A Mortality-Based Approach to Reserving for Lifetime Workers' Compensation Claims

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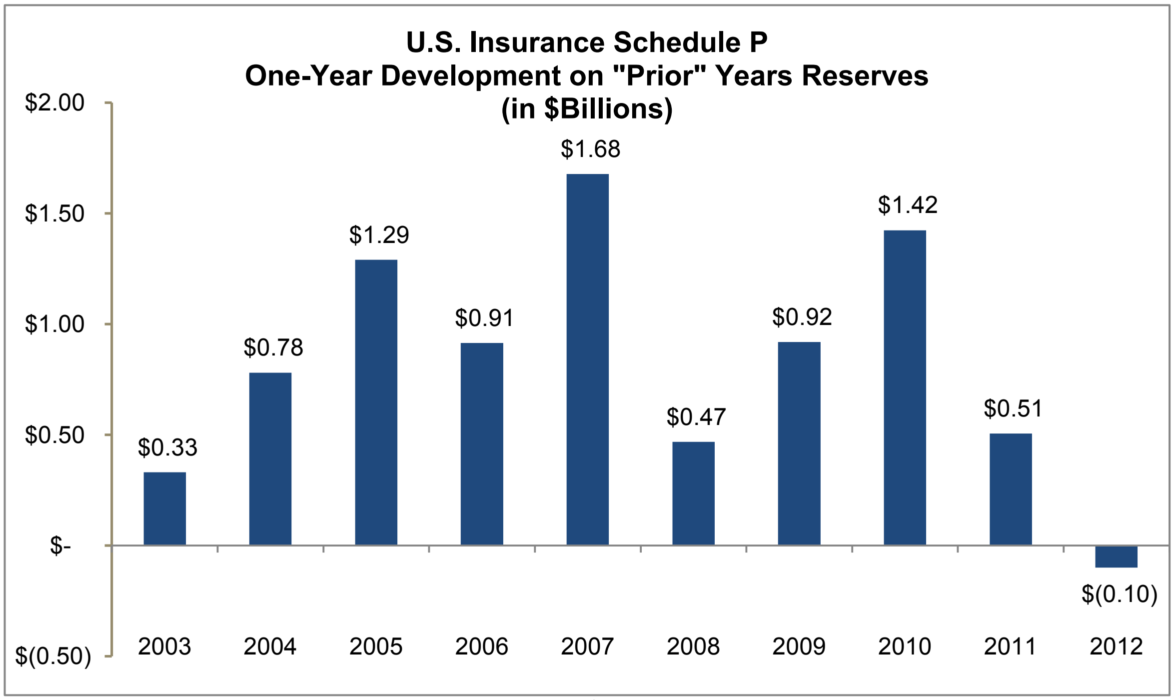
Abstract: Adverse reserve development in older accident years (i.e., related to injuries occurring more than 10 years ago) is a continuing issue in the workers' compensation industry. The use of informed judgment or the application of advanced modeling techniques for projecting this runoff (such as curve fitting) in traditional loss development methods often misstate projections. A mortality-based approach, similar to pension and life/disability insurance models, may produce more meaningful liability estimates when applied to older workers' compensation claims. This paper provides the basic framework of a mortality-based approach, including important considerations regarding the underlying assumptions and model design.

Keywords: mortality; reserving; medical trend; life expectancy/contingency; workers' compensation, pension.

1. INTRODUCTION

Adverse reserve development in older accident years is a persistent problem in the workers' compensation industry. In fact, the one-year workers' compensation reserve development of "prior years" (case and incurred but not reported or "IBNR" reserves for claims at least 10 years old) has been adverse in nine of the last ten years. The following chart shows a history of this development over the past decade.



Note: Based on Schedule P annual statement data for workers' compensation. Data excludes insolvencies.

Predicting the final cost of workers' compensation claims is particularly difficult due to the long period of time over which claimants receive statutory indemnity and medical benefit payments. Even with judgmental modifications and/or the use of advanced modeling techniques (such as curve fitting), traditional, aggregate actuarial methods typically used to project "bulk" incurred-but-not-reported (IBNR) reserves often fall short. Misestimation of reserves for these claims can result in financial reporting errors, claim settlement inequities, loss of reinsurance protection due to late reporting of large claims (through "sunset" clauses) as well as a drag on current earnings. The misestimation of reserves for lifetime workers' compensation cases can stem from many issues including:

- *Insufficient historical loss development data.* Some serious lifetime injury claims can stay open for several decades, but only limited historical loss experience may be available for analysis (e.g., 10 to 20 years).
- *Significant impact of inflation on future costs.* Generally, claims adjusters establish case reserves based on today's costs without consideration of future indemnity benefit escalation and medical inflation. Compounding this issue is the relatively high workers' compensation medical escalation rate (though tempered somewhat in very recent years) compared to general or medical consumer price indices (CPIs).

- *Increases in medical utilization over time.* Case reserves often do not anticipate future intermittent medical costs such as surgeries, prosthetic replacements, and the high cost of end-of-life care. Other significant costs, such as those resulting from technology improvements, new treatments and greater use of expensive prescription narcotics also can contribute to inadequate case reserves.
- *Implicit discounting for large, excess claims.* Current accounting guidance for insurance companies generally does not permit reserving that reflects the time value of money. A reluctance by some companies to recognize large nominal claim values today likely results in some implicit case reserve discounting.
- *Use of outdated or static life tables.* Even if case reserves reflect mortality considerations for lifetime claims, often the mortality assumptions do not reflect future improvements in life expectancy. Also, the averaging nature of a simplistic life expectancy approach generally underestimates gross claim costs in an inflationary environment (i.e., the impact on costs of claimants dying before and after the life expectancy is not offsetting) and changes the distribution of losses in various layers.
- *Industry case reserving practices.* Industry case reserving philosophies and practices vary widely and can lead to different incurred development patterns by company. For example, some organizations may only case reserve for a fixed number of years of payments (e.g., 5 years) or to a "settlement" value instead of an "ultimate value," leading to continual case reserve increases or "stair stepping."

A mortality-based approach can help address each of these issues, making it a valuable alternative or supplement to traditional actuarial methods. The prospective nature of the model, which produces a projection of future cash flows, alleviates the need for extensive loss development history of both open and closed claims. Because it is a payment-based approach, the model does not explicitly require case reserve values (although these amounts can provide a comparison for reasonableness testing). It can directly address the impact of significant changes in the environment (e.g., laws/benefits, regulation, etc.) on only outstanding cases. The approach also is amenable to identification and testing of key assumptions, including trend, discount and mortality, which can provide additional insight to management related to claim cost drivers, claim settlement options, and target areas for cost savings opportunities.

While many of the concepts introduced in this paper are not entirely new, the application of mortality-based models for estimating lifetime workers' compensation claims has gained popularity in recent years, likely due to:

- Recent high loss ratios in workers' compensation;
- Persistent adverse movement in older years' reserve values;
- Higher interest in reinsurance commutations (e.g., from the large number of workers' compensation insurers that went into runoff or insolvency in the late 1990s and early 2000s);
- The increase in limits retained by primary companies;
- Recent low investment returns turning management's focus to underwriting profitability and a better understanding of the drivers of claim cost inflation; and,
- The availability of more sophisticated technology to run (and re-run) the detailed mortality calculations.

1.1 Research Context

Previous research includes foundational discussions around the need to consider mortality in workers' compensation reserving, with later papers providing deeper analyses of other key assumptions and more detailed instructions on how to build a mortality model. In 1971, Ferguson [3] points out the necessity of considering mortality in long-term pension-type workers' compensation awards. He notes the understatement of ceded reserves when employing a simplified approach that subtracts the lower layer of loss from the expected gross reserve. In his paper, Ferguson provides mortality-based calculations which illustrate this point. Steeneck [11] provides an update to Ferguson's paper, incorporating escalation of indemnity benefits and medical inflation in mortality-based forecasts. Snader [10] expands on the use of life contingency concepts in establishing reserves for claimants requiring lifetime medical care using a three phase approach -- claim evaluation, medical evaluation and actuarial evaluation. His paper provides a comprehensive discussion of mortality modeling, including considerations for selecting key assumptions such as inflation, life expectancy, discounting and medical.

Other authors discuss specific assumptions impacting a mortality-based model. For example, Blumsohn [2] examines the errors resulting from using a deterministic approach to model parameters other than mortality, such as medical usage, medical inflation, cost of living adjustments (COLAs), and investment income. He recommends using a stochastic approach to model these parameters and demonstrates that the deterministic method produces biased estimates which understate losses in higher, excess layers. Gillam [4] focuses on mortality assumptions in his discussion of the NCCI Special Call for Injured Worker Mortality Data in 1987 and 1988 and the ensuing analysis of that data. He concluded that differences in mortality, while significant, did not, at that time, imply significant redundancy or inadequacy of the tabular reserves.

