HIGHLIGHTS OF THE 2014 CIU ANNUAL GENERAL MEETING

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Executive Summary *The 28th Annual General Meeting of the Canadian Institute of Underwriters was held May 28-30 in Montreal. Highlights included an informative presentation on surgical mortality, a review of cerebral aneurysms, a keynote address on global trends in the insurance industry, an overview on addictions and what the insurance industry needs to know about them, a review of alpha-1 antitrypsin deficiency and a look at predicting longevity.*

Surgical Mortality

Dr. Peter Lin, Director of Primary Care Initiatives at the Canadian Heart Research Center, reviewed surgical mortality and how it has improved over the years. He began with a brief history of surgery, noting in the old days, surgery was done on a wooden table and usually involved a saw to remove limbs. For anesthesia, ether was put on a cloth and placed over the patient's face to knock him out. He pointed out that anesthesia today is safer than walking around, because with technology, anesthesiologists can control everything–pulse, blood pressure, heartbeat and respiration. Whereas surgery was done with blades in the past, it is now often done through cautery and lasers. While this has increased the overall cost of surgery, it has significantly reduced the risk of complications. The first pacemaker was the size of a toaster, but today is a small implantable device with even a defibrillator included in it.

In 1900, dysentery was common due to the contaminated water supply. The water supply was fixed and people started living longer. Today, with science and technology extending mortality, we are seeing an increased incidence of cancers, Alzheimer's, etc. For operations, the key people are the patient, nurse, surgeon and anesthesiologist. Dr. Lin explained that visceral fat is a risk factor for surgical mortality. Visceral fat is found around the intestines and liver in the belly. It is very metabolically active and portends an increased risk of diabetes, elevated lipids and hypertension. Waist circumference compared to hip measurement predicts one's risk of coronary artery disease (CAD). Having a large waist and narrow hips carries an increased risk, while having a large waist and wide hips is less risky.

Surgical training has significantly improved over the years and surgeons now use simulators for training on how to do complex operations like coronary artery bypass surgery. In looking at infections, *C. difficile* is still commonly found in hospitals and is now tracked statistically by hospital, as is staph aureus (MRSA) and hand-washing hygiene. Data is also available by hospital on surgical mortality rates by surgery type, so hospitals can use that information to see where they need to improve. One caveat that Dr. Lin pointed out is that teaching hospitals always get the worst cases, so their numbers tend to look bad, which can make the data misleading. He also mentioned the issue of medical tourism, with Canadians going to other countries to have surgical procedures and then coming home where the Canadian doctors and hospitals have to deal with the post-op complications.

The World Health Organization has developed a surgical safety checklist to address 10 objectives for medical staff to address with any surgery. The checklist includes anesthesia pre-op checks, checks prior to the surgeon making an incision and post-op checks. It requires nurse, surgeon and anesthesiologist to check that they have the correct patient for the correct surgical procedure and the correct surgical site. They also discuss any anticipated critical events that may be encountered during the procedure. Dr. Lin noted that in the US, there are over 1500 wrong-site surgeries per year, and 1 in 5 surgeons admits to having performed a wrong-site surgery at some time in their career.

The checklist was piloted in eight hospitals throughout the world–most of them were not doing all of the

things on the list. After adopting the list, the results showed a decrease in surgical death rate by almost 50%, a decrease in complications from 11% to 7%, and a decrease in disability from 6.2% to 3.4%. While death rates decreased in both high- and low-income countries, they decreased more in the low-income countries. A 2010 study showed that more hospitals were using the surgical safety checklist and were improving their surgical mortality as a result.

Dr. Lin next looked at a few surgical advancements. The CT scan of the bowel looks for tumors and polyps, and only if the scan shows polyps would a patient then need to have the invasive colonoscopy. There is a slight risk from the radiation the CT scan uses, but with colonoscopy there is also a risk of bowel perforation. More recently, there is the video colonoscopy, with the patient swallowing a capsule that contains a tiny camera that takes pictures from mouth to rear as it moves through the gastrointestinal tract. He indicated that in the future, many surgeons may be using or be replaced by robots in remote areas.

