Informal Discussion Transcript
Concurrent Session 5A: SOA Mortality and Longevity Research

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R. DALE HALL: Okay. I have us right at around 9:15 a.m., so to keep us on time, I think we're going to get started with Session 5A. I'm Dale Hall, managing director of research at the Society of Actuaries. Our goal in this session is to give you a little bit of where we're headed at the SOA with mortality and longevity research, and do a little bit of history on where we've come from. I think that gives us a little bit of indication of where future mortality and longevity research will be going. And then have some specifics to show you on research projects that we've done.

I'm joined today by Cindy MacDonald, who is our senior experience studies actuary at the SOA. Cindy heads up all of our experience studies projects across a wide variety of different contingencies that we study. We also have Andy Peterson, who we call an honorary research member. He sits in our section practice area at the SOA and is our pension staff fellow and very involved in a lot of retirement and pension analysis that we do in the research area.

Mortality and longevity seem to be in the news more than ever before. I don't know if you were noticing over the last three or four weeks of 2016, with people dying and also the fact that the CDC came out with some information on lesser mortality improvement, that seemed to grab a lot of news headlines. And you combine that with famous deaths that were highlighted in 2016—Prince and David Bowie and Muhammad Ali. We thought the whole year was closed, and then suddenly we had this whole other rash of celebrity deaths—George Michael and Carrie Fisher and Debbie Reynolds. I think even there was a news story I saw, [saying] the guy who invented the red Solo cup had died in the last waning minutes of 2016, just to put a cap on the year. So mortality, more than ever before, has been in the news.

We see all the time and people send to us quotes about mortality, both inside the actual profession and even broader than that. So here's a few to kick us off.

This is one I see fairly often: "Each of us is merely a small instrument; all of us, after accomplishing our mission, will disappear." Of course that's attributed to Mother Teresa—honorary actuary Mother Teresa.

We also see "Never use abstract nouns when concrete ones will do. If you mean more people died, then don't say mortality rose" —attributable to the author C. S. Lewis.

Then one that I use, not necessarily in a technical sense, but more with high school students

or college students or candidates that we talk to along the way: "To understand the future we have to go back in time." Of course, that's attributable to pop singer Pitbull, but it resonates pretty well with the audiences that we talk to. Maybe that's more appropriate if this meeting was in South Beach, Miami, [rather] than here in Orlando, but I think it gives a good flavor to the way things have developed in mortality research, an indicator of where things might be going in the future.

Dating back even before the SOA was in existence, we had a lot of predecessor organizations, and if you look at the history of some of those organizations, straight in their "reason for being" statement, back in the late 1800s even, was the concept of getting actuaries together—aggregating data for the benefit of the study of mortality and longevity, so that you could provide good results, whether it was your insurance company or your sponsored plan, or any client or principal that you might be working for. That then triggered studies along the way of what really drives mortality. So you see in the 1920s these predecessor associations doing build and blood pressure studies—really the first establishment of BMI as something that is correlated [with] or causal to mortality, and so it's something that we should look and keep track of.

Then along the way on the annuitant and pensioner side, you see different studies—the McClintock table in the late 1800s, the American Annuity and Standard Annuity tables in the first few decades of the 20th century. If you ever have time, I highly recommend to go out to our collection of databases, mort.soa.org, and it gives a pretty interesting view of where all these tables have come from, some details on how the data was collected, and a good repository of all these tables.

If we look both specifically at life insurance and then at pension mortality studies, we put together a little bit of history of how studies have come along. And I think, again, it's a good indication of the way things are evolving well into the 21st century on what drivers of mortality that we should be studying.

One of the first things that happened just previous to the SOA being formed between the AIA [American Institute of Actuaries] and the ASA [American Society of Actuaries] merging together was the 1941 Valuation Basic Table and CSO [Commissioners' Standard Ordinary Table]. And today, when we say "table," we know that means a lot of different things. But literally

the 1941 VBT was just a table—one table of mortality rates by attained age—and that just was indicative of the science at the time, knowing that age differential is certainly something that you want to have q_xs varied by. But that was the limit of it at that point in time.

At the bottom of this screen, just for information, we've been putting what the male age 45 mortality rates were on some of these tables, starting at 6.69 deaths per thousand in the '41 VBT. And then as time goes on, we'll see that progress to the '58 CSO, where that was the first time we actually saw a commissioners' table that had more than one table involved in it; it had four tables. Mortality was now varying by gender, and the concept of having age nearest and age last birthday was important, and we see the mortality rate dropping below 6 to 5.59 deaths per thousand.

