AGING CURVES FOR HEALTH CARE COSTS IN RETIREMENT

By

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ABSTRACT *This paper explores the relative significance of aging as a determinant of financial cost of health care beyond age 50, with particular attention to the effect for ages 65 and older. The paper presents concepts of aging factors and aging curves, which define relative values between ages for utilization or cost of health care services. General conclusions are drawn from Medicare data that utilization and cost differ by age, but that aging factors vary across services and may be less significant at very old ages. The author then turns to the question of measuring the significance of an aging curve assumption and what accuracy is lost in the simpler alternative of a single value across an age range. The practical effects of relative value aging curves are examined through hypothetical examples of increasing complexity in a retiree health valuation. A method to measure the impact is put forth. Three important variables are discussed in some detail. A survey to ascertain aging curve findings and preferences of health actuaries is introduced and discussed, with one representative curve presented. This curve is then measured to understand its impact vis-à-vis other curves. It may be important to note this is not a study deriving a recommended aging curve. Rather, it is an exploration of the significance of an assumption that has not received much public actuarial scrutiny. A conclusion places the paper's findings in a context of a dynamic health care economy in an aging society.*

Introduction

A key component of health actuarial work is the changing pattern of health care utilization and cost over the course of an individual's lifetime. Differences due to age have been demonstrated and well quantified for those in their working years but have been less available for those who are elderly, disabled or retired. Health actuaries, however, continue to study data and develop assumptions for relative differences by age in claim cost rates for those over age 50, with particular attention paid to those retired and over age 65. To determine the importance of the differentiation by age, the study examined several measures of the effect of aging factors, noted their advantages and disadvantages and illustrated the use of the measures on practical examples. The study also included surveys and interviews with health actuaries to find if there was consensus about assumptions that should be used when determining relative values of health claim rates across a wide range of older ages.

The study found general agreement that cost and utilization differences due strictly to age continue into the older ages, although this may not be true for all health services or at the oldest ages. The differences, however, are not consistently modeled with a simple arithmetic or geometric pattern and seem also to be variable with gender, time and the health care service involved. These findings suggest that more detailed studies would be useful, both to the actuarial profession involved with employer-sponsored retiree health benefits and a larger audience concerned with the implications for an aging population. The findings also suggest that such studies will have to be complex to be comprehensive. Nevertheless, focused studies may attain quite useful results.

This paper discusses considerations to be taken into account in establishing assumptions about age-related cost differences and draws conclusions as to the quantification of such differences. The desired end product is an array of relative values, not absolute values. One question investigated might be phrased as follows: “Are there algorithms such that if one knows the cost or utilization of heath care at one age, then one could predict the cost or utilization at a second age?” The answer, within limits, is yes. But the limits are formidable and subject to influences that this paper can only briefly delineate.

The Premise of an Aging Curve

The basic assumption behind the study is that, for a large enough group of participants, there is a mathematical relation between the utilization of health care services at different ages such that if the utilization (or cost) at one age is known, then the utilization (or cost) at the second age can be determined. If a function, $r(x)$, describes the relation between two ages, x and $x+1$, then a set of functions over a comprehensive range would allow the determination of utilization (or cost) at every age in the range. Ideally, a single function, $R(x)$, would describe the relation for every age x in the range and an aging “curve” would be established, based on relative values. No one, however, has discovered such a single function that has more than narrowly limited predictive success for health care costs or services for those under age 60 or 65. The practical answer has been a set of multiplicative factors that establish the relation from age to age. These factors usually increase as the age examined increases, but the factors for the first years of life and later childbearing years of women will usually result in decreases, at least for health care plans that include such maternity coverage.

A factor in mathematics is defined as a one of two or more numbers which when multiplied together form a given product. Here the “aging factor” multiplied by the utilization or rate at a younger age produces the utilization or rate at an older age. For the purposes of this paper’s discussion, however, aging factors will be defined as the percentage difference between a rate or utilization indicator at one age and a similar rate or utilization indicator at the immediately following age. A factor of 1.04 between the rate at age x and the rate at age $x+1$ will be referred to as an aging factor of 4 percent, applied at age x to estimate the rate at age $x+1$.

An aging factor effect thus may be separated from other trend effects in analysis of changes over time in per capita health care cost rates. An example of a relative value aging factor is an increase of 5 percent in average cost between ages 60 and 61, all other things being equal. A comprehensive collection of continuous aging factors between two ages is referred to as the aging curve for that period of life. If the same factor, 5 percent for example, is used at every age in the period, then the set of factors might be referred to as the “5 percent aging curve.”

For retirement ages, however, there is no published study of what the year-to-year aging factors are. This has led to considerable confusion about the effect on cost over time due to aging. Some actuaries use no increase above age 75; some studies indicate 5 percent might be appropriate each year above that age. The differences in assumption can lead to significant differences in result. Anecdotal evidence has too often been substituted for good data.

Conceptually, there was reason to believe that aging factors for older ages might be represented narrowly. For one thing, there would be no childbearing years. Early Medicare studies seemed to indicate aging factors of 4 percent or 5 percent per year might hold over all the older ages. Early retiree health valuations that projected future payment streams for lifetime retiree benefits based on such factors generated very high per capita values at ages over age 80.

When data was analyzed, however, for a few corporate programs that had enough data to provide some credibility for the upper ages, the factors seemed much smaller and occasionally negative. That is, per capita rates for those over age 80 did not seem to increase significantly when all other things except age were equal. Several rationales for such an effect were put forward, with most emphasizing that employer coverage was secondary to Medicare, but also with the occasional thought that a portion of the very old might not recall they had retiree coverage. Whatever the rationale, the use of relatively minor aging factors at the older ages produces much lower per capita rates above age 80 than if the 5 percent aging factors had continued to the end of the mortality table. The application of a 5 percent aging curve over 30 years to a per capita rate quadruples the final rate when compared to the beginning rate, something not to be ignored when insurance coverage stretches over many years and a mortality table includes some probability that an 80-year-old will live to be 110.

Early Valuations of Retiree Health Benefits and Medicare Aging Data

As health insurance expanded in the United States in the early and middle part of the last century, the senior market attracted relatively few private insurers. The advent of Medicare left some coverage open to insurers. Medicare supplements on a one-year term basis seemed more manageable than the hospitalization risk covered by Medicare. Unions and employers ventured to extend their active employee coverage into postretirement years. Actuarial analysis of employee benefit plans that were continued into the postretirement period, other than pension plans, began to emerge as an actuarial practice area in the early 1980s. For postretirement health plans in particular, analysis of short-term group experience was not sufficient (although still necessary) because individual participants would often be eligible, once they retired, for many years of coverage from the same plan. For both groups and individuals, patterns of health care cost during longer periods of time came under scrutiny.

While the postretirement benefit concerns raised by many non-actuaries centered around the inflation in health care and the uncertain future of Medicare, actuaries who dealt with health care on a regular basis were aware of differences in rates across age categories, which remained significant when other variables were eliminated. Available studies indicated increases below age 65 in the neighborhood of 3 percent to 5 percent from age to age. Above age 65 data was sparser, except for Medicare, which indicated increases in the same neighborhood. Medicare data was dominated by hospital costs but was attractive for analysis because it was a very large sample with consistency over a multi-year period. While the costs were not grouped at each age, two-year age bands were often available for the early Medicare ages, although for older ages all data was grouped together. Since private insurer data from Medicare supplements was not generally available and would, at any rate, have been a much smaller sample, the Medicare increases that conformed to the 3 percent to 5 percent age-to-age increases seen for those under age 65 were adapted to the actuarial models being developed for retiree health valuations. These models wedded the long-term projections of the pension actuarial practice with the short-term complexities of cost-sharing and secondary coverage associated with group health insurance. The models were quite complex, so the accuracy of the aging factors took a back seat to other aspects of the rapidly evolving models.

Attention was eventually devoted to actual experience of plans that were secondary to Medicare. The Financial Accounting Standards Board (FASB) was moving purposefully toward an accounting mandate for the financial reporting of employers who had these postretirement benefits. Also, actuaries and others had developed new analysis tools to investigate the ever-upward trend of medical costs and utilization. The recommended response to control costs, in what came to be known as “managed care”, demanded good data and analysis for effective management of the utilization and associated costs. One result of good analysis of the data was the insight that the aging curve for non-Medicare coverage for seniors did not always follow the expected pattern of 3 percent to 5 percent increases at the older ages. At about the same time and as an indirect result of data analysis, Medicare itself began to change in such a way that the emphasis on hospitalization decreased, with many medical procedures gravitating to an outpatient basis. This shift may have had an effect on the cost curve associated with aging. Recent analysis indicates aging curve differences between inpatient and outpatient service costs, although the apples-and-oranges nature of the two makes it difficult to distinguish cause from effect.

Medicare Data

The most recent Medicare data exhibits considerable diversity in aging curves for cost and utilization, depending upon which coverage is examined. Data is available on a yearly basis for short-stay hospitals, physician and supplier services, and skilled nursing facilities. The data, however, does not include any experience from Medicare’s managed care enrollment.

The Centers for Medicare and Medicaid Services (CMS) historical data examined is for each of seven calendar years, 1992 through 1999, excluding 1993. It shows Medicare data for, at most, six age bands–under 65, 65-69, 70-74, 75-79, 80-84, and 85+. These bands were available for short-stay hospitals and skilled nursing facilities. But in the case of program totals and physician and supplier services, the four 5-year age-bands were replaced by two 10-year age-bands, ages 65-74 and 75-84. (Data was also available for those under age 65, who are eligible for Medicare for reasons of disability. Cost and utilization data for this group was always aggregate, however, without any subgroups by age. Comparisons within the disabled group were not available, and thus no age factors could be derived. The health status of this disabled group meant that comparisons with those over age 65 would include differences in each group's general health status as well as each group's age bands. A factor attributed mainly to age could not then be easily determined.)