Innovation is also helping with infection rates. Bacteria like to clump together. It was noted that sharks do not grow bacteria on their skin. As such, surgical tables are now made with a pattern like shark skin, so bacteria can't clump and grow like they did in the past. Another advancement is in the area of thoracic aortic aneurysms. Surgeons can now repair a thoracic aortic aneurysm with a minimally invasive procedure, placing a stent without opening the chest. The procedure, much less invasive, has resulted in significant surgical mortality improvement. There is no long-term (20-year) data available yet, so the long-term risks are unknown at this time. Dr. Lin noted that in the future, it will likely be possible to take a patient's cells, grow different types of cells, and then with 3D printing, create organs such as kidney, liver, etc. Because they would be the patient's own cells, there would be no rejection by the body. Research is ongoing in this area and printing a patient's organ will likely be possible in our lifetime.

Cerebral Aneurysms

Dr. Tuong Minh Nguyen, Medical Consultant for Optimum Reassurance Inc., reviewed cerebral aneurysms (CA) in risk selection. He started by defining some terms: meninges–the membranes covering the brain and spinal cord, and cerebral aneurysm–an outpouching of an artery in the brain. The fear with a cerebral aneurysm is that a subarachnoid hemorrhage (SAH) will occur, causing bleeding in the brain. Eighty percent of SAHs are due to aneurysm rupture. SAHs are very deadly–50% of patients who have a SAH die quickly; the other 50% have significant residuals. The global incidence rate is 10-20 per 100,000 persons, with an average age of 55 years. Two percent of the general population have a CA noted on random MRI testing and are asymptomatic, so CAs are not a rare occurrence.

Many cerebral aneurysms occur in the anterior system, most commonly in the middle cerebral artery and the internal carotid artery, with only 20% occurring in the posterior system. Size is an important prognostic factor. Small aneurysms (<7 mm) almost never rupture. Aneurysms 2.5 cm or greater have a 5% per year risk of rupture. In a study of 4,000 patients with SAH who were followed for 4 years, 2400 received treatment, 1600 were watched, with a rupture rate of .74% per year noted. When a CA bulges, it has a larger radius, which increases the risk of rupture due to the increased pressure. A second study of 142 patients found a rupture rate of 1% per year–much higher than previously thought. While there is always a risk of rupture (1-2%) regardless of size, a small CA (<7 mm) has a rupture risk of .1%, a medium-sized CA (7-10 mm) has 3x that risk of rupture, and a large CA (>10 mm) has a 5x risk of rupture. If a patient has a small CA and symptoms, he then has a 4x risk of rupture.

On a global basis, Japan has a higher risk of CA rupture at 1.2% based on a study of 5,000 cases. The Japanese do preventive MRI studies like we do chest X-rays and labs in North America. Women also have a higher risk of CA rupture than men. As CA size increases, so too does the risk of rupture. Location of the CA is a significant prognostic factor. Best case is a CA in the middle cerebral artery–one-third of all CAs occur there. Worst case is a posterior cerebral aneurysm. The riskiest is a CA with a daughter sac. In a study of 400 patients with a small CA (<5 mm) who were followed for 3.5 years with no treatment, only 1.9% ruptured or approximately .5% per year.

