Guiding population health management programs with comprehensive clinical insight

The Population Health Alliance describes three principal components of successful programs: **upfront analytics, varied and targeted interventions, and ability to measure outcomes.**[1] This requires a member-centric approach where analytics are used to identify and stratify members to deliver the most impactful interventions. Tracking member outcomes is key to improving programs and delivering improved health.

Optum® Impact Pro® combines predictive analytics, clinical insight and member segmentation to help health plans deliver successful population health management programs. Combining advanced data analytics with clinical knowledge, Impact Pro allows a holistic perspective of member care needs to enable patient-centered care. This allows organizations to deliver specifically targeted interventions based on precise insight on conditions and care opportunities for individual patients.

Clinical expertise and improved predictive models provide many benefits:

- Combines readily available data through medical, lab and pharmacy claims with advanced analytics to provide various predictive models to help manage cost risk and identify members at high risk for utilization
- Allows users the ability to track and identify members using pre-populated registries and custom-built registries

- Includes a powerful reporting application that allows users to visualize model outputs and factors contributing to risk, and to identify patients who would benefit most from care management programs
- Tools provide insight into current clinical situation of members, care opportunities, future costs and utilization risk in an easy-to-use interface
- Ability to tailor rules and member stratification to suit specific client intervention needs
- Clear and concise business applications that easily integrate with other tools and data
- Outputs that support effective care management

Guiding population health management programs with Impact Pro

Impact Pro is a multi-faceted health management platform designed to support population health management programs. At its core are clinically determined episodes of care and evidence-based medicine measures.

Developing a member profile that comprehends the whole person

Impact Pro includes numerous capabilities and predictive analytic models to identify care gaps and clinical conditions in support care management.

- **Care opportunities:** Powered by the Optum® Symmetry® EBM Connect® engine, Impact Pro can help identify a member's care gaps and intervention opportunities using a library of over 700 evidence-based, clinically accepted guidelines.
- **Predictive models:** Member-level risk scores that indicate future cost, inpatient and emergency department (ED) utilization.
- **Care management tools:** Integrated case management (ICM) and population health dashboards combine utilization and cost risk, member condition information and care opportunities to stratify members who might benefit the most from increased case management.
- **Social determinants of health (SDOH) propensity indexes:** Ability to incorporate Optum SDOH propensity indexes and ICD-10 SDOH data to increase accuracy of models and ability to use SDOH markers for member identification.
- **Pharmacy analytics:** Incorporation of pharmacy data improves risk models as well as ability to identify members with complex pharmacy regimens.
- **Survey results:** Integrate health risk assessment data directly into Impact Pro.
- **Filtering and drill down:** Segment and stratify individuals in populations by a wide range of criteria including risk score, condition and compliance with clinical guidelines as well as analyze every level of every member of a population, including individual claims.

Targeting members for population health management programs

Impact Pro provides a powerful analytic platform to identify and stratify members for population health management programs. Tools allow the targeting of members who most benefit from clinical interventions. Clients can use powerful built-in condition registries and risk prediction tools, or even can create their own registries and custom models to suit their exact needs. Two key tools that enable care management programs are the impactable case management and population health dashboards.

Impactable case management: ICM registries allow case managers to identify and prioritize members who are clinically at risk and have impactable care opportunities. Using both elements allows clients to identify those members who may have the most need of intervention but also those who can be acted upon immediately to improve their quality of care.

> **Two sets of distinct rules characterize these registries:**
>
> - **Clinical risk** registries are used to determine which members are either high-complexity/high-risk or rising risk.
>
> - **Impactable opportunities** registries are used to expose areas where members may not be following recommended guidelines, potentially receiving care that is wasteful or overly complicated, or if a member has other contributing circumstances that may warrant further attention.

Clients can choose which ICM registries to include in their strategies (by deactivating those rules that don't fit). They can also create and score their own rules to complement the Optum standard rules.

