# Predicting the Financial Risks of Seriously Ill Patients

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## About the Foundation
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# Contents

# I. Introduction

Predicting the health care financial risks and adverse clinical outcomes risks of individuals or groups involves systematic use of key information about them, including their past utilization of services, current and previous diagnoses, demographics, and medications, as well as other factors regarding their functional and psychosocial status. By leveraging such information, risk stratification tools can usually help identify high-risk patients and enable providers to match them with the appropriate level of intervention — be it diabetes management, intensive care management services, or home-based or other kinds of specialized care — to improve clinical outcomes and maintain and even reduce health care costs in many instances. Of course, clinical judgment always trumps metrics when ensuring the best fit between patient needs and high-quality, cost-effective care.

This report provides an overview of common risk stratification tools; how the health care industry uses them to treat illnesses and prevent costly events, such as avoidable hospitalizations, and to treat illnesses; and their many limitations. Matching high-risk patients, many of whom are elderly, with the most appropriate and effective interventions is often a challenging task, yet an important given the current squeeze on health care resources and continuous efforts to improve clinical outcomes.

# II. Background

Risk stratification is prospective. That is, in contrast to capitation and provider profiles, it tries to accurately predict future risks related to health care costs, utilization of services, and health exacerbations resulting from comorbidities so providers can match patients with the most appropriate, cost-effective interventions. Two common types of tools are utilization-based and diagnosis-based, such as the Chronic Illness and Disability Payment System and the Charlson Comorbidity Index, respectively. The Vulnerable Elders Survey and other tools focus more narrowly on seniors.

The utilization- and diagnosis-based designs both have significant limitations, including the facts that they do not capture data about psychosocial issues and neither is calibrated to assess subpopulations. Their predictive ability can be enhanced by adding data from patient surveys, like self-reported health status; clinical assessments, such as

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the results of a comprehensive health exam or, in the case of someone who might benefit from palliative care, a clinician's response to the question, "Would you be surprised if the patient died in the next 12 months?"; or both. Combining a utilization-based tool with input from the primary care physician and other members of the health care team is often the most reliable predictor of future costs. Deciding which tool to use is best determined by considering the targeted population, the available data, and the desired end result.

Interest in reliably predicting health care needs and expenses is rapidly increasing. Identifying risk factors and health decline has long been a function of actuarial science. But health reform, rising health care costs, and the skyrocketing prevalence of chronic diseases with avoidable exacerbations are turning a spotlight on predicting and preventing negative health outcomes, especially those that lead to unnecessary hospitalizations and emergency room (ER) visits. Contributing to this interest is the success of complex care management programs; they devote more resources and take a proactive, team approach to preventing medical complications in certain patients.

For purposes of this report, the authors sought to answer five primary questions:

1.  Which tools are most commonly used?
2.  How do they differ in their ability to predict future utilization and health outcomes in populations and unique individuals?
3.  In which populations does each tool work best?
4.  What are the tools' limitations?
5.  How can the tools be applied most successfully to care management interventions?

## III. Utilization- and Diagnosis-Based Tools: a Literature Review

The authors reviewed 34 risk stratification studies in depth to get a sense of the current science behind risk stratification, the tools available for predicting costs and other outcomes, and best practices for using the tools to identify individuals who could benefit from advance care management interventions.[1] These studies were selected for in-depth review based on their design and scope, the tools they evaluated, and the tools' targeted populations. Studies were excluded from review if they did not evaluate a tool or estimate

at least three of four key outcomes: (1) total cost; (2) utilization, including hospitalizations and ER visits; (3) partial costs, such as hospital or outpatient expenses; or (4) death.

Two important risk-stratification factors that the authors assessed were discrimination and calibration. Discrimination is a tool's ability to identify a high-risk population — one for whom health care will be expensive. "Variation explained," or $R^2$, reflects the ability to predict differences in costs between patients. For instance, an $R^2$ of 33% means a tool can predict individual cost differences 33% of the time. Calibration is a tool's ability to make predictions across subpopulations in a data set. A classic measure of calibration is "goodness of fit," in which a population is divided into groups of equal size and the actual costs for each group are compared with the predicted costs.

## Findings

Table 1 summarizes the design characteristics of the 34 studies, most of which were prospective. Analysis revealed two main categories of tools: utilization-based and diagnosis-based. Utilization-based tools start with costs and patients' use of the health care system, while diagnosis-based tools start with chronic illnesses and may add utilization to improve total cost prediction. Table 2 describes four utilization-based and three diagnosis-based tools in greater detail.

**Table 1. Design Characteristics of Studies for In-Depth Review**

| Total studies: 34 | | |
|---|---|---|
| **TYPE/FEATURE** | **NUMBER** | **% OF TOTAL** |
| Prospective | 26 | 76.5 |
| Retrospective | 4 | 11.8 |
| Review | 3 | 8.6 |
| Cross-sectional | 1 | 2.9 |
| Control group* | 4 | 11.8 |
| Validation used‡ | 8 | 23.5 |
| Compared risk stratification models | 12 | 35.3 |

Source: the authors
*Participants, assigned as controls before the study began, did not receive the intervention.
‡Post-hoc, random separation of participants into groups, each with an estimation set and a validation set of data.

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## Table 2. Utilization- and Diagnosis-Based Risk Stratification Tools

| TOOL | PURPOSE | TARGETED POPULATION | PUBLISHED EVIDENCE OF USE? | IN THE PUBLIC DOMAIN (FREE)? | LIMITATIONS | VALIDATED? | DATA SOURCES | WHO USES IT? |
|---|---|---|---|---|---|---|---|---|
| **UTILIZATION-BASED** | | | | | | | | |
| Chronic Illness and Disability Payment System (CDPS) | Predicts payment costs | Medicaid, Medicare | Yes | Yes | For reliable results limited primarily to Medicaid | Yes | Claims | Medicaid/ Medi-Cal |
| Probability of Repeat Admissions (PRA) | Identifies risk of repeat hospitalization | At-risk patients after hospitalization | Yes | No | Primarily one-dimensional | Yes | Questionnaire | Programs that offer proactive, comprehensive care for people with severely chronic conditions; Geriatric Resources for Assessment and Care of Elders (GRACE); Assessing Care of Vulnerable Elders (ACOVE) |
| Impact Pro (from Ingenix) | Provides predictive analytics to support care management | Primarily commercial patients | Review articles only | No | Must purchase; targeted primarily to commercial patients | No | Claims | Commercial insurers |
| Dorr algorithm (from Care Management Plus) | Identifies risk of death or hospitalization | Older patients and Medicare beneficiaries | Yes | Yes | Based on one study in one population | Yes | Combination of claims and questionnaire | OHSU |
| **DIAGNOSIS-BASED** | | | | | | | | |
| Charlson Comorbidity Index (and derivatives) | Predicts utilization and mortality | Veterans Affairs (VA), commercial, and Medicare patients | Yes | Most yes. | Must purchase some derivations; questionably reliable for Medicare patients | Yes | Claims | VA health systems |
| Adjusted Clinical Groups (ACG) | Predicts utilization | High-risk individuals | Yes | No | Must purchase; for commercial patients only | Yes | Claims | Commercial insurers |
| Diagnosis Cost Groups (DCG)* | Predicts utilization | Members of commercial health plans | Yes | No | Must purchase; for commercial patients only | Yes | Claims | Commercial insurers |

Source: Authors.
*A reweighted derivation of DCG used by Medicare is known as Hierarchical Category Codes (HCCs).

Of the 34 studies, 16 addressed the ability of risk stratification tools to predict total costs. Table 3 summarizes the prediction performance of tools in these 16 studies, which included three review articles. Virtually all of the tools had moderate value in predicting total costs. Even for the most predictive ones, $R^2$, or variation explained, ranged from just 27.2% to 35.4% after optimal weighting — that is, the tools could predict individual differences in financial risk 27.2% to 35.4% of the time. To be accurate from one group to another, they required significant reweighting of the factors used to

predict risk. However, even after some adjustment, most of the tools scored only in the mid-20% range.

