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Session 6PD
Changing Patterns in Insured Mortality: Do We Understand Them?

Track: Product Development
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Summary: Panelists identify the changing patterns in insured mortality that we are currently experiencing and that we might experience going forward. These changing patterns in insured mortality are related to:

- *Mortality improvement*
- *Tobacco usage*
- *Age and gender*
- *Effective use of underwriting tools*

Panelists provoke thoughts and questions relative to whether we know enough about the changing patterns of insured mortality to evaluate future business. Not only do we have the mortality patterns of the typical insured population changing, but we also have the basic makeup of this population changing at the same time. The panelists present their thoughts on how to address our need to know more about mortality expectations.

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Note: All charts referred to in the text can be found at the end of the manuscript.

Ms. Katherine A. Anderson: We have three panelists who are going to present to you some interesting and thought-provoking information on mortality trends.

It was very rewarding working with this group in preparation for this session. They are very motivated and have performed a lot of mortality research. Today they are going to share with you the results of some of that research.

To begin, I would like to introduce the first panelist, Mary Broesch. Mary is the director of Actuarial Research at ING Reinsurance in Denver, Colorado. Mary spends the majority of her time performing mortality-related research for ING and ING's clients. In addition, she also assists in the market research and regulatory research of the organization. In her spare time, she participates in technology-related teams and projects at ING Reinsurance.

Mary's actuarial career spans 16 years. Over this period, she worked at Transamerica Occidental, AMEX Life, Certus Financial Corporation, and Security Life of Denver. She currently works at ING Reinsurance. Her experience and responsibilities throughout her career include actuarial research, financial actuarial work, direct response life, A&H pricing and product development, and GIC underwriting and negotiation.

Mary graduated from the University of Nebraska in 1984. She earned her SOA Fellowship in 1997, and she is a member of the AAA. Mary continues to develop her actuarial career through her job responsibilities at ING, her involvement in SOA activities, and her contributions to various industry task forces and councils. Mary will present historical trends and future expectations of secular and insured mortality improvement.

Ms. Mary Ann Broesch: During the next 20 minutes you will gain an appreciation for how and why mortality has changed so dramatically over this past century. A look at the leading causes of death, along with the underwriting tools in use, will provide additional insight into these mortality changes. Finally, we will explore whether recent mortality trends will continue. But, first, let's take a brief look at some factors that affect mortality.

Age and gender are factors that actuaries are most familiar with. Birth year, or birth period, is often referred to as a cohort. Socioeconomic characteristics such as education, occupation, and income significantly influence behavioral health characteristics, such as lifestyle, attitudes, and expectations. Biologically based or healthcare-based factors could include a reduction or elimination of particular diseases, causing a decline or improvement in mortality or a rise in an antibiotic-resistant bacteria, causing an increase or worsening of mortality. Changes in public policy can cause major behavioral changes or have a great influence on biologically based factors which affect mortality, such as tobacco use, disposable income, environment, public health, direct healthcare expenditures, education, and public attitudes. For insured populations, mortality is affected by those who choose to buy insurance and how the insurance products are sold and underwritten.

Chart 1 shows the impact these factors have had on U.S. mortality. It shows the average expected future lifetime at birth from 1900 to 1997 for the general U.S. population. It illustrates the remarkable improvements in mortality over the long run. Since the turn of the century, life expectancy has increased 30 years, from 47 years in 1900 to almost 77 years in 1997. Until about the 1950s extreme short-term fluctuations are evident because of infectious diseases and epidemics. For example, during the 1918 flu epidemic, life expectancies plummeted 24% from 51 years to 39 years. Sir Alexander Fleming's discovery of penicillin as an antibacteria in 1928 contributed to the common use of antibiotics in the 1940s. Thus, during the first half of the century improved medical technology, health behaviors, and standards of living led to enhanced public health and longer life.

After 1950, because of the reduction of infectious diseases due largely to the widespread use of antibiotics, life expectancies over the second half of the century have been much less volatile. During most of the 1950s and 1960s life expectancy was relatively flat, corresponding to the increase of tobacco consumption. According to the Centers for Disease Control (CDC), cigarette smoking is the single most important preventable cause of mortality. After the definitive 1964 U.S. Surgeon General's Report, documenting the negative health consequences of smoking, cigarette consumption has steadily declined. Rick Rogers will delve into this in more detail. In the 1960s the U.S. government encouraged physical fitness as a means to improve health and reduce the risk of death. Thus, the substantial mortality improvement in the 1970s was due to reduced consumption of tobacco and increased exercise. Improvement in the 1980s slowed from the rate seen in the 1970s because of the impact of AIDS and the major flu epidemics of 1985 and 1988, which increased mortality. The information shown on Chart 1 is from the National Center for Health Statistics. Their Web site address is www.cdc.gov/nchswww/, or you may call at (301) 436-8500.

Now, let's compare life expectancy at birth in the U.S. general population with the U.S. insured population. The 1985–90 SOA Basic table for a male, Age Nearest Birthday, is used to represent the insured population. During 1985–90, a male in the secular population could be expected to live about 75 years. As you know, self-selection will weed out those individuals who do not know about life insurance, who have no desire for life insurance, and who cannot afford life insurance. Given the life expectancy of 76.5 years for the ultimate mortality in the 1985–90 table, the selection effect raises life expectancy of the insured population by about 1.5 years. This may also be evidence that the benefits of underwriting last beyond the select period. Based on issue age, the life expectancy based on the 1985–90 table is 87 years. The difference between the select and ultimate life expectancies is 11 years. This difference is due to the effects of underwriting and how the life insurance products are marketed.

Those individuals who buy life insurance have better access to health care and are more likely to adopt healthier lifestyles, less likely to have prevalent disease, and more likely to comply with treatment protocol. Therefore, insured populations are typically healthier, better educated, and more affluent than the secular population and, thus, exhibit lower mortality.

Chart 2 compares how life expectancy for the insured population has changed over the last 25 years, from 1965 to 1990. Based on the SOA 1965–70 table, the difference in life expectancy at birth between select and ultimate mortality is seven years, and this increased to ten years based on the 1975–80 table. Again, these differences are due to underwriting. Testing for nicotine and the effect of reduced tobacco consumption are driving this difference between the 1965–70 and 1975–80 experience. The difference between select and ultimate mortality increased almost four years over this time period, as new underwriting tools have been developed and implemented.

Chart 3 compares the same difference between select and ultimate life expectancy at each issue age, starting at birth. The difference remains relatively constant by issue age.

Let's overlay the secular population experience on top of insured experience. During the 25 years from 1965 to1990, life expectancy at birth improved from 70 to 75 years, for a difference of 5 years, compared to an overall insured improvement from 79 years to 87 years, for a difference of 8 years. Thus, insured mortality improvement has outpaced secular improvement because of better underwriting tools.

What about the annual rate of change in age-adjusted death rates for the general U.S. population over various time periods? Age-adjusted death rates eliminate the distorting effects of the aging of the population. In other words, they show the level of mortality with no changes in the age composition of the population from year to year. Negative numbers indicate declines in mortality or mortality improvement. Positive numbers indicate increases in mortality over time or mortality deterioration.

The largest decline in mortality is during 1970–75, when mortality improved by 2.25% per year. Once again, this is due to the promotion of public health, widespread vaccinations, cessation of smoking, and increased exercise. From 1970 to 1985, there was more improvement in the younger ages compared to the older ages, especially in infant and child mortality. From 1985 to 1995, the older ages saw significantly greater improvement than the younger ages because of better treatment of heart disease. Also, during this time three major flu epidemics in 1985, 1988, and 1993 caused mortality to increase during those years. Given more variability over shorter time periods, careful consideration must be taken when forecasting mortality changes since results are very sensitive to the time period chosen.

During the 1970s mortality improved about 2% per year, compared to about 1% in the 1980s, with most improvement occurring at the youngest ages. From 1965 to 1995, mortality improved about 1% per year, with the youngest and oldest ages improving slightly more than the middle ages.

Table 1 shows the top 14 causes of death in the general U.S. population. Over half of all deaths are due to heart disease or cancer. The second column shows the percentage of the cause of death to the total in 1996, unadjusted for age. The top 5 causes represent 71% of all deaths in 1996. The third column shows the age-adjusted change in mortality over the time period from 1976 to1996. Again, negative numbers indicate declines in mortality, while positive numbers indicate increases in mortality. The last column shows whether the mortality change in the general population carries over to the insured population.

Large declines in mortality for heart disease and stroke are related to risk factor modifications and improved treatments. Similar risk factors exist for both diseases, including hypertension, hyperlipidemia, and smoking. Drugs that control high blood pressure and high cholesterol, and changes in lifestyle—most notably reduced smoking and increased exercise—play a major role in these past mortality reductions. All of the mortality improvement in the general population is occurring in the insured population. Heart disease treatments include stenting, angioplasty for coronary heart disease, drugs for congestive heart failure, and minimally invasive coronary bypass procedures.