Then moving forward to the '80 CSO, suddenly things like smoking status became very important for the actuarial profession to study. So we went from one to four to now 12 tables: a nonsmoker, a smoker, and a uni-smoker/aggregate-smoker table being part of the mix there, and mortality rates for the nonsmoker and smoker shown at the bottom of this screen. There are still mainly ultimate tables at this point; eventually, we had some selection factors that could be applied to the '80 CSO, but that concept really didn't gravitate until we got to the 2001 CSO, where now we have select and ultimate tables. [There were] 56 tables in all in the 2001 CSO, because now we're talking about different categories of smoking and gender, and other select- and ultimate-type frameworks that are building to this. And you see the relative mortality dropping, of course, over time, both for the select and the ultimate parts of the table.

It was around this time in the 1970s, '80s, '90s where the SOA started doing much more frequent, every-five-year experience studies—aggregated studies across the industry. Some of those were actually just crude studies: take the number of deaths divided by the number of exposures, no real smoothing or anything. But then those would lead into the creation of Valuation Basic Tables and ultimately with margins on to Commissioners' Standard Ordinary Tables.

Finally, as you may be aware, most recently, the 2015 VBT and the 2017 CSO—with all the relative risk tables that are built in here, and the mixture between males and females, and all the different categories—at a minimum have at least 132 tables. That may just be for the VBT, and then you have the CSO with margins that are added on. And in some cases, you have other

valuation tables that don't add margins for reference points, and just a wider variety of tables. So overall, you see this trend of exponential growth in the number of items that are used for selection in the life insurance world.

The same thing happens, of course, on the pension side. Giving an indication of what is to come, here's a little bit of a history of the pension side. One of the first things the SOA did when it formed in 1949, right in our volume 1 of *Transactions*, is the 1949 Standard Annuity Table. Actually, some concepts in there talk about how you can use this table for mortality improvement and the projection of future mortality. Then came the concept of when annuities are sold to individuals versus as part of groups, and that can be a differentiation in the mortality structure, that you start to see that emerge.

That concept continues on in the '70s and '80s, through individual and group annuity tables for mortality. And then the question came for pensioners more than ever before. You might have annuitants that are in insured vehicles, but obviously many pension plans, too, were taking on that risk themselves. So there's a need to have a difference between uninsured pension mortality tables and ones that are used to value annuity liabilities that are actually inside of an insurance company.

So the SOA, along with its Retirement Plans Experience Committee, started to look at the wider variety of types of mortality tables that were needed. A unisex pensioner table from large, uninsured pension plans was developed in the '80s, repeated in the '90s, where you then had an unloaded table for some privately sponsored along with a loaded table for group annuity valuation. Then, in the modern era, where the conversation flipped to the fact that there's a lot more variables that happen to be drivers of mortality, we're seeing those need to be published and studied. So we had male versus female, whether you're a healthy employee versus disabled versus retirees. And some ratios by job color start to appear in RP 2000. Mortality improvement scales become more of the state of the day with scale AA, then leading to scale BB, and then obviously on to what we kind of know and love today with the current structure of RP 2014, and the mortality improvement tables of MP 2014, '15 and '16 being updated annually. But still a broader set of tables became available, depending upon the specifics of the characteristics of one individual covered person in a private plan. Are they a blue- or white-collar worker? Do they have a small, medium, or large

pension? What quartile or quintile of income might they have? And mortality improvement scales to reflect the emerging U.S. population mortality trends.

I would encourage you, if you have the time, to review some pretty good resources and references. One that is out there is a write-up of some of this history called "The History of Actuarial Mortality Tables in the United States," by Edwin Husted in 1988. And then, if you've been out to our Pension Section website, there's this great collection of different references and history, showing where some of these things have come from, leading up to more current events and topics, and articles that you can look at for the evolution for pension and annuitant mortality.

We saw, both on the life side and the pension side, this exponential evolution of the number of things that we've been studying to drive mortality. To understand where the future might go, we might [want] to look back at the trends that have happened, and I think it's very accurate here. What will future mortality studies hold? Well, we know on the life side, the process for underwriting and selection of life risks is more intensive than it has ever been at any point in time, with predictive-analytics models, with a collection of not only personal/health data, but items like your driving record and your family history—way beyond just normal blood and fluids into personal behaviors, and your credit score, and on to your social-media history. And all those things are being pulled together—prescription checks to identify whether a person should be qualifying for life insurance. And how will that need to change for future mortality studies? I think the idea is we may not exactly know, but we'll have to evolve beyond just normal tabular tables within the SOA into more predictive-analytics models for our members to use in their work, but then also for evaluation of those liabilities once they are written.

The same thing obviously applies to the pension and annuitant side. There's more evidence growing all the time as to what drives different relative mortality risks, both in the population and in private plans and insured cohorts. We've heard through different sessions this week about income and education and all the different socioeconomic factors that are important to learn about in order to drive the future of mortality studies. And so part of our efforts in our experience studies committees and through the staff at the SOA is trying to pull together how we can formulate those things. I would think we would start to see in 2017 more predictive-analytics models on annuity

and life tables. We've already done a little bit of that on the long-term care side in trying to build more of that to put in the hands of members for use with their employers and principals.