## Table 3. Ability of Risk Stratification Tools to Predict Cost

Number of studies: 16
Total number of patients: 4,586,521
Range in number of patients per study: 5,861–2,320,043
Average number of patients per study: 305,768
Standard deviation in number of patients per study: +/-604,032

| TOOL | PERFORMANCE AS MEASURED BY VARIATION EXPLAINED ($R^2$) | | |
| --- | --- | --- | --- |
| | WEIGHTED AVERAGE (RANGE) | BEST PERFORMANCE WITH REWEIGHTING | BEST PERFORMANCE INCLUDING PRIOR COSTS (RANGE) |
| Chronic Illness and Disability Payment System (CDPS) | 10.5%† | 11.0%† | N.A. |
| Diagnosis Cost Groups (DRGs) | 15.7% (7.0%-20.6%) | 29.1%† | 29.1%† |
| Adjusted Clinical Groups (ACGs) | 18.3% (5.0%-22.7%) | 35.4%† | 29.1% (25.4%-35.4%) |
| Charlson Comorbidity Index and derivatives | 6.4% (4.0%-11.0%) | 33.0%† | 26.3% (22.0%-33.0%) |
| Impact Pro | 24.2%† | N.A. | 27.2%† |

Source: the authors, 2011.
*The Dorr algorithm and the Probability of Repeat Admissions are excluded because they predict the likelihood of hospitalization rather than total costs.
†One study.

The ACG tool had the best overall $R^2$ — a weighted average range of 5.0% to 22.7%. The Charlson Comorbidity Index had the worst — a weighted average range of 4.0% to 11.0%. The only published study on Impact Pro, a review article, cited average performance of the tool by itself and when it included prior health costs. In five studies, the tools used only demographic information, such as age and gender, to predict total costs; the $R^2$ for them was a low 3.1% to 9.0%. Tools that used only prior health care costs to predict future total costs had much greater predictive value — an $R^2$ range of 27.2% to 35.4%. Therefore, in order to maximize $R^2$, most of the tools in these studies included prior costs. Those that centered on diagnosis rather than prior costs had to be a hybrid of diagnosis and utilization tools so they would have similar outcomes as tools that used prior costs of care. None of the studies used scores based on probability of repeat admission for predictive purposes.

The authors evaluated the studies and results individually rather than cumulatively, as differences between studies did not allow a comparison of results. In their evaluations, the authors looked at the extent to which tools under- or over-predicted

patients' health care costs. Over-prediction was extreme — from 5,500% to 7,800%; notably, it occurred in very-high-cost patient groups rather than in less costly groups.

Among the 34 reviewed studies, three were reviews of available tools. In two reviews, from 2004 and 2007, the Society of Actuaries tested six of the available tools to predict patients' future utilization based on utilization in the prior year.[2] A highly proprietary tool called MEDai had the best $R^2$: 14.9% to 32.1%. However, because little information about MEDai is publicly available, it is not included in this report.[3] A reweighted version of the Diagnostic Care Group (DxCG) tool, derived from the Diagnostic Cost Groups tool cited in Table 2, had the next best $R^2$: 27.8%. Calibration of the six tools was generally poor, as the mean average prediction error ranged from 78% to 95% of total costs. The poorest ability to predict future costs of care was for patients who had the lowest utilization costs in the previous year; their predicted expenses were overestimated by 5,500% to 8,000%. For patients with the highest previous costs, future costs were underestimated by 50% to 75%.

## Discussion

The authors found that tools to predict discrimination performed poorly, with the best $R^2$ in the 30% to 35% range. Combinations of tools and complex tools did slightly better in some studies, but only after they were reweighted and fitted to the population. The tools also performed poorly in terms of calibration ("goodness of fit") for many subpopulations. Although this is to be expected when the data for groups of people, like those with very high prior health care costs, are extreme, the overestimation of health expenses for low-cost groups indicates a fundamental shortcoming.

The authors did not review several other gauges of risk stratification, such as quality-of-life surveys, the Short Form-12 and Short Form-36 health surveys, or the one-question health rating, because they target particular types of patients. The goal was to focus instead on more common data sources.

As the review findings suggest, choosing an appropriate tool is not simple. The Society of Actuaries notes that using diagnosis-based tools may be more straightforward for health care providers than for insurers and payers because providers can proactively reduce health complications. Reducing utilization is more daunting and ethically questionable for many providers; they may have difficulty balancing the benefit and cost

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of an expensive procedure if, for example, their income depends on reducing utilization. On the other hand, failing to consider past utilization may limit the usefulness of risk stratification tools in predicting future costs. A more targeted but untested approach would be to apply the tools only to the tier of patients at highest risk for costly care. Studies have shown that the top 5% of such patients incur about 50% of costs and that people with multiple chronic conditions are more likely to be in this category.[4] For these patients, providers could also consider factors such as functional limitations, frailty, and previous sentinel events — for example, falls or certain hospitalizations — in developing appropriate models of care.

## IV. Targeted Risk Stratification Tools

Two risk stratification tools targeted to a particular population are the Vulnerable Elders Survey (VES-13) and the SCAN Health Plan method. VES-13 focuses on functional status and self-reported health, while the SCAN method taps a wide variety of indicators to maximize effective placement and treatment of seniors.

Providers can leverage data from domains other than utilization and diagnosis, such as age, number of previous hospitalizations and ER visits, and the presence of a severe health condition or comorbidity, to predict the risk of high health care costs in older adults.

### VES-13

It is important to consider using the VES-13 in all health care settings because the survey is available to both individual physicians and health delivery systems, and can be administered by a physician's office assistant. Interpretation is simple: A score of 5 or greater predicts a patient's frailty and decompensation in the ensuing year. Most significantly, a 5+ score predicts the need for an advanced care plan to be in place, as the patient is likely to decompensate to the point of requiring lifesaving interventions. Survey results can be tabulated by hand in the physician's office and included in a database and disease registry.

A team of researchers from the RAND Corporation, the University of California-Los Angeles, and the U.S. Department of Veterans Affairs developed VES-13 (available at: http://www.rand.org/content/dam/rand/www/external/health/projects/acove/docs/acove_ves13.pdf) to accurately identify vulnerable elders living in the community who are at greater risk of death or functional decline, a critical step in providing focused interventions and improving the quality of care for this population. The team used publicly available data from the 1993 and 1995 Medicare Current Beneficiary Survey to develop the VES-13 scoring rules. Administered in person or by phone, the survey assesses self-reported activities of daily living and disability in instrumental activities of daily living — items that can signal health risk and, according to researchers, are free of age and gender bias.7 Scores range from 1 to 3+, with high scores indicating greater risk of death and functional decline.

In addition to being consistent with widely accepted models of health that emphasize the physical functioning of individuals in their environment, the VES-13:

- Is easily transportable across survey settings;
- Will remain relevant as health care systems evolve;
- Does not depend on the quality of administrative data;
- Does not require direct observation or laboratory data;
- Does not rely on utilization patterns or on the ability of health care providers to detect medical conditions;

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**What VES-13 Testing Found**

Testing of the survey on a national sample of elders revealed that:

▪ 32 percent were vulnerable; they scored 3 or higher on the 1–3+ scale;
▪ The risk of death or functional decline in these vulnerable participants was four times greater than among seniors who scored lower; and
▪ During the subsequent five years: (1) participants with a score of 3 or higher were at risk of frailty; and (2) those with a score of 5 or higher were also at greater risk of succumbing to chronic disease, likely to need advance directives in the upcoming year, and more likely to be hospitalized and to die during the measurement year.

In addition, the vulnerable participants:

▪ Visited their primary care physician more often;
▪ Received more home visits by public health nurses;
▪ Were more likely to have received the flu vaccine in the previous year; and
▪ Were more likely to have received emergency room, inpatient, and outpatient services.