Treatment of cerebral aneurysms is by surgical clipping or endovascular coil, although one-half of patients with a ruptured CA die before they arrive at a hospital. A 2003 study of 1700 unruptured CA patients found that at 30 days post-treatment, 2% were dead. That same study found that at 1 year post-op, 10% of them were disabled. When a CA is unruptured, Dr. Nguyen explained that there needs to be a good reason to clip or coil it, due to the high morbidity and mortality surgical risk. There is a current trial under way that is looking at unruptured intracranial aneurysms and endovascular aneurysm management. Results of that study should be available within a few years. However, once a CA has ruptured, surgery must be done. He then looked at long-term post-rupture

mortality, indicating at 1 year post-op, a person still does not seem to be a standard risk. In one study of 900 CA post-rupture patients, almost 8% died within the first year–60% of the deaths were due to coronary artery disease or cerebrovascular disease and 15% died of a recurrent SAH. An international study of long-term CA post-rupture mortality also found very high mortality in the first year, further validating that those patients do not appear to be a standard risk for life insurance even at 1 year post-op. While treatment reduces the risk of a rebleed by 99%, there is still a 1% chance that a patient will have a rebleed within 10 years of treatment.

The risk of a SAH in a person with a family history of SAH in one immediate family member is low and probably OK at standard rates for life insurance. However, if a person has a family history of SAH in two or more immediate family members, their risk of SAH is increased. When a SAH occurs in a first-degree relative, screenings have shown the risk of SAH to immediate family members to be twice that of the general population.

Dr. Nguyen then summarized the take-home messages on underwriting cerebral aneurysms. Approximately 2% of the general adult population has a cerebral aneurysm. There is no evidence that screening provides benefits. Global aneurysm rupture rate is approximately 1-2% per year. Rupture rate is influenced by many factors including size and location. Proposed insureds should be postponed for 1 year post-SAH and underwritten after that with careful attention to residuals. Even when successfully treated, post-SAH cases do not automatically appear to be standard risks. SAH and/or aneurysm in one family member indicates very little increase in mortality for the rest of the family.

Using Global Trends to Create Local Opportunities

John Cardus, Head of Global Underwriting, Swiss Re Life & Health, stated that it's a great time to be in underwriting as the needs of the business evolve and the scope for influence increases. Outside of North America, there is a general push to get less evidence and rely more on customer disclosure, while in Canada and the US, the focus remains on preferred underwriting. Some of the key forces impacting risk management are the increasing relevance of protection, consumer power, data, technology and increasing competition. Cardus spoke about the increasing relevance of insurance protection and the positive perception of it in the market. Since 2007, there has been about a 10% growth in protection worldwide. The advanced markets such as Canada, the US and Europe have been stagnant with little or no growth. The emerging markets are where the growth is occurring. This shift has smarter insurers in the advanced markets thinking differently and seeking new ideas. There is a mortality protection gap that has the potential for growth in most countries, especially with the aging population. Consumer attitude has also changed, with consumers taking greater control and responsibility for their financial well-being and not relying solely on state support.

Consumers are becoming more sophisticated and have higher expectations of the products and services they access. Customer expectations are increasing that a policy will pay out when needed, that the policy amount and premium will be fair, that they have rights available for the risks they take, that they understand and accept the limitations of a policy, and that they are happy with the advice they are given. A major factor is trust–in particular, do and should underwriters trust the consumer? Is the underwriting mindset such that they don't? Cardus said that, in his experience, the answer was yes, stating underwriters need to think about that answer and consider whether a mindset shift is required. Consumer influence will continue to drive the way we think about underwriting.

Cardus then covered some recent activity in the industry. In Europe since December 2012, insurance companies cannot discriminate on the basis of base premium rates between males and females, and now age and disability are additional factors that are under consideration. In France, there is lobbying for "the right to forget," which says there should be no need for applicants to disclose cancer history following treatment. Use of predictive non-genetic tests is also under attack–for example, in Portugal, family history cannot be asked on the application. In Germany, there is a debate on the right not to know, which would allow proposed insureds to refuse certain testing. Consumers are increasingly able to access their personal data including medical records, and one proposal is that doctors should be required to deliver responses to insurers for information via the patient, who would then pass them to the underwriter. Consumer groups are lobbying around disability and mental health, challenging insurers to prove their mental health rates. Most of these initiatives are proposals and not yet implemented. Insurers are therefore considering steps to use different ways to underwrite.

