SOCIETY OF ACTUARIES

Article from:

Reinsurance News

August 2012 – Issue 73

New Medical Markers in **Life Underwriting**

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Actuaries involved in the reinsurance markets can be very knowledgeable about cutting edge underwriting practices. To get a sense of where underwriting practices are going in the future, the Society of Actuaries (SOA) partnered with the Association of Home Office Underwriters (AHOU) and the Canadian Institute of Underwriters to conduct research focused on new medical tests and markers that may have significance and relevance to the life insurance markets. Specifically, within the SOA, the Reinsurance Section initiated and led the project with co-sponsorship from the Committee on Life Insurance Research and the Product Development Section. This article will give you an overview of the research work and some of the discoveries. For a complete understanding of the research, you can find the report posted on the SOA website (www.SOA.org) under Research/ Completed Research Projects.

As the researchers, we first had to establish criteria for the markers of interest. In this context the words "marker" and "test" both refer to a specific assessment of an individual's health status, usually analyzed by way of a laboratory analysis of blood, urine or other specimen. The criteria we used to establish whether a marker was to be included in the research was twofold: (i) the marker had to be currently available (i.e., analysis of the marker available through the medical laboratories), but not yet widely used by the life insurance industry as part of their routine age and amount requirements; and (ii) it had to be applicable to life insurance underwriting. The first objective was to discover the larger list of potential markers. This was accomplished through interviews with a representative from each of the three major laboratories. These individuals made a significant contribution to this work product and we are grateful for their time and patience. Using the established criteria together with input from the laboratory representatives, we winnowed the larger list down to 11 markers for study. More than half of these are designed to pinpoint cardiovascular problems or conditions that precede cardiovascular conditions.

The 11 markers chosen were:

Apolipoprotein 1 and B (Apo 1 and B)
Complete blood count (CBC)/red cell distribution width (RDW)
Cystatin C
Hemoglobin
Hemoglobin A1c
Microalbumin
Amino-terminal pro B-type natriuretic peptide (NT-proBNP)
Oxidized low density lipoprotein (oxidized LDL)
Phospholipase A2 (Lp-PLA2)
Tumor necrosis factor-alpha (TNF-alpha)
Troponins I and T

The research report provides a background and description of each of these 11 markers. A large part of the research was committed to performing a cost-benefit analysis on each marker. The cost side included consideration for hard costs such as the charge levied by the laboratories to perform the analysis as well as the softer costs such as the time necessary to train the underwriter in evaluating the marker and its implications and the time for the underwriter to analyze the results from the marker. The benefit side of the analysis involved an evaluation of each marker's ability to predict the additional all-cause mortality not found from other testing. We sourced relevant medical studies available through Internet searches. Medical studies were gathered, reviewed and compared. Ideally, we used two relevant medical studies for each marker, but this wasn't always a possibility. To determine the benefit portion of the cost/benefit analysis, the mortality savings due to the introduction of the test was estimated using a consistent process for each marker. The process included the following steps:

1. Finding a relevant medical study. As discussed above, we endeavored to find two relevant studies providing all-cause mortality results on healthy lives and, ideally, not authored by the contributing laboratories. We always found at least one non-laboratory study to use, although the level of data provided between studies varied considerably.

2. Assume a normal distribution for the marker readings in the study. It was not always the case that the medical study we referenced presented the study results in terms of expected mean and standard deviation. For those studies that did not, we worked to develop these statistics from the data presented in the medical study. We then used

the mean and standard deviation to determine the average substandard reading for the marker. We did this by assuming a normal distribution of marker readings and choosing the "worst" 5 percent of the distribution of these readings. The worst 5 percent of the distribution was considered to represent the substandard mortality portion of the population, a reasonable assumption that is based on industry averages. Once the 5 percent tail, or 95th percentile point was identified, we found the marker reading associated with the 97.5 percentile. We considered this point estimate to be the average of the substandard population.

3. The complement to the 5 percent tail area under the curve would be the remaining, or non-substandard, population of risks. We found the average reading for the non-substandard population using a simple formula. The X term in the formula below represents the average reading for the non-substandard population.

$95\% \times X + 5\% \times Average\ Substandard\ Reading = Mean\ Reading\ for\ the\ population$

4. Using hazard ratios from the medical study and the marker readings for substandard and non-substandard derived in steps 2 and 3 above, we determined the excess mortality between the two groups. Dividing the substandard hazard ratio by the non-substandard hazard ratio quantified the initial amount of extra mortality that could be expected from risks associated with the sub-standard reading when these values were given. Modifications were made in performing this step to accommodate the data as presented by each medical study.

5. The extra mortality factor from step 4 was used against an assumed table of standard mortality rates to derive the mortality savings. This involved more detail than provided here.

The report is designed such that the reader can focus on any one marker and follow its cost/benefit analysis independently of the other covered markers.

Our research concluded that many of these next generation markers are cost effective, especially at the older

Marker	Primary purpose	Ages recommended by labs for testing	Average substandard reading	Average non-substandard reading	Net mortality savings (based on male age 70 and $100,000 face amount)	Cost for marker	Face amount to near $5,000 where benefit > cost (for male age 70)
Apo 1 and B	Cardio	40+	1.57 (ratio)	0.97 (ratio)	$ 33.70	$ 21	$65,000
Red cell distribution width	All cause	60+	15.42%	14.48%	193.44	17	10,000
Cystatin C	Kidney	55+	2.16 mg/L	1.07 mg/L	272.29	19	10,000
Hemoglobin	Anemia, more	65+	6.94 g/dL	11.21 g/dL	558.76	20	5,000
Hemoglobin A1c	Glucose	35+	7.41%	5.41%	151.95	19	15,000
Microalbumin	Kidney	35+	-	-	148.80	23	20,000
NT-proBNP	Cardio	60+	237.23 pg/ml	64.20 pg/ml	407.64	37	10,000
Oxidized LDL	Cardio	45+ (males), 55+ (females)	2.77 mg/dl	1.24 mg/dl	104.65	27	30,000
Phospholipase A2	Cardio	45+	1219 µmol/min/L	796 µmol/min/L	45.77	25	55,000
TNF-alpha	Immune system	50+	6.71 pg/ml	3.96 mg/ml	199.09	11	10,000
Troponin I and troponin T	Cardio	55+ (males), 65+ (females)	- µg/L	- µg/L	I: 114.13 T: 186.54	31	I: 30,000 T: 20,000

ages even for face amounts well below $100,000. The table below summarizes critical findings of the research work. We encourage you to download a copy of the article for a more comprehensive review.

An Excel workbook was also made available as part of the research project to allow the reader to experiment with their own company assumptions. This tool could also be used for other cost/benefit analysis. We believe this is another of the many benefits of this research project.

Reinsurers and direct companies know how important their relationship is. Likewise, the relationship between actuaries and underwriters is also important. In this project, the Project Oversight Group consisted of actuaries, underwriters and medical directors. All were valuable in making this a successful research project. We believe this demonstrates how powerful the combined work of actuaries and underwriters can be and we encourage more joint discipline projects in the future. ∎