Optum

Symmetry Episode Risk Groups

A successful approach to cost risk assessment

Introduction

Risk assessment is the measurement of the expected health care cost or utilization of an individual or population. It enables health plans and other managed care organizations to assess the risk of the members they enroll and to predict the potential medical and pharmaceutical costs associated with those risks.

Risk assessment is a critical tool for any health care organization, whether to:

Support accurate payment rates

Obtain meaningful comparisons of provider performance

Identify patients of highest cost risk

Symmetry® Episode Risk Groups® (ERG®) represents a modern approach to measuring risk, using an individual's episodes of care as markers of risk, rather than simply using diagnoses from medical encounters. These episodes are built by collecting all inpatient, outpatient and ancillary services into mutually exclusive and exhaustive categories, which provides details about a patient's underlying medical condition, rather than just the individual services provided in its treatment. This focus allows ERG to provide appropriate incentives for medical care, supporting a wide range of practical applications.

The episodes supporting ERG development are created using the uniquely powerful Episode Treatment Groups® (ETG®) methodology. This methodology provides clinical richness while relying on information readily available in medical and pharmacy claims. Each ETG has an episode-specific severity score that reflects the risk due to a patient's demographics, comorbidities and condition-specific complications. The incorporation of this severity score into ERG allows for significant differentiation of risk within the same base condition.

ERG offers three model options:

- **Retrospective (or concurrent)** models use risk markers for an individual for a base year to measure cost risk for that same year. Retrospective models can be used for risk adjustment of the conditions a member was actually treated for. They're often used for comparisons of provider and health plan performance, such as physician profiling.

- **Prospective** models use risk markers for an individual for a base year to measure cost risk for the next year. Prospective models are often applied when setting payment rates, or for risk stratification of members.

- **Actuarial/underwriting** models use risk markers for an individual for a base year to measure cost risk for a 12-month period beginning 6 months after the base year. Actuarial models are used for determining future risk in situations where a prospective model may not be immediately useable, due to expected delays in claims data or delayed application of the risk scores.

These models are available with different variations of input and output data requirements, cost threshold values and enrollment criteria, to meet a wide variety of business needs. Separate models are available for both commercially insured and Medicare Advantage populations.

The next section of this paper provides an overview of four main steps in the ERG 10.0 grouping and ERG scoring process. A second section provides an assessment of the predictive performance of ERG 10.0 risk prediction models. The examples and performance statistics provided in this paper are specific to the models for commercially insured populations. But similar functionality is available for Medicare Advantage populations.

ERG: Grouping and risk-scoring process

The ERG approach involves four important steps (see Table 1):

1. **Create ETG episodes of care.** The building blocks of ERG are created using ETG methodology. The software identifies and combines related services – both diagnostic and procedural – into medically relevant units describing complete episodes of care. Each patient will have an ETG for each of their episodes of care during the review period.

2. **Map ETGs to ERGs.** Episodes are further categorized into one of 862 Episode Risk Groups. The ERGs, markers of member risk, are based on the member's ETGs and associated severity levels, which account for the clinical comorbidities and complications affecting each episode. In the case of a member having related ERGs, a hierarchy is applied to determine which is most clinically meaningful. A member can be assigned zero, one or, if they have multiple medical conditions, multiple ERGs.

3. **Develop member's ERG profile.** Age, gender and mix of ERGs provide a clinical and demographic risk profile for a member.

4. **Create member risk scores.** A member's risk score is computed by summing the predetermined weights attached to each ERG and to the demographic characteristics observed in their profile. Retrospective, prospective, actuarial and demographic risk scores are computed for each member.

Table 1

ERG development of member cost risk score

Inputs	Process	Outputs
Medical claims data Pharmacy claims data Member enrollment data	**Step 1: Create ETG episodes of care** Using the ETG methodology, enrollment data, and the diagnostic and procedural information available on medical and pharmacy claims, health care services for a member are first assigned to unique episodes of care (ETGs). **Step 2: Map ETGs to ERGs** Episodes are further categorized into one of 862 Episode Risk Groups, based on the member's ETGs and associated severity levels. A member can be assigned zero, one or multiple ERGs. **Step 3: Develop member's ERG risk profile** Age, gender and mix of ERGs provide a clinical and demographic risk profile for a member. **Step 4: Create member risk scores** A member's risk score is computed by summing the predetermined weights attached to each ERG and to their demographic characteristics. Retrospective and prospective risk scores are computed for each member.	Retrospective risk score Prospective risk score Actuarial/underwriting risk score Demographic risk score