In Asia, living benefits are a primary focus. There is a high incidence of cancer there, yet we are seeing product segmentation–for example, simplified underwriting with an application only and no evidence. In

addition, for advanced cancer (Stage 3 and 4), there are medical products that specifically cover these. On critical illness plans, there is further product diversification (e.g., those focused on female disorders only). Juvenile plans that are investment-linked but mortality-based are very popular.

In the UK, simplified disability income policies are available that will only cover specific costs (e.g., a person's mortgage for a limited period)–no evidence is needed. In Europe, there is a developing focus for elderly coverage for acute care based on specific triggers, while in Asia, there is a focus on covering mild/moderate dementia. In South Africa, there is severity-based critical illness which pays based on the severity of the condition, not just on the condition. HIV insurability products are available in Europe and South Africa due to consumer demand.

A 5-year wealth forecast for 2010-2015 indicates the Middle East, Europe and Asia Pacific markets have the most growth potential. International underwriting considerations include residence–is it important and how should it be managed? Cardus suggests underwriters need to change their thinking on it and allow more flexibility on residency and citizenship. Likewise, on international risks, medical evidence requirements need more flexibility. Medical reports do not exist in some parts of the world and there needs to be a balance between medical requirements and excessive testing. The broker relationship is key to financial underwriting on these risks. Third-party verification of wealth and references should be obtained as well.

Cardus next looked at global data trends. Technology advances offer new ways to underwrite. Expert underwriting systems have been around for 10+ years, and now information can be pulled out of them to check the protective value of application questions. Companies need to balance risk management, pricing and efficiencies from guaranteed issue to full underwriting products. Pricing is lower with full underwriting but requires more underwriting effort. In Europe, there are products in which a proposed insured answers three medical questions to get a life insurance policy on an accept/decline basis only, with a maximum age and limited amount that will be issued. Predictive underwriting accesses different data to supplement or replace existing underwriting, thereby potentially reducing the amount of traditional underwriting (e.g., a one-question application with no underwriting requirements but high cost). Insurance companies need to get consumers to share their information for things like wellness, personal medical devices used and social media. In a risk assessment matrix, underwriting is increasingly at the center, as an interface between the consumer and the insurance company.

Lastly, Cardus looked at the future needs and opportunities for the underwriter. Underwriters need to develop new skills and expand their focus from just technical underwriting; be able to understand and work with new variables, develop and use new models, explore and understand new data sources to become experts of new technologies; and be open-minded and look to other markets for additional expertise and inspiration. Insurers will need business-savvy underwriters going forward. Underwriters need to adapt and change the way they think and underwrite. It's a great time to be in underwriting–it is what drives the business!

What the Insurance Industry Should Know About Addictions

Dr. Ronald Fraser, Head of Inpatient Detoxification Service of the McGill University Health Centre's Addictions Unit, and Associate Professor, Department of Psychiatry at McGill University/Dalhousie University, began by defining addiction: a chronic condition of the motivational system in which a reward-seeking behavior has become out of control–in other words, a brain disease. He explained that addiction is a disease, although unfortunately, society does not see it as such.

Substance-related disorders can be divided into two groups: substance use disorders (SUD) and substance-induced disorders. Substance use disorders were previously split into abuse or dependence. This disorder involves impaired control, social impairments, risky use and pharmacological criteria which include:

- Using larger amounts or for longer time than intended.
- Persistent desire or unsuccessful attempts to cut down or control use.
- Great deal of time obtaining/using/recovering.
- Craving.
- Failure to fulfill major roles (work, school, home).
- Persistent social or interpersonal problems caused by substance use.
- Important social, occupational, recreational activities given up or reduced.
- Use in physically hazardous situations/occupations.
- Use despite physical or psychological problems it causes.
- Tolerance.
- Withdrawal (not documented after repeated use of PCP, inhalants, hallucinogens).