TABLE 1
1996 U.S. POPULATION MORTALITY BY MAJOR CAUSE OF DEATH

Cause of Death	Percentage of Total 1996 Deaths	Mortality Changes 1979–96	Impact on Insured Population (Est.)
1. Heart Disease	31.7%	-32.6	ALL GAIN
2. Cancer	23.3	-2.2	ALL GAIN
3. Stroke	6.9	-36.5	ALL GAIN
4. COPD	4.6	+43.8	1/2 LOSS
5. Accidents (1/2 MV)	4.1	-29.1	ALL GAIN
6. Pneumonia/Flu	3.6	+14.3	ALL LOSS
7. Diabetes	2.7	+38.8	1/2 LOSS
8. HIV	1.3	+101.8*	1/3 LOSS
9. Suicide	1.3	-7.7	ALL GAIN
10. Chronic Liver	1.1	-37.5	ALL GAIN
11. Kidney Disease	1.0	0	0
12. Septicemia	0.9	+78.3	ALL LOSS
13. Alzheimer's	0.9	+1250.0	ALL LOSS
14. Homicide	0.9	-16.7	ALL GAIN
Others	15.5	-11.5	
Total—All Causes	100.0	-14.8	

Source: Peters, Kochanek, Murphy, NVSR Vol. 47, No. 9 1998, and NCHS
*HIV Rates for 1987–96

Over most of this century death from cancer has changed very little. Since 1991 mortality from cancer has started to improve as a result of risk factor modifications and early detection through screens such as mammograms for breast cancer and prostate-specific antigen screening for prostate cancer.

Mortality from chronic obstructive pulmonary disease (COPD), or chronic lung disease, has increased significantly and is related to cigarette smoking. Although smoking is on the decline, elevated mortality effects last long after someone quits. COPD includes emphysema with increases in mortality related to environmental effects such as pollution. It is estimated that only half of the increase in mortality is transferred to the insured population since chest X-rays and nicotine testing screen out those at risk.

About half of all accidents are from motor vehicles. Accidents have also shown significant declines in mortality, with lower speed limits and increased use of seat belts having the greatest impact. The 102% increase in HIV is over nine years. It was first tracked separately in 1987.

Septicemia, staph infection, or bacterial infection of the blood affects older ages more than younger ages. Does anyone know why this is increasing?

Alzheimer's change over 17 years is misleading. There really has not been that big of an increase in its prevalence; instead, doctors are becoming more aware and are classifying it more as a primary cause of death. The insured population has not really seen an increase in Alzheimer's, right?

The leading cause of death varies significantly by age. For ages under 45, the top cause of death is accidents. Cancer is the top cause for ages 45–64, and heart disease is the number one cause for ages 65 and older. Table 2 shows the top ten cases of death by age group.

TABLE 2
1996 TOP TEN CAUSES OF DEATH BY AGE GROUP FOR U.S. POPULATION

Ages 25–44	Ages 45–64	Ages 65 and older
1. Accidents	Cancer	Heart Disease
2. Cancer	Heart Disease	Cancer
3. HIV	Accidents	Stroke
4. Heart Disease	Stroke	COPD
5. Suicide	COPD	Pneumonia/Flu
6. Homicide	Diabetes	Diabetes
7. Chronic Liver Disease	Chronic Liver Disease	Accidents
8. Stroke	HIV	Alzheimer's
9. Diabetes	Suicide	Kidney Disease
10. Pneumonia/Flu	Pneumonia/Flu	Septicemia

Source: Anderson, Kochanek, and Murphy, NVSR, Vol. 47, No. 9

Are the leading causes of death different for the insured population? Based on the latest SOA study found in the *TSA 1995–96 Reports*, "Mortality by Cause of Death Under Standard Ordinary Insurance Issues Between 1983 and 1988 Anniversaries," there are some surprising differences. Accidents and homicide for the secular population are combined to make a direct comparison with the insured population.

The top three insured causes of death for the insured population correspond to the top three causes of death for the secular population at ages 45–64. The differences shown in Chart 4 reflect how effective the underwriting tools are in screening out potential risks, as well as the composition of the insured population.

Excellent underwriting tests, such as EKGs, treadmill testing, lipid analysis, and nicotine testing are used to evaluate the risk of heart disease and stroke. In the past there were not very effective underwriting screens for cancer. In the insured population, suicide is the number four cause of death. This suggests antiselection is occurring, despite the incontestability clause.

Table 3 repeats the top 14 causes of death in the secular population for 1996. The tables list the underwriting tests that are currently in use and ones that will likely be in use in the future. Since I'm an actuary and not a medical doctor or an underwriter, I do not claim to understand everything in these tables. However, it does lend additional evidence to support the declines in mortality because of underwriting advances.

TABLE 3
UNDERWRITING SCREENS

Cause of Death (1996 % of Total)	Routine Tests	New Tests	Future Tests
1. Heart Disease (31.7%)	EKG, TM, Lipids, Nicotine Testing	Microalbuminuria	Non-invasive CAD Testing (Ultrafast CT), Genetic Markers, Apolipoprotein Analysis, Homocysteine
2. Cancer (23.3)	LFTs Albumin, Globulin, Nicotine Testing, CXR, PSA		Genetic and Tumor Markers (Cancer Specific)
3. Stroke (6.9)	EKG, TL, Lipids, Nicotine Testing	Microalbuminuria	Non-invasive CV Testing
4. COPD (4.6)	CXR, Nicotine Testing		PFT Testing Use
5. Accidents (4.1)	MVRs, LFTs, Cocaine Testing	Alcohol Markers	Better Alcohol Markers
6. Pneumonia/Flu (3.6)			
7. Diabetes (DM) (2.7)	BSHgb, A_{1c}, Fructosamine, Urinalysis: Glucose, Protein	Microalbuminuria	Genetic Markers
8. HIV (1.3)	Blood Testing, Saliva, Urinalysis		
9. Suicide (1.3)	Contestable Period, Alcohol Markers		
10. Chronic Liver (1.1)	LFTs, Albumin, Globulin, Alcohol Markers	Hepatitis B and C Testing	Other Hepatitis Markers
11. Kidney Disease (1.0)	BUN, Creatine, Urinalysis, Blood Pressure Exam	Microalbuminuria	Genetic Markers
12. Septicemia (0.9)			
13. Alzheimer's (0.9)		PHI for ADLs	MMSE, Apolipoprotein, Albumin, Genetic Markers
14. Homicide (0.9)	MVRs, Cocaine Testing, Alcohol Markers		Internet

Here are some clarifications and definitions for the acronyms listed in Table 3:
EKG—shows abnormalities in heart pattern that could indicate heart disease
TM—tread mill/stress test
GXT—graded exercise test

Microalbuminuria—urine test; albumin and globulin are blood tests
LFT—liver function test (blood test)
CAD—coronary artery disease
CV—cerebrovascular disease
CXR—chest X ray
PFT—pulmonary function test—blow into machine to test lung capacity
MVR—motor vehicle report
BS—blood sugar
BUN and creatinine are blood tests for kidney disease
PHI—personal history interview/inventory
ADLs—activities of daily living
MMSE—mini-mental status exams; indicates cognitive impairment
Internet—to check criminal history

Table 4 repeats the top causes of death once more. The second column shows the mortality changes we looked at before. The third column is an annualized rate of change over the 1979–96 time period. The fourth column is the annual rate of mortality change between 1996 and 1997. This data was recently released by the CDC and is still preliminary. Again, negative numbers indicate mortality improvement and positive numbers indicate increases in mortality. The last column gives a forecast as to whether or not recent trends will continue over the next five years.

TABLE 4
WILL THE RECENT TRENDS CONTINUE?

Cause of Death	Mortality Changes 1979–96	Annual Rate* 1979–96	Preliminary Mortality Changes 1996–97	Mortality Changes (Estimate) Next 5 years
1. Heart	-32.6	-2.3	-3.4	↓
2. Cancer	-2.2	-0.1	-2.3	↓
3. Stroke	-36.5	-2.7	-1.9	↓
4. COPD	+43.8	+2.1	+1.9	↑
5. Accidents (1/2 MV)	-29.1	-2.0	-4.9	↓
6. Pneumonia/Flu	+14.3	+0.8	+3.1	←→
7. Diabetes (DM)	+38.8	+1.9	-1.5	↑
8. HIV	+101.8[(A)]	+7.8[(A)]	-46.8	↓
9. Suicide	-7.7	-0.5	-4.6	↓

TABLE 4
CONTINUED

Cause of Death	Mortality Changes 1979–96	Annual Rate* 1979–96	Preliminary Mortality Changes 1996–97	Mortality Changes (Estimate) Next 5 years
10. Liver	-37.5	-2.8	-4.0	
11. Kidney	0	0	+4.7	
12. Septicemia	+78.3	+3.4	+2.4	↑
13. Alzheimer's	+1250.0	+15.3	0	
14. Homicide	-16.7	-1.1	-11.8	
Others	-11.5	-0.7	+2.9	Unknown
Total—All Causes	-14.8	-0.9	-2.7	-1.0 to -2.0

Source: Peters, Kochanek, Murphy, NVSR Vol. 47, No. 9, 1998, and NCHS
*Annual rate based on exponential growth
(A)HIV Rates are for 1987–96

The forecasts are based on historical trends, potential medical advances, and potential rises of new diseases. Predictions over the next five years can be made with some degree of confidence. However, there are many unknowns beyond that, most notably the impact that the Human Genome Project will have over the next five to ten years. Over the next 10–30 years, there are many potential scenarios. However, one thing is certain, mortality improvement cannot be projected indefinitely. Some believe that there is a theoretical biological age that humans cannot live beyond. If this is the case, then improvements in life expectancy will slow down and life expectancy will remain level at some point.