In his discussion of "ultimate" loss reserves (i.e., case plus IBNR reserves estimated on an individual claim basis) in the context of runoff operations, Kahn [5] comments on a number of important considerations, including medical escalation, longevity of claimants, and inuring reinsurance, that may impact model scenarios. Sherman and Diss [9] comment on medical cost severities, escalation rates, and mortality rates used to estimate a workers' compensation tail for the medical component of permanent disability claims. In this paper, the authors demonstrate that case reserves estimated based on the expected year of death (i.e., life expectancy approach) are significantly less than the expected value of such reserves using a life contingency cash flow approach.

1.2 Objective

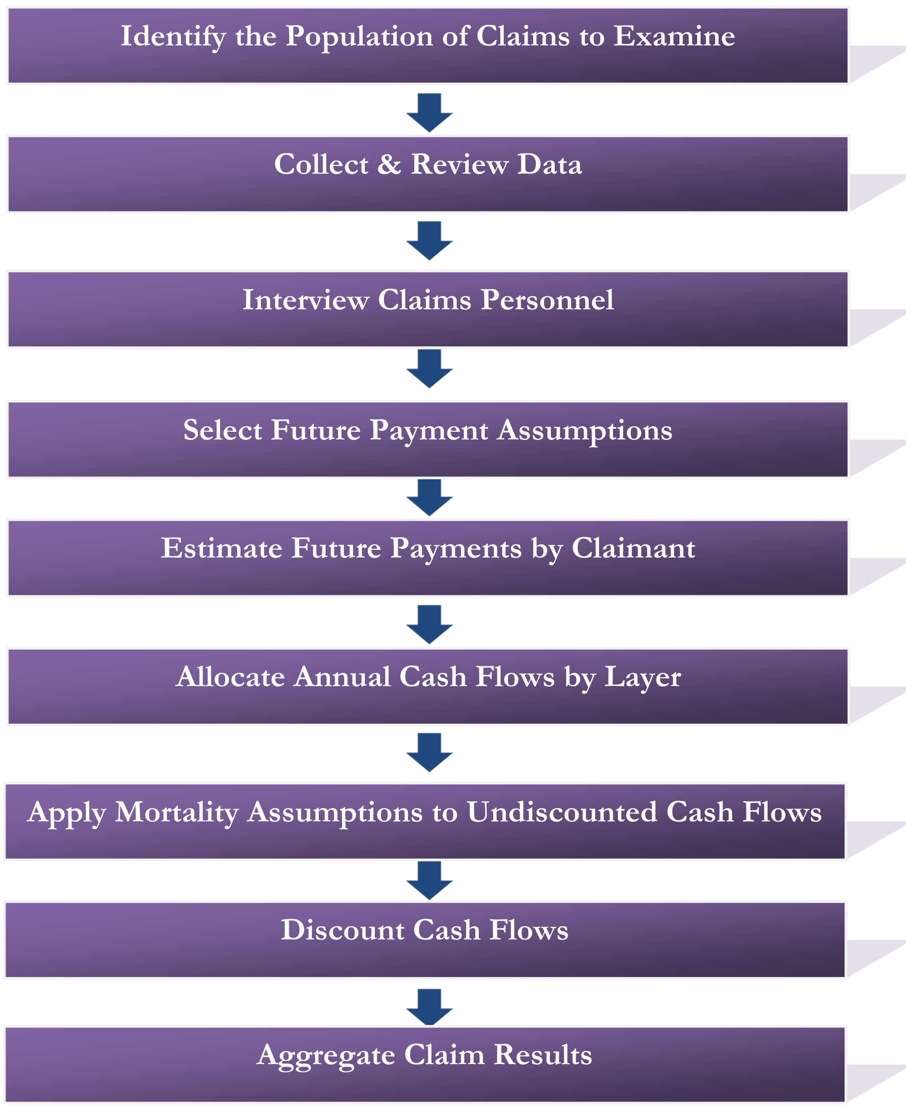
The previously noted research focused on specific assumptions, components or applications of claim-specific models. The purpose of this paper is to reintroduce and synthesize the major concepts, update certain trends and resources, and provide a practical framework to construct a mortality-based approach to model lifetime workers' compensation claims.

1.3 Outline

The remainder of the paper proceeds as follows. Section 2 includes nine steps to construct a mortality-based model for lifetime workers' compensation claims, including a detailed discussion of key model assumptions. Section 3 presents the strengths and weaknesses of the model, and Section 4 summarizes the benefits of considering a mortality-based approach as an alternative or supplement to traditional actuarial methods.

2. BUILDING A MORTALITY-BASED MODEL

The major steps in building a mortality-based model are shown below.



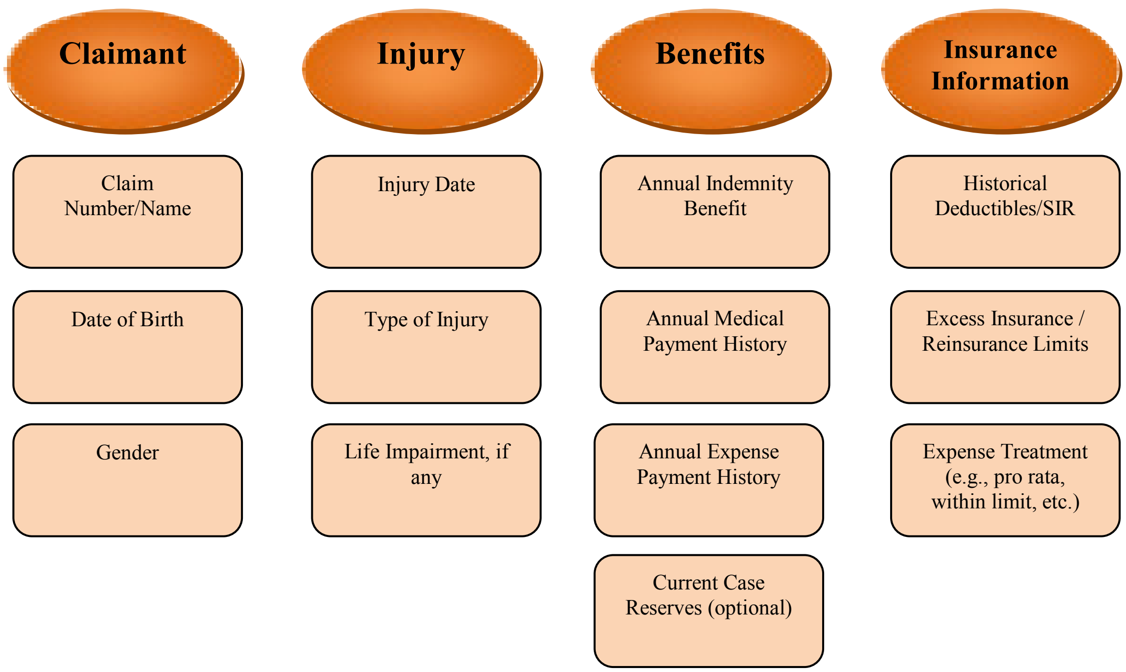
The chronological order of these steps is critical to ensuring that the model appropriately allocates losses to primary and excess layers. Specifically, applying mortality and discounting to the entire loss before layering will understate losses in the excess layer and overstate the primary layer as discussed in Step 6.

2.1 Step 1 – Identify the Population of Claims to Examine

A mortality model is appropriate for lifetime claims or claims that have reached a steady state or maintenance mode such that annual payments are normalized and reflect scheduled disability payments and/or regular, ongoing medical expenses. In cases where the focus is on estimating excess layers of loss, the model should evaluate claims well below the attachment point with the potential to develop into the excess layer due to the nature of the injury (e.g., brain, paralysis) and duration of inflationary impacts.

2.2 Step 2 – Collect and Review Data

Mortality-based models require a considerable amount of detailed claimant and injury information which claims personnel and/or a third-party administrator (TPA) typically can provide. For example, important data elements for a mortality-based model include:



The first three data categories – claimant, injury and benefits – are essential to model the ground-up losses for each claim. The fourth data category -- insurance information -- increases the complexity of model calculations; however, the model requires these elements when estimating losses by layer and, as such, these elements are critical in estimating various stakeholders' liabilities.