Addiction severity depends on the number of symptom criteria a person meets–2-3 symptoms is considered mild, 4-5 symptoms is moderate, and 6 or more criteria met = severe addiction. Addiction is a vicious cycle where low mood/anxiety leads to consuming mood-altering substances, which results in financial, social, legal and medical problems. In Canada, while 90% of the people drink alcohol, 15-16% of them are actually addicted to it. Substances of abuse include alcohol, drugs (prescription and non-prescription), caffeine, inhalants, nicotine, gambling and possibly sex, shopping and food. Alcohol is the number one substance abused in Canada, aside from tobacco. In looking at some of these substances, Dr. Fraser noted that while 45,000 people die from cigarette use each year, cannabis is not seen as a problem in Canada, and alcohol misuse is socially acceptable with many advertising dollars spent on it. In Nova Scotia, the average age of the first drink is at 12–a worrisome statistic. In a 20-year period (1981-2001), 484,000 people died from AIDS. During that same time, 10 million Americans died from tobacco-related diseases.

Substance use disorders are one of the most common and costly health problems in Canada and the United States, with estimated costs of over $40 billion annually in Canada alone. These disorders cause extensive medical, psychiatric and social complications too. Twenty percent of all ER visits are substance-related; 10% of premature deaths are due to hazardous drinking; 50% of fatal motor vehicle accidents involve alcohol; 50% of suicide attempts/completions involve alcohol; and alcohol is implicated in more than 30% of childhood violence and sexual abuse cases. SUD is more prevalent in men, younger individuals, unemployed people, larger metropolitan areas, those with a psychiatric illness, in certain race/culture/religions, and when there is another SUD or family history of SUD. Dr. Fraser noted that family history of SUD is the strongest predictor of addiction. Drug abuse is far less prevalent than alcohol, but abuse of prescription drugs is rapidly increasing. Men are twice as likely to abuse alcohol and be dependent on it.

Medical problems resulting from hazardous drinking (more than three drinks/day for men, two/day for women) include hypertension, cardiomyopathy, diabetes, trauma, stroke and cancers. Morbidity and co-morbidity from cocaine use includes cardiac, pulmonary, renal and cerebral impairments, and can be deadly in intoxication. Among prescription drugs, opioids and benzodiazepines are the most abused medications. There has also been an explosion of ADHD medication use in the adult population. Prevalence of SUD is significantly higher in those with psychiatric disorders–47% of schizophrenics and 84% of those with antisocial personality disorder have a lifetime SUD. Substance-related disorders include intoxication, withdrawal, delirium, mood/anxiety/psychotic disorders, sleep disorder, etc. Addiction is a complex brain disease–it affects how people think and behave. Prolonged use of alcohol, tobacco and drugs can physically alter the structure and function of the brain. In fact, after 100 days off cocaine, an addict's brain has still not fully returned to normal.

Dr. Fraser emphasized that addiction is the worst treated disease in North America. Only 10% of addicts seek treatment, and of those, only 10% actually get effective treatment. For every dollar spent by federal, state and local governments on risky substance use and addiction, only 1.9 cents goes for prevention and treatment, while 95.6 cents pays for the consequences of addiction. SUD and addiction account for almost one-third of all hospital costs in Canada. Addiction is a complex disease with effective treatment options, although no single treatment works for everyone. Treatment needs to be more readily available–detox is a precursor to treatment, it is not a treatment by itself.

Effective treatment options include pharmaceutical therapies to reduce cravings/withdrawal symptoms and maintenance, psychosocial therapies such as motivational interviewing, and cognitive behavioral therapy and combination therapies, although they are not used as often as needed. Scientifically based approaches to addiction treatment work, but not on every patient. Examples of these are cognitive-behavioral interventions, 12-step programs, community reinforcement, contingency management and relapse prevention. The best treatment practices require a comprehensive assessment, stabilization, acute care, chronic disease management and ancillary services/peer support. Core components of comprehensive services for addiction treatment are medical, financial, mental health, vocational, educational, legal, HIV/AIDS risks, family, child care, and housing and transportation. Dr. Fraser noted that the last part of life affected is the job. Addiction affects home, family, relationships and, lastly, one's job.