Step 1

Create ETG episodes of care

The fundamental building blocks of ERG 10.0 are the individual ETG episodes of care observed for each member. The foundation of an episode is an anchor record, which demonstrates that a clinician has evaluated the patient and decided which further services may be required to identify or treat a medical condition. Three types of services are eligible to be anchor records:

- A claim submitted by a clinician for services related to the evaluation of a member's condition
- A claim submitted by a clinician for services for surgical or related procedures
- A claim submitted by a treatment facility for room and board or emergency room services

Ancillary records such X-rays, pharmaceuticals and lab tests are grouped to the most appropriate anchor record, based on the type of provider, the nature of the service performed and the diagnoses assigned. This process creates clinically relevant clusters around each anchor record.

Clusters are then grouped into episodes based on a series of clinical rules. ETG prioritizes related medical conditions, allowing focus on the condition that best describes the mix of services required for the ongoing evaluation, management and treatment of an episode of care. For incidental diagnoses, rather than indicate a separate incidence of a new condition, ETG combines the services into the episode for the primary disorder. This complex, hierarchical grouping of conditions provides a "filter" for characterizing markers of patient risk.

The complete episodes are assigned to a base ETG category, examples of which are shown in Table 2.

Note that base ETGs can be created from pharmaceutical claims alone, to accommodate cases in which a physician prescribes medication for an ongoing condition without requiring the patient to make an office visit. These instances are not technically episodes of care. They are categorized into base ETGs based on the likely indications for the drug treatment prescribed in order to retain as much information as possible from the original claims data. These pharmacy-only base ETGs have been proven valuable in assessing total risk.

Next, the ETG methodology identifies any episode-specific comorbidities and complications. Comorbidities represent ongoing chronic conditions that impact treatment requirements for the episode. Complications indicate a sicker patient who may require more extensive treatment for a related condition.

A model specific to each base ETG's unique pattern of increased severity factors in presenting comorbidities and complications. This helps determine whether there is substantial variation in the resource costs of the episodes in that ETG that merit division of the episodes into distinct levels.

Table 2

Examples of base ETGs

ETG	Description
130100	AIDS
130200	HIV sero-positive w/o AIDS
901100	Rx only – HIV/AIDS antiviral treatment
207200	Leukemia
238800	Mood disorder, depression
386900	Cardiomyopathy
351500	Glaucoma
903300	Rx only – glaucoma treatment
437200	Viral pneumonia
440000	Malignant lung metastases
521800	Cirrhosis
601100	Pregnancy with delivery
667600	Parasitic skin infection
711902	Major joint inflammation, knee and lower leg
711400	Adult rheumatoid arthritis

If there is such variation, the episodes are split into 2, 3 or 4 severity levels. If there is minimal variation, all episodes in the base ETG are assigned severity level 1.

Variation introduced by different types of treatment – such as whether surgery is performed or the type of surgery performed – is not factored into ETG severity levels. Therefore, patients with the same ETG and severity level will have comparable risk based on clinical status alone.[1]

Step 2

Map ETGs to ERGs

The ETG output provides a record of the different episodes of care identified for an individual. A key step in developing Episode Risk Groups is deciding how these episodes can best be used as markers of risk. Both clinical input and empirical evidence guided the mapping, which involves several steps and assumptions:

- Episode Treatment Groups with relatively low prevalence were combined with other Episode Treatment Groups based on clinical similarity and implications for risk assessment.
- ERG assignment does not vary with the number of episodes or ETGs observed for an individual within the same ERG. Patients with single or multiple episodes within an ERG receive identical assignments.
- ERG assignment is not dependent on episode completion status. (Episode Treatment Groups are considered complete when no related treatments are identified within a time frame that is specific to the Base ETG.)
- To enhance clinical relevance and homogeneity in terms of risk, in each of the other steps described, ETGs were typically combined only with other ETGs in the same major practice category (see Table 3).
- Finally, in assigning episodes to ERGs, a hierarchy was employed that prioritizes selected related ETGs within an MPC. This method prevents duplicating or overestimating risk for members with closely related medical conditions.

In general, to keep the risk prediction blind to choices in utilization, differences in treatment are not factored into the ERGs. The risk assessment should not reward or penalize treatment decisions, such as the decision to admit a patient to the hospital, perform a surgery or prescribe a medication. That means the assessment may be useful for payment purposes or assessing efficiency in providing medical care.