Similarly, we're in a process now and starting in 2017 to rebuild up some of our focus on mortality and longevity. We have an ever-growing international membership. For the first time in 2016, we did some partnership with the Chinese Actuarial Association on review of their industry life table that was created. It actually became in effect about two weeks ago—so working with that local association, working with their regulator to do a peer review, to highlight some things that they can look at for their industry. And maybe even when they do a next table, here are some concepts that they should build into the valuation process, leveraging off the expertise of staff and members of the SOA. We formed a Longevity Advisory Group of people to help decide and steer what mortality and longevity projects we should be focusing on for years to come.

We have this concept of a Strategic Research Programs initiative in 2017, where we're really trying to focus on what are the five or six really big research rocks that we want to put in our research jar and make sure that resources flow to those important things, and get the word out to members and stakeholders. And I have to believe that mortality and longevity will eventually become one of those big rocks, and more resources will flow to that. So you'll probably start to see more consistent publication, releases on a wider variety of mortality and longevity topics from the SOA because of that, and not trying to deviate too much from the academic underpinnings of some of these studies. We have, for instance, a mortality-modeling project that we're doing jointly with the Institute and Faculty of Actuaries to build up new, modern mortality-modeling methods beyond what we're accustomed to today.

We have a project on the components of historical mortality improvement that is trying to break down this 1 percent mortality improvement rate into how much is based upon age and period and cohort, and maybe an error term in there as well, for better modeling of mortality improvement in the future. I think Cindy will be pointing out for us some of the new things that we're doing in partnership with Medicare and Medicaid to gather data together and use the WONDER database to create new output for the actuarial profession to use, and most importantly, too, looking at cause-of-death analysis.

Finally, one thing to note if you saw Magali's presentation earlier today: She gave a good understanding of all the details that go into creating the mortality database at HMD, but now the output starts to come as well. And we've got, in the next week or two, a release of cause of death in eight specific countries—a history of that to show what really are the main causes of death and what the trends have been, down to state-level mortality within the United States, given data that the CDC has provided, and then even down to causes of death by state when you mesh those two together.

I did put up here just a quick screen print of what the cause-of-death components of HMD [are]. The eight countries are listed there, and when you drill down into this section of HMD, you start to see different subset details on the major causes of death for these eight particular countries.

With that, that's the end of my quick overview, and I think I'll hand it next to Cindy, in order to cover some of the experience study and population mortality analysis that we're doing.

CYNTHIA MACDONALD: Thank you, everybody. Thank you, Dale. My portion of this discussion is going to be about our learnings of U.S. population databases. In the interest of full disclosure, I'm not the Cindy that presented a couple days ago. That was Cindy Hutchins, but I'm Cindy MacDonald. I've gotten a few compliments on that presentation, so if Cindy is in the audience—I don't think I see her—but I just want to pass those compliments on to her.

There has been a growing interest from our members at the SOA to understand historical and emerging mortality patterns. In light of that, the SOA research department has devoted some resources to look into the available data sources of U.S. population data and to try to understand what is in those data sources and how those data sources might relate to one another. I don't have an agenda per se, but instead, I have this simple graphic. What I intend to do during this presentation is to fill in these five bubbles with the five sources of U.S. population data that I will cover today. So you will see how these sources relate to one another as we fill out this graphic.

The first data source I'm going to cover is the Medicare data. This data comes from the Centers for Medicare and Medicaid Services, or CMS. It's considered to be, as Magali mentioned earlier, a more reliable source of information in the U.S. for ages 65 and above, simply because age is verified. In order to enroll in Medicare, you have to verify your age.

Medicare makes updates to their data on an annual basis. Their updates come out in January of every year, but [there] are lags involved. For example, in January 2016, CMS came out with final death counts as of 2013 and final enrollment counts as of 1/1/2015. Also at that time, they released preliminary death counts for 2014 and preliminary enrollment counts as of 1/1/15. It's important to realize that there are lags in this data, especially if you're dealing with other data sources. And because this database is only for ages 65 and above, you'll likely have to combine this data with other data sources. Unfortunately, this data is not available online. The SOA was able to get this data via a direct request to the CMS.

Here are some considerations when using the Medicare data. As I mentioned, it's only a subset of the full age spectrum. Magali mentioned also, this data is based on people insured by Social Security or Medicare, so it's not the full U.S. population. We've done some work to look at just what percentage of the full U.S. population is represented here. It's about 85 to 90 percent of the full Census Bureau population data, depending on age. If you look at calculating raw death rates from this data, the age 65 rate will be low, and that's because the death counts at age 65 are low. This has to do with the enrollment process. Sometimes people die before the enrollment process is complete. If you wish to use this information, you may want to make some adjustments to death counts at age 65.

