Milliman Irix® – Risk Score 2.2 :
Stratifying mortality risk using prescription drug history

KEY FINDINGS

Primary high-level findings include the following:

- Relative mortality risks increase as Irix® - Risk Score 2.2 increases.

- Risk Score 2.2 has more lives with higher scores and more lives with lower scores compared to prior versions, allowing carriers to identify more lives with better mortality.

- A larger proportion of lives in lower scores and higher scores compared to previous versions is observed across all age groups, but more noticeably for ages below 70.

- The score effectively stratifies mortality risk across age groups, and is particularly effective at segmenting mortality for ages 30 to 49.

- The score continues to be especially effective at identifying high mortality risk at earlier durations.

- Applicants with a prescription history hit have better mortality relative to those without one. For individuals with a hit, the score provides segmentation regardless of the severity of an applicant's drug history.

Predictive models and life insurance

Munich Re assessed version 2.2 of Irix® - Risk Score, a predictive modeling tool developed and owned by Milliman that assesses mortality risk using an individual's prescription drug history. Insurers either considering or already using prescription drug-based scores should perform a retrospective validation study on their own 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

Irix® - Risk Score is a proprietary scoring algorithm that uses prescription drug history to predict the mortality risk of individuals relative to other individuals of the same age and gender.

In 2018, Munich Re assessed Risk Score 2.0, an earlier version of the prescription drug-based mortality score, and concluded the scores are predictive of mortality for the U.S. insurance applicant population. Since then, Milliman enhanced its methodology to incorporate clinical mortality rules into the score and further refined the score across risk attributes, resulting in Risk Score 2.2.

Milliman provided Munich Re with 25 million lives sampled from the U.S. general insurance applicant population which includes life, health, Medicare supplement, LTC, final expense, and DI lines of business, the same population used to validate Risk Score 2.0. The Risk Score ranges within 0.0 and 10.0.

Munich Re performed an analysis of Risk Score 2.2 and confirmed it is predictive of mortality for the U.S. insurance applicant population. Compared to previous versions, Risk Score 2.2 more effectively stratifies mortality risk and identifies more lives with better mortality. A company-specific insured population is not expected to have identical underlying characteristics as this insurance applicant population; Munich Re recommends replicating the study on a company-specific insured dataset to help assess the value of Irix® - Risk Score.

Life insurers interested in Irix® - Risk Score should conduct a retrospective study in order to calibrate the tool to the carrier's own underwriting paradigm. This process will help carriers balance the score with expected mortality with respect to their unique target markets, distribution channels, and underwriting processes. For carriers who are already using Irix® - Risk Score, version 2.2 provides more effective mortality segmentation than its prior versions.

Methodology

Munich Re assessed the effectiveness of the latest version of Irix® - Risk Score in stratifying the mortality risk profile of a pool of 25 million applicants with entry ages 0 - 100. Each life entered the study between the first quarter of 2005 and the last quarter of 2016. Deaths were sourced from the Social Security Death Master File and third-party proprietary databases. The study population is comprised of 468,491 deaths out of 104 million exposed life-years.

The expected mortality basis was taken from the 2015 VBT primary select and ultimate ANB 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 ratios (A/E) by various factors (e.g., age, gender, duration, line of business, and most severe drug priority) to assess whether the mortality risk stratification by Irix® - Risk Score 2.2 is influenced by those factors.

Results

Overall Results

Figure 1 is a high-level overview validating Risk Score 2.2's ability to stratify mortality risk. Lives with higher scores have higher mortality risk, while lower scores correspond with lower mortality risk.

Figure 1. Relative A/E and Exposure vs Risk Score 2.2
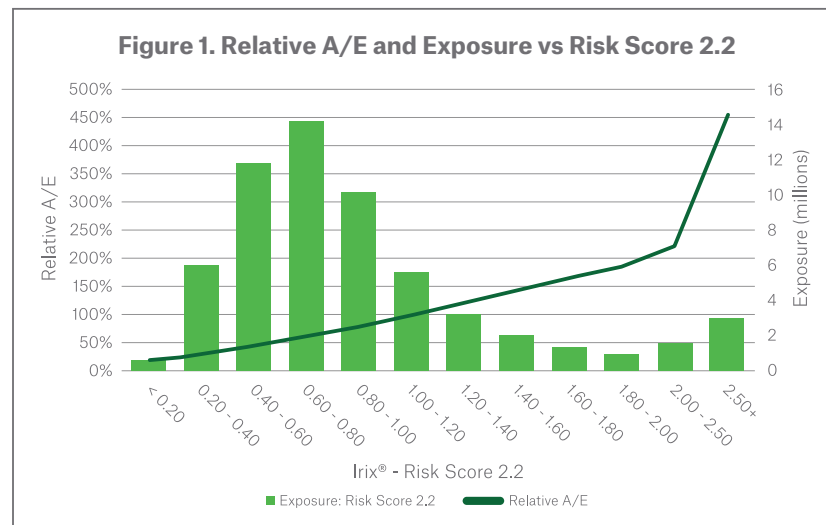
Exposure

