimum quality within the parameters of appropriate resource expenditure.

Even though predictive modeling is a somewhat new idea to home care, it is not a new concept to healthcare. Home health is uniquely positioned with the data available—including patient demographics, clinical and functional information, and outcomes of care—to develop models that determine risk of outcomes for individual patients. It is

pragmatic that home health follows the lead of other segments of healthcare. With several years of standardized data collection and a vast data warehouse, now is the time for the home health industry to take advantage of historical information to affect the future.

The cost of health care is expected to skyrocket once again, after the flattening trends of the last decade when the government infused health care with private-sector competition in the form of managed care. According to the Health Insurance Association of America, an aging population, heavier reliance on medical technologies, higher malpractice awards, new government rules, and rising drug prices guarantee that consumer spending on health care goods and services will continue to outpace inflation. By 2011, total national expenditures on health care are expected to reach \$2.8 trillion.⁶

There is no time to lose in the business of finding new cost-control measures. Homecare, much less expensive than inpatient care, will prove to be one of the most important methods of care delivery in the future. By understanding and utilizing a predictive methodology, home health will further its role as an effective and efficient provider of healthcare. Through predictive modeling, home health agencies will gain an advantage in understanding key drivers of their business, thereby improving outcomes and controlling costs—both their own costs and costs to the system overall.

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