Another thing to keep in mind when using Medicare data is that some other census data sources have their population counts as of the middle of the year. The CMS does their population counts as of January 1. If you're going to merge this data with other data for younger ages, you may want to make some type of adjustments and make sure your enrollment counts are on a consistent basis at all ages.

As I mentioned before, the final Medicare data is essentially lagged by a year, and CMS releases preliminary data. We've done some comparisons between the final data and the preliminary data, and they tend to be pretty close. The differences are in the population, in the enrollment counts, mainly at ages 65 to 69. It could be because of some retroactive enrollments coming in later on.

Here, in our graphic, I filled in the CMS bubble. You'll see that CMS data is used in a

couple other data sources that I'm going to discuss.

The next source of data is the CDC data. This is the Centers for Disease Control and Prevention. This data is sourced by the National Center for Health Statistics, which is housed within the CDC. Now, the CDC has a querying facility; it's called WONDER. There's a database behind WONDER with a lot of population data. You can get data by age, by gender, by race. There's cause-of-death information and geographic information. The data goes back to 1999. Some things to keep in mind if you're looking at death counts: the data is aggregated at ages over 100, and the population counts are only available up to age 84.

Here are some considerations if you're using the WONDER data-querying facility. CDC does not do age verification of their underlying data. They base their data from death certificates, and sometimes the date of birth may not be as reliable at older ages. So in recognition of this, they actually phase in the Medicare data over a 30-year period. Also, there are a number of attributes available that you can query on, but you're limited to retrieving five attributes at a time. And if you want to download the data, you can only download a maximum of 75,000 rows at a time. That can be rather restrictive, depending on the analysis you want to do. The CDC is on a cycle to update their data annually, and just a few weeks ago, they updated the 2015 data.

The CDC also has data in a less user-friendly format. This data is stored in CSV or text-type files. There are mortality death files are called the mortality multiple-cause files. There's a file for every year of deaths. They are quite large, so you'll need to have some different tools to access the data in these files. Each file has about 2 to 3 million records, because there's a record for every death, and there are about 2½ million deaths per year in the U.S.

There is more detail available for the advanced ages in the multiple-cause files for ages above 100 than in WONDER. All the fields that are in the WONDER database are essentially in here, with the exception of years 2005 and later. Files for those years do not contain state or county information. This is due privacy regulations that have increased over time. If you want access to state or county data for years 2005 and later, you can go through an organization called NAPHSIS. It stands for the National Association for Public Health Statistics and Information Systems. If you want this data, you have to propose a very specific research project. You must include the names

of your researchers and include their résumés. You also have to state the data, in detail, that you want to study. If NAPHSIS approves your proposal, they will send you the data you requested, and you can complete your proposed research project. However, you will have to remove and delete any data you receive from NAPHSIS after the project is done.

The SOA just recently tried to obtain data with the county and state information from NAPHSIS. We were hoping to reproduce the data behind the WONDER database without the restrictions on the number of records you can download and the number of fields you can query. We were not able to get around the NAPHSIS restrictions to present a specific project. So we're currently on plan B. More to come on that later, but right now, we're just going to be working with these death files without the county or regional information.

There are also population files available on the CDC website. These are the same files you can get from the Census Bureau website. The CDC houses population files back to 1990. These population files contain data available from age 0 to 84. If you'd like information for ages above 84, you can request this from the CDC. I requested this data a week ago, and the CDC was very responsive. I got a response within an hour or so. If you want population data before 1990, you can find it on the Census Bureau website. The links shown on this slide will take you to all this different information.

Here is our graphic again. I put the CDC and Census Bureau in the middle, because, as you will see as we talk about some of these other sources, a lot of the data actually comes from the CDC and Census Bureau.

Our next source is the Social Security Administration. If there are any pension actuaries out in the audience, you're probably familiar with the mortality improvement scales, MP 2014, '15, and '16. And if you work with individual annuities, there's a mortality improvement scale called Scale G2. All these scales—and I believe even prior scales, like Scale AA—all use the Social Security Administration mortality rates as the basis for developing the rates in these scales. So our mortality improvement scales are based on U.S. population data. They're not based on insured data.

Now, when the Social Security Administration [SSA] publishes their mortality rates, they

publish smoothed rates. They smooth the rates within an observation year across different age ranges. There are no population counts or death counts available in this data, just the smoothed mortality rates. The rates are published in the summertime, when the trustees report is released. Last year, that was around June or July. At that time, the SSA published mortality rates through 2013.

Now, I know when I started working at the SOA about six years ago, we were working on Scale G2. I guess I was pretty naive, because when we went to the Social Security Administration to request their mortality rates, I assumed that their mortality rates were based on Social Security data. But they're not. They're actually based on data from the CDC and Medicare data from the CMS.

