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Session 18PD
Mortality Trends and Patterns

Track: Product Development

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Summary: This session discusses how insured mortality has changed during the past 30 years, which published mortality tables are most appropriate to use in today's pricing environment with the proliferation of preferred risk plans, what factors have historically contributed to mortality improvement assumptions, and how underwriting requirements should be coordinated with setting pricing assumptions.

MR. RICHARD L. BERGSTROM: I'm with the Seattle office of Milliman. I've done a lot of work in my career in mortality and underwriting-related issues and risk assessment, and I thought it would be kind of interesting to have a session like this. Oftentimes, we as actuaries do not have time to put stuff together ourselves, to recognize how mortality has changed in days gone by, where it is now, the importance of using certain tables, or maybe not using certain tables in the pricing of products, that we do.

So, my first presentation will necessarily include a lot of numbers. Our second presenter is Saul Gercowsky. Saul is currently at Manulife Reinsurance in the retrocession, research and development and inforce management area. He studied actuarial science at the University of Western Ontario and after graduation worked at North American Life until ITS merger with Manulife. Since then, he has worked in

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Note: The chart(s) referred to in the text can be found at the end of the manuscript.

a variety of areas at the company, including product development and corporate actuarial.

Our third presenter is an underwriter, Anna Hart. She is an independent consultant. She has been consulting on her own now for about three years. I've worked with Anna on a variety of projects involving underwriting and risk assessment. She is also on the Mortality/Morbidity Liaison Committee. It's an SOA standing committee, which I'm on as well. She's also the secretary of the Individual Life Experience Studies Committee, which is the committee that puts together the mortality experience and tables that we all use. Prior to becoming a consultant, Anna worked for EMSI in Waco, Tex.

One thing I want to just touch on briefly is some of the historical tables that we have used. Obviously most everybody in this room is familiar with the 1975-80 tables. Many companies in their pricing, even for preferred products, are still using them. I did not put up the 1985-90 table in this presentation. Those tables were generated in about 1997, and were published shortly thereafter. But within a year, the 1990-95 tables came out, and I don't know of too many companies that are actually using the 1985-90 tables themselves.

Is anybody in this room using 1985-90 for pricing? How many people are using 1990-95? There's one very proud person over there. There are two. How many people are using 1975-80? Therein lies the rub. Several years ago we came out with the 2001 valuation basic select and ultimate tables. The difference between the valuation basic table and the other two basically is that it was designed with the 2001 CSO table in mind. So, that's why we don't call it an experience table.

The 1975-80 tables were the first tables to provide experience on nonmedical, paramedical and medical bases. The issue age range was zero to 70 with a 15-year select period. There have been a number of companies and consulting firms that have modified that table to go to higher issue ages, and also I've seen 25-year select periods on those. So, there are a number of versions of this table floating around. One of the biggest problems I've noticed is if companies want to use 1975-80 as the basic table for pricing, once you get past Duration 15 and enter into the ultimate table, there can be a large disconnect there, as you'll see. If you've not looked at that before, you'll see what I'm talking about when I say large, particularly at the older ages. Another thing—the slope of the '75-80 is really quite flat compared to what recent experience has been showing us.

The 1990-95 tables used a 25-year select period. While the underlying data did not have experience in the very old issue ages, there was an extrapolation made out to issue age 99. The ultimate table goes out to age 120, and there wasn't much information available there either at those ages. So the ultimate table was an extrapolation of a couple things, mainly ultimate mortality. I think the age 120 was probably just pegged as the terminal age.

There are two independent tables: the ultimate and the select. The older issue age select mortality was basically an interpolation between what data they had in the early durations and the ultimate table. If you think of the table as a matrix, there just was not a lot of data down in the bottom part of the table at the high issue ages and high ultimate ages. So those mortality rates are not based on real data. It's our best guess and what we thought might be representative of what mortality would look like.

There was no smoker/nonsmoker table published. Instead, there was a series of factors created based on early duration experience. For the first 10 durations, there were factors between the ages of 20 and 72 based upon actual experience, and, of course, some companies and consulting firms have extended those factors out to later durations so that we can, indeed, have a smoker/non-smoker version of it, but the SOA did not publish a version of that. There was experience collected on paramedical, nonmedical and medical bases. We did not create tables for those either, but one thing we did look at was business experience by policy size. I think we actually had a group for the under-$25,000 policy sizes. I don't think we published factors on that, but we did have the experience. Certainly there were factors created for under $100,000, $100.000 to $250,000 and $250,000 and up. Like the smoker/non-smoker factors, they were simply factors.

I think policy size was one of the ways we wanted to look at paramedical, medical and nonmedical. The correlation didn't work out like we thought it might, and the reason for that mainly is because many companies are still writing nonmedical business for the younger ages well above $100,000. So, while that was our attempt, it didn't work out like we had hoped, and we just left the factors as they were. One of the other interesting things about 1990-95, at the younger male ages, between about 15 and 30, the mortality experience in duration 7 and higher was really quite poor over this exposure period. The biggest problem we found was that where we were seeing some emerging AIDS claims, and, in fact, as a percentage of 1975-80, the male experience beyond about Duration 6, issue age 25, for example, is actually quite a bit higher than the 1975-80 experience. We ended up with this mortality "hump."

The 2001 valuation basic tables (VBTs) were actually created from the 1990-95 experience tables. Because companies were now testing fluids at the $100,000 level or below, we felt on an ongoing basis we would not have quite the same experience or the same problem in trying to recognize the influence of AIDS. So the Academy committee that put this together flattened the AIDS hump. They minimized it by capping mortality at a certain amount of 1990-95 to create the basic table. From the 1990-95 experience, they also projected mortality forward to the year 2000 or 2001 using some projection factors. Again, this was to be used as the basis for the valuation table; in creating the actual tables there was more of an emphasis on smoothness as opposed to fit. So they tried to minimize some of the discontinuities that can happen between certain ages and durations.

The ultimate table again was created separately and had a variety of sources that the committee looked at. Of course they looked at whatever insured experience we had, but feeling that that was not totally representative or credible enough at the very old ages, they looked at such sources as the Railroad Retirement Board mortality and the Veteran's Administration mortality. So they looked at a variety of sources to develop an ultimate table. Finally, they extrapolated the issue ages out to issue age 99, but there is no selection, though, at issue age 99. The 25-year select period started grading down to 24, to 23 to 22, as issue age went up from 74 to 75 to 76. So, by the time you get to issue age 99, there's no selection.

I want to look now at some mortality ratios, and I'll try to minimize getting into a lot of detail about the specific numbers except where I think it's important to prove a point. I'm going to show the ratio of various issue age mortality rates. In fact, I pegged Duration 10, and I divided it up by Duration 1 mortality for that issue age for both the 2001 VBT and the 1975-80. So, these are ratios of ratios.

I realize there are a lot of numbers in Chart 1. The important thing I want to point out is in this column under Duration 10, all these numbers are ratios of these ratios. The 152 percent number, for example, indicates to me that the slope of the VBT is 50 percent higher than the slope of the 1975-80 for that issue age. And you can see at 35 there wasn't too much difference, but then it creeps up again back up to 152 percent at issue age 70. So, that's just a comparison of the tables and the differences in slopes in those tables.

We now look at the new 1995-2000 experience (Chart 2). Compared to the 1975-80 tables, the new 1995-2000 experience, when looked at by policy year, starts out quite nicely at 47 percent in Durations 1 and 2, but then look at what it does here. That's quite a difference. If companies wanted to use a flat percentage of 1975-80 to price a product, if future experience is really going to conform to this pattern, there is a lot of implied mortality improvement built in by using the flat 1975-80 table. You'll notice this number here. This is where the select table bumps into the ultimate table. And then mortality continues to go up, but you can see there is quite a sloping of the recent experience compared to 1975-80.

I get questions oftentimes by people writing very simplified issue products or maybe even guaranteed issue products, but maybe one health question. What's an appropriate table to use? Shouldn't we use an ultimate table? Or maybe we should use a population table? Let's see what the difference in mortality is between the 2001 VBT ultimate and the 2000 U.S. life tables, and here are what the ratios are by selected attained ages. This is for females (Chart 3). The females' insured mortality never gets up as high as population mortality, even at age 100. Now what happens is the U.S. population tables kill everybody off at age 100. So that number doesn't mean anything. It's probably something like 0.3 or some number there, but that's not what they do. You can see kind of a dipping down and then the grading back up again.

As for males there is quite a lot of difference here (Chart 4), because the male ratios of VBT to U.S. life are quite low, half, at these attained ages here, and then start creeping up and actually do, indeed, hit the life table mortality rate at age 95.

What I've done here is just look at aggregate mortality ratios during the select period from exposure year 1983-84 up to recent (Chart 5). I broke it down by medical, paramedical and nonmedical, so you can see some interesting things happening there. This is the combined of these risk classes here. Back in 1983-84, you can see that the actual experience was pretty flat. It didn't matter whether you were nonmedically underwritten or paramedically or medically. It's pretty flat. That tends to change once you start running into the issue with AIDS. In fact, there are a couple of years in here where the nonmedical experience is actually as good as or better than some of the other risk classes, which doesn't make a lot of sense on the surface.

