Planning Healthcare for the 21st Century

Working Paper

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Presented to:
The Institute of Actuaries of Australia
2003 Biennial Convention
Shaping the Future: In a World of Uncertainty
18 – 21 May 2003

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April 18, 2003

> ***How admirable!***
> ***To see lightning and not think***
> ***Life is fleeting***
>
> *Bashō*

Life *is* fleeting, yet, as fleeting as life is today, it is far less so than only a few decades ago. Both life expectancy and health have improved dramatically from beginning to end of the 20th century. These are outcomes of very effective public health programs and, even more visible to us, almost miraculous improvements in medical care. We celebrate these marvels --- and, also, we pay dearly for them.

Developed countries are aging. Their elderly citizens are growing rapidly: both in numbers and as proportions of their populations. Among the potentially serious consequences of this demographic maturation is widespread concern about the costs of providing for healthcare needs of aging populations. Healthcare today is already enormously costly. Will rapidly increasing numbers of elderly with their disproportionately high healthcare needs simply overwhelm healthcare systems? Do we have the capital and human resources to respond to their needs in the 21st century? Is demographics driving our destiny?

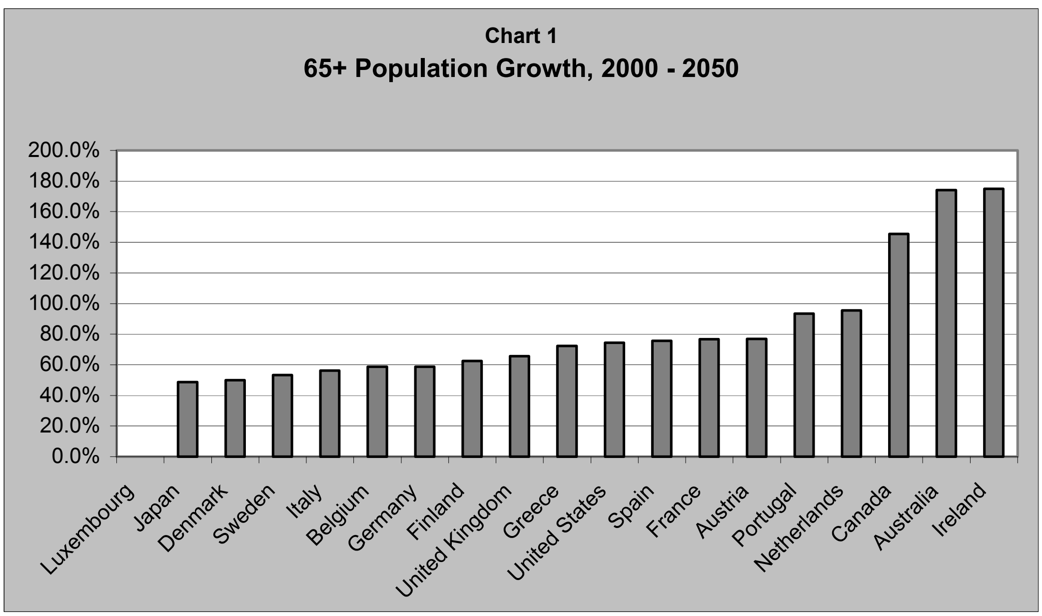
What seems superficially as a realistic concern, that rapidly aging populations will drive healthcare costs wildly higher, becomes much less certain when explored in depth. Developing reasoned alternative future scenarios is the purpose of this paper. As we will see, careful analysis of the aging problem leads to very interesting considerations that, in turn, create a wide range of plausible futures for healthcare and healthcare costs in the 21st century.

This paper analyzes the consequences of an aging population by first looking back at historical relationships between aging and healthcare costs. Then, we develop a structure for discovering the most important variables that will affect the future of healthcare and its potential costs. This is followed by a review of current evidence for the likelihood of the various futures, and, a discussion of the implications of this analysis for those who are thinking about and planning for the future.

I. Perceived Problem

Life expectancy increased significantly during the 20th Century, and, there is virtually unanimous agreement that this positive trend will continue into the 21st Century (Olshansky, Carnes, and Cassel 1993). For example, in the United States, a newborn was expected to live 47 years at the beginning of the 20th century; over 75 years at its end; and, newborn life expectancy is now projected at more than 81 years by mid-21st Century. Equally dramatic increases were recorded in the 20th Century for the elderly: Life expectancy at age 65 increased from 12 years to over 17 years, and at 85 from 4 years to 6 years. Similar trends in life expectancy are characteristic of national populations throughout the developed world.

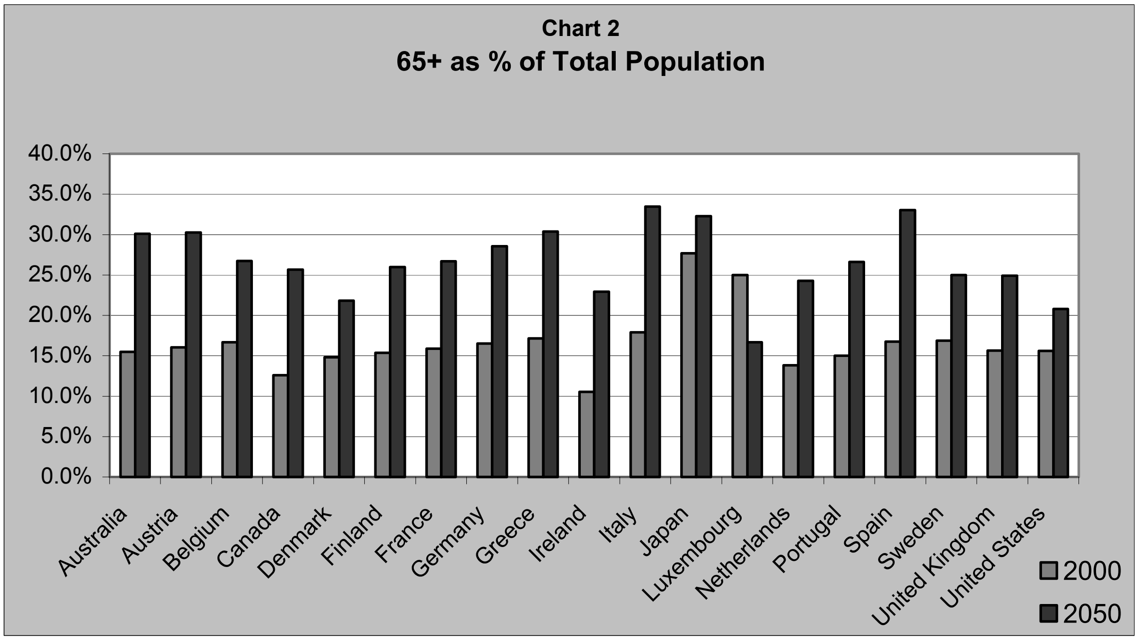
The consequence of these increases in life expectancy is large growth in elderly populations. **Chart 1** summarizes projected percentage increases in population age 65 and over from 2000 to 2050[1] for the US, Canada, Australia, Japan, and 15 EU nations[2].



[1] This paper uses two sources for projections of future public medical care and long term care spending during the first half of the 21st Century: an OECD Working Paper (Dang, et.al. OECD 2001) and a EU Economic Policy Committee Report (EU Economic Policy Committee 2001). Between these two sources, we have projections of healthcare costs and demographics for 15 EU Member nations, US, Canada, Japan, and Australia. Both the OECD and EU projections cover only public spending and their projections are based on limited range of assumptions. There are differences between these two sources in the countries included, specific assumptions, and methods used. Despite these limitations and differences, their use in this paper allows us to make reasonable estimates of the potential costs of aging populations for a range of plausible futures. Readers interested in details of the OECD and EU projections and methodologies can download the reports using their cited web links. Unless otherwise noted, charts and data used in this paper are based on these two sources.

[2] 10 nations from Central Europe recently signed agreements to become EU members. Data from these new EU members is not included in this paper.

Chart 2 presents these increases as a percentage of total population for these same countries. Either way of looking at these data clearly show that these countries' populations are aging.



We also know that healthcare costs per capita increase rapidly with age. The EU Economic Policy Committee report presents data on costs as percentages of GDP by EU country, by age for medical care (**Chart 3)** and long term care **(Chart 4)**. Both components of healthcare costs show significant increases for people age 65 and older, long term care costs being even more skewed to older ages than medical care costs.