2.3 Step 3 – Interview Claims Personnel

Discussions with claims personnel often provide important information regarding the nature of individual claims and the general health status of claimants, including the types of treatment a claimant receives, upcoming surgical procedures and the existence of co-morbidities (i.e., diabetes, cancer, heart disease, etc.), which may impact the claimant's mortality as discussed further in Step 7. This "soft" information is useful particularly when selecting model assumptions.

2.4 Step 4 – Select Future Payment Assumptions

Lifetime workers' compensation claim payments consist of three components – statutory indemnity benefits, unlimited medical benefits and loss adjustment expenses. When selecting future payment assumptions, the modeler could review several recent years of payments, separately for indemnity, medical and expense, for each claim, including the impact of trend on the historical payments (i.e., trend adjusted or "on-level" payments). Alternatively, the model could utilize future payment projections used to determine the case reserves for each claim, which the claims department can provide. In either case, the medical payment assumption should consider expected costs for upcoming surgical procedures, prosthetic device replacements or other intermittent costs.

The selection of future payment assumptions is an important step in the estimation process due to the leveraged impact over payout periods that could extend 60 to 70 years or more into the future (although the impact is less if the model discounts these cash flows). In addition, the cumulative effect of trend over many years of future claim payments can be significant, particularly for severe cases. A variety of social and economic factors, including changes in statutory benefit levels, medical utilization and inflation, drive these trends. Since these factors influence the indemnity, medical and expense payments in different ways, a mortality-based model should project these components separately for each claim.

2.4.1 Indemnity

Projecting future indemnity payments generally is the easiest task due to state and federal workers' compensation statutes that prescribe periodic indemnity/wage replacement benefits. Under many workers' compensation statutes, indemnity benefits remain fixed once the claim is awarded, and no trending is necessary. Some state and Federal disability benefits, however, are subject to automatic escalation (e.g., COLAs), historically at 2-3% based on historical wage inflation levels. In addition, Social Security or other programs may cap or offset indemnity benefits in certain states, which increases the complexity of the model. If indemnity costs include vocational rehabilitation benefits, the model should consider the size and duration of these benefits separately.

2.4.2 Medical

Projecting future medical costs typically is one of the most controversial issues in a mortality-based model because workers' compensation medical benefits are unlimited, consist of both recurring and non-recurring costs, and may extend far into the future. For serious injuries, substantial medical payments may occur early in the life of a claim as a result of initial hospitalizations, surgeries, and treatments. These payments tend to level-off or decrease after a few years as claimants reach maximum medical improvement. Spikes in future costs still may occur for follow-up surgeries, replacement of equipment/devices, or end-of-life care which often results in additional custodial/hospital expenses, particularly for serious, permanent impairments such as brain injuries or paralysis. Alternatives to explicitly projecting such specific, non-recurring costs are building an average provision (i.e., load) into recurring costs, increasing the medical inflation rate, or employing stochastic modeling.

Selecting an appropriate medical trend assumption is another challenge in using a mortality-based approach. Numerous influences – "inflators" and "deflators" -- drive changes in workers' compensation medical costs and ultimately result in partially offsetting increases and decreases in costs over time.

INFLATORS

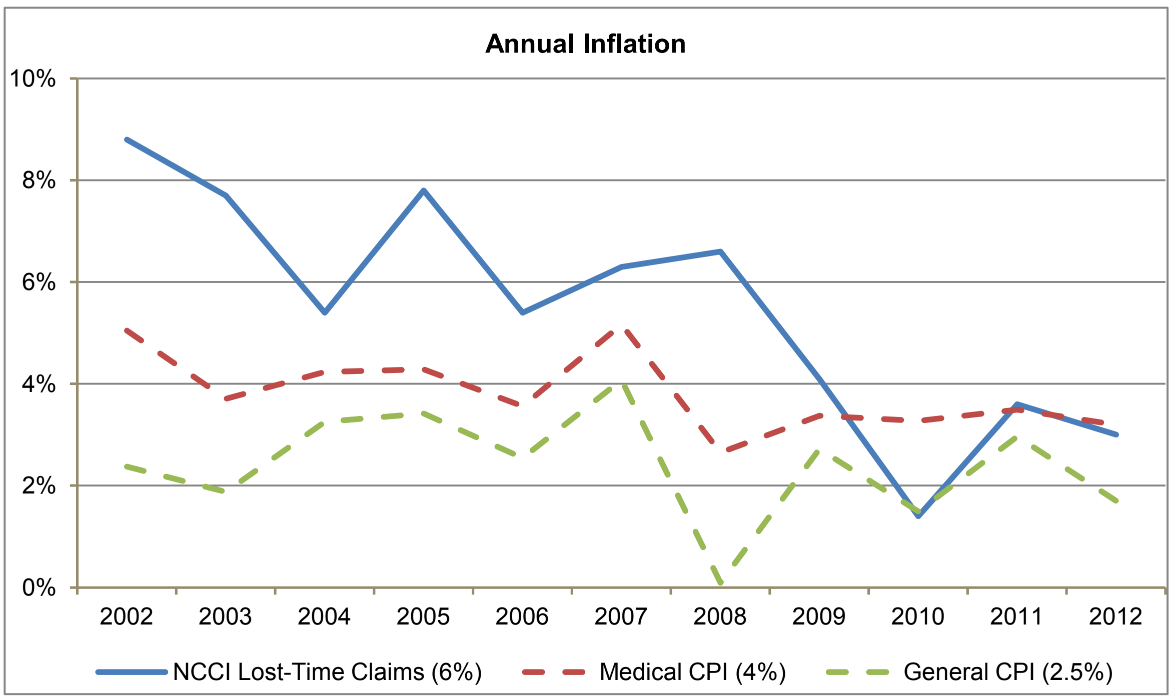
- Aging population
- Consolidated of healthcare providers
- Cost of services
- Increasing utilization
- Medical and technological advances
- Mix of services toward more expensive care alternatives
- More expensive medical devices
- Potential cost shifting from healthcare related reforms/Medicare (MSAs)
- Use of more expensive, patented drugs

DEFLATORS

- Increasing price transparency leads to competition and cost reductions for non-emergency services
- Potential cost reductions related to healthcare reform
- Recent medical supply equipment abatement with hospital consolidation, physician employment with hospitals, and insurer pressure
- Recent pharmaceutical "patent cliff" fostering the use of cost-saving generics

For some of these factors, the effect on medical costs will be short-term, while other factors may continue to influence medical costs indefinitely. Estimating changes in medical costs resulting from each factor as well as the duration of its influence is difficult and requires informed judgment, particularly in light of the significant cumulative effect of these assumptions.

Publicly available trend benchmarks include the general CPI and medical CPI on a calendar year basis and accident year changes in medical severity for NCCI lost-time claims. As the graph below shows, over the last 20 years, workers' compensation medical trends, as reported by the NCCI, have outpaced both the general CPI and the medical CPI.



Source: NCCI's State of the Line presentation for NCCI lost-time claims and the Bureau of Labor Statistics for CPI information.
Note: The average trend over the period from 2002 to 2012 is 6% for NCCI lost-time claims, 4% for the medical CPI, and 2.5% for the general CPI.