Clinical risk scoring takes all the Clinical Risk Factors and assigns a weight to them by default as determined by the Optum clinical team. The scoring can be configured by clients as necessary to align with their case management strategies. Weights are summed at the member level and stored in Impact Pro output tables. Using the default weights, our testing of the Clinical Risk Factor rules generated a maximum score of 40 points assigned to a member. Based on the distribution of the clinical risk score, clients can group members with similar risk scores to be prioritized into levels (e.g., H, M, L) by setting up calculated columns in the Impact Pro Reporting System. Specific thresholds for each level are determined based on the weights chosen for each rule and a health plan's patient population.

Once the clinical risk factor scoring is determined, impactable opportunities are assessed. The available categories are Medical (M), Drug (R), Social (S) and Behavioral Health (BH). The actionable category score helps identify what interventions might be most needed by a member.

In addition, Impact Pro clients that also subscribe to the Optum SDOH propensity indexes may layer this data onto the clinical and impactable opportunity matrix. SDOH propensity models include various models that predict social isolation, health ownership, housing security, transportation access, financial security and propensity to engage. These models are built with consumer analytic data, so they capture information not available in medical claims data. Propensity to engage models can be incorporated into ICM to determine those likely to engage in care management. This allows segmentation of the population and targeting of specific outreach modalities to those who may be harder to reach or more reluctant to engage in a program.

As a baseline to help determine resource allocation and through case study research using data with a mix of commercial, Medicare and Medicaid members, it's expected that less than **1%** could require significant case management services; **16%** could require moderate case management services. The majority of the population should not require any form of case management services. However, these numbers are adjusted based on the characteristics of the population.
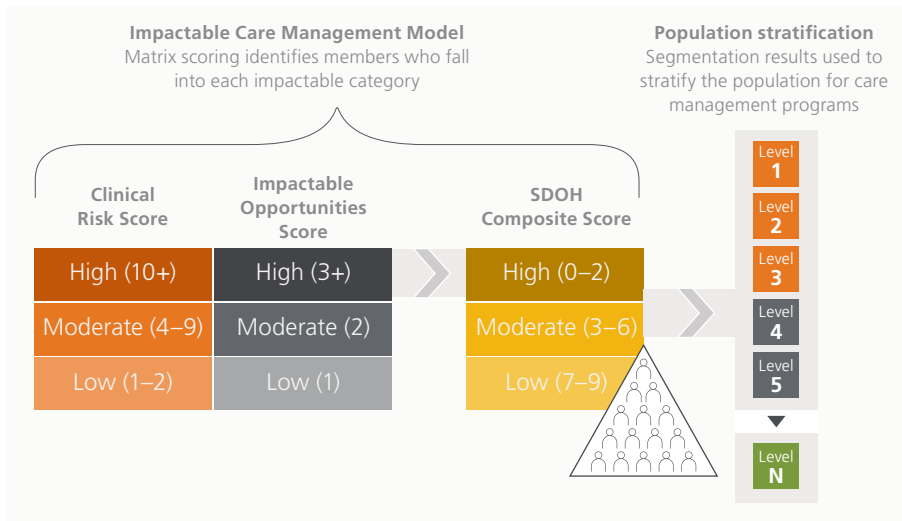
Population health: Population health registries empower case managers with the ability to classify members into mutually exclusive population health categories representing overall health status (acute, catastrophic or chronic) based on the concept of a Health Continuum Model with associated per-member-per-year costs.

All functionality in Impact Pro is built on top of several foundational pieces. Below we go into detail about the elements that support the breadth of member identification and stratification capabilities.
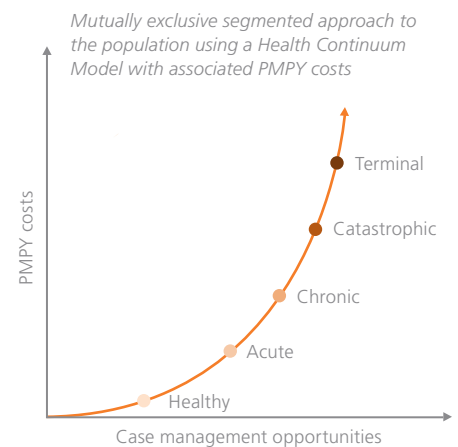
Best practices to design effective interventions

As the population health management framework illustrates, it's important to understand multiple attributes of a person to direct the most effective interventions. To maximize the use of Impact Pro, the same approach must be taken. The various tools identifying clinical conditions, care opportunities and likelihood of future utilization should be used in conjunction to understand care a member may need. An example of this would be the ICM dashboard, which identifies and displays members who are at high clinical risk and have actionable care opportunities.

