What do we gain in underwriting by accessing medical claims data in addition to pharmacy prescriptions?

Assessment of underwriting rules and Irix® Risk Score

Guizhou Hu
Vice President,
Head of Risk Analytics

Laiping Wong-Stewart
Vice President
and Actuary

Jacqueline Waas
Vice President,
Underwriting Research
and Development

Taylor Pickett
Vice President
and Actuary

RGA

www.rgare.com

Introduction

Medical claims data, also known as "Dx," contain medical billing codes for diagnoses and procedures during patient encounters with healthcare providers. Pharmacy prescriptions, also known as "Rx," contain historical medication fills. The Milliman Intelliscript Medical Data product provides a view of up to seven years of historical Rx and Dx data. In addition to the raw data, IntelliScript also provides Milliman Irix Rules Engine and Irix Risk Score for mortality.

Irix Rules

Irix rules work similarly for both Rx and Dx. Each rule indicates a medical condition (such as benign skin condition) or medication type (such as corticosteroid). Each rule also comes with a unique identifier or "rule number" and a "rule modifier" to account for recency and other updates. Each rule has a suggested risk class, which can be customized by carriers according to their own underwriting philosophies, a process also known as rule calibration.

Rule-specific conditions can roll up to a condition group based on a condition classification hierarchy. For example, various types of cancers can roll up to all cancer as a condition group. Rule decisions can roll up to an individual's overall risk classification. For a given individual, if there are multiple rules that are triggered, then those rules will roll up to the worst class for the final individual risk-class suggestion.

Irix rules provide the underwriter with an easily understandable decision they can use to communicate decisions to agents, clients, and regulators. However, they have limited ability to account for the multivariate impact coexisting conditions have on the underwriting risk.

Risk Scores

Risk scores, conversely, are very adept at working in a multivariate environment. The predictive model development involves data-driven model training and testing. The inherent benefit of a predictive model is its capability to use data to assess relationships between features and risks, and account for those multivariate relationships among various features.

The results, however, are not always as easily understandable and can lack transparency. Milliman IntelliScript addresses this by equipping underwriters with both the raw data and a Risk Score summary to give context around which rules contributed to the score.

There is an additional concern of model overfitting, meaning the model may fit too closely to the dataset on which it was trained. This can be addressed through external independent validation and study. For example, a carrier could perform its own retrospective experience study.

Objective

The purpose of this study is to evaluate and gain a better understanding of the incremental value medical claims have in addition to prescription data. This was assessed from the perspective of Irix rules and the Risk Score for mortality. Our objectives were two-fold:

1) To illustrate and quantify the benefit of adding Dx to Rx; and
2) To illustrate the differences in value and use of rules versus scores.

Study Data

Milliman provided RGA with two data sets to perform the analysis.

1. Data set Number 1 included 25,000 deidentified life insurance applicants across 25 carriers. This data set contained detailed Irix Rx and Dx rules along with Milliman's starting risk classification per rule. For the purposes of this study, we limited the applicants to those who had both Rx and Dx hits, and excluded Rx eligibility only (N=19,162).

   The data not only allow us to make risk classification comparisons between Rx only and Rx-plus-Dx at the individual person level, but also to stratify the comparisons by condition group. This stratified approach helped illustrate the value of Dx data and where that value was found.

2. Data set Number 2 (Milliman Risk Score validation study set), included 42 million individual insurance applicants from 2005-2020 who had Risk Score 3.0 (Rx) and Risk Score 3.0 (Rx, Dx) and mortality experience. Just as in data set Number 1, the applicants were limited to those who had both Rx and Dx hits and excluded Rx eligibility only. In addition, we only looked at life insurance applicants with ages between 18-64 years (N=13 million).