(For this reason, no comparisons with Medicare-eligible participants under age 65 have been included in this study. It may be worth noting, however, that in every service category for almost every year under examination, rates were higher for the under-age-65 group than the next oldest group. Since the rates almost always increase with age above the age of 65, the presumption is that the disabilities of covered persons in the under-age-65 Medicare population are the extra factor that makes this group have higher rates of utilization and cost despite being younger. The rates for the under-age-65 group are rarely higher, however, than the oldest age-band group.)

Each year's data for those age 65 and over was analyzed on the rough assumption that the average payment and utilization figures within these age bands are five years apart in the first case (short-stay hospitals and skilled nursing facilities) and 10 years apart in the second case (program totals and physician and supplier services). The age-to-age increase in the first case was derived by taking the 5th root of the geometric difference of the older age-band's average payment versus the adjoining younger band's average payment. Where only 10-year age bands were available, the 10th root was taken to determine the age-to-age aging factor. Since the distribution of ages within the age bands was not known, there is undoubtedly some inherent inaccuracy in the results, particularly beyond age 85, but this study is seeking only general implications. Here are some observations, first for the Medicare program as a whole (but excluding managed care payments and enrollees) and then for various services.

For the Medicare program as a whole, the rate of payment per enrollee increased between the 65-74 age band and the 75-84 age band in every year examined. The factors are between 4 percent and 5 percent on an age-to-age basis for every year, averaging 4.5 percent. The per capita rate increases between 75-84 and 85+ are between 2 percent and 3 percent on an age-to-age basis, averaging 2.1 percent. Again, these increases were consistent between 1992 and 1999.

Cost-sharing per enrollee follows this general pattern, but is about a percentage point lower. Cost-sharing is a generic term that includes co-payments, coinsurance, deductibles and out-of-pocket payments. On a per enrollee basis, cost-sharing does not increase with age as much as payments because it decreases as a portion of the payment for the older age bands. Another way of looking at the cost-sharing is that an older person uses more health care goods and services, and the same deductibles will have less of a proportional effect. When this increase of the excess above a fixed limit occurs over time, it is called a leveraging effect. For a particular time period, when deductibles and maximums are the same regardless of age, it appears as lower cost-sharing for those with more utilization and plan cost, i.e., those who are older.

For short-stay hospitals, the payment per enrollee increases at a relatively steep rate with age. Payments per enrollee in the age band for those ages 85 and above are double what they are in the age band for those ages 65 to 69. The annual payment per enrollee is always highest at the oldest age group, but the rate of increase by age declines with increasing age. For 1999, between ages 65-69 and 70-74, there was a 30 percent increase in payments per enrollee. Translating this five-age difference to one-year age factors gave a 5.4 percent, one-year age factor in the average payment per enrollee, which dropped to 5 percent between the next five-year categories, and then 3.3 percent and 2.5 percent (for the difference between the 80-to-84 age band and the age 85+ band).

Utilization figures for short-stay hospitals are also published with the age splits, allowing an examination of various components of the following equation:

Payments/Enrollee = Payments/Inpatient Day x Days/Discharge x Discharges/Enrollee

For example, the 1998 payment per enrollee for the age-85-plus age band is $3,595, which can be shown as the product of the following three factors: $927 per inpatient day, 6.33 days per hospital discharge and 613 discharges per 1,000 Medicare hospital insurance enrollees. As was noted above, the payment per enrollee figure for the age-85-plus age band is more than twice as much as that for those who were age 65 to 69 in 1998, which is $1,649 per enrollee. But for the younger age band, the three factors have quite different weights: $1,255 per inpatient day, 5.8 days per hospital discharge and 228 discharges per 1,000 Medicare hospital insurance enrollees. The younger group of Medicare enrollees had payments per inpatient day that were more than one-third higher than the oldest group, hospital stays that were somewhat less, and a discharge rate that was only 37 percent of the oldest group’s rates.

These relations are similar to those found in all years. The discharge rate increases the most steeply with age, but the days of care per discharge also increase with age. These increases with age are countered, however, by a payment per day figure that decreases with advancing age. The result is that while payments per Medicare enrollee increase with age, they do not increase as much as the discharge rate per enrollee. One is left to speculate why the older patients receive less care (as represented by payments) per day.

The components also can be combined to provide information on payments per discharge and annual days per enrollee. Payments per discharge decrease with age, and the rate of decrease is higher as the age bands get older, although the age factor is usually between zero and -2 percent.

The annual days per enrollee is always highest at the oldest age group, as with payments per enrollee, and the rate of increase by age generally drops with increasing age. The exception is that, in each of the last six reporting years, the rate of increase by age between ages 65-69 and 70-74 has accelerated before dropping in the next higher age band. The one-year age factors are also higher. For example, in 1998, the one-year age factor for annual days per enrollee between ages 65-69 and 70-74 was 6 percent. It rose to 6.3 percent between the next five-year categories before dropping to 5.1 percent and then 4.8 percent. The effect of all these increases is that in 1998, the annual short-stay hospital days per fee-for-service enrollee for the oldest group, in the 85+ age band, was three times that for the age 65-69 band. Over the years examined (1992 to 1999), the days per enrollee generally decreased in every age group, but the older groups decreased less, both in proportion and in absolute amount.

The utilization increases between the five-year-age bands for skilled nursing facilities is twice as steep as for hospitals, ranging from 11 percent to 14 percent for one-year age factors. These increases do not seem to get less with older age. When broken between admission rates and days of care per admission, the predominant factor in the aging increases is the admission rate. Payments also increase dramatically with age. While there is a decrease in payment per day, it is very slight, always less than 1 percent for one-year age factors. The 1998 relations between categories do not seem to be dissimilar to the earlier years examined.

Payments for physician and other supplier services increase for the first comparison of 10-year-age bands, but only at about 2 percent for one-year age factors. The 85+ age band shows little change over the preceding 10-year-age band.

The analysis from these relatively few data points might be summarized in the following way: The total fee-for-service per capita rate seem to be increasing about 4.5 percent per age between ages 65 and 80 and then about 2.5 percent per age above age 80. The main component of this cost, hospital charges, has age increases a little higher than this, while the age increases for skilled nursing facilities are much higher but are offset by the relatively slim age increases for physician and other services.

The data and conclusions might be affected by the fact that the data examined does not include any experience from Medicare's managed care enrollment. If we assume there is no difference in the actual health status of those of the same age, whether they opt to enroll in a managed care plan or remain in the traditional Medicare fee-for-service, then there is no change in the conclusion. Enrollment figures for those older than age 65 show that the proportion in managed care decreases slightly with age (this seems to be more pronounced in recent years than it was in 1994 and 1995). If we assume a bias among the less healthy to stay in the traditional Medicare program, then some of the aging increase is explained by the older age bands having higher percentages of traditional Medicare enrollees. But the other side of the argument–an argument that has no settled answer–is that the additional benefits offered as incentives by managed care plans attract less healthy people. In that case, the aging increases discussed here in the traditional Medicare data are mitigated by the variance by age in enrollment proportions. Then the aging factors are actually more dramatic than shown here. The enrollment differences are quite small, however, and are unlikely to have an effect on the aging factor of more than a tenth of a point.

The Medicare data shows that the effect of age is important in health care analysis. Given the diversity in Medicare aging curves for cost and utilization, it is worth asking how important the differences are when projecting future costs and whether coverage outside of Medicare for older Americans is subject to different aging factors. The study sought answers to these questions and results are discussed in the sections that follow.

Practical Effects of Aging Factors

The significance of aging factors in retiree health valuations can be measured in several ways, and the significance can appear quite different depending upon which measure is selected. This section of the paper examines factors above age 50, using some simple examples to illustrate the practical effects of aging factors. Some of those effects are very dramatic, while other measures seem to indicate that differences in aging factors make little difference in the hurly-burly world of retiree health valuations. A measure can simply be a comparison of per capita rates at two ages or as complex as looking at present values for groups. Since other variables such as mortality and discount rates are also having an impact on valuation results, some attention is given to the interplay of those variables and the aging factors.

The difference between a 5 percent yearly aging factor and no aging factor over a long age range is most dramatically seen when comparing values at the end of the period. Table 1 below shows numerous ratios indicating comparisons between measurement results when aging factors are applied and when no changes are assumed due to age. In the far right column is the ratio of two single-year values at age 110 resulting from the application of an aging factor from the initial age of 80. (Measurements assume annual health care payments once at year-end for those who survived the year.) The value at age 110 with an aging factor of 5 percent is compared to a similar value with an aging factor of zero, i.e., without an aging factor. The ratio of 4.32 thus represents the accumulated 30-year aging factor at 5 percent per year compared to the value 30 years later if no aging factor were applied. Arithmetically this is $1.05^{30} / 1.00^{30}$, or 1.05 raised to the 30th power. If the initial age had been 65, the 5 percent aging factor would have been applied for 45 years by the time age 110 was reached, for a ratio of 8.98 times a value that had not been "aged." If the 5 percent aging curve began at age 50 (and there are 50-year-old retirees and retiree dependents) the ratio leaps to 18.68.

When a lower aging curve of 3 percent is used the effect is considerably less, but still substantial. To introduce a different perspective on the table's meaning, the ratio of 3.78, for an initial age of 65 and a 3 percent aging curve, implies that if the claim rate for a 65-year-old were known, then the claim rate at the same time for a 110-year-old would be 3.78 times as much. For a particular plan of health care coverage for which the 3 percent aging curve was appropriate, a $1,000 rate for a 65-year-old would reconcile with a $3,780 rate for someone at the end of the mortality table at age 110, without any cost effect other than aging.

The impact on costs over a valuation period, however, builds gradually, which is reflected in the rest of the table. A quadrupling effect seen when comparing a rate in the first year with a rate in the 30th year after application of a 5 percent aging curve is not indicative of the whole effect on the costs over 30 years. A geometric increase compounds with the addition of each year. A summation over all 30 years of age is a better measure of the valuation effect than just looking at single ages, but there are several summation possibilities. Comparison ratios demonstrating the effect of a uniform aging factor will be derived first without mortality or discount, then with mortality but no discount, and finally with mortality and discount, using two different discount rates. These results are discussed following the table.

