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Part One: A Short History of A New Product

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Critical Illness insurance is still in its infancy in the United States, but it is gaining ground. While local information is scarce, foreign developments are being closely followed by U.S. specialists.

History.

A physician, Marius Barnard, invented Critical Illness Insurance in South Africa, circa 1985.

Barnard first verbalized the obvious: for almost all his patients, a catastrophic health event such as diagnosis of cancer, heart attack or stroke was a life transforming event, leading, in the vast majority of cases, to personal financial ruin due to massive non-reimbursable expenses, truncation of productive working lifetimes and uncompleted asset accumulation.

Barnard felt strongly that insurance companies should address this problem, offering suitable protections.

South African insurance companies quickly saw the potential market associated with Barnard's idea.

In devising products to fill Barnard's "void," insurers realized that every policyholder's financial needs after diagnosis would be unique: one policyholder would have an unpaid mortgage, another would have children to send to college, a third would have insufficient savings to support dependents when earning powers are reduced.

Thus there could be no basis for projecting and adjudicating utilization. Instead, it made sense to have every applicant estimate his/her future financial exposure just as one would for life insurance, and then apply for an appropriate face amount.

Product Properties.

Barnard was concerned with the most common Critical Illness incidences such as cancer, heart attack, and stroke, but also realized that protection against financial devastation by kidney failure and cost of organ transplant should be insured. Over time, Critical Illness coverages were extended to other calamities such as: loss of sight, loss of hearing, loss of speech, paraplegia, quadriplegia, and multiple sclerosis. Many Critical Illness policies today provide for partial payment of the Face Amount for coronary bypass surgery and angioplasty. Some modern Critical Illness policies provide for as many as 30 different calamities.

Paradoxically, while Critical Illness Insurance pays out on diagnosis of very serious maladies, it has almost none of the features of health insurance and most of the features of life insurance.

A working knowledge of Critical Illness Insurance is best attained by looking at the product through a life insurance "microscope" and not through a health insurance "prism."

Basic Actuarial Issues

Critical Illness Insurance is a straightforward incidence product free of any utilization concepts. This simplifies the Critical Illness Insurance product actuary's work, reducing it to the determination of age-specific critical illness incidence rates that "look and smell" just like mortality rates.

Since there is a known policy Face Amount to be paid on diagnosis, only incidence rates matter; utilization rates are of no consequence.

Sticky issues such as inflation of health-related expenses can safely be ignored. All you need are appropriate tables of age-specific incidence rates. Like mortality rates, these incidence rates are binomial, and subject to the same laws of large numbers as mortality rates.

This is not to say that the actuarial issues in managing Critical Illness Insurance are trivial. Ratemaking for Critical Illness Insurance adds layers of complexity to the processes employed in modern actuarial pricing models.

Basic Underwriting Issues.

The major Critical Illness claim diagnosis events (cancer, heart attack, stroke) are also the major "killers" of human beings. Overall, nearly 75% of all deaths are caused by these three diseases. Hence, it shouldn't surprise you that scientific Critical Illness underwriting closely "tracks" life underwriting.

If you are underwriting individual lives for life insurance, you need to know whether the applicant is in normal good health and whether the amount of the insurance is justified. In Critical Illness underwriting, you also need to classify risks in appropriate health categories, and to eliminate financial anti-selection.

The concerns of Critical Illness underwriters and life insurance underwriters should be, and very often are, the same.

While Critical Illness Insurance underwriting practice generally is very much like life insurance underwriting practice, there are some differences. Critical Illness Insurance is purchased for the insured's own sake, while life insurance is purchased for beneficiaries. One should expect self-interest stronger than the usual concern for loved ones and a tendency towards stronger anti-selection among Critical Illness Insurance applicants. On the other hand, suicide risks in life insurance have no counterpart in Critical Illness.

You can underwrite Critical Illness Insurance as an individual product or as a group product.

Whatever your Critical Illness Insurance marketing opportunity, you can make a good practical start by modeling your underwriting on your company's life insurance product most closely resembling your proposed Critical Illness Insurance product.

