



The RMS LifeRisks Monitor is a periodic review of the latest developments affecting mortality and morbidity risk for the clients of Risk Management Solutions.

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This edition features the creation of a deadly flu virus, updates on cancer drug developments, some news about developments in the science of aging, what the latest U.K. mortality data reveals about trends and the social divide, and how a period of economic downturn could be expected to affect mortality rates in the next few years.

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MAN-MADE STRAIN OF DEADLY AVIAN FLU VIRUS POSES NEW PANDEMIC RISK

Scientists in the Netherlands have developed a transmissible version of the highly virulent H5N1 influenza virus. Safety concerns have led to a 60-day moratorium on further research. The escape of a virus from the laboratory, either by accident or malice, could trigger a high mortality pandemic.

'Avian flu', the feared H5N1 strain of the influenza virus has been a concern of public health authorities, the life insurance industry, and society in general, since cases were reported in 2003 in Southeast Asia. In the past nine years there have been 583 human cases of which 344 (59%) died, making it the most virulent strain of influenza ever observed. The only positive attribute of H5N1 was that it could only be caught from close contact with a bird – unlike other strains of influenza such as H1, H2 and H3, it had not adapted to spread between people through airborne transmission in coughs and sneezes. There were major doubts that H5 could ever trigger a pandemic.

Until now.

At a recent conference Ron Fouchier, a virologist in Rotterdam, announced that he has managed to achieve what nature hasn't yet done on its own: create a strain of the virus that can be spread between mammals by airborne transmission. A second independent researcher, Yoshihiro Kawaoka at the University of Wisconsin, has achieved something similar, splicing a gene from the H5N1 virus into the transmissible strain of the mild H1N1 virus. Research in this topic is intended to help understand the genetic mutations required for transmission to occur, and to help prepare vaccines if it did.

However many in the public health community have reacted in horror. The fact that the virus now exists makes it possible for a highly pathogenic pandemic to occur through accidental or malicious release, which may be more likely than from a natural mutation occurring randomly. Around a hundred laboratories are thought to have requested a copy of Fouchier's virus, and most of these are only bio-security level (BSL) 3 facilities, rather than the highest BSL 4 for deadly airborne viruses. The U.S. National Science Advisory Board for Biosecurity (NSABB) asked the scientists not to publish details of their research to avoid replication

of the experiments by others. Another group of scientists published an assessment of the dangers of accidental release of the virus from laboratories where the experiments are taking place. The implications for national and global health security have resulted in a 60-day moratorium being announced by the research community. This will enable debate and potentially allow time for new regulation of the research to be put into place.

The implications of these achievements will take some time to fully digest. Fouchier's version is the more virulent and of more concern. His experiment was clever and surprisingly successful. It involved accelerating the mutation rates for the H5N1 virus using infected ferrets, as they mimic human influenza reactions quite closely. Fouchier manually cross-infected ferrets repeatedly, until after 10 rounds of experiments, a strain was produced that spread to ferrets in nearby separate cages – and killed them. The experiment showed that the mutation path was simpler than virologists had previously believed – only a few genetic modifications of the H5N1 virus were required.

Many unknowns remain about Fouchier's virus. To understand how it compares with other influenza viruses we need to establish how infectious it is, and how virulent the virus would be in a human population. The fear is that if this virus got into circulation in the human population, it would be capable of causing a pandemic with a very high mortality level. Because of this risk, there are likely to be new levels of bio-security safety measures put into place that will try to prevent this from happening. As these measures become clear, we will have a better picture of the threat posed by the existence of the new virus.

One thing is certain. The virus now exists and cannot be un-invented.

The existence of the Fouchier virus means that there is a candidate scenario for an extreme mortality shock to a life insurance portfolio that did not exist before. Life insurance solvency capital assessments using pandemic models may need to be adjusted if, for example, the implications of a Fouchier-driven pandemic affect the 1 in 200 return period level of concern for Solvency II. RMS is currently preparing an assessment of the potential severity of a pandemic that would result from the release of a Fouchier virus, and the probabilities that should be assumed around the chances of accidental or malicious release. An RMS white paper will report on this as soon as the relevant facts are available to make this assessment. Please contact RMS if you would like to receive a copy of this when it is published.

PROSTATE CANCER DRUG STUMBLES AT THE FOURTH HURDLE

The war on cancer is still in its infancy. The new generation of cancer drugs holds out the promise of major reductions in future cancer mortality, but they are very costly and still produce only marginal benefits. A new drug available for prostate cancer has been judged as insufficient value for money for the U.K.'s National Health Service. The cost-effectiveness of cancer drugs is a major factor in future mortality improvement.