Rather than going through each cause, I will just make a few brief points. Much of this has already been discussed. Upon further review, some of the mortality changes expected over the next five years have been updated compared to what is in Table 4. For example, since 1980 the only years that have not shown declines in mortality are 1985, 1988, and 1993. The reason for this is major outbreaks of flu. If this continues to occur every three to five years, there could be another one in the next five years.

The huge decline of 47% in mortality related to HIV has caused HIV to drop to the 14th leading cause of death in 1997. New medical treatments, such as triple-drug therapy, are causing this decline. However, it is important to note that these new treatments could just be delaying death.

Some believe hepatitis C may become a leading cause of death with mortality exceeding that of AIDS. If this is true, mortality from chronic liver disease will not continue to decline and may in fact start to rise over the next five years.

Overall, mortality in the secular population is expected to decline in the near future, perhaps 1–2% each year. On top of this, perhaps another 1–2% decline could occur in the insured population because of new and future underwriting tests. However, a word of caution is necessary: These aggregate scenarios can and do vary for specific segments of a population.

In summary, we have seen huge declines in U.S. general population mortality. Since 1965 mortality has improved about 1% each year on average, and life expectancy has increased by five years. Medical advances and changes in health behaviors, especially smoking, are the primary drivers. Additional declines in insured mortality have increased life expectancy almost four years because of advances in underwriting. Finally, overall mortality improvement is expected to continue in the near term, but at varying rates for different population segments.

Ms. Anderson: Nick Simonelli is vice president and actuary at the Prudential Insurance Company of America in Newark, New Jersey. Currently Nick spends the majority of his time on the reinsurance of Prudential's individual life business. Nick's actuarial career spans 28 years. He has spent all 28 of those years at Prudential. He has worked in individual and group life, health, and annuity lines of business. Nick graduated from Rutgers University in 1971. He earned his SOA Fellowship in 1977, and he continues to expand his actuarial insurance-related knowledge through his activity at Prudential and his involvement in the SOA and other industry activity. Today Nick will present somewhat of a case study. He's going to present his findings on gender-specific mortality trends; much of this information is coming from Prudential's experience. I trust some of Nick's findings will resonate with you, and from what I've heard and what he's presented here, he's going to provoke some questions in your mind that I think will apply over to your own company's mortality experience.

Mr. Nicholas M. Simonelli: When I started working for Prudential in the 1970s, individual life insurance premium rates for women were determined by using male rates and an age setback to reflect that females live longer. Life insurance was basically a male market, and it was acceptable to use approximations for females. As the female market grew, we started to price for women using their own experience. Through the years more and more attention has been given to mortality differences by gender. Nevertheless, we might ask ourselves how much we really know about these differences and what is causing them. I will share with you data reflecting the changing patterns of mortality by gender. This will include data from Prudential, the industry, and the general population. Following that, I will examine some of the possible reasons for these patterns.

To begin, let's look at Prudential's experience. The experience that I'm about to show you is from our regular ordinary business. It is the combined experience of our traditional permanent, term, and variable and interest-sensitive products; our nonmedical, paramedical, and medical business; and our smoker and nonsmoker business. This experience excludes substandard rated business, corporate-owned life insurance business, group and term conversions, and any business beyond the 20th policy duration. The experience period is from 1982 to 1998. The 1982 and 1998 exposures by number of policies and face amounts are shown in Table 5. Exposures for the other years generally fall between the 1982 and 1998 figures. I believe that the exposures are significant enough to provide credible patterns of mortality over the experience period.

TABLE 5
EXPOSURES

Males	Number of Policies	Amounts of Insurance
1982 1998	4.9 million 2.2 million	$72 billion 144 billion
Females	**Number of Policies**	**Amounts of Insurance**
1982 1998	3.2 million 2.4 million	$27 billion 84 billion

I wish I could show you gender-specific trends in mortality for various homogeneous classes of business such as medically examined business in the nonsmoker rating class. Unfortunately, our historical files did not yield this level of detail. What was available were the male and female ratios of actual-to-expected claim amounts for all classes combined with a calculation of expected claims based on the 1975–80 Basic tables. The following charts show these ratios over the experience period. Chart 5 is for males. These ratios are slightly over 100% at the beginning of the period and trend downward steadily to around 70% at the end of the period. Chart 6 is for females. These ratios are generally over 100% at the beginning of the period and also show improvement over the period. However, unlike Chart 5, Chart 6 shows virtually no improvement in female mortality after 1989. In fact, there is a slight deterioration in the ratios over the last few years in the experience period. When Chart 5 and Chart 6 are shown side-by-side in Chart 7 we note that the trends are comparable until 1992. Beginning in 1993, however, they begin to diverge. Is the recent female trend an aberration? Will the divergence in trends by gender continue? Is this just a Prudential phenomenon or is it something that is happening within the industry? These are important questions for insurers and reinsurers focusing on a market segment that continues to grow in importance.

Now let's look at industry experience. In 1998 SOA published its 1985–90 Basic tables. The following set of tables shows the changes in mortality from the earlier

1975–80 Basic tables for selected issue age groups and durations. Table 6 shows the ratios of the male mortality rates in the 1985–90 tables to the rates in the 1975–80 tables. A ratio under 100% represents an improvement. Mortality has improved for all cells in the table except for issue age group 25–29 at duration 7 and issue age group 65–69 at duration 16. Table 7 shows the ratios for females. Some of the ratios are lower than the corresponding ones for males, indicating a greater improvement for females over the period. However, there are several cells for which the ratios are over 100% indicating a deterioration in mortality over the period. These cells are concentrated at the higher issue age groups and later durations.

TABLE 6
RATIO OF MALE MORTALITY RATES
FROM 1985–90 BASIC TABLES TO 1975–80 BASIC TABLES
(FOR SELECTED AGE GROUPS AND DURATIONS)

	Duration					
Issue Ages	**1**	**4**	**7**	**10**	**13**	**16**
25–29	63%	93%	104%	97%	88%	93%
35–39	69	72	71	75	74	85
45–49	94	77	79	91	92	93
55–59	78	87	85	86	72	81
65–69	88	69	81	87	96	118

TABLE 7
RATIO OF FEMALE MORTALITY RATES
FROM 1985–90 BASIC TABLES TO 1975–80 BASIC TABLES
(FOR SELECTED AGE GROUPS AND DURATIONS)

	Duration					
Issue Ages	**1**	**4**	**7**	**10**	**13**	**16**
25–29	55%	73%	83%	82%	71%	76%
35–39	52	68	66	73	81	91
45–49	64	95	88	94	96	98
55–59	74	100	106	108	114	125
65–69	82	125	114	103	112	133

Table 8 shows the differences between the male ratios and the female ratios. A positive value means that the change in female mortality was more favorable than the change in male mortality. A negative value means the opposite. A definite pattern has emerged with the females showing relatively greater improvement in mortality at the younger ages and early durations and the males showing relatively greater improvement at the older ages and later durations. Since we do not yet have basic tables based on experience for the 1990s, I cannot demonstrate whether the divergence in the mortality trends by gender experienced by Prudential is being experienced by the industry as a whole. However, I did conduct an informal survey of six of the companies that contributed data to the SOA to develop the 1985–90

Basic tables. In general, five of the six companies have experienced more favorable male mortality trends than female trends in the 1990s. The sixth company experienced similar trends for the males and females.

TABLE 8
ABSOLUTE DIFFERENCES IN MORTALITY IMPROVEMENT BY GENDER

	Duration					
Issue Ages	**1**	**4**	**7**	**10**	**13**	**16**
25–29	8%	19%	22%	15%	17%	16%
35–39	17	3	5	2	-7	-6
45–49	29	-17	-9	-3	-4	-4
55–59	4	-13	-21	-22	-42	-44
65–69	6	-56	-33	-16	-17	-15

Now let's look at some trends in mortality in the general population. Table 9 shows average annual rates of improvement in mortality for males and females for all ages combined by decade throughout the 20th century. As you can see, from the 1920s to the 1970s female mortality improved at a faster rate than male mortality. However, in the 1980s this relationship was reversed. Furthermore, in the 1990s female mortality actually increased slightly while male mortality continued to improve. These same trends are noticed when examining life expectancy. Table 10 shows the life expectancy at birth for males and females every ten years throughout the century starting in 1905. The difference between female life expectancy and male life expectancy generally increased until 1975 when it reached its peak of 7.8 years. Since 1975 the difference has declined. In 1995 the difference of 6.4 years was the smallest difference in 35 years. While not shown in Table 10, the difference for 1996 was 6 years, which was the smallest difference in 46 years. Table 11 shows the average annual rates of improvement in mortality for selected age groups from the 1970s through the 1990s. The deterioration in female mortality relative to male mortality, which we saw take place in the 1980s and 1990s, appears to have taken place at the older ages, that is, around age 50 and above. If we focus on the 50–64 age group, we see that the average annual percentage reduction in mortality for males was more than one-half of a point higher than for females over the 24-year period. When studied by cause of death the areas of greatest relative improvement in mortality for males versus females in the 50–84 age group from 1968 to 1994 were for heart disease, respiratory disease, and digestive disease.