Finding Suitable Incidence Rates

Finding suitable Critical Illness incidence rates applicable to insured lives was no simple matter in 1985, when the product was invented: there were no critical illness insured portfolios that could be studied by actuaries. In 1985, Critical

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Illness Insurance incidence rates were in the same "dark ages" as life insurance mortality rates were 150 years ago.

Fortunately, actuaries working for international reinsurance companies found clever ways to calculate Critical Illness incidence rates for members of the general population on the basis of available population statistics and also invented powerful calibration techniques to adjust these population incidence rates to Critical Illness incidence rates that would be applicable to insured portfolios.

Even today, these foreign actuarial techniques are not well-known or widely understood in the U.S.A. They are not part of the SOA's syllabus for students. As far as we know, no scholarly papers dealing with Critical Illness have been published by any U.S. actuarial body.

Incidence Rates for Two Distinct Products

The first sets of rates actuaries developed through calibration techniques were used to price two distinct types of products:

Product One: Standalone Critical Illness Policies. The contract is simple. The policyholder pays premiums. The Face Amount is paid on diagnosis and the policy is canceled.

Product Two: Critical Illness Acceleration Policies. The basic policy is a life insurance. The Face Amount is paid on diagnosis of a Critical Illness or on death. Premiums cease after the Face Amount is paid and the policy terminates.

Given a known Critical Illness annual unit incidence rate ix at age x, the cash flow cost of a Critical Illness exposure of Ex for the year of age x to x+1 is simply $i_x E_x$. This last expression is the net one-year term cost of a standalone Critical Illness policy. It is suitable for pricing Product One above.

Given a known critical annual unit incidence rate ix at age x, and the proportion of deaths due to Critical Illness at age x, kx, the cash flow cost at age x of a benefit of Ex payable on diagnosis of Critical Illness or on death during the year of age x to x+1 is

$Ex \{i_x+(1-k_x)q\ x\}$. This last expression is the approximate (slightly overestimated) net one-year term cost of a one- year term life policy which is payable on death or Critical Illness diagnosis. It is suitable for pricing Product Two.

Export of Critical Illness Product Ideas

After its birth in South Africa, the reinsurer Critical Illness midwives quickly exported the Critical Illness concept to the U.K., Canada, Europe, Australia, and the Far East.

In Australia and in the U.K., Critical Illness products became an instant success.

Available Australian information is anecdotal, but observers in the Pacific rim warn that it is almost impossible to sell a life insurance contract in Australia if you are unable to offer a Critical Illness Acceleration Rider, and that reinsurance companies that are unable to offer Critical Illness product development support in the far east are unable to get any traction with the major direct life insurance companies.

Hard data covering annual Critical Illness sales in the U.K. show that sales of individual Critical Illness policies increased seven-fold from 100,000 insurance policies in 1990 to 700,000 policies in 1998. This can be compared to stagnant, declining sales of pure individual life insurance policies (without Critical Illness rider), which declined over the period by roughly 20%.

In the U.K., fully 86% of Critical Illness policy sales closed on life insurance policies with the CI Rider; only 14% of policies sold were of the standalone type.

Slow Growthin the United States.

Although Critical Illness Insurance has been so successful elsewhere, it has not yet taken off in the U.S.A. Why has the U.S. been slow to develop Critical Illness Insurance Products? Reasons for the slow takeoff may be among the following:

Ill-considered criticism by industry "pundits" and "experts."

A small number of "pundits/experts" have said things like: "If you are going to insure your automobile, would you separately insure the fenders and the doors and the trunk lid? So why purchase Critical Illness Insurance, since it works this way?" This "sound bite" is plausible, but the analogy is flawed, since the purpose of all personal insurance is to ameliorate financial loss, not to replace or repair health conditions and human body parts. These "pundits" often appear to be under the mistaken impression that Critical Illness Insurance pays out on death due to CI, not diagnosis.

Lack of local rate-making expertise.

To our knowledge, none of the U.S. professional actuarial or insurance bodies offer any training in Critical Illness Insurance product design, ratemaking, or underwriting. Until the SOA provides training in the mathematics of Critical Illness Insurance, many U.S.-trained actuaries may, for the most part, be unable to provide their companies with appropriate technical support.