If we look at what paramedical mortality has done over the years, it's gone from 92 percent down to 58 percent. Nonmedical has improved, too, but not as much, and medical has improved as much or more than paramedical experience. These are the exposure years from which we got the 1985-90 tables, 1990-95 tables, and although we're not coming up with 1995-2000 tables, we do have the experience to look at. Does that mean the mortality is improving that much? That's not necessarily true. The improvement is oftentimes based as much as, if not more, on the mix of business of companies and what their mortality looks like.

This is not a homogenous set of the same 20 companies, for example. There could be some overlap of companies between these, but by and large there are a lot of different companies in each of those sections for each of those years. So, I'm not going to say the mortality has gone from 92 to 59 in 20 years, but that's an interesting pattern. There's a pattern in the middle here where the actual paramedical mortality was really better than medical mortality, again during these same years from which the 1990-95 tables were published.

Chart 6 shows you what the distribution of issues looks like from the prior chart. You can see that in 1980 it was pretty uniform, about as much in any three of the risk classes. In 1986, more than half of our business by policy count in that exposure year was nonmedical—almost 60 percent. Also we run into the AIDS issue again. Companies started dropping their testing limits from about $1 million. It was very common in 1985 and prior to have $1 million limit before you even did blood testing. By 1987, it was $100,000. It came down that fast for many companies. And, of course, what happens is to collect blood, at least, you need a paramedical, and so the amount of business issued paramedically jumped by 50 percent in that eight-year period of time. We didn't change the medical much, but where that increase came in we lost in the nonmedicals. So that just gives you an idea of what the exposure is and has been by risk class.

I have a couple of observations that I thought would be important because

sometimes we don't think too deeply about how we choose a table. We're thinking more about the percentage of the table we have, but on an overall basis the pattern of assumed mortality that you use should reflect the underwriting requirements for the plan in question. That's just something obvious but maybe something we don't spend a lot of time thinking about. Some other observations: Preferred risk plans will have steeper mortality slopes in the best risk classes than their standard cohorts or certainly for simplified issue plans. Simplified issue plans will have, I say, a shorter selection period than fully underwritten plans, even if you use the 1975-80 tables.

If you ask one health question or maybe two health questions or maybe one takeout question such as, "Have you ever had AIDS?" you're not going to get a 15-year select period. One way to shorten the selection period is to start out using an issue age five years younger, but then start my mortality at Duration 6. That creates a smooth table. It makes a 10-year select table, and then you use the ultimate after 10 years. So, that's a way to at least get started in the select period other than just guessing at it.

Some plans will certainly have early antiselection. That antiselection is probably best represented not by a percentage, like a table, a percentage of tabular mortality, but by some kind of a flat extra. In other words, some of the plans that I've seen, the mortality really is almost age-insensitive, and so a better way to describe the pattern is to use a flat extra in the early durations and then run that flat extra off after a few years. That's why I made my comment about 1975-80 being too flat. They certainly are too flat in my mind for preferred risk plans. You saw the mortality experience going from 47 percent to 70-some percent. So, unless you want to inherently include a lot of mortality improvement in that mortality assumption, you really can't use a flat percentage of 1975-80 in my mind.

Issue age mortality: I thought this was important. I took two specific exposure years in a recent study, 1995-96 and 1999-2000 (Chart 7). I just wanted to see if I could depict any patterns of mortality improvement by issue age. This happens to be for both males and females and smokers and non-smokers, so it's a collection that way. I'm comparing it to the 1975-80 tables. Overall we can see that during that four-year period, mortality "improved" 10 percent, but it sure didn't do it on a very consistent basis. We have evidence here that it didn't improve at all at those two issue ages. It went the other way. This is just one year's exposures. You can draw your own conclusions from that chart.

Getting back to the disconnect in 1975-80 tables, I did a ratio of Duration 15 to Duration 14 at certain attained ages, right before you enter the ultimate table, and the Duration 16 to Duration 15. Well, at the younger attained ages they're pretty consistent. Mortality went up 12 percent in there; it went up 13 percent there, but as you get down to the older ages (this is for males aged 80-85), this is what you do. Mortality is increasing at 113 percent or so in the durations prior to that. All of a sudden you enter the ultimate table, and you're at 150. For attained age 85, it's

even more pronounced. Mortality is increasing at about 110 percent, and now you're up to 151 when entering the ultimate table.

If you look at the same thing for females, you're okay down here in the younger ages, but certainly by the time you get to the older ages, if you're issuing business at issue age 65 and issue age 70, and if you just use a percentage of the 1975-80 going into its own ultimate, that's the disconnect you have to deal with. Over here you'll find mortality that's increasing 12 percent. You have this one big hiccup right there at Duration 16.

I have a couple of comments about patterns for preferred. Many companies look at their preferred plans as constant percentage between classes. Chart 8 is representative, let's say, of four non-tobacco class systems where one is an index. It's just an index of whatever your basic table is. You have a pretty heavy discount for your best preferred class, a little bit less discount for your preferred class, and here you have kind of a standard plus class and then your residual standard class. Many companies are assuming mortality patterns like that.

In reality, I think they're going to look more like this (Chart 9). I think you're going to have the same discounts in the early years. But almost by definition, if you're giving very heavy discounts even on very well underwritten mortality in the early years, as time runs off, that mortality is not going to stay down here. It's going to start grading up. It has to. And mortality up here doesn't actually decrease, but the slope is flatter. That's why we have that curve down. So, by the time we get out here to Duration 25 or so, these things are going to be almost on top of each other. The remaining cohort of bodies at that point, irrespective of their initial risk class, is going to have pretty much about the same mortality with maybe a little differential between them. That's about it.

I'll pose a question. What is mortality hiccup? Well, we don't see this a lot in the SOA experience studies. Where I run into this the most is looking at an individual company's experience. The Duration 1 and 2 mortality should be lower than your basic assumption in your table because of the contestable period. You're going to contest some claims, so even if your mortality in general is right on, this is the pattern. Chart 10 is what it's going to look like. You have some good mortality there. You hit Duration 3 and it jumps up, and those numbers are just relative.

I'm just trying to give you an idea what the pattern looks like. Some claims come through that were fraudulently issued, but did survive the contestable period. You have to pay now. What happens is that the excess claims start tailing off after about three or four years, getting back to normal, and the reason for that is because of these issues I was just talking about. The fraudulent claims are going to basically die in the early durations. So by the time you get past Duration 7, 8, 9, those fraudulent applicants are gone.

Now, what I see in reality at some companies is what I call the big hiccup (Chart

11). This is actual experience from a company that I did some work with. Their early duration mortality was very good. They expected it to be good. All of a sudden in Duration 3, it was 200 percent. So, I would suggest that a couple reasons for this would be they were very aggressive on their underwriting. They were also very aggressive on their contestable period, in other words, contesting claims, but there could have been some problems in the types of business they issued. They didn't catch what they wanted to catch in the underwriting. This is really sensitive also to what your pricing assumption is. If you're at 15 percent of 1975-80, it doesn't take too many of those claims to get a spike like that.

This comes up all the time, particularly when we get into preferred plans. You have a three- or four-class preferred system, and by the time you're actually out at your standard, residual standard, that's the wrong class to which to apply substandard ratings. We did a preferred risk survey, in which we asked a specific question, and we got a variety of answers to this. The residual mortality is probably too high to apply reinsurance debits to. So if you have an impairment that's worth 50 debits, to what risk class do you apply the 50 debits? Some companies use a composite, in other words, like a traditional standard. It may not even be a risk class. It's just a composite mortality to which they apply the 50 debits.

Other companies may use the next best preferred class down from residual standard. In this example, the best preferred is at 80 percent of some table; preferred is at 100 percent; and residual standard is at 120 percent. Applying 50-100 debits or whatever to 120 percent is wrong because you overstated the mortality 20 percent. The reason this is wrong is because the reinsurers did not create impairment debits by risk class. They do it by composite risk class. So, even if you don't write a lot of impaired business, ask your underwriters, "What are you doing here?" Which class are we writing or reflecting here? See what they say.

MR. SAUL GERCOWSKY: Today I get to talk to you about mortality improvement, a subject that's actually getting a lot more attention lately, even in non-actuarial circles. Of course, if you actually mention the words mortality improvement in non-actuarial circles, eyes kind of glaze over. It's kind of a loss of interest. But when you start talking about life expectancy, everybody suddenly has an opinion. Even the comedian Woody Allen has an angle on it. He's been quoted as saying, "I don't want to achieve immortality through my work. I want to achieve it by not dying."

I'm going to talk to you about the state of where we are right now with mortality improvement. I'll start by looking at population mortality and also talk about insured mortality and how that differs from population mortality. I'll then move onto estimating future mortality improvement both in terms of what companies are currently using and what they think the expectations are. I'll also discuss the key issues that you need to consider when setting your mortality improvement assumption.