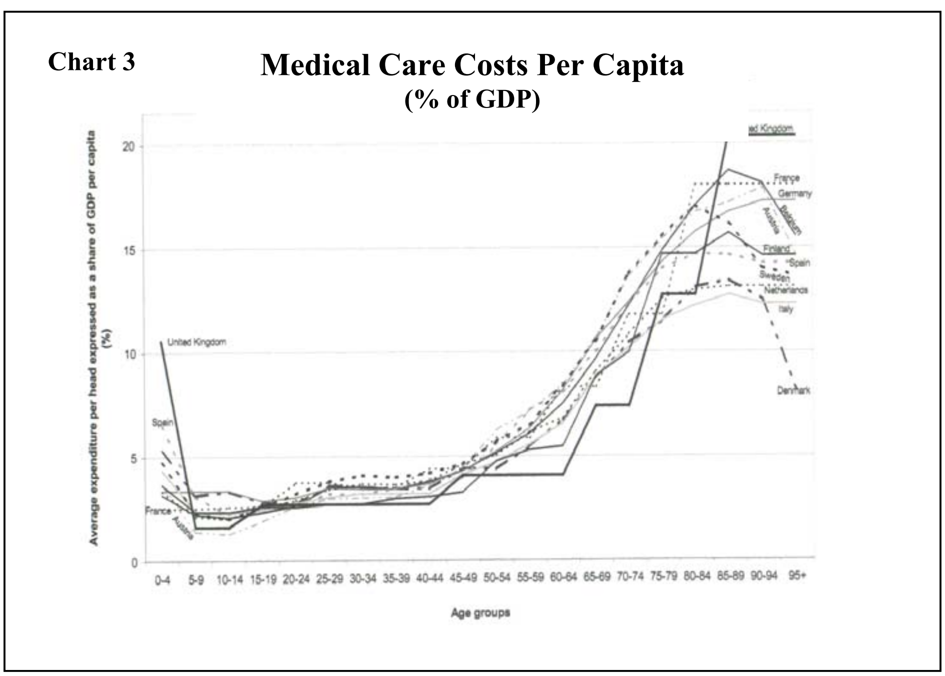
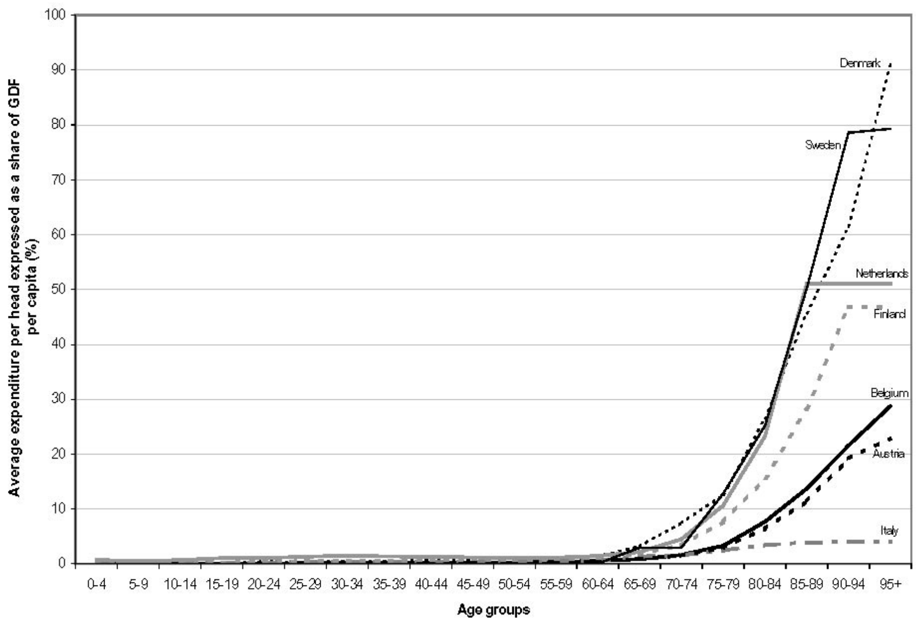
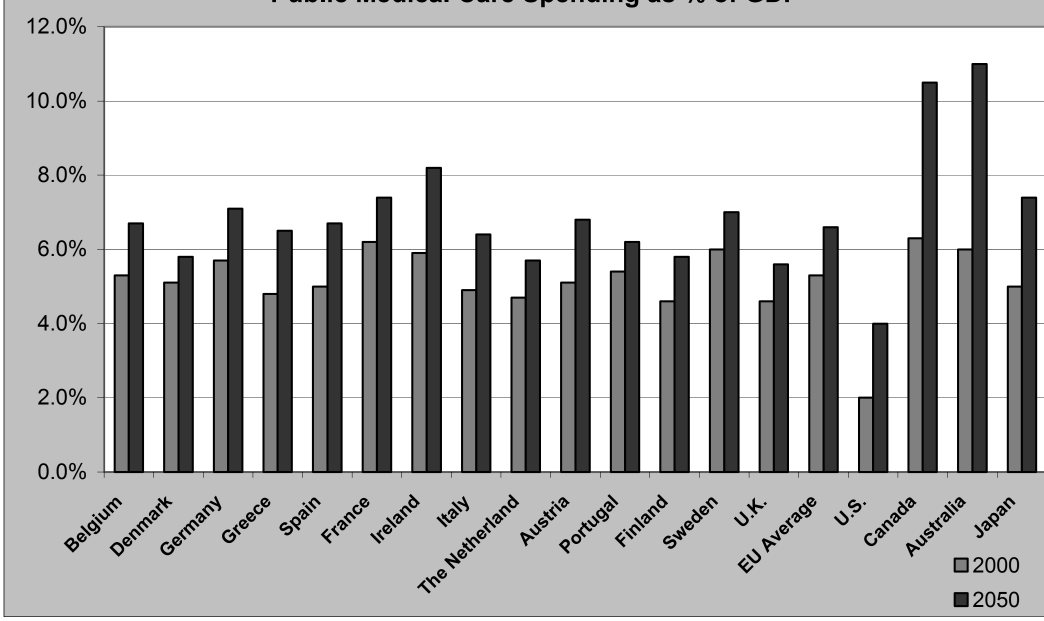


Chart 4 **Long Term Care Costs Per Capita**
(% of GDP)

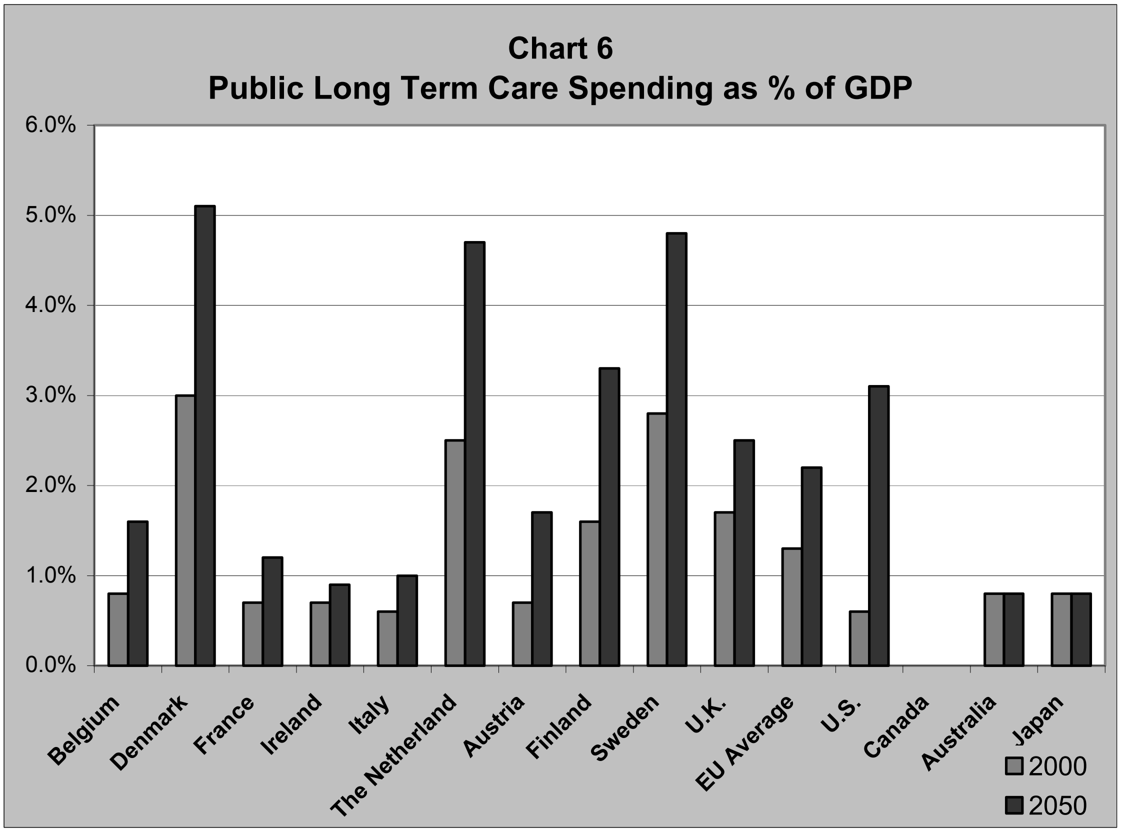


A first estimate of the potential cost consequences of an aging population can be made from combining these demographic data with age-cost data. This technique captures the cost consequences of population aging, assuming that the relative cost of healthcare by age remains unchanged. Projections made using this simple method provide us with base-line cost increases.