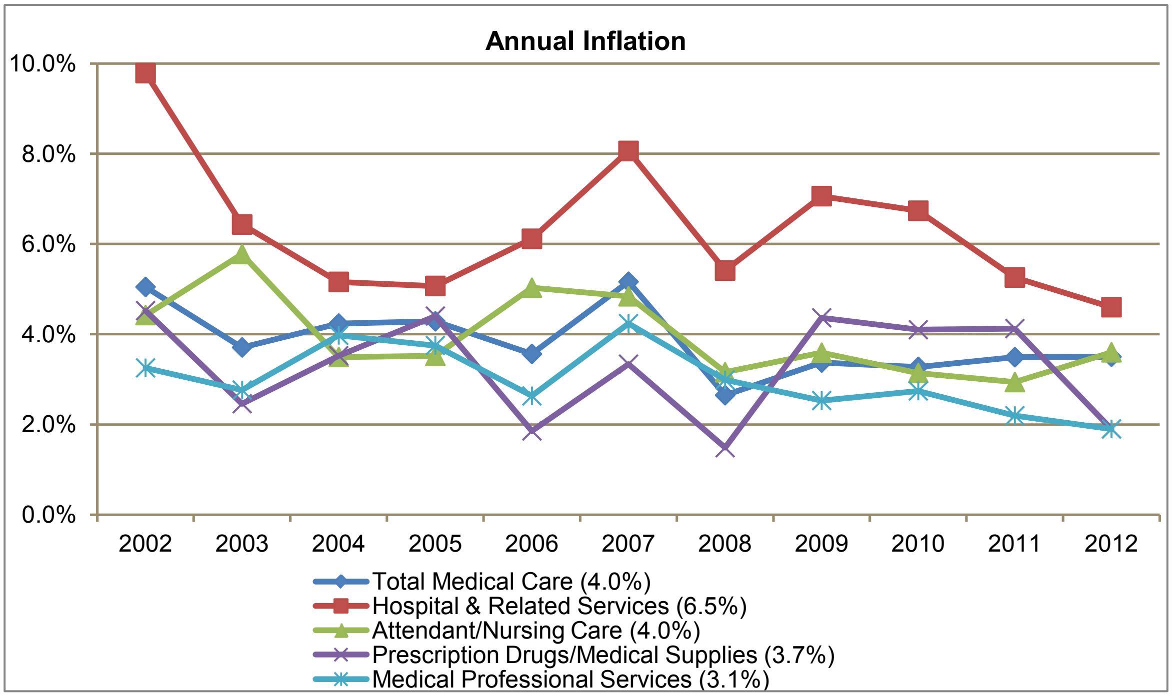
Historically, the medical CPI, which captures the trend in prices for a fixed "basket" of medical goods and services, has been about 200 basis points higher than the general CPI. Medical and technological advances, use of higher cost patented drugs, mix of services toward more expensive care alternatives, and costly medical devices are the primary drivers of this differential. All of the inflators and deflators listed above affect workers' compensation medical costs; however, not all of these factors are captured in the changes for the "basket" of care tracked by the medical CPI. As such, the trend is higher for workers' compensation claims than the medical CPI.

Similarly, changes in service costs and utilization impact workers' compensation medical costs differently than medical costs in health insurance; specifically, mandated benefits and coverage options, such as deductibles, influence health insurance utilization, but do not affect workers' compensation. Decreasing costs due to competitive pressures resulting from greater price transparency of medical services would also benefit workers' compensation costs, although perhaps not to the same degree. Further, the deflator impact of the pharmaceutical name brand "patent cliff" resulting in greater availability of generic drugs is offset by the growing use of biologics and other specialty drugs. The Patient Protection and Affordable Care Act (PPACA; i.e., healthcare reform) also may impact costs by providing incentives for healthcare providers to control costs through high performance networks and hospital readmission penalties; however, the PPACA encourages hospital consolidation, which may increase costs as the acquiring entities typically charge higher prices for services. The following table compares cost inflators and deflators impacting workers' compensation and health care with those captured by the medical CPI.

	Medical CPI	Health Insurance	Workers' Comp
Inflators			
Aging population		X	X
Consolidation of healthcare providers	X	X	X
Cost of services	X	X	X
Mandated benefits/healthcare reform		X	
Mix of claims/diagnosis		X	X *
Utilization-more expensive drugs (specialty drugs/biologics), devices, procedures		X	X
Utilization-more procedures per claimant		X	X
Deflators			
Change in care method (retail clinics, virtual access, etc.)		X	
Greater price transparency and consumer price sharing	X	X	X **
High performance health care networks providing lower-priced care	X	X	
Medical supply and equipment abatement	X	X	X
New hospital readmission penalties		X	X
Pharmaceutical "patent cliff"	X	X	X

Source: PwC's Health Research Institute's "Medical Cost Trend: Behind the Numbers 2014".
* Impacts new claims
** May not have as strong an impact

A more robust mortality model may segment or consider the mix of medical services – hospitals, physicians, drugs, attendant care, equipment, etc. – in a defined population of claims since each component may be subject to different trends over time as shown in the calendar year trends in the chart below.



Source: Bureau of Labor Statistics.
Note: The average trend over the period from 2002 to 2012 is 4.0% for total medical care, 6.5% for hospital and related services, 4.0% for attendant/nursing care, 3.7% for prescription drugs/medical supplies, and 3.1% for medical professional services.

The proportionate cost of these medical services changes over the lifetime of a workers' compensation claim. According to the NCCI Research Brief, *Medical Services by Size of Claim - 2011 Update* [6], "the medical services profile for workers with serious injuries is quite different in the later years of their treatment from the mix of services required early on." More specifically, physical therapy, hospital services, and surgery/anesthesia drive medical costs in the first six years of a claim, whereas prescription drug costs tend to represent a substantially larger proportion of total medical costs paid after the sixth year. Since the proportion of these components is different for more mature claims, the trend rate may be different than the overall medical CPI or workers' compensation medical cost trend.

The NCCI conducted a detailed study of changes in workers' compensation costs over different periods in a Research Brief titled, *The Relationship Between Medical Utilization and Indemnity Claim Severity - Comparing the Factors Driving Medical and Indemnity Severity*, [8]. The results showed a large divergence in trends for accident years 1996/97 through 2000/01, contrasted with much smaller deviations for accident years 2001/02 through 2005/06. This 2011 study presented the following observations:

- Price for workers' compensation medical moved consistently with medical inflation, its leading indicator.
- While utilization (measured as treatments per claim) was a major driver of severity increases in the first period, utilization decreased in absolute terms in the second period.
- The impact of changes in diagnosis mix was significant in the first period and eased off in the second period.

2.4.3 Expenses

A mortality model also may build in expense provisions based on separate allocated and unallocated annual expense payment and trend assumptions. While general CPI or payroll trends may align closely with the trend in unallocated costs, which consist largely of claims adjuster payroll expense, these benchmarks may not apply to allocated costs comprised of attorney and investigation fees.

An alternative method for projecting expenses is to apply a percentage loading to the model's estimated future indemnity and medical expense payments. This abbreviated practice often is deemed sufficient since these expenses typically represent a small proportion of the total claim payments for mature workers' compensation claims that have reached a steady state of annual payments and require minimal file maintenance. When using this method, however, the modeler should consider the following:

- The procedure implicitly assumes that the underlying indemnity and medical trends also are appropriate for expenses.
- The percentage of expense relative to loss for older workers' compensation claims may be lower compared to less mature claims.
- The relationship between expense and loss may change in different layers of loss, so a ground-up ratio may not be appropriate.

2.5 Step 5 – Estimate Future Payments by Claimant

A mortality-based model applies trend assumptions to the selected periodic payments, separately for indemnity benefits, medical benefits and expenses, to project future payments for each claimant. As previously mentioned, a mortality model could further segment these components into finer categories, such as vocational rehabilitation, type of medical services, or legal versus other expense. This step results in cash flows by payment type for each claim.

2.6 Step 6 – Allocate Annual Cash Flows by Layer

After estimating cash flows for each claim, the next step is to allocate the cash flows to primary and excess layers. Since the model separately estimates indemnity, medical and expense cash flows for each claim, it can accommodate varying treatments of expense (e.g., included with loss in limit, excluded from limit, pro-rata, etc.) for each layer. As noted previously, the allocation of annual cash flows by insurance layer must precede the application of mortality and discounting assumptions; otherwise, the benefit of these assumptions will inure to the highest layers of loss (i.e., the model will underestimate the excess layers and overestimate the primary/lower layers). Steeneck [11] observed that the application of mortality "impacts layering in oftentimes non-intuitive ways, especially that lower layers need not fill up fully before a higher layer becomes liable." For example, a claimant may die earlier than assumed in a reserve calculation, allowing some probability that a claim may not actually pierce the excess layer as projected. The following example shows the estimated payments by layer when the model applies mortality assumptions before allocating payments to deductible and excess layers versus after the allocation.

Male – Age 50
Estimated Annual Benefit Payments = $10,000
Assumed Benefit Trend = 4% per year
Deductible = $250,000; 1st Excess = $250,000 xs $250,000; 2nd Excess = xs $500,000
In Thousands

	2013 to 2022	2023 to 2032	2033 to 2042	2043 to 2052	2053 to 2062	2063+	Total
(1) Trended annual payments							
	$ 120.1	$ 177.7	$ 263.1	$ 389.4	$ 576.4	$ 2,272.0	$ 3,798.6
(2) Unadjusted Cash Flows Allocated by Layer							
Deductible	$120.1	$ 129.9					$ 250.0
XS Layer 1		$ 47.8	$202.2				$ 250.0
XS Layer 2			$ 60.8	$ 389.4	$ 576.4	$ 2,272.0	$ 3,298.6
(3) Probability of survival							
	98.2%	90.7%	70.7%	34.6%	5.4%	0.1%	
(4) Mortality adjusted annual payments = (1) x (3)							
	$ 117.9	$ 161.1	$ 186.0	$ 134.7	$ 31.3	$ 1.2	$ 632.3
(5) Mortality Applied Prior to Allocating Cash Flows by Layer							
Deductible	$ 117.9	$ 132.1					$ 250.0
XS Layer 1		$ 29.0	$ 186.0	$ 34.9			$ 250.0
XS Layer 2				$ 99.8	$ 31.3	$ 1.2	$ 132.3
(6) Mortality Applied After Allocating Cash Flows by Layer							
Deductible	$ 117.9	$ 120.0					$ 237.9
XS Layer 1		$ 41.1	$ 149.7				$ 190.9
XS Layer 2			$ 36.3	$ 134.7	$ 31.3	$ 1.2	$ 203.5

Note: Numbers may not add due to rounding. See Appendix A for complete cash flow calculations.