Results

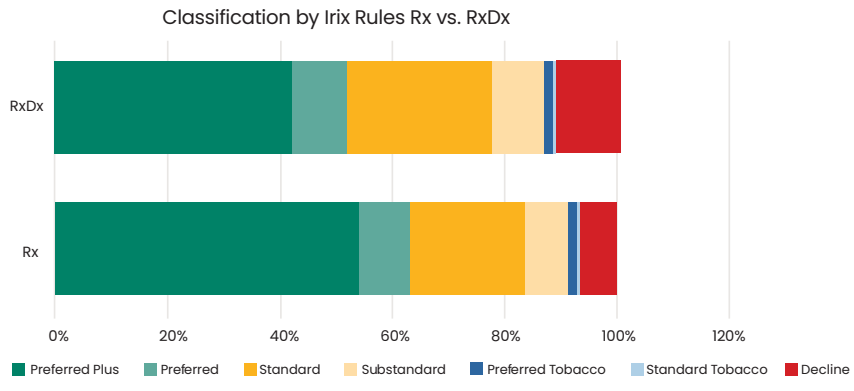
The incremental value and benefit of adding Dx to Rx from Irix Rules Perspective

With data set Number 1 (25,000), we compared individual risk classification by Irix rules between Rx only and Rx-plus-Dx. As shown in Figure 1, adding Dx to Rx shifts the risk classification to a higher risk class. Specifically, with Rx-plus-Dx, more cases are rated as declined (red) and less qualified for preferred-plus class (dark green) when compared with Rx alone. Thus, Dx is able to identify more adverse risk than Rx alone.

Figure 1 shows a comparison of Rx only versus RxDx combination among insurance applicants who had both Rx and Dx hits. Milliman's default Irix rules were used for risk classifications.

More detailed comparisons, stratified by 18 main condition groups, are shown in Figures 2 and 3. While Figure 2 is about the frequency of decline, Figure 3 is about adverse risk load among non-decline cases.