One consideration with the SSA rates is that those rates are smoothed. If you use these rates, you're essentially adopting their smoothing methodology. If you want to learn more about that methodology, it's described in actuarial study note 120. There's a link available on this page.

This is our graphic again. I filled in the SSA bubble on the bottom. The SSA is getting their data from the CDC and Census Bureau, along with CMS.

Here at the SOA, we thought it would be useful to have the crude rates that are behind the rates that the SSA publishes. Also, the Social Security Administration rates most recently published were through 2013. But there is preliminary data available for 2014 from Medicare, and the data for ages below 65 now available on the CDC website is through 2015. With this data, we thought we could calculate preliminary 2014 SSA-type rates—crude rates, but without the smoothing —and get a jump on the 2014 mortality rate levels. We worked with the SSA and were able to essentially reproduce their mortality rates. We went back to 2000 and recreated the mortality rates, but we stopped short of applying the smoothing methodology. We have a database that's in Excel that has these crude SSA-type mortality rates back from 2000 and through 2013. For 2014, the rates in database are considered to be preliminary, because they're based on the preliminary Medicare data that was available at the time. So if you'd like to take a look at those rates, they're available at the link here.

If anybody has been following recent mortality emergence, you'll concur with some of

these observations. At the end of the last decade, the mortality improvement rates for males and females were averaging around 2 percent level, but in the more recent data, as of 2013 and 2014, these rates are actually closer to zero. This slide contains more specifics if you'd like to look at them.

This slide shows some historical average mortality improvement rates. These rates are for retirement ages only. This is probably hard to read, and I apologize for that. So this is for ages 65 and above. It goes back to 2001. There are some relative peaks here. In 2004, rates peaked around 4 percent for males and 3.4 percent for females, and then in 2009, there was a relative peak around 4 percent. Since 2009, rates have generally been declining, although if you're looking at just the retirement age population, there's a slight uptick in 2014.

Here I'm filling in the graphic again. I've added the SOA crude rates that we've published. Similar to the Social Security Administration, the SOA is using data from the CDC and Census Bureau and Medicare.

I have one last source that I'm going to talk about, the Human Mortality Database, or HMD. I'm not going to go into a lot of detail, because we just heard Magali in the prior session. There are a couple of things I want to point out that were covered in Magali's Q&A. The HMD uses a different methodology to tabulate the deaths and exposures. The HMD data is also sourced directly from the CDC and Census Bureau. HMD is not currently using Medicare data. If you were to look at a comparison of the rates, that will cause some of the differences between the HMD and CDC.

Here I am just filling in the graphic. So the HMD is pulling data currently from the CDC and Census Bureau.

Here is just one final slide before I turn it over to Andy. This is just a comparison of rates between the five sources that I've talked about today. You'll notice the SOA rates are the same as the CDC rates for ages below 65, and they're also the same as the CMS rates for ages above 65, basically because we're using that data directly. Looking at the CDC and HMD rates gives you a feel for how close those methodologies do or don't line up. Again, the difference between the methodologies is the CDC incorporates the Medicare data over a 30-year period, and the HMD has some different tabulation methods.

So with that, I will turn it over to Andy Peterson. Thank you.

ANDREW PETERSON: Thanks, Cindy. I'm going to give a little bit of historical context, and most of this stuff is going to be very familiar to this audience. In fact, I was thinking as I was reviewing this last night that if you ever watched Olympic sports like gymnastics, there are all the technical elements that they have to do to get the basic scores. So I have a few slides up there that are like my technical elements that you all have seen five times already this event. Then I'm going to shift pretty quickly though into projects that the SOA has been doing more on the consumer side of longevity, and some of them you will actually have seen highlighted in events or different sessions already, so I won't go into those in detail. But this is more about giving you the version of all the different things that we're doing, so that you can pique your interest to perhaps go and dig into something a little bit more or just be aware of what the SOA has been doing in different arenas. I find often, as I'm out talking or at events or talking to members, that somebody will say, "Oh, well, you have to do X," and not always, but oftentimes, I can say, "Well, we actually have X done," but the person just wasn't aware of it, and no fault of their own, but it's just, you know, people are busy, and all that sort of thing. So this is really a lot of what I'm trying to do—to build awareness today.

First, for the historical context, I think people will recognize this mortality curve. This is SSA data from the U.S. from 1900, just looking at the mortality curve and then for 1950 and then 2000. Again, we all know this information, but this shows how infant mortality has declined and life expectancy has been pushed out, and really, the mortality curve looks very different now than it did 100 years ago. Certainly, we can add 2010 on here. I also point out that these first four or five slides are all part of—well, most of them are part of—a presentation that we put together that's available on our website as a resource for actuaries if they were trying to use slides in a client presentation. We particularly did it on the pension side when we rolled out the RP 2014 tables, because we wanted people to have a deck of slides that they could use to have an intelligent conversation with their clients, and not just have this conversation of "Well, mortality's improving," or "The SOA's making me strengthen my mortality assumption," and this negative connotation, but more of a factual-based discussion about how things have changed over the last

several years—in this case, actually, 100.