Figure 2 shows the exposure distribution in Risk Score 2.0 and Risk Score 2.2. We observe that Risk Score 2.2 allows carriers to identify more lives with better mortality compared to prior versions; there are now more lives that have a score greater than 2.5 and more lives that have a score less than 0.6.

Figure 2. Distribution of Exposure for Risk Score 2.0 and 2.2
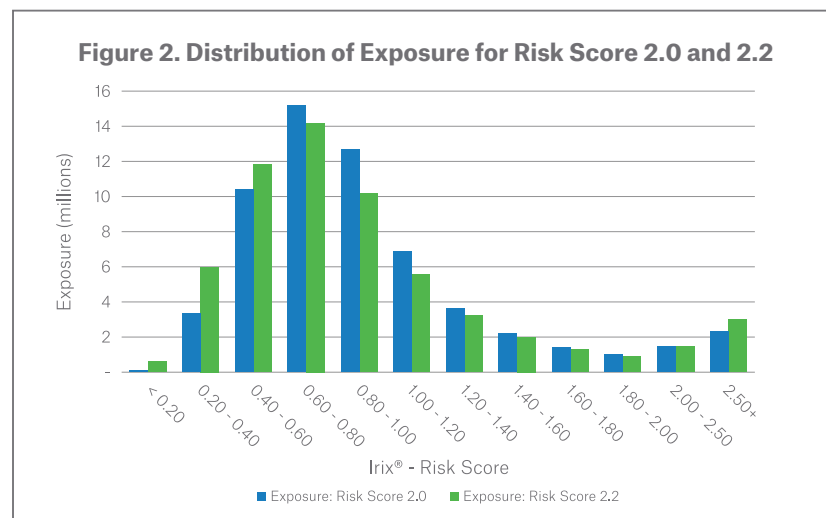
Age

Figure 3 shows the Risk Score exposure distribution within each age group (excluding Eligibility-Only and No Hit); the Risk Score is controlled for age. Compared to prior versions, Risk Score 2.2 has a higher proportion with lower scores and higher scores. The shift towards lower scores is more noticeable for ages below 70.
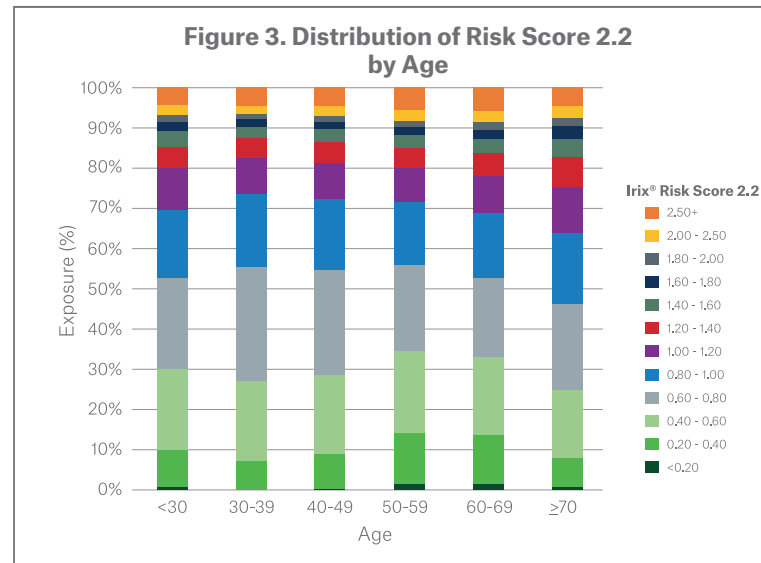

Figure 3. Distribution of Risk Score 2.2 by Age

Irix® Risk Score 2.2: 2.50+, 2.00 - 2.50, 1.80 - 2.00, 1.60 - 1.80, 1.40 - 1.60, 1.20 - 1.40, 1.00 - 1.20, 0.80 - 1.00, 0.60 - 0.80, 0.40 - 0.60, 0.20 - 0.40, <0.20

Figure 4 demonstrates the mortality risk segmentation of the Risk Score by age group. All age groups follow the same pattern, where mortality risk increases as scores increase. From the chart, we observe that the score is more effective at segmenting mortality for ages 30 to 49.

