

Milliman Irix[®] –

Risk Score with Medical Data

Stratifying mortality risk by combining
prescription drug history and medical claims records

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Predictive models and life insurance

Munich Re Life US assessed Milliman Irix® – Risk Score with Medical Data, a predictive modeling tool developed and owned by Milliman that assesses mortality risk through the combination of an individual’s prescription drug history and medical claims records. Insurers interested in prescription- and medical-based mortality scores should perform a retrospective validation study on their experience data. Munich Re can assist carriers with the retrospective study, advise on changes to mortality assumptions, and recommend ways to incorporate the scores to streamline the underwriting process.

Executive summary

Milliman Risk Score with Medical Data is a proprietary scoring algorithm that combines prescription drug history and medical claims records to predict the mortality risk of individuals relative to other individuals of the same age and gender.

In 2020, Munich Re assessed Risk Score 2.2, a score based on prescription drug history with the option to include credit data, and concluded that the scores are predictive of mortality for the U.S. insurance applicant population.¹ Since then, Milliman has upgraded its Risk Score to version 3.0 and incorporated medical claims data to produce the Risk Score with Medical Data. Carriers currently using prescription-based scores typically establish thresholds and decision guidelines to streamline their underwriting process while managing mortality risk.

Milliman provided Munich Re with a dataset comprised of 42 million lives sampled from the U.S. general insurance applicant population, including life, health, LTC, DI, final expense, and Medicare supplement lines of business. Life represents the majority of the dataset. Version 3.0 of Prescription-only and Prescription with Medical scores were provided, which range from 0.0 to 100.

Munich Re analyzed the Risk Score with Medical Data and confirmed it is predictive of mortality for the U.S. insurance applicant population. Compared to a Prescription-only score, the Prescription with Medical score increases the volume of scored individuals and more effectively stratifies mortality risk. Furthermore, the Risk Score with Medical Data model is more effective at identifying high mortality risk when medical claims data hits are available.

A company-specific insured population is not expected to have identical underlying characteristics as this insurance applicant population. Munich Re recommends that carriers interested in the Risk Score with Medical Data conduct a retrospective study on company-specific applicants dataset to calibrate the tool to the carrier’s underwriting paradigm. This process will help carriers balance the score with the expected mortality of their unique target markets, distribution channels, and underwriting processes. For carriers already using a prescription-only mortality score, a Prescription with Medical combined score provides a more holistic assessment of mortality.

Key findings

Primary high-level findings include the following:

- Risk Score with Medical Data combines prescription history and medical claims information. Relative mortality risks increase as the score increases.
- A Prescription with Medical score is provided for an individual with prescription history only, medical claims record only, or a combination of both. Thus, the number of individuals with a Risk Score is greater than when using a Prescription with Medical model compared to a Prescription-only model.
- Risk Score with Medical Data allows carriers to identify a higher proportion of lives with low mortality risks and with high mortality risks compared to a Prescription-only Risk Score.
- The Prescription with Medical score effectively stratifies mortality risk across age and gender groups. It is more effective at identifying high mortality risk when medical claims data is available.

Methodology

Munich Re assessed the effectiveness of the new Risk Score with Medical Data in stratifying the mortality risk profile of a pool of 42 million applicants with entry ages 0 - 99. The data provided includes version 3.0 of Prescription-only and Prescription with Medical scores on a scale of 0 to 100. Each life entered the study between the first quarter of 2005 and the last quarter of 2020. Deaths were sourced from a reliable third-party source of death data. The study population is comprised of 1.7 million deaths out of 235 million exposed life-years.