TABLE 9
AVERAGE ANNUAL PERCENTAGE REDUCTIONS
IN AGE-ADJUSTED DEATH RATES FOR U.S.
(ALL AGES COMBINED)

Time Period	Males	Females
1900–10	0.59	0.85
1910–20	0.44	0.07
1920–30	-0.15	0.65
1930–40	0.61	1.18
1940–50	1.68	2.52
1950–60	0.37	1.12
1960–70	0.09	1.29
1970–80	1.82	2.25
1980–90	0.82	0.64
1990–94	0.44	-0.07

Source: Office of the Chief Actuary, Social Security Administration

TABLE 10
GENDER DIFFERENCES IN U.S. LIFE EXPECTANCY AT BIRTH

Year	Males	Females	Absolute Differences
1905	47.3	50.2	2.9
1915	52.5	56.8	4.3
1625	57.6	60.6	3.0
1935	59.9	63.9	4.0
1945	63.6	67.9	4.3
1955	66.7	72.8	6.1
1965	66.8	73.8	7.0
1975	68.8	76.6	7.8
1985	71.1	78.2	7.1
1995	72.5	78.9	6.4

Source: Centers for Disease Control and Prevention, July 1996

TABLE 11
AVERAGE ANNUAL PERCENTAGE REDUCTIONS
IN AGE-ADJUSTED DEATH RATES FOR U.S.
(BY AGE GROUP)

Time Period		15–49	50–64	65–84
1970–80	Males	2.28	2.44	1.55
	Females	3.25	1.91	2.19
1980–90	Males	0.00	1.64	1.02
	Females	1.00	0.79	0.54
1990–94	Males	-0.87	1.27	0.90
	Females	-0.71	0.75	-0.09

Source: Office of the Chief Actuary, Social Security Administration

Now that we have looked at the trends and experience, I would like to examine potential reasons for their occurrence. The first is smoking habits. We should examine whether something as simple as a shift in the distribution of business by smoking status is having an impact on Prudential's actual-to-expected ratios.

Smoking habits could also explain the trends in the industry and the general population. Table 12 shows the prevalence of smoking among adult males and females in the general population for selected years starting from 1965. Table 12 shows that the prevalence of smoking has declined from 1965 to 1994. The prevalence declined more for males than females. The absolute difference between the percentage figures for males and females was 18% in 1965. By 1985 this difference leveled off at about 5%. I have no doubt that this greater decline in the incidence of smoking among males has contributed to a greater improvement in mortality for males in the general population. Before we can determine what impact the prevalence of smoking has had on the Prudential actual-to-expected ratios, we need to examine how the Prudential exposures have changed over the years.

TABLE 12
PERCENTAGE OF U.S. ADULTS WHO SMOKE

Year	Males	Females	Absolute Differences
1965	51.9%	33.9%	18.0%
1974	43.1	32.1	11.0
1985	32.6	27.9	4.7
1994	28.2	23.1	5.1

Source: Centers for Disease Control and Prevention, July 1996

Table 13 shows the distribution of the amounts of insurance exposed by smoker status for selected years from 1987 to 1997. As you can see from the table, the percentage of males and females classified as smokers has been declining. Therefore, this would account for some of the downward trends in Prudential's actual-to-expected ratios. However, the distributions of business by smoking status have been the same for males and females for each of the years in the table. Therefore, this by itself does not appear to explain the divergence in Prudential's actual-to-expected ratios by gender. Before reaching the conclusion that the divergence in the ratios is not due to smoking, we should examine the ratio of smoker mortality to nonsmoker mortality separately for males and females. If the ratio for males is higher than the ratio for females, then the reduction in our smoker exposures would be contributing to the divergence in Prudential's actual-to-expected ratios by gender. Table 14 shows the ratios of our smoker actual-to-expected ratios to our nonsmoker actual-to-expected ratios. As you can see, these have been a little higher for females than for males. Therefore, we cannot say that smoking habits have been a factor in the divergence of Prudential's experience by gender.

TABLE 13
DISTRIBUTION OF PRUDENTIAL AMOUNTS OF INSURANCE EXPOSED
BY SMOKER STATUS

	Males		Females	
Year	Nonsmoker	Smoker	Nonsmoker	Smoker
1987	79%	21%	79%	21%
1989	80	20	80	20
1991	82	18	82	18
1995	84	16	84	16
1997	85	15	85	15

TABLE 14
RATIO OF SMOKER MORTALITY TO NONSMOKER MORTALITY FOR PRUDENTIAL

Year	Males	Females
1987	207%	190%
1989	206	222
1991	201	204
1995	216	229
1997	Not Available	Not Available

The next potential reason for the different trends in mortality by gender is AIDS. As everyone knows, AIDS began to have its impact on the U.S. population in the 1980s. It quickly became the number 1 cause of death for males in the 25–45 age group. No doubt this was a factor in the trends seen in male mortality in SOA's basic tables. As we saw earlier, it was the younger ages where the males did not improve as much as females from the 1975–80 tables to the 1985–90 tables. As trends in AIDS were emerging, one of the questions on people's minds was, would the disease and its impact on mortality spread from the few high-risk groups to which it was limited to the mainstream population? If so, it would spread from a population comprised almost totally of males to one with a significant female representation. The gender mix of AIDS claims for Prudential is shown in Table 15. It shows that female AIDS claims as a percentage of total AIDS claims have increased since 1988. However, the 11.5% figure for 1997 is still a disproportionately low figure. Taking into account that our total AIDS claims are still a small percentage of our total claims, AIDS has not caused anything more than a small upward blip in Prudential's actual-to-expected ratios for females.

TABLE 15
DISTRIBUTION OF PRUDENTIAL AIDS CLAIMS BY GENDER

	1988	1991	1994	1997
Males	96.2%	94.7%	91.1%	88.5%
Females	3.8	5.3	8.9	11.5

The next potential reason for the different trends by gender is the role of women in society. Table 16 shows the percentage of men and women in the civilian population who were employed at various points in time starting with 1960. It shows that from 1960 to 1997 the percentage of women employed increased from 35.5% to 56.8%, a 60% increase. Table 17 shows the percentage of men and women in the civilian population who were employed in managerial and professional jobs; that is, jobs that entail significant amounts of responsibility. From 1983 to 1992 the percentage of women in managerial and professional jobs increased from 10.5% to 17.5%, a two-thirds increase. Table 18 shows the average total fertility rates for the U.S. starting with the 1960–64 period. While this table shows a decrease from the 1960–64 period to the 1970–74 period, the total fertility rates basically have been level ever since. We have seen that over the same period women have continued to enter the workforce. Therefore, women appear to be managing both a career and a family. In fact, for many women family responsibilities have increased. The percentage of U.S. families headed by a woman increased from 19% in 1980 to 27% in 1997. Some of these societal changes may suggest that women are under greater pressure and have less leisure time today than years ago. However, they also may experience more self-fulfillment and a greater sense of self-worth, which can have a beneficial impact on disease and mortality. I cannot say definitively what impact, if any, the changing role of women in society is having on their mortality. Nevertheless, these significant changes do tend to raise our curiosity about their impact.

TABLE 16
PERCENTAGE OF U.S. MEN AND WOMEN
IN CIVILIAN POPULATION WHO ARE EMPLOYED

Year	Males	Females
1960	78.9%	35.5%
1970	76.2	40.8
1980	72.0	47.7
1990	72.0	54.3
1997	71.3	56.8

Source: Statistical Abstract of the United States, 1987 and 1998

TABLE 17
PERCENTAGE OF U.S. MEN AND WOMEN
IN CIVILIAN POPULATION WHO ARE EMPLOYED
IN MANAGERIAL AND PROFESSIONAL JOBS

Year	Males	Females
1983	16.7%	10.5%
1997	19.7	17.5

Source: Statistical Abstract of the United States, 1987 and 1998

TABLE 18
TOTAL FERTILITY RATES FOR U.S.

Time Period	Average Fertility Rates
1960–64	3.4
1965–69	2.6
1970–74	2.1
1975–79	1.8
1980–84	1.8
1985–89	1.9
1990–94	2.1
1995	2.0
1996	2.0

Source: Statistical Abstract of the United States, 1998

The next potential reason for the different trends by gender is advances in medicine. One reason that male mortality has been improving faster than female mortality over the last 10 to 20 years may be that men have benefited more than women from medical research. In general, illnesses affecting both men and women have not been studied in women as well as they have been in men. Many research studies have included only male subjects, and their findings may not be as applicable to females. This applies to studies of disease, prevention, and treatment. Heart disease is the number one cause of death in the general population for both men and women at all ages. In 1995 heart disease accounted for 31% of all deaths for males and 33% of all deaths for females. Improvement in mortality because of heart disease has been the greatest area of improvement in overall mortality for many years. Furthermore, the improvement for males has exceeded the improvement for females. Chart 8 shows the total number of deaths from heart disease for males and females from 1979 to 1996. Starting in 1984 the number of female deaths exceeded the number of male deaths, and the difference has been growing. Table 19 shows the reductions in death rates for heart disease from 1980 to 1995 for various age groups by gender. For each of these groups the male death rates have decreased more than the female death rates.