Figure 4. Relative A/E vs Risk Score 2.2 by Age

Irix® - Risk Score 2.2

<30, 30-39, 40-49, 50-59, 60-69, ≥70
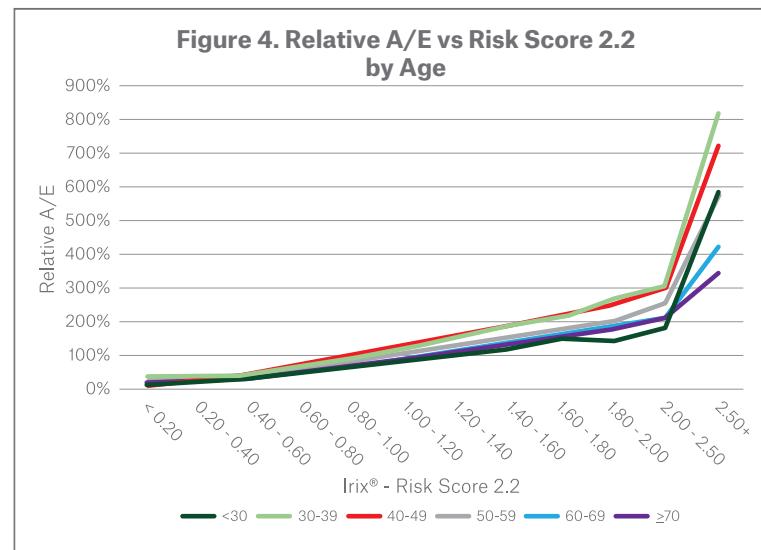
Duration

From **Figure 5** we can see that the Risk Score provides mortality segmentation across durations. Duration is measured as the number of years that have passed since the prescription data was retrieved for a given applicant. The most effective mortality segmentation is achieved in the first duration. As duration increases, we observe a decrease in mortality segmentation effectiveness, particularly for the high mortality risks. The decrease in mortality segmentation is more evident as duration increases, as seen by the narrowing of relative mortality differences for high scoring lives.

Figure 5. Relative A/E vs Risk Score 2.2 by Duration

Irix® - Risk Score 2.2

1, 2, 3-4, 5-12
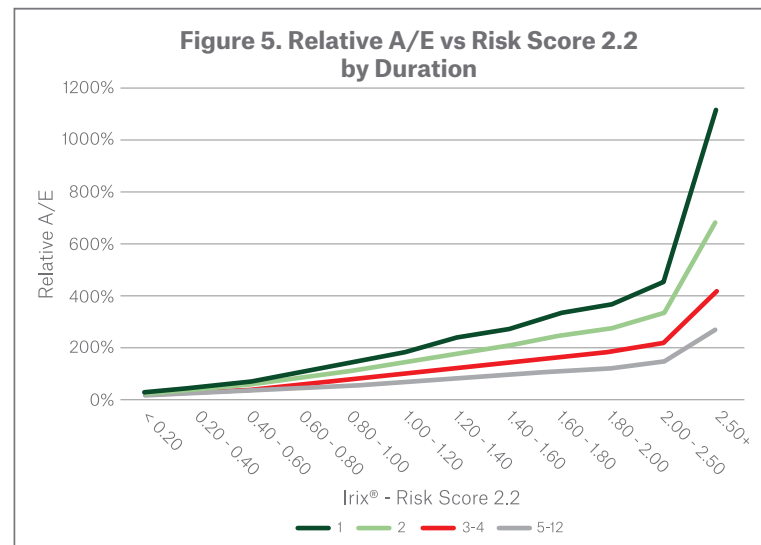
Line of Business

The Risk Score stratifies mortality risk across different lines of business as shown in **Figure 6**. All lines of business follow the same pattern, where mortality risk increases as score increase. From the chart, we observe that the score is the most effective at segmenting mortality for life business.