When the model applies mortality prior to allocating cash flows by layer (item 5 in the table), excess layer 2 includes $132 thousand of estimated payments versus $204 thousand when the model applies mortality to the cash flows after allocating by layer.

2.7 Step 7 – Apply Mortality Assumptions to Future Years

After allocating cash flows by layer, a life contingency model should apply mortality assumptions to estimate the undiscounted expected cash flows for each claim. A life contingency model will yield results that differ from a life expectancy approach, which is commonly used to establish case reserves. In a life expectancy approach, the claimant's future life expectancy serves as a proxy for the number of future years that a claimant will receive benefits; however, this approach underestimates the reserve as illustrated in the following example:

Male – Age 50
Life Expectancy = 30 years
Estimated Annual Benefit Payments = $10,000
Assumed Benefit Trend = 4% per Year
In Thousands

	2013	2014	2015	…	2042	2043	…	2060	…	Total
(1) Trended annual payments										
	$ 10.00	$ 10.40	$ 10.82	…	$ 31.19	$ 32.43	…	$ 63.18	…	$ 3,798.62
(2) Probability that claimant survives through year										
	99.8%	99.5%	99.3%	…	57.9%	54.2%	…	2.0%	…	
(3) Expected future annual payments = (1) x (2)										
	$ 9.98	$10.35	$ 10.74	…	$ 18.05	$ 17.57	…	$ 1.23	…	$ 632.25
(4) Life expectancy approach without trend										
	$ 10.00	$ 10.00	$ 10.00	…	$ 10.00	n/a	n/a	n/a	n/a	$ 300.00
(5) Life expectancy approach including trend										
	$ 10.00	$ 10.40	$ 10.82	…	$ 31.19	n/a	n/a	n/a	n/a	$ 560.85

Note: Numbers may not add due to rounding. See Appendix A for complete cash flow calculations.

The life expectancy approach underestimates the future liability. With trend, the reserve estimate is $561 thousand using a life expectancy approach, which compares to $632 thousand using a life contingency method. Claims professionals often do not consider trend in establishing case reserves. In this example, the estimate without trend is $300 thousand.

Blumsohn [2] further developed the comparison of a deterministic approach (using average life expectancy) versus the stochastic approach (using mortality probabilities). His paper discusses the application of a stochastic approach to medical utilization, medical inflation, COLAs, and investment income.

> "Just as it is wrong to assume a claimant's life-span is fixed, so it is wrong to assume that medical usage and inflation are fixed. Assuming a deterministic life-span leads to inaccurate calculations. Likewise, assuming deterministic medical care and inflation will lead to inaccurate calculations. A deterministic life span implies that high layers of reinsurance will not be hit, when they do, in fact, have a chance of getting hit if the claimant lives long enough. Likewise, deterministic medical care and deterministic inflation understate the costs to the highest reinsurance layers."

When selecting a mortality table for a workers' compensation claim model, the modeler should consider the applicability of the base population to the claimant population, the impact of disability on mortality, and adjustments for improvements in mortality over time as described in the following sections.

2.7.1 Applicability of the Base Population to the Claimant Population

In selecting a mortality table for use in modeling workers' compensation claims, the modeler should understand the purpose for which the mortality table was constructed and differences in the underlying population used to derive the various mortality tables. For example, the base population for a life insurance mortality table typically would include wealthier, better educated and married populations which, on average, exhibit lower levels of mortality and higher levels of improvement in mortality compared with general population mortality tables, such as tables produced by the Centers for Disease Control (CDC) from the U.S. census and Medicare data. General population mortality also is higher (i.e., higher probability of death) than pensioner (or worker) experience since some individuals in the general population are unable to work due to health conditions (e.g., mental disorders, as well as diseases of the nervous system, circulatory system, endocrine system, and respiratory system).

The most commonly used mortality tables for U.S. pension plan valuations are the RP-2000 mortality tables based on a study of over 11 million pensioner life-years from 1990 through 1994 (projected to 2000). These tables were developed separately by gender (male versus female) and health condition (healthy versus disabled) and also contain adjustments for worker type (white vs. blue collar). Since the base population used in the construction of the RP-2000 tables is "pensioners," who presumably earned wages and pensions while working, these tables also may be useful for workers' compensation claims. We note that these tables likely will be replaced by a new set of retirement plan mortality tables, which the Society of Actuaries (SOA) anticipates publishing in 2014.

2.7.2 Impact of Disability on Mortality

Separate mortality tables are available for healthy and disabled individuals, with mortality being much higher for the latter; however, the applicability of a healthy or disabled mortality table for injured workers is surprisingly debatable in workers' compensation. Although some serious injuries (e.g., brain trauma, paralysis) would likely diminish life expectancy, many lifetime cases related to other injuries (e.g., back, knee) would have little or no impact. In fact, there is some speculation that many injured worker life expectancies may even improve due to less risky work environments and better medical care. In his 1991 paper analyzing the NCCI Special Call for Injured Worker Mortality Data, Gillam found that "the mortality rate for injured workers is slightly higher than standard at ages less than 60, but very slightly lower for ages 61 to 72" and "the average life pensions on injured workers should be 1.6% lower than on standard." When answering a question regarding how injured worker's mortality could be so near standard, Gillam points to the cohort for the study, saying "an injured worker has been healthy enough to have worked in the first place. Such a person has demonstrated an ability to survive an accident long enough to be put on a pension".

A model may use a variety of approaches to address potential life impairment issues including:

- A "rated age" approach (the most common) using an estimate of the future life expectancy of claimants based upon individual facts and circumstances. The model could utilize a healthy mortality table with an adjustment to an injured worker's age (or "set forward"). Using this simple technique, a 10-year set-forward would define the probability of death for a 52-year-old male equal to that of a 62-year old male. While such an individual approach would seem optimal, it requires considerable judgment and is difficult to collect and maintain for a large population of claims.

- Use of a disabled table for only certain serious injuries and application of a healthy table for all other cases.

- A blending (e.g., 90%/10%) of healthy/disabled mortality factors applied to the entire claim population determined based on perceived impairment in the claims population. Application of a scaling factor or multiplier to healthy mortality rates based on a review of actual to expected historical death experience.

2.7.3 Adjustments for Improvements in Mortality over Time

RP-2000 Combined Healthy Employees & Annuitants - Male
Base Year = 2000
Mortality Improvement = 1.0% per year

Probability of Mortality by Year

Age (in base year)	*2000*	*2001*	*2002*	*...*	*2020*
40	*0.108%*	*0.113%*	*0.119%*	*...*	***0.552%***
...	*...*	*...*	*...*		*...*
58	*0.527%*	*0.589%*	***0.661%***	*...*	*4.263%*
59	*0.595%*	***0.668%***	*0.752%*	*...*	*4.738%*
60	***0.675%***	*0.760%*	*0.858%*	*...*	*5.265%*

The probability of mortality at age 60 is 0.675% in the base year. With a 1% per year improvement in mortality, the probability of mortality at age 60 for an individual who is age 59 in the base year is 0.668% (= 0.675% x [1 - 1.0%]). The probability of mortality at age 60 for an individual who is age 40 in the base year is 0.552% (= 0.675% × $[1\text{-}1.0\%]^{20}$).

Mortality tables may be static (aka "period") life tables or generational (aka "cohort") life tables. Static life tables, such as the CDC tables, are based on the mortality experience of a population over a relatively short period of time and do not include adjustments for potential improvements in mortality. As such, adjustments to these tables, such as a scale adjustment, may be necessary to reflect the actual mortality of the claim population more accurately. For example, the RP-2000 tables are static tables that reflect mortality improvements through the table creation date (2000). The application of a related mortality improvement scale (e.g., Scale AA) for a fixed number of years easily modifies the tables. The adjustment period will depend on the purpose of the calculation or the financial reporting context of the estimates and must be updated with each valuation. When the SOA publishes its new mortality tables, it will also provide new mortality improvement rates (i.e., Scale BB).