Alpha-1 Antitrypsin Deficiency

Dr. Robert Profumo, Medical Director at Aurigen Reinsurance, gave an overview of alpha-1 antitrypsin (AAT) deficiency and its underwriting implications. He began with a description of AAT and its pathophysiology. AAT is an inhibitor of elastase–a proteolytic enzyme that is released by neutrophils as part of the inflammatory cascade. AAT limits elastase activity by binding to it and destroying it–preventing excessive damage. If there is not enough AAT, the elastase

proliferates. alpha-1 antitrypsin deficiency is a genetic disorder which leads to decreased/abnormal amounts of circulating AAT. AAT levels of 11 micromol/L are needed to protect the body from excessive elastase activity. AAT deficiency leads to problems in various organs–lungs, liver, skin, vascular. Genotypes of AAT deficiency are M (normal), Z (deficient), Null (no AAT) and F (abnormal AAT). While MM is a normal state and ZZ means one has significantly decreased AAT (<11 micromol/L), MZ genotype has no clinical significance as there is enough AAT circulating to prevent clinical manifestations of the disease.

The prevalence of AAT is similar to that of cystic fibrosis–2-3% of Caucasians in the US carry the Z allele (4% carry the CF gene). There are 80,000-100,000 Americans who have low AAT, and 3 million worldwide. It is underdiagnosed since not everyone with AAT will have clinical disease. In a study of 1000 people with COPD who were tested, 3% were found to have severe AAT deficiency. The number of known AAT cases is much lower than the real number of cases that exist. A diagnosis of AAT deficiency should be considered in clinical situations where a person under age 45 has chronic obstructive pulmonary disease (COPD); a nonsmoker has COPD; a person has COPD with basilar changes; or there is a family history of COPD and/or liver disease, unexplained liver disease or panniculitis. AAT is diagnosed by a blood test that measures the amount of AAT and by genotyping–with ZZ being the most common symptomatic variant.

Dr. Profumo explained that AAT can have various clinical presentations–lung disease, liver disease or in the skin and other organs. In lung disease, insufficient AAT allows unfettered elastase activity, with elastin destroyed, reducing the FEV1 and leading to emphysema with mostly basilar changes (lower lung) seen on chest X-ray (CXR), while COPD usually involves the upper lungs. Not everyone with low AAT levels develops COPD. An AAT level of 5-6 micromol/L is a strong risk factor for emphysema. In newborn screenings, most ZZ diagnosed persons remained nonsmokers and had normal CXR and pulmonary function tests (PFTs) at age 30. Secondary risks for early emphysema in ZZ persons include smoking, environmental exposure to dust and particulates, asthma and a family history of COPD.

The natural history of AAT lung disease is a persistent decline in FEV1 with 75-85% of AAT deficient people developing COPD. Treatment involves getting the normal/missing protein in the AAT patient with known COPD. The AAT protein structure and genes coding for AAT are known, allowing for treatment options such as augmentation therapy, increased endogenous AAT production or gene therapy. The most common and only approved treatment involves IV infusion of purified human AAT that raises the AAT levels in the blood and epithelial lining of the lung and slows the rate of FEV1 decline (but doesn't stop it). Treatment is via weekly infusions but is only done in nonsmokers, those who have proven low AAT and those who have COPD with abnormal pulmonary function tests. Treatment is not given to those of MZ genotype, those with AAT levels over 11 microl/L or those with a normal FEV1. An experimental therapy is IV recombinant AAT made by sheep, but there are high rates of allergic reactions to it. Other experimental therapies are aerosolized AAT, which requires daily administration and augment endogenous production that uses hormones to fool the body into making more AAT. Gene therapy is looking to replace the defective AAT gene with exogenous DNA that contains the M genotype–but it's not there yet.