Chart 5
Public Medical Care Spending as % of GDP



There appears to be potential for very large increases in public costs of healthcare driven solely by aging populations. **Charts 5 and 6** present projected cost increases for medical care and long term care. The cost effect of aging alone on public healthcare spending (medical plus long term care) from 2000 and 2050 is a projected average increase in EU countries of 2.2% of GDP (country range 1.7% to 3.0%) and 4% to 5% of GDP increases in Australia, Canada and the US.

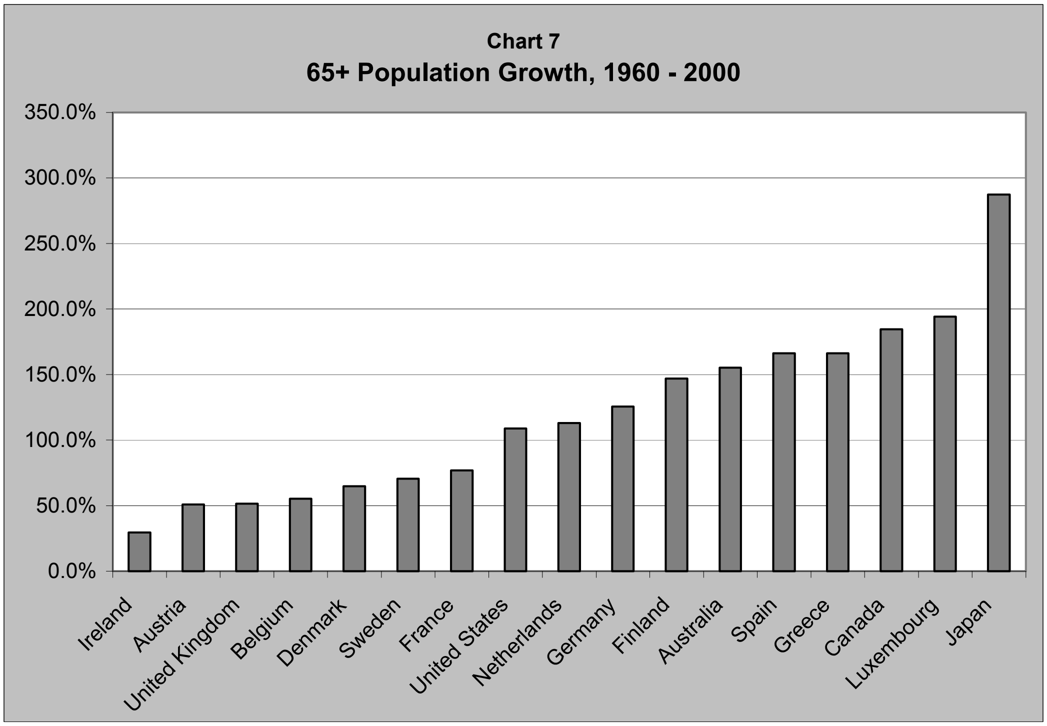


Without further analysis of other factors affecting the future, analysts and public policymakers are left with realistic worries about how their countries might plan and pay for the healthcare consequences of aging. The elderly populations in developed nations *are* rapidly increasing. The cost of caring for the health and frailty needs of the elderly *is* much more expensive than the cost for younger people. Is a healthcare cost crisis unavoidable: Is demography our destiny? It is to these questions that we turn our attention.

II. Historical Relationship Between Aging and Healthcare Costs

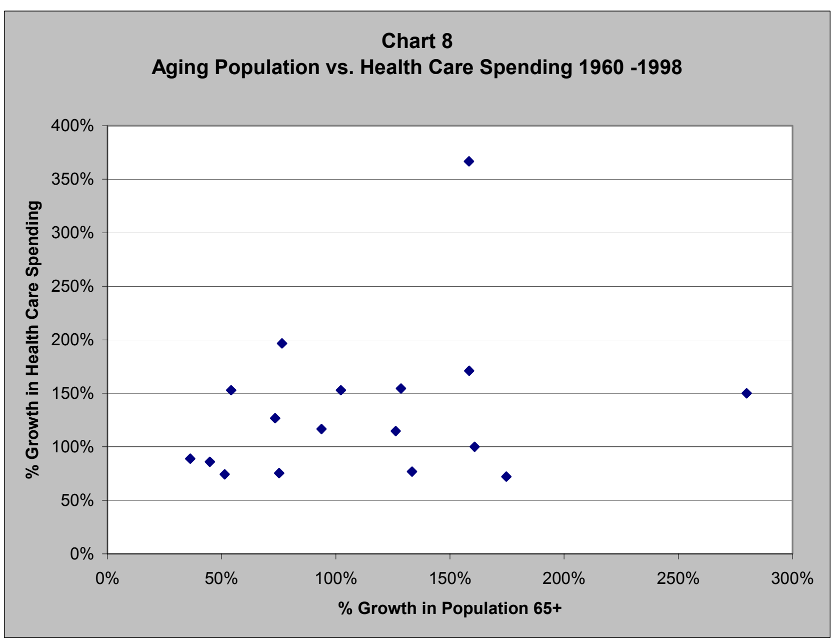
Increasing numbers of elderly citizens is a demographic characteristic not limited solely to the first half of the 21st Century. The last half of the 20th Century was also a time of large increases in elderly citizens in many develop countries. These countries' demographic pasts give us an historical perspective to the aging population problem.

Chart 7 displays historical growth in the elderly from 1960 to 2000 for the 19 countries included in our study. The past 40 year rate growth in elderly populations across



countries is quite large, ranging from a low of 29.4% in Ireland to a high of 287.3% in Japan. This wide range provides a good basis for testing the proposition that increases in the elderly population drive increases in healthcare costs.

Chart 8 compares the percentage increase in elderly population to the percentage growth



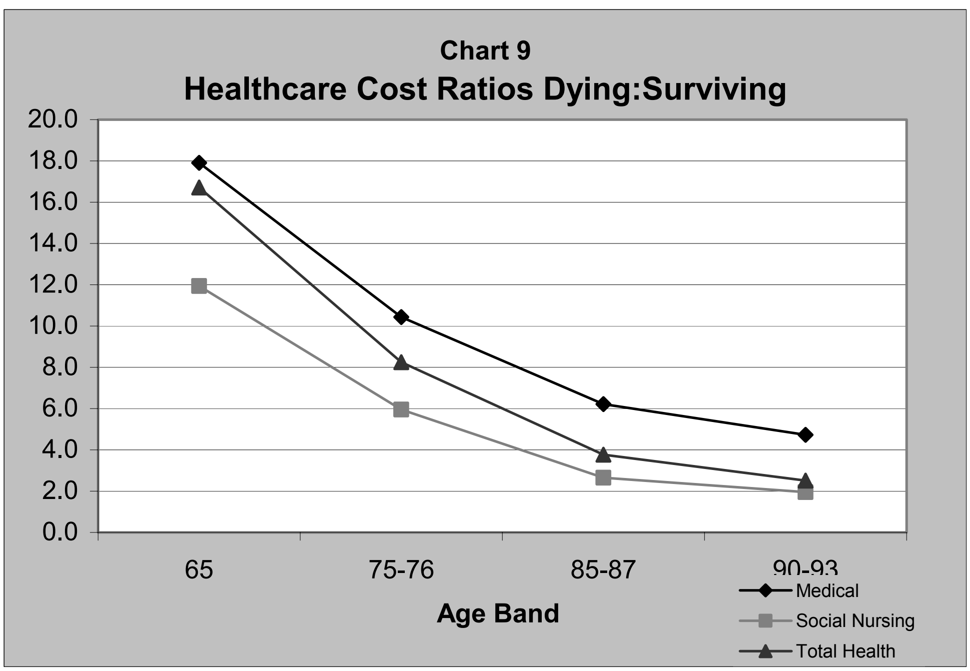
in healthcare costs for a subset of 17 OECD countries[3] that reported all necessary data. A look at the chart shows no discernable relationship between these two variables. With the exceptions of two outliers, Spain (cost increase, 367%: elderly population increase, 158%) and Japan (cost increase, 150%: elderly population increase, 280%), the remaining 15 countries fit into a range with no pattern, and certainly no pattern revealing a positive causative relationship. These OECD data do not demonstrate any meaningful historical relationship between healthcare cost increases and aging. Other investigators have reached this same conclusion (Getzen 1992).

A study of historical U.S. healthcare costs (Peden and Freeland 1995) provides more detailed evidence of a lack of significant correlation between population aging and healthcare cost increases. This econometric analysis of medical care spending from 1960 through 1993 showed that U.S. cost increases were driven by the following factors:

Changes in age/sex mix	7.2%
Increases in disposable income	17.6%
Broader insurance coverage	5.3%
Technology induced increases	69.9%

Technology and increased disposable income account for virtually all of the increase. Despite a 102% increase in the elderly population from1960 to 2000 (see Chart 7), and typically large differences in medical care costs between those under and over age 65, the contribution of aging to overall increase in U.S. costs is negligible.