A generational table is a more robust, and often preferred, mortality assumption as it is a series of static tables combined to reflect mortality improvements with each year of survival. To construct a generational table, an improvement scale is applied to the base table to yield a static table for each future year. The resulting series of static tables combine to form a generational table.

The following table shows a comparison of the life expectancies for males and females at various ages using four commonly cited mortality tables – GAM-83, UP-94, CDC 2007 and RP-2000. Also included are life expectancies based on the RP-2000 tables with Scale AA and generational adjustments to reflect mortality improvements.

Age	GAM-83	UP-94	CDC 2007	RP-2000 Disabled	RP-2000 Combined Healthy	RP-2000 Scaled to 2013	RP-2000 Generational
Male Life Expectancy							
30	46.5	48.5	47.1	26.9	49.5	50.8	54.6
40	36.9	38.9	37.8	22.7	39.8	41.1	44.0
50	27.7	29.5	29.0	17.7	30.3	31.6	33.6
60	19.3	20.7	20.9	13.3	21.2	22.4	23.6
70	11.9	13.3	13.7	9.3	13.4	14.3	14.8
Female Life Expectancy							
30	52.8	53.1	51.5	39.5	52.5	53.2	55.6
40	43.1	43.3	41.9	32.2	42.7	43.4	45.2
50	33.5	33.7	32.7	24.6	33.1	33.8	35.0
60	24.3	24.5	23.9	18.1	23.9	24.5	25.3
70	15.9	16.3	16.0	12.4	15.7	16.3	16.7

The RP-2000 generational table includes the largest adjustment for mortality improvements and results in the highest life expectancies. The impact of generational mortality or the reflection of mortality improvements has a greater impact on males and individuals at lower ages.

2.8 Step 8 – Discount Cash Flows (If Appropriate)

To estimate the present value of reserves by layer, discounting should be the final assumption applied to the cash flows. Discounting by layer will reflect the greater discount for the longer duration cash flows of excess layers and lesser discount for the shorter duration cash flows of deductible, or primary, layers. Similar to the application of mortality assumptions, a model should apply discounting to cash flows allocated by layer to avoid underestimating excess layers and overestimating primary layer(s). The following example shows the difference in estimated payments by layer when a model applies discounting before allocating payments to deductible and excess layers versus after allocation by layer.

Estimated Annual Benefit Payments = $10,000
Payout Period = 10 years
Assumed Benefit Trend = 4% per year
Assumed Discount Rate = 3%
Deductible = $50,000; 1st Excess = $50,000 xs $50,000; 2nd Excess = xs $100,000
In Thousands

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total
(1) Trended annual payments											
	$ 10.0	$ 10.4	$ 10.8	$ 11.2	$ 11.7	$12.2	$ 12.7	$ 13.2	$ 13.7	$ 14.2	$ 120.1
(2) Undiscounted Cash Flows Allocated by Layer											
Deductible	$ 10.0	$10.4	10.8	$11.2	$ 7.5						$ 50.0
XS Layer 1					$ 4.2	$ 12.2	$ 12.7	$ 13.2	$ 7.9		$ 50.0
XS Layer 2									$ 5.8	$ 14.2	$ 20.1
(3) Discount Factor											
	0.97	0.94	0.92	0.89	0.86	0.84	0.81	0.79	0.77	0.74	
(4) Discounted annual payments = (1) x (3)											
	$ 9.7	$ 9.8	$9.9	$ 10.0	$ 10.1	$ 10.2	$ 10.3	$ 10.4	$ 10.5	$ 10.6	$ 101.4
(5) Cash Flows by Layer with Discounting Applied Prior to Allocation											
Deductible	$ 9.7	$ 9.8	$ 9.9	$ 10.0	$ 10.1	$ 0.5					$ 50.0
XS Layer 1						$ 9.7	$ 10.3	$ 10.4	$ 10.5	$ 9.2	$ 50.0
XS Layer 2										$ 1.4	$ 1.4
(6) Cash Flows by Layer with Discounting Applied After Allocation = (2) x (3)											
Deductible	$ 9.7	$ 9.8	$9.9	$ 10.0	$ 6.5						$ 45.9
XS Layer 1					$ 3.6	$ 10.2	$ 10.3	$ 10.4	$ 6.0		$ 40.5
XS Layer 2									$ 4.5	$ 10.6	$ 15.1

Note: Numbers may not add due to rounding.

When the model applies discounting prior to allocating cash flows by layer (item 5 in the table), excess layer 2 includes $1,441 of the estimated payments compared with $15,058 when the model correctly applies discounting to the cash flows after allocating by layer.

Since the average duration of lifetime payments can be quite long, e.g., 20+ years, discounting has a significant impact on claim values. The following considerations are relevant in the selection of a discount rate(s):

- The purpose of the calculation (e.g., claim settlement, commutation, etc.)
- The financial reporting context (prohibited/limited/prescribed discounting)
- The time period for future payments (average duration of the liabilities)

Under U.S. statutory accounting rules, most states allow discounting for tabular indemnity reserves, but few states allow discounting of other workers' compensation reserves. U.S. GAAP guidance generally does not allow discounting unless claim payments are fixed and reliably determinable; however, if statutory guidance allows discounting (e.g., tabular indemnity reserves), U.S. GAAP may allow an exception. Emerging IFRS guidance takes a more economic approach and allows some form of discounting, although discounting may be coupled with risk margin considerations.

One of the advantages of a mortality model is that it produces a series of future cash flows which may be discounted, using either a single blended rate or multiple rates based on a yield curve. The selection of the type of rate (e.g., risk free, high grade bond, portfolio, risk-adjusted, etc.) is dependent upon the context and purpose. From a true economic rather than accounting perspective, the gap between the inflation and discount rates also should be considered as some correlation likely exists.

2.9 Step 9 – Aggregate Claim Results

In the final step of the mortality-based approach, the model combines the indicated reserves for all claims to yield the total reserve estimate. The actuary should review the reasonability of the results and the underlying assumptions by comparing the projected payments (both by claim and in the aggregate) to the historical payments and current case reserves. Such a validation exercise may require additional discussions with claims personnel when significant differences exist between the projected future payments and current case reserves or when the model produces counter-intuitive results.

3. RESULTS AND DISCUSSION

In our exploration of mortality-based models and prior research, we have found many benefits compared to traditional casualty actuarial techniques. A mortality approach is appealing intuitively because it incorporates individual claim characteristics without requiring a long and complete history of open and closed claims experience or even case reserve values. It accelerates development to an individual claim basis (versus bulk IBNR) which allows for examination of specific facts and circumstances. In contrast to classic triangulation methods, a mortality approach can better address significant changes in factors such as benefit levels, regulation, legislation, policy limits and retentions that may impact outstanding cases. Finally, by its very nature, a mortality-based model easily allows for scenario testing of the sensitivity of important cost drivers (e.g., trend, mortality, discount, etc.)

Like any method, however, mortality-based models possess limitations and are not a panacea for achieving more "accurate" results. A mortality approach may not be applicable to all claims, but rather lifetime and other claims that have reached a relatively steady cost state (e.g., runoff books of business). This approach also requires detailed information on open claims and the modeler must apply judgment to select appropriate assumptions for future costs. In addition, the practitioner will require the requisite statistical/programming skills and software to model the liabilities, and while the initial model design can be time consuming, updates will take considerably less time.

In comparing reserve indications from a mortality approach with traditional development models, settlement activity could create differences between the liabilities under the two methods. Without adjustment, a mortality model generally assumes that payments end only with a claimant's death. However, some claimants accept lifetime settlements (prior to death), and development models incorporate these settlements, which often reflect significant discounts, at least for the time value of money. Although such information often is not available, a mortality model could include an adjustment based on a review of the incidence of such settlements and the magnitude of the difference between the two approaches.

Prior research on the use of mortality models for workers' compensation was not particularly divisive, although the authors presented some varying viewpoints, particularly in the areas of mortality and trends. The prior research does reveal many possible applications for such a model for those with the requisite skills, knowledge and capabilities.