Liver disease has various presentations–neonatal hepatitis, cirrhosis and hepatocellular carcinoma. AAT accumulates in the liver and can't get out of the liver cells, although it's unclear how AAT causes liver disease. Fortunately, AAT liver disease is rare–only 15% of AAT deficient people develop it. Liver disease in children is usually seen as hepatitis, and 70% of those cases resolve by the time the child reaches age 10. Liver disease in adults is secondary to lung disease, and 40% of those cases go on to develop cirrhosis. There is no specific treatment for liver disease, other than liver transplantation for end stage disease in children only, since adults have COPD as well and would not survive a transplant.

Necrotizing panniculitis and inflammatory skin lesions are seen in AAT deficiency skin disease, due to unregulated proteolysis. Treatment is with AAT replacement and steroids. Other organs such as kidneys, intestines and the vascular system can be involved in AAT deficient people. The mortality of AAT deficiency is still murky since only the sickest get diagnosed and treated. Various studies have reported annual mortality rates ranging from 7-37%, with mortality being closely associated with PFTs – an FEV1 <15% portends a 36% mortality rate.

Lastly, Dr. Profumo discussed underwriting considerations. He noted that ZZ individuals have a progressive decline in their FEV1 level, and that level closely correlates to excess mortality, even in nonsmokers. MZ individuals do not have the progressive FEV1 decline or other associated problems, unless they smoke or work in a mine. Liver disease, though rare, is progressive in 10-30% of individuals.

For those adults whose hepatitis resolves, they will still need to deal with the lung disease as their primary issue. Children with AAT liver disease are not insurable. Adults with liver disease tend to be young and likely have significant lung disease as well, making insurability unlikely. He cautioned underwriters to be conservative on Null and other variants of AAT deficiency because little is known about them yet– those should be referred to the medical director for guidance. The long-term effects and efficacy of AAT replacement therapy are not yet known. The rate of FEV1 decline is only slowed with IV AAT therapy; it is not a cure. Gene therapy may offer a true cure for AAT deficiency in the future.

Predicting Longevity – Precise Science … Fool's Errand

Dr. Tim Meagher, Vice President and Medical Director at Munich Re, discussed the importance to life insurers of accurately assessing future changes in life expectancy (LE). At its most simple, if LE continues to increase, the insurer will be happy on the life insurance side of the ledger, but less so on the living benefit side. Should LE level off or decrease, the insurer will be unhappy on the life side of the ledger, but more content on the living benefit side. Whatever direction LE takes, the insurer must be able to plan and price in consequence. An accurate assessment of future LE is equally important to those managing private and public pension plans. If LE continues to increase at the rate it has done for the past few decades, the draw on pensions will be substantially larger than current contribution levels can support. An underestimation of future life expectancy would amplify this effect, whereas an overestimation would stretch the ability of individuals, employers and government to adequately finance their plans.

The topic of human longevity is now receiving plenty of press. A recent *National Geographic* magazine cover claimed that a baby born today will live to be 120 years old on average, with some living 140+ years! However, experts disagree about such predictions; some actually predict a decrease in life expectancy, largely as a result of the impact of obesity on mortality.

One way to predict future life expectancy is to examine past experience and then extrapolate forward. LE in most developed countries has increased by approximately 3 months/year for the past 150 years. While there was a number of mortality peaks during these decades, LE improvement on aggregate remained remarkably linear. Why not simply project similar rates of improvement for future decades? Such an approach would produce quite striking increases in LE, perhaps proving the *National Geographic* article correct! Those who are bullish about future LE increases point out that cures for cancer and dementia will inevitably arrive, regenerative medicine (heart replacement, etc.) will become the applied standard of care, and rejuvenation therapies will delay the changes of aging.

The more numerous opposing opinions point out that before 1950, most of the gain in LE was due to mortality reduction at younger ages. Since 1950, LE increase has been due to mortality reduction in the >65 age group. We are now at a point that future mortality improvement will be much more difficult to achieve and we can therefore expect LE increases to slow down. These opposing opinions also argue that new infections, antibiotic resistance, natural disasters, pandemics and terrorism will render future LE improvements even more difficult to achieve.