There were no differences among participants in terms of blood pressure or cholesterol readings, or whether they had received health advice about smoking.[4,5]

- Can be used and scored by clinicians and nonclinicians; and
- Is free of charge to providers, health care organizations, and researchers.

The VES-13 may not meet the needs of care management because it identifies individuals at risk of death and functional decline rather than those at risk of hospitalization or other costly care. Furthermore, in managed care settings, having all patients complete the VES-13 annually, then collecting the results and entering them into a systemwide database, can be very difficult. And because frail, vulnerable patients are less likely to complete a self-report survey, there may be a significant nonresponse bias.

## SCAN Health Plan Method

For some proprietary tools, disclosure of the algorithms in their risk stratification logic system is prohibited. The proprietary SCAN Health Plan method, in contrast, is the only available, sophisticated database analysis tool that allows public disclosure so others can gain insight into risk stratification.

SCAN Health Plan is a Medicare Advantage plan with about 130,000 members in California and Arizona. In 2004, its health care informatics team developed an internal risk stratification method for assessing seniors after the team learned there were no tools for this purpose other than the VES-13, which did not meet the health plan's needs.

Ideally, the new method would enable SCAN Health Plan's case managers and contract providers to predict, with reasonable accuracy, members' future health care costs. It would entail two principal measures: (1) correct identification of individuals whose total costs would likely be in the top 5% to 10%; and (2) alignment of projected costs with the allowable fee-for-service amounts under Medicare for hospital, physician, laboratory, and other services, and for medications.

To develop and evaluate a new method, the informatics team collected data from more than 73,000 SCAN Health Plan members who had both medical and pharmacy coverage. All of them had been enrolled for at least four months at baseline and for a full 12 months when the team later studied their claims history. Dollar amounts on claims during the baseline and follow-up periods were adjusted to conform with Medicare fee schedules and allowable prices for services. In addition, the team determined the total amount spent on drugs during both the baseline and follow-up periods—members'

copayments plus the health plan's share of payments—to eliminate variations in cost sharing.

The team also used other information about members to generate potential predictors: their enrollment and eligibility information, and data from Medicare hierarchical category codes (HCCs), at baseline; their responses to a health questionnaire; and lab data. Different types of statistical methods can be used to combine data for analysis — categorization, clustering, summarization, or grouping (for example, using HCCs to group medical diagnoses) — before the information is entered into a model like SCAN. Ultimately, the team came up with 10 categories of variables as building blocks for its method (see box).

The team used a split-sample design to develop and test the method. Among the 73,000 health plan members, 70% (about 51,000) were selected at random for development purposes and the other 30% (about 22,000) for testing purposes.[8] Results for both groups showed that the top 10% who were at risk of hospitalization/high total cost of care accounted for 52% of total costs and the bottom 50% for only 10% of those costs.

> **The Ten Categories of Variables in SCAN Health Plan's Risk Stratification Method**
>
> 1. Demographic information, such as age, gender, and residential location.
> 2. Medical conditions, as suggested by Medicare hierarchical category codes (HCCs) and other sources.
> 3. Utilization of services, such as hospitalizations and physician/emergency room visits.
> 4. Durable medical equipment, such as wheelchairs.
> 5. Medications, including specific classes and the number of prescriptions.
> 6. Inpatient, pharmacy, and other costs, including total costs.
> 7. Lab measures, such as those for HbA1C (blood glucose) and potassium or sodium levels.
> 8. Responses to a health questionnaire.
> 9. Geriatric conditions not in HCCs.
> 10. Disease interactions specified and not specified in HCCs.

Retrieving complete data in a heavily capitated environment like SCAN Health Plan is challenging. Although cost data for members in the sample were adjusted to accurately reflect Medicare reimbursements for services in this environment, the low quality and incompleteness of data may have limited the tool's validity. The informatics team used various techniques to detect and impute missing information. And while the total sample size was large, even 73,000 individuals may be inadequate for developing an accurate risk stratification tool.

Health care providers often apply one tool to all patients, then assign them accordingly to a relevant care management program, whether for complex care or to manage heart failure, chronic obstructive pulmonary disease, or some other condition.

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This "one size fits all" approach may not produce optimal results. If, for example, the only data available are from a health assessment survey, a risk stratification method that relies on the survey results and utilization data will underestimate a patient's risk, as it assumes the patient did not previously utilize any services. Instead, providers might consider customizing an existing tool to fit a specific care management program and data source.[9]

SCAN Health Plan currently uses its predictive modeling tool for all patient selection, including enrollment in various care management programs. HealthCare Partners combines the SCAN Health Plan tool with a variety of other risk stratification methods to develop comprehensive care plans for their high-risk patients. For an in-depth look at HCP's risk stratification efforts, see Appendix A.

## V. Goodness of Fit and Clinical Metrics

A number of factors make predictive modeling complicated. They include:

- The interchangeability of terms such as "risk adjustment," "case-mix adjustment," and "relative resource utilization";
- Different uses of individual prediction models;
- Adaptation of models originally developed for capitation or other purposes; and
- The ambiguous meaning of "risk," which can denote financial risk (the focus of this report) or other kinds of risk, like mortality.

"Risk adjustment" is the most commonly applied term in predicting a patient's health costs. One prominent tool for this purpose is diagnosis-related groups (DRGs) in the prospective payment system. Developed for Medicare in the capitation setting, DRGs predict annual, per-member health care expenditures based on claims data. They exclude past costs, one of the most powerful predictors of future costs, so that past costs will not be used to justify future costs in capitation calculations.

In contrast, models that identify patients for disease management do use past costs as predictors of future costs. Traditional models can potentially provide a valuable predictor, such as risk scores, or a combination of predictors for developing more

targeted tools — for example, a tool that focuses on identifying patients readmitted to the hospital.

## Risk Versus Cost Predictions

Predicting total costs or aspects of service utilization may not be the best way to identify patients for enrollment in disease management programs, because this approach does not account for actions that could be taken to avoid "mutable costs" through better health care. Yet for many high-risk patients, the scope of remedial actions is limited. Furthermore, there apparently is no common way to identify mutable costs for predictive purposes. Some lower-risk patients may present opportunities for greater potential savings, but using predicted costs to estimate savings may have limited value if, for instance, interventions are not available to generate savings.

Given these constraints, it is prudent to focus initially on populations that present the highest financial risk, subclassifying individuals by morbidity (diabetes, for example) to enroll them in the appropriate care program (diabetes management). Patients with multiple morbidities are candidates for broader interventions.

The anticipated savings from a disease management program depend on how effectively it cares for a generally defined population of patients. However, among these patients are subpopulations with wide-ranging medical diagnoses and social needs that drive very different interventions, which in turn produce varying benefits not reflected in overall efficacy evaluations. Tools such as the VES-13, the SF-12 health survey, the Patient Health Questionnaire (PHQ) 9 for depression, the Probability of Repeat Admissions (PRA), tools that measure psychosocial support for patients by caregivers, and scales for activities of daily living and instrumental activities of daily living seek to assess patient variables that are often difficult if not impossible to measure. Yet integrating such information into risk stratification databases can significantly improve predictive value.  The lack of more detailed information about patients makes it necessary to match certain of their characteristics with program features. For instance, a subpopulation of patients who resist taking oral anti-diabetic medication may not be a good fit for a disease management program that increases adherence to such treatment.

The matching approach may involve tools with less predictive power but other positive attributes. An example is the Charlson Index: Although it has less predictive

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power than any of the major commercial, risk stratification products, it is easy to understand and may do a better job of identifying subpopulations of patients for whom disease management programs are well-suited.

A program's estimated return on investment (ROI), based on projected costs and savings, drives the business decision about which subpopulations to target for disease management. A health care provider might first implement programs that offer the highest potential ROI. Continuous monitoring and evaluation of a program — simply comparing the health care costs of patients before and after they enroll, or more sophisticated analysis using control groups or other techniques — reveal if it is delivering the anticipated savings. This may identify barriers if it is underperforming, enabling improvements or replacement with an alternative.