Table 1 Ratios of Values with Aging compared to No Aging

Measure of Comparison	Aging Curve	50	Initial Age 65	80
Single Year Value at Age 110	5%	18.68	8.98	4.32
	3%	5.89	3.78	2.43
Accumulated value without Mortality or discount	5%	5.89	3.55	2.21
	3%	2.72	2.06	1.59
Accumulation with UP94 female mortality (but no discount or trend)	5%	2.87	1.91	1.38
	3%	1.82	1.45	1.21
Present Value with UP94F mortality and 6% discount	5%	1.96	1.59	1.29
	3%	1.45	1.30	1.16
Present Value with UP94F mortality and 4% discount	5%	2.19	1.68	1.32
	3%	1.55	1.34	1.18

A 30-year annuity certain that includes a 5 percent annual increase is 121 percent greater in undiscounted value than a 30-year annuity certain without any increases (and thus generates a ratio of 2.21 from an initial age of 80 to age 110). In the table this is shown in the row labeled, "Accumulated value without mortality or discount." Over 60 years (from age 50 to 110), the ratio is 5.89 with a 5 percent aging curve and 2.72 with a 3 percent aging curve. Over 30 years (from age 80 to 110), the 3 percent aging curve generates a 59 percent increase in this accumulated value.

Introducing mortality (in this example, the female UP94 mortality table) mitigates this impact. The mortality assumption decreases the proportion of people who will be alive when the most dramatic compounding effects of the aging factor over time will actually occur. For an accumulation from age 80 to the end of the mortality table, the ratio of an accumulation with a 5 percent aging curve to an accumulation without an aging factor is 1.38. If the initial age is younger the factor is much higher, an indication not only of the compounding effect of the aging factor but also of lower mortality under age 80. The 5 percent aging factor ratio is 1.91 when the initial age is 65.

The 3 percent aging factor ratio when the initial age is 65 is 1.45, which means that the expected payments across a stable population that followed UP94F mortality would be 45 percent higher with a uniform 3 percent aging factor than without an aging factor.

Another way to express this is to envision a group of people with ages ranging from 65 to 110, formed over the previous 45 years when a thousand new 65-year-old retirees had entered the group each year and survived in the following years according to the mortality table. If rate increases with age had averaged 3 percent with each birthday, then current payout to all survivors would be 45 percent higher than if there had been no rate increases with age. This would be true regardless of any other utilization or price increases or the discount rate.

Aging and mortality assumptions are also a vital part of group projections of future health costs and utilization. If a thousand 65-year-old people were to enter a health benefit program simultaneously, a projection with mortality of the group's future costs would result in the same 1.45 ratio between the accumulated value with and without a 3 percent aging curve. When that projection includes future trend increases in costs and utilization, the comparison ratio will increase. The greater the trend, the more the ratio would increase above 1.45 (or any other accumulation ratio with mortality). Although health projections need trend, this effect on the comparison ratio suggests trend distorts the quest for a measure of the importance of the aging assumption.

Much the same can also be said about the effect of discounting. A measure of the difference of present value calculations of two projections with differing aging assumptions would depend on assumptions about the discount rate and trend. These assumptions have opposite effects; an increase in discount rate lowers the present value, while an increase in trend increases the present value. To measure the effect of differing aging curves, it would be optimal to freeze the discount rate and freeze the trend rate. If either are frozen at any rate other than zero, however, the ensuing calculations do not match the "snapshot" picture mentioned above of a hypothetical population formed from the same number of new entrants each year for many years. So, to best quantify the significance of one aging curve over another, the trend and the discount should be set to zero; that is, they should be ignored.

Nevertheless, Table 1 includes some comparison ratios of present values with a discount rate but without a trend rate. The discounted present values, when compared to a non-discounted accumulated value, emphasize the projections nearest to the initial age and give lesser weight as the group ages. This is included as much to show the relatively limited effect of the discounting as it is to show the lower ratios generated when discounted present values are used. For instance, the use of a discount rate of 6 percent lowers the comparison ratio from 1.45 to 1.30 for the age 65 present values with a 3 percent aging factor. While this is not an insubstantial decrease, it is much less of a decrease than would otherwise be expected for a 45-year projection. To show how the discount rate usually effects such long-term projections, the ratio shown in Table 1 before taking mortality into account, 2.06, would be lowered to 0.54 (not shown) simply through the use of a 6 percent discount. That is, the inclusion of a 3 percent aging factor doubles the value of the 45-year annuity certain, but the inclusion of both 3 percent aging and 6 percent discount results in a value only about half the original. The discounting has a very significant effect on the annuity certain, but in contrast, only a small effect after mortality has been introduced. The limited effect of the discount on the comparison when mortality is taken into account can be attributed to the fact that both mortality and discount are working to the same effect of reducing the weight of the oldest ages.

Table 1 does not show the effect of trend rate, but a fixed trend rate has exactly the same kind of quantitatively compounding impact as a fixed discount rate, only in the opposite direction. Of the measures mentioned above, the one best suited to understanding the significance of the use of one aging curve over no aging curve, or over a second aging curve, is the accumulated value with mortality but without discount or trend. Aging curves effective over a period of many years operate in a setting where mortality always has significance but discounting is sometimes irrelevant. At other times discounting would be offset by health care trend. In Table 1, therefore, the most important measure is shown in the rows labeled "Accumulation with UP94 female mortality (but no discount or trend)."

Interaction of Aging Curves and Available Claims History

This theoretical discussion of the practical effects of the aging factor has so far focused on the effect on an individual or a demographically stable group of people. The working actuary seldom, if ever, has the luxury of such demographic stability, however. For a retiree health valuation, the most likely initial situation is to receive plan provisions, a population census and some claims history. The claims data most likely will be a summary report of claims totals, but sometimes it may be just a set of premium rates. The actuary will, in almost every case, be fitting an existing theoretical aging curve to a claims history that has insufficient data to establish its own credible aging curve. The following section draws on the comparative measurement analysis outlined above to examine the use of aging curves under circumstances that, while hypothetical, simulate the working situation of a retiree health valuation.

The summary report of claims data totals that an actuary is apt to receive after requesting a plan's claims history often boils down to one claim amount total for each reporting period for major categories of services and participants. Sometimes it may be a paid claim total for all covered services for all participants for a 12-month period. Other times it may be a submitted claim total for each of several different services (inpatient hospital, physician, etc.) for each of several different participant groups (retirees under age 65, spouses under age 65, children, retirees age 65 and over, etc.) for each month in a year. This variety in reports may be augmented with reports on incurred claims.

What the data report will rarely be, however, is an age-by-age summary sufficient to establish a credible aging curve. Nevertheless, an experienced health actuary making a projection of rates for this participant group for a retiree health valuation will need to convert the claim history, whatever its form, to an age-by-age claims rate to fit most projection software. The actuary will either obtain, or estimate, the age distribution of the participants who generated the claims history. This will be matched to an aging curve selected by the actuary for that age distribution. The selected curve will establish the assumed relationship among the rates at the various ages. An equation can be formed that involves this assumed relationship (the aging curve), the historical participant age distribution, and the historical claim total. The equation can be solved for the rate at one age, from which the aging curve determines the assumed rates at all other ages for that historical period.

In this way the claims history pieces for a time period are fit to the relative values of the selected aging curve, with the result being a set of per capita rates across the age range for that time period. Comparing and adjusting similar sets of per capita rates for the different available and relevant time periods should yield enough age-adjusted claims data to establish assumptions for the initial health care claims rates for a retiree health valuation.

How important is the selection of the aging curve to the retiree health valuation? No matter which aging curve is selected, the process described above of fitting it to the claims history ensures that there is some internal consistency in the initial health care claims rates, particularly in the first year. Given an accurate fitting of the curves to the history, there will be some offsets between any two possible curves because they will have to intersect within the age distribution at some point near the average age (This discussion assumes the common case when there is only one intersection point between two aging curves under consideration for selection). The curve that will yield higher rates on one side of the intersection will have to yield lower rates on the other side of the intersection. The influence of such offsets suggests that, when establishing per capita health rate assumptions from claims history, the effect on accumulated values of using a different aging curve is mitigated somewhat from what was shown in Table 1.

Three Important Variables

For rate projections beyond that first year, however, the population of the valuation begins to change, both in age and actual participants, and the choice of aging curve will have more effect. The significance of any differences stemming from the aging curve selection depends as much on variables affecting the fitting process as it does on the aging curve. Among the variables that can be readily identified before beginning the valuation are three–the age distribution of the current participants, their average age, and the age range of eligibility for receiving benefits–which will be discussed in some detail here.

The average age of the current participants in relation to the age range of benefits. Within a given benefit-coverage age range, the higher the average age of the retired participants, the less likely the choice of aging curves will be significant, at least for the closed group of retirees. The current average age is important because that is about where the average cost of the claims experience will be found in relation to the age-adjusted rates and where the intersection point will be for potential aging curves. A higher average age means a shorter future average life expectancy during which the expected present values will be measured and thus a more limited period for the effects of varying aging curves to be felt. A higher average age may also mean that the offsets (between two competing aging curves) are more evenly distributed over the benefit-coverage age range.

As an example, take a situation where the age range of the benefits is from age 65 to death and the valuation participants are a closed group, with a current age range of 10 years and an even age distribution, so that the average age is in the middle of the 10-year range. Then the choice of an aging curve will be less important if the 10-year age range is from 75 to 85 with an average age of 80 than if the age range is from 65 to 75 with an average age of 70. The 75-to-85 group will have fewer years of expected life to be affected by differences in aging curve and the mortality will be higher, eliminating more participants. In terms of offsets, those from younger ages in the 10-year age range will have more impact on the 75-to-85 group because that group will average only 30 years of possible benefits (age 80 to 110) while the 65-to-75 group will average 40 years of possible benefits. Below is another comparison of the ratio of aging, with the 3 percent and 5 percent aging curves, to no aging, such as was seen in Table 1. In Table 2a, the results are ratios of accumulated value measures, to age 110 under UP94 Female mortality, assuming an equal number of participants at each end of the age distribution.