4. CONCLUSIONS

A mortality-based approach is a valuable alternative to traditional property/casualty methods for estimating the future liability for mature claims with stable future annual payments, such as lifetime workers' compensation claims. Actuaries can use such an approach to estimate liabilities directly or to enhance traditional reserving for mature, stable, lifetime claims by corroborating tail factors used in loss development methods. Either way, consideration of a mortality calculation can enhance reserve projections, which is particularly important in the context of negotiating claim settlements, commutations and loss portfolio transfers, reserving for run-off books of business, and reinsurance reporting, as well as the collection or allocation of funds for insolvent companies, state guaranty funds and the run-off of state second injury funds. Since the mortality-based approach requires significant communication with claims personnel, including a detailed review of claim-specific information, actuaries, claims adjusters and management alike can develop a better understanding of the case reserving process and the associated liabilities. Finally, the important assumptions underlying a mortality-based model can lead to better identification of the primary drivers of claim costs over a claimant's lifetime and, therefore, potential avenues for future cost saving opportunities.

With unprecedented changes affecting workers' compensation, particularly with regard to medical and mortality trends, the estimation of workers' compensation liabilities is increasingly difficult. The use of a mortality-based approach will provide valuable insights into the variability of the liabilities through sensitivity testing of the key assumptions and provide information that may be used to better manage costs.

Appendix A

The attached appendices include complete cash flow calculations underlying the charts used throughout this paper.

5. REFERENCES

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Abbreviations and notations

ALAE, allocated loss adjustment expense
aka, also known as
CDC, Centers for Disease Control
COLA, cost of living adjustment
CPI, consumer price index
GAAP, Generally Accepted Accounting Principles
GAM, group annuity mortality
IBNR, incurred but not reported
IFRS, International Financial Reporting Standards
MSA, Medicare set-aside
NCCI, National Council on Compensation Insurance
RP, retirement plan
SCIF, State Compensation Insurance Fund
SIR, self-insured retention
SOA, Society of Actuaries
TPA, third-party administrator
ULAE, unallocated loss adjustment expense
UP, uninsured pensioner
U.S. United States

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Male - Age 50
Estimated Annual Benefit Payments = $10,000
Assumed Benefit Trend = 4% per year
Deductible = $250,000; 1st Excess = $250,000 xs $250,000; 2nd Excess = xs $500,000

Appendix A

								Deductible = $250,000				1st Excess = $250,000 xs $250,000				2nd Excess = xs $500,000			
Age	Year	Probability of Survival (1)	4.0% Trend Factor (2)	Trended Annual Payment (3)	Cumulative Payments Sum of (3) (4)	Expected Annual Payment (1)x(3) (5)	Expected Cumulative Payments Sum of (5) (6)	Cumulative Payments (7)	Annual Payment (8)	Expected Annual Payment (1)x(8) (9)	Expected Cumulative Payments Sum of (9) (10)	Cumulative Payments (11)	Annual Payment (12)	Expected Annual Payment (1)x(12) (13)	Expected Cumulative Payments Sum of (13) (14)	Cumulative Payments (15)	Annual Payment (16)	Expected Annual Payment (1)x(16) (17)	Expected Cumulative Payments Sum of (17) (18)
50	2013	99.8%	1.000	10,000	10,000	9,979	9,979	10,000	10,000	9,979	9,979	-	-	-	-	-	-	-	-
51	2014	99.5%	1.040	10,400	20,400	10,352	20,331	20,400	10,400	10,352	20,331	-	-	-	-	-	-	-	-
52	2015	99.3%	1.082	10,816	31,216	10,738	31,069	31,216	10,816	10,738	31,069	-	-	-	-	-	-	-	-
53	2016	99.0%	1.125	11,249	42,465	11,135	42,203	42,465	11,249	11,135	42,203	-	-	-	-	-	-	-	-
54	2017	98.7%	1.170	11,699	54,163	11,543	53,746	54,163	11,699	11,543	53,746	-	-	-	-	-	-	-	-
55	2018	98.3%	1.217	12,167	66,330	11,961	65,708	66,330	12,167	11,961	65,708	-	-	-	-	-	-	-	-
56	2019	97.9%	1.265	12,653	78,983	12,387	78,095	78,983	12,653	12,387	78,095	-	-	-	-	-	-	-	-
57	2020	97.4%	1.316	13,159	92,142	12,823	90,918	92,142	13,159	12,823	90,918	-	-	-	-	-	-	-	-
58	2021	96.9%	1.369	13,686	105,828	13,265	104,183	105,828	13,686	13,265	104,183	-	-	-	-	-	-	-	-
59	2022	96.4%	1.423	14,233	120,061	13,714	117,896	120,061	14,233	13,714	117,896	-	-	-	-	-	-	-	-
60	2023	95.7%	1.480	14,802	134,864	14,166	132,062	134,864	14,802	14,166	132,062	-	-	-	-	-	-	-	-
61	2024	95.0%	1.539	15,395	150,258	14,620	146,682	150,258	15,395	14,620	146,682	-	-	-	-	-	-	-	-
62	2025	94.1%	1.601	16,010	166,268	15,071	161,753	166,268	16,010	15,071	161,753	-	-	-	-	-	-	-	-
63	2026	93.2%	1.665	16,651	182,919	15,517	177,270	182,919	16,651	15,517	177,270	-	-	-	-	-	-	-	-
64	2027	92.1%	1.732	17,317	200,236	15,956	193,226	200,236	17,317	15,956	193,226	-	-	-	-	-	-	-	-
65	2028	91.0%	1.801	18,009	218,245	16,383	209,609	218,245	18,009	16,383	209,609	-	-	-	-	-	-	-	-
66	2029	89.7%	1.873	18,730	236,975	16,792	226,401	236,975	18,730	16,792	226,401	-	-	-	-	-	-	-	-
67	2030	88.2%	1.948	19,479	256,454	17,183	243,585	250,000	13,025	11,490	237,891	6,454	6,454	5,694	5,694	-	-	-	-
68	2031	86.6%	2.026	20,258	276,712	17,551	261,136	250,000	-	-	237,891	26,712	20,258	17,551	23,245	-	-	-	-
69	2032	84.9%	2.107	21,068	297,781	17,892	279,028	250,000	-	-	237,891	47,781	21,068	17,892	41,137	-	-	-	-
70	2033	83.0%	2.191	21,911	319,692	18,194	297,222	250,000	-	-	237,891	69,692	21,911	18,194	59,331	-	-	-	-
71	2034	81.0%	2.279	22,788	342,480	18,457	315,680	250,000	-	-	237,891	92,480	22,788	18,457	77,789	-	-	-	-
72	2035	78.8%	2.370	23,699	366,179	18,672	334,352	250,000	-	-	237,891	116,179	23,699	18,672	96,461	-	-	-	-
73	2036	76.4%	2.465	24,647	390,826	18,829	353,180	250,000	-	-	237,891	140,826	24,647	18,829	115,289	-	-	-	-
74	2037	73.8%	2.563	25,633	416,459	18,918	372,098	250,000	-	-	237,891	166,459	25,633	18,918	134,207	-	-	-	-
75	2038	71.0%	2.666	26,658	443,117	18,930	391,029	250,000	-	-	237,891	193,117	26,658	18,930	153,138	-	-	-	-
76	2039	68.0%	2.772	27,725	470,842	18,857	409,886	250,000	-	-	237,891	220,842	27,725	18,857	171,995	-	-	-	-
77	2040	64.8%	2.883	28,834	499,676	18,692	428,578	250,000	-	-	237,891	249,676	28,834	18,692	190,687	-	-	-	-
78	2041	61.4%	2.999	29,987	529,663	18,426	447,004	250,000	-	-	237,891	250,000	324	199	190,886	29,663	29,663	18,227	18,227
79	2042	57.9%	3.119	31,187	560,849	18,053	465,057	250,000	-	-	237,891	250,000	-	-	190,886	60,849	31,187	18,053	36,280
80	2043	54.2%	3.243	32,434	593,283	17,567	482,624	250,000	-	-	237,891	250,000	-	-	190,886	93,283	32,434	17,567	53,847
81	2044	50.3%	3.373	33,731	627,015	16,953	499,577	250,000	-	-	237,891	250,000	-	-	190,886	127,015	33,731	16,953	70,800
82	2045	46.2%	3.508	35,081	662,095	16,212	515,790	250,000	-	-	237,891	250,000	-	-	190,886	162,095	35,081	16,212	87,013
83	2046	42.1%	3.648	36,484	698,579	15,348	531,138	250,000	-	-	237,891	250,000	-	-	190,886	198,579	36,484	15,348	102,361
84	2047	37.9%	3.794	37,943	736,522	14,369	545,507	250,000	-	-	237,891	250,000	-	-	190,886	236,522	37,943	14,369	116,730
85	2048	33.7%	3.946	39,461	775,983	13,289	558,796	250,000	-	-	237,891	250,000	-	-	190,886	275,983	39,461	13,289	130,019
86	2049	29.5%	4.104	41,039	817,022	12,123	570,920	250,000	-	-	237,891	250,000	-	-	190,886	317,022	41,039	12,123	142,143
87	2050	25.5%	4.268	42,681	859,703	10,893	581,813	250,000	-	-	237,891	250,000	-	-	190,886	359,703	42,681	10,893	153,036
88	2051	21.7%	4.439	44,388	904,091	9,623	591,436	250,000	-	-	237,891	250,000	-	-	190,886	404,091	44,388	9,623	162,659
89	2052	18.1%	4.616	46,164	950,255	8,342	599,778	250,000	-	-	237,891	250,000	-	-	190,886	450,255	46,164	8,342	171,001
90	2053	14.8%	4.801	48,010	998,265	7,085	606,863	250,000	-	-	237,891	250,000	-	-	190,886	498,265	48,010	7,085	178,085
91	2054	11.8%	4.993	49,931	1,048,196	5,896	612,759	250,000	-	-	237,891	250,000	-	-	190,886	548,196	49,931	5,896	183,982
92	2055	9.3%	5.193	51,928	1,100,124	4,804	617,563	250,000	-	-	237,891	250,000	-	-	190,886	600,124	51,928	4,804	188,785
93	2056	7.1%	5.400	54,005	1,154,129	3,829	621,391	250,000	-	-	237,891	250,000	-	-	190,886	654,129	54,005	3,829	192,614
94	2057	5.3%	5.617	56,165	1,210,294	2,984	624,375	250,000	-	-	237,891	250,000	-	-	190,886	710,294	56,165	2,984	195,597
95	2058	3.9%	5.841	58,412	1,268,706	2,273	626,648	250,000	-	-	237,891	250,000	-	-	190,886	768,706	58,412	2,273	197,870
96	2059	2.8%	6.075	60,748	1,329,454	1,693	628,340	250,000	-	-	237,891	250,000	-	-	190,886	829,454	60,748	1,693	199,563