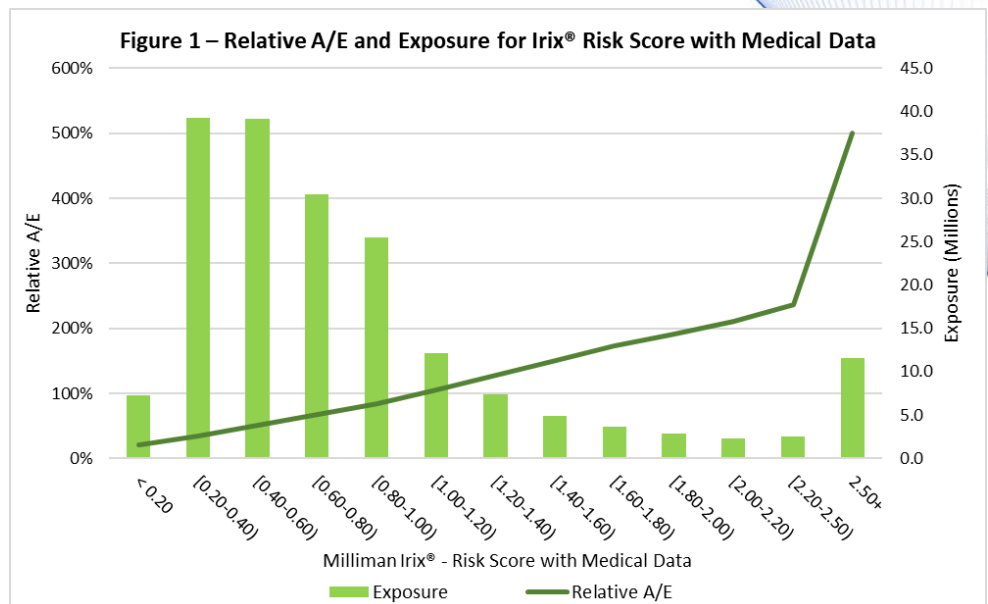
The expected mortality basis was taken from the 2015 VBT primary select and ultimate age-nearest birthday tables split by age and gender with a 1 percent mortality improvement. We did not have the smoking status of each applicant, so we used an 85 percent non-smoker/15 percent smoker blend of the smoker distinct tables.

Munich Re completed additional analyses of relative actual to expected mortality ratios (A/E) by various factors (e.g., hit type, age, and gender) to assess whether the mortality risk stratification by the Risk Score with Medical Data is influenced by those factors.

Results

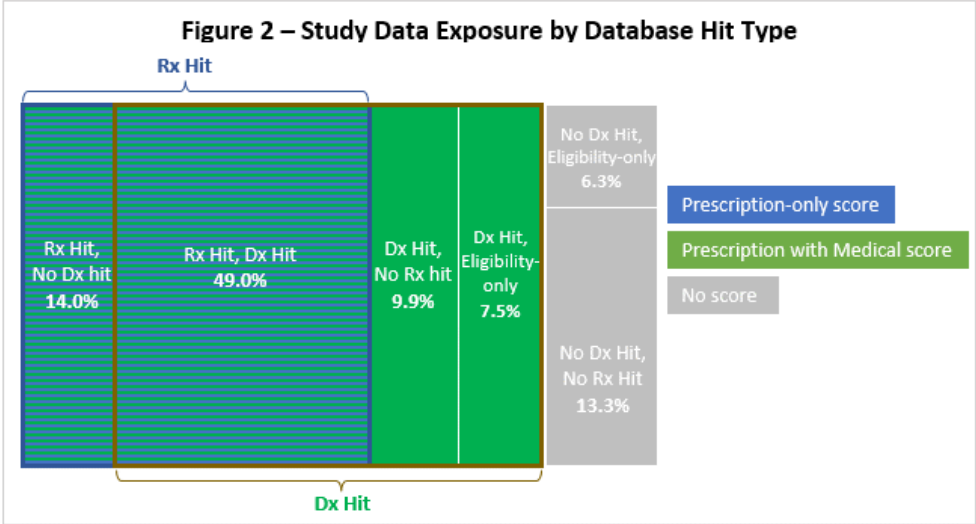
Overall results

Figure 1 is a high-level overview validating Risk Score with Medical Data's ability to stratify mortality risk. Lives with higher scores have higher mortality risk, while lower scores correspond with lower mortality risk. 19.6% of the total exposure did not have a score from the Risk Score with Medical Data model, and are not shown in Figure 1.