The past two decades has seen major life expectancy gains from treatments for cardiovascular disease. Cancer mortality has proven more stubborn to erode. Cancer has now overtaken heart disease as the leading cause of pensioner deaths in several countries including the U.K. and Canada, and is predicted to do so soon in the U.S. and elsewhere. The next wave of mortality improvement in European countries will depend on the speed at which treatments for cancer become effective. This is proving to be a struggle. Cancer treatment drugs are still very expensive and producing only marginal benefits. The case of Abiraterone, a new prostate cancer drug, is a good example.

Abiraterone, a drug developed by Janssen, prolongs the lives of late-stage prostate cancer patients but has been tentatively rejected for use by the U.K.'s free-for-all National Health Service (NHS) due its high expense. For patients who do not respond to standard cancer treatments, the drug offered the potential of an additional average of four months of life. However at £3,000 (\$4,500) a month, the National Institute for Health and Clinical Excellence (NICE) has ruled that the new drug exceeds its cost effectiveness threshold of £30,000 (\$45,000) per quality-adjusted life year (QALY).

Prostate cancer is the most common type of cancer to affect men in the U.K., accounting for 24% of all male cancers and 14% of all male deaths from cancer. The lifetime risk of being diagnosed with prostate cancer is 1 in 9 for men in the UK. Treatment of the disease is complex and depends on whether the cancer has spread beyond the prostate gland. Hormone therapy with drugs or surgery is the standard first line treatment for more advanced stages and involves halting or reducing the production of testosterone, the main driver of prostate cancer growth. When hormone therapy is ineffective, a patient has very limited treatment options. Abiraterone inhibits an enzyme that creates testosterone.

Abiraterone can help sufferers, but it failed to pass what is commonly described by the pharmaceutical industry as the "fourth hurdle". Abiraterone passed the first three hurdles (safety, efficacy and quality) with drug regulators in the U.S. and Europe. The fourth

hurdle is for a medical product to gain market access and become profitable. With such limited treatment options for advanced stage prostate cancer, the drug is already in wide use in the U.S. healthcare system and approved for use on most of the U.S. healthcare insurers' formularies. However the nationalized healthcare system in the U.K. applies cost-effectiveness criteria that have ruled out the provision of the drug at the taxpayers' expense. Critical public reaction in U.K., and pressure from patients and interest groups may lead NICE to reassess their decision.

If the drug were made available in the U.K., it could quickly benefit the 10% of prostate cancer patients who currently fail to respond to other therapy. For a typical U.K. pension portfolio of men, the proportion likely to eventually die from unresponsive prostate cancer and the additional life expectancy granted to these cases could result in an increase in liabilities of up to 3 basis points.

This relatively small increase in liabilities would be easily absorbed by most pension schemes, but is only one of many incremental increases that might be expected from future cancer treatments. As more drugs become available and become more effective, their impact on pension liabilities will grow. There are currently 900 drugs undergoing clinical trials for cancer-related treatments, over 10% of them for prostate cancer. These new drugs will continue to come to market, but a major constraint is the economics of their development. A new drug costs between \$500m to \$2bn to develop, involving expensive core research, clinical trials, approval filings, and marketing. Costs vary by disease, therapy and technique.

The U.K. spends around 6% of its NHS budget on cancer treatment and management, just under £100 (\$150) per capita, well below France and Germany at \$200 per capita. The U.K. austerity measures mean that the NHS will have further constrained budgets in forthcoming years, but demand for cancer drugs is likely to continue and to become more political as cancer starts to become the major cause of death. Mortality improvement from cancer will be incremental but of growing significance into the future.

RMS modeling of mortality and longevity incorporates developments in cancer treatments as part of the vitagion category of Medical Intervention. This recognizes not only the potential impact of treatments on future mortality, but also the uncertainty around the hurdles they face, including the 'fourth hurdle' of market adoption and cost effectiveness.

ANTI-AGING RESEARCH TAKES ONE STEP FORWARD, AND TWO BACK

Research into 'geroscience' – understanding the mechanisms of aging – is at a very early stage and subject to significant reversals. Recent research has made progress in the area of senescent cells but some early promising findings on sirtuins and resveratrol appear to be wrong.