Table 3

Major practice categories

MPC	Description
1	Infectious diseases
2	Endocrinology
3	Hematology
4	Psychiatry
5	Chemical dependency
6	Neurology
7	Ophthalmology
8	Cardiology
9	Otolaryngology
10	Pulmonology
11	Gastroenterology
12	Hepatology
13	Nephrology
14	Urology
15	Obstetrics
16	Gynecology
17	Dermatology
18	Orthopedics and rheumatology
19	Neonatology
20	Preventive and administrative
21	Late effects, environmental trauma and poisoning
22	Isolated signs and symptoms

1. The ETG output includes a treatment indicator, a guide to the type of treatment the patient received, so those data can be included in analysis at the episode level.

The exception to this rule is anti-neoplastic chemotherapy and radiation therapy. Because of the high clinical stakes involved with these therapies, the decision to pursue anti-neoplastic treatment is considered to be a good indicator of actual disease status. Therefore, ERG does consider indicators of active cancer management in risk group assignment.

Step 3

Develop ERG profile

A member's age, gender and mix of ERGs are used to create their ERG profile. Every member is assigned to an age-sex group, using 17 age groups: 0–1, 2–12, 13–18, 19–24, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59, 60–64, 65–69, 70–74, 75–79, 80–83 and older than 83. Members without claims will have no episodes of care and no ERGs. For these members, risk is based solely on age, gender and length of enrollment.

Members with claims are assigned to one or more ERGs depending on their mix of episodes of care. The rules employed in mapping ETGs to ERGs are identical for all three applications of the model: retrospective, prospective and actuarial/underwriting (a prospective variant).

Step 4

Create member risk scores

The next step is the assignment of a weight to each ERG and demographic marker of risk. These weights describe the contribution to risk of being in a specific age-sex group or having a particular medical condition included in an ERG. The model of risk can be defined generally as:

$$RiskR_i = a_s * AgeSex_{i,s} + \sum b_e * ERG_{i,e}$$

Where $RiskR_i$ is the ERG risk score for person i; $AgeSex_{i,s}$ indicates their age-sex group(s); $ERG_{i,e}$ indicates their ERG (e) assignments; and a_s and b_e represent the risk weights. The age-sex and ERG markers are set to 1 if the marker is observed for an individual, 0 if not. Each member has their own profile of age-sex and ERGs. A person's risk score is the sum of these risk weights for each marker observed.

ERG 10.0 provides significant flexibility for supporting different business applications and data availability. Models are built by combining the following options, as dictated by specific business needs:

- **Retrospective and prospective applications** – An ERG may have a different impact on risk depending on whether current or future risk is being measured. Chronic conditions have similar impacts on current and future risk. In contrast, acute conditions generally have a greater impact on retrospective than prospective risk. To accommodate this, separate models are defined for retrospective, prospective and actuarial applications. Risk weights for each model are derived separately.

- **Actuarial and underwriting timing** – A/U practices require time between the period used in measuring risk and the future time period being predicted. This allows the additional time necessary for claims lag and analysis prior to development of group premiums. The ERG A/U model has a six-month interval between the experience period and the prediction period.

- **Pharmacy benefit status** – Separate models are available depending on the availability of pharmacy input data and/or the need to predict pharmacy-related costs. Medical claims data can be used alone to predict either medical cost risk or medical plus pharmacy cost risk, or medical plus pharmacy claims data can be used to predict medical plus pharmacy cost risk.

- **Length of enrollment** – A member's length of enrollment may impact their risk. Partial enrollment models utilize different risk weights corresponding to the member's length of enrollment during the period used to measure risk.

- **Dollar thresholds** – ERG models support application of either a $100,000 or $250,000 cost threshold, above which costs are truncated. This option is important for several reasons. First, truncating expenditures for higher-cost members limits the impact of extreme outliers on model development and testing. Second, most real-life applications of cost risk assessment involve some use of a threshold or stop loss above a predetermined catastrophic amount.

As seen in Table 4, the type of claims input into the processing engine, the risk outcome desired, the risk score being produced, the length of enrollment being analyzed and the expenditure threshold are all factors in determining which model is used when calculating a given risk score. Each option can be combined with any combination of other options to most appropriately assess the risk of the target population.