Table 2a Effect of Age Distributions		
Claims History	*Aging Curve*	
Age Distribution	***3%***	***5%***
Ages 65 to 75	1.33	1.62
Ages 75 to 85	1.17	1.31

Note that if the groups were not closed, most new entrants in this example would begin benefits at age 65. Then the offsets from younger ages would be more extensive, particularly for the 75-to-85 group. Depending upon (among other variables) the shape of the aging curve and the proportion of new entrants to those beneficiaries currently in the age range, the new entrants could entirely offset the additional accumulated value associated with using the aging curve versus using no aging. But such an event is unlikely because a plan with substantial new entrants will, by that very fact, not have an average age that is particularly old. Also, as was seen in Table 1, the younger ages have higher accumulation ratios, so offsets from new entrants may not be of long duration.

The following is a general rule: the older the average age of the retired participants, the less significant the choice of aging curves. This is also applicable below age 65, where the relevance of comparing the average age to the benefit-coverage age range becomes apparent. Age 63 is not high when looking at a lifetime benefit, but it is relatively high when valuing a benefit that extends from retirement only to age 65 and Medicare eligibility.

Age range of the benefit coverage. Regardless of the current age distribution of the participants, the age range covered by the projected benefits is an important variable and can be identified easily. The wider the age range of possible benefit coverage is, the more important the selection of the aging curve will be on valuation results. In the United States, with Medicare becoming the primary health insurer at age 65 for most people, there are essentially three age ranges for benefit coverage of retirees. Assuming retirement does not begin until after age 50, these are:

1. Age 50 to Medicare eligibility at age 65,
2. Lifetime from age 65, and
3. Lifetime from age 50.

This last is, of course, just a combination of the first two and is less common now than it was at a time when active employee benefits were often simply extended to all retirees, integrating with Medicare when appropriate. Now those who are Medicare-eligible often are switched to a separate plan of coverage. On the other hand, prescription drug coverage is now more prominent and is, as of this writing, little affected by Medicare. Conceivably, an actuary could have enough credible data to break up these age ranges into smaller ranges, but the three noted are those used most often.

The 15 years of age between age 50 and age 65 are small compared to the 45 years of age between age 65 and age 110, much less the 60 years between 50 and 110. In addition, relatively few employees retire before age 55, so claims histories of retiree health plans that cover only those retired and under age 65 usually have an average age of 60 or more. The difference aging curves make in an age range from age 50 to Medicare eligibility, a period of at most 15 years and likely to be less than 10 years, is smaller than in the wider age ranges. For pre-Medicare eligibility, the extension of years on either side of the average age is, in practicality, less than 10, usually less than five. There is not enough "distance" from the average age in which to build up a significant difference in age-adjusted rates, plus the offsets are more likely to have a counterbalancing effect in this diminished age range, even for new entrants. As will be noted later, however, there also seems to be more variability in what health actuaries deem appropriate for this 50-to-65 age range than some older age ranges that have less "data noise" from active and disabled employees.

In summary, when the aging curve assumption impacts retiree benefits only to age 65 and does not extend to participants below age 50, the effect of a change in aging curve on accumulated values will be much less substantial than it can be when the benefit period extends for life. The shorter the age range of the benefit coverage, the less likely the aging curve choice will be significant. (This is most apparent when dealing with one-year term health insurance and explains why the aging curve topic is of little interest to actuaries who primarily serve insured and contracted health plans.) The use of an aging curve is still important for the age-50-to-Medicare-eligibility plan that serves "early" retirees, particularly since the evidence from Medicare and secondary plans indicates that in this range the aging factors may be higher and the curve steeper. Nevertheless, the implications of choosing a "wrong" curve are not as great in this relatively narrow benefit range as with wider, older age and benefit ranges. If the benefit range is from age 50, or another early retirement age, to death, however, the choice of aging curve is very important.

The age distribution of the retirees being valued. The third variable of some importance in determining the appropriateness of an aging curve is the age distribution of the retired participants. Given an average age of the historical retiree distribution, then, as a general rule, the wider the age distribution, the less significant the choice of aging curves is. Or, to put it the other way around, the tighter the distribution, the more carefully the aging curve should be chosen.

Table 2b is a comparison of the ratio of aging to no aging, using three different distributions around an average age of 80. Again the results are ratios of accumulated value measures, to age 110 under UP94 Female mortality. The age 80 results (from Table 1) are included to show the difference between applying the aging curve to a five-, 10- and 15-year spread from age 80 and applying it to age 80 alone. The distribution calculations assume an equal number of participants at each end of the age distribution. This last assumption maximizes the age distribution effect when compared to a single age. If participants were distributed evenly across the age range, the ratios would be higher, although never exceeding the ratio at the single age (age 80, in this example).

Table 2b Effect of Expanding Age Distribution		
Claims History	*Aging Curve*	
Age Distribution	***3%***	***5%***
Age 80 only	1.21	1.38
Ages 75 to 85	1.17	1.31
Ages 70 to 90	1.08	1.12
Ages 65 to 95	.95	.89

In the situations constructed here, each additional five years of spread lowers the aging/no-aging ratio significantly more than the previous five years. A contributing factor is the assumption that the distribution is solely participants at each endpoint of the age distribution, but there are other reasons worth examining. The fifteen-year age spread either side of age 80 results in a 30-year age distribution and a ratio less than 1.0. Thus, the 30-year age distribution actually decreases the accumulated value measure of the 3 percent and 5 percent curves below that of the no-aging scenario. This effect is rare, being a function of the particular aging curves as well as an endpoint assumption that is highly unlikely, but shows the unexpected effect a wide distribution of participant ages can produce.

The reason is not because an expanded age distribution provides more data points and a better fit. As described above, the method for fitting the claims history to the aging curve usually involves a single data point, derived by dividing the claims total by the participants. So a wider age distribution usually does not lead to additional data points. Because of this, an expanded distribution will not necessarily have more data points. If additional credible data points can be established, however, and the actuary chooses to use them, each would need to be fit to an aging curve. The matching of one data point and one aging curve would lead to a set of age-adjusted rates. But it would be highly coincidental for the same set of rates to fit even two of the historical data points. This would lead to the need for connecting and smoothing between the curves, consideration of which would be likely to lead back to the desirability of a single curve and a single data point.

Under most circumstances tested, the choice of aging curves becomes less significant with a wider age distribution around the average age. Several factors are operating, including the force of mortality. A wider age distribution means some of the retirees are older and, therefore, closer to the end of receiving benefits. Future accumulated values decrease as age increases. At the same time, of course, a wider age distribution will also mean some of the retirees are younger, with a longer benefit period and subject to lower mortality initially. Nevertheless, the force of mortality does increase with age, so that the lower mortality of additional younger participants being valued is more than offset by the higher mortality of the additional older participants.

Other factors are associated with the non-linearity or asymmetrical aspects of most aging curves. The basic premise of an aging curve is that per capita claims rates vary by age. Experience indicates that the absolute values separating various per capita claim rates at each age appear to differ, and not be the same as they would be in a linear relation. Thus a distribution around a central age does not result in an exact offset. Widening the distribution by adding a participant one age higher and a participant one age lower would increase the rate in the usual situation where the per capita rate accelerates with age. This would raise the average accumulated value, the opposite direction of the mortality effect.

While these two effects work over time, there is another factor with a non-linearity aspect that can be quantified immediately. This other effect is such that, given a particular aging curve and average cost for an average age, whenever a different participant age distribution exists there will be a different set of age-adjusted rates that fits the given values.

For example, if the actuary chooses to use the 3 percent aging curve to fit claims experience that indicates an average cost of $1,000 for an age distribution with an average age of 72, the age-adjusted rate set that fits these assumptions will most accurately be known only when the age distribution is known. If all participants were age 72, then the age-adjusted rate set can be established. The age 72 rate is $1,000, the age 73 rate (before trend) is $1,030, and the age 71 rate is $971. The age 74 rate would be $1,061 and the age 70 rate would be $943.

Note, however, that the average for the rates at just age 74 and age 70 is not $1,000; it is $1,002 (i.e., 1061/2+943/2). Thus, if an age distribution made up of only participants age 70 and age 74 was evenly split between the two ages such that the average age was 72 and the average cost was $1,000, the set of age-adjusted rates to fit a 3 percent aging curve would have to be different than the set mentioned in the previous paragraph.. A set of rates that would meet this age distribution would be $941 at age 70 (also $969 at age 71, $998 at age 72, $1,028 at age 73) and $1,059 at age 74.

The average age would be the same, as would the average cost and the aging curve, but the age-adjusted rates would all be different. The implication is that if an actuary knows the historic average cost, the historic average age and the aging curve, the set of age-adjusted rates still cannot be pinned down until the historic age distribution is known. The only time the age distribution of the historical experience does not make any difference in the rates is when the aging curve approximates a straight line, as measured with coordinates of age and per-capita rate.

Warping Error

In a retiree health valuation, this "warping" can introduce an error that is common and worth discussing briefly. The beginning of this section of the paper outlined the method of fitting claims history to the relative values of the selected aging curve to determine an assumption set of per capita rates for a time period. A shortcut to this procedure may become necessary if the participant age distribution is not known or if only an average age can be identified. The claim cost average can be considered the claim rate at the average age and the rates at other ages can be determined from the aging curve. This assumption results in minimal distortion if the aging curve is linear, but error is introduced if the curve is not linear and extends over many ages. In that case, the claim cost average is not representative of the rate at the average age, due to a "warping." The actuary needs to analyze the situation to determine if the error introduced is large enough that an offsetting adjustment is needed. Shown in Table 2c, in examples with the 3 percent and 5 percent aging curves used previously, are the overstatements resulting from assuming the average cost represents the rate at the average age.