## Programs Offering Integrated Care

Integrated care management — that is, engaging patients and their families, providing a variety of coordinated services, and enhancing communication among all parties — can

optimize patient satisfaction and improve cost efficiency. Examples of this approach are listed in the adjacent box. The main goal of predictive modeling is to place patients in an integrated program that will best address their needs.

Each risk stratification tool must be tailored to a specific population. For instance, the Chronic Illness and Disability Payment System (CDPS) was originally designed for Medicaid beneficiaries, but now it is also appropriate for Medicare

▪ **Assessing Care of Vulnerable Elders (ACOVE)**, a RAND Corporation project: www.rand.org/health/projects/acove.html

▪ **Geriatric Resources for Assessment and Care of Elders (GRACE)**, developed at the Indiana University Center for Aging Research: medicine.iupui.edu/IUCAR/research/grace.asp

▪ **Guided Care**, developed at Johns Hopkins University: http://www.guidedcare.org/index.asp#

▪ **Care Management Plus**, a cooperative project between the Oregon Health & Science University and John A. Hartford Foundation: caremanagementplus.org/index.html

▪ **The Care Transitions Program**, based in the School of Medicine at University of Colorado

beneficiaries. (See Table 2 for more details about CDPS and other utilization- and diagnosis-based tools.)

Guided Care, Assessing Care of Vulnerable Elders (ACOVE), and Geriatric Resources for Assessment and Care of Elders (GRACE) use the Probability of Repeat Admissions (PRA), a survey that identifies individuals at high risk for readmission to the

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hospital. Commercial insurers use Impact Pro, among other tools, for the purpose of "transparent predictive modeling, evidence-based medicine, and tailored clinical and business rules to identify, stratify, and assess" individuals for care management.[10]

The ACOVE project identifies important medical conditions that affect the vulnerable elderly — people at least 65 years old who are at high risk for functional decline. It has considered adding the VES-13, the PRA, or both to better risk stratify patients for clinical interventions; ACOVE currently uses the VES-13 to select patients for advanced care planning interventions. The project has developed a comprehensive set of evidence-based indicators of quality of care (QoC) specifically geared to the limitations and needs of this population. Measuring QoC for the elderly may be more difficult than measuring QoC for younger people, as preferences for care vary widely among older adults. In addition, many chronically ill older patients cannot advocate for themselves regarding health care services and may not have family or friends who can advocate on their behalf.

Geriatricians and other specialists at RAND, the University of California-Los Angeles, and Veterans Affairs assembled the 236 QoC indicators, which cover 22 topics including continuity and coordination of care, dementia, appropriate use of medication, and end-of-life care. Four domains apply to each topic: prevention, diagnosis, treatment, and follow-up. A dementia QoC indicator, for example, might be documentation of vulnerable elders who are hospitalized or new to a physician practice and who undergo multidimensional assessment of cognitive ability and assessment of functional status, as such screening may delay progression of dementia.

This approach has two key limitations: QoC indicators only specify the minimum standard for acceptable care — they are not the same as practice guidelines — and ACOVE's indicators work only at the system level, precluding evaluation of the care that physicians provide to individual patients.

For chronically ill and/or frail older adults, two state-of-the-art care coordination interventions have reportedly enhanced health care quality through improved clinical outcomes while also reducing the total cost of care. Care Management Plus first used its Dorr risk stratification tool (an algorithm) to select high-risk patients, and then

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GRACE aims to improve care delivery to chronically ill older adults, mainly by optimizing their health and functional status and by reducing ER visits and hospitalizations. First, a support team consisting of a nurse practitioner and a social worker performs a comprehensive geriatric assessment of the patient at home. An interdisciplinary team — a geriatrician, a pharmacist, physical therapists, a social worker, and a community services liaison — develops a customized care plan based on the support team's findings. Two studies suggest that GRACE has improved patients' quality of care and health-related quality of life while reducing ER visits. In the program's second year, it also reduced hospitalizations by 20% among patients identified as at-risk for admission.[13,14]

In primary care clinics, patients — especially those with long-term chronic illnesses — often need to be educated about one or more aspects of their therapy, such as medications. Care Management Plus brings care managers and health information technology to bear specifically on patients with complex medical conditions by emphasizing better access to services, best practices, and enhanced communication between patients and the health care team. Research shows that this model reduces the number of deaths and hospitalizations, and improves the quality of, and patient satisfaction with, care.[15] It is most effective in a high-risk group of patients with multiple chronic conditions. Given the expense of implementing Care Management Plus, carefully selecting the most appropriate patients for this type of intervention — those whose risk scores are above the baseline — is essential. The goal is not only to improve the overall quality of care and clinical outcomes, but also to demonstrate cost-effectiveness and thereby significantly alter the overall health-care cost curve.

Engagement, action, and self-management are important aims in caring for the chronically ill. Remote monitoring of clinical parameters and patient behavior, with features such as interactive voice recognition (IVR), not only engages patients and their families but also can reduce utilization of services and expand nursing capacity. However, using IVR to achieve desired clinical outcomes has shown mixed results. The patient's clinical team must be empowered to take action based on remote monitoring.

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HealthCare Partners has used technology from 4PatientCare, supported by the Gordon and Betty Moore Foundation and the Center for Technology and Aging, to remotely monitor patients with congestive heart failure and chronic obstructive pulmonary disease. HCP's preliminary findings show improved clinical outcomes and cost efficiency for such patients.[16] Two challenges are determining how to fully integrate this technology into daily clinical care and convincing health care providers to see this as a practical, time-saving instrument.

## Factors That Affect Predictability

Capturing accurate and complete patient data from health care providers, especially when relying primarily on HCCs and physician coding, is challenging but is essential for predicting risk more precisely and enrolling patients in the type of care management most likely to improve clinical outcomes while maintaining and reducing costs. Factors that may lead to over- or underestimation of risk include variations among delivery systems in terms of physician performance (individually or as medical groups) and clinical outcomes. By customizing interventions to meet the needs of an individual patient or groups of patients, and by identifying gaps in the coordination of care, interventions will more likely produce optimal, cost-effective outcomes.

The quality and availability of data at the health plan and practitioner levels can be problematic. Health plans may say their information is "complete" when, in fact, collection lags or information in essential clinical domains is not available. Diagnoses may be missing due to incomplete encounter information or shortened diagnostic codes. Not only are data from practitioners often inaccurate and incomplete, but clinicians, allied health professionals, and administrative staff may code medical conditions and procedures differently. Obtaining the information also can be difficult: Medical groups and delivery systems vary in terms of the access they provide to electronic health records and medication data.

Pharmacy data regarding nondiscretionary medications—which, along with new-claims data, significantly enhance predictability—are relatively accurate. However, off-label prescribing and whether or not physicians know which pharmacies have filled their prescriptions may skew these data.

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Other important prediction-related considerations are the scope of high-risk patients to be targeted, the specific types of interventions they will receive, and the care venue. The fact that most physicians are in IPAs rather than medical groups, and provide most of the clinical interventions and oversight, can be problematic. This is challenging because the ability to control the actual delivery of care in terms of both its cost and quality is limited when the physician is not employed by the medical group. Socioeconomics, measures of activities of daily living and instrumental activities of daily living, and home- and community-based interventions can cause tremendous variation in predictability. The more frail people are, the more influential these factors become.

Some predictive tools can be modified by reweighting factors — the criteria that the tools use — for populations other than those they were originally designed to assess. For example, the Chronic Illness and Disability Payment System targets the chronically ill, and a gauge called MedicaidRx, which adjusts capitated payments to health plans that enroll Medicaid beneficiaries, targets the Medicaid/Medi-Cal population. These two tools also work reasonably well for commercially insured patients. However, the diagnosis categories in predictive tools may not be specific enough for analyzing high-risk elderly patients. Flexible models must include variables such as age, gender, and medical condition so providers can accurately meet the health care needs of these patients.