Figure 1

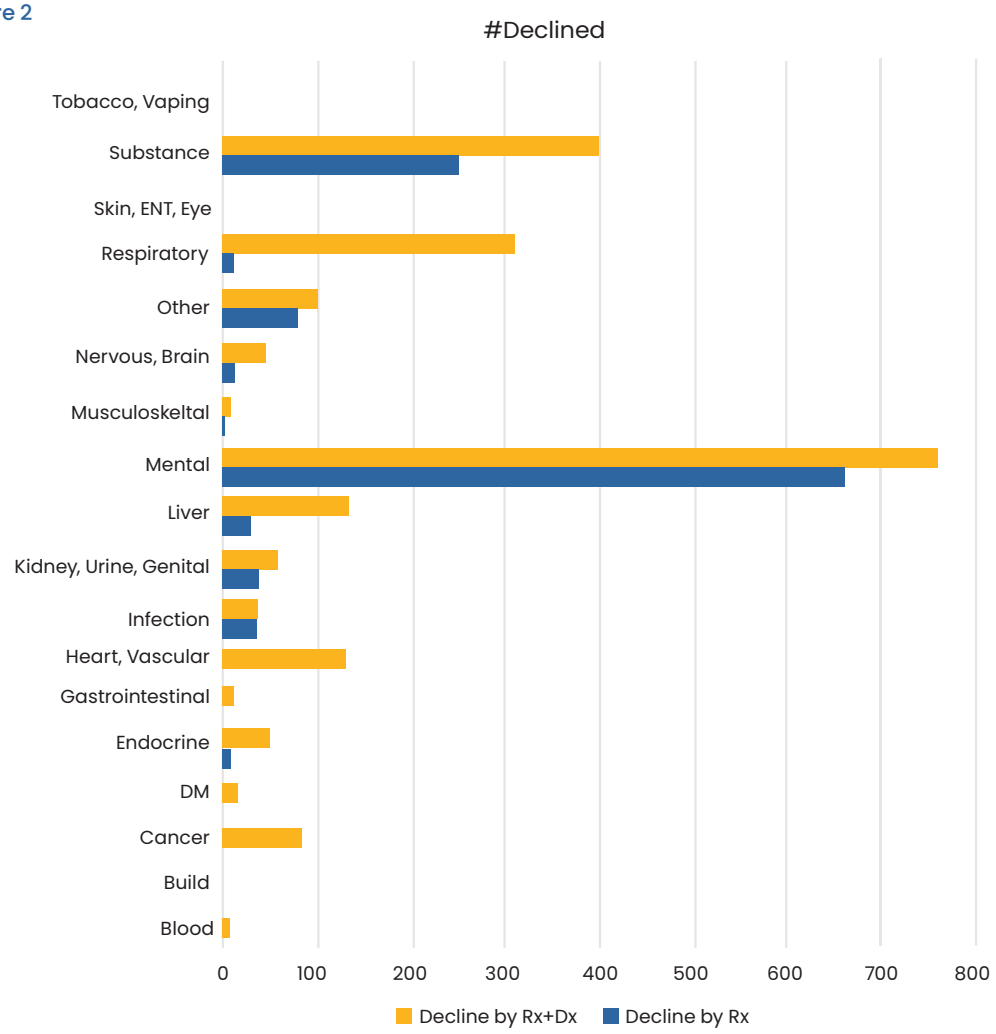


Findings from Figure 2 are:

1. While Dx increases declines across all condition groups, the most significant increase was on respiratory condition.
2. After Dx is considered, mental health and substance abuse remain the top two reasons for decline.

Figure 2 shows the number of declined cases by Rx only vs. Rx-plus-Dx, stratified by medical condition groups.