When used properly, Impact Pro has a powerful and flexible tool set to identify and stratify members for a wide variety of clinical strategies and care management programs. However, when designing frameworks to stratify members, it's important to pay attention to the use of models so you don't inadvertently introduce disparities into member selection. Algorithmic models often reflect disparities that are seen in the real world. We evaluated potential bias in our models through a variety of methods, including an open-source toolkit from Aequitas.[2] Even though models may be fair when predicting what they're designed to predict, some gaps in selection may appear when models are used for proxies of other outcomes. For example, cost models should not be used as proxies for member health. There are many components to cost of care that may not be directly related to how severe a member's condition is.

There are several best practices that need to be kept in mind when constructing identification methods using Impact Pro.

- Use population health and ICM dashboards in Impact Pro as starting points to identify and stratify members.

Mutually exclusive segmented approach to the population using a Health Continuum Model with associated PMPY costs

- Leverage custom rule and indicator abilities to tailor existing tools to your specific needs.
- Cost risk models are accurate in predicting future cost but shouldn't be used as a proxy for clinical outcomes.
- Identification and stratification tools in Impact Pro should be selected with the care management intervention in mind. Tools should be used that identify members who could benefit the most from the intervention.
- Cost risk models should not be used alone to identify members for care management interventions. They should be used in conjunction with clinical tools in Impact Pro.

Building a member profile that comprehends the whole person

Symmetry episodes of care

At the foundation of Impact Pro is the Optum® Symmetry® Episode Treatment Groups® (ETG®)software. This processing engine organizes claims into homogenous units that describe complete episodes of care. Episodes are created by assigning inpatient, outpatient and ancillary services to mutually exclusive categories that are meaningful to care providers. In addition, some episodes have differing severity levels that consider a member's comorbidities and complications.

Episodes are built by first classifying claims as either anchor or non-anchor records. Anchor records are defined as a face-to-face encounter between a clinician and a patient. Only anchor records can start an episode. Following episode initiation, the grouper evaluates every ancillary and pharmacy claim (non-anchor records) against all episodes to determine the best fit, and groups each accordingly. The results are clinically homogenous, statistically stable episodes. Each episode is assigned to an ETG base class, which identifies the medical condition. Examples of ETG base classes include diabetes, hypertension and chronic obstructive pulmonary disease. If applicable for that base class, comorbidities and complications are also assessed to assign severity level for a member. ETG episodes of care are the building blocks for determining member risk.

ETG evaluates all the clinical information available for each record to determine optimal grouping through a proprietary hierarchy that leverages the known clinical relationships between diagnoses, services and provider types.

Clinical analytics

The Impact Pro Clinical Analytics module provides details about clinical conditions and care opportunities for individual members.

Care opportunities: Impact Pro includes approximately 700 care opportunities or gaps in care powered by EBM Connect in 77 primary disease categories. Examples of categories with the most opportunities include diabetes, substance abuse, mental health, asthma and chronic kidney disease. Care opportunities identify individuals with gaps in care who could benefit from clinical interventions.

Clinical indicators: Impact Pro also includes over 900 clinical indicators that identify patient conditions and utilization events. These indicators can be used in conjunction to select members who best fit an intervention. Beyond the included indicators, you can also create your own custom indicators using Impact Pro rules editor.

Registries: Registries enable users to combine the different pieces of member information in Impact Pro to identify populations for particular care management programs. Impact Pro contains many standard registries and users can also make their own custom registries. The ICM and population health dashboards mentioned previously are examples of standard registries.

Predictive analytics

Impact Pro has several types of prospective models that predict future cost risk and those that predict future utilization like inpatient events and avoidable emergency department encounters. All models share similar steps in creating a risk score for a member.