Exposure

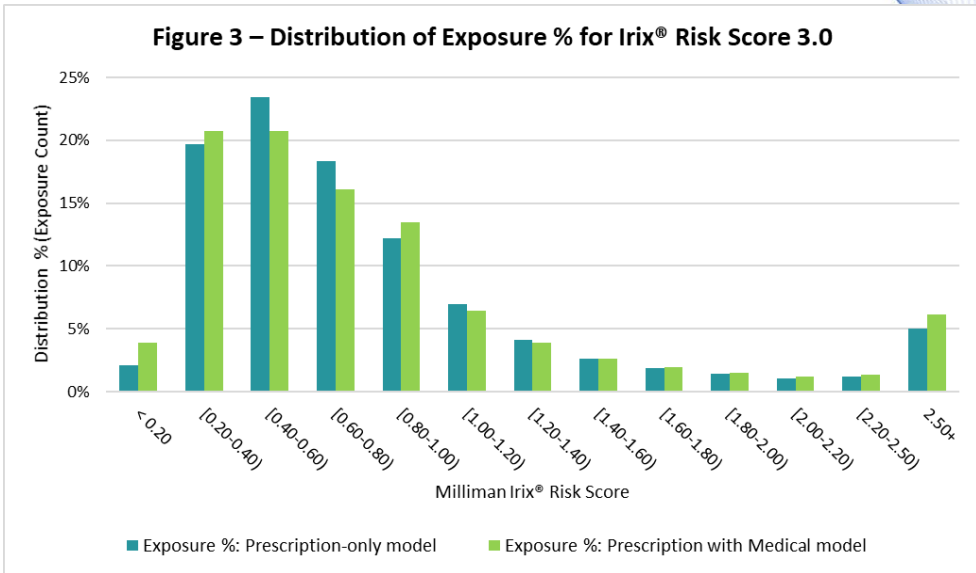
The Risk Score with Medical Data model produces a score for an individual with a prescription history (Rx) only, medical claims record (Dx) only, or a combination of both. “Eligibility-only” refers to applicants found in the prescription history database but with no prescription fills. As illustrated in **Figure 2**, a Prescription with Medical model yields a Risk Score for a larger subset of the same population exposure compared to a Prescription-only model.



Compared to a Prescription-only model, the use of a Prescription with Medical model increases the percent of total exposure with a Risk Score from 63.0% to 80.4%, based on the study data.

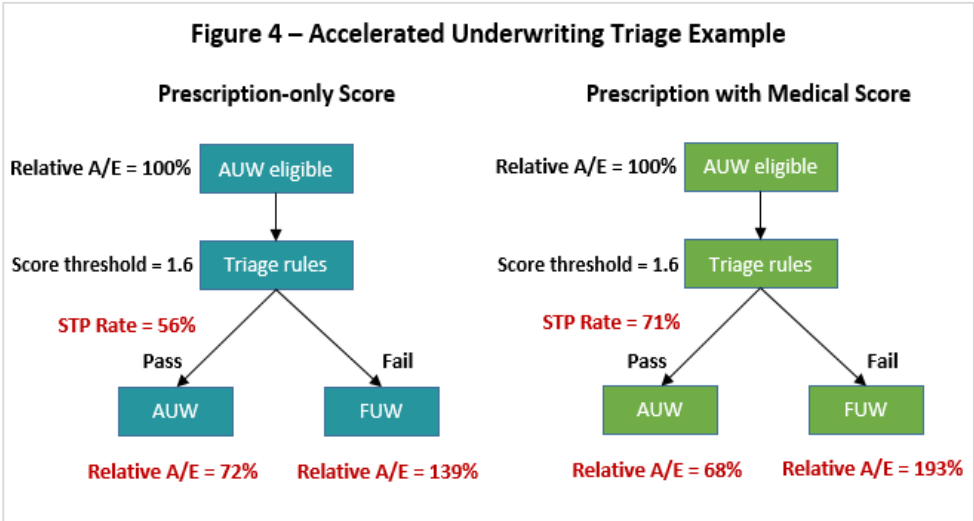
The current hit rate as of late 2022 for the Prescription with Medical model has increased to 91%, given more recent Dx data source became available subsequent to the study.

Figure 3 compares the exposure distribution % between version 3.0 of the Prescription-only and Prescription with Medical scores (excluding lives with no score). We observe shifts in exposure % to both ends of the score spectrum for the Prescription with Medical model. This means that in addition to an increase in total scored lives, a Prescription with Medical score allows carriers to identify a higher proportion of lives with low risks and adverse mortality risks than a Prescription-only score.



Use Case – accelerated underwriting triage tool

Figure 4 illustrates an example of using Risk Score as a triage tool to segment lives into accelerated (AUW) and full underwriting (FUW) paths. Both scenarios were based on the same insurance applicant population and a kick-out threshold score of 1.6. Using the same kick-out threshold score, the Prescription with Medical model can straight-through process (STP) more lives while maintaining lower relative mortality for the accelerated cases compared to the Prescription-only model.