Other historical data reveals one factor that helps to explain why the relationship between aging and healthcare costs is weaker than expected. **Chart 9** present data that



[3] Data from four EU nations are missing: Denmark, The Netherlands, Portugal, and Luxembourg. OECD

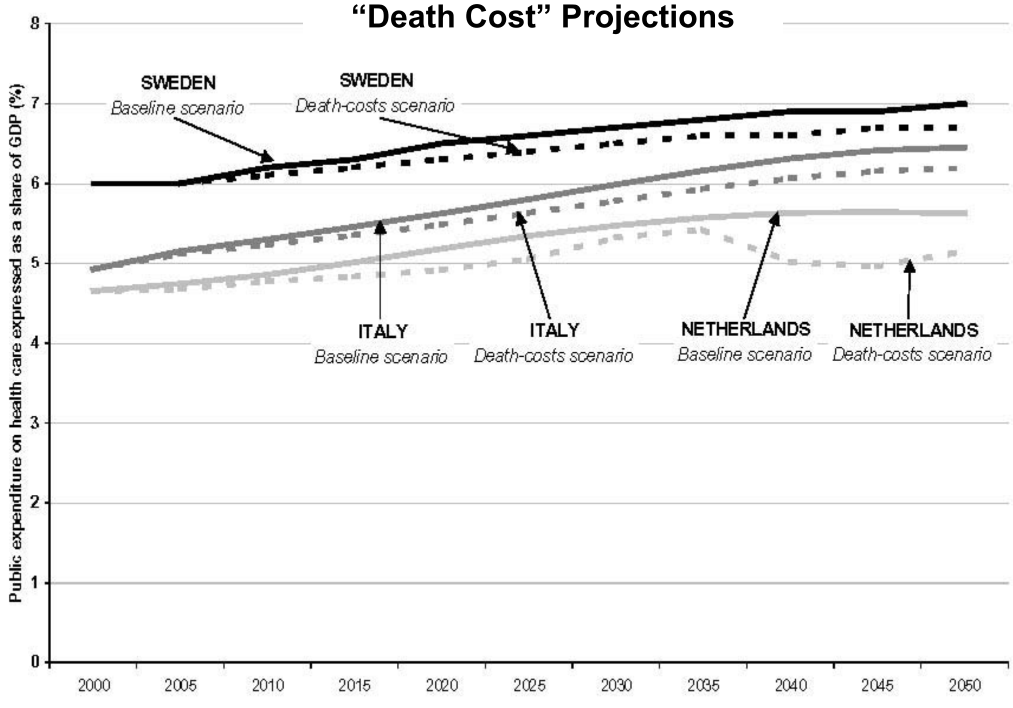
demonstrates a very high relative cost of healthcare in the last year of life. The researchers (McGrail, et. al. 2000) used Canadian healthcare data from British Columbia to separate costs by age bracket for Canadians who died during and those who lived through the study years.

McGrail found that medical care costs in the last year of life are relatively much higher than social nursing (long term care) costs. Total healthcare costs in the last year were found to range from 16.7 times (at age 65) to 2.5 times (at ages 90-93) the cost for same age individuals that live. The high cost of dying also has been reported in other countries including The Netherlands (van Weel and Michaels 1997) and the United States (Scitovsky 1984) (Lubitz and Riley 1993).

Healthcare costs are particularly steep in the last year of life. The longer people live, the higher the age that they enter their last year of life. Straight demographic projections, like the ones presented above, do not reshape the age-cost relationship to delay the high cost of dying to later ages as life expectancy increases.

The EU Economic Policy Committee Report (p. 60) contains a projection done by three EU Member states that adjust for the cost of dying. **Chart 10** compares public medical care spending projections for Sweden, Italy, and The Netherlands using a straight "demographic" (baseline) model and a "death cost" model.

Chart 10
"Death Cost" Projections



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data for Iceland, Norway, and Switzerland is included in this comparison.

Differences in cost increases over a 50-year projection period ending in 2050 are quite significant. Longer life expectancy causes projected medical care costs to drop .3%-.4% of GDP in 2050 versus the baseline demographic-only projections. This is large enough to offset 20% to 40% of projected baseline cost increases in these three countries.

Based on data from the three studies described in this section, there is strong evidence to dispel concerns that aging populations will drive healthcare costs higher and higher. There is at best only a weak historical relationship between aging and costs, and adjusting for increasing average age at death as life expectancy continues to expand, by itself, significantly reduces the effect of aging on cost projections. So, what is going on here? What can we really expect to happen to healthcare costs as the 21st Century unfolds?

III. Healthcare Effectiveness – the Long View

Taking a look at the health, life expectancy and healthcare costs over a very long term starts to bring the aging problem into a more understandable perspective. In a seminal work on demographic history, Abdel R. Omran (Omran 1971) argues that the modern age of history encompasses three distinct epidemiological eras.

> An Age of Pestilence and Famine predated 1650. This age was characterized by stagnation of death rates at extremely high levels. Life expectancy at birth fluctuated widely between 20 and 40 years. Major killers were infectious diseases; plague, influenza, pneumonia, diarrhea, smallpox and tuberculosis. The greatest toll from infectious disease was among the young and childbearing women.
>
> Beginning about 1650-1700 the civilized world began introducing public health measures like sanitation, and living habits changed due to improved public health and higher incomes. These changes brought on an Age of Receding Pandemics by beginning to bring infectious diseases under control. Fewer deaths occurred at early ages. More people lived to older ages. This brought a redistribution of deaths from young ages to older ages. The risk of death from infectious diseases receded which correspondingly increased the risk of death from chronic disease. During this period life expectancy increased to roughly 50 years.
>
> The Age of Receding Pandemics continued through World War I. By then, knowledge of medicine and medical care became effective enough to affect life expectancy. We entered Age of Degenerative Diseases of Affluence. During the 20th Century medicine increasingly made death from infectious diseases an historical curiosity in developed countries, and increasingly focused it's benefits on managing, and sometimes curing, chronic diseases.

> Major causes of death became today's familiar chronic conditions of heart disease, stroke and cancer. Life expectancy in these countries broke through 50 years at birth and rose to above 70 by the end of the Century.

Omran argues that the Age of Degenerative Diseases of Affluence will continue for the foreseeable future: There will continue to be improvements in mortality and morbidity as medical care improves and as people increasingly choose to live healthy lifestyle.

During the last half of the 20th Century, developed nations experienced significant advances in public health and medical technology. These advances included public and private healthcare financing programs aimed at improving population access to healthcare services, particularly for the elderly and poor, and, widespread reduction in risk factors (high blood pressure and high cholesterol) leading to substantial reduction in heart disease and stroke. This resulted in significant improved in survival, particularly at ages 65 and above resulting in the marked shift in developed nations' age structures to higher proportions of elderly citizens that we have documented above.

Building upon Omran's observations, S. Jay Olshansky and Brian Ault (Olshansky and Ault 1986) argue that that the effect of changes in medicine and lifestyle during the 20th Century are so significant that they constitute our moving from the <u>Age of Degenerative Diseases of Affluence</u> into a fourth epidemiological era, the <u>Age of Delayed Degenerative Diseases</u>. This new epidemiological era is characterize by:

- Rapid decline in death rates and improved survival concentrated at advanced ages;
- Major causes of death remain the same chronic degenerative conditions: heart disease, stoke, and cancer; and,
- Age distribution of deaths from degenerative causes continues to shift towards older ages.

To the extent that this trend is real, an <u>Age of Delayed Degenerative Diseases</u> may herald an era of both *longer* life and *healthier* life. This might be the basis for significant changes or, even reductions, in the cost of health care, despite an aging population.

<u>IV. Long-Term Drivers of Healthcare Costs</u>

We have demonstrated that developed nations are undergoing a rapid upward shift in the age composition of their populations. We have examined historical evidence and feel comfortable concluding that, by itself, an aging population does not necessarily drive significant increases in healthcare costs. We also know that there have been, and almost certainly will continue to be, advances in medicine and healthcare technology, and changes in peoples' social and lifestyle habits. These advances and changes will affect future mortality, future morbidity, the range of medical and social services available to support health and frailty, and ultimately the future cost of healthcare.

These insights provide a structure for thinking about healthcare costs in the long-term future. Long-term projections pose a very different problem than short-term healthcare cost projections such as those that actuaries use as tools to manage private sector health plans and health insurance pools. In the short-term we can safely make implicit assumptions that mortality, morbidity, and the scope, intensity and cost of healthcare services are closely related to recent past experience. It is highly unlikely that anything will change so drastically that actuaries must take account in their projections of a wide range of possible changes in their underlying assumptions. In the short-term, the past is a pretty good predictor of the future.

Long-term healthcare cost projections must address potentially significant changes in health and healthcare.