Geroscience, research into understanding the mechanisms of aging, holds as its goal the development of treatments to prolong healthy life. Occasionally early-stage research spawns headlines about some potential wonder-drug that might deliver big increases in life expectancy. News of this type is of concern to managers of pension risk in case it might imply increases in tomorrow's liabilities. However, anti-aging research is a very nascent science and as in any early field of exploration, progress is sporadic and apparent early advances can quickly be revealed as false starts. Recent publications from the field have shown mixed progress. There have been promising advances in understanding senescent cells, but optimism about understanding sirtuins in genes and the effects of resveratrol have been shown to have been misplaced.

Cleansing senescent cells seems promising...

One track of research is the understanding and cleansing of senescent cells – dying cells that can no longer replicate and accumulate in various tissues and organs. The compounds they secrete are thought to disrupt healthy tissue structure and function. Through a combination of genetic engineering and drug therapy, scientists have been able to purge the senescent cells from a particular mouse strain, which then subsequently suffered less from normal aging processes. The mouse strain did not develop cataracts, were able to exercise longer, had less muscle-wastage, and retained fat layers preventing their skin looking aged and wrinkled. The studies showed that the aging of tissues in mice was delayed. However the mice did not live longer. It was reported that the researchers chose a fast-aging mouse strain to save time. Plans are underway to repeat the experiment with an ordinary strain of mouse. The real test will come if the same treatments result in longer life expectancy for normal mice.

RMS includes potential future treatments that might cause 'Retardation of Aging' in mortality improvement scenarios of its forward-looking GASP longevity risk model. This vitagion category is modeled as a stochastic process where advances are slow and erratic with occasional reverses, as seen recently. Progress in this early science is expected to take many years, and even if successful will still need lengthy safety trials, making it several decades before pensioners could see any benefit from treatments.

...but studies of sirtuins were flawed...

Sirtuin proteins in cell nuclei seem to play a role in regulating cells, controlling stress resistance and have been thought potentially to have an influence on aging. Some influential original research published in 2001 by Leonard Guarente at MIT suggested that genes that boost sirtuins were associated with increased longevity. This kind of early-stage promise caused GlaxoSmithKline to spend \$720m on buying Sirtris, a company specializing in sirtuin research.

However new studies re-examining the earlier findings are showing the opposite of what was previously reported. A new report in *Nature* suggests that sirtuins were merely associated with other genetic changes that increased longevity. It reported that "overexpressing a sirtuin gene in two model organisms – the nematode *Caenorhabditis elegans* and the fruitfly *Drosophila melanogaster* – does not boost longevity". Some expert researchers on aging welcome these new finding and believe the previous research was over hyped but Guarente stands by his original work.

...and resveratrol studies in 2008 were faked

The rumored health benefits of resveratrol have had a mythical status in longevity studies, not least because it is found in red wine. A publication in 2008 by Dipak Das at the University of Connecticut was one of several studies that have reported health benefits from resveratrol. In January the University of Connecticut repudiated his research and accused him of 145 counts of fabrication and falsification of data. Red wine drinkers can no longer use Das's research to justify their tipple.

In these early days of geroscience, it is one step forward, two steps back.

U.K. MORTALITY STILL IMPROVING STRONGLY BUT IN A POLARIZED SOCIETY

The 2010 mortality data just published in the U.K. shows no sign of a slow-down in mortality improvement rates. It does reveal that underprivileged groups are seeing much lower improvements. Accounting for social differences in future mortality projections is becoming more important.

The most recent publication of the U.K. *Mortality Monitoring Bulletin* published by the U.K. Department of Health provides data for 2010. It uses three year rolling averages to compare trends starting from 1999-2001 through to the latest period of 2008-2010, and reveals a number of interesting features in the data.

The headline is that mortality improvement continues to be strong, with no sign yet of any exhaustion of this upswing. In fact quite the opposite. Plotting the three year average 'central mortality improvements' by age shows a peak at 5.0% annual improvement rate for 72 year old males, up from 4.7% in the previous year's publication, and 4.5% the year before. Mortality improvement rates are slowing in 50 year old males (down to 2.3% from 2.8% three years ago). Similar but less strong trends are seen at these ages for women.

Mortality continues to fall for most of the major causes of death, particularly in the reporting focus of premature deaths in the under 75 year olds, with circulatory diseases having declined 41% since 2001. Cancer mortality has also dropped, but only by around 14%. During the first half of the past decade suicide rates fell around 15%, but has remained relatively constant since. Accidental death is one of the only causes that has not seen a major decline.