The first thing I'll do is show you a graph (Chart 12). If you look at the dark bar,

that's mortality improvement for males. These are population mortality rates per 100,000 of people alive, and the source for this data is the Centers for Disease Control (CDC). In 1950, the overall rates were much higher than in 2000. In 1950, the average mortality per 100,000 was 1,446. This is male and female combined. By 2000, it had dropped to 869. That's a huge improvement. If you also look at the difference between the dark bar and the white bar, you'll see that female mortality didn't quite improve as much as male mortality.

Chart 13 converts the graph into a chart, so you can actually see by decade what the implied annual improvements in population mortality were. For example, in the 1950s, the average male mortality improvement was 0.4 percent compared to the female average of 1.1 percent. Now, as you can see, there's quite a bit of variation in there. There's a definite improvement in every decade, but even between males and females there's not a lot of predictability in terms of which would be higher or lower in different times. The one thing that is noticeable, though, is that female mortality appears to have improved more than male mortality in, say, the 1950s and 1960s, whereas in the more recent decades male mortality has actually improved more than female mortality. But that was population mortality.

For insured mortality there are other considerations. Generally the trend would be similar, but due to underwriting you don't really know what part of the population is getting into the insured group. People might get kicked out. It's hard to really know what the impact of underwriting could be. Similarly, who are the people in the insured group? What's the target market involved? There are definitely people in the population who are not really covered in insured mortality. They just never apply for insurance or they're under certain limits that wouldn't be included. These are other considerations that you need to look at.

Chart 14 looks at the insured mortality rates. It shows insured mortality as a percentage of the SOA 1975-80 basic table, to the extent, as Rick mentioned, it's relevant. Either way, that's what measure is used in the SOA 1991-95 individual life report. I'm showing policy year 16 and beyond. That to some extent strips out the impact of variations in early duration underwriting and basically says this is what insured rates are in the ultimate period. In 1983-84, the rates were 91.8 percent of SOA 1975-80. By 1994-95, they dropped substantially to 80.6 percent, a large improvement.

There's one caveat here, just as Rick mentioned. There isn't necessarily homogeneity among study periods. The SOA recognizes that originally there were 13 companies used in the 1983-84 study. If those were used all the way through, apparently the mortality improvements would have been not quite as dramatic as this. Nevertheless, still improvements, and, using these numbers, the implied annual improvement is 1.2 percent per year, which is quite substantial as well, and somewhat comparable to the population mortality.

So then the question is: We've seen some evidence of mortality improvement, but

why? What caused them? If you go back to the early 1900s, which is not what we looked at, but if you do go back that far, you'll find that a lot of mortality improvement was due to things like improved sanitation or vaccines against infectious diseases or better diet. But now those causes have less impact. Instead, medical advances are really driving the mortality improvement, particularly in heart disease and in cerebral vascular disease. In addition to medical advances, fewer complications resulting from a decrease in smoking prevalence have been attributed to causing a lot of the mortality improvement.

As an example of this, Chart 15 shows the leading causes of U.S. deaths in 1950 and in 2001. Heart disease has dramatically improved. The proportion of deaths due to heart disease has dropped from 41 percent in 1950 to 29 percent in 2001, a massive decrease. Similarly, for cerebral vascular disease, it's dropped from 12 percent in 1950 to 7 percent by 2001. Cancer has increased from 13 percent to 23 percent by 2001. So basically people are not dying as much of heart attacks, and they're surviving longer, and they're getting cancer. This is evidence of the impact that medical advances have had on mortality improvement.

I'll go back now and just talk about the smoking prevalence side of it. Between 1965 and 2001, there have been pretty big changes. In 1965, about one-half of males and one-third of females were considered smokers. By 2001, that dropped to one-quarter male and one-fifth female. That was a very big improvement, and it shows that the implied annual decrease in smoking prevalence is about 2 percent for males and 1.4 percent for females. This difference in improvement may account for why male mortality in the last couple of decades has improved more than female mortality.

It hasn't been looked at so much in the United States, but in the United Kingdom there is something called a cohort effect. The cohort born in the years 1925 to 1945 has experienced better mortality improvements than the surrounding generations. Chart 16 is a graph of mortality improvement rates, and the closest pane there to you is 1975. If you look at the 40-year-olds in 1975, they had the highest mortality improvement of all the groups in the chart in that year. If you move out to, say, 1995, once again the same cohort who are now 60-year-olds had the highest mortality improvement. It's a pretty startling trend, and one interesting point here is that it seems to be continuing into the future. The question is: Why?

There has been quite a bit of research done in the United Kingdom on this, and two causes have been linked to it. First is that the prevalence of smoking in different generations has been a cause supposedly for the cohort effect. The second one is diet in early years of life.

If you look at a recent article from the *North American Actuarial Journal*, April 2004, there were also some other causes that were identified as being relevant for the cohort effect. One of them was that this generation was the first to have exposure to certain medical advances. Maybe those medical advances were most relevant at

certain ages. Another issue would be that welfare programs in the United Kingdom were improving. Thirdly, this generation apparently had fewer kids than prior generations. I guess that means there's less stress involved there. Whatever the causes, this is one of the reasons why people may be living longer in that generation. And then, the last factor was exposure or experiences in the Great Depression, the 1930s. This generation was very young at that time and maybe didn't feel the full brunt of it. Relative to the earlier generation, I guess they weren't as stressed, but possibly that's another reason why this cohort effect exists.

It's definitely an issue in terms of what's going forward in the future, what you expect of this particular generation. For example, social security issues in the United Kingdom, etc. It definitely appears to persist until later years, and that kind of effect hasn't really been documented so much in the United States. It may or may not exist. I don't think there's been a lot of research in the United States into it in part because I think the United Kingdom has a more homogeneous population, more so than the United States, where it's tougher to track these trends. But the fact is this kind of effect does exist in the United Kingdom. Maybe it'll show up for other reasons as well in other areas. It's definitely something to think about.

That was all historical mortality improvement. A lot of you, I guess, are more interested in future mortality improvement. I looked at the SOA preferred underwriting reinsurance survey that was released in August of last year. They surveyed 15 companies. Thirteen of them admitted to using future mortality improvement in pricing, and they all said they varied the mortality improvement, according to the following factors: largely duration and gender, also, to some extent, age, smoking status and some other factors as well, for example, medical versus nonmedical.

Typically the mortality improvements were for limited durations; sometimes they were not. For example, 1 percent per year, level for 10 years or 15 years or 20 years. Improvements generally were also greater for males than females, for example, 1 percent per year for males and 0.5 to 0.6 percent per year for females. Another example is, say, 1.5 percent for males and 0.3 percent for females. So there could even be greater variation than what's shown up there. It's definitely worth looking at the actual survey. There's more detail in there, which is very interesting to read.

Another interesting source of data that is similar to this in terms of its overall results, although there are other details, is the report of the SOA Mortality Improvement Survey Subcommittee, which was issued in March 2003. It also has a lot of very interesting information and identifies some other factors by which mortality improvements should vary. One of them would be by product. Another one would be by underwriting class. And, finally, there's another preferred underwriting survey coming out soon, and when it does come out, some of the results may be quite similar to what's presented here, although, of course, the details will be slightly different. It's worth looking into that as well.

We've seen that there have been historical mortality improvements. We know that people are pricing for them, but are they there in the future? Possibly in the future the expectation is that we've had medical advances before, so they'll probably continue. To some extent I think that's reasonable to expect, and, based on the current techniques, doctors are improving their medicine. Then there's genetic testing, kind of in the forefront of medicine right now. There's a lot of testing going on. They've mapped the human genome, but what are they going to do with it? It's hard to really know where that's going to go and how that's really going to impact life expectancy.

Similar, but not identical, is anti-aging research, which could eventually affect the entire life span of humans, in which case, the sky's the limit. You don't really know whether it's going to happen, or when or how. It's definitely a possibility.

However, the other side of it is what are possible sources of deterioration, things that maybe might not lead to mortality deterioration but at least might stall improvements? One of them definitely is obesity. I'd heard about obesity, and I knew it was potentially an issue, but I'll discuss it later. It's quite startling how quickly the population in the United States is becoming obese.

Another possible source of future deterioration is new infectious diseases. It seems like every year now there's a scare about flu or something. We've recently had SARS. No one really knows where West Nile's going to go. It doesn't seem to have quite the hype as the others, but bit by bit you never really know. I think last year there was a flu epidemic that was predicted to have some major repercussions. Fortunately it didn't materialize into anything huge, but there seems to be a scare every year.

Then next on the list is antibiotic resistance. Even with those basic old diseases that have been cured for years, you never really know when they can come back with a vengeance. Let's just say microbes react, and we don't really know what's going to happen in the future. Our medicine is evolving. Yes, it's improving. You have medical advances. But can it outpace the microbes? To some extent it has, but you never really know.

Next is environmental pollution. That's a huge unknown as well. For years we've been spewing out toxins into the environment. We just don't know the long-term impact of what's going to happen. It's possible that pollution could lead to a cohort effect worldwide; we don't really know. There could be a cohort effect in the opposite direction in which maybe certain generations after a certain point are going to have worse mortality. We all know about the pollutants in the water and the air, but we also haven't really considered things like microwaves or radiation, like radio waves—being bombarded for years with TV, radio, cell phones.