- In the short-term, life expectancy does not change enough to merit consideration in healthcare projections. In the long-term, increases in life expectancy significantly alter healthcare costs by age.
- In the short-term, population health can be assumed to be fixed. In the long-term, people may live their additional years of life as years of good health or poor health: The mix significantly affects healthcare costs.
- In the short-term, healthcare changes slowly and in relatively predictable ways. In the long term, healthcare itself may change drastically: The scope and intensity of medical care services available to treat or to prevent illness may well make medicine by mid-21st Century something unrecognizable by today's standards, and, the cost of healthcare relative to other goods and services may also differ significantly from what we experience today.
- Lastly, in the short-term the use of institutional services for frail elderly is fairly stable. In the long-term the site and cost of supportive services is difficult to predict.

It is virtually certain that over a 50 year period there will be significant changes in technology, lifestyle, and social norms that make it impossible today to accurately predict the shape of health, healthcare, and healthcare costs. Possible changes and their effects, though, can be understood by developing plausible future scenarios based on three key interrelated drivers:

- Changes in <u>life expectancy</u> capturing a plausible range of added years of life.
- <u>Biological morbidity</u> scenarios covering possibilities that added years of life will be lived as years of relative health or relative ill-health.
- <u>Economic morbidity</u> options that address future changes in the scope, intensity, and relative cost of healthcare.

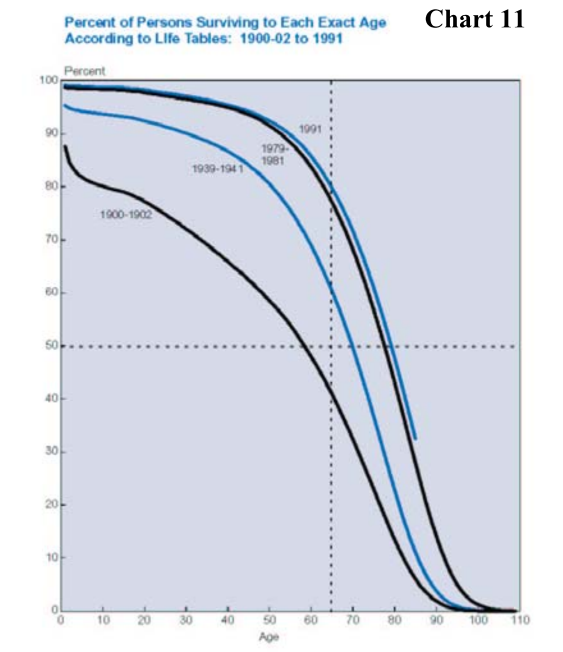
While the direction and intensity of change of these three key drivers cannot be predicted accurately, we assume that we can use these drivers to describe scenarios that adequately capture the range of plausible healthcare futures and their cost implications.

A. Life Expectancy

Life expectancy is clearly increasing, but by how much? There are two theories about possible limits. One theory builds on the assumption that there is a fixed maximum life span. A second theory assumes that life expectancy can increase without limits.

James F. Fries in an influential paper (Fries 1980) analyzes historical mortality data to determine upper limits to life expectancy and life span. His analysis is based on an implicit assumption that humans have genetic limits to life and an explicit argument that advances in medicine along with social and lifestyle changes will increasingly reduce most early deaths. As we approach the natural genetic limits to natural life, Fries demonstrates a rectangularization of the survival curve (see **Chart 11**). The ultimate survival curve is characterized by very high survival rates until people reach their natural end-of-life: 95% of all deaths in an age-cohort will take place between ages 77 and 93 with a maximum life expectancy of 85 years and a maximum life span of 115 years.

Chart 11



Having in the future reached the ultimate survival curve, cause of deaths usually will be ascribed to a familiar chronic disease (heart, stroke and cancer). However, end-of-life death is more correctly attributable to a general decline of the body's ability to withstand illness. These deaths are not curable they are simply *natural deaths* that mark the end-of-life.

A plausible alternative scenario is that life span and life expectancy will be increased, perhaps without limits, through advances in genetic medicine. Research may uncover an aging gene, or the process leading to senescence. With this knowledge, it may become possible to intervene or repair genetic damage and to increase life span and life expectancy well beyond the limits uncovered by Fries' research. The popular and scientific presses often carry articles and papers on scientific research being done in this area (for example see Lane, Ingram and Roth 2002). We currently do not know whether or not science will discover effective means to delay natural death, nor do we know how many years can be added to life. We do know that additional years of life expectancy will result in even larger elderly populations and additional consequences for healthcare costs.

B. Biological Morbidity

War, hunger, a widespread and unchecked AIDS epidemic, or other unknown factors may counter the trend, however longer life expectancy in developed countries in the 21st Century is almost a universally agreed upon certainty. We will be living additional years of life. But in what state of health? Two theories described the range of plausible outcomes: a *compression of morbidity* (Fries 1983) (Fries 1989) or an *expansion of morbidity* (Brody 1985).

Fries argues that morbidity will be postponed as life expectancy continues to increase and approaches its ultimate natural limit. He sees evidence that social and lifestyle changes and early non-medical interventions can both postpone and actually prevent onset of clinical morbidity. For example, even though lung cancers will continue to develop at the end of life, smoking cessation can clearly postpone or prevent the disease from breaching a symptom threshold that requires medical intervention. Fries sees application of this virtuous life style dynamic to most chronic diseases. This leads to a *compression of morbidity* where the elderly live both longer *and* healthier lives.

Brody argues for plausibility of the opposite outcome: An expansion of morbidity. In his future, longer life expectancy does not postpone the clinical onset of disease. Brody looked for evidence of the relationship between increases in life expectancy and health using data from the 1950s the early 1980s. He observed over this period that there was little evidence of any compression of morbidity.

Fries envisions a future in with less clinical chronic disease. Brody presents evidence that Fries' future hadn't taken hold by the mid-1980s. Which of these trends evolves in the 21st Century is very important driver of future healthcare costs.

C. Economic Morbidity

What we learn from looking more carefully at life expectancy and biological morbidity is that people, particularly the elderly, will live longer in the 21st Century, but the burden of disease that they experience may either increase or may actually decrease. Now, given any particular burden of disease that exists, we need to ask another independent questions: What changes might we experience in the scope and intensity of medical care and the resultant costs of treating diseases? The scope, intensity, and cost of healthcare are what is referred to in this paper as "economic morbidity".

Alternatives plausible futures for economic morbidity are quite divergent. Four key long-term driver, expectations and ethics, technology, and public health are described below.

1. Physician-Patient Expectations and Medical Care Ethic

The need to examine medical care expectations and ethics is derived directly from James Fries' compression of morbidity. Fries basis his argument on there being a fixed 115 year life span and a maximum 85 years life expectancy. Death is not a consequence of curable disease. Death, and the almost inevitable illness that accompanies it, is the consequence of living to the end of natural life.

Earlier in this paper we discussed a study of the cost of healthcare in the last year of life (McGrail, et. al. 2000). This study and other similar ones cited above amply demonstrate that developed countries spend enormous amounts of money, and a very significant proportion of their healthcare expenditures in their citizens' last year of life. This is entirely understandable when we consider how dying elderly, their families and society think of medical care and death. The high cost of death that we observe today is consistent with expectations and ethics that usually commit physicians and their patients to "do everything medically possible to stave-off serious illness and death" and a real hope that "death can be conquered".

This attitude and ethic towards death and dying is not inevitable. There is an alternative expectation and ethic that could develop, one recognizing aging and death as inevitable and natural (Callahan 1996). When death occurs, and it will certainly do so for all of us, physicians and their patients might more commonly that today recognize that end-of-life is approaching and choose "death with dignity": A death process aimed, not at cure, but at making the inevitable end as peaceful as possible.

Expectations and an ethic consistent with natural death might have enormous consequences for the use of medical care and social/supportive care for frail elderly. Far more relatively low cost palliative medical care and supportive care might be offered to people nearing the end of their *natural lives*, and much more costly curative medical care increasingly may be foregone. This change would have a significant impact on healthcare costs and on the shape of a future healthcare system.

2. Healthcare Technology

The other implicit assumption that needs exploration is that healthcare technology only increases the scope and intensity of medical care. This dynamic clearly has been the main cause of medical care cost increases during the last half of the 20th Century. But will it continue to drive costs well in to the 21st Century?

A complex interrelationship between medical care technology and healthcare financing has been described by medical sociologist Burton Weisbrod (Weisbrod 1991). Weisbrod describes the relationship between technology and financing as a "healthcare quadrilemma". The causative sequence in his argument is that:

- There is an existing array of medical care technology;
- Third-party financing for medical care (private insurance and social health insurance) lowers barriers to the cost consequences of higher medical care utilization;
- Insurance provides assured financing that stimulates demand for and use of new medical technology and, in turn, increases the scope, intensity, and cost of medical care;
- Higher costs increase the scope and demand for insurance, which supports a new, more costly array of medical care technology.