Over-specialization of the U.S. Actuarial Profession.

In the United States, few actuaries practice in life insurance and also in health insurance. Actuaries tend to specialize.

Most U.S. health insurance actuaries focus on employer-provided group health plans with underwriting and ratemaking processes completely unrelated to life insurance practices. Critical Illness Insurance, with its life-like features, is, therefore, a strange animal for many health insurance actuaries.

Yet, when your CEO first recognizes Critical Illness Insurance as a major marketing opportunity, he will most likely refer his request for evaluation of a Critical Illness Insurance product idea to his health insurance actuaries. Since Critical Illness Insurance does not fit anywhere in health actuarial practice, this product's chances of a favorable evaluation by health actuaries are practically zero.

Most U.S. life insurance actuaries are comfortable with mortality rates and not

familiar with current health insurance issues. If a U.S. life actuary is asked to evaluate Critical Illness Insurance as a product opportunity, his/her first reaction might be to route it to the health insurance actuaries who will very likely reject the product idea.

Thus any good Critical Illness Insurance idea in your company may very well circulate from your life insurance actuaries to your health insurance actuaries and back, remaining in product development "limbo" until its original salesman champion moves on to another company, and it dies a natural death in a dusty file.

Inimical and Ponderous State Regulatory Processes.

In our work, we have found that Critical Illness Insurance is poorly understood by regulators. Regulators are not certain whether it should be "vetted" by departmental health actuaries or life actuaries. Some regulators appear to find the serious consequences of CI diagnosis too frightening to even think about and have, perhaps viscerally, placed the insurance on their list of coverages that are never to be approved.

Reasons given by regulators in private conversations for their animosity to Critical Illness Insurance generally come around to the conviction that the mere prospect of Critical Illness will "scare" consumers.

Ironically, in conversations with numerous state legislators, we have seen tremendous and vocal support for the Critical Illness Insurance idea, once the features and benefits are explained.

Legal Overhead in Product Development.

The sheer weight of work in getting 50-state approval for a revolutionary product like Critical Illness Insurance will likely discourage very large, surplus-rich, and widely licensed insurance companies from developing the product. This view appears to be supported by the fact that most Critical Illness Insurance products in the U.S. are currently marketed by regional companies that are not household names and are not strongly capitalized.

Finding Incidence Rates.

Hampered by zero available insured lives experience, actuaries have had to turn to incidences experienced by the general population containing the members of the portfolio to be insured against critical illness.

Since critical illness Insurance benefits are paid on first Critical Illness diagnosis, population incidence rates have to be "scrubbed clean" of repeat incidences before they can be used in ratemaking. Suitable mathematical techniques exist for doing this. They were mostly invented by demographers, not actuaries.

Once you have a set of "scrubbed" incidence rates, you need to employ calibration techniques to adapt your population critical illness incidence rates to the insured portfolio. Miraculously, techniques for such adaptation have been invented. These techniques were first published by Dash & Grimshaw in their landmark paper "Dread Disease Cover: An Actuarial Perspective." (At the time the Dash & Grimshaw paper was written, the term "dread disease" was commonly used to refer to "critical illness.")

Dash & Grimshaw were the first researchers to produce population critical illness incidence rates for the United Kingdom. The Dash & Grimshaw incidence rates as published in 1990, remain an important standard of comparison for British actuaries. They are used extensively in this primer in a comparative capacity.

The Rate Calibration Formula.

Clearly, population critical illness incidence rates, no matter how accurately derived, cannot be directly used in insurance ratemaking. They have to be carefully calibrated from a population level to a level appropriate to the risks to be insured.

In their 1990 paper, Dash & Grimshaw published the Rate Calibration Formula. Unfortunately this very important result was only one of many interesting mathematical results published in the Dash & Grimshaw paper. Many actuaries may not have accorded it the importance it deserves. This may be the reason that it appears to be less well understood than one might have hoped. It also seems as if its almost universal applicability has not yet been appreciated by many technical workers.