Figure 6. Relative A/E vs Risk Score 2.2 by Line of Business
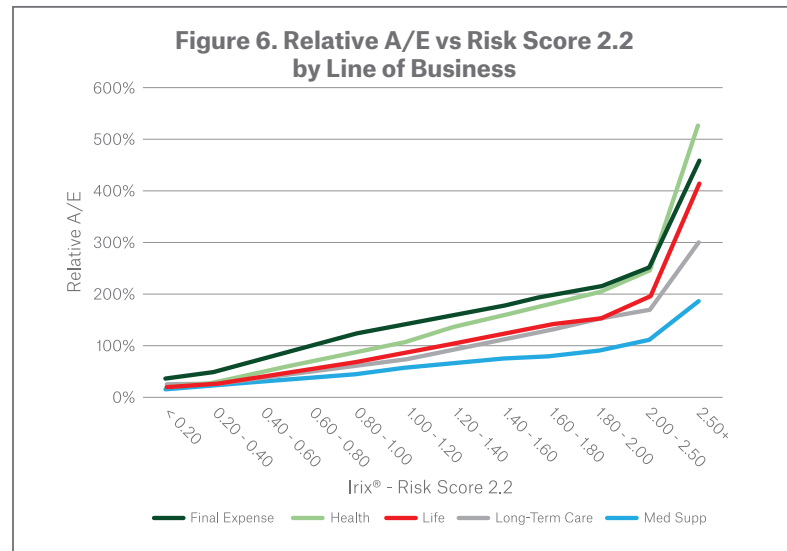

Most Severe Drug Priority

Applicants with a prescription history hit are assigned one of three "most severe drug priority" ratings: green, yellow, and red. A green rating indicates the applicant has a prescription history with only drugs corresponding to low mortality risk. A yellow rating indicates the applicant has a prescription history with drugs corresponding to moderate mortality risk or lower. Similarly, a red rating indicates the applicant's prescription history contains a drug corresponding to high mortality risk.

Applicants without prescription history may be a result of no records found in any prescription history database ("No Hit") or a result of no history of prescription fills in the records found ("Eligibility-Only"). When we expand the analysis to include applicants with No Hit and Eligibility-Only on their prescription history, we observe that applicants with No Hit have higher relative mortality compared to applicants with Eligibility-Only, as shown in **Table 1**. We also observe that Eligibility-Only has a higher relative mortality compared to applicants with a prescription history hit.

Table 1 - Relative A/E Hit Type

Prescription History Hit Type			Relative A/E
No Hit			108%
Eligibility-Only			99%
Hit	Drug Priority	Green	66%
		Yellow	75%
		Red	158%
	Subtotal		97%
Total			**100%**

As illustrated by **Figure 7**, the Risk Score successfully segments mortality risk across drug priority ratings. Because the Risk Score uses a multivariate approach to incorporate prescription history information, it provides mortality segmentation in addition to drug priority alone, especially for higher mortality risks. While the green ratings suggest an irregular pattern for scores greater than 1.6, we noticed there is a very low number of records in these groups.

Figure 7. Relative A/E vs Risk Score 2.2 by Drug Priority
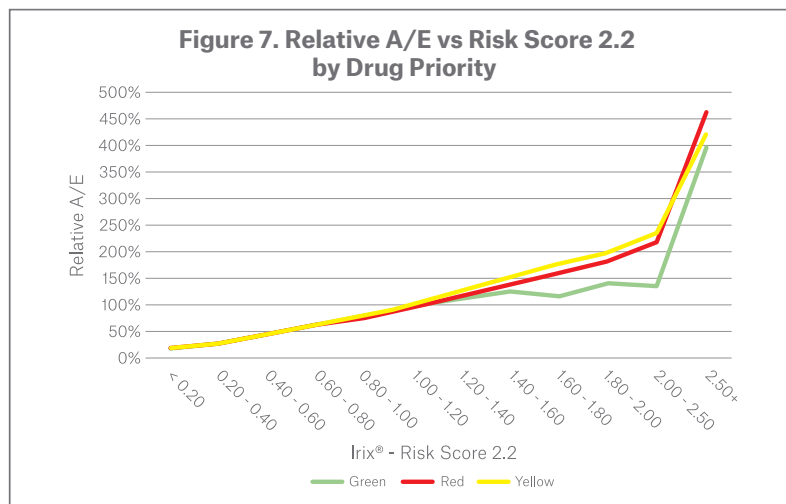
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Summary

Munich Re concludes version 2.2 of Irix® - Risk Score is an effective predictor of mortality for the U.S. insurance applicant population. Compared to its prior versions, Risk Score 2.2 more effectively stratifies mortality risk across multiple attributes; we observe more lives with higher scores and more lives with lower scores, allowing carriers to identify more lives with better mortality.

Risk Score continues to be especially effective at identifying high mortality risk at earlier durations, and at providing mortality segmentation in addition to an applicant's most severe prescription drug history. The score's mortality risk segmentation is effective across all ages and multiple lines of business.

Risk Score might be particularly valuable in identifying mortality risk when less medical data is available, for example, in fluid-less underwriting programs. However, a company-specific insured population is not expected to have identical underlying characteristics to this insurance applicant population discussed in this article. Thus, we recommend each carrier perform a retrospective study to best assess the value and application of the Irix® - Risk Score.

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