The inevitable result of this "healthcare quadrilemma" is a system creating new, expensive technology that is demanded by patients and providers with no limit or self-correcting economic mechanism. The Peden and Freeland study of US medical care cost drivers cited above (Peden and Freeland 1995) demonstrates the force of this dynamic. They found that from 1960 to 1993, 69.9% of the increase in costs came from technology-induced demand.

To the extent that this dynamic remains intact, healthcare costs will almost certainly increase in the future. Weisbrod's argument rests, though, on the assumption that new technology is expensive: It increases costs by expanding the scope and intensity of medical care. In the long-term this dynamic may not continue. As we will discuss more below, recent advances in scientific knowledge may ultimately tip the balance from medical technology as cost-driver to medical care technology as cost-reducer.

3. A New Public Health

James Fries has been a strong advocate for the effectiveness of risk-factor reduction to delay clinical onset of chronic disability. As we will discuss below, there are strong relationships between known risk factors a chronic disease. For example smoking, regular exercise, control of blood pressure and cholesterol levels, excessive use of alcohol, weight control significantly reduce the chances of chronic disease. All of these interventions are controllable. A "new" public health refers to efforts to educate people about detrimental consequences of unhealthy lifestyles and to promote increasingly healthy lifestyles. "New" public health differs from the highly effective history of public health in that it focuses on individuals' responsibility for their own good health and not on public works (clean water, clean air, etc.) that require government management.

4. Scope, Intensity, and Cost of Healthcare

New technology makes it virtually certain that the scope of medical care will expand in the future. It is not as inevitable, though, that intensity and cost will also continue to increase. It is certainly a plausible scenario for the past trend of technology-driven increases in scope, intensity, and cost to continue into the long-term future. It is also plausible that increased scope of medical care will be accompanied by offsetting decreases in intensity driven by changes in medical ethics, healthier lifestyles, and currently unforeseen technological advances. It may also be possible that technology might contribute to lower medical care intensity. If so, future healthcare costs might actually be quite moderate.

V. Future Healthcare and Cost Scenarios

Life expectancy, biological morbidity, and economic morbidity all affect the long-term course of healthcare and healthcare costs. A plausible range of long-term healthcare cost projections must incorporate these key drivers. **Chart 12** provides an overview of how these three drivers might interact[4].

Life expectancy will almost certainly continue to improve: Only its pace and ultimate limit, if any, is uncertain.

As ***life expectancy*** improves, ***biological morbidity*** may expand, stay the same or compress.

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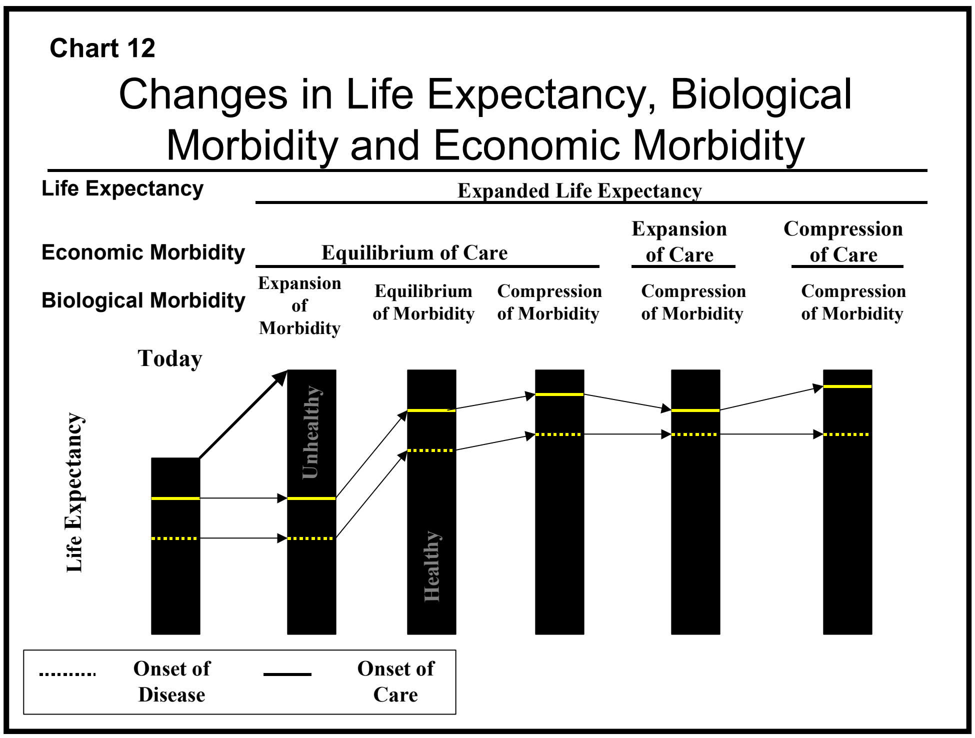
[4] The structure of Chart 12 is derived in part from schemas used in two research papers: (Howe 1999) and (Barer, Evans, Hertzman, and Lomas 1987).

- *Expansion of morbidity* depicts longer life, but with age of onset of chronic diseases unchanged from current. In this scenario, elderly live longer, but their added years often will be unhealthy ones.
- *Equilibrium of morbidity* depicts longer life with age of disease onset increasing and life expectancy increasing by roughly the same number of years: Elderly live longer and the number of end-of-life years with chronic disease is the same as today. Age of disease onset is delayed by better social conditions, healthy lifestyles and early non-medical interventions.
- *Compression of morbidity* is the best plausible outcome. Longer life is accompanied by age of onset of disease increasing even faster than life expectancy. Elderly life longer and have fewer years of disease than at present.



Following the path of *compression of morbidity* within ***biological morbidity*** on **Chart 12**, there are three plausible futures for ***economic morbidity***: same as today, more care, or less care for chronic disease.

- *Equilibrium of care* scenario depicts the course and treatment of disease following its onset that is generally the same as it is today. Medical technology and ethics are static and do not change the scope, intensity, and relative cost of medical care. The needs of frail elderly are met as they are today: the future brings no material changes in institutionalization or de-institutionalization of frail elderly.

- *Expansion of care* depicts a future in which the time from biological onset of disease to onset of medical care is reduced. This happens due to changes in medical care technology that provide means to identify and treat illness closer to its onset than at present. In this scenario, new technology increases the scope and intensity of medical care, and new care is likely drives costs higher. Care for frail elderly is increasingly institutionalized which adds to future cost increases.
- A *compression of care* scenario recognizes there may be changes in medical technology and/or in the medicalization of biological disease that actually reduce the intensity of medical care. Widespread reductions in intensity could actually decrease the relative cost of future medical care. Care for frail elderly is increasingly de-institutionalized which helps to control future cost increases.

Combining different outcomes for **life expectancy**, **biological morbidity**, and **economic morbidity**, we can create plausible future scenarios. Three scenarios that encompass a reasonable range of healthcare cost outcomes are described below.

A. Scenario I – Continuing Today's Healthcare Environment Into the Future

This first scenario describes a future healthcare environment not much different than today's.

- *Life expectancy* continues increasing towards an ultimate 85 years expected life at birth.
- There is only a modest improvement in health caused by wider adherence to healthy lifestyles and discovery and use of effective pre-morbidity interventions. *Biological morbidity* continues to improve as it has in the recent past so that the elderly both live longer and live about the same number of years in ill health from chronic diseases as they do today (a rough *equilibrium of morbidity* – see "Biological Morbidity" in section below).
- *Economic morbidity* continues on its current path (*expansion of care)*. Medical technology continues to increase the scope and intensity of health care interventions much as it has in the past few decades. End of life debility and illness is increasingly recognized as it occurs, but patients and physicians continue to approach end-of-life pursuing aggressive medical care intervention. Frail elderly increasingly make use of expensive institutional care.

This scenario uses healthcare cost drivers consistent with a continuation of existing long-term trends. Using OECD health data and projections prepared by member nations for the EU Economic Policy Committee Report (EU Economic Policy Committee 2001), we can make estimates of the cost consequences of this, and our other scenarios for public spending in the 15 EU nations covered by this Report.

EU public healthcare spending in its 15 nations averaged 6.6% of GDP in 2000. Over a 25 year period from 1973 through 1998, these nations experienced healthcare cost increases equal to their GDP plus 1.4% per year (OECD 2001). The excess 1.4% growth incorporates the future cost consequences of historical rates of population aging, changes in biological, and changes in economic morbidity, including, most notably, increases in scope and intensity of medical care resulting from the introduction of new technologies. If this historical trend continues into the future, then public healthcare costs will grow from 6.6% of GDP in 2000 to 13.2% of GDP in 2050. Referring to EU Policy Committee projections, the composition of this increase can be estimated:

EU Public Healthcare Costs – 2000	6.6% of GDP
Incremental Costs Due To:	
Aging Populations and Increasing Life Expectancy	1.9%[5]
Changes in Biological Morbidity	nil
Changes in Economic Morbidity	4.7%
EU Public Healthcare Costs – 2050[6]	13.2% of GDP.