Similarly, then, we've got a chart where we're showing life expectancy at birth. Again, this will not look surprising. It's very similar to other charts that have been shown—life expectancy at age 40, and then particularly for a lot of our actuarial work, particularly pension actuarial work, the life expectancy at age 65 improving but not those dramatic increases. I think if you look at the numbers here—and I think it's very consistent with what I heard our Canadian social security colleagues present at the last session yesterday—that life expectancy at birth is increasing about three years per decade over the 1900s. At age 40, the increase was about a year per decade, and age 65 was about a half a year per decade if you look at that time period.

Similarly—this is my key technical-element slide here, as I think I've seen this in almost every session—the mortality, the squaring the life curve, and again just illustrating with every 10 years from the Social Security Administration, how that has changed over time. And so I'll just keep going.

The one slide that's perhaps a different one that's not actually part of our standard presentation but something I found recently was some work done by the Health Inequality Project. I know this concept was touched on in another session. I'm not sure that these particular slides were, but this is looking at U.S. data, and looking at expected age of death for 40-year-olds, and just showing by different household incomes. What's particularly challenging, of course, here is that you're showing almost a 15-year difference in male life expectancy for somebody who's at the very bottom of the income distribution versus somebody at the very top. You also see the disparities between men and women decline as you move up the socioeconomic status. And again, this is probably not surprising to a lot of folks in this audience, but these are good context slides that I think are helpful if somebody is making a presentation on mortality to a client in that context. It's a little bit small, but if you Google this, healthinequality.org, they have a lot of other interesting slides on that page that would be good for presentation and discussions.

The quick summary of the 20th century was that we did see that life expectancy has increased at birth, very dramatically. More gradual increases at the middle ages so to speak, and from the standpoint of actuaries, we know that undervaluing future mortality improvement is a

real challenge and a real problem, at least in the pension area, where I'm most familiar. We've had a history of understating mortality and mortality improvement, and that's a real problem if you're mispricing your liabilities through your pension plans or your annuities. Obviously, you get a reverse effect on your life insurance, in which case, it could be overpricing, but these are important things.

Also, I think particularly this last point has become much more of something that we're getting a lot more attention to, especially at least in the U.S. context: the variability within subpopulations and some of the work we're doing now, even as we're looking at the next iteration of our RP tables. Actually, we have a project under way with public pensions, and in that context, in the U.S. context, when we mean public pensions, we mean for employees covered by or who work for governments, not social insurance schemes, but we have a public pension mortality setting. We're hoping to look—I'm not sure if we've got the data, but we were hoping to look—by geography as well as different job classifications, public-safety versus general employees, versus teachers, because we know that those subgroups historically have had very different mortality experience.

Now on to some of the work that the SOA has been doing. This is just a list of three different projects that aren't really necessarily consumer oriented but are talking about social-policy aspects, and you'll have seen our Risks and Process of Retirement Survey highlighted in several sessions already. Particularly, there was a short report done in 2015 looking at living longer and the impact on planning—so the longevity aspects. As well yesterday, there was a session where Vicky Bajtelsmit talked on this last project—the challenges of strategies for financing an increasingly long life. So those are a couple of projects that might pique your interest to look at.

In terms of more consumer-oriented projects, I'm going to get into this with the Actuaries Longevity Illustrator. Just out of curiosity, how many of you have heard of that or maybe even been on that website? So maybe a third. Okay. We'll get into that in a minute.

We've also done some work out of the Post-Retirement Needs and Risks Committee on developing what we've termed Age Wise infographics, and I'll show you a couple of those that have been done.

We have a whole series of decision briefs—we call them Managing Retirement Decisions—where we've got 12 of them done. They're not necessarily all about longevity, but they're about retirement-related projects. This is a screen shot, which is probably a little out of focus from where you're sitting, but it's about lump sums or monthly pensions, which to take. So it was trying to give advice, not necessarily directing people to one decision, but one of the issues that individuals need to consider if they're faced with a retirement versus—or an annuity versus lump sum decision as they're leaving their retirement program, their defined-benefit program, and what are some of the considerations that they should think about. All those documents are available just as free downloads of PDFs off of our SOA website.

Now, moving into the infographics, this was the first one we did, focused on longevity, and basically the concept of the infographic is that it is trying to distill a number of facts into a very simple approach, so that consumers can understand it, and it might make sense to them in a way that they might not think about otherwise. So we've got three different key messages on here: The first one [is] that you may live longer than you think, and in that case, we're looking at what the likelihood is that somebody who's in their middle age, in their 50s, will actually live to be 90. And we're saying for females, it's one-out-of-two likelihood, and for males, about one out of three. Similarly, then, we looked at couples and some different statistics about couples, and first, looking at sort of how wives might outlive husbands, and then the joint life expectancy, but trying to boil it down into very simple concepts that people can understand. Then on this right panel, we're talking about the different factors that drive mortality and longevity. Again, this isn't rocket science or anything here. I mean, for all of you in this audience, it's probably very basic, and you might sit here and come up and argue with what we've put up here in the detail, but this is trying to provide what might otherwise feel inaccessible to the average person in the public, and make that available to them in a little more intuitive manner. So that's the first infographic we did.

