Symmetry Risk Engine

Analyzing future risk and health care utilization

Understanding the future risk of a population or an individual is crucial for payers and providers to manage costs and care for their members or patients.

For over a decade, the Optum® Symmetry Suite has included risk products that address both retrospective and prospective risk assessment. In addition, the Optum® Impact Pro care management solution has been powered by an internal risk engine developed using the Symmetry technical architecture, called the Optum® Symmetry Risk Engine® (SRE®).

With the release of Symmetry 12.0, Optum is introducing an enhanced version of the Symmetry Risk Engine to the market as a new, stand-alone prospective risk engine within the Symmetry Suite. The SRE product will include:

- A range of prospective risk models that predict future cost risk, as well as models that predict the probability of a future inpatient admission and an avoidable emergency department visit.

- The integration of Symmetry Pharmacy Risk Groups® (PRG®) models with SRE. PRG models rely only on pharmaceutical information to predict future cost risk.

- New, innovative functionality that will allow customers to recalibrate the SRE cost risk models using their own data

- The ability to create custom risk models using the standard SRE risk markers or client defined risk markers and then include them in the processing engine

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Prospective risk models can be used for a variety of purposes. They can identify individuals who are expected to incur high medical expenditures in the coming year or as one component in identifying candidates for care management programs. The models can also be used by actuaries to stratify and analyze populations based on risk, or by underwriters in their pricing algorithms.

Like other products in the Symmetry Suite, SRE is an analytic engine that can be run independently or embedded within broader decision support solutions. It leverages the power of Symmetry Episode Treatment Groups® (ETG®) software, includes an extensive inventory of risk markers, relies on administrative claims and membership data, and predicts a variety of outcomes.

Types of models in SRE

Broadly, SRE offers 3 types of models for both commercially insured and Medicare Advantage populations.

Cost risk models predict a patient's future cost, with a variety of options including:

- Medical-only, pharmacy-only, or total medical and pharmacy cost
- Cost in the next 12 months, or cost in the 12 months following a 3-month or 6-month gap (typically used for actuarial and underwriting purposes)
- Cost specific to behavioral health conditions
- Cost subject to stop-loss thresholds ($100K, $250K, or no threshold)

These models are intended for identification and stratification of members at risk of incurring high future costs, as well as for actuarial pricing and other actuarial and underwriting needs. Cost predictions are also available from the SRE PRG models, which use only pharmacy data as input, for situations when medical claims are unavailable or otherwise less reliable or timely than available pharmacy claims. For more information about the PRG models, see the PRG White Paper.

Inpatient probability models predict the probability of a patient having a non-obstetric inpatient admission in either the next 3 months or next 12 months. These models are intended to assist care managers in identifying members at high risk of inpatient admissions, as a component in designing potential programs and interventions.

The avoidable ED model predicts the probability of a patient having an avoidable emergency department encounter in the next 12 months. The outcome of the model is determined using the NYU Emergency Department Algorithm,* where "avoidable" is defined as non-emergent, emergent but primary care treatable, or preventable through prior intervention. This model is designed to support interventions that help patients at high risk of avoidable ED events access health care in more timely and more effective ways.

Most of the models available in SRE support differences in available input data, i.e., separate models are applied based on whether the patient has only medical coverage or both medical and pharmacy coverage. Also, while the SRE models are designed to use 12 months of prior claims data for predicting the future outcome, many of the models are designed to specifically support partial enrollment, so separate models are applied for patients with shorter enrollment in the prior year to more effectively assess their future risk.

Developing member risk scores

Based on the input claims data, the risk engine compiles a set of risk markers for each member, called the member's *marker profile*.

The basis for the SRE risk markers is the uniquely powerful Optum® Symmetry Episode Treatment Groups methodology, which organizes medical and pharmacy claims data into homogenous units that describe complete episodes of care for approximately 500 distinct clinical conditions. An observed episode for a condition will result in a *clinical base marker* corresponding to that condition, and condition-specific *severity markers* may also be assigned to signify increased condition severity due to comorbidities, complications, or more granular information about the status of the condition.

Risk related to the condition is further quantified by *medical event markers* indicating:

- The frequency and timing of the patient's visits with their physician about the condition
- The presence and recency of an inpatient stay due to the condition
- The presence and recency of an emergency room visit due to the condition
- And/or the performance of any surgical procedures related to the condition

Other risk markers are then assigned based on factors including:

- Age and gender (*demographic markers*)
- Pharmacy prescriptions, both individually (*pharmacy markers*) and the complexity of the patient's total prescription regimen complexity (*Rx Complex score marker*)
- Social determinant of health factors identified from ICD-10 Z-codes (*SDOH markers*)
- DME, oxygen, emergency transport, and other service utilization (*service-based markers*)
- Length of enrollment in the past year (*enrollment markers*)
- Lab results (*lab markers*)
- BMI, family history and susceptibility to certain conditions, added patient complexity due to management of multiple chronic conditions, and numerous other factors