TABLE 19
CHANGE IN ANNUAL DEATH RATES FOR HEART DISEASE 1980–95

Age Group	Males	Females
45–54	-40%	-34%
55–64	-38	-29
65–74	-36	-33

There are a number of reasons why mortality for heart disease has been improving at a greater rate for males than females. One is that heart disease has been regarded as a male disease. As a result, male heart disease has received more attention than female heart disease in the laboratory, in public health messages, and in doctors' offices. In a 1995 Gallup survey 80% of women ages 45–75 and 32% of physicians did not know that heart disease was the number 1 cause of death in American women. One reason for this lack of knowledge may be the fact that heart disease strikes men earlier in life than it does women. On average, women develop heart disease 10 years later in life than men and have myocardial infarction and sudden death 20 years later in life than men. Another reason may be due to the fact that studies through the years have shown a poor correlation between chest pain and heart disease in women. Therefore, chest pain in men is likely to be taken more seriously. Whatever the reasons, the relative lack of knowledge about cardiac risk in women is believed to have resulted in women not seeking medical evaluation for potential symptoms in as timely a manner as men do. It is also believed to have resulted in physicians not pursuing appropriate diagnostic testing for women in as timely a manner as they do for men.

Another reason why mortality from heart disease has been improving at a greater rate for males is that noninvasive diagnostic testing procedures are not as reliable for women as they are for men. These procedures include the stress electrocardiograph test, the stress echocardiograph test, and nuclear perfusion imaging. Because physicians have greater confidence in these test results for men, they are more likely to refer men with abnormal test results for invasive testing and treatment in a timely manner. Still another reason for the more rapid improvement in heart disease mortality for men has to do with lipid risk evaluation. Traditionally, this has focused on low density lipid, which is of primary importance in men. In contrast, high density lipid, and triglycerides, which are more important for women, have been given less attention.

Another potential reason for the trends in gender is medical underwriting. Just as a gender bias in medical research may be contributing to a greater improvement in male mortality in the general population, a gender bias in life insurance medical underwriting may be having an additional impact on mortality differences by gender in the insured population. First, underwriting tools and guidelines have more often been based on male studies. Second, the same rules are used for male and females to determine when a medical examination or a specific test is required. Third, except for blood pressure and build, underwriting decisions for males and females are based upon the same specific test criteria. For example, in the absence of any other known differences a total cholesterol reading of x milligrams per milliliter would result in the same risk classification for males and females. The use of cholesterol in medical underwriting may be a factor in Prudential trends in mortality by gender in the 1990s. Blood testing became a regular requirement for large face amounts in the late 1980s as a result of the growing concern for AIDS. However, just as cholesterol readings may not be of equal value in assessing the risk of heart disease in men and women, we may not be deriving equal benefit from them in the risk classification of male and female applicants.

Ms. Anderson: I would like to introduce the third panelist, Dr. Rick Rogers from the University of Colorado. Dr. Rogers is a leading expert in the educational field. He holds both a Ph.D. and a Masters in Demography and serves on the faculty of the University of Colorado in the department of population studies.

Rick has a well-established track record of research in demographic and behavioral risk factors associated with mortality and has most recently focused on issues related to smoking and the recurrence of infectious diseases.

Dr. Rogers is going to present trends in tobacco usage and relate these trends to other mortality risk factors and to the smoker-related mortality rates. He will also identify cause-specific mortality as it relates to smoking.

Dr. Richard G. Rogers: Understanding cigarette consumption is of vital importance since smoking contributes to chronic conditions, functional limitations, and higher overall and cause-specific mortality. From an actuarial perspective, smoking contributes to sex differences in mortality and age differences in mortality and influences mortality improvement over time.

There is vast smoking literature, as exemplified by this quote from Fletcher Knebel in 1961: "It is now proved beyond a doubt that smoking is one of the leading causes of statistics."

We will review historical trends in cigarette smoking and examine the current patterns and compositional effects of former smokers among nonsmokers, heavy smokers among current smokers, and age, period, and cohort effects. I will also speculate about future directions in secular mortality declines, underwriting, and composition.

These are the key questions: How do smoking rates vary by sex and age? What is the composition of smokers and nonsmokers? How will smoker and nonsmoker risks change in the future? Also keep this riddle in mind: How can mortality improve for a group without improving?

Historical Cigarette Consumption

Tobacco has a long, rich history. It comes in many forms, including chewing tobacco, snuff, cigars, pipes, and cigarettes. Tobacco also has an unparalleled impact on mortality.

Initially, cigarettes were expensive and hand-rolled, but in 1881 James Bonsack invented the cigarette-making machine. James Duke of Durham [who founded the American Tobacco Company (ATC) in 1890] helped Bonsack perfect the machine.

By 1884, the Bonsack model could produce more than 200 cigarettes per minute and 46.8 million cigarettes per year. This reduced the cost, increased the production, and increased the popularity of cigarettes.

Cigarette consumption was low at the turn of the century. There were 54 cigarettes per capita; that is, roughly 1 cigarette per week, on average. In the early 1950s, the negative health effects of smoking first surfaced. By 1954, publicity about the relationship between smoking and lung cancer reduced sales by 5%. The peak of cigarette consumption was 1963. There were 4,345 cigarettes per capita and 217 packages of cigarettes per adult; that is, on average over one-half pack per adult per day.

The 1964 U.S. Surgeon General's Report clearly outlined the dangers of smoking. Per capita cigarette consumption declined. The current level is approximately that of the mid 1940s.

Between 1965 and 1995, cigarette smoking prevalence had a one-half reduction among males and a one-third reduction among females. The convergence of male and female rates was one-fourth males and one-fifth females. The convergence resulted in a narrowing of sex gap in life expectancy.

Chart 9 shows cigarettes and sex gap in life expectancy. There is a lagged effect between early smoking initiation and increasing sex gap in life expectancy and smoking later cessation and decreasing sex gap in life expectancy. There is a 5 to 15 year lagged effect between smoking and increased mortality risk, and, similarly, a 5 to 15 year lagged effect between quitting smoking and decreased mortality risk. The sex gap peaked in 1975 and 1979, 10 and 15 years after the U.S. Surgeon General's Report. Therefore, cigarette consumption not only impacts overall mortality, but sex differences in mortality as well. It is *crucial* to understand what proportion of smokers are heavy smokers and what proportion of nonsmokers are former smokers.

Chart 10 shows the hypothetical examples of disease incidence by smoking status. There are three possible scenarios for the effects of quitting smoking. Former smokers may experience risks of disease similar to current smokers (Curve A), intermediate-to-current smokers and never-smokers (Curve B), and never-smokers (Curve C). Quitting smoking reduces the risk of lung cancer, other cancers, heart attack, stroke, and chronic obstructive pulmonary disease (COPD). The benefits to quitting smoking may be observed after 1 year or less or 15 years or more. Furthermore, smoking cessation provides benefits to individuals who already have specific diseases.

Cigarette consumption is related to cause-specific mortality. Since the 1960s, as cigarette consumption has declined coronary heart disease has steadily declined, lung cancer has leveled off, emphysema and COPD have plateaued, and cerebrovascular disease has plummeted. How much will mortality improve in the future? How much will the sex gap in life expectancy change? How much of future mortality improvement is due to compositional effects?

Let's examine trends from 1965 to 1991 for the percentage of former smokers among nonsmokers. Among nonsmokers, never-smokers have lower mortality than former smokers. Currently, about 75% of the population do not smoke. Male nonsmokers include more than 40% former smokers (higher risk). The male peak was in 1974, ten years after the Surgeon General's Report. In 1965, only 12% of female nonsmokers were former smokers, and in 1991, 25% of female nonsmokers were former smokers. Among males, smaller mortality improvements among nonsmokers were expected between 1975 and 1980 because of the increase in former smokers. Among females, smaller mortality improvements among nonsmokers were expected over the last 30 years, but especially over the last five to ten years because of the increase in former smokers. Compared to female nonsmokers, male nonsmokers were expected to have relatively higher mortality. Over time, the gap between male and female nonsmoker mortality should be closing because females experience a greater increase in former smokers among nonsmokers.

The percentage of heavy smokers among smokers is declining for both males and females. This should lead to reduced mortality among smokers.

Table 20 shows the compositional effects among smokers for the hypothetical question, What would happen to the mortality of group of heavy smokers if they became light smokers? Thus, based on Table 20, in a 10-year period, you could witness a 60% mortality improvement (6% per year), with no change in overall mortality rates. Currently, 65–80% of female smokers are light smokers (25 or fewer cigarettes per day). If all female smokers were light smokers, their mortality would decline 10–30%. Thus, in a 10-year period, you could witness a 10–30% mortality reduction (1–3% per year), with no change in overall mortality rates.

TABLE 20
PERCENTAGE MORTALITY REDUCTIONS CREATED BY FEMALE SMOKERS SWITCHING FROM 100% HEAVY SMOKERS TO:

Age	75% Heavy Smokers	50% Heavy Smokers	25% Heavy Smokers	0% Heavy Smokers
25	9	18	26	35
45	15	29	44	59
65	15	31	47	65

Note: Assumes no improvement in mortality
Source: Derived from Rogers and Powell-Griner, 1991

Chart 11 shows cohort smoking rates among females. There are extremely low rates among the 1881–90 cohort (less than 3%). The 1931–40 cohort had the highest rates (they peaked around 45%), but the later 1941–50 and 1951–60 cohorts displayed lower rates.