Step 1: Data preparation

Readily available administrative data including medical, pharmacy, lab claims, patient demographics and enrollment are used by Impact Pro. Typically 12 months of member experience is used to predict future cost or events in either the next three months or 12 months.

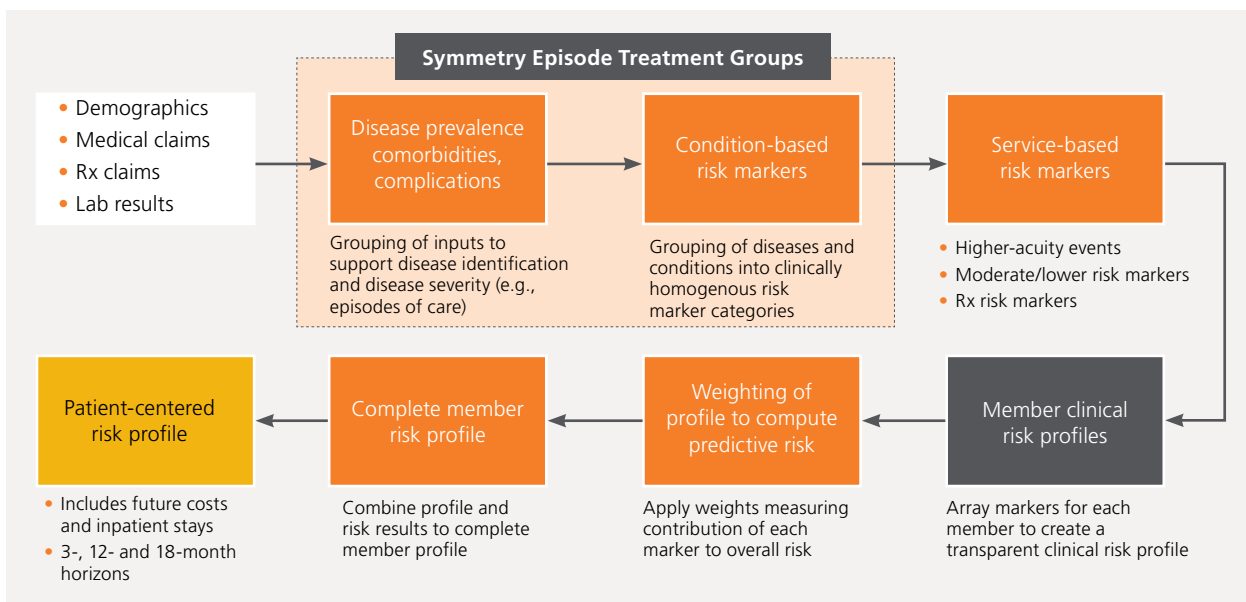### Step 2: Creation of member markers

Markers are elements of risk that are experienced by each member. These can include various episodes of care, comorbidities, severity of episodes, demographics, pharmacy usage, past utilization and SDOH. Claims are grouped into unique episodes of care. These episodes identify a member's mix of conditions and underlying comorbidities.

Step 3: Weighting of markers to compute risk

A profile for each member is created based on the markers that each member triggers. A weight for each marker is tallied to compute the overall risk. Each risk score has its own set of weights. The weights come from predictive models that are created for that particular outcome. Further information on validation of the predictive models is below.

Step 4: Outputting the risk scores

Impact Pro assembles the risk results and other relevant information describing a member and their mix of risk factors to support the data marts, reports and reporting system.

Symmetry Episode Treatment Groups		
• Demographics • Medical claims • Rx claims • Lab results	Disease prevalence comorbidities, complications	Condition-based risk markers	Service-based risk markers

Grouping of inputs to support disease identification and disease severity (e.g., episodes of care)

Grouping of diseases and conditions into clinically homogenous risk marker categories

• Higher-acuity events
• Moderate/lower risk markers
• Rx risk markers

Patient-centered risk profile	Complete member risk profile	Weighting of profile to compute predictive risk	Member clinical risk profiles

• Includes future costs and inpatient stays
• 3-, 12- and 18-month horizons

Combine profile and risk results to complete member profile

Apply weights measuring contribution of each marker to overall risk

Array markers for each member to create a transparent clinical risk profile

Markers of patient risk: A member's episodes of care play a key role in determining member risk. Markers created from episodes of care describe a member's clinical conditions and severity of those conditions. In addition, a member's demographics, SDOH, medications and past utilization are used to create markers of risk. Below, we'll go into more detail about various risk markers.