Table 2c Effect of Using Average Cost at Average Age		
Warp Overstatement	*Aging Curve*	
Time Duration	***3%***	***5%***
2 Years	<0.1%	<1.0%
10 Years	1.1%	3.0%
20 Years	4.4%	12.1%

Since these two curves represent geometric progressions, the effect is the same no matter where on the curve it is measured, as long as the time duration between the two ages being averaged is the same. What is true of evenly distributed populations in these theoretical examples will be all the more true of the uneven participant age distributions that occur in reality.

The error introduced by the shortcut will carry through to all the valuation results if not corrected. The per capita rate that is distorted at the average age becomes the anchor point for all the other age-adjusted rates and distorts them in the same proportion. The proportional error carries on to cash flow projection and present values, including funding, plan design and FAS 106 accounting.

One way of quantifying the problem of the impact of the age distribution is by looking not at the overstatement ratio, but its inverse, which will be called the warp effect. In the example shown above, where an average cost of $1,000 for an age distribution is determined for a group with an average age of 72, it could be seen that, as the age distribution widened and an aging curve with a geometrically increasing progression was applied, the resulting age-adjusted rate set decreased. If all the rates are lower, then the accumulated values have to be lower. A wide enough age distribution might then cause the accumulated values ratio, of those with aging to those without aging, to approach or go below 1.0, even with a curve of uniform aging factors that form a geometric progression. That is what happened in Table 2b.

Table 2d quantifies two simultaneous effects of changing the age distribution–the warp effect and the age-spread effect. The warp effect is the ratio of the claim rate at the average age to the rate obtained from averaging rates from the ages at the two endpoints of the ranges. The warp effect shown here is the inverse of the overstatement numbers shown above. The spread effect is the same "accumulation" ratio of aging/no-aging accumulated values that has been used throughout this paper, with the values generated from just one set of age-adjusted rates for each curve. In a sense the warp effect measures the one-time effect of fitting an aging curve rather than using an average cost, while the spread effect measures the long-term effect of projecting rates for participants with varying mortality and claim rates. The product of the warp effect and the spread effect gives the accumulation ratios, which were also seen in Table 2b.

Table 2d Two Effects of Expanding Age Distribution

Claims History	*Aging Curve*					
Age Distribution	***3%***			***5%***		
	Warp	Spread	Accumulation	Warp	Spread	Accumulation
Age 80 only	1.000	1.208	1.21	1.000	1.383	1.38
Ages 75 to 85	.989	1.185	1.17	.971	1.348	1.31
Ages 70 to 90	.958	1.124	1.08	.892	1.257	1.12
Ages 65 to 95	.909	1.047	.95	.781	1.143	.89

In this example, the warp effect is always 1.0 or less and the spread effect is always above 1.0. Both decline, however, as the age distribution increases. Inevitably, at some age distribution the aging/no-aging ratio falls below 1.0, indicating that, when the average historical claims rate for that distribution is fit to the aging curve, the resulting set of age-adjusted rates generates accumulated values for the endpoint ages that are less than the accumulated values if no aging assumption had been used. In terms of stretching the hypothetical examples, this result may be inevitable, but it is far-fetched in practicality. Here the ratios fall below 1.0 with the age-65-to-age-95 distribution, but that hypothetical assumes the claims history is for participants who are either age 65 or age 95, with no one between and an equal number at age 95 as at age 65, a highly unlikely participant group. Also in this example the warp and spread are both more dramatic in the 5 percent curve than in the 3 percent curve.

These measures will be used again in a later section to examine a flatter curve. The rule noted above, that a wider age distribution will mean the choice of aging curves is less significant, has exceptions when the aging curve either does not increase with age or increases at a substantially slower rate at the older ages than the younger ages in the coverage range. Then it is possible a wider age distribution will increase the differences between the effects of aging curves, although the increase was relatively small in most scenarios that were tested. This rule also ignores a present value situation where trend exceeds the discount rate for a significant period.

Other Variables

Identifying these three easily measurable parameters at an early stage of the more complex retiree health measurement process will allow the actuary to understand the care with which the aging curve should be selected. Depending upon the age range of the benefits, the average age of the retirees from the experience data and the age distribution of those retirees, the actuary can decide how much attention to give to the aging curve selection. Other parameters immediately arise, including the purpose of the actuary's measurement, which might be anything from financial reporting or funding to plan design and retiree contribution determination. Selection of the aging curve will usually be less important in making a one-year budget projection than it will be in determining prospective liabilities for a merger or acquisition valuation. But there are numerous other variables that will also play a part.

Earlier it was noted that, in an open group with new entrants, the offsets from younger ages might be extensive. The proportion of new entrants to those beneficiaries historically in the age range is an important variable, as is the age distribution of the open group. Although actuaries are often called upon for valuations of closed groups of retirees, more often new retirees are expected and their experience is not yet in the retiree claims history of the plan. This is a reason to look more closely at the impact of the aging curve chosen, not a reason to ignore the impact of aging.

This section of the paper has examined some of the practical effects of aging curves, using some increasingly complex, but hypothetical, curves and scenarios to illustrate likely situations. Comparisons were made with several measures, with illustrations using three different aging curves, one of which was described as "no aging." Once it is accepted that aging is an important variable, the "no aging" curve might more accurately be seen as a set of zero aging factors and a curve with no slope at any age. The other illustrative curves had uniform factors at every age, one of 3 percent, the other of 5 percent.

The accumulated value comparison, with mortality but without discount or trend, was put forth as the best measure of the significance of differences between aging curves. This measure could be used to test whether the impact of proposed changes to an aging curve assumption set is significant enough in the actuary's judgment to justify the change, under the circumstances. Important variables to be identified in considering the circumstances are the age distribution of the current participants, their average age and the age range of eligibility for receiving benefits.

The section then examined how an actuary might transform claims experience into an effective set of age-adjusted rates, using an aging curve, and how important the selection of an aging curve might be, given varieties of claims experience. The paper now moves on to examine the uses of aging curves from the perspective of experienced practitioners.

Survey of Aging Experience and Assumptions

The experience of health actuaries who work with senior populations provides important perspectives on the significance of the aging curve assumption and its interrelation with the many other variables that are taken into account in their practice. To better understand that perspective, a survey was sent to a small group of experienced health actuaries in positions of responsibility in actuarial work, asking for information about their use of aging curve assumptions.

The survey was relatively informal and open-ended to encourage insights on a topic not previously investigated on a profession-wide basis, but also promised confidentiality of responses, so that proprietary interests would not be too much of a barricade to participation. The survey was conditioned on both extensive experience with health rate-making and a follow-up phone interview. For this reason, the survey went to only a small number of actuaries, not all of whom were expected to reply. About two-thirds replied, some with more detailed responses than others. While this is a very high response rate, the survey results should not be considered comprehensive for the health actuarial community. It is missing the input of many experienced health actuaries who might have drawn different, but equally valid, conclusions from the same or different data.

Many of the survey questions asked only for general opinions about the appropriateness of aging factors under different circumstances, but the survey specifically asked for quantification of aging factors in a format of five-year age bands from age 50 to 90. Twenty-one of the survey respondents included at least one such aging curve. Several sent more than one curve, which was an indicator of their view that "one size fits all" does not pertain to the application of aging factors to all health care services.

Some who did not include aging curves in their responses noted it was difficult to segregate claim data in a way that eliminated, within given age bands, variables known to influence health costs. For instance, there is general agreement that retirees and active employees at the same age will have different claim levels. If, in a given database, retiree claims cannot be segregated from active claims, then it is difficult to accurately ascertain the effect of aging in age bands where both types of claimants may be present, but in different proportions at different ages.

Such mingling seems to be more of a problem for insurers than for self-insured employers and their consulting actuaries. This may explain why few responses were received from insurers; most of the responses came from consultants. Consulting actuaries who work in the area of retiree health benefit measurement have been incorporating aging curve assumptions in their models for quite some time for employer clients. An employer is likely to have good records of who is retired and who is not among its insured participants. An outside insurer, however, is unlikely to have access to retirement records and may not particularly care if a claimant is recently retired or not.

Insurers are not issuing long-term policies on employer postretirement plans, so their risk exposure does not motivate them to capture and analyze claims data in the age 50 to age 65 group for the effect of aging. Medicare supplement policy data may be available by age, but even if coverage mix issues can be eliminated, there seems to be a major concern with adverse selection and its differing impact across differing age bands. Most of the responses based on experience studies were derived from the claims data of one or more large employers for which consultants projected retiree health benefits for financial reporting purposes.

The curves that were submitted were not necessarily those that the actuary used in his work. For instance, some of the respondents usually use curves where the aging factors differ by each age, rather by five-year age band. Such respondents conformed their submitted curves to the structure of the survey, which asked for age-to-age factors within five-year age bands. Their survey answers can, however, be considered representative of the assumptions they use.

The survey form asked respondents to indicate if responses beyond age 65 were for primary coverage, as opposed to secondary to Medicare. One respondent indicated it was; the rest presumably answered for secondary coverage. Most all of the age factors can be taken as changes in net plan payments, although follow-up conversations showed that the distinction to be made in examining aging curves between net and gross was more important to some actuaries than to others. The author did not delve into this, but would encourage those who find it of importance to publish a discussion.

Of the 21 respondents submitting curves, 15 indicated that the curves they submitted were different from what they might have submitted five or 10 years previously. Four indicated that either they had not changed the curves or they were using a curve endorsed by their companies and were unsure of an update within that period. Two had revisited data and derived male/female curves that they would not have used previously.

The actuarial basis for most of the submitted curves was an experience study of claims data gathered from one or more of a consulting firm’s clients. Eleven of fifteen indicated they had performed experience studies in recent years, as did three of those who responded only with comments. At least one of the respondents who had not changed curves recently also had performed an experience study. Often the studies were based on data from a single employer client, although for many respondents, such a basis might then have been tempered or confirmed by less detailed reviews of other client or public claims data.