The Rate Calibration Formula furnishes a method for calibrating critical illness incidence rates of a "seed" population P to critical illness incidence rates for a "target" population G. The formula is as follows:

Where

$$i_x^G = i_x^P \frac{w_x^G k_x^G q_x^G}{w_x^P k_x^P q_x^P}$$

and

$$w_x^G = \frac{1}{q_x^{D1.G}} \frac{(1 - \frac{l_x^{S.G}}{l_x^G} \frac{q_x^{D2.G}}{k_x^G q_x^G})}{(1 - \frac{l_x^{S.G}}{l_x^G})}$$

And where

$$w_x^P = \frac{1}{q_x^{D1.P}} \frac{(1 - \frac{l_x^{S.P}}{l_x^P} \frac{q_x^{D2.P}}{k_x^P q_x^P})}{(1 - \frac{l_x^{S.P}}{l_x^P})}$$

k_x^G is the proportion of deaths due to critical cause occurring between age x and age x+1 in the target population,

k_x^P is the proportion of deaths due to critical cause occurring between age x and age x+1 in the seed population.

l_x^G is the number of lives exposed to death due to critical cause at age x in the target population,

l_x^P is the number of lives exposed to death due to critical cause at age x in the seed population.

q_x^G is the mortality rate at age x in the target population,

q_x^P is the mortality rate at age x in the seed population.

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$l_x^{S.G}$ is the number of lives that are suffering from a critical illness at age x in the target population,

$l_x^{S.P}$ is the number of lives that are suffering from a critical illness at age x in the seed population.

i_x^{G} is the critical illness incidence rate in the target population,

i_x^{P} is the critical illness incidence rate in the seed population.

$q_x^{D1.G}$ is the death rate at age x applicable to healthy lives contracting a critical illness after age x

$q_x^{D1.P}$ in the target population, is the death rate at age x applicable to healthy lives contracting a critical illness after age x in the seed population.

$q_x^{D2.G}$ is the death rate at age x applicable to lives critically ill at age x in the target population,

$q_x^{D2.P}$ is the death rate at age x applicable to lives critically ill at age x in the seed population.

The Rate Calibration Formula is derived from a differential equation describing a general process of transition from critical illness to death. The Rate Calibration Formula says that, if you know the critical illness incidence rate in a 'seed' population P, and you know the proportion of deaths due to critical cause for P as well as for the "target" population G, and you can make reasonably accurate estimates of the wx factors for both P and G, you can derive reliable critical illness incidence rates for target population G. Application of the Rate Calibration Formula is perfectly general. You can define your seed population in any way you wish. Proper implementation of the Rate Calibration Formula requires that critical illness definitions for your seed and target population correspond very closely. It also requires that cause of death certification in the target population and the seed population are consistent. This means that critical illness diagnosis protocols and cause of death registration systems of the Seed population and the Target population must be similar. unfortunately, these correspondence and consistency requirements void the application of the Rate Calibration Formula to derive critical illness incidence rates for U.S. insurance underwriters from U.K. population critical illness incidence rates.

The Rate Calibration Formula is widely used by practitioners to derive insured portfolio Critical Illness incidence rates from population Critical Illness Incidence Rates. But its general applicability to other types of transitions is less well understood, even by foreign practitioners.

A little reflection may convince you that the Rate Calibration Formula can be even more effectively applied when one wishes to transition from one group of risks in a portfolio to another group of risks in the same portfolio. The Rate Calibration Formula is a powerful tool that can enable actuaries to transition from ultimate critical illness incidence rates to select critical illness incidence rates in the same insured portfolio. The Rate Calibration Formula is also directly applicable in deriving substandard underwriting extra mortality ratings under the numerical rating system. These powerful intra-portfolio adjustments are possible because of the "almost assured" correspondence between critical illness diagnosis protocols and cause of death registration systems.

Johan Lotter wrote this article. It is the first part of our Primer on Critical Illness. Alistair Cammidge, FIA, ASA, of Lotter Actuarial Partners Inc. reviewed it. Johan Lotter will provide "Part Two: An Overview Of Foreign Critical Illness Claims Experience" in the next edition of this newsletter.

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