Last is war and political unrest. War exclusions do kind of help in terms of insured mortality. Clearly we've seen that political unrest isn't necessarily considered war,

and you really don't know where all the boundaries are. Population mortality clearly could be affected and so could potentially insured mortality.

Speaking of insured mortality, there are other issues that you need to consider when you talk about insurance mortality. One is medical testing. What's in the underwriting process? How does it evolve over time? And then even if it does evolve, what limitations are there?

There are privacy restrictions. What could insureds find out that could cause antiselection that maybe the insurance companies don't know about? There are also competitive pressures. To what extent does the prevalence of exceptions impact mortality improvements? I already mentioned antiselection. But there's also the sentinel effect. It's hard to really know, again, who actually makes it into the insured group and how the mortality improvement in the population differs according to who is in the insured group.

Lastly, the obesity trend is quite amazing. Chart 17 shows the percentage of obese U.S. adults. Obesity is defined as the body mass index (BMI) (your weight divided by height squared) of greater than or equal to 30 kilograms per meter squared. It looks at 1991 when statistics were first compiled. I don't think anyone really tracked this too much in the past. It compares it to 2001. Looking at the top row, overall, 12 percent increased to 20.9 percent. That's a 74 percent increase. So, nearly double the number of people were obese in 2001 compared to 1991, and if you look at the trend from 1991 to 2001, it's pretty much 1 percent per year almost. So by now we might be up to 25 percent, or somewhere in that range. It's hard to really know where it's going to go. I also have males and females separately on here, and, as you can see, both males and females are getting obese at comparable rates. Interestingly, all age groups are getting obese; it's more pronounced, though, for the younger age group. For example, the 97 percent number in the 18- to 29-year-old range says that 18- to 29-year-olds are about twice as obese. But if you look at the 18- to 29-year-olds in 1991 with a 7.1 percent obesity rate, if you follow that cohort, until they become 30- to 39-year-olds in 2001, well, a 20.5 percent obesity rate is almost triple. Basically, it's huge at younger ages—the next 30- to 39-year-old group basically doubled during the next 10 years.

The overall increase is lower when you get into the older ages, but it's kind of scary because for preferred classes, when you put a build criterion in there, well, you'd think that means that people are healthier. But if people are getting overweight so quickly, what does that really mean? This is a BMI that is 30 and over, which is pretty big already, but even if people are going from 25 to 26 or 26 to 27, what does that really mean? There are a lot of unknowns, and we don't really know where it's heading. One real issue is: What is obesity connected with? Well, it's connected with heart disease, just general lack of activity, diabetes and hypertension. There are a lot of complications. And it's more a question than anything else. We just don't know. But potentially it could cause deterioration in

mortality.

I'm going to close with just some general considerations on what you need to know when setting mortality improvement assumptions. I guess the first real question is, as I've talked about, will mortality improvements continue into the future? Will they continue at the current or the historical rates? Will they be bigger? Will they be smaller? Could there even be deterioration? If so, for how long? As well, should they vary by, say, gender or age or cohort or underwriting class or product or some other criterion that's relevant? Lastly, to what extent do mortality improvements apply to whatever market you're pricing for?

MR. BERGSTROM: You know what's scary about BMI? We don't normally in our underwriting requirements look at BMI. We have a table. I've seen some companies' requirements, though, that having a 30 BMI would actually allow people to qualify. We're talking about clinical obesity now, not just overweight, but clinical obesity.

MS. ANNA HART: I'm not even going to play like being an actuary. So, be assured. I am a gerontologist by training. Some of my charts will be oriented toward the older ages just because that's one of my specialties. I'm going to hopefully complement what Rick and Saul have done, talking about mortality trends and patterns but concentrating a little bit more on the underwriting side and some of the things that can happen that can reduce the natural mortality improvement we are building in.

Risk selection is important in order to properly classify applicants into the appropriate risk class. It seems very basic, but some of us do it better than others. When you have six, seven and eight preferred classes, it becomes very important to classify those applicants realistically and with data to back it up. Also, you should be protecting against fraud, which never goes away, looking at third-party kinds of issues where parents are buying insurance on children or children are buying on their elderly parents, which is more frequent.

When I attend a gerontology meeting, the focus is on up-to-date research findings, e.g., talking about lifespan research and things like this. We talk about causes of death and how it varies by age. Whereas total mortality increases consistently; obviously, we all die. The appearance differs by life stage.

So, in your middle ages, late reproductive women who have stopped having children and at older ages, you will see different patterns in the cause of death and the distribution of death by cause. It changes considerably with advancing age. Saul mentioned some of this, and I'm going to show you a little different presentation. Cancer increases markedly when you're in your 30s and 40s and 50s. You see lung cancer, breast cancer, and colon cancer until up at age 60 when 45 percent of the deaths by cause are due to cancer. That decreases, and this is interesting, to 15 percent in those who are between 85 and 89. If you're lucky

enough to make it to age 100, and more and more of us are, only 5 percent of the distributions of death are due to cancer.

Cardiovascular disease shows a little different pattern. While the proportion of deaths is 40 percent and continues to rise with age—again, the slopes are different—and 40 percent of the distribution of deaths in your 80s and 90s are due to cardiovascular disease. Interestingly, respiratory disease and what is called unspecified causes are becoming more prevalent. The causes of death are not well defined on the death certificate. These are things like the dementias and combinations of impairments, so the type of cause is often unspecified.

Chart 18 is a different presentation, similar to what Saul showed. This is a rate per 100,000, U.S. mortality rates. It only goes to 1998, but is a little different way of showing the same information. In 1973, 27 percent of the deaths were due to heart disease, and in 1998, 20 percent. That's right; by 1998 it was 20 percent. The cancers, again, are 21 percent of the deaths in 1973 and 27 percent. If you look at the slope, you can note years of death in the rate per 100,000. With ages under 65 and then over 65, you can see the different pattern and slope of the causes of death.

For mortality improvement in the very old, look for risk markers. A lot of the research now is looking at fine-tuning some of these markers. One of the articles I read recently discussed hypertension in the very old and how important it is to control at any age, but there are others doing research that says, well, maybe there's more to it. There's an inverse relationship, and it's a little bit more important to keep your blood pressure up a little when you get older. While control is always important, there are some patterns and research that show at the older ages it's a little different in what you watch for, and your levels will be different. Also, cardiovascular disease is always going to be there. Mortality improvement is there only because there are doctors willing to do surgery on 90-year-olds. So, the research and the technology have shown there are ways and benefit to keeping people alive older and older while still maintaining relative quality of life.

Cohort data is interesting. Saul talked about this from the U.K. perspective. I found some articles that combined some U.S. data with some French and German from the United Kingdom While it has limitations, it reflects, again, about age-related changes in middle age and female late reproductive and older age. The variations in the cohort data reflect the changes in the environment, which again include the effect of medical technology that we're seeing and also the standard of living, which has gotten so much better. There are more people who can afford the medical technology. They're, of course, living longer.

Next are causes of death that have high relative mortality increases, and this is really important if you're concentrating your market and distribution in the older age market Disease that's caused by infection, influenza and pneumonia is prominent. You don't see the downward slope. You're going to see an increasing

slope. Causes of death related to frail muscular skeletal system, like accidental falls, are important in the older ages. The old age causes of death are more diverse. Common diseases are more serious threats in older ages, and then the middle diseases not related to alcohol, such as Alzheimer's. Of course, with Ronald Reagan having just died there is current interest. One time when I received a reinsurance application on a woman with Alzheimer's, we got the records from the Alzheimer's facility. They showed us the person was doing well. I went to the actuary and asked, what's my mortality on this? Can we do this?

This was actually progressive at that point in time. He told me the actuarial life expectancy was about eight to 10 years. Look at how long Ronald Reagan having the best access to medical care and medical technology lived—10 years from start to finish.

Some causes of death have opposite patterns for males and females, and that's also an important consideration. Female cardiovascular disease has about a 10-year lag. I did a presentation in Colorado Springs about why women live longer than men, and if you look at the mortality rates, there is a convergence. But rest assured—I have it on high authority—they are never going to actually meet. They appear to get really close, but women will always apparently outlive men. Male mortality is getting better.

Next is middle-age mortality. Again, looking at the different cohorts and the different age-related changes, the increases are dominated by major degenerative diseases such as cancers, atherosclerosis, hypertension, cirrhosis and diabetes. But what are very important in middle age are the familiar trends. I started looked at applications with the standard question. "Do you have a family history of heart disease"? I've seen some companies ask, "Do you have a history of heart disease? Cancer? Mental disease?" They ask every kind of family history question. But the ones that are really important are coronary diseases and specific cancers. There's some really interesting research being done on how much that really plays into things.

What is important? The use of genetic factors in specific mortality at middle ages is being seen as less common, and environmental factors are being recognized more, things like smoking. There are extrinsic versus intrinsic factors. The extrinsic being more involved in chronic disease, which exhibits higher mortality increases in the middle age versus your older age, i.e., acute myocardial infarctions (MIs) and liver disease. Your intrinsic factors, of course, would include things like smoking, alcohol, diet, exercise and occupation. More and more important is the concept of working longer into your older ages, and the mortality is playing out showing the higher your education is and the more involved you are with your work, the better your mortality is.