These latest figures show that the big driver of mortality improvement is still the continuing reduction of deaths from cardiovascular disease (CVD), but that other causes of death are also making increasing contributions to mortality improvement. Other detailed public health studies indicate that reduced mortality from CVD is being driven partly by adopting healthier lifestyles and partly by better medical treatments. Lifestyle changes, and particularly reductions in smoking, are also driving the reductions in other causes of deaths, such as cancers and respiratory

disease. Medical progress in preventing cancer deaths is more gradual, as described in the article on page 3.

The data include some element of diminishing birth cohort effect (strong improvements seen in the generation born around 1930) but it is possible that the contribution to the mortality improvement rate from CVD prevention may be starting to diminish. The data for CVD deaths in isolation show that the three year rolling central improvement rate for 72 year old males, the peak age of improvement rate, has reduced from 10.1% improvement rate in 2008, to 8.5% in 2010.

One of the key findings from the latest data is the continuing wide difference in life expectancy between the poorest and the rest. Life expectancy for the underprivileged is not growing at the same pace as life expectancy for the rest of England. The 'Spearhead Group' is made up of people from Local Authority Districts and Primary Care Trusts, which represent the most underprivileged members of society in England. Life expectancy for both males and females in the Spearhead Group has continued to increase but just not at the same rate as everyone else. The absolute and relative gaps with the rest of the population have increased. The absolute gap (difference in life expectancy between the average for England and the Spearhead Group) widened slightly for both males and females between 1998-2000 and 2007-2009.

These newly released statistics highlight the difference in mortality trends between the underprivileged and the average. It doesn't include analysis of the mortality improvements of the socio-economic groups at the other end of the spectrum: the higher earners and better educated groups. These are of particular interest to pension providers and life insurance companies as these individuals constitute a high proportion of annuitant liabilities.

RMS uses national mortality data and other sources to calibrate its models of future mortality improvement for longevity risk. RMS research is focused on estimating how much more improvement – and for how long – could be driven by further benefits from lifestyle and medical treatments for specific causes of premature mortality. Current development work includes understanding mortality trends in the social groups in the upper deciles of pensioner income.

MORTALITY RATES INCREASE DURING ECONOMIC DOWNTURNS – TRUE OR FALSE?

With the Western world facing a prolonged period of economic austerity, the question of how this might affect mortality rates is important. The answer isn't as obvious as it sounds.

It is well known that wealthier countries have lower mortality. Relationships can be derived between higher GDP and longer life expectancy, so it is natural to assume that mortality rates would follow this pattern during economic downturns and increase to higher levels of mortality with fewer resources to spend on healthcare and medical treatment.

However analysis of historical data suggests that the relationship between mortality and the economy is rather more complex. A 2009 review of evidence published in the *Canadian Medical Association Journal* concluded that economic downturns were associated with **declines** in mortality rates in richer countries – those where the gross national product (GNP) per capita is above \$5,000. Research also showed that mortality rates decline faster during recessions in rich countries than during periods of economic growth.

For poorer countries, when economic growth is shared, general health improves due to better access to food, clean water, housing, and basic health care services. However, once a country exceeds \$5,000 GNP per capita, few immediate health benefits arise from further economic growth that would result in a short-term acceleration in mortality improvement.

A 2005 analysis in the *International Journal of Epidemiology* by José Tapia Granados examined mortality rate fluctuations during economic expansions in the U.S. between 1900 and 1996. It showed that the secular decline in mortality accelerates during economic recessions and slows or reverses during expansions. The analysis utilized time-series data on total deaths, as well as age-specific and cause-specific mortality. Other similar studies published in the same journal used different approaches but came up with the same result: mortality rates decelerate or can even see a reversal in decline during economic expansions.

An earlier study by Christopher Rhum, a health economist at University of Virginia examined the

fluctuations of mortality with the economy in 50 U.S. states, from 1972 to 1991, for 3 different age groups (20–44 years, 45–64 years, and 65 years and older), together with infant and neonatal mortality. Results showed that a 1% rise in a state's unemployment rate, relative to its historical average, was associated with a 0.5% to 0.6% decrease in total mortality. The same effect was seen among people who were over 65 and younger than 65. The findings were not consistent for all causes of mortality. Deaths from cancer, for example, did not display this relationship. Suicide rates went up during economic downturns and people's mental health also suffered.