Dr. Meagher reviewed the significant improvement in CAD mortality that has occurred over the past 15 years. The mortality reduction rate has been about 3%/year in Canada and the US. This impressive figure is explained by fewer smokers, better control of blood pressure and cholesterol, use of angioplasty/stenting/bypass surgery and statins. Are such improvement

rates sustainable? Will smoking rates continue to decline? Will cardiac intervention techniques improve? Will genetic technologies have an impact? And will stem cell therapies allow the heart to be regenerated?

Similarly, cancer mortality has also improved in the past 15 years, but not to the same degree as cardiovascular mortality. Much of this improvement has been due to smoking cessation. Considerable progress can still be made in reducing cancer mortality, but both the extent and timing of these improvements are speculative. Improvements will likely be due to improved screening and prevention strategies and more effective cancer treatments, the latter largely due to the application of genetic profiling of both tumors and patients.

Dr. Meagher presented some recently published Canadian LE projections. At present, Canadian women, on average, live 4-6 years longer than men. It is predicted that the gap will close over the next 50 years and, in fact, has already begun to close. In Canada, LE for a baby born in 2012 was 80 years, both sexes. By 2030, Canadian life expectancy at age 65 will be 21 years for males (from current of 18.5) and 23.5 for females (from current of 21.5).

Dr. Meagher next defined aging and raised the question whether there was actually an upper limit to human lifespan. He noted that there are various definitions for aging, and while aging is not programmed, there is no clearly established mechanism nor explanation why aging occurs at different rates in different individuals. Aging has been defined as a progressive, generalized impairment of function, with a growing risk of disease and death. Also unknown is whether there is an upper limit to lifespan. We are programmed to survive, not to die. Survival demands energy and there are many competing demands for that energy from birth, including poor nutrition, stress, fatigue and environmental factors. While aging is in part under genetic influence, it is more of an accumulation of environmental "hits" against that genetic makeup that define the speed and extent of the aging process.

Dr. Meagher cautioned that if obesity continues at the same pace in the US and Canada, it might erase all of the CAD improvements of the past 20 years. Canada has seen a significant increase in the prevalence of obesity since 2000, though not as severe as in the United States. Canadian children are getting fatter and obesity is starting in the first decade of life. Obesity prevalence is leveling off, but since obesity begins at younger ages, people are now obese for longer periods of time. The number of obese years may add a new element to the impact of obesity on mortality.

Today, people watch a lot of television, are sedentary and overweight. However, it is possible to increase life expectancy with exercise. Studies have shown that as little as a 75-minute brisk walk/week can increase LE almost 2 years, while 450 minutes of brisk walking/week can increase LE almost 5 years. Smokers, on the other hand, lose 6-10 years of life expectancy depending on how much they smoke. In combination, a 65-year-old, male nonsmoker who is physically active would have a LE of 16.2 more years, while a 65-year-old, male smoker who doesn't exercise would only have a LE of 9.5 more years. Additional ways to increase life expectancy: reduce sitting to <3 hours/day and LE increases by 2 years; limit TV to <2 hours/day and LE increases by 1.4 years!

Dr. Meagher pointed out that the various determinants of future LE could be categorized, with each category likely to have an impact at different times in the future. The traditional determinants of mortality (lifestyle, health environment and medical advances) will likely continue to impact mortality over the next 20 years. Regenerative medicine, nanomedicine, advances in transplantation, genetic therapies and artificial organs are unlikely to make any significant contribution to population LE for the next 20-40 years. Retardation of aging, which for the present is examining the impact of caloric restriction, the use of the drug rapamycin and techniques to preserve telomere function, is unlikely to have any impact on mortality for the next 40-60 years. With respect to both regenerative medicine and the retardation of aging, these numbers remain quite speculative.