There are some basic markers that we all use when we're looking at underwriting that everybody is trying to fine-tune. You've always had cholesterol. You've always

had HDL. Actually, LDL tends to be more important than HDL, but we don't necessarily address that in underwriting specifically. Then there are c-reactive protein (CRP) and homocystine levels. There are always some hot topics that people are trying to use to kind of fine-tune themselves and to see: Can I underwrite better or can I make my mortality improve better than someone else down the road? There are lot of different things that people are trying to latch on and use. The cancer markers, BRCA 1 and 2 for breast cancer, CEA, PSA, and then there's been recent controversy about PSA and whether we've set our limits too high and need to start looking at these people whose levels are under four and perhaps pay more attention to them. So, whether we lower our thresholds remains to be determined.

Next are diabetic markers. Everybody's working on this. If you have oral fluid, there are certain things that you can do regarding diabetics and certain things you can't. The ones we've always had are the hemoglobin A1C. Albumen is always important because you start seeing the effects of long-term diabetics' bad control with albumen and micro-albumen. Family history is a familiar trend. A very recent article, within the last couple of weeks, talked about the effect of a parent's history of early heart disease in children. Of course it is a major risk factor for heart disease and stroke, but this is independent of cholesterol, blood pressure, diabetes and smoking. There is the Framingham Study, which many are using in our research, if you have an underwriting manual, and you're a reinsurer. This study has been broken down and is very usable in Hanes 1, 2, 3, Framingham Study.

The original study in 1948 tracked 1,128 men and 1,174 women whose parents were original Framingham participants. In this study, the children of the original participants of the Framingham Study were followed. The participants were followed from 1971 to 2001 and showed very few life-threatening events if they had few other risk factors for heart disease, but multiple risks like a smoker or high cholesterol or overweight and a family history had a 30-fold higher risk of heart disease than those with healthy lifestyles. So, part of our mortality improvement or things that we need to be paying attention to when we're looking at our applications and our underwriting is the questions that seem to get overlooked. Do you exercise? Non-smoking has always been there. Some of the higher detail things that we're not asking are probably going to be the ones that will make the difference in our mortality down the road.

The conclusions of this study were that the challenge was those who fell in between the extremes, no risk factors, or have a family history, and the follow-up studies have not been done. What needs to be concentrated on is reducing the traditional risk factors such as build, stress, smoking and alcohol. Looking at Saul's charts about obesity, I've seen some company underwriting guidelines on build. The limits were incredibly high, and I believe we're actually creating a preferred class and a standard class that is based on obese population, an overweight population. Two-thirds of your population may not be necessarily obese, but overweight and increasing at a steady rate.

Chart 19 gives you an example of risk selection and mortality improvement. These lab stats are a couple of years old, but they're actual data, and I'm going to use cholesterol because that's one of the risk factors that we all use. Across the top are ages 20, 29 and 30, all the way up to 60 and 69. Down the left axis is your cholesterol ranges under 200 and all the way up to 301. There were some respondents who allowed levels up to 300 in some of their preferred classes, which is just astonishing. If you look at the first two rows, if you add each of these up, 94 percent fall from 249 and under. So, at that 20-29 group it's 87 percent, 84 percent, 86 percent and 88 percent.

You can see there's a huge percentage of actual lab statistics—males with cholesterol, their distribution—with values under 240. Next figure out what goes into your preferred. You have everybody out here, and 90 percent is already out there. We may be doing it wrong. Look at your lab data and determine how much of the population is falling into the class. I need to rethink how I'm dividing my population because the buckets are getting filled with the wrong people basically. Look down again at a cholesterol level of 301: 1 percent. If you have almost 90 percent of everybody under 250, and you are putting them all into the preferred, it's not going to work in the long term.

For preferred risk classes, what is your process? Look at the difference in the requirements by risk class. For example, how much does cholesterol and HDL ratio change from your preferred best to your preferred class? Set your limits from five to six—a change from 5.0 to 6.0 has an implied mortality differential of 10 percent. Also look at the prevalence of requirements by risk class. So you know 90 percent of those are people up there. For example, your prevalence may be 25 percent. Then determine the mortality effect of a change on a requirement. That would be your prevalence times your mortality differentiation. Ten percent times the 25 percent is a prevalence of 2.5 percent. If you apply the same procedure to all of your requirement differentials and sum it, then you get your total expected difference in risk class mortality.

Underwriting criteria is important. If you don't capture the proper percentage of applicants per risk class, then you have some issues in which you have to determine which of your requirements have wiggle room and which don't. A lot of people create this wiggle room. For example, for preferred criteria, there's a little chart that gives you a little extra here and a little extra here. and a little extra That's some companies' way of giving something extra and getting more people in that preferred class.

Figure out which ones do not and which ones you cannot get away with. Look at cholesterol, build and blood pressure. Again, if you have a blood pressure of 142 over 85 versus 140 over 85, consider what impact it's going to have on your mortality. Should the preferred class qualifications vary by issue age? If you have some of the selected criteria, absolutely. All of the above—cholesterol, build and blood pressure—you must vary by issue age, and you can see that cholesterol

probably should be, but it's not always, but blood pressure absolutely must be.

I'm going to touch on table-shaving programs only because I do a lot of audits in my consulting work and have seen some important issues. What is a table-shaving program? Typically, you get a product which has four tables built in, and you're going to dump all Table 4 risk there, resulting in a standard. You're allowing a certain percentage of substandard to fall into your standard class. These are some of the pitfalls and no-nos of what you need to be careful about doing in a table-shaving program. You have a Table 6, and you've fit it into your table-shaving program reducing the risk to a Table 4. All of a sudden, it's standard. You're giving away six tables versus what you would have been giving away before.

How is it often used? Ideally table shaving should be 5 percent to 8 percent of your whole, not more than that. Here's an example of effects on your mortality. If your average rating is plus 50, and you use the table-shaving program 10 percent of the time, your standard mortality has increased 5 percent, but you have to be sure to acknowledge this in your mortality assumption or you will have some skewed results. One of the audits I did recently was 30 percent exception rate. Now, I can guarantee you this wasn't priced for; the average rating was +75. So, what are you giving away? A lot more than 5 percent when you look at it that way.

Next are business decisions. I wrote some from the recent preferred survey because I thought they were timely. The definition of a business decision is it is a conscious decision almost always to give something away. Either you have a good producer or you have a good applicant, and you want to give him a little bit better deal. Now, the effects of that on mortality are very similar to a table-shave program. You have to control it, and you have to know what percentages you can allow in that. Quantifying your exceptions is not easy to do. I won't do this, but I could ask you to raise your hands and say how many of you actually know the number exceptions your underwriting department does, and do you keep logs on that? Do you know what all your underwriters are doing? Many of you are thinking you don't know. You have to know the percentage of exceptions and also know the aggregate mortality of them.

What is a good exception? I'm going to give you an example. An individual, 50s, has a history of heart disease, compliant with medication, low cholesterol, good build, and he's on statin now. If this risk fell outside your guidelines, would you make a business exception and give him a little bit better class? Yes, probably so. You could go Table 4, credit to standard, and not feel uncomfortable doing that because you have a basis for your exception. It's documented, and it has research to support it. A bad decision, however, would be the same kind of individual, adding diabetes into that individual's profile. Consider an individual with cardiac disease, and yes, he's controlled. He has this. He's compliant. But he's also diabetic. Even with all the other factors being the same, you would not want to allow that person into a standard class because you're giving away the co-morbidity, and the mortality improvement will not be there for that individual.

Some of the business exceptions that I've seen on non-preferred are build, financial and blood pressure. Liver function is a big giveaway, and many are not tracking that in your company. I think there are a lot of companies giving away on liver function, diabetes and tobacco, and that's on non-preferred. Here are some of the giveaways or exceptions on preferred. The top 10 include: cholesterol, which would be expected; medical history; build; wage requirements; labs; and family history. The example in family history would be where, yes, the family had a history of cardiac disease, but he's still alive. So, let's go ahead and give him something. And that happens pretty frequently. The difference in the exceptions will vary by preferred and non-preferred, for sure, but the mortality giveaway is going to be similar. You get a lot more impact in your preferred classes than you would expect to have. How many are too many? Well, no more than 5 percent or 8 percent exceptions, and if you document them, then you can be comfortable with that.

In 1984, $3 million was spent on heart attack patients. By 1988, the total amount spent was $5 billion. This shows a 3.4 percent annual growth in real terms of money spent, but the increase was not a result of more people having heart attacks because heart attacks declined by 1 percent a year. So, what was the reduction due to? Well, you're looking at probably better risk-management, factor management, like reduced smoking, better control of blood pressure and cholesterol. The total spending increased because the average amount spent for heart attack increased. In other words, more people are utilizing the medical technology. Therefore, we're seeing improvement of nearly $10,000 per case or a 4.2 percent increase per year.