Table 4

Options for ERG models	
Claims input/to predict claim costs	Med&Rx/Med&Rx; MedOnly/Med&Rx; MedOnly/MedOnly
Member risk-prediction period	Retrospective; Prospective; Actuarial/Underwriting (A/U)
Length of member enrollment	1–3 months; 4–6 months; 7–9 months; 10–12 months
Expenditure threshold	$100,000; $250,000

Each set of options uses a different set of predefined weights. A total of more than 60,000 separate risk weights produce very finely calibrated ERGs.

Estimating ERG risk weights

The risk weights for ERG 10.0 were determined using regularized linear regression and a data set containing member enrollment, medical claims and pharmacy claims data for a managed care population of more than 8 million members. The ERG development data were obtained from the Optum national database comprised of claims and membership information aggregated from a number of data sources.

Tables 5–7 provide three examples of how retrospective, prospective and A/U ERG risk are calculated. The total risk scores in each table reflect each member's measure of risk relative to that of the overall population used in developing ERG 10.0. A score of 1.00 indicates risk comparable to that of the development population; a score of 1.10 indicates 10% greater risk; a score of 0.85, 15% lower risk and so on. The score is the sum of risk weights that are specific to the model being used, the conditions found and demographics.

The first example presents a 58-year-old man who, over a 10-month enrollment period, was observed to have five unique episodes of care: diabetes, ischemic heart disease, an ulcer and two episodes for a minor skin problem. These ETGs map to four different ERGs. Risk calculations are based on the presence or absence of the patient's actual underlying medical condition, not the number or type of treatments. For example, the two acute incidents of minor skin problems are combined into a single ERG.

Table 5

Examples of ERG risk score assignment

Example 1: Male, age 58
Model: MedRX-MedRX, 100k threshold, 10–12 months

ETG	Severity level	Description	ERG	Description	Retrospective risk weight	Prospective risk weight	A/U risk weight
163000	2	Diabetes	163000_0_2	Diabetes, severity 2	0.8258	1.0922	1.1732
386500	1	Ischemic heart disease	386500_0_1	Ischemic heart disease, severity 1	0.6524	0.5171	0.4507
473800	3	Ulcer	473800_0_3	Ulcer, severity 3	1.1726	0.6749	0.6234
666800	1	Contact dermatitis	666800_0_1	Contact dermatitis, severity 1	0.1136	0.0341	0.0185
666800	1	Contact dermatitis	666800_0_1	Contact dermatitis, severity 1	–	–	–
Demographic risk group: Male 55–59					0.0532	0.4387	0.5264
Enrollment length of 10 months					0.0579	0.0147	0.0388
Total risk score					**2.8755**	**2.7717**	**2.8310**

The three right-hand columns of Table 5 show the risk weights assigned to each ERG, to the patient's age-sex group and to the patient's enrollment length, and the three resulting total risk scores. The 58-year-old male described in Example 1 has a prospective total risk score of 2.7717, indicating a high level of cost risk – almost three times that of the average person for the large managed care population used to develop ERG. His retrospective total risk score, 2.8755, is higher than his prospective score because it is driven by an ulcer, which may not be a recurring condition and therefore presents less risk for the next year. The prospective and A/U model total risk scores also differ, reflecting the impact of different timing for the predicted outcome. The risk attributed to the ulcer decreases even more for the A/U model. The additional risk provided by the member's enrollment length reflects the small amount of uncertainty as to the member's true conditions, when compared to a member with a full 12 months of enrollment.

This example also demonstrates the continued risk of significant chronic conditions, such as diabetes and heart disease. The risk weights are specific to the underlying clinical condition: factors such as whether the patient is insulin dependent, and the presence and type of comorbidities contribute to the risk weight.

The second example, a 14-year-old girl with full enrollment in the prior year, demonstrates the effect of another chronic condition, asthma, the risk of which is fairly stable across models, and an acute infectious disease, the risk of which is decreased after enough time has passed (as evidenced by the decreased A/U weight). Because we have a more complete picture of her condition due to her full enrollment, her risk is slightly reduced by her enrollment length weight.