The studies suggest that the reasons for deaths decreasing during recessions and increasing during periods of economic expansions were that in times of prosperity people smoked more, drank more alcohol, and ate more saturated fats in their foods. There is also an identifiable increase in injury-related mortality due to higher road traffic volumes and the accidents they cause, and also in industrial accidents with increased commercial activity. There are even medical data to suggest that economic expansions are associated with decreased levels of immunity and health resilience resulting from reduced sleep, increased stress, reduced social interaction, and decreases in social support for the vulnerable.

The conclusions suggest that periods of economic downturns cause an initial short term effect on mortality rates: reducing mortality during recession and increasing mortality during a boom. The duration of this effect is around four years, similar to the average economic cycle. Over longer periods than this, the more intuitive effect takes over: improving economic conditions and increasing wealth drives general trends of mortality improvement. Measured in decades, the relationship is maintained between GDP per capita and life expectancy.

The issue of how a period of economic austerity might affect mortality improvement assumptions is studied by RMS to inform longevity risk modeling estimates. Scenarios of different levels of future economic progress inform assumptions that might be made about long term rates of improvement. Currently RMS is preparing a client-available white paper on what assumption sets would cause different levels of long term mortality improvement rates. Please contact RMS if you would like to receive a copy of this when it is published.

OTHER DEVELOPMENTS IN BRIEF

Treating Parkinson's disease with stem cells

Human pluripotent stem cells (PSCs) are a promising source of cells for research in regenerative medicine. Scientists have differentiated PSCs into spinal motoneurons (specialized cells) or midbrain dopamine (DA) neurons, but have not made much progress in showing PSCs to be effective in cell therapy. Excellent DA neuron survival, function and lack of neural overgrowth in animal models indicate promise for using cell-based therapies to treat Parkinson's disease. Studies using PSC-derived DA neurons to treat Parkinson's disease in mice have shown good results but similar studies in humans have not shown efficacy. Researchers are examining the negative potential for PSCs to cause cancers or neural overgrowth.

One In 10 Adults Predicted To Have Diabetes By 2030

The International Diabetes Federation (IDF) released the 5th edition of the authoritative *IDF Diabetes Atlas* which shows the estimated number of adults currently living with diabetes has grown to 366 million, representing 8.3% of the global adult population. It is projected to increase to 552 million people, or 9.9% of adults by 2030. Projections have been increased since the 4th edition, due to new data available from China, the Middle East, and Africa. More than 80% of diabetes deaths now occur in low- and middle-income countries. Diabetes is increasing at a faster pace in these countries as economic development and urbanization causes changes in lifestyle and increases in life expectancy.

Pension Liabilities - Largest Increase in 15 Years

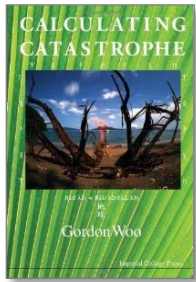
Turmoil in the bond market has led to the highest ever value being placed on FTSE 350 pension scheme liabilities. The Aon Hewitt 350 index showed an increase in the collective final salary pensions accounting deficit of the U.K.'s FTSE 350 companies of 13.2%, up from £53 billion to £60 billion. The collective buyout deficit increased by £400 billion to £435 billion. As a result of a collapse in yields, buy-outs and buy-ins are becoming less affordable and premiums are soaring. Further increasing liabilities are adding to the risks faced by businesses. Experts believe there will be greater emphasis on alternative ways to manage liability in the future. The recent Rolls-Royce longevity swap is a case in point and deals like this may become more common. Rolls-Royce did a longevity swap to manage their liabilities with Deutsche Bank in November 2011. The contract with Deutsche Bank reduces the risk on approximately £3bn of their fund's liabilities.

Increasing Focus on Alcohol Consumption as a Mortality Risk

The quantity and frequency of alcohol consumption has been more precisely linked to cancer risk in a new U.S. study published in the *American Journal of Epidemiology*. Higher quantity drinking – more than three drinks in a session – is shown to increase cancer mortality in men, while higher frequency drinking – more than three days a week – increases cancer mortality in women. Alcohol increases lung cancer risk in smokers, but not in those who have never smoked. Higher frequency drinking is particularly associated with higher risks of prostate cancer and breast cancer. Higher quantity drinking increases the risk of colorectal cancer mortality, particularly in women. In the U.K., another study shows that people are drinking less but deaths from excessive drinking are becoming more common. Hospital admissions for alcoholic liver disease for people in their early 30s in NE England have increased by more than 400%. There were 189 hospital admissions for 30 to 34 year olds in 2010 compared with 37 in 2002. The rise in the rest of England was 61%.