Chart 12 shows the cohort smoking rates among males. Past smoking indicates future mortality rates. Overall, the male rates are higher than the female rates. The 1881–90 cohort of males had low rates of smoking (no more than 30%). The 1921–30 cohort had the highest rates (around 70%), 10 years before the female cohort with the highest rates. Thus, 70-year-olds today are likely to still smoke or to have had high smoking rates. The1951–60 cohort had rates very similar to female rates. The newer cohorts demonstrate continuing lower rates of cigarette consumption. We can expect current cohorts to experience similar smoking by sex, fewer heavy smokers among males and females, fewer former smokers among males and females, and more never-smokers among both sexes.

Future Trends

We need to observe the compositional effects of the mix of heavy and light smokers among smokers and the former and never-smokers among nonsmokers. We need to pay attention to cohort, age, and period effects. The U.S. has established national goals toward achieving longer life and better health. The Year 2000 goals are to reduce smoking prevalence to 15% from 25% among adults. The recent tobacco settlements will further erode the tobacco presence in the U.S.

There have been lower smoking rates in the last 50 years, and fewer former smokers among nonsmokers. The fewer heavy smokers among smokers will reduce the numbers of smokers; increase numbers of nonsmokers; reduce mortality for males and females; reduce nonsmoker mortality because of fewer former smokers; reduce smoker mortality because of fewer heavy smokers; keep the mortality differential between smokers and nonsmokers, which in time will see greater gains among nonsmokers as more become never-smokers; and further close the mortality gap between males and females (females will experience slower mortality reductions).

Here's the answer to that riddle, How can mortality improve for a group without mortality improvement? Although mortality rates of light and heavy smokers remain constant, a change in the composition of light and heavy smokers among smokers can have a profound impact, changing mortality by 10–60%.

I'd like to close with this quote from George Prentice in 1860: "Some things are better eschewed than chewed, and tobacco is one of them."

Ms. Anderson: The next step after observing those trends is to ask questions of why they are that way. So, I invite you to start those questions today by asking the panelists a few of them.

Mr. Sam Gutterman: One segmentation of the population that I've observed over the last decade is by income. I know that there has been a significant difference in smoking trends, for example, for males and females by income level, which might influence the observation of industry or insurance industry statistics. That is a significant drop in male smoking in the higher income levels relative to the lower income levels, and since insurance companies primarily market to the higher income levels, this differential in trends may have a significant impact. Any observations regarding income disparities, whether it be by tobacco or in the general population?

Dr. Rogers: Yes, I think you're right. One of the interesting trends is that income inequality has stayed the same or increased over the last few years so that if you look at the national population, we've actually seen an increased split between the lower incomes and the higher incomes. Within that, there's a further interesting twist between smoking levels. There's an inverse relationship between cigarette smoking and income—the higher the incomes, the lower the smoking. But one of the new trends that's starting to emerge is with cigar smoking. There's a direct relationship between income and cigar smoking. Higher incomes lead to higher rates of cigar smoking. So in the future one of the interesting twists may be that the insurance industry starts to focus a little bit more on cigar smokers and higher incomes.

Mr. Gutterman: There is also a differential in chewing tobacco: a far larger increase in males chewing tobacco relative to females, in particular in lower income levels versus higher income levels.

Dr. Rogers: Yes, certainly with the other types of tobacco consumption, such as pipe smoking, chewing tobacco, and snuff. It's usually more of a male phenomenon than a female phenomenon. More females have started to smoke cigars, but there's still a bigger gap between males and females on cigar consumption.

Mr. Matthew S. Easley: The issue of former smokers is an interesting one. It was indicated that there's a fairly long period of time before the effects completely wear off. A lot of times we'll treat somebody as a nonsmoker after maybe one to three years. I'm just interested in your reaction to that as an underwriting methodology.

Mr. Broesch: With COPD as a cause of death, the increase in that, I believe, is really due to the fact that there is a period of time that you are still at higher risk after you quit smoking, and that can be anywhere from 10 to 15 years after you quit. So I think that it is important to consider that in underwriting. I don't think that it is being considered right now, but there is evidence that the ones who have smoked and have quit still exhibit much higher mortality than the never-smokers.

Dr. Rogers: One of the things that's interesting to look through is the U.S. Surgeon General's Report. The major one came in 1964, but they have different reports. In 1990 they issued a special Surgeon General's Report on the effects of quitting smoking on overall mortality. They followed the trends for specific causes and then looked at the effect of duration of quitting versus overall mortality. Normally the duration has a strong influence on mortality. During the first one, two, or three years after quitting smoking mortality rates stayed the same, if not spiked up a little bit. They spiked because many individuals quit because of health problems. They were already sick, so they quit smoking. It makes sense from an insurance perspective to underwrite for specific causes and to be cautious over the first couple of years. Then after the first three years they fairly quickly start to fall more in line with nonsmokers, if not never-smokers.

Mr. Larry N. Stern: There's been an awful lot of concern in the press and also from the government about younger people smoking in greater quantities than ever before. I noticed in the table that broke the cigarette smokers by age group it stopped in 1991. Do you have any statistical information beyond 1991 that shows the 18–24 group increasing in the amount of smoking, and do you also have any statistics about the age at which these people start to smoke by cohort group?

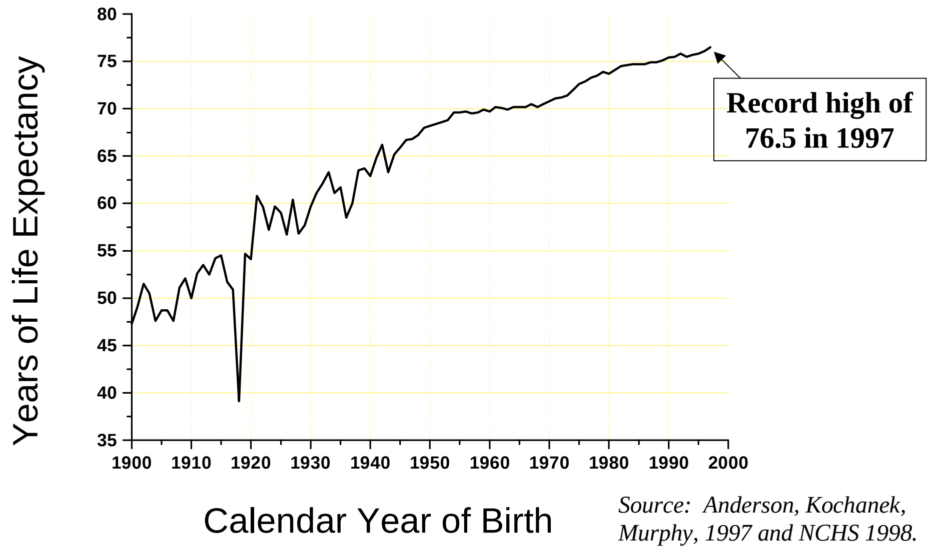
Dr. Rogers: Yes and no. Most current and recent information is published by the CDC, which tracks national smoking patterns by age and sex and then looks at it over time. With some of it you can get aggregate information on smoking up through about 1996, but then once it's divided up by sex and by age sometimes you get more spotty information for more recent periods depending on national data sets that are released. A lot of it's based on national data sets that then lag behind by a few years. There's been a lot in the news about the increased concern of adolescents maintaining their smoking habits, if not increasing their level of cigarette smoking, and a few years ago there was increased concern about females increasing their overall rates of smoking. Females were catching up with male rates of smoking, especially in young adolescents. The rates are still relatively high. I'm not sure exactly what the actual level of the rates are. Part of the concern is whether those rates are going to continue into the future; that is, if this is really establishing new cohort rates or if they're going to decline. Most of the cohorts' patterns that I've seen have shown declining prevalence in smoking, so I'd assume that will continue, but it's disconcerting to see adolescents with high rates of smoking.

Mr. Michael Slipowitz: I wonder if anyone in the panel can comment on experience in the 1990s relative to the 1975–80 table by issue age and how that experience might be impacted by some of the patterns of smoking that have been discussed?

Mr. Broesch: The 1985–90 table is currently just split into male and female. There is no breakdown between smoker and nonsmoker for that experience. So we cannot really tell how much it has changed compared to the 1975–80 table. If anyone knows anything different, please say something.

Mr. Simonelli: I believe that the SOA is making a strong effort in the production of the 1990–95 tables to split them smoker/nonsmoker. That would give you the answer you're looking for, but it's not out just yet.

CHART 1
U.S. LIFE EXPECTANCIES AT BIRTH



Source: Anderson, Kochanek, Murphy, 1997 and NCHS 1998.