## VI. The Future of Risk Stratification

Risk stratification tools such as the VES-13 and SCAN Health Plan method have proved helpful in identifying high-risk elderly patients for case management. But current tools are far from perfect. Among other shortcomings, they generally can only assess particular types of patients rather than an array of populations, which vary by types of insurers (public or private), venue of health care delivery, primary disease, comorbidities, and clinical interventions. Advances in health information technology and statistical methods will likely make future tools significantly better.

Adoption and widespread use of increasingly sophisticated electronic health records could greatly improve risk stratification modeling and could control costs by readily providing information such as:

- Lab results for interpretation within the clinical context that is possible only with medical records;

- Disease history and assessments of health risk obtained at physician offices;

- The forthcoming International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10), which promises better and more specific disease groups; and

- Chart notes and reports.

Researchers typically use statistical modeling or computer algorithms to develop risk stratification tools.[17] In coming years, tools may employ text mining to analyze chart notes and boost predictive power, and take advantage of pattern recognition to analyze images. Furthermore, the authors believe that instead of relying on only the best tool, as is current practice, future efforts to identify high-risk patients for case management will be enhanced by expert panels or a mix of tools — perhaps some "meta" combination of informatics-generated statistics, computer algorithms, and expert clinical oversight, review, and opinion.

## VII. Conclusion

Predictive modeling is critically important in efforts to address the rising costs of health care and the squeeze on limited resources, and to discover the most appropriate and cost-effective clinical interventions for individual patients and patient groups. Despite numerous limitations, the risk-stratification and other tools described in this report are, to varying degrees, potentially helpful. The paramount goal is to avert costly events, be they hospitalizations or unnecessary end-of-life interventions that neither the patient nor family wants.

In choosing a tool for stratifying patients, health care providers must first know what a tool was designed to do and the particular population to which it would be applied. Also, whenever possible, they must take advantage of anything that will enhance a tool's application, such as additional health assessment surveys, clinical case conferences, and clinical teams to triage patients to the most appropriate interventions. Because predictive tools do not address psychosocial issues, input from clinical teams

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enables an organization to better target those patients who would most benefit from intervention or whose health care would be the most expensive.

The more variables there are in a risk stratification approach, the better its predictive ability. Adding pharmacy data and disease management education, for example, can improve the design of a predictive tool. In some cases, an existing complex tool may need to be re-engineered for a specific purpose.

Researchers are continually improving risk stratification methods. Formerly inexact predictions about the cost of care for patients with serious medical conditions or comorbidities are likely to become much more accurate over time—to the benefit of providers, patients, and the health care system alike.

## Endnotes

1. Abstractors identified a total of 394 articles for possible review.

2. Society of Actuaries, "A Comparative Analysis of Claims-Based Tools for Health Risk Assessment" (April 2007), www.soa.org/files/pdf/risk-assessmentc.pdf.

3. Here is how Swati Abbott, president of MEDai Inc., generally described this tool in a September 2010 interview: "The way we do things at MEDai is very different than a lot of the predictive modeling companies or other risk analytics companies in that we actually use an engine that we have created internally to mine data. We take de-identified client data, create a big database, and then we mine it. For example, we can look for patients with chronic conditions that need to be managed proactively. We can look at outcomes over time and determine what behavior lends to the best outcome. We can ask specific questions like what drug is more effective, what treatment is more effective, etc." Frost & Sullivan, "Movers and Shakers Interview With Swati Abbott, President, Medai Inc.," www.frost.com/prod/servlet/market-insight-top.pag?docid=210965743.

4. Agency for Healthcare Research and Quality, "The High Concentration of U.S. Health Care Expenditures" (June 2006), www.ahrq.gov/research/ria19/expendria.htm.

5. H.M. McGee et al., "Vulnerable Older People in the Community: Relationship Between the Vulnerable Elders Survey and Health Service Use," *Journal of the American Geriatrics Society* 56 (2008): 8-15.

6. L. Min et al., "The Vulnerable Elders-13 Survey Predicts 5-Year Functional Decline and Mortality Outcomes in Older Ambulatory Care Patients," *Journal of the American Geriatrics Society* 57 (2009): 2070-2076.

7. D. Saliba et al., "Identifying a Short Functional Disability Screen for Older Persons," *Journals of Gerontology. Series A, Biological Sciences and Medical Sciences* 55 (2000): M750-756.

8. Student t, Chi-square, and Wilcoxon ranking tests on the difference in characteristics between these two groups of SCAN members found no significant difference.

9. Other health care delivery systems may want to develop their own risk stratification method and modify it based on the patient population and the types of clinical interventions they provide.

10. Ingenix, "Impact Pro for Care Management Overview," www.ingenix.com/employers/solutions/health-management-emp/impactpro-care-mgmt/overview.

11. David A. Dorr et al., "The Effect of Technology-Supported, Multidisease Care Management on the Mortality and Hospitalization of Seniors," *Journal of the American Geriatrics Society* 56 (2008): 2195-2202.

12. S.R. Counsell et al., "Geriatric Care Management for Low-Income Seniors: a Randomized Controlled Trial," *Journal of the American Medical Association* 298 (2007): 2623-2633.

13. S.R. Counsell et al., "Cost Analysis of the Geriatric Resources for Assessment and Care of Elders (GRACE) Care Management Intervention," *Journal of the American Geriatrics Society* 57 (2009): 1420-1426.

14. Counsell et al., "Geriatric Care Management for Low-Income Seniors," 2623-2633.

15. A list of studies regarding the financial and clinical benefits of this model is available at caremanagementplus.org/pubs.html.

16. More information about 4PatientCare is available at www.4patientcare.com. Pharos Innovations (www.pharosinnovations.com) also makes remote monitoring technology.

17. The algorithms include classification and regression trees (CARTS), multiple additive regression trees (MARTS), and neural networks.

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**Appendix A: Risk Stratification at HealthCare Partners**

HealthCare Partners Medical Group (HCP) is a national, physician-owned and -led accountable care organization that accepts global capitation in Southern California, Nevada, and Florida. Through evidence-based medicine, it delivers coordinated, integrated, and innovative care to more than 600,000 patients (including more than 100,000 seniors) in Los Angeles and Orange counties. The total number of HCP patients is nearly 1 million (almost 200,000 seniors). The physicians belong either to staff-model, HCP-owned and -employed medical groups or to groups affiliated with HCP through its independent practice associations. The IPAs comprise more than 1,300 primary care physicians and 1,500 specialists who serve 50% of HCP's patients in California and 40% of those in Nevada and Florida.

HCP has developed its own risk stratification method based on lessons learned at SCAN Health Plan and on work by the medical group's decision-support and information technology departments. Following risk assessment, patients are triaged into the high-risk program that most appropriately meets their individual clinical needs, improves the quality of care, and reduces total care costs.

Thus far, HCP's risk stratification method for placing patients in appropriate clinical programs has been about 60% predictive in terms of matching them with the best care at the right time. Predictability is even better with additional physician oversight. The authors anticipate predictability of greater than 80% for both individual patients and groups of patients as the risk stratification method and the clinical delivery system improve over time.

HCP clinicians often provide more intensive care for some patients than is medically necessary, and they miss some individuals who otherwise would stratify into the top 20 percent of high-risk patients. Recently, however, HCP has found that it can ameliorate this problem somewhat by adding clinical oversight to statistical risk-stratification tools.

Although each HCP geographic region has its own medical management infrastructure, the infrastructures are similar. Each region also has geographic "pods" with care management programs for high-risk patients. Clinical teams that care for high-risk patients meet weekly to review all cases the risk stratification tool has identified, as

well as hospitalized patients, those who have visited the ER, and those referred by any clinician or nurse/care manager in the HCP system. The teams consist of physicians (including hospitalists), nurse care managers, nurse practitioners, social workers, and others. They look at risk-stratification, medical-records, claims, pharmacy, lab, and radiologic data, as well as diagnoses, hospital and other patient records, and information generated by any other measurement tools, such as the VES-13, Probability of Repeat Admissions, Patient Health Questionnaire 9, and Mini-Mental State Examination. The teams then assign patients to an appropriate medical home.