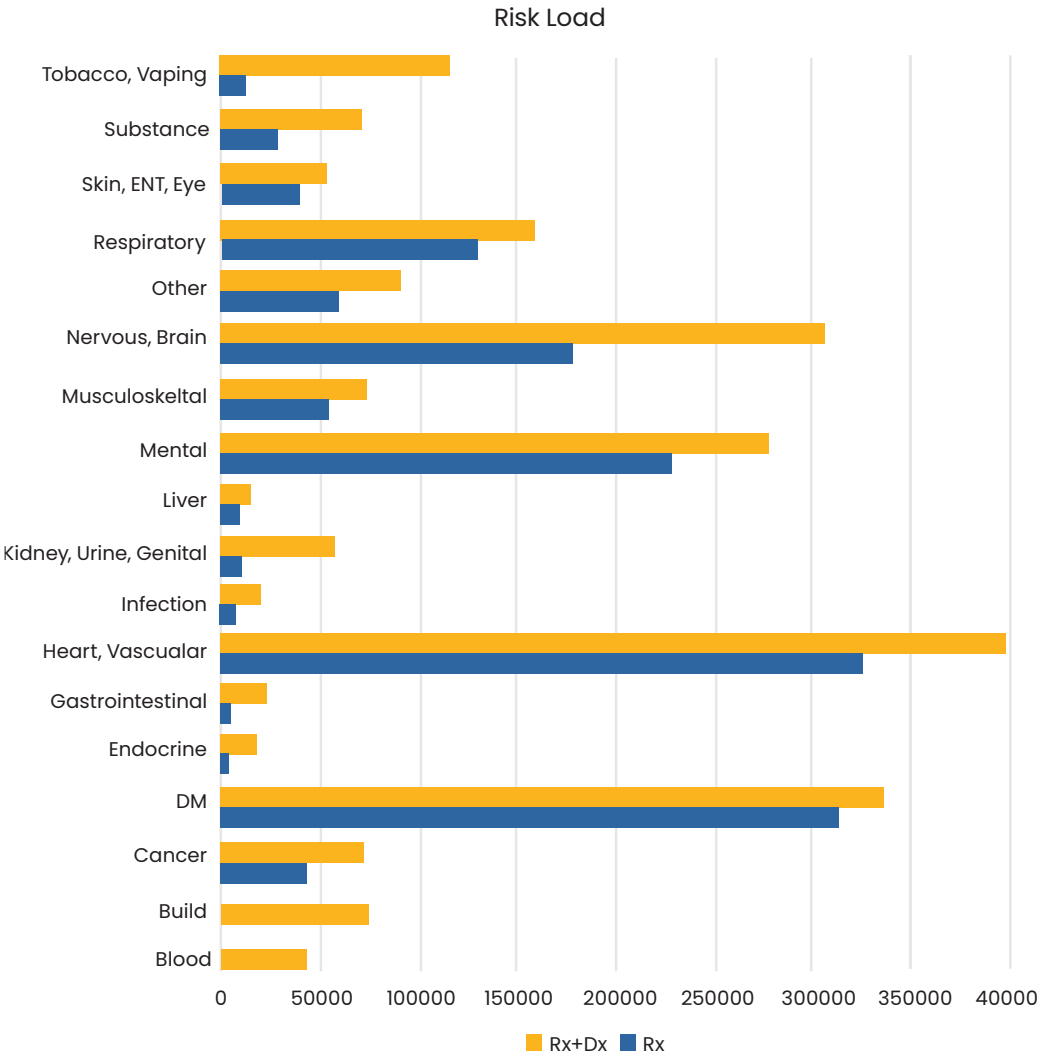
Figure 2



For non-declined cases, we calculated adverse risk load, which is a concept that is like total debits. Instead of treating standard as zero debits, we made the preferred-plus class as having zero adverse risk load. The second-best class (preferred), with assumed mortality ratio over the preferred plus class of 129%, was regarded as having a risk load of 29. Similarly, the risk load of standard NT, substandard NT, preferred tobacco, and standard tobacco are 66, 232, 224 and 301 respectively. The total risk load was a summation of risk load among all cases. Comparisons of risk load among all non-declined cases are shown in Figure 3.

Figure 3 shows the risk load by Rx only vs. Rx-plus-Dx, stratified by medical condition group.

Figure 3



Findings from Figure 3 are:

1. Dx increases risks across all condition groups.
2. The Dx impact of risk on respiratory condition is much less significant than what is for decline.
3. Diabetes (DM) and heart and vascular diseases, mental health, brain, and nervous system conditions remain the top four sources of risk among non-decline cases for both Rx and RxDx.

We further extended the analysis by including estimated mortality impact. The results are shown in Tables 1-4. The findings are:

1) Adding Dx data decreases the size of preferred-plus (best class) from 53% to 43% (Table 1) with an estimated mortality reduction from 105% to 100% (Table 2) after a set of mortality assumptions were applied.
2) Adding Dx data would decrease the accept rate from 94% to 90% due to the additional 4% declined by Dx (Table 3). The estimated mortality among accepted classes decreased from 119% to 100% (Table 4).

Table 1 illustrates how adding Dx data would decrease the size of the best class offering rate (rule perspective, analysis on data set Number 1).

Table 1

s

		RxDx		
	Classification	Best	Other	
Rx only	Best	43%	11%	53%
	Other	0%	47%	
		43%		100%

Table 2 illustrates the estimated mortality impact associated with decreasing the size of the best class offering (rule perspective, analysis on data set Number 1).

Table 2

		RxDx		
	Relative Mortality	Best	Other	
Rx only	Best	100% (ref)	125%	105%
	Other	110%	125%	
		100%		

- The preferred-best class by both Rx Only and RxDx is treated as a reference point.

Table 3 illustrates how adding Dx Data could decrease the accept rate (rule perspective, analysis on data set Number 1).

Table 3

		RxDx		
	Classifications	Accept	Decline	
Rx only	Accept	90%	4%	94%
	Decline	0%	6%	
		90%		100%

Table 4: Illustrates the estimated mortality impact associated with the decreased accept rate (rule perspective, analysis on data set Number 1).