CHART 2
SELECTION EFFECT AT BIRTH
INSURED POPULATION

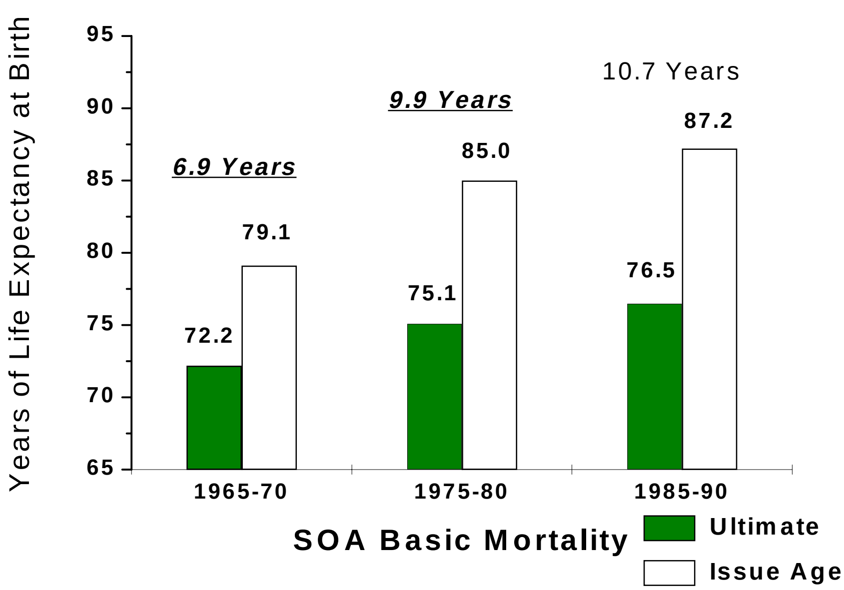


CHART 3
SELECTION EFFECT AT VARIOUS AGES
INSURED PUPULATION

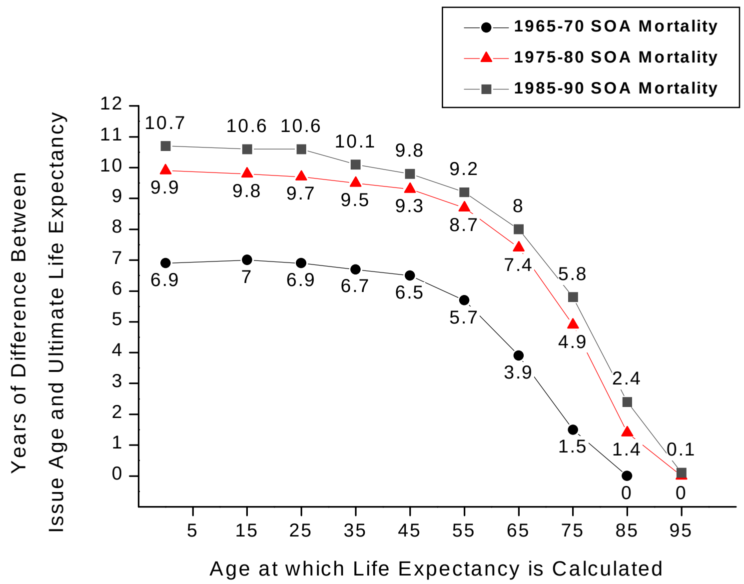


CHART 4
TOP CAUSES OF DEATH

U.S. Secular Population	*U.S. Insured Population*
1. Heart	1. Cancer
2. Cancer	2. Heart
3. Stroke	3. Accidents & Homicide
4. Accidents & Homicide	4. **Suicide**
5. **COPD**	5. Stroke
6. Pneumonia/Flu	6. Pneumonia/Flu
7. Diabetes	7. Diabetes