After a medical home's high-risk clinical team evaluates a patient, it provides care for a short while until he stabilizes, then refers him back to the primary care physician; provides care for a longer period; or transfers the patient to a more appropriate medical home for high-risk individuals. The patient receives care for as long as necessary, often until death.
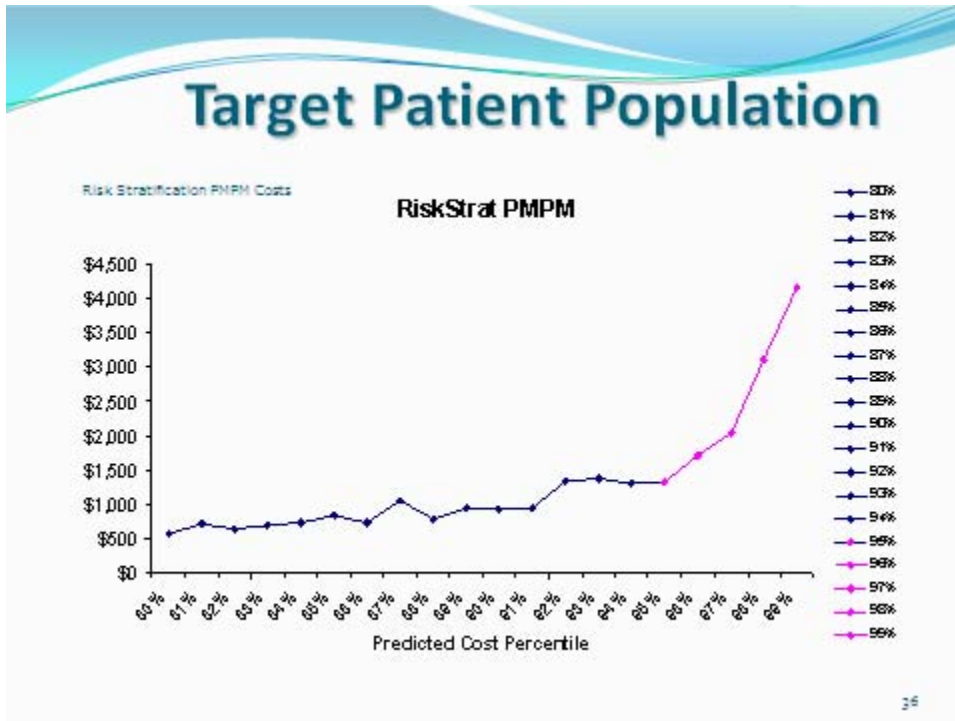
Figures 1 through 4 illustrate the risk stratification and care management process at HCP.

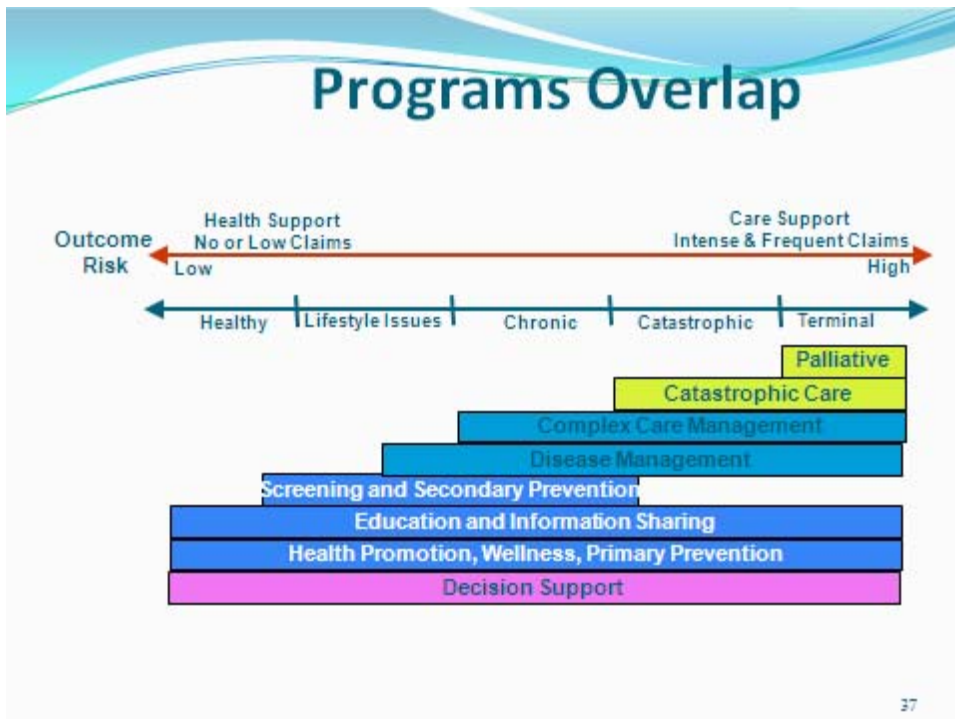**Figure 1. Risk Stratification at HCP**



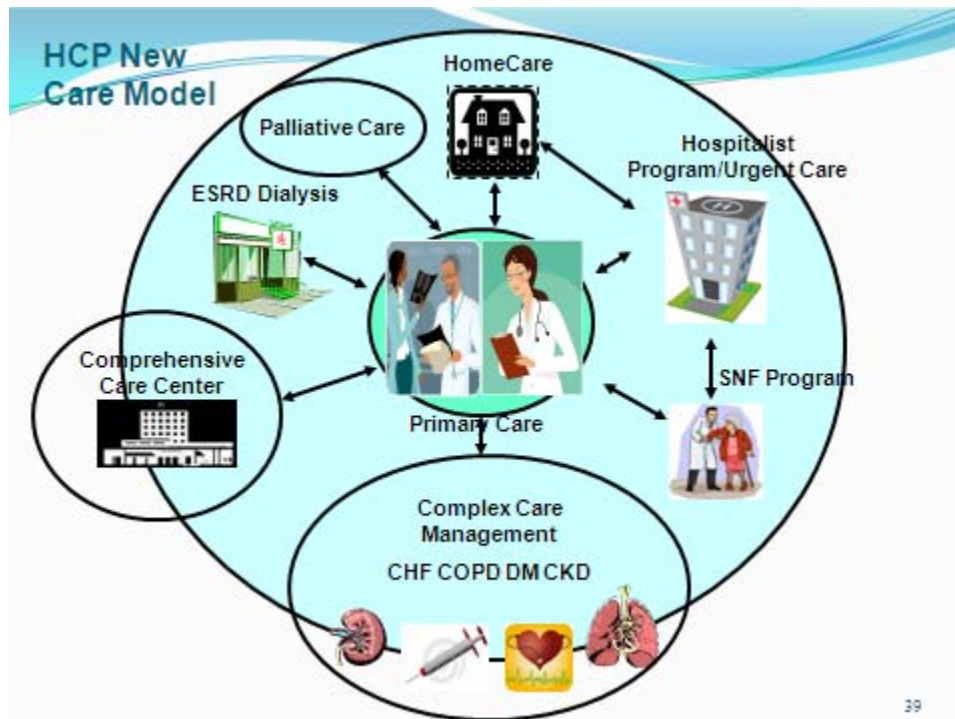Source: the authors, 2011.