The survey offered a choice of what other influences might have caused a change in aging factor assumptions. After experience studies, the influence most often cited was “actuaries within my firm” (five cites), followed by published studies (three), and competitors’ assumptions (two). One actuary mentioned rate manuals, by which he meant finding an aging curve in a rating tool purchased from a consulting firm and then modifying it to conform more closely to other influences. Several of the actuaries who had not mentioned published studies as an influence indicated that they had consulted publicly available databases when determining their aging curves. Usually mentioned was Medicare data (HCFA or CMS), although there was also a second reference to a rate manual and mention of data from prescription drug managers (pharmaceutical benefit managers). Only one respondent mentioned studies published by the Society of Actuaries (SOA). Two respondents went out of their way to indicate that none of the published data was very useful in answering the aging question.

Health Care Service Categories

Actuaries have expanded their investigation of the aging effect to different categories of services and found underlying differences. Health insurance actuaries have been generally aware of likely differences in the aging curve by service category for some time. A study by actuaries and accountants at Coopers & Lybrand for the Financial Executives Research Foundation in 1989 illustrated it in relation to retiree projections, although their published study did not specify any actual differences. The increase with age is now generally recognized as higher for use of inpatient facilities (hospitals and nursing homes) than for the use of other goods and services. This difference for basic categories mirrors the findings of Medicare data analysis and was shown in the survey in several ways.

One actuary specified that the changes to his curve in recent years were influenced by a change in the relative values of services, implying that a change in the underlying curves for services such as hospital, physician and prescription drugs may not have been as important. The comment signifies that the main curve the survey investigated was an aggregate curve, but that, like all health care, it is made up of component pieces. Each component may have its own set of aging factors. If service category A has a different aging curve than service category B, the aggregate curve combining the two will be different when, for example, A has only 30 percent of the aggregate use or cost, as opposed to when it had 60 percent.

A possibility implied in the comment, then, is that for a particular situation under analysis in the last five years, the inpatient curve and prescription drug curves may not have changed, but since the portion of coverage devoted to inpatient had decreased while prescription drugs had increased, the aggregated curve had changed. This actuary's response reflects a broad look at what more focused responses addressed.

The survey included sets of general questions that asked the actuary's level of agreement with the use of variation by age when developing rates in the following six health care categories: hospital, physician, prescription drugs, dental, vision and nursing home care. This set of questions was asked for ages 50 through 64 and then again for ages 65 to 90 (The survey also asked the general question of whether aging factors were used above age 90. Only three respondents used factors above age 90 and two of those used negative factors.)

Respondents were asked whether they agreed with the use of variation by age in claim cost rate development in different categories and were given the following five choices: strongly agree, agree neutral, disagree and strongly disagree, as well as the option of indicating “not in my practice area.” The results for the six service categories and two age groups are summarized in Tables 3a and 3b. The “Other” column combines responses for neutral, disagree and strongly disagree, while the weighted agreement index assigned a value to the responses (strongly agree: +2; agree: +1; neutral: 0; disagree: -1; and strongly disagree: -2) and then averaged them. A weighted agreement index above 1.00 would indicate a consensus that age was an important variable for that service category and age group; an index of 0.00 or negative would indicate a consensus of skepticism about the importance of age for that service category and age group.

Table 3a	Question: Please indicate the level of your agreement with the use of variation by age when developing rates for people age 50 to age 64 in the following health categories:				
Category	Responses	Strongly Agree	Agree	Other	Weighted Agreement
Hospital	18	44%	39%	17%	1.22
Physician	18	44%	39%	17%	1.22
Prescription Drug	18	33%	50%	17%	1.06
Dental	16	0%	19%	81%	-0.50
Vision	17	0%	35%	65%	0.00
Nursing Home Care	13	23%	46%	31%	0.85

Table 3b	Please indicate the level of your agreement with the use of variation by age when developing rates secondary to Medicare for people age 65 to age 90 in the following health categories:				
Category	Responses	Strongly Agree	Agree	Other	Weighted Agreement
Hospital	18	50%	33%	17%	1.33
Physician	18	44%	39%	17%	1.28
Prescription Drug	18	28%	55%	17%	1.06
Dental	17	6%	6%	88%	-.47
Vision	17	6%	18%	76%	-.06
Nursing Home Care	14	50%	29%	21%	1.21

The survey respondents chose various levels of agreement with each of the categories, but as a group, felt that the most likely categories where age was a significant variable were hospital and physician from ages 50 to 90 and nursing home care from ages 65 to 90. Nursing home care from ages 50 to 64 and prescription drugs for the whole age group were also thought by most to be categories where costs and utilization would vary with age. There was considerably less agreement that dental or vision services were consistently used at different levels within the older ages. One actuary commented that a data study had shown that dental costs decreased at older ages. Other than dental and vision, however, respondents believed age to be a significant variable.

In addition to the general opinions about aging within health care categories, four actuaries submitted aging curves with variations by service and three others responded that they used such curves. These responses, plus anecdotes from the interviews and the positive responses to the question of whether there was age variation in the health categories of hospital, physician, prescription drug and nursing home care, create a picture that is clear in outline. Seasoned health actuaries feel that aging is a significant influence on health care costs for the senior population, across a variety of goods and services, but the influence on costs is itself affected by the health category used.

While the picture is clear in outline and shows the need to take aging into account in actuarial calculations about health costs for seniors, exact consensus on aging curves does not emerge. Much detail remains to be quantified and might never achieve the accuracy one would hope for. The current study simply furnishes some parameters and considerations.

The consensus from the four submitted curves that accounted for variations in service category is that, above age 65, the aging curve is steepest for inpatient hospital services, followed by physician services, and then prescription drugs. Medicare covers the first two items and the steepness hierarchy matches what was found in the Medicare analysis, although the actual aging factor assumptions were different in every curve submitted. (These differences in assumption should not be surprising: only two of the 21 general aging curves submitted were identical and they came from the same office. Other survey responses of two or more actuaries who were in the same consulting firm always resulted in different aging curves.) The data analysis does not result in convergence.

Thus, consensus has not formed on the specific factors for general aging curves. As the one respondent suggested, this may be due to component parts that are, over time, shifting in their proportional relation to each other. One could conceive that, while the aggregate curve is shifting, the aging curves of the underlying components (such as hospital, drugs, etc.) are relatively stable. Analysis of the curves for the component services, however, does not yield consensus on specific factors.

Responses were too few in any one category of service to give much credibility to any conclusions, but one example may be instructive. The only category for which all four respondents furnished a curve was for prescription drugs over age 65. All used a zero factor above age 85, but, for each of the four five-year age bands between age 65 and 85, the suggested factors differed by at least 2.7 percentage points. When the high outlier was removed, the other three showed some convergence for the age 65 to 69 group, with all three factors between 2 percent and 3 percent, but showed divergence at later ages. (To say that the composite of the responses received is not of high credibility should not be considered a judgment on the credibility of any one aging curve. It may be that one or more of those curves was based on 100,000 lives at each point for each of 10 years while another was based on a random number generator; this study did not delve into the credibility of databases and conclusions, beyond what the respondents volunteered.)

A Representative Curve for General Use

The lack of consensus then appears to the author to be caused not by different approaches or opinions about the analysis of data, although that may exist, or by the effects of a changing health care system, although that may turn out to be a significant factor over time, but rather by different data showing different patterns. Again, this should not be a surprise to anyone who has viewed health care data closely. Two different groups of demographically identical members will produce different illness and treatment patterns. The variety of human behavior and illness is probably not susceptible to one-size-fits-all management controls on treatments anywhere, but especially not for a market system that celebrates the freedom of its medical practitioners and has disparities in access to care. Actuaries looking at cost and utilization data for one group are likely to find different relationships age-to-age than the same actuaries examining costs for a demographically similar group of seniors.

But the randomness is within limits and therefore is not really random. Given those 100,000 lives at age x, a valid estimate of their health care cost and utilization at age x+1 can be made if their cost and utilization at x is known. Similarly, credible utilization data for a group at age x can lead to a valid estimate of the utilization at the same time of a different group at age x+1 if the two age groups come from the same general pool, i.e., no operative selection or underwriting factors signify differences, other than age, between the two groups. (All of the experience studies were based on this second type of comparison; no one was aware of a longitudinal study that followed a closed group of individuals over a number of years.)

The author has chosen the following aging curve as representative for a group of retirees:

Age Band	Representative One Year Aging Factor
50-54	3.3%
55-59	3.6%
60-64	4.2%
65-69	3.0%
70-74	2.5%
75-79	2.0%
80-84	1.0%
85-89	0.5%
90+	0%

The representative curve is neither an average of all those submitted, nor any single curve submitted that would serve as middle ground, nor a consensus that all respondents have embraced. Rather, this curve is an interpretation of the collective response of those answering the survey, influenced by survey comments and later discussions with respondents as to nuances and credibility that could not be apparent in the examination of the numerical aging factors submitted. This is a curve the author feels that the responding actuaries might have agreed to if they had sat around a table and come up with a single aging curve for retired seniors.

The representative curve is, however, close to the average of the 21 responses, being within two-tenths of a percentage point for six of the eight age bands. For the other two age bands, between ages 60 and 70, the representative curve is higher than the 21-response average because the aging factors submitted by actuaries who had more recently analyzed experience from large employers were higher than the 21-response average. As a measure of the responses to which more credibility was assigned, an eight-response average was also determined from their eight aging curves. The representative curve is within thirteen hundredths of a percentage point for the eight-response average in every age band except the age 85 to 89 band, which the eight respondents felt was relatively insignificant, if not negative.

While the representative curve is a close fit to the survey answers of the respondents, this does not make the curve a good fit for any one particular situation. Indeed, it may not be a good fit to any situation, because the survey did not attempt to elicit the situation for which the actuaries thought their aging curve response was appropriate. Early on it was decided the survey would receive more useful information by not defining too narrowly the situation to which the aging curve would be applied. Comments submitted with returned surveys, and later interview remarks, confirmed that numeric responses could differ in innumerable ways. Averaging responses to the general inquiry, then, undoubtedly involves some mixing of apples and oranges. The result from such averaging is not necessarily appropriate to any situation.