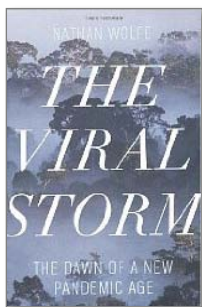
Obesity Expert Advisory Group Disbanded by the Government

The U.K. government has disbanded its expert advisory group on obesity. This group was set up by the previous Labour government to advise on research that emerged from the *Tackling Obesities: Future Choices* project of Foresight, part of the Department for Business, Innovation and Skills. Members of the advisory group have criticized the government for not taking expert advice. Critics say that the government's plan for reducing obesity in England focuses only on individual responsibility and fails to tackle the influence of the food and drinks industry.

BOOK REVIEWS**Calculating Catastrophe** by Gordon Woo

Declaration of Interest: Gordon Woo is a catastrophist with RMS and the architect of the mortality and longevity models developed by the RMS LifeRisks team.

His most recent book provides the reader with a deeper conceptual understanding of the basic principles governing the occurrences and management of catastrophes, both natural and man-made. This book provides a valuable contribution to the subject of risk management and an excellent reference point for senior decision makers. In an increasingly interconnected world, the communication of disasters and catastrophes can be circulated around the world almost immediately. The impact and aftermath usually raises questions about predicting or avoiding such events if possible, often without any perspective as to how this might be done. This book sets out in a concise and comprehensible manner how this might be addressed. Gordon makes use of day to day examples to establish context for the arguments made.

**The Viral Storm: The Dawn of a New Pandemic Age** by Nathan D. Wolfe

Stanford biologist, Nathan Wolfe, has just published a book about modern microbe threats to human civilization. The transmission of animal microbes to humans is the source of most global pandemics. HIV is thought to have originated in a similar virus found in chimpanzees. Wolfe believes that if you look in the right places you can monitor the flow of viruses into human populations. In his book, Wolfe lays out how he is casting a wide net to catch these microbes before they reach blood banks, sexual networks and airplanes. Wolfe has also founded a pandemic early warning system called the Global Viral Forecasting Initiative.

RISK MANAGEMENT SOLUTIONS FOR THE LIFE & HEALTH INSURANCE INDUSTRY

Risk Management Solutions (RMS) applies the latest science in analytical tools for making risk management decisions in the life and health insurance industry, including management of excess mortality and longevity risk.

RMS provides mortality scenario generators and licenses its models on the RMS LifeRisks™ software platform. RMS provides consulting services, technical support, model outputs, and other applications of its research and development.

RMS Models

RMS models include probabilistic stochastic simulation of mortality shocks arising from influenza pandemic, emerging infectious diseases, terrorism mass mortality and group life concentration risk analysis, natural catastrophes and other sources of mass mortality. RMS also provides a longevity risk model comprising probabilistic stochastic models of mortality improvement scenarios. RMS models are designed to provide holistic assessments of mortality risk to enable diversification benefits, risk capital hedging between mortality and longevity risks, and other analyses to be quantified.

RMS produces excess mortality coverage for most countries with significant life insurance markets. RMS Longevity Risk models are available for United States, United Kingdom, Canada, Netherlands, France and Germany.

Consultancy Services

RMS provides consulting services to help clients across many areas of risk management. Projects include economic capital requirements, Solvency II internal model calibration and approval, insurance product design, risk transfer and de-risking strategies, and reinsurance optimization. RMS acts as Modeling Agent on capital market transactions. RMS has provided risk management services for a number of the leading life and pension insurers worldwide.

RMS Seminars

RMS will host its latest LifeRisks seminar for clients at the Merchant Taylors' Hall, London on Thursday, May 24, 2012.

Investigating Future Mortality - Blending medical and actuarial science for life and longevity risk management

Registration by invitation only, via the rms.com website

Publications

Catastrophe, Injury, and Insurance: The Impact of Catastrophes on Workers Compensation, Life, and Health Insurance, Risk Management Solutions Inc., 2004

http://www.rms.com/publications/casualtystudy_final.zip

Catastrophe Mortality in Japan: The Impact of Catastrophes on Life and Personal Accident Insurance, Risk Management Solutions Inc., 2006

http://www.rms.com/publications/rms_japanmortalitystudy.pdf

Managing Influenza Pandemic Risk, Risk Management Solutions Inc., 2007

http://www.rms.com/publications/influenza_pandemic_risk.pdf

RMS Pandemic Influenza Model Overview factsheet

<http://www.rms.com/publications/pandemic.pdf>

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