Table 4

		RxDx		
	Relative Mortality	Accept	Decline	
Rx only	Accept	100% (ref)	500%	119%
	Decline	150%	500%	
		100%		

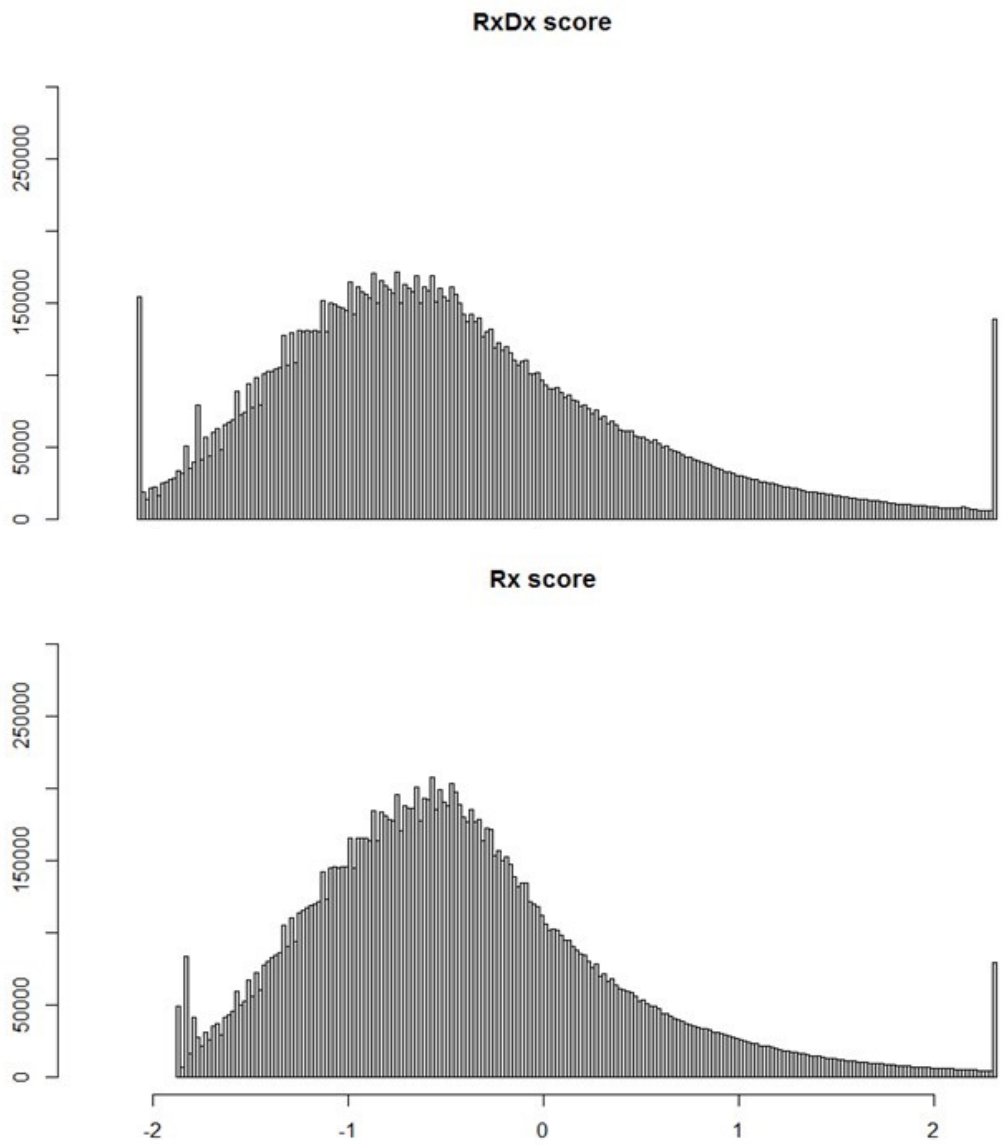
The incremental value and benefit of adding Dx to Rx from a Risk Score perspective.