Along with the differences in service category already referenced, there are other variables such as age, gender, disability and employment status. There may also be differences not mentioned in the survey or paper. The dynamics of the health care seem to consistently produce new variables, although clarification may come from further study of age-related utilization.

Before going on to the differences, however, it is worth noting that the survey gives a significant consensus answer to the question that prompted the study. At some point after age 70, many age factors begin to decline, and by age 90 they are insignificant for some major categories of health care service. Whether that will remain true will continue to be subject to analysis. It may also change with changes in Medicare, since above age 65, much of the surveyed data is derived from claims secondary to Medicare.

Variance under age 65

In terms of variance of the representative curve from the average, it was greatest over age 80 and under age 65. Differences of opinion on the meaning of data above age 80 are not surprising since that is where the fewest data points are available. Some of the variance under age 65 was identified as being due to the active/retiree distinctions mentioned earlier. Several actuaries noted the complex mix of variables affecting aging factors for the years from 50 to 65, when employees are retiring in the highest proportions and when disabilities are also likely to be most prevalent among employees. An aging factor derived from active employees and retirees of the same age may not be appropriate for use with a retiree-only group, but data from retiree-only groups is subject to a good deal of self-selection influenced by employer retirement policy during these years before Medicare eligibility becomes effective.

Actuaries trying to determine health rate structures for retiree groups under the age of 65 mentioned the following problems that affect both absolute cost and utilization levels as well as the aging factors:

1. If data comes from an employer, Employer A, that encourages early retirements, aging factor assumptions derived from that data may not be appropriate for an employer, Employer B, that does not encourage early retirement. The retirees for Employer A are likely to be healthier than those of the same age retired from Employer B. By age 65 and beyond the distinction might disappear, but for the ages before that Employer B retirees would be expected to have higher claims and a flatter aging curve.

2. If data comes from an employer, Employer C, where early retirements are encouraged earlier than they are at another employer, Employer D, the aging curve from Employer C may not be appropriate for Employer D. The retirees for Employer C are likely to be healthier than those of the same age retired from Employer D, up to that age where retirement from Employer D is encouraged. For example, if Employer C has a significantly higher proportion of retirees at age 50 to age 60 than Employer D, the retirees of Employer D in that age group are likely to have higher claims and a flatter aging curve leading up to age 60, after which the curves and rates might be expected to be parallel.

3. If data comes from an employer, Employer E, where disability retirements are more prevalent than they are at another employer, Employer F, the aging curve from Employer E may not be appropriate for Employer F. The retirees for Employer E are likely to be less healthy than those of the same age retired from Employer F and the aging curve flatter up to normal retirement age, and possibly beyond.

4. Further complicating matters, the effect of disability on the health cost of the disabled is very significant, but tends to diminish over time, and may cause the employer plan to be the secondary insurer. The employer plan becomes secondary

if the disability is serious enough to warrant classification as disabled under Social Security, at which time Medicare becomes primary health insurer, regardless of age, after a disability of at least 29 months. Ironically then, the more severely disabled retirees may be less costly for the employer than other disabled retirees.

5. Dependents who are covered by the employer plan are not expected to have their health costs affected significantly by the disability or retirement status of the retiree. Also, dependents more often than not have a different age than the associated retiree. To the extent that the cost of dependent coverage is substantial and the claims experience is not segregated from that of the retirees, the effects mentioned above are likely to be mitigated by the dependents' experiences. This assumes it is within the actuary's power to segregate the data. The coding of dependents' claims is sometimes systematically not separated from that of the retiree and then the resulting data may hinder an understanding of the effects of aging.

Such variations in data for the age 50 to 65 age group indicate that variance from the representative curve shown above can be expected to be greater for these ages than for later ages, for quite legitimate reasons.

The curves submitted in response to the general question varied by as much as 3.5 full percentage points for the eight five-year age bands surveyed. More generally, the percentage point variance was about two points for ages 50 to 65, 1.5 points for ages 65 to 80, and above two points over age 85. This does not mean that aging factors outside this range would not be legitimate.

Male/Female Differences

Among other variable circumstances, those identified most often were sex and medical service category. Of the five who furnished separate male and female aging curves, all thought the male curve to be steeper between ages 50 to 64 with percentage point differentials of from six tenths to 3 percentage points. One actuary furnished an example showing that if the level of the female cost was far enough below the male cost at a younger age group, say 45 to 49, then the female curve was likely to be steeper than the male curve in the following years. While such a relation might exist in isolated cases, none of those responding with male/female aging curves indicated female aging curves that were steeper than the male.

Above 65, no one indicated the female should be steeper, but the differential addition for the males decreased from between half a point and 1 point at 65 to 69 to nothing at later ages. One respondent thought the difference due to sex went away after 70, others at later ages. This did not necessarily mean that male and female rates were the same, it might simply mean that the proportional relationship stabilized after a certain age. Many of the respondents would agree with this comment from one of their colleagues: "Retired males aged 65+ tend to have a slightly stronger aging factor than females. This tendency diminishes as age increases."

Specific Medical Service Categories

The relationships between the aging curves submitted by medical service category were more varied. There were just four of these, and one addressed only prescription drug costs. The extent of variation in the four prescription drug curves was commented upon earlier. When comparing the aging curves submitted by medical service category, this variation in prescription drug curves meant that there was no consensus about the comparative steep nature of the curves. Two of the sets of curves submitted placed the prescription drug curve as the least steep of the medical service categories. An actuary who did not submit curves by category supported this with a comment that the prescription drug curve was flatter than the others. One actuary, however, submitted curves that showed prescription drug consistently above the curves for physician and outpatient hospital charges, although below that of inpatient hospital charges. The prescription drug curve of the actuary who submitted no other medical category curves was above the main composite curve submitted by that actuary, as well as above the representative curve.

The lack of consensus about the aging curve for prescription drugs may be attributed to the dramatic changes taking place in the health care arena as drugs take a larger portion of resources devoted to health care and as employee benefit plans change in a multitude of ways in reaction to the increased prominence of prescription drugs. More so than other medical categories, the cost analysis of prescription drugs in recent years has depended on what data was looked at and when it was analyzed. Also, the assumption that prescription drug usage will, in the future, be distributed across age groups more evenly than inpatient utilization, and thus have a flatter curve, is challenged by the possibility of drugs that will prove an effective and attractive treatment for medical problems associated today with one particular age segment. Differences in the submitted curves may stem from past drug introductions.

The three submitted curves that contrast inpatient hospital with other services all show inpatient hospital as the steepest curve at all ages. This mirrors what is seen with the Medicare data and is consistent with the survey results shown in Tables 3a and 3b, where responding actuaries rated aging variation as most significant for hospital coverage. (One actuary did note, however, that if a nursing home care aging curve had been available, it would be significantly steeper than any of the others, which would also mirror Medicare data analysis.) The excess of the hospital curve over their main curve was greatest in the age 65-70 band, with two showing variances of more than 3 percentage points. At each of the other age bands one or more of the respondents indicated that the hospital excess was at least 1.2 percentage points, although none indicated more than a 2 percentage point excess.

One respondent was surprised that the inpatient hospital aging curve for those above age 65 was not flatter. He reasoned that the coverage is secondary to Medicare and the main liability for secondary coverage is often associated with the Medicare deductible, which does not vary in amount by age. But analysis of the Medicare data for Part A, cited at the beginning of the paper, shows that while hospital costs increased steeply with age, the increase was due much more to frequency of hospitalization than intensity. More frequent hospitalization means more frequent payment of the Medicare deductible by the secondary payer and is in conformance with a steep aging curve. A flatter aging curve might fit secondary hospital coverage with high deductibles and a carve-out approach to Medicare integration.

The survey asked whether, for a plan with significant deductibles and co-pays, the actuary would use a different aging curve than for the same plan coverage with no deductibles and co-pays. There was no consensus to the answers, and there was even less agreement on the question of whether a different aging curve would be used for a managed are plan than for the same coverage unmanaged. The extent to which an actuary would view the leveraging effect of cost-sharing provisions as also having a substantial impact on aging might depend on the circumstances of a case. It should also be noted that all responses were based on rates before retiree contributions. Since contributions during any given period almost never vary by age (other than over and under age 65), the net effect if contributions were subtracted would show age to be an even more significant factor.

For the aging curve for physician charges, the three submissions concurred that the aging factors were lower than those of the main composite curve and the curve was flatter than the main curve. The age band where the physician curve was closest to the main curve was ages 65 to 70, which was also the age band where one respondent placed the physician age factor as higher than the corresponding composite curve. One actuary never put the physician curve more than a full percentage point below his composite curve; a second was as low as 2.2 percentage points below; the third was in between and felt there were no differences after age 80. Nonetheless, none of the responses showed a negative aging factor for physicians at any point.

These conclusions from the survey responses should be taken merely as suggestions of what might be found if the response sample had been larger. The lack of consensus among the prescription drug curves submitted might have been clarified with a larger sample. On the other hand, larger samples do not always confirm the findings of small samples. The seeming consensus that inpatient hospital utilization and costs rise more sharply with age than do physician utilization and costs is likely to have been reinforced with a larger sample, but it might possibly have been less conclusive, or even reversed, if more curves had been submitted.

The sample is small because the majority of respondents did not submit separate aging curves distinct by sex or medical category. Of those who did not, some acknowledged in their responses that specific differences existed. Many who submitted only one aging curve would probably have some hesitation in applying that curve to a male-only group or a benefit plan that covered only prescription drugs or only inpatient hospital charges.

Yet, many do not distinguish by sex or medical category when quantifying future health care costs, particularly for retiree health benefit projections.

The reasons for not using distinct curves by gender or medical category vary, but might fall under two main headings: lack of data availability, and doubt that significant additional knowledge would result from the additional effort needed to determine, with sufficient credibility, a second or third aging curve assumption. To phrase it another way, the cost of additional curves outweighs the benefits likely from their use.