CHART 5
ACTUAL TO EXPECTED CLAIMS RATIOS—MALES

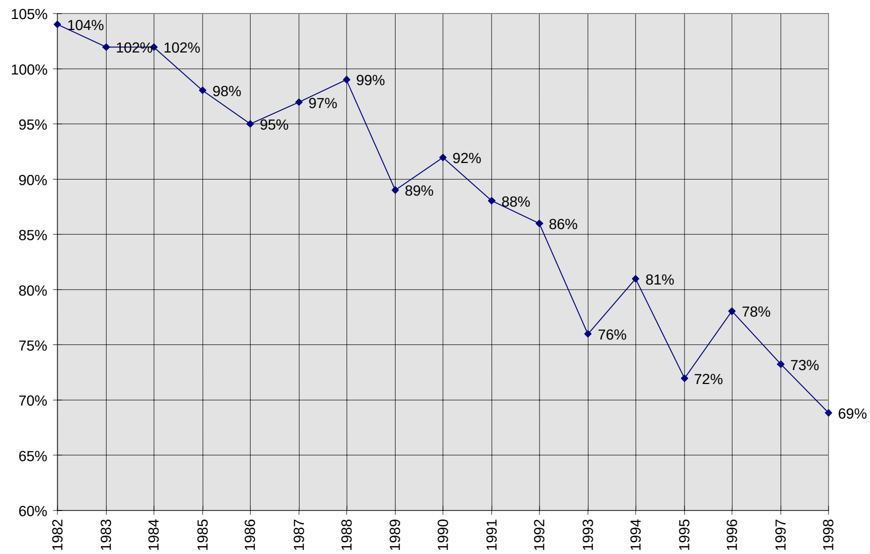


CHART 6
ACTUAL TO EXPECTED CLAIMS RATIOS—FEMALES

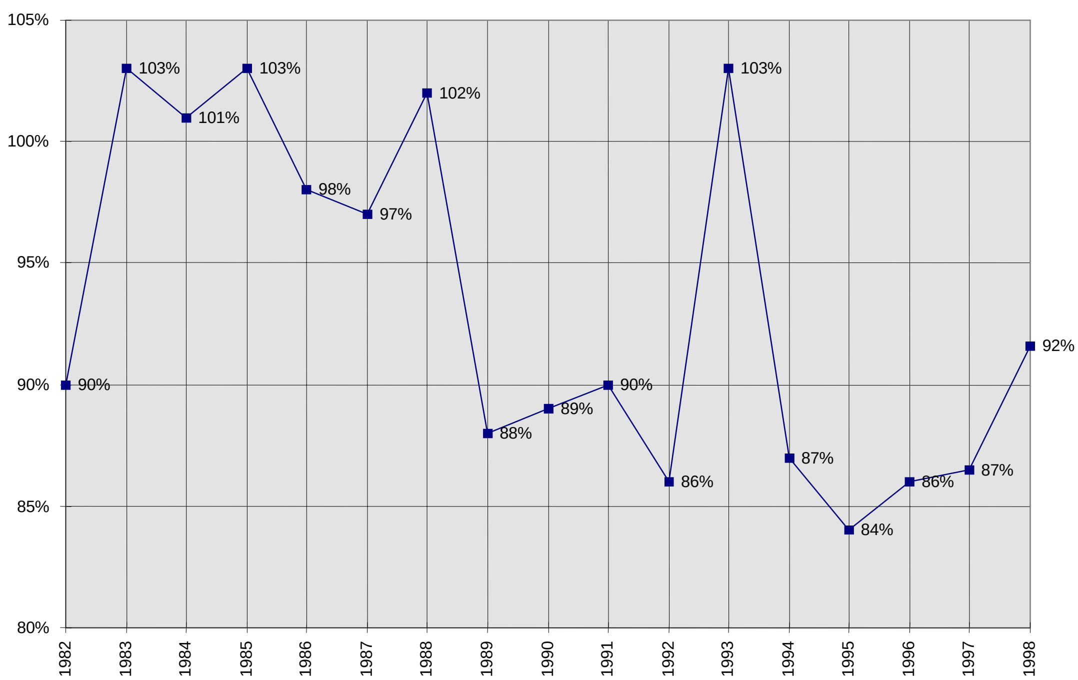


CHART 7
ACTUAL TO EXPECTED CLAIMS RATIOS—MALES AND FEMALES

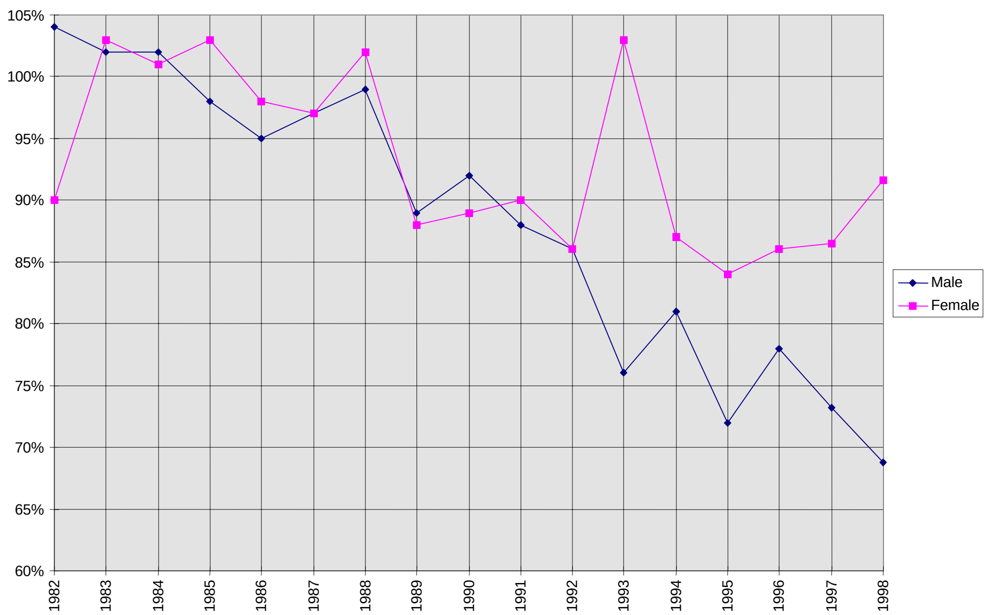


CHART 8
CARDIOVASCULAR DISEASE MORTALITY TRNEDS FOR U.S. FROM 1979–96

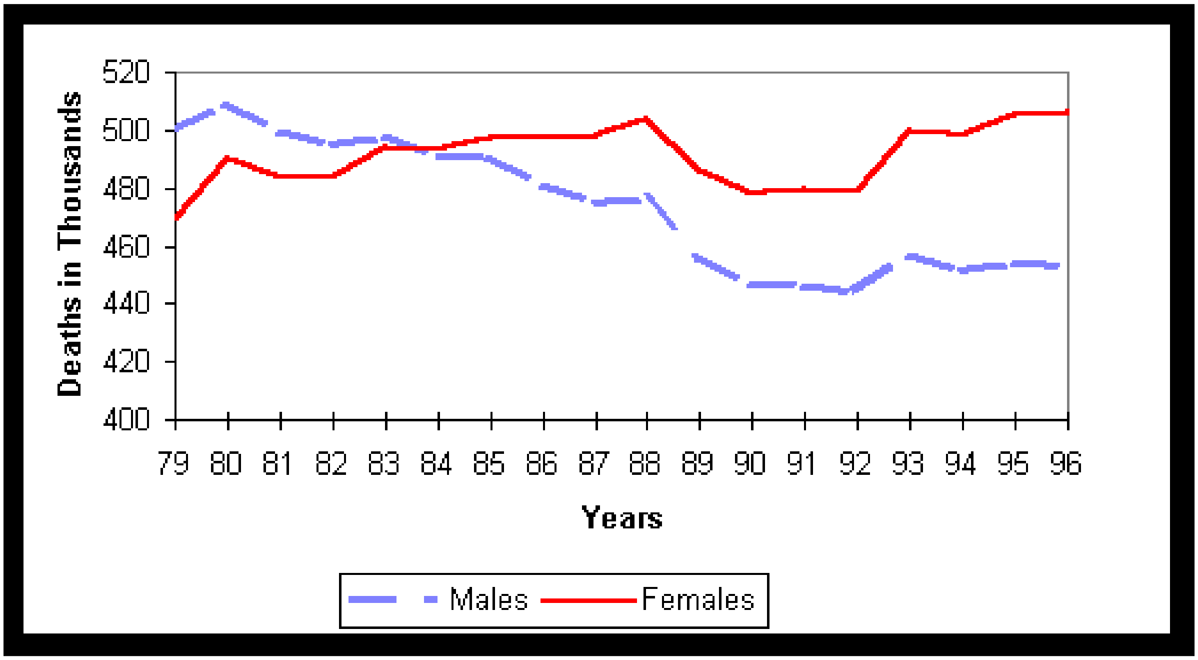


CHART 9
CIGARETTES PER CAPITA AND SEX GAP IN LIFE EXPECTANCY, U.S. ADULTS, 1900–94

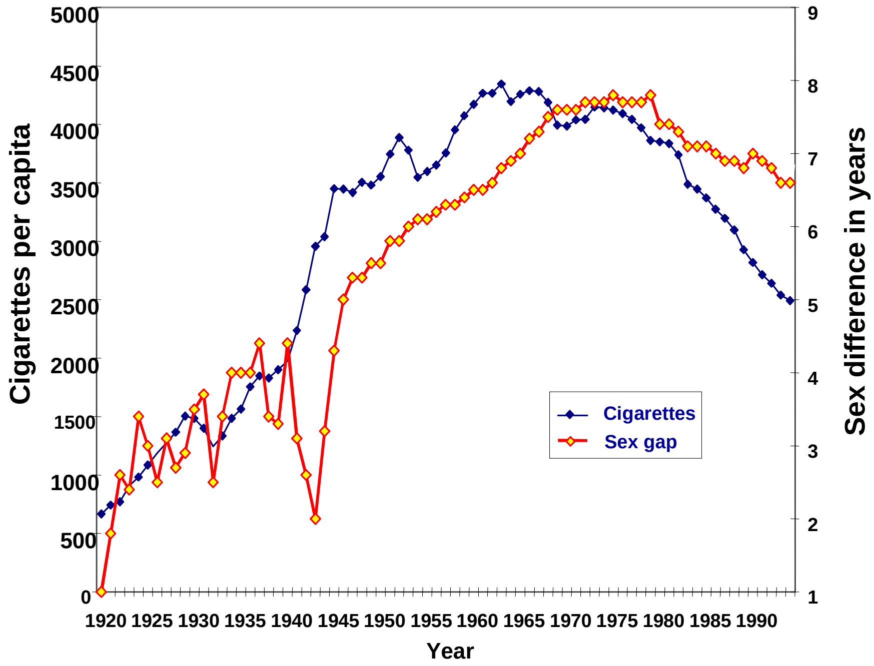


CHART 10
HYPOTHETICAL EXAMPLES OF DISEASE INCIDENCE BY SMOKING STATUS

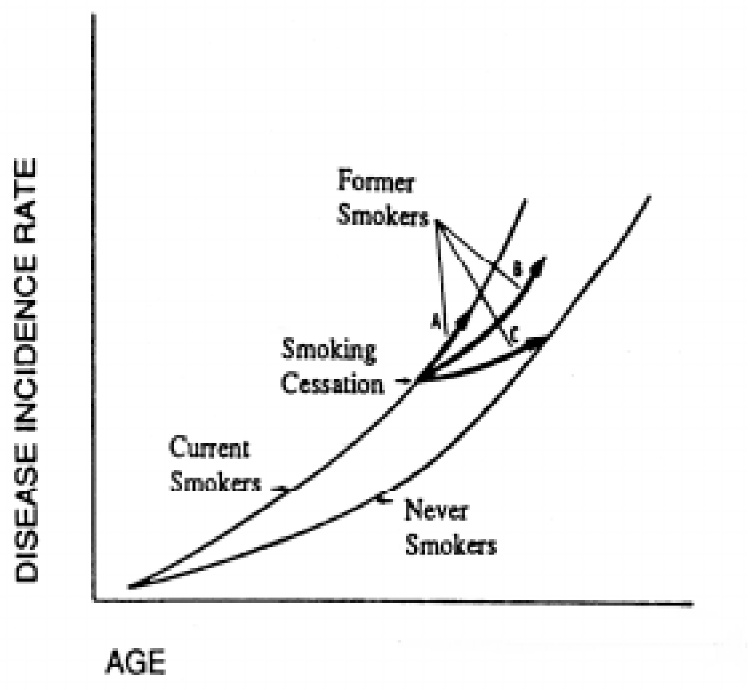
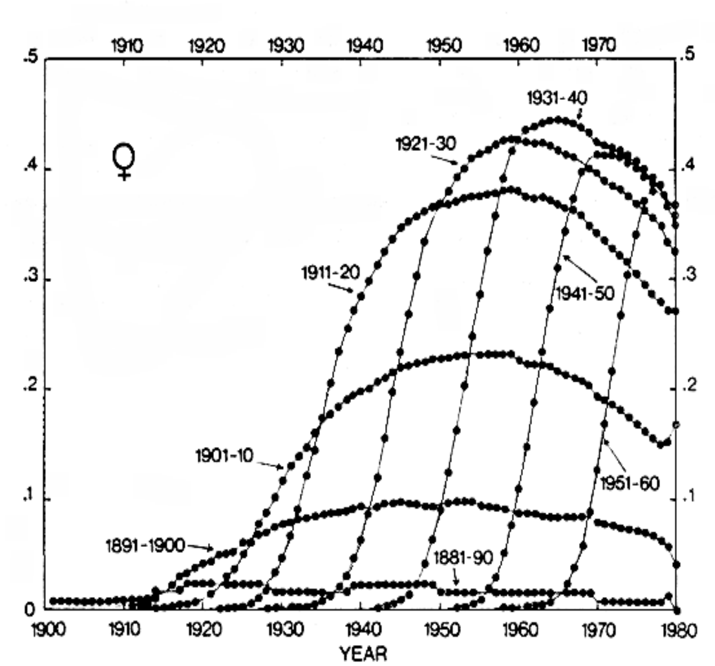
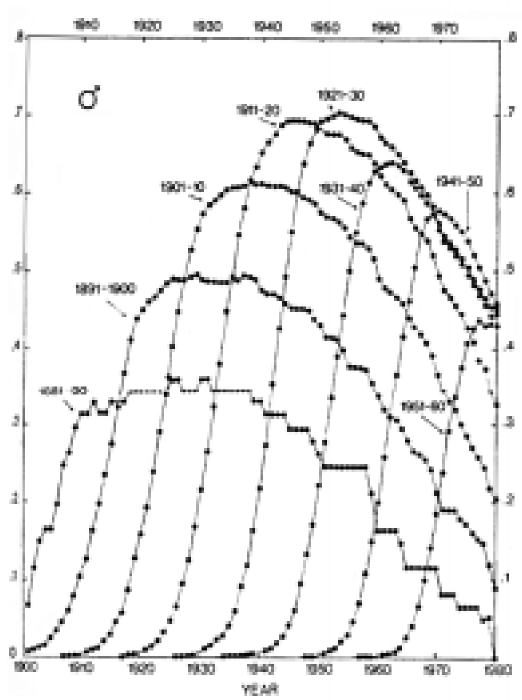


CHART 11
COHORT SMOKING RATES, U.S. FEMALES



Source: Harris, JNCI, 1983

CHART 12
COHORT SMOKING RATES, U.S. MALES



Source: Harris, JNCI, 1983