We utilized data set Number 2, Milliman Risk Score validation study data set, to make Rx only vs RxDx comparisons from Risk Score perspectives.

The distribution plot of Rx scores and RxDx scores in log scale are shown in Figure 4. Log transformation is a common technique for distribution illustration when the score is a ratio. Log transformation could make it more bell shaped. As shown in Figure 4, the average score for both is close to 1 (0 in log scale), but the center peak (close to the value of median) is well below the average, meaning even with log transformation, the score is still skewed to the right. The reason for the peak to the far right is because the score is truncated at 10. The truncation is for graph illustration only, by avoiding having a very long tail on the right.

Figure 4 shows the most notable differences between Rx and RxDx score is that the RxDx score is more widely spread, suggesting it provides greater risk segmentation.

Figure 4: Distribution for Rx and RxDx score in a log scale.



Similar to the analysis with data set Number 1, we looked at the impact of adding Dx data on the size of best- and worst-rated classes and associated mortality (Tables 5-8). Scores of 0.5 and 2 were arbitrarily chosen as score cut-off points to define the best and worst classes. The key difference from analysis of data set Number 1 is the mortality in this data is observed rather than estimated. The results are:

1) Adding Dx data would increase the size of the best class (score <=0.5) from 40% to 46% (Table 5). Note this is directionally different from what was observed while using Irix rules to make the best class selection (Table 1). The actual observed mortality of the best class is reduced from 119% to 110% (Table 6). This reduction is also much higher than what is shown in Table 2.

2) Table 7 shows adding Dx data could decrease the accept rate from 92% to 88%, and the actual observed mortality for accept, or non-decline (score<=2), is reduced from 126% to 104% (Table 8). This is very similar to what was estimated from the rule perspectives (Tables 3 and 4 above).

Table 5 illustrates how adding Dx would increase the size of the best-class offering rate (score perspective, analysis on data set Number 2).

Table 5

		RxDx		
		Score <=0.5	Score >0.5	
Rx only	Score <=0.5	34%	5%	40%
	Score >0.5	12%	49%	
		46%		

Table 6 illustrates the observed mortality associated with the increased size of the best class offering (score perspective, analysis on data set Number 2).

Table 6

		RxDx		
		Score <=0.5	Score >0.5	
Rx only	Score <=0.5	100% (ref)	257%	119%
	Score >0.5	137%	688%	
		110%		

Table 7 illustrates how adding Dx could decrease the accept rate (score perspective, analysis on data set Number 2).

Table 7

		RxDx		
		Score <=2	Score >2	
Rx only	Score <=2	86%	4%	92%
	Score >2	1%	8%	
		88%		100%

Table 8 illustrates the observed mortality associated with the decreased accept rate (score perspective, analysis on data set Number 2).

Table 8

		RxDx		
		Score <=2	Score >2	
Rx only	Score <=2	100% (ref)	579%	126%
	Score >2	267%	898%	
		104%		

Conclusions

Irix rules and risk scores represent different views of Rx and Dx data interpretations, and each has its own advantages and disadvantages. The obvious advantage of Irix rules is transparency, and it is helpful in understanding the reasons and sources of the incremental value when Dx is added to Rx data. For example, while Dx could identify more adverse risks across all medical conditions, the high-risk respiratory condition at decline level is a significant differentiation between Dx and Rx.

Compared to risk scores, the Irix rules may not be able to capture the full potential of having both Rx and Dx data. For example, we found from a Risk Score perspective that having both Rx and Dx could increase the best-class offering rate and significantly reduce the mortality at the same time. From the rule perspective, however, having both Rx and Dx actually decreases the size of the best-class offering rate, and the estimated mortality was only moderately reduced. If the focus is on identification of high risks for the purpose of making appropriate decline decisions, somewhat surprisingly, both rules and Risk Score perspectives give very similar results.