Underwriting Liver Function Tests (LFTs) Using a Data-Driven Approach

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What's new?

RGA's new liver function test (LFT) calculator simplifies and accelerates the assessment of life ratings linked to complex LFT patterns. Powered by RGA's proprietary algorithm, the tool accurately and instantly translates predicted mortality risks into specific, actionable underwriting guidance.

Key features of the LFT calculator:

- Fast and easy to use
- Designed for cases where the cause of LFT elevation is unknown
- Built on data from US life insurance applicants
- Eliminates the need to interpret complicated guidelines
- Handles complex relationships and interactions
- Estimates mortality risk with a level of granularity that enables consistent, precise life rating decisions
- Performs optimally when complete results are available for five LFTs - alanine transaminase (ALT), aspartate transaminase (AST), gamma-glutamyl transferase (GGT), alkaline phosphatase (ALP), and total bilirubin. It can account for negative or unknown hepatitis serologies (hepatitis B and hepatitis C), and can also function if only ALT and AST are available
- Offers transparency and explainability

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Overview

As part of its ongoing commitment to efficiency, RGA has developed a data-driven LFT calculator to generate life ratings for the US market. The tool enhances underwriting accuracy by more effectively evaluating various combinations of LFT abnormalities when the underlying cause of elevation is unknown. This brief outlines the structure of the statistical model that powers the calculator and explains how it translates complex data into life rating decisions.

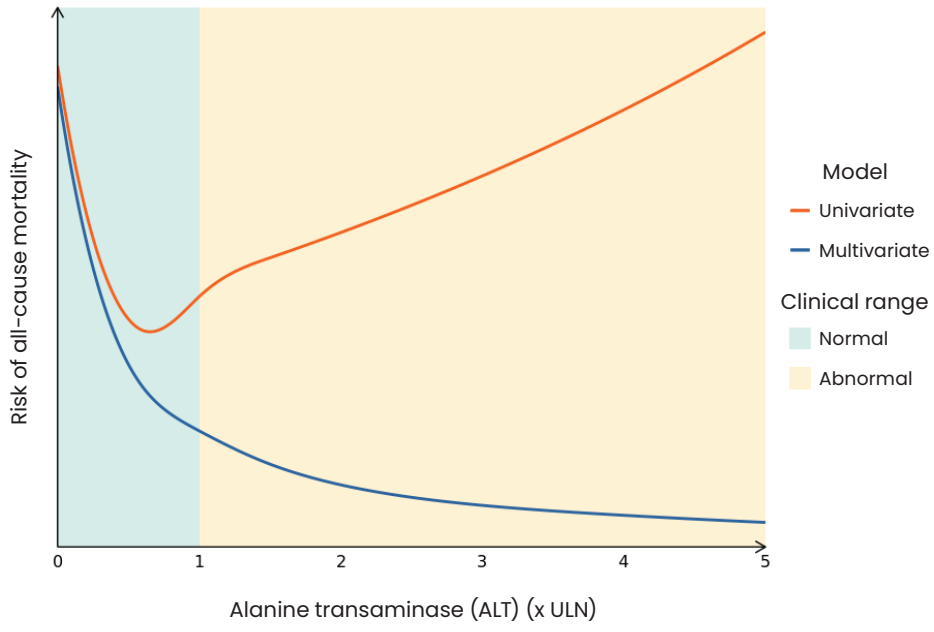
Methods and insights

RGA developed a generalized linear model using data from US life insurance applicants to examine the combined impact of five LFTs (ALT, AST, GGT, ALP, and total bilirubin) on all-cause mortality risk.

One the key findings is illustrated in Figure 1, which compares the univariate and multivariate relationships between ALT and mortality risk across clinically normal (≤1x upper limit of normal [ULN]) and abnormal ranges (>1x ULN). The univariate analysis indicated that ALT largely shares a "U-shaped" relationship with mortality. However, after adjusting for the other LFTs, the multivariate analysis showed that ALT predominantly shares a negative non-linear relationship with mortality across the two clinical ranges. In other words, the risk of death was observed to be higher at lower values of ALT and lower at higher values of ALT, with the association appearing to be stronger in the clinically normal range as opposed to elevated range.

This finding is particularly important for calculator development, as the relationship between ALT and mortality differs significantly depending on whether it is examined in a univariate model or a multivariate model. In the multivariate context, the observed relationship is largely driven by the correlation between ALT and AST (data not shown).

Figure 1: Alanine transaminase (ALT) vs. risk of all-cause mortality



Other key insights from the multivariate analysis:

- AST exhibited a "U-shaped" relationship with mortality, with low AST values notably associated with an increased risk of death.
- GGT demonstrated a positive linear relationship with mortality across the entire value range.
- ALP showed a sigmoidal relationship with mortality across all values.
- Total bilirubin shared a mild "U-shaped" relationship with mortality, most significantly with low values linked to higher mortality risk.

These findings largely aligned with the published literature.[1-4]

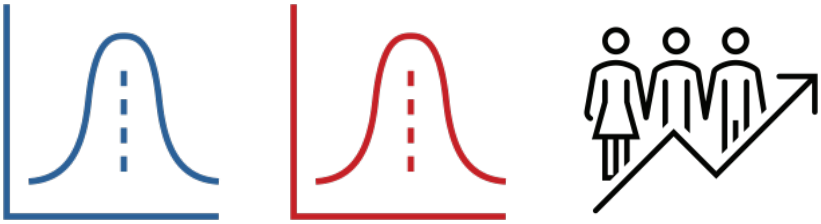
Figure 2 shows the high-level steps taken to derive data-driven life ratings using the developed model. Note: A limited set of expert-defined business rules, developed in collaboration with RGA medical doctors and underwriters, was incorporated to ensure clinical alignment. These rules help override any model behaviors that deviate from clinical expectations.

Figure 2 – Deriving life ratings using the developed model

1. The developed model predicted a mortality risk score for each case in the data.

2. The existing life rating philosophy was used to generate a manual life rating for each case.

3. Based on the matched ranked distributions of the predicted mortality risk scores and computed manual life ratings, the calculator estimated a model life rating for each case by deriving cut-off values. These cut-off values are the crux of how the calculator generates any life ratings.



Conclusion

The development of this calculator has yielded valuable insights for underwriting life insurance using LFTs. The multivariate model, adjusted for all five LFTs, showed that high levels of ALT are associated with a lower mortality risk, while low levels of ALT, AST, and total bilirubin are linked to higher risk. It also indicated that high levels of AST, ALP, and total bilirubin are correlated with a higher mortality risk. These findings support previously published evidence, including the consistent linear relationship between GGT and mortality.

Additionally, actual-to-expected (A/E) analyses using a life table indicated that cases classified as "standard" showed significantly improved mortality outcomes when assessed through the model, compared to the existing rating philosophy. This underscored the clear advantages of a data-driven approach.

RGA's new LFT calculator enables underwriters to convert mortality risk into life ratings with speed and precision, reducing manual burden without compromising accuracy. As a result, RGA is expanding this calculator to additional regions and product lines.

To learn more, contact us for more information.

References

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