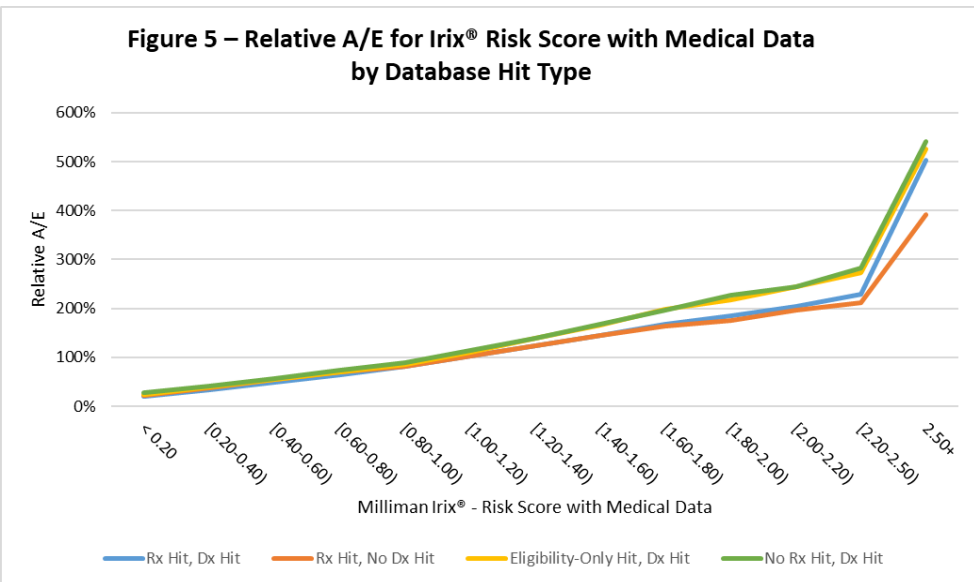


Database hit type

Table 1 summarizes the relative A/E by prescription and medical claims data hit type. The subsets with medical claims record (Dx) hits have higher relative mortality than subsets without medical record hits. The subsets with prescription (Rx) hits have lower relative mortality than subsets with no hits or hits with no prescription fills (Eligibility-only).

Table 1. Relative A/E by Hit Type				
Relative A/E		Dx		
		Dx Hit	No Dx Hit	Total
Rx	Rx Hit	99.8%	88.1%	97.7%
	Eligibility-Only	104.1%	93.2%	100.1%
	No Rx Hit	112.3%	99.6%	106.5%
	Total	102.4%	93.5%	100.0%

Figure 5 illustrates the mortality risk segmentation of the Prescription with Medical score across prescription, and medical data hit types. While the scores provide a similar stratification of mortality across hit types, scores with a medical claims record hit are more effective at identifying high mortality risks than scores with a prescription-only hit.



Age and Gender

Figure 6 shows the distribution % of the exposure within each age group for the Prescription with Medical score (excluding lives with no score). The Risk Score is controlled for age and gender. The distribution of scores has a bell-shaped curve, with a higher proportion of lives at both ends of the score spectrum for ages 40 to 69.