B. Scenario II – Adverse Future Healthcare Environment

A second plausible scenario can be constructed that creates very serious concern for developed countries' ability to continue funding their public healthcare programs.

- Science discovers effective means to extend life expectancy beyond its natural limits causing *life expectancy* to increase beyond it natural limit.
- There is *expansion of biological morbidity.* Longer life is not accompanied by better health; so added years are lived in relatively poor health.
- *Economic morbidity* contributes to the problem (*expansion of care*). People continue to pursue unhealthy lifestyles: Medical technology expands the scope and intensity of costly, aggressive medical care interventions a an even more pace than in the past; end-of-life is not recognized and disease at any age is treated aggressively with an aim to cure; institutionalization of the frail elderly becomes ever more common.

Future healthcare costs in this scenario will exceed those in Scenario I. Longer life expectancy may increase the average age of populations beyond those implicit in Scenario I; an expansion of morbidity adds to nations' burdens of disease; and, greater increases in scope and intensity of care adds even more to healthcare costs. A reasonable range of cost estimates (in relations to Scenario I) is as follows:

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[5] The EU Economic Policy Committee Report baseline healthcare cost increase (Charts 5 and 6) driven solely by demographic changes is 2.2% of GDP. A (.3)% "Death Cost" adjustment is made to reflect longer life and delayed onset of death (Chart 10) for a net estimated cost of aging of 1.9% of EU GDP.

[6] The EU Economic Policy Committee Report contains basic projections of healthcare costs calculated solely on changes in the demographic composition of 15 EU member nations. There are also alternative projections demonstrating cost sensitivity to various assumptions including: income elasticity of demand, cost of end-of-life medical care, improvement in health of the elderly, and different demographic assumptions. We use these various projections to estimate the cost consequences of the three scenarios presented in this paper. **Cost estimates in this paper have not been modeled by the authored and, therefore, are only general indicators of the cost consequences of the three scenarios.**

EU Public Healthcare Costs – 2000	6.6% of GDP
Incremental Costs Due To:	
Aging Populations and Increasing Life Expectancy	1.9% to 2.3%
Adverse Changes in Biological Morbidity	1.0% to 2.0%
Changes in Economic Morbidity	4.7% to 6.7%
EU Public Healthcare Costs – 2050	14.2% to 17.6%.

C. Scenario III – Favorable Future Healthcare Environment

A plausible and relatively low cost long-term healthcare future might evolve. This is our third alternative.

- *Life expectancy* will continue to increase towards its current projected ultimate of 85 years at birth.
- People change their lifestyles and widely practice good health habits. Interest in healthy lifestyle is accompanied by low cost, pre-clinical health care interventions that effectively postpone the onset of disease of delay the onset of clinical care. Added years of life will be lived in relatively good healthy so that we experience a *compression of biological morbidity*.
- These positive trends will be complemented by significant improvements in *economic morbidity* (*compression of care*). Break-through in scientific knowledge of the human body and chronic disease allow development of medical technology that creates low-cost pre-clinical interventions and curative treatments. Ethics and sensitivities change so that inevitable end-of-life debility and illness is clearly recognized and treated with care and support, but not with aggressive medical interventions. The frail elderly are supported in their homes and lost cost institutional settings (e.g., day care).

This Scenario will result in costs much lower that than in Scenario I. In this Scenario, favorable to very favorable changes in biological morbidity and a major change in the trend of technology, allowing it to actually reduce intensity of medical care while improving healthcare outcomes, could result in significantly lower future costs.

EU Public Healthcare Costs – 2000	6.6% of GDP
Incremental Costs Due To:	
Aging Populations and Increasing Life Expectancy	1.9%
Favorable Changes in Biological Morbidity	(1.0)% to (2.0)%
Changes in Economic Morbidity	3.7% to (1.0)%
EU Public Healthcare Costs – 2050	11.2% to 5.5%

D. Range of Plausible Future Scenarios

The range of plausible futures for healthcare and healthcare costs is quite wide. Costly outcomes include: longer and relatively unhealthy lives; new and more expensive medical technology; and, demands for aggressive pursuit of good health and cures. Less costly, or even cost-reducing outcomes include: longer and relatively healthy lives; favorable changes in medical technology making less intense medical care possible; development of a less aggressive medical ethic, particularly at the end-of-life; de-institutionalization of long-term care for frail elderly. We have incorporate plausible combinations of these cost-increasing and cost-decreasing trends into three plausible future scenarios that demonstrate the extremely wide range of healthcare characteristics and healthcare costs in 2050. Our three Scenarios are summarized below:

Scenario	2050 - Average EU Public Cost (% of GDP)
I. Continuing Today's Healthcare Environment Into the Future	13.2%
II. Adverse Future Healthcare Environment	14.2% - 16.6%
III. Favorable Future Healthcare Environment	6.5% - 11.2%

VI. Evidence for a More Likely Future

The wide range of plausible long-term healthcare scenarios and their cost consequences is overwhelming. To focus our investigation, we want to look for evidence that might suggest a more likely future path.

A. Life Expectancy

Projecting life expectancy is a familiar exercise to many actuaries. The major unresolved question for our investigation is whether or not science will discover effective means of extending natural genetic limits to life. If science accomplishes this goal, we can look forward to even larger populations and higher proportions of elderly than is currently incorporated in to various long-term healthcare cost projections.

Science has long been interested in understanding the reasons for aging and death. Three theories have been developed that ascribe a genetic limit to life (Olshansky, Carnes and Cassel 1993).

- In 1957, evolutionary biologist George C. Williams proposed a theory that *antagonistic pleiotropy* provides a genetic basis for aging. Williams' theory is based on the idea that reproduction is our genetic reason for existence. Evolutionary forces will concentrate on selecting genes that affect life through the reproductive years. Genes that have damaging effects later in life will not be as effectively eliminated by natural selection. It is these genes, he hypothesizes, that underlie the aging process and senescence.

- T.B.L. Kirkwood in 1977 suggested a variation on Williams' theory: the *disposable soma* theory. He suggested that humans divide their energy between sexual reproduction and maintenance of the body (soma). Energy is needed to repair genetic damage. Humans divide their limited lifetime energy between these needs, and a less than optimal amount is available for perfect repair and, thus, immortality. Senescence is the genetic result of an energy trade-off favoring sexual reproduction.

- More recently attention has been focused on the *dysdifferentiative* hypothesis of aging. Genes are carefully regulated. Over time there are gradual accumulations of random molecular damage that disrupts that normal regulation of gene activities. Disruptions ultimately trigger a cascade of consequence leading to senescence.

A genetic limit to life implies an upper limit to life span and life expectancy since medicine cannot cure death, absent discovery of human means to change the natural genetic senescence of our bodies.

There has also been a great deal of medical research into the aging process. Tantalizing hints of its biological basis and genetic control mechanism have already been uncovered. Clearly, the human genome project provides researchers with a treasure trove of new information that may well prove invaluable in understanding the aging process and, perhaps ultimately, in finding ways to delay our natural aging process and death. Readers interested in an overview of the current science of aging can refer to a recent summary article by Gene Held published in the North American Actuarial Journal (Held 2002).

It is clear that science is able to learn a great deal about the human aging process. However, it is not at all predictable whether or not new knowledge will result in effective means of increasing life expectancy beyond its natural genetic limits. The current state of knowledge about aging and death leaves us virtually certain that in the 21st Century life expectancy will continue its increase. It is, though, currently unknowable if this increase will slow as life expectancy reaches its natural limits or if medical knowledge will find ways to delay the our natural aging process and death. Our best guess is that life expectancy will continue to expand toward its natural limit of 85 years of life. If a scientific breakthrough is made, chances are that any resultant changes in medicine will result in greater increases life expectancy creating even larger than expected elderly populations nearer to 2050 than today.

B. Biological Morbidity

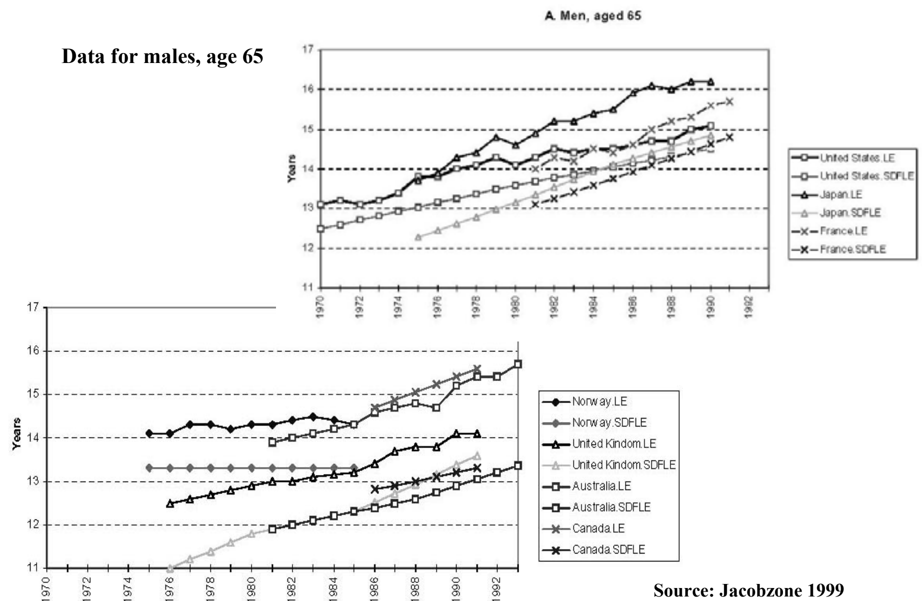
Earlier in this paper we described a survey done by Jacob Brody (Brody 1985) looking for evidence for change in biological morbidity. Brody's mid-1980s paper failed to detect any meaningful evidence that longer life was accompanied by more years of good health. He concluded that the US elderly population might be experiencing an *expansion of morbidity*.