What are we looking at in the future, moving forward? We're looking at continued mortality improvement, not as much for insured females, more so for insured males. Again, the main reason for this is that the males' rates were so much higher to begin with, and they have more room to improve. There's increasing morbidity at the older ages. It's not like the mortality's really getting good. People are living longer but sicker. So, it's a different way to look at it. An example: The quality of life deteriorates even though the individual continues to live. Some of the concerns are obesity and metabolic syndrome, and we are not probably paying as close attention to that and probably should.

FROM THE FLOOR: Well, the statistics were basically gender-neutral. The definition of obese was purely the weight divided by the height squared. It's obese, though, and that's not necessarily defined.

MS. HART: There are statistics out there that showing differing BMI levels for females and males. It does differ.

MR. BERGSTROM: I've certainly seen that there are tables out there that are gender-specific. I was going to ask you a question. You had average mortality. You started in 1950 and went down to 2000, and it was an average rate per 100,000?

MR. GERCOWSKY: Correct.

MR. BERGSTROM: My question is do you have any idea how much of that improvement was simply built in because there are more younger people in the later cohorts?

MR. GERCOWSKY: That chart is available by age group as well, and there is improvement in all the age groups. The really, really young had the best improvement, but even then there is improvement throughout. If you go to the CDC's Web site (www.cdc.gov), you can get all the details by age. The numbers are age-adjusted.

MR. ROBERT M. BEUERLEIN: I'm totally in concurrence that underwriting at the older ages (70, 75, 80) is so much different than underwriting at the younger ages, but we, as an industry, have traditionally done the same thing at the older ages. So we're in agreement that we need to change how we do it for the older ages. In your opinion, how are we going to get the industry to move to do this? If one company starts testing activities of daily living (ADLs) or checking dexterity, flexibility, so on and so forth, they're not going to sell any business because Company B is not doing that. Do you have any ideas or any thoughts?

MS. HART: Company B will eventually go out of business. Therefore, A will succeed.

MR. BERGSTROM: But not in our lifetime. That's what he's getting at.

I think a lot of it is just basically education. I still don't think we collectively, as actuaries, as an industry, talk enough with our medical directors. We talk more with our underwriting department now. We have our meetings, and the medical people have theirs. I don't believe there's enough interactive talk in those areas as there should be. So, bottom line, I think education—by gerontologists and others—would be a way to start that movement, and there are companies that are looking at things like that. They tend to be doing it, though, more on almost simplified issue-type business, not so much preferred-type business.

MR. JIM WAGNER: We keep talking about preferred underwriting surveys, and I know the answer is that everyone's classes are different, and we can't come up with a standard. I'm wondering if we as an industry came up with a standard, which would mean when we're underwriting somebody we're doing that per the company's guidelines, but we're also coming up with a number that we compare across the industry. We would report on that and do industry mortality studies on the standard basis if that'd get us a lot better information. I think it would, as long as we could get some buy-in that we would do that as an industry.

MR. BERGSTROM: That's coming.

MS. HART: Preferred-type.

MR. BERGSTROM: The problem that I have with the specific comment you made is that different companies have different requirements for screening purposes versus mortality purposes. We underwrite to the best that we can to a certain risk class; we try to achieve a certain mortality. All companies' mortality is not the same for the risk classes because the risk classes are defined differently. If I want 50 percent of my super preferred and Company A wants 10 percent, what's your screen? If you have the same requirements, the same lab tests, for example, that's not a good screen. You want to be able to screen to your qualification percentages, and the qualification percentages should be tied to the mortality. In fact, the mortality experience that will be published shortly, the experience of the best company contributing data to the worst company contributing data differs by a factor of more than 2:1, and yet we're all calling this standard, and that just is the way it is.

MR. ALLEN M. KLEIN: I wanted to address Jim's question and for the rest of the audience as well. The Society of Actuaries put together a Mortality Study Working Group that came out with some recommendations. I'm not going to go into all the details, but one of those is to do a preferred mortality study. A task force is being formed right now and will probably start work next month. So, if anyone in this group is interested in participating, let me know or let someone from the Society of Actuaries know, but there is a preferred mortality study that is to be completed by the end of next year getting started.

MR. BERGSTROM: At least early durations, right.

FROM THE FLOOR: I just wanted to put together a couple of comments, one that Rick made and one that Saul made. Saul, you basically noted that 13 or 15 companies acknowledged mortality improvements. I think, Rick, you had made a comment that if you're using the 1975-80 table that that has an implicit mortality improvement in it. So my guess is the two companies that didn't are using the 1975-80 table because of the flatness of the 1975-80 table. It probably has mortality improvement of close to 1 percent in it a year, if you're using the 1975-80 table. The second question I have is could you focus a little bit on the oldest ages in terms of what sort of mortality improvement have we seen there? Maybe the ones where we're starting to get some interest in, issue ages 70 and above, do you have anything on that, Saul?

MR. GERCOWSKY: Fifteen were surveyed, and 13 said they use mortality improvement.

FROM THE FLOOR: Yes, that's what I said. That's what I meant. The other two probably were using the 1975-80 table.

MR. BERGSTROM: Which means they already had the improvement built in there.

FROM THE FLOOR: I'm asking for a little bit of a discussion on the mortality improvement.

MR. GERCOWSKY: I didn't actually summarize that level of detail. I can give it to you, though. I have it available.

MR. BERGSTROM: One of the things that I see with population mortality is there comes an age—we'll call it a super senior age, and call it age 85—beyond which the acceleration of mortality deterioration actually slows down. A lot of people at post-85 do not die from the same causes that people under that age die of. They get to a point where they die of old age, organ failure. It's not so much cancers and heart diseases. The impact of this is the mortality curve accelerates as age increases, but then tends to flattens out, still going up, but there's a cusp around this super senior age where the acceleration of the curve actually slows down.

FROM THE FLOOR: Several of the presentations have pointed out that there's an improvement in mortality in the general population, and you can then track that into the insured population. In the most recent study, the 1995-2000 study of experience of SOA, data shows that for smokers there really hasn't been any improvement, and I wondered whether there was any parallel U.S. population or other population data on smokers and their overall mortality improvement.

MS. HART: There is.

MR. BERGSTROM: I've not personally seen it. Anna says there is.

Chart 1

Age/Dur	1	2	3	6	8	10	13	15	Ultimate
25	46%	53%	61%	69%	70%	70%	70%	71%	70%
Ratio 10-1						152%			
35	47%	51%	50%	57%	56%	55%	60%	60%	58%
Ratio 10-1						118%			
45	48%	46%	43%	49%	58%	62%	62%	58%	55%
Ratio 10-1						127%			
55	47%	54%	57%	55%	63%	68%	67%	66%	58%
Ratio 10-1						146%			
65	49%	54%	53%	64%	65%	68%	82%	88%	68%
Ratio 10-1						139%			
70	48%	58%	58%	62%	61%	73%	91%	101%	75%
						152%			

[]

Chart 2

Pattern by Policy Year M+F
1995-2000

Policy Yr.	1975-80	2001VBT
1-2	47.4	79.4
3-5	51.2	84.2
6-10	64.5	89.2
11-15	72.6	91.4
16-20	63.7	83.4
21-25	69.7	85.6
Total	62.6	87.2

Chart 3

Attained Age	Females 2001VBT	**2000** U.S.Life	Ratio
25	0.00042	0.00052	0.81
35	0.00076	0.00097	0.79
45	0.00149	0.00215	0.69
55	0.00437	0.00503	0.87
65	0.01044	0.01267	0.82
75	0.02497	0.03102	0.81
85	0.06764	0.08718	0.78
95	0.17558	0.20729	0.85
100	0.24610	1.00000	0.25

Chart 4

2001 VBT Ultimate VS. 2000 U.S. Life Tables

Attained Age	Males 2001VBT	2000 U.S.Life	Ratio
25	0.00095	0.00144	0.66
35	0.00099	0.00183	0.54
45	0.00222	0.00390	0.57
55	0.00534	0.00839	0.64
65	0.01515	0.01994	0.76
75	0.03814	0.04647	0.82
85	0.10706	0.11490	0.93
95	0.24481	0.24282	1.01
100	0.32453	1.00000	0.32

Chart 5

AGGREGATE MORTALITY RATIOS BASED ON 1975-80 SELECT BASIC TABLES

Expos Yr	Medical	Paramed	Nonmed	Combined
1983-84	93.6	92.2	89.6	92.4
1984-85	90.5	94.3	92.5	91.9
1985-86	83.7	91.8	92.4	88.0
1986-87	79.1	91.9	92.0	86.3
1987-88	83.5	87.2	86.5	85.6
1988-89	82.3	80.9	85.0	82.6
1989-90	78.0	79.3	86.6	80.7
1990-91	76.0	77.5	88.3	79.6
1991-92	74.1	72.8	82.8	75.6
1992-93	72.1	64.4	81.4	71.3
1993-94	72.2	66.4	77.1	71.2
1994-95	71.4	66.9	78.6	71.4
1995-96	64.9	63.9	74.0	66.5
1996-97	60.4	68.4	75.8	66.7
1997-98	60.7	60.9	70.2	62.7
1998-99	57.0	60.0	68.5	60.6
1999-00	54.9	58.1	69.6	59.3