Base markers: Base markers are derived directly from a member's episodes of care. Impact Pro uses groupings of episodes for this purpose, combining episodes with similar clinical and risk characteristics into the same group. Some groups include a single ETG, while others encompass multiple ETGs. Impact Pro assigns members with one or more of the ETGs in a group to the base marker for that group. Using this approach, it identifies a total of more than 500 episode-related base markers.

Finally, for some clinically related base markers, Impact Pro applies hierarchies — allowing focus on that single clinical condition most responsible for future risk. This step permits additional focus on those episodes best describing a patient's underlying medical condition within a general disease category. For example, a patient with episode activity for both multiple sclerosis (MS) and amyotrophic lateral sclerosis (ALS) would only receive a base marker for MS.

Medical service markers: Medical service markers describe the prior use of medical services for a member related to those episodes of care included in a base marker. These markers reflect both the nature of the services provided and their relative timing. Four key categories of medical service markers are used:

- Higher-acuity event markers
- Episode cluster markers
- Recency of admission markers
- Treatment markers

The higher-acuity event markers describe an acute care inpatient stay or ED encounter during an episode of care. Episode cluster markers represent the number of physician encounters and ancillary services a member experiences outside of the anchor record within the episodes grouped to a base marker. ETGs identify these clusters as part of the process of episode-building. Recency markers are continuous variables that represent how close the last inpatient admissions occurred to the end of the experience period. Treatment markers make use of surgical procedures within a member's ETG episode to evaluate changes in future risk due to these procedures. When a base marker is assigned to a member, the risk engine evaluates whether an associated treatment marker can also be assigned. Treatment markers use the final base marker plus an associated treatment to determine whether additional treatment-based risk is to be assigned. Treatment markers are comprised of surgical procedures, and for some cardiology-based conditions, the specific surgical treatments of coronary artery bypass graft (CABG), valve surgery and angioplasty.

Pharmacy markers: Impact Pro can also define markers using pharmacy claims. These markers supplement the base and medical service markers to identify patients with diseases or conditions or to provide an indicator of severity for patients with the same base marker. Impact Pro assigns pharmacy markers using the presence of a therapeutic agent regardless of diagnosis or conditions found for a member. Additional pharmacy markers can also indicate the complexity of a member's drug regimen. Rx Complex is an additional module available for Impact Pro to evaluate a member's drug regimen. The Rx Complex marker determines risk associated with the complexity of a member's medication history. This marker is a weighted average score, which is the aggregation of scores for different drug therapies observed for the member in the last three months of the experience period, averaged by the number of days the member had pharmacy

coverage in the last three months of the experience period. This score is available as a marker for member risk regardless of licensing of the Rx Complex module.

SDOH markers: Markers for social determinant of health assess risk for elements outside of a member's clinical situation. This data element leverages specific ICD-10 diagnosis codes allowing usage by all clients without the need of an outside data feed. Individual z-codes that are related to SDOH are grouped into 16 markers. Models including SDOH markers were found to have better predictive ability than models without SDOH markers.

Risk models: Cost risk models predict a member's future cost in the next 12 months. Typically, 12 months of member experience are used for the prediction. However, Impact Pro does have partial enrollment models to better predict risk for members who were not enrolled for a full 12 months. Cost risk is shown as a relative number or a predicted cost. The relative risk is a comparative number where 1 is the average risk for a benchmark population. Those with risk scores above one would have a higher predicted cost risk than an average member in the benchmark population. The predicted cost is the predicted PMPM spend for a member calculated from the risk score and the average PMPM spend, which can be customized by the end user. Impact Pro also includes models that have a gap in prediction (12-month cost after a 6-month gap) that are used for actuarial and underwriting purposes.

Probability models: Probability models predict the probability of non-obstetric inpatient admissions or avoidable ED encounters. The inpatient prediction uses 12 months of experience to predict events in the next three months or 12 months.