New studies provide evidence that *expansion of morbidity* is not taking place. In a recent OECD study, Stephane Jacobzone (Jacobzone 1999) presents international evidence comparing *severe disability free life expectancy* (SDFLE) to *life expectancy*, both at age 65. SDFLE is a measure of the ability of surveyed elderly to perform all Activities of

Daily Living (see p. 10 for definition). While SDFLE is a measure of frailty and not directly of illness, it is useful evidence about trends in biological morbidity since consistent data has been gathered over extended periods from elderly populations in a number of OECD countries. **Charts 13 and 14** graphically present data reported by Jacobzone. His analysis of these data (p.10) shows that additional years of life are

Chart 13

Trends in Severe Disability Free Life Expectancy

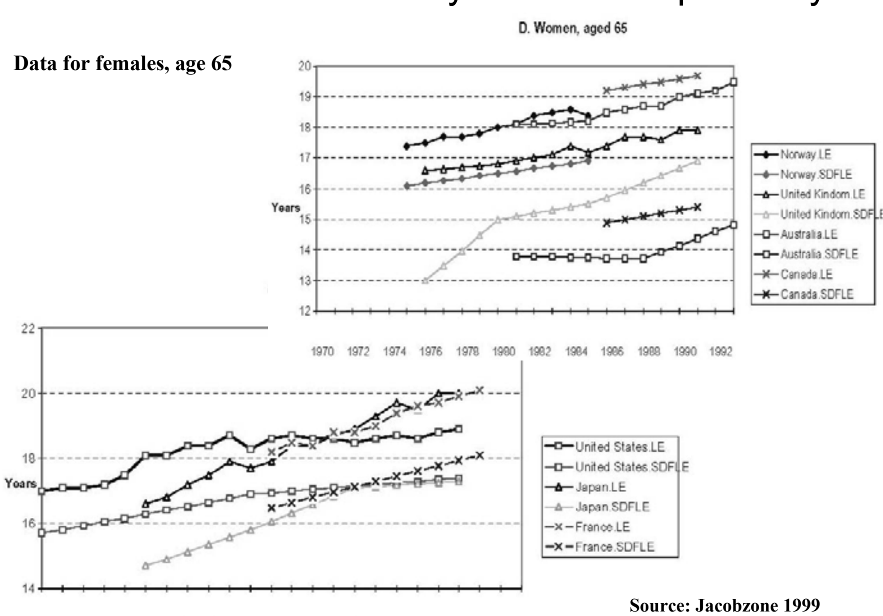


healthy ones: SDFLE increases about the same as, or a bit more than life expectancy. Multi-national data, then, is suggestive of a rough equilibrium of biological morbidity during the last decades of the 20th Century.

Colin Mather (Mather 1999) reviewed published studies of trends in disability, including

Chart 14

Trends in Severe Disability Free Life Expectancy



studies from OECD and REVES (Reseau Esperance de Víe en Sante/Network on Health Expectancy), which is a research network set-up in 1989 to facilitate international comparisons of health and disability data[7]. Mather concludes, as does Jacobzone, that data shows no evidence of an expansion of severe morbidity. He then notes that recent data from Europe and North America may be indicative of a disability decline consistent with *compression of morbidity* (p. 34). Mather cautions that while severe disability may be declining, data suggests that there may be a concurrent expansion of less severe states of disability (p. 38).

A. "New" Public Health – Controlling Risk Factors for Chronic Diseases

While data on morbidity trends should ally fears that increasing life expectancy may be accompanied by *expansion of morbidity*, trends are not sufficiently robust to distinguish between a future characterized by *equilibrium of morbidity* or *compression of morbidity*. In order to help distinguish between the plausibility of these two more favorable outcomes, we return to our earlier epidemiological observations and the influence of public health on healthcare outcomes.

Our earlier review of the epidemiological history of mortality and morbidity suggests that medical care is a recent (20th Century) contributor to health and increased life expectancy. Historically, public health measures, by controlling the spread of infectious diseases, have been the single greatest contributor to a much lower burden of disease, particularly in developed nations. Today we rarely think of public health, our focus is on medical technology and medical care. This focus ignores the potential for new public health initiatives to help reduce the future burden of disease.

In a paper presenting arguments for greater focus on health prevention J. Michael McGinnis and his colleagues (McGinnis, Russo and Knickman 2002) review estimates of the underlying causes of early deaths and diseases leading to death in the US. Their estimates of underlying causes are:

Genetic predispositions	30%
Social circumstances	15%
Environmental exposures	5%
Behavioral patterns	40%
Shortfalls in medical care	10%

Of these causes 60% are non-medical (social circumstances, environmental exposures, and behavioral patterns.

[7] REVES data and information about its conferences and publications is accessed at www.euroreves.ined.fr/reves/.

To demonstrate that public health measures affecting social, environmental, and behavioral factors of health have significant potential to reduce biological morbidity and healthcare costs, we look first at the leading medical diagnoses of morbidity. Druss and his colleagues (Druss, Marcus, Olfson, and Pincus 2002) used the 1996 Medical Expenditure Panel Survey (MEPS) to determine the 15 most costly medical conditions affecting the US population. **Chart 15** lists the conditions along with data on the percentage of total healthcare costs and the number of people estimated to have had

Chart 15

Most Expensive Medical Conditions
US, 1986

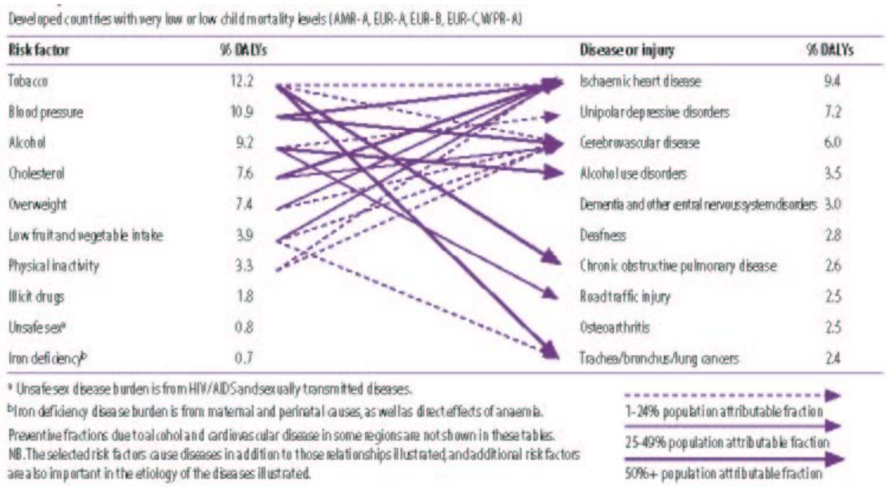
Rank	Disease	% With any ADL/IADL	Controllable Risk Factors
1.	Ischemic Heart Disease	19%	Smoking, weight
2.	Motor Vehicle Accidents	11%	Seat belts
3.	Acute Respiratory Infections	4%	
4.	Athropathies	14%	
5.	Hypertension	14%	
6.	Back Problem	8%	
7.	Mood Disorders	15%	
8.	Diabetes	21%	
9.	Cerebrovascular Disease	55%	
10.	Cardiac Dysrythmias	18%	
11.	Peripheral Vascular Disease	18%	
12.	COPD	7%	Smoking.weight
13.	Asthma	8%	
14.	Congestive Heart Failure	48%	Smoking
15.	Respiratory Malignancies	45%	Smoking

healthcare expenses associated with treatment of these diseases. The list includes both chronic and acute diagnoses, and, life-threatening and prevalent but mild illnesses. These conditions accounted for 44.2% of 1996 healthcare spending in the US.

There is a clear link between most expensive diseases and controllable risk factors. The World Health Organization (The World Health Report 2002) recently prepared a major

Chart 16

Major Burden of Disease, 2000
Developed Countries
Leading 10 Selected Risk Factors and Their Relationships to Leading 10 Diseases and Injuries



World Health Report, 2002

study of the links between diseases and risk factors. WHO measures the burden of disease and causative effects of risk factors using Disability Adjusted Life Years