The table below demonstrates the marker profile and resulting total medical and pharmacy cost risk score for a 62-year-old, commercially insured female patient based on her claims data from the prior year. While this patient has several ongoing chronic conditions, her future cost risk is most significantly impacted by her increased provider interaction relating to diabetes (as indicated by the 15 "clusters" of provider activity in the 3 months ending the claims data period) and her recent inpatient stay due to complications of hypertension, which occurred near the end (340 days into) the claims data period. Because she had no recent provider interaction related to her joint degeneration and a surgical procedure to treat it, her future cost risk related to that condition is somewhat minimal. Her medication regimen and the complexity thereof also contribute significantly to her future cost risk. Accounting for all of these factors results in a total cost risk score of 5.1579, indicating that she is expected to have medical and pharmacy costs more than 5 times higher than an average patient in the benchmark population used to develop the models.

Marker description	Marker value	Marker weight	Marker weight x value
Diabetes	1	0.0505	0.0505
Diabetes, clusters, 4–12 mos	3	0.0136	0.0407
Diabetes, clusters, 0–3 mos	15	0.0872	1.3080
Diabetes, severity III	1	0.1263	0.1263
Hypertension	1	0.0205	0.0205
Hypertension, clusters, 4–12 mos	3	0.0060	0.0180
Hypertension, clusters, 0–3 mos	7	0.0118	0.0829
Hypertension, IP timing	340	0.0030	1.0234
Hypertension, severity II, III, IV	1	0.0258	0.0258
Joint degeneration — knee and lower leg	1	0.1446	0.1446
Joint degeneration — knee and lower leg, clusters, 4–12 mos	4	0.0196	0.0784
Joint degeneration — knee and lower leg, severity II, III, IV	1	0.2093	0.2093
Joint degeneration — knee and lower leg, w surgery	1	−0.2726	−0.2726
Mood disorder, depressed	1	0.0182	0.0182
Mood disorder, depressed, clusters, 4–12 mos	1	0.0103	0.0103
Mood disorder, depressed, clusters, 0–3 mos	1	0.0569	0.0569
Antidepressant, anxiety, sedative, cost level 7, Rx source	1	0.1237	0.1237
Diuretics, II, cost level 1, Rx source	1	0.2977	0.2977
Insulins, cost level 3, Rx source	1	0.7904	0.7904
Rx complex weight	6.64	0.0451	0.2993
Chronic condition score ≥9 and <14	1	0.3001	0.3001
12 months enrollment	1	−0.0047	−0.0047
Females, ages 60 to 64	1	0.4102	0.4102
Total Cost Risk Score			**5.1579**

Model validation

There are a number of criteria to consider when evaluating the performance of a risk assessment model.

In addition to empirical testing, Optum ensures clinical validity of the models in SRE by relying on Symmetry Episode Treatment Groups (ETG) methodology as the foundation for the risk markers. The proven clinical validity of the Symmetry ETG methodology enhances both the scope and accuracy of the SRE risk models and the resulting understanding of the key drivers of member risk.

It is also important to address the predictive accuracy of the models, that is, how close actual outcomes are to risks predicted. For cost models, this accuracy is often evaluated by the R^2 statistic, which is the percent of variance in the target variable that is predictable by the model. The table to the right summarizes the R^2 values obtained from an evaluation data set of approximately 4 million members across both commercial and Medicare Advantage lines of business (LOB), with a wide range of demographics, health statuses, and enrollment lengths.

Model	LOB	R^2
Total cost risk	Commercial	0.2952
Pharmacy cost risk	Commercial	0.4680
Behavioral health cost risk	Commercial	0.1828
Total cost risk	Medicare	0.2113
Pharmacy cost risk	Medicare	0.4493
Behavioral health cost risk	Medicare	0.1776

For event models, global predictive performance is often measured using the area under the receiver operating curve (AUROC or just AUC), which is the probability that the model assigns higher risk to a positive outcome than a negative outcome. AUC values for the inpatient and avoidable ED models on the same evaluation data set are given in the table to the right.

Model	LOB	AUC
IP probability	Commercial	0.7933
IP probability	Medicare	0.7447
3-month IP probability	Commercial	0.8196
3-month IP probability	Medicare	0.7719
Avoidable ED probability	Commercial	0.6897
Avoidable ED probability	Medicare	0.7285

Beyond clinical validity and predictive accuracy, models must also be evaluated for their potential impacts on health equity. This requires a holistic view of each model's intended usage and careful consideration of how details of the model's design and performance may affect disparities within the health care system. With this in mind, Optum has established a Responsible Use of Machine Learning program designed to provide a structured approach to using artificial intelligence and machine learning responsibly, including a Machine Learning Review Board which proactively reviews models for unintended consequences and provides guardrails in the application of predictive models within the health care system. For more information about how these models were evaluated as part of this process, please contact your Optum client manager.

Client-side model recalibration and custom models

SRE gives clients the ability to automatically recalibrate existing cost models to better fit their particular data, while maintaining the power of the original models.