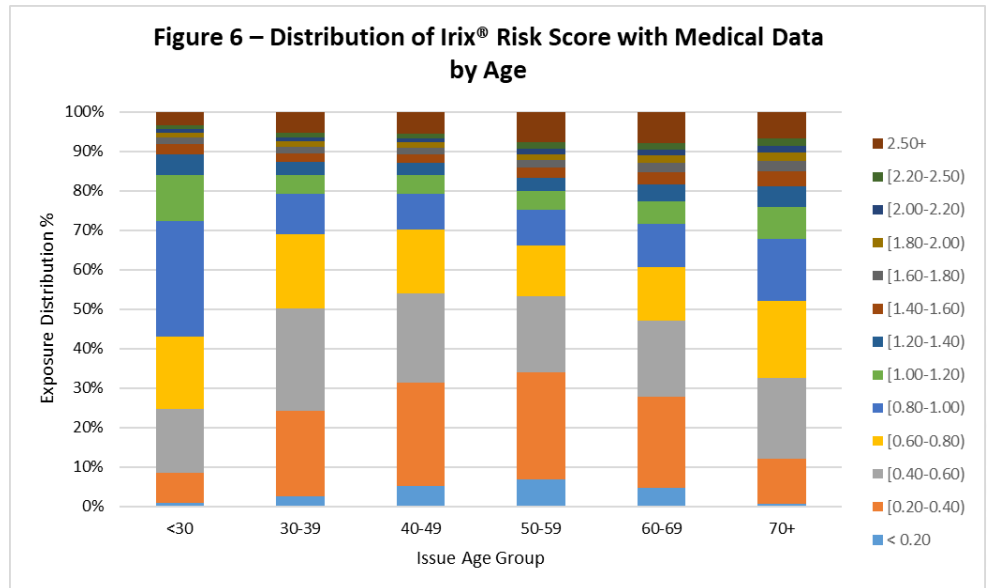
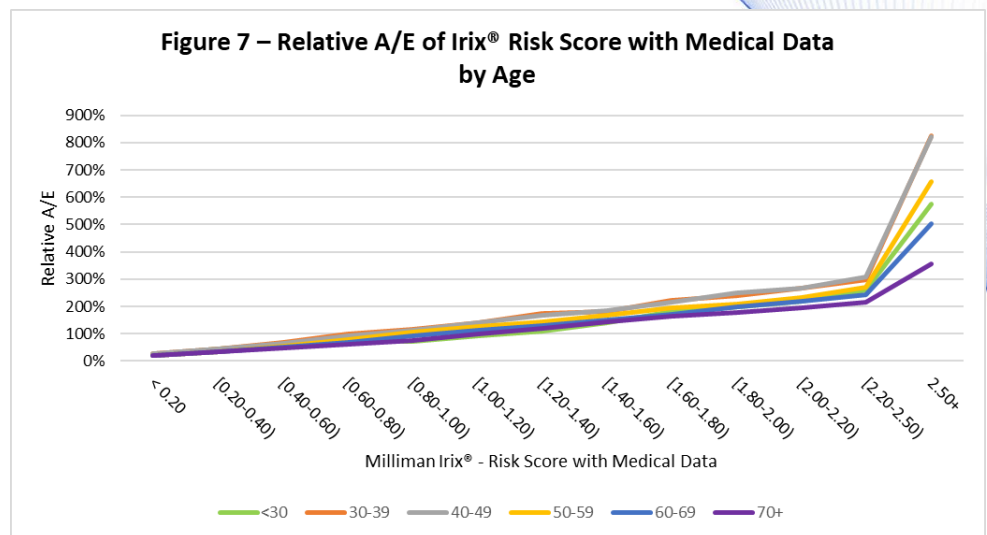


Figure 7 demonstrates the mortality risk segmentation of the Prescription with Medical score by age group. All age groups follow a similar mortality stratification pattern, where mortality risk increases as scores increase. The charts show that the score is particularly effective at segmenting mortality for ages 30 to 59. The mortality segmentation pattern also looks similar across both males and females.



Bias Testing

The Risk Score with Medical Data has been tested for bias. Milliman tests for disparate impact by age and gender, defined as favoring or disfavoring certain demographics more than actuarially justified, by ensuring the impacts of the scores and score distribution track changes in the observed empirical mortality. For instance, for any given age or gender, Milliman tests that a higher score will have proportionally higher average relative mortality, consistent with the results shown by Munich Re in Figure 7. We encourage carriers to conduct bias testing as part of the retrospective study on the company-specific insured population.

Summary

Munich Re concludes that the Milliman Risk Score with Medical Data is an effective predictor of mortality for the U.S. insurance applicant population. Compared to its Prescription-only original product, the Risk Score with Medical Data increases the volume of scored individuals and more effectively stratifies mortality risk across age and gender. A score is provided for an individual with prescription history only, medical claims record only, or a combination of both. While mortality segmentation is effective and comparable across all three cases, the score is more effective at identifying high mortality risk when medical claims data hits are available. In the context of an accelerated underwriting triage tool, the Prescription with Medical score provides better risk segmentation than the Prescription-only score, allowing carriers to achieve higher STP with better mortality.

Finally, a company-specific insured population is not expected to have identical underlying characteristics to this insurance applicant population; we recommend that each carrier perform a retrospective study, including bias testing, to best assess the value and application of the Risk Score with Medical Data. Munich Re can assist carriers in structuring bias testing and the retrospective study and advise on ways to incorporate Milliman Risk Score with Medical Data in underwriting.

References

¹Milliman Risk Score 2.2 – stratifying mortality risk using prescription drug history, Munich Re, 2020. <https://www.munichre.com/us-life/en/perspectives/alternatives-for-stratifying-mortality-risk/milliman-irix-risk-score-2-2-stratifying-mortality-prescription-drug-history.html>

Milliman Irix® - Risk Score with Credit Data – stratifying mortality risk by combining prescription drug history and credit attributes, Munich Re, 2020. <https://www.munichre.com/us-life/en/perspectives/alternatives-for-stratifying-mortality-risk/milliman-irix-risk-score-credit-data-stratifying-mortality-prescription-drug-history.html>



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