Table 6

Examples of ERG risk score assignment

Example 2: Female age 14
Model: MedRX-MedRX, 100k threshold, 10–12 months

ETG	Severity level	Description	ERG	Description	Retrospective risk weight	Prospective risk weight	A/U risk weight
438800	1	Asthma	438800_0_1	Asthma, severity 1	0.2560	0.2047	0.1835
473100	1	Infection of stomach and esophagus	437100_0_1	Infection of stomach and esophagus, severity 1	0.0932	0.1044	0.0586
Demographic risk group: Female 13–18					0.0538	0.1742	0.2272
Enrollment length of 12 months					−0.0489	−0.0157	−0.0232
Total risk score					**0.3541**	**0.4676**	**0.4461**

The third example, a 35-year-old woman, shows how the risk of a high severity fracture has a high retrospective risk weight, but significantly decreased risk for both the prospective and A/U time periods. ERGs for similar high cost but highly acute events tend to show similar patterns of risk (e.g., appendicitis, pregnancy with delivery).

Table 7

Examples of ERG risk score assignment

Example 3: Female age 35
Model: MedRX-MedRX, 100k threshold, 10–12 months

ETG	Severity level	Description	ERG	Description	Retrospective risk weight	Prospective risk weight	A/U risk weight
317500	1	Carpal tunnel syndrome	317500_0_1	Carpal tunnel syndrome, severity 1	0.3045	0.1720	0.1484
713101	4	Closed fracture or dislocation – foot & ankle	713101_0_4	Closed fracture or dislocation – foot & ankle, severity 4	2.3811	0.1128	0.0201
Demographic risk group: Female 35–39					0.0513	0.3424	0.4152
Enrollment length of 12 months					−0.0489	−0.0157	−0.0232
Total risk score					**2.6880**	**0.6115**	**0.5605**

ERG: How well does ERG perform?

There are a number of criteria to consider when evaluating the performance of a cost risk assessment model. The previous section demonstrated the administrative practicality and clinical relevance of ERG 10.0 for both risk adjustment and population stratification. However, it is also important to address the predictive accuracy of the models: how close actual expenditures, or risks, are to risks predicted. This accuracy is often evaluated by the R^2 statistic, which is the percentage of variance in the target variable that is predictable by the model. An R^2 of 1 indicates that the model perfectly predicts the outcome on the evaluation data set, and an R^2 of 0 indicates that the model performs no better than simply using the population average. Table 8 summarizes the R^2 values obtained from an evaluation data set of over 4 million members. This population is similar to one that most users would have: a commercially insured population with a wide range of demographics, health statuses and enrollment lengths. Costs for members with annual expenditures exceeding the indicated thresholds were truncated to the given threshold amount.

Table 8

Predictive performance of ERG 10.0

Expenditure threshold (annual)	Input/output	Retrospective ERG R^2	Prospective ERG R^2
$250,000	Med/Med	0.57	0.19
	Med/MedRx	0.57	0.25
	MedRx/MedRx	0.57	0.26
$100,000	Med/Med	0.57	0.20
	Med/MedRx	0.57	0.27
	MedRx/MedRx	0.57	0.28

The R^2 values for retrospective ERGs are consistent across expenditure thresholds and input/output types. As expected, ERG predicts an individual's current year expenses most precisely. For prospective ERGs, R^2 values range from 0.19 to 0.28, as prospective models are more heavily influenced by the added variation due to choices of threshold and output type.

Summary and conclusions

Cost risk assessment is increasingly important for the day-to-day operations and strategic decision-making of health care organizations. Risk assessment is also a critical component of health-based payment systems and plays a key role in effective resource allocation and in targeting opportunities for clinical and financial improvement.

Cost risk assessment has a number of practical applications for health care analysis and health services research. Accurate assessment is essential to creating valid comparisons of the efficiency and quality of the services provided to patients. It also plays an important role in underwriting and actuarial processes.

Symmetry ERG provides an effective tool for understanding patient profiles of medical conditions and how they impact current and future cost risk. The efficiencies gained by organizations using consistent methods for performing both risk assessment (ERG) and episode-of-care grouping (ETG) also offer significant advantages. The ETG methodology and the architecture for mapping ETGs to ERGs employ systematic, logical and transparent clinical approaches.

Optum strives to continually improve ERG. As the field of medicine evolves and predictive modeling techniques advance, updates to ERG will be made.

About Optum

We're evolving health care so everyone can have the opportunity to live their healthiest life. It's why we put your unique needs at the heart of everything we do, making it easy and affordable to manage health and well-being. We're delivering the right care – how and when it's needed; providing support to make smarter and healthier choices; and making prescription services easier while helping you save money along the way. It's everything health care should be. Together, for better health.

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