Then a second one we've done is looking at some research from the risk survey, where we looked at shocks. In this case, this is the graphics in a little different display, so I've got half the graphic on this slide and half on the next. In our risk survey research, we looked at shocks that people experienced in retirement. And so basically, we're saying that seven out of 10 have

experienced one shock, and of those who have experienced those shocks, two of seven have experienced three or more shocks.

Then when we talk about the shocks, you actually see here's what people are saying some of the shocks are. Twenty-eight percent are saying that the shock was a major home repair or upgrade, and this was discussed in another session, so I won't go into details of the surprise of whether that really should be a shock or not. But then we have a few tips about how an individual might actually deal with that shock. Similarly, another shock that retirees identified was dental expenses—which again, you might not think is that that big of a deal, but it's something that people have identified as a shock to them—and again, there are tips about that. Again, the last one we identify in this is out-of-pocket medical. This is, again, an approach to try to get consumers, individuals, participants in the public thinking about longevity, retirement planning, those sorts of things.

So now on to the Actuaries Longevity Illustrator. There have actually been a number of sessions where I've been in an event where we felt like we could have talked about this. I think we'll have time to do a quick demo, but basically, this is a tool that we developed as a joint project with the American Academy of Actuaries.

I think there are two distinctives to this tool versus other tools that might be out there. There are plenty of life expectancy calculators out on the Internet, and some of your firms may have been involved in developing those. We're not disparaging any of those, but I think there are two unique aspects of what we tried to do in developing this tool. One is that we don't really ever say what your life expectancy is. We provide a range of outcomes, and the whole idea is trying to get away from the idea that you can expect to live *x* years and then die, because we know as actuaries that that's not how things work. Similarly, we also added joint life expectancy in this. So the majority of our population is planning for retirement as a couple. Not everybody, I understand that, but many are, and when you look at single life expectancy, that's different than looking at it as a joint basis, as we all know. So those are the two keys that we think were unique to this particular tool.

This just illustrates what my point was about the probability of dying in any specific year is not really that high. This is for a 65-year-old, but you'll see it never peaks much above 4 percent

in any particular year. So it's just illustrating or trying to address misconceptions.

We have a little bit of information we ask. We ask some very basic underwriting questions. One of the financial services firms has a very detailed calculator, but I would have had to have just gone to my yearly physical to actually be able to fill it out by the time they talk about all the—I mean, they're asking for all sorts of cholesterol and all sorts of things like that, which probably gives them a more accurate estimate. But in our case, we didn't want people to have to call their doctor to be able to fill this out. So we have a couple of different, simple underwriting criteria, and then we show the output in three different ways—looking at the probability of living to specific ages, looking at planning horizons, so the chance of survival in both single and joint lifetime information, and then the probability of living for a specific number of years—and I'll show you those in just a minute.

Let me just flip over here, and the web address is there, www.longevityillustrator.org. You can follow along or play along right now if you like. We have an introductory screen, but I'm going to skip right into the get-started information. Basically, we have this set up so you can enter information for two people. I'm just going to say I have Jack, who I'm going to say was born in the '50s, and we have an age for illustration to start. There are little help screens over here on the right for what we mean by these things, but for the illustration age, basically, we're saying that's—in technical terms, that's when we turn on the mortality. So we're assuming people live until this illustration age. I'm going to say 67 for this individual. The idea is, if I'm a 45-year-old entering this information, I might say, "Well, I want to assume I'm going to survive until 65 or 68 or whatever age I think is my retirement age." Enter gender, do I smoke. So this is one of our underwriting criteria. I'll just say yes for this individual, and then general health. The idea here is your general health that relates to who you are and your age group, not necessarily the population as a whole, and so I might say, "Actually, for my age group, despite being a smoker, I think I'm in good health." And then I'm going to enter Jill, and we're going to make her born a few years later, just to illustrate the typical situation; make her a female, although this can go with same-sex couples as well—there's not any restraint there. And we're going to make her average health and review our results. So very simple underwriting criteria. We share the results.

This first chart is just spitting back what the person has entered, so that they have that information. Then three results—three charts of results here on the right—a little description on the left side and the chart on the right. In this case, the probability of living to a specific age. Somebody can kind of look at this and say, "All right, the 50 percent probability is somewhere between—for Jack, it's somewhere between 75 and 80." And they can back into a rough life expectancy, but this is really what we're trying to do is say, "All right, well, there's a 20 percent chance that you're going to live to be age 90," or for Jill, it looks like a 25 percent chance out to age 95. And a little additional feature [is] just that we do give the ability to show any of these charts in a data table as well. So that's the first table we show.