Male - Age 50
Estimated Annual Benefit Payments = $10,000
Assumed Benefit Trend = 4% per year
Deductible = $250,000; 1st Excess = $250,000 xs $250,000; 2nd Excess = xs $500,000

Appendix A

								Deductible = $250,000				1st Excess = $250,000 xs $250,000				2nd Excess = xs $500,000			
Age	Year	Probability of Survival	4.0% Trend Factor	Trended Annual Payment	Cumulative Payments Sum of (3)	Expected Annual Payment (1)x(3)	Expected Cumulative Payments Sum of (5)	Cumulative Payments	Annual Payment	Expected Annual Payment (1)x(8)	Expected Cumulative Payments Sum of (9)	Cumulative Payments	Annual Payment	Expected Annual Payment (1)x(12)	Expected Cumulative Payments Sum of (13)	Cumulative Payments	Annual Payment	Expected Annual Payment (1)x(16)	Expected Cumulative Payments Sum of (17)
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
97	2060	2.0%	6.318	63,178	1,392,632	1,233	629,573	250,000	-	-	237,891	250,000	-	-	190,886	892,632	63,178	1,233	200,796
98	2061	1.3%	6.571	65,705	1,458,337	878	630,450	250,000	-	-	237,891	250,000	-	-	190,886	958,337	65,705	878	201,673
99	2062	0.9%	6.833	68,333	1,526,671	611	631,062	250,000	-	-	237,891	250,000	-	-	190,886	1,026,671	68,333	611	202,285
100	2063	0.6%	7.107	71,067	1,597,738	417	631,479	250,000	-	-	237,891	250,000	-	-	190,886	1,097,738	71,067	417	202,701
101	2064	0.4%	7.391	73,910	1,671,647	278	631,757	250,000	-	-	237,891	250,000	-	-	190,886	1,171,647	73,910	278	202,979
102	2065	0.2%	7.687	76,866	1,748,513	182	631,938	250,000	-	-	237,891	250,000	-	-	190,886	1,248,513	76,866	182	203,161
103	2066	0.1%	7.994	79,941	1,828,454	117	632,055	250,000	-	-	237,891	250,000	-	-	190,886	1,328,454	79,941	117	203,278
104	2067	0.1%	8.314	83,138	1,911,592	74	632,128	250,000	-	-	237,891	250,000	-	-	190,886	1,411,592	83,138	74	203,351
105	2068	0.1%	8.646	86,464	1,998,055	46	632,175	250,000	-	-	237,891	250,000	-	-	190,886	1,498,055	86,464	46	203,397
106	2069	0.0%	8.992	89,922	2,087,978	29	632,203	250,000	-	-	237,891	250,000	-	-	190,886	1,587,978	89,922	29	203,426
107	2070	0.0%	9.352	93,519	2,181,497	18	632,221	250,000	-	-	237,891	250,000	-	-	190,886	1,681,497	93,519	18	203,444
108	2071	0.0%	9.726	97,260	2,278,757	11	632,233	250,000	-	-	237,891	250,000	-	-	190,886	1,778,757	97,260	11	203,455
109	2072	0.0%	10.115	101,150	2,379,907	7	632,240	250,000	-	-	237,891	250,000	-	-	190,886	1,879,907	101,150	7	203,462
110	2073	0.0%	10.520	105,196	2,485,103	4	632,244	250,000	-	-	237,891	250,000	-	-	190,886	1,985,103	105,196	4	203,467
111	2074	0.0%	10.940	109,404	2,594,507	3	632,247	250,000	-	-	237,891	250,000	-	-	190,886	2,094,507	109,404	3	203,470
112	2075	0.0%	11.378	113,780	2,708,288	2	632,248	250,000	-	-	237,891	250,000	-	-	190,886	2,208,288	113,780	2	203,471
113	2076	0.0%	11.833	118,332	2,826,619	1	632,249	250,000	-	-	237,891	250,000	-	-	190,886	2,326,619	118,332	1	203,472
114	2077	0.0%	12.306	123,065	2,949,684	1	632,250	250,000	-	-	237,891	250,000	-	-	190,886	2,449,684	123,065	1	203,473
115	2078	0.0%	12.799	127,987	3,077,671	0	632,251	250,000	-	-	237,891	250,000	-	-	190,886	2,577,671	127,987	0	203,473
116	2079	0.0%	13.311	133,107	3,210,778	0	632,251	250,000	-	-	237,891	250,000	-	-	190,886	2,710,778	133,107	0	203,474
117	2080	0.0%	13.843	138,431	3,349,209	0	632,251	250,000	-	-	237,891	250,000	-	-	190,886	2,849,209	138,431	0	203,474
118	2081	0.0%	14.397	143,968	3,493,177	0	632,251	250,000	-	-	237,891	250,000	-	-	190,886	2,993,177	143,968	0	203,474
119	2082	0.0%	14.973	149,727	3,642,905	0	632,251	250,000	-	-	237,891	250,000	-	-	190,886	3,142,905	149,727	0	203,474
120	2083	0.0%	15.572	155,716	3,798,621	-	632,251	250,000	-	-	237,891	250,000	-	-	190,886	3,298,621	155,716	-	203,474
Total				3,798,621		632,251			250,000	237,891			250,000	190,886			3,298,621	203,474	
Subtotals by Age Band																			
2013 to 2022		98.2%		120,061		117,896			120,061	117,896			-	-			-	-	
2023 to 2032		90.7%		177,720		161,131			129,939	119,995			47,781	41,137			-	-	
2033 to 2042		70.7%		263,069		186,029			-	-			202,219	149,749			60,849	36,280	
2043 to 2052		34.6%		389,406		134,721			-	-			-	-			389,406	134,721	
2053 to 2062		5.4%		576,416		31,284			-	-			-	-			576,416	31,284	
2063+		0.1%		2,271,950		1,189			-	-			-	-			2,271,950	1,189	

(1) Annuity factor based on RP-2000 Combined Healthy Employees & Annuitants. For example, at age 60, the probability of survival is represented by the single life annuity factor with a starting age of 60 and ending age of 61 for a male currently aged 50. For subtotals by age band, column (1) = column (5) / column (3).
(3) Trended annual payment = $10,000 x column (2).
(7) Cumulative payments = column (4) subject to $250,000 deductible.
(8) Annual payments = column (7) minus prior column (7).
(11) Cumulative payments = column (4) within $250,000 excess $250,000 layer.
(12) Annual payments = column (11) minus prior column (11).
(15) Cumulative payments = column (4) excess of $500,000.
(16) Annual payments = column (15) minus prior column (15).