The SRE predictive models are built on large, nationally representative commercial and Medicare Advantage datasets. Clients with markedly different populations (e.g., Medicaid enrollees) or highly distinct sub-populations (e.g., with different plan types, payment structures, geography, etc.) may see significantly improved predictive performance with models that account for the unique features of those populations or sub-populations.

Using 2 years of historical claims data as input, SRE derives risk markers and cost risk scores from the first year of data and computes the appropriate costs from the second year of data. Recalibrated risk models are then developed that adapt the original SRE models to the specifics of the client's data, and the scores from these recalibrated models are output in future runs of the risk engine. Like many of the standard models in SRE, the recalibrated models support both differences in input data (with separate models applied based on the availability of pharmacy data) and variation in enrollment lengths (with separate models applied to members with varying lengths of enrollment). The recalibrated models support further segmentation by a user-defined input field, which can be used to segment separate plan structures, benefit types, geographical regions, or any other meaningful population division.

In the example below, 2017–2018 data from a commercial health plan with 4 different plan divisions was used to recalibrate the standard commercial SRE total medical and pharmacy cost model, resulting in models tailored to each plan segment individually. The recalibrated models were then used to predict cost outcomes for the same organization in 2019, resulting in a 4.2% relative improvement in R^2 on the largest plan, and an 18.4% relative improvement in R^2 on the non-standard plans. Due to the nondeductible and PPO plans having less data and being more standard in design, the associated recalibrated models remained close to the standard SRE model and saw minimal change in predictive performance.
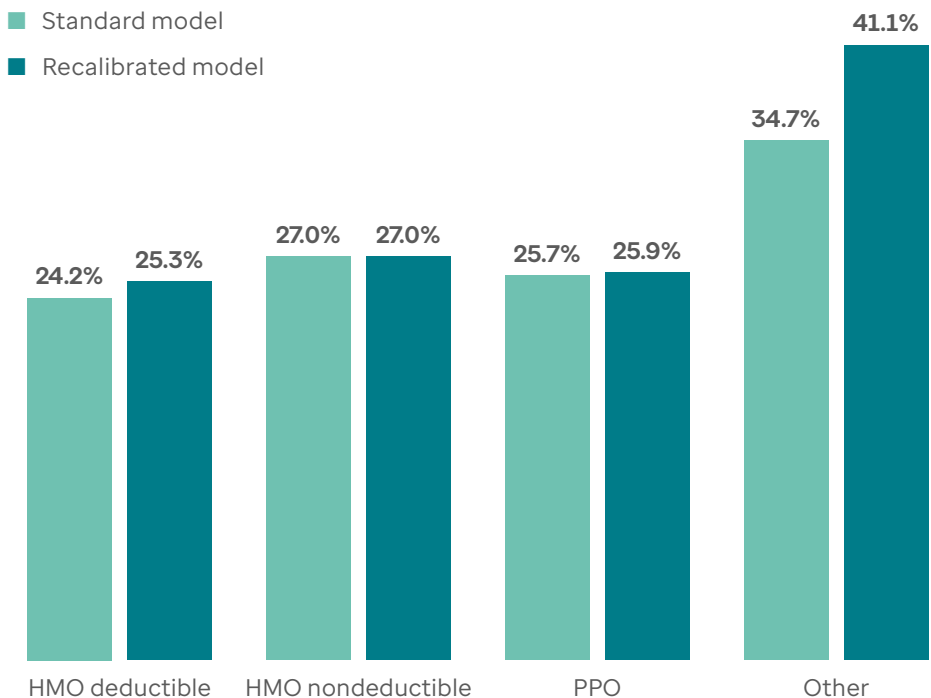
Member counts	
HMO deductible	139,997
HMO nondeductible	18,403
PPO	32,096
Other	19,483

SRE also supports integration of custom models built on the robust SRE risk marker framework. Clients' data scientists can use the SRE risk markers to build custom risk models for their specific outcomes and use cases, and incorporate those models directly into the risk engine output. SRE can also process custom risk markers, so clients can integrate factors specific to their data into their custom models. For example, an organization wanting to design a new maternity care management program or evaluate an existing program could create a custom model predicting premature births among their pregnant population. They could then use this model to assist with identifying patients who may benefit from their program, or use the model to evaluate the program's effectiveness at avoiding premature births.

Optum support and consulting services are available for clients who need assistance taking full advantage of the recalibration and/or custom model functionalities in SRE.

Conclusion

Risk assessment is increasingly important for health care organizations in managing costs and providing optimal care for their patients. The Symmetry Risk Engine provides the predictive modeling capabilities necessary for organizations to understand the clinical patient profiles within their population and how they impact future cost and adverse outcome risk. SRE also reflects the Symmetry Suite commitment to flexibility, by allowing users to recalibrate models to best fit their own data and build custom models to meet their own needs. Between the wide range of available models and unlimited potential for customized solutions, SRE can help organizations assess any aspect of future risk for their members or patients.

Contact us to learn more about how the Symmetry Risk Engine can help you assess future risk and health care utilization:

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