The ED model uses 12 months of experience to predict events in the next 12 months. The outcome of the model is defined using NYU criteria[3] that classifies emergent and non-emergent ED visits. Avoidable ED was defined as non-emergent ED visits and emergent ED visits that could have been avoided with proper preventive care. The prediction from both models are displayed in Impact Pro as a relative risk and a probability of the event.

SDOH markers
Alcohol and drug use
Diet and exercise
Other health and lifestyle behaviors
Medication regimen non-compliance
Other treatment non-compliance
Sexual activity
Tobacco use
Air and water quality
Education
Employment
Care dependency factors
Childhood and upbringing factors
Family and support group factors
Other psychosocial factors
Social environment factors
Other social and economic factors

Member example: Future cost risk score

Description	Marker model weight	Marker value*	Marker final weight (marker model weight X marker value)
DME high impact	1.2051	1	1.2051
Mal neo thyroid gland wo a/m	2.062	1	2.062
Mal neo thyroid gland wo a/m ER Visit Q123	-3.8712	1	-3.8712
Mood disorder, Bipolar	0.1219	1	0.1219
Mood disorder, Bipolar Sev 34	0.2173	1	0.2173
Mood disorder ER Visit Q123	0.0029	1	0.0029
Chronic sinusitis	2.0223	1	2.0223
Chronic sinusitis Cluster Q4	0.1515	15	2.2725
Oth inflam lung disease IP Linear	0.0204	180	3.672
RX Complex weight	0.05	10	0.5
Females, age 65 to 69	0.5379		0.5379
		Risk score	**8.7427**

Marker values can be binary (yes/no) or continuous values.

Model validation: There are several criteria to consider when assessing the performance of a predictive model. In addition to empirical testing, Optum validates risk markers from a clinical perspective. A key component of the clinical validity of the Impact Pro risk model is its reliance on Symmetry ETG as a foundation for the creation of these risk markers. The proven clinical validity of the Symmetry ETG methodology enhances both the scope and accuracy of Impact Pro and the clinical understanding of the key drivers of risk.

Another main concern is how well the model predicts the outcome. Performance validation is a crucial step in the model development process.

Optum develops Impact Pro predictive models using cost and utilization experience from a large population of 5.6 million patients.

The richness of the database supports validation from a variety of perspectives, from global measures of model performance to expected results in specific use cases. Global performance is often measured using R-squared (R^2) (the percentage of variation in the response predictable by the model) for cost models and AUC (the probability that the model assigns higher risk to a positive outcome than a negative outcome) for event models. However, because many use cases for these models focus on high-risk members, model accuracy within those groups may be more relevant than global accuracy. The tables below provide global performance measures for the cost and inpatient event models as measured on an evaluation data set, as well as a set of relative risk versus actual outcomes for the avoidable ED utilization model. These measurements provide confidence that the Impact Pro models are effective tools for a wide variety of use cases.

Input data type	Model	R^2
Medical + Pharmacy	Cost Risk	0.2952
Medical + Pharmacy	Pharmacy Cost Risk	0.4680
Medical + Pharmacy	Underwriting Cost Risk	0.2132

Input data type	Model	AUC
Medical + Pharmacy	12-Month Inpatient Probability	0.7933
Medical + Pharmacy	3-Month Inpatient Probability	0.8196

Table: Actual ED percentage at different predicted risk ranges

Avoidable ED relative risk ranges	Average actual outcome
0.0–1.0	3.50%
1.0–2.0	8.30%
2.0–3.0	14.60%
3.0–4.0	19.90%
4.0–5.0	25.00%
5.0–6.0	29.50%
6.0–7.0	34.40%
7.0–8.0	38.40%
8.0–9.0	44.30%
9.0–10.0	49.50%
10.0–11.0	52.80%
11.0–12.0	60.90%
12.0–13.0	64.90%
13.0–14.0	71.00%
14.0–15.0	78.50%
15.0+	83.60%

Summary

Impact Pro provides clinical insight, predictive modeling and identification of care opportunities to fully understand needs of a member to power a successful population health management program. As described above, the capabilities are built on longstanding researched clinical foundation. Addressing all the elements in the population health framework necessitates the use of complete platforms like Impact Pro. The tools in Impact Pro blend rules-based clinical rules with advanced analytics to meet the challenges of understanding health care needs of diverse populations and to deliver interventions to those who most need it.