Comparing Curves

This paper can be useful to actuaries considering additional curves. The survey results discussed above, though limited, give some sense of what might be found if data becomes available distinguishing between aging curves for males and females or among medical categories. An earlier section of this report, which quantified the effect upon financial results of differences in aging curves, may aid the practitioner in deciding whether the use of separate aging curves could quantify important information not available without those additional aging curves.

As an example of the considerations that might go into deciding whether to use an aging curve (or to use a second aging curve), the discussion below examines use of the 3 percent aging curve as it might be complemented or supplemented by use of the curve referred to as the representative curve. The 3 percent curve, which is one long geometric progression between ages 50 and 110, is contrasted with a curve that is more variable, having different geometric progressions in five-year age bands, resulting in a more gradual but still significant 42 percent increase between ages 65 and 80, with a relatively insignificant increase (7 percent) above age 80. Table 4a shows what the differences between results from the two curves might be if all other inputs and assumptions stayed the same. The format of the table is the same as that of Table 1 earlier, exhibiting several measures of comparison and showing the results for each curve compared to a baseline result with no aging. The results for the curves can then be compared to each other. The most significant of the measures is that of accumulated value without discount but with mortality. UP94 Female mortality was again used.

Table 4a Ratios of Values with Aging Compared to No Aging				
Measure of Comparison	Aging Curve	50	Initial Age 65	80
Single Year Value at Age 110	Rep	2.60	1.51	1.07
	3%	5.89	3.78	2.43
Accumulated value without mortality or discount	Rep	2.13	1.40	1.06
	3%	2.72	2.06	1.59
Accumulation with UP94 female mortality (no discount)	Rep	1.82	1.29	1.04
	3%	1.82	1.45	1.21
Present Value with 6% discount	Rep	1.51	1.22	1.04
	3%	1.45	1.30	1.16
Present Value with 4% discount	Rep	1.59	1.25	1.04
	3%	1.55	1.34	1.18

All the measures show that above age 80, a change to using the representative curve adds only a little to the value when compared to ignoring aging but would more substantially mitigate the effect of aging when compared to the 3 percent curve. Above age 65, the effect is significant in relation to no aging factors, although less so than use of the 3 percent curve; most of the effect is before age 80. For a 65-year-old, the ratios under the accumulation-with-mortality measure are 1.29 for the representative curve and 1.45 for the 3 percent curve. The difference implies that accumulation results under the representative curve would be 89 percent (1.29 / 1.45) of those under the 3 percent curve, before applying trend and discount. Above age 50, the effect of the representative curve is very significant when compared to ignoring aging. The ratio is the same as the 3 percent curve, 1.82, under the accumulation-with-mortality measure. This means the result would be approximately equal in the valuation of a 50-year-old under either curve. But the fact that the ratios are not equal under any of the other measures indicates that for other ages, or a mixed group, or with trend or discount, the effect would be more varied.

An earlier section analyzed the fit of aging curves to existing claims experience by viewing the effect of changes in the age distribution of retired plan participants. The hypothetical situations illustrating the different results assumed participants were gathered in two groups of equal number at the endpoints of a specified age distribution. This assumption exaggerates the distribution but allows the effect to be illustrated more easily and is used again in Table 4b. The ratios are again those comparing the accumulated values with the aging curve to those without an aging curve, but now the Representative Curve is shown alongside the 3 percent curve and the distributions are extended in 10, 20 and 30 years around the following three central ages: 80, 70 and 60.

Table 4b	**Effect of Expanding Age Distribution**	
Claims History	*Aging Curve*	
Age Distribution	***3%***	***Representative***
Age 80 only	1.21	1.04
Ages 75 to 85	1.17	1.05
Ages 70 to 90	1.08	1.05
Ages 65 to 95	.95	1.06
Age 70 only	1.36	1.19
Ages 65 to 75	1.33	1.17
Ages 60 to 80	1.24	1.15
Ages 55 to 85	1.11	1.11
Age 60 only	1.56	1.47
Ages 55 to 65	1.53	1.42
Ages 50 to 70	1.44	1.34
Ages 45 to 75	Not Applicable below age 50	

Several patterns emerge from Table 4b. The use of either curve would result in ratios above 1.0, meaning a higher valuation result than without use of aging, with one exception (ages 65 to 95) discussed in a previous section. Disregarding that exception, a change to the representative curve from the 3 percent curve would lower the valuation result. All other things being the same, the lower the central age, the more either curve increases the valuation result, relative to ignoring aging. A pattern emerges that the wider the age distribution, the lower the ratio, with the exception of the behavior of the representative curve around age 80. For this exception, the wider age distribution leads to a slightly higher ratio. This can be seen a little more clearly when the distribution ratios are split between the initial warp effect and the spread effect stemming from the long-term projections.

Table 4c	Two Effects of Expanding Age Distribution					
Claims History	*Aging Curve*					
Age Distribution	***3%***			***Representative***		
Effect	Warp	Spread	Accumulation	Warp	Spread	Accumulation
Age 80 only	1.000	1.208	1.21	1.000	1.041	1.04
Ages 75 to 85	.989	1.185	1.17	1.020	1.027	1.05
Ages 70 to 90	.958	1.124	1.08	1.064	.988	1.05
Ages 65 to 95	.909	1.047	.95	1.129	.936	1.06
Age 70 only	1.000	1.357	1.36	1.000	1.185	1.19
Ages 65 to 75	.989	1.340	1.33	1.004	1.168	1.17
Ages 60 to 80	.958	1.291	1.24	1.028	1.118	1.15
Ages 55 to 85	.909	1.219	1.11	1.063	1.046	1.11
Age 60 only	1.000	1.557	1.56	1.000	1.474	1.47
Ages 55 to 65	.989	1.544	1.53	.977	1.456	1.42
Ages 50 to 70	.958	1.506	1.44	.949	1.407	1.34
Ages 45 to 75	Not Applicable below age 50			Not Applicable below age 50		

The spread effect decreases with every widening of the age distribution around the central age. In the oldest age group for the representative curve, centered on age 80, the warp effect and the spread effect are essentially turned around from what is seen with aging curves that are a consistent geometric progression, like the 3 percent curve. The warp factor is above 1.0 and the spread factor moves below 1.0 when the age factors for ages under 75 come into the equation. Those age factors (2.5 percent per year between 70 and 74, 3.0 percent per year between 65 and 69) are not relatively high when contrasted to most aging factors discussed in this paper, but stand in contrast to the flatness of the curve above age 80. The accumulation factor that is the product of warp and spread factors hardly changes at all, even though the two components are changing about as much in this situation as they do in the other situations. The fact that the warp factor exceeds 1.0 indicates the age-adjusted claim rate at the average age is above the average cost. In other words, the aging curve is above the average cost in this range, rather than below it. This has an effect on the initial year (i.e., the warp factor) but also on the longer term, since the addition of older lives in a wider distribution adds less to accumulation when the curve flattens out in that older age range. Younger lives below age 75, in contrast, are still in a part of the aging curve with a steep slope. Their addition lowers the average accumulation and the spread factor is actually below 1.0

The usefulness of these additional measures, here called warp effect and spread effect, is not clear, but they are presented as possible keys to a fuller understanding of the aging curve. As noted previously, the warp effect can be said to measure a one-time effect of fitting an aging curve, while the spread effect is more of a long-term measure of the projection effect. In the short term, different aging curves can be fitted to generate the same claims total in a one-period model. In the multiple period model of a retiree health projection, however, the participants grow older, may die or otherwise become ineligible, and may be joined by new entrants. As a result of these changes in demographic makeup of the participants, the different aging curves generate different long-term accumulations.

Conclusion

An actuary measuring retiree health benefits needs to be aware of the potential change in long-term accumulations due to the effect of aging assumptions. Actuaries and others dealing with the provision of health care to large numbers of older people for long lengths of time also need to be aware of the implications of aging on financing and resource allocation. The analysis and survey results discussed in this paper indicate that the financial implications of ignoring the aging effect in long-term projections can be significant. They also indicate a general consensus about the shape of aging curves can be gathered, both from Medicare data and from the data of plan sponsors, but the consensus may be less important than it first appears. Substantial differences emerge when data about health care and the people it serves are examined in detail. The effect of age on health care cost and utilization for older Americans differs by medical service categories and, in the opinion of actuaries surveyed, is probably affected by gender, disability status and retirement status.

The evidence gathered, statistically and anecdotally, does not support the pleasing hypothesis that a simple algorithm or formula can be used to universally describe the effect of age in the area of retiree health care. Significant differences by medical service are seen in given age categories. Nursing home care is most affected by age, while dental care and vision care are least affected. With the exception of nursing home care, the aging factors associated with all the other services appear to decrease with advancing age, although not in a uniform way. Some actuaries surveyed believe aging factors that are negative, i.e., leading to lower costs with age, come into play at advanced ages with some services.

The paper puts forward elements for an actuary to take into account when analyzing the health care costs and utilization of an older population. A desirable outcome for this study originally was a generic aging curve, at least for some category of care. The reality, however, is that the aging effect is influenced by so many variables that it was neither feasible to establish a credible data base for such a generic curve nor desirable to advocate one. As with many health actuarial numerical relations, the aging curve seems to be a moving target. This paper cannot cover all distinctions and, thus, is not a definitive study. It can, however, provide a published touchstone that will take the aging curve from the realm of black-box magic to a topic of open discussion and accumulating public knowledge.

Changes in the age factors over the years can be seen in the Medicare data, although that may be a function of changing plan designs. Many actuaries working with private plans, however, also have changed their factors in recent years. This shifting of factors leads to the question of whether aging curves will shift over time in a way that is somewhat predictable, similar to mortality experience. The answer to that question has enormous consequences for a nation, and a world population that is witnessing longer human life spans and must plan the allocation of sophisticated resources to meet new health care challenges. Further monitoring of the analysis that actuaries carry out as they hone their projection models may help identify the financial and economic implications of an aging society.

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