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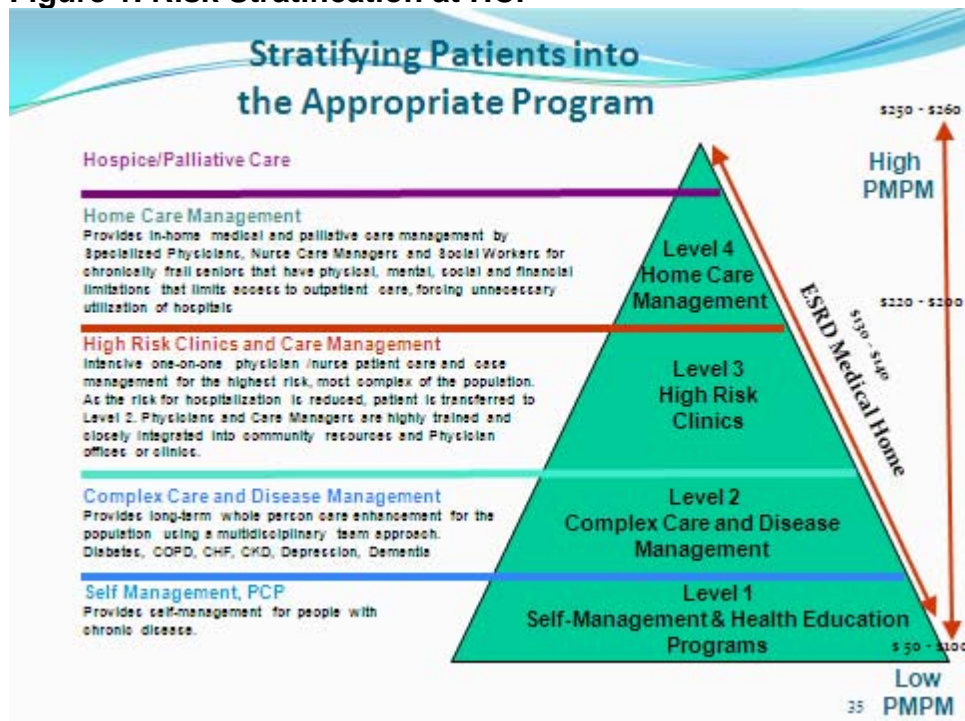
**Figure 2. Target Patient Population**

**Figure 3. Overlap of Programs**

**Figure 4. HCP's New Care Model**



HCP originally developed risk stratification tools to pare total health costs by improving the coordination of outpatient care, reducing unnecessary ER visits and hospitalizations, and expanding access to health care. Now it also uses the tools for quality improvement — applying evidence-based protocols and medical management practices to achieve better, cost-effective clinical outcomes. HCP's risk stratification method is a hybrid, one based on adaptation of the SCAN Health Plan approach and on methods used to develop the Medicare hierarchical category codes, with continuous modifications and improvements. The method enables HCP to identify patients at greatest risk for expensive care and to assign them to the most appropriate and cost-effective complex care or disease management program *before* hospitalization and ER visits stemming from acute events, and *before* poorly treated chronic illnesses occur.

Patients and their families receive treatment and support on many levels at HCP, including:

- Self-management;
- Health education and health enhancement programs;

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- Peer counseling;

- Disease-specific and complex-care-management programs;

- Comprehensive care clinics. These are for patients at high risk of serious ailments or expensive care after hospital discharge, and for those who are chronically frail or have complex medical conditions; and

- Home care for patients who are too frail or ill to receive services through the traditional delivery system and/or need palliative care.

The following sections describe programs that target HCPs higher-risk patients. For lower-risk patients, self-management and standard primary care are sufficient. HCP's Health Enhancement Department and resources in the community empower these patients to manage their health conditions by being more engaged, proactive, and knowledgeable about healthy behaviors — factors that can improve their quality of life.

## Complex Care and Disease Management

A multidisciplinary team composed of a nurse care manager, nurse practitioner, and adjunct social worker with physician oversight provides complex care and disease management through a variety of programs for patients with comorbidities such as congestive heart failure, chronic obstructive pulmonary disease, chronic kidney disease, diabetes mellitus, dementia, or depression.

*Congestive Heart Failure*

At HCP, the main goals of the congestive heart failure program for at-risk patients who have been hospitalized are to:

- Get patients and their informal caregivers, such as family members and friends, engaged in self-management;

- Educate the patient and family about managing the disease with appropriate interventions;

- Manage medications, including titration, and adhere to them; and

- Educate patients about available resources for managing urgent situations and make sure they have an action plan if such a need arises.

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The program ensures that patients have appropriate and ready access to their primary care physician, cardiologist, and other specialists for treatment plan guidance. A cardiology nurse practitioner monitors and manages patients, does lifestyle coaching, reinforces education provided by a nurse care manager, coordinates care with the primary care physician and cardiologist, and identifies urgent symptoms that trigger early intervention, thus avoiding ER/urgent care visits or hospitalizations. In addition, nurse care managers and their patients regularly meet and talk by phone. At a minimum, the cardiologist supervises the nurse practitioner's and nurse care manager's work, but may meet face-to-face with particularly challenging and complex patients who have not stabilized. The social worker addresses psychosocial issues and, if necessary, visits the patient's home to assess social and environmental dynamics.

To document patient interactions and thereby ensure coordination of care, all team members use HCP's proprietary Clinical Case Management Information System and its TouchWorks/AllScripts electronic health record. A subset of patients are also enrolled in a program for interactive voice recognition, which automates telephone communications. Between the nurse care manager's scheduled phone calls, it monitors patients and alerts the clinical team to take immediate action if a patient's clinical condition destabilizes and there is a risk of an ER visit or hospitalization.

*Chronic Obstructive Pulmonary Disease*

The complex care management program for chronic obstructive pulmonary disease (COPD) is similar to that for congestive heart failure; key elements are support from a multidisciplinary team and education of patients and their families. Patients initially meet with the nurse care manager and nurse practitioner. They then receive scheduled follow-up visits at home from a nurse practitioner/registered nurse or respiratory therapist, who determines the complexity of disease and the treatment and care plan, ensuring appropriate use of medications and home safety. Respiratory therapists make at least one follow-up visit if the patient is on supplemental oxygen, or as necessary.

HCP is evaluating remote monitoring of older COPD patients through a telehealth program.

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*End-Stage Renal Disease*

Another program seeks to improve the quality of care for pre-dialysis patients and those with end-stage renal disease who are undergoing dialysis. The primary objectives are to: Reduce avoidable hospitalizations, ER/urgent care visits, and acute care;

- Reduce emergency vascular interventions;
- Increase adherence to treatment for renal disease and comorbidities, and promote self-management;
- Improve primary care for dialysis patients;
- Establish early-access placement of dialysis shunts; and
- Prepare for scheduled transition to dialysis.

The multidisciplinary team in this program comprises a care manager, nurse practitioner, nephrologist, and social worker who intensely monitor the patient before and after admission to the hospital. The care manager regularly evaluates patients between visits to ensure they are stable and to coordinate care before and after dialysis. The nurse practitioner monitors patients inside and outside of contracted dialysis centers, manages their care at those centers, and coordinates outside care with the primary care physician, nephrologist, and other specialists. Patients receive any intervention necessary to prevent heart failure decompensation. The HCP nephrologist works with community-based nephrologists to formulate treatment plans and tracks patients' glomerular filtration rate to determine when dialysis should begin. The social worker addresses psychosocial issues and assesses patients' homes and the caretaker environment.

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To date, these specialized programs for congestive heart failure, COPD, and end-stage renal disease have reduced hospital admissions/readmissions and ER visits by at least 30% to 40%. The reduced admission/readmission rates apply regardless of whether patients are insured under Medicare or commercially. The programs have also improved patient satisfaction and quality of life, treatment adherence, and advance care planning by 30% to 60%, depending on the measure.

Patients qualify for this special care based on their disease. All of those receiving dialysis are automatically enrolled in the end-stage renal disease program. All patients with heart failure and COPD who have had at least one ER visit or hospitalization in the

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previous 12 months, who are in the top 20% on the risk stratification scale, or who have been referred by any clinician, nurse, care manager, or social worker in the HCP delivery system are enrolled in the applicable program. Such patients include those in the top 20% in terms of risk for hospitalization who are not enrolled in a higher-intensity program—an end-stage renal disease medical home, a comprehensive care center, HomeCare, or hospice.