Chart 6

Distribution of Issues by Risk Class

Issue Year	Medical	Paramed	Nonmed
1980	38%	33%	29%
1986	16%	27%	57%
1994	20%	42%	37%
2000	20%	46%	34%

Chart 7

Pattern by Issue Age M+F
1975-80

By Issue Age	1995-96	1999-00	Ratio
20-29	63.6	54.3	85%
30-39	49.8	41.6	84%
40-49	51.0	40.2	79%
50-59	54.5	55.1	101%
60-69	60.3	71.8	119%
70 and over	91.8	77.9	85%
Total	55.4	50.1	90%

Chart 8

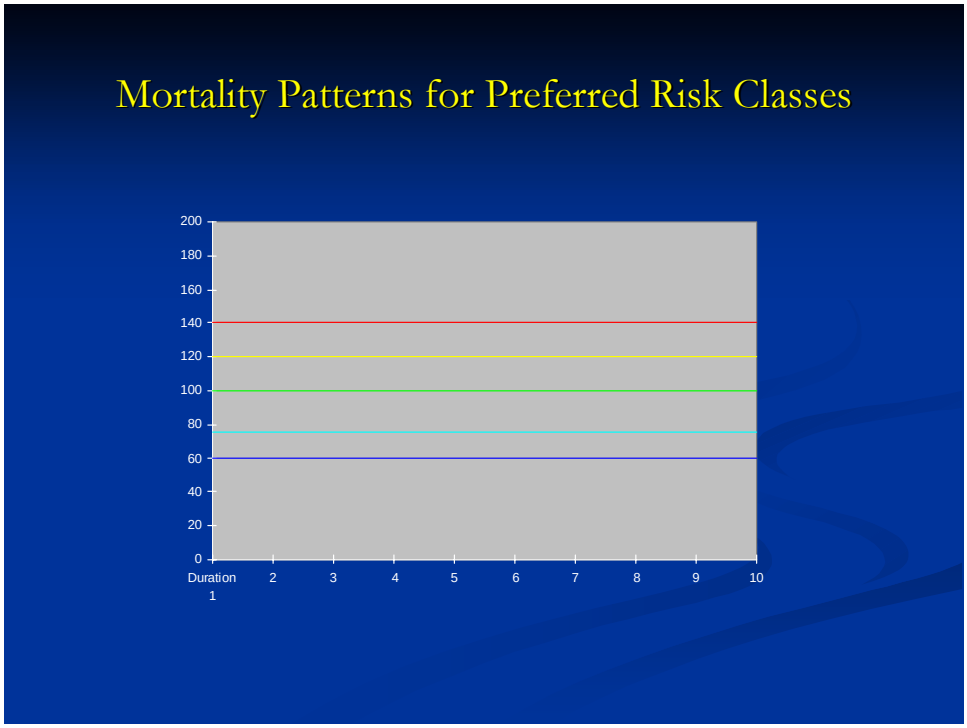


Chart 9

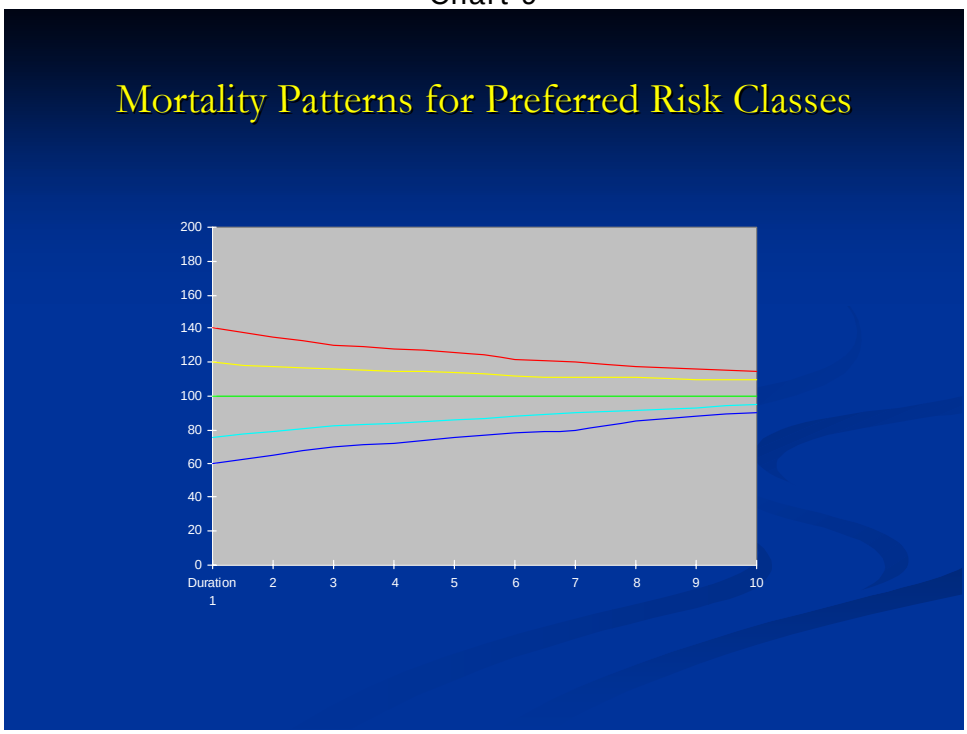


Chart 10

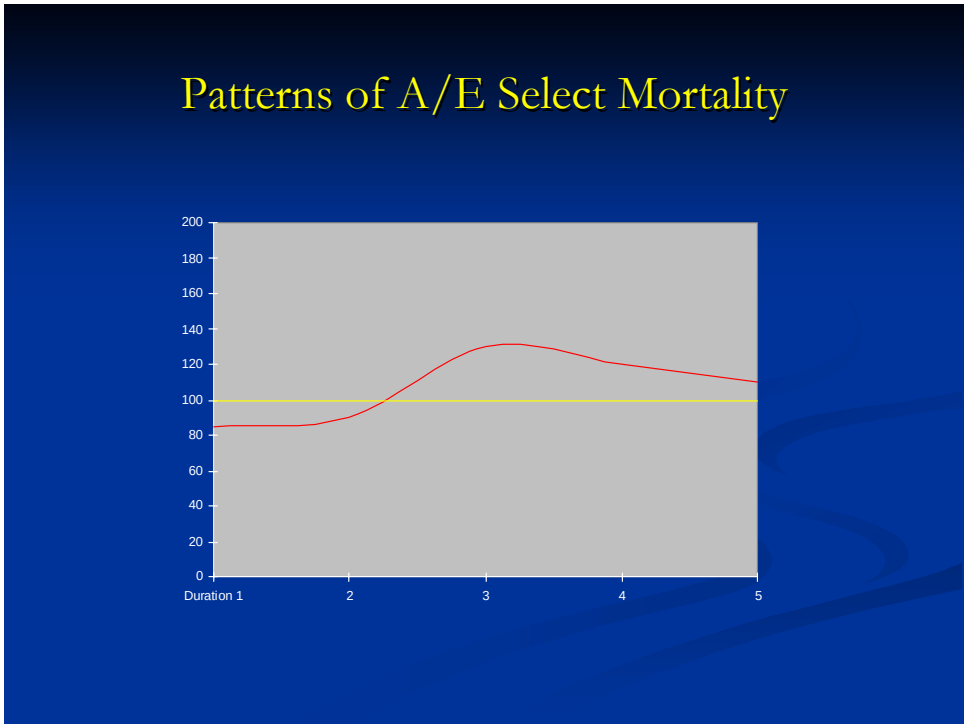


Chart 11

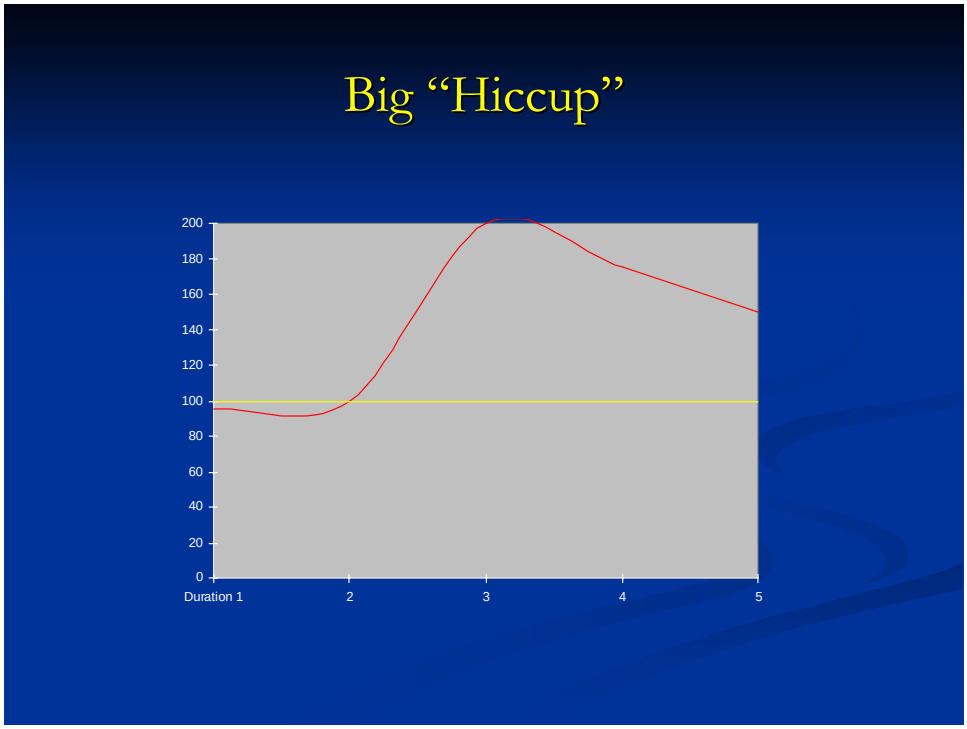
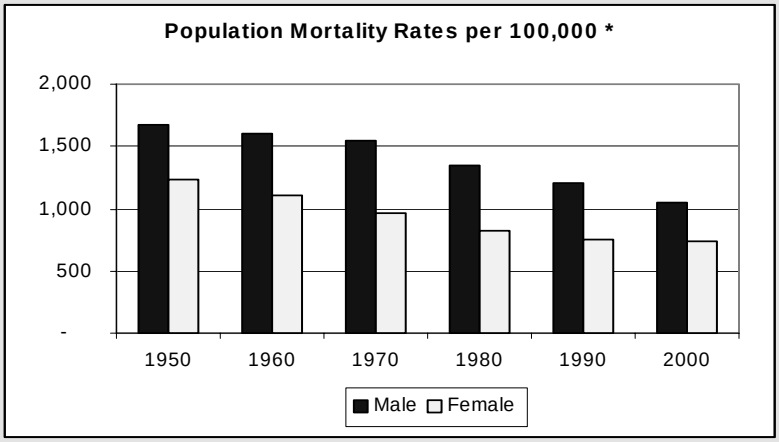


Chart 12

Historical Mortality Improvement



*** Source: CDC (www.cdc.gov/nchs/data/hus/tables/2003/03hus035.pdf)**

Chart 13

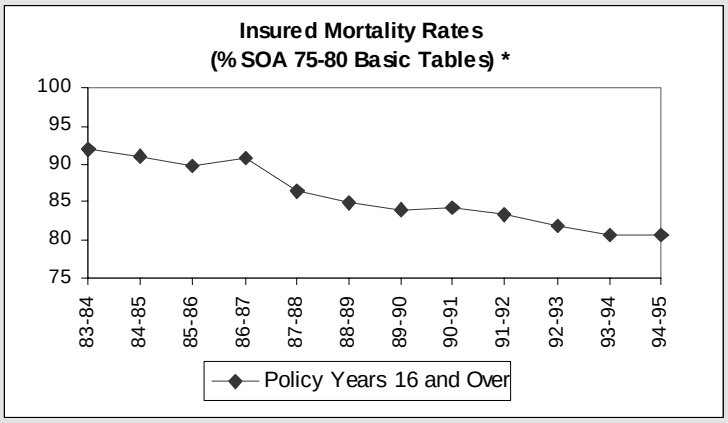
Historical Mortality Improvement

Population Mortality Improvements

Implied Annual Improvements in Population Mortality over Historical 10 Year Periods			
Period	**Male**	**Female**	**Overall**
1950-1960	0.4%	1.1%	0.8%
1960-1970	0.4%	1.3%	0.9%
1970-1980	1.3%	1.7%	1.6%
1980-1990	1.1%	0.9%	1.0%
1990-2000	1.3%	0.3%	0.8%

Chart 14

Historical Mortality Improvement

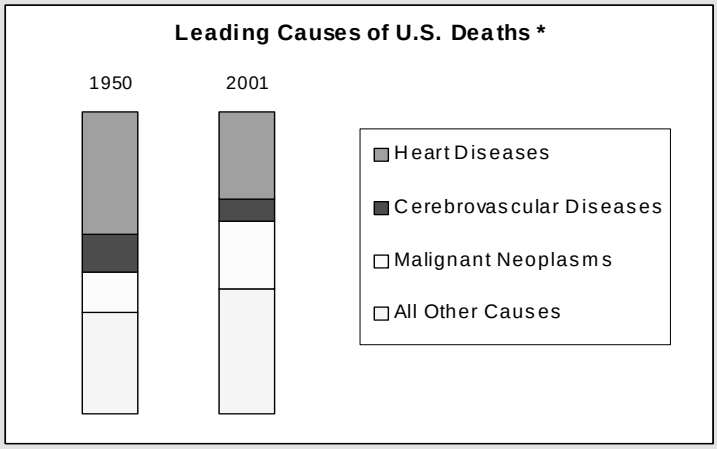


Implied Annual Improvement (1984-1995): 1.2%