Figure: Impact Pro displays risk scores and categories for all members in one member list, allowing filtering of individuals and understanding various member characteristics

Figure: Member profile allows drill down into individual members to identify drivers of risk and other demographic information

Figure: ICM dashboard shows segmentation of population by clinical risk and care opportunities. Clicking on cells allows further drill down into that category

Impactable Case Management (ICM) Model Summary

Save

Clinical Risk Level	High(>=4)	Moderate(2 - <4)	Low(1 - <2)	None
High(>=10)	1,579 (0.8%)	788 (0.4%)	191 (0.1%)	156 (0.1%)
Moderate(4 - <10)	3,397 (1.7%)	3,275 (1.6%)	957 (0.5%)	350 (0.2%)
Low(1 - <4)	3,677 (1.8%)	7,888 (4.0%)	3,846 (1.9%)	2,435 (1.2%)
None	8,015 (4.0%)	71,675 (35.9%)	59,420 (29.8%)	31,882 (16.0%)
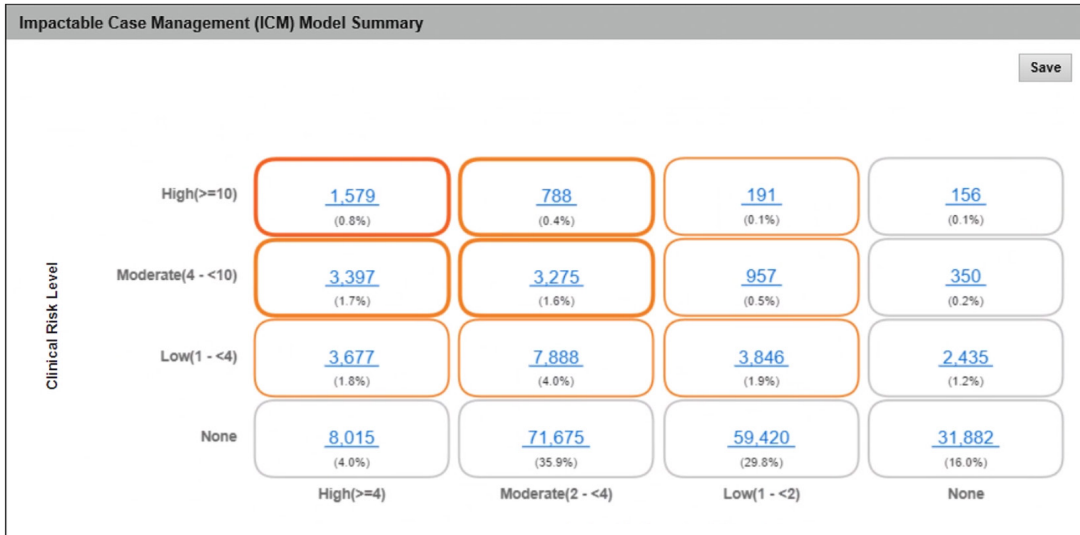
Sources:

1. Population Health Alliance, PHM Framework.

2. For more information about this topic, email empower@optum.com or call 1-800-765-6807 and reference this white paper.

3. Billings J, Parikh N, Mijanovich T. Emergency room use: The New York story. Issue brief, The Commonwealth Fund; Nov. 2000.

About Optum

Optum is a leading health services innovation company dedicated to helping make the health system work better for everyone. We create simple, effective and comprehensive solutions for organizations and consumers across the whole health system by integrating our foundational competencies of consumer experience, clinical expertise, data and analytics and embedded technology into all Optum services. By understanding the needs of our customers, members and patients and putting them at the center of everything we do, we will achieve our aspiration of improving experiences and outcomes for everyone we serve while reducing the total cost of care.

OPTUM ®

optum.com

11000 Optum Circle, Eden Prairie, MN 55344