**High-Risk Care**

HCP's Comprehensive Care Centers (CCCs), Post-Hospital Clinics, and Collaborative Care Centers are clinics that help manage primary care physicians' highest-risk patients. The long-term, high-risk patients at CCCs are frail and have chronic medical illnesses as well as dementia. The Post-Hospital Clinics are for short-term, high-risk patients — those who are frail and chronically and medically ill, who generally require six or fewer clinic visits after a medical hospitalization to make sure their conditions are stable, and who are then triaged back to their primary care physician and a complex care/disease management program. At the collaborative care clinics HCP is developing, chronically mentally ill patients will receive collaborative medical and psychiatric care from a team in one clinic delivery system.

HomeCare is for HCP's most frail patients, many of whom need palliative care. Again, a multidisciplinary team focuses on the patient, family, and caregivers; facilitates continuity of care; and coordinates treatment plans among providers. These patients have been hospitalized multiple times in the previous year or had frequent visits to ERs or urgent care centers. They may not have adhered to treatment; may have been referred by other programs, such as those for complex care, ambulatory care, disease management, or health enhancement; or may have been discharged from a hospital or skilled nursing facility.

CCCs and HomeCare differ primarily in terms of where patients receive services. The centers are located in HCP physician offices, while HomeCare is for patients who generally are not mobile or choose not to come to the doctor's office. In both cases, the multidisciplinary team consists of a physician, a nurse care manager, a nurse practitioner, a physician assistant, and other specialty clinicians. The latter include but are not limited

to behavioral health specialists, cardiologists, pulmonologists, neurologists, physical therapists, and a social worker who broadly meet the complex medical, behavioral, and social needs of patients. Initial visits entail a comprehensive assessment of patients' medical and behavioral status, living conditions, level of caregiver and family support, adherence to treatment, and social and financial needs. The goals, as in other programs, are better patient satisfaction and quality of life, shorter hospitalizations, fewer ER/urgent care visits, and lower health care costs.

Patients enter one of two tracks in the CCC and HomeCare programs: post-acute or chronic. The post-acute track is for those referred by the inpatient care team at a hospital or skilled nursing facility. They undergo one to six visits at a clinic or at home, are enrolled in a complex care or disease management program and, once stabilized, typically return to their primary care physicians for services. However, those who still need high-level care can remain in the program or be referred to a different one. The chronic track is for chronically frail patients who need long-term care management. Usually they are referred by their primary care physician, a specialist, or some other provider of services for these types of patients.

CCC and HomeCare services include medications management/reconciliation, advance care planning, palliative care, disease education, additional community resources, and 24-hour access to a provider of care for high-risk patients. To coordinate care, the teams document patient encounters in the case management system and electronic health record, and keep each patient's primary care physician abreast of the treatment plan. There are two options for CCC patients: up to six visits and then triage back to the primary care physician, or ongoing care due to their complex medical and social needs. In either instance, primary care physicians who want to remain in the loop receive written communications and phone calls regarding patients and they participate in all treatment planning sessions.

## Risk Stratification of HomeCare Patients

HCP uses both the SCAN risk stratification method and its own internal risk stratification program to select patients for HomeCare. To fully gauge the clinical status of these patients, HCP incorporates data about their claims, hospital admissions, ER/urgent care

visits, medications, disease interaction, and total health care costs, and other information described earlier regarding the SCAN method. Clinicians involved in patient selection also consider lab results, referrals to specialists, information from the electronic health record, and other clinical metrics. HCP is studying the effectiveness of this approach for enrolling HomeCare patients, including clinical oversight of patient selection and triage by the high-risk clinical team. Generally, HomeCare patients are in the top 5% in terms of health risk and are predicted to have one year or less to live. When the team evaluates patients for enrollment, it also takes into account the hospitalization and rehospitalization risk, and, for each individual, compares the likely effectiveness of home care versus other high-risk programs, such as care at a CCC, complex care, or disease management.

## Referrals From Other Sources

Another way HCP identifies high-risk patients is when clinical professionals refer them for care. Such patients include those who, according to their primary care physician, do not adhere to the treatment plan, lack adequate caregiver or family support, raise psychosocial concerns, need close monitoring because of complex diagnoses, or are not achieving expected outcomes from the current intervention. HCP's high-risk clinical teams triage them to the most appropriate clinical programs.

In addition, hospitalists, professionals at skilled nursing facilities, and urgent care physicians refer patients to HCP who they believe may encounter difficulties after discharge. HCP accepts those who are recurrently hospitalized, lack adequate caregiver or family support, have psychosocial issues, or are dealing with a new or unfamiliar drug regimen. Sometimes patients are enrolled in particular programs according to hospitalists' recommendations, then are placed in different programs based on additional evaluations by the high-risk clinical team. In other cases, an HCP team may conclude from the outset that a program other than the one recommended by a hospitalist would be more appropriate and the patient is redirected immediately.

Nurse case managers also make referrals based on the above criteria. Care managers in the inpatient setting often are privy to information that the patient and family have not shared with physicians, while care managers in the outpatient setting may know

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of fragile patients who warrant greater attention and steer them to the most appropriate, high-risk clinical intervention.

After selection of a referral destination, HCP notifies the patient's primary care physician and the physician's office. It also notifies the patient and family, requests that the patient participate, and explains the program. When nurses and medical assistants call these patients to schedule appointments, they read from scripts to ensure that all information is presented and in a consistent manner. Physicians also reach out to patients who need additional information or to help them understand why a special program is necessary. The high-risk clinical team can immediately arrange alternative placement if any of a number of reasons warrants it.

## Results and Challenges

HCP is evaluating the effectiveness of its risk stratification efforts. Generally, on a population-wide basis, the SCAN method has accurately selected patients for the high-risk programs and care management about 61% of the time, and patients for other high-risk programs about 50% of the time. However, on an individual basis, risk stratification has over-selected patients for inclusion in high-risk programs. The SCAN approach seems to work better than Medicare hierarchical category codes in identifying patients for these interventions, but neither is more effective across all programs without clinicians' oversight and input.

There have been numerous risk stratification challenges:

- Data about patients do not reflect the psychosocial issues they face, and no currently available risk stratification tool takes such issues into account. This compromises the ability to make accurate predictions about the highest-risk individuals, including safety net patients, seniors and persons with disabilities who are not enrolled in Medicare, and patients enrolled in both Medicare and Medicaid/Medi-Cal. This patient population has the greatest health care needs and psychosocial and financial challenges, which are difficult to manage and assess, and complicate the process of predicting what the ultimate impact will be on patients' health care needs and utilization. These patients also have the most complex medical conditions, are the most chronically ill, and are the primary

focus of most innovations in coordinated care, accountable care organizations, and health reform;

- Patient records are necessary to get a full clinical picture for purposes of triaging and augmenting risk stratification methods. However, obtaining these records from primary care physicians, and hospital discharge summaries and other documents from ancillary vendors such as specialists, is difficult. One reason has to do with electronic health records (EHRs): Only 25% of patients who receive care through an HCP independent practice association (IPA) visit doctors who use EHRs, and only 55% to 60% of all HCP physicians have them;

- Data collection is laborious, slowing the selection of high-risk patients;

- Along with data, clinical knowledge improves the selection process for specific clinical interventions, such as those for congestive heart failure and end-stage renal disease. But each patient evaluation requires using many different information systems and assessment tools simultaneously, an arduous task; HCC coding by primary care physicians varies, which affects the accuracy of risk stratification, especially among IPA-contracted doctors;

- Because the clinical care provided by primary care physicians varies from patient to patient, it is not possible to uniformly apply risk stratification. However, this information is critical in deciding which risk stratification method would be best in weighting the associated statistics and clinical evaluation; and Initial risk stratification is only a starting point. Subsequently, depending on whether patients' medical conditions improve or deteriorate, they may need a different level of care.