*** Source: SOA 1991-95 Individual Life Report**

Chart 15

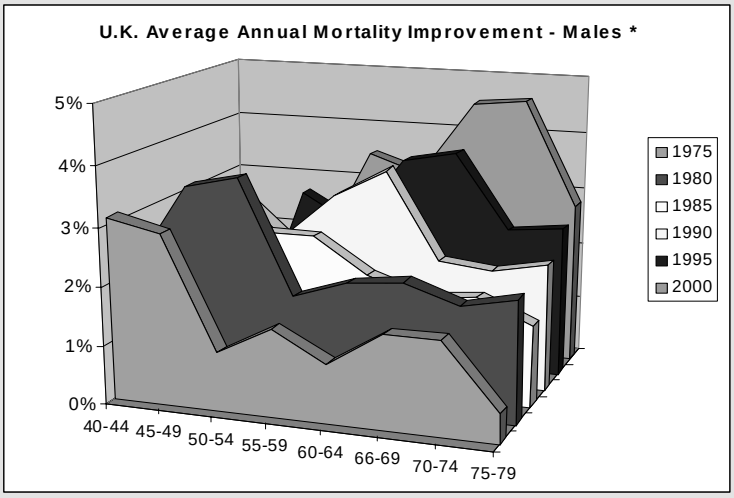
Historical Mortality Improvement



*** Source: CDC (www.cdc.gov/nchs/data/hus/tables/2003/03hus029.pdf)**

Chart 16

Historical Mortality Improvement



*** Source: "The Cohort Effect: Insights and Explanations", R. C. Willets - 2004 (www.actuaries.org.uk/files/pdf/sessional/sm20040426_cohort.pdf)**

Chart 17

Future Mortality Improvement

Obesity Prevalence among U.S. Adults (18+)

	Percentage of Obese U.S. Adults * (BMI ≥ 30 Kg/m²)		Percent Increase 1991-2001
	1991	2001	
Overall	12.0	20.9	74%
Males	11.7	21.0	79%
Females	12.2	20.8	70%
18–29	7.1	14.0	97%
30–39	11.3	20.5	81%
40–49	15.8	24.7	56%
50–59	16.1	26.1	62%
60–69	14.7	25.3	72%
>70	11.4	17.1	50%

*** Source: CDC (www.cdc.gov/nccdphp/dnpa/obesity/trend/prev_char.htm)**

Chart 18

US Mortality Rates 1973-98

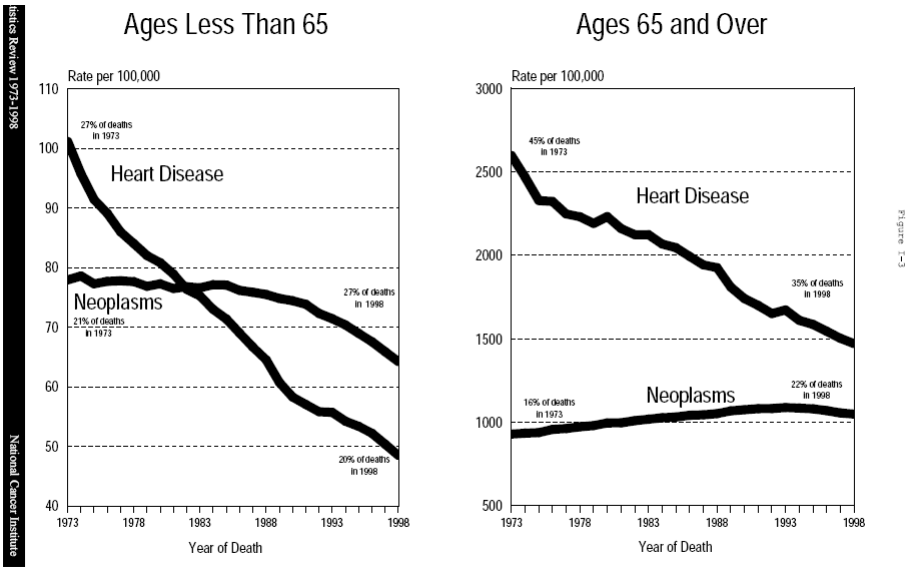


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Chart 19

Lab Statistics
Cholesterol Distribution - Males

Test Range	20-29	30-39	40-49	50-59	60-69
<200	63%	47%	39%	38%	45%
200-249	31%	40%	45%	46%	43%
250-300	6%	11%	14%	14%	10%
301+	1%	2%	2%	2%	1%

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