Then the second one we show is a planning horizon, and this is where we bring in, really, the joint life expectancies. So looking at years from the illustration age, what's our chance of survival for different numbers of years? So you might say from a planning perspective, "Well, I want to be 90 percent sure that—or kind of look at the 90 percent likelihood of being alive." So you're going to be over here in this 10 percent probability side, and what we're showing is not only Jack and Jill's individual results, but the likelihood or the probability that either of them will be alive, or that they'll both be alive, and I think particularly the "either" is what, from a planning perspective, is important for couples to understand.

Then the final chart is one where we show basically the same information, but now we're showing probability with just a different display—years from the illustration age again and the probabilities on the *y*-axis with explanation over here. Then the tool encourages people to go back and modify your data, so you can either start over and it clears out everything, or you go modify it and say, "All right, well, what if I changed my health from excellent to average?" or, "Well, I used to smoke, but I don't smoke anymore; how does that impact things?" You can play around with your results, print out a PDF for an individual if they work with a financial planner, [so they can] take that to the financial planner for some discussions with them. Anecdotally, I've heard from at least two financial planners that have emailed us and said that they're using that in their practice now, which is exactly the kind of thing that we'd hoped would happen based on this information.

We've been able to get a lot of publicity around this. We have had a number of personal-finance writers write about this in their columns, and the site itself has had about 100,000 hits—a little over 100,000 since we published it, I think, in April/May time frame, so about a half a year. It's not perfect; there are little things that people said, "You could improve this or change that." But we are trying to really work on that, and we think it's a nice site for individuals.

I think I'm basically done. Conclusions: We know from our risk survey that individuals have a tendency to underestimate their life expectancy, so we hope that this illustrator provides them with a tool to better understand that aspect. And we as the SOA, as the profession, are working to try to make a difference in this area. But educating the public is not something you do overnight; it's a process. And with that, I think I will wrap up my presentation. I think we've got four or five minutes for questions, Dale.

R. DALE HALL: Yeah, we do. We have about five minutes left, if there are any questions or clarifications on anything that the three of us have presented. We've got some mikes in the middle of the room. I'll note as well, I may not have mentioned at the start that we have EA credit forms, if you want to fill those out, and there's some evaluation forms as well that we prefer you help us turn in.

DALE HAGSTROM: I'm Dale Hagstrom from Milliman. A question for Andy: I'm just curious about the mortality assumption that's behind the illustrator. I recognize that there are distinctions there by smoker/nonsmoker, age, sex and some rough sense of health, but I'm curious what, if any, mortality improvement assumptions are in there, and what mortality table or tables did you start with?

ANDREW PETERSON: We debated that a little bit. It is actually in there if you look; it's in the fine print. You can find it. We basically used the 2010 Social Security table for the base table, and we used the MP 2015 mortality improvement scale. So we do have an improvement being projected in there, which some will suggest—I mean, you'll see that for a healthy person, you get some pretty good life expectancy kind of numbers in there. But that was what we were using.

ANNA RAPPAPORT: I just wanted to comment. Andy mentioned some of the projects that we're doing, but we're now also trying to focus on the last part of life. The post-retirement risk research

has been concentrated on pre-retirees and retirees, but we realize that we haven't really included the last years of life, and we're working on that now. So three years from now, we'll have a report for you, or if you watch the publications from the SOA, before that.

R. DALE HALL: I would note, too, one of the things that I've enjoyed watching with the Post-Retirement Risk Survey, too, is now the inclusion, over the past couple of surveys, of interviews of caretakers of people who have had a shock—maybe most importantly, a big health shock in retirement. And since you can't really interview that person directly, you get this kind of firsthand view of a caretaker, whether it's a surviving spouse or a child or something like that—a lot of good information as to what was being planned, what was such a shock, how did the retiree financially deal with it, what were some of the downstream ramifications on that. It's pretty good information in there as well.

ANNA RAPPAPORT: A very late-in-life study that we're doing will combine interviews and some surveys. There will be another caretaker component, because of the difficulty of reaching some of this group. We've discussed how you can reach people who cannot participate directly, and not exclude them. That seems to be the only way to do it. But if you have better ideas, let us know.

R. DALE HALL: So I think we're to the end of this session. I would say, if you're interested in learning more, we're always looking for more volunteers. One of the best ways to kind of keep in tune with some of the stuff that we're doing is to work in our research or experience study or just general practice research committees at the SOA—a pretty helpful way to keep in tune with all that's going on. I appreciate your feedback. Thanks for joining us here, and we'll break for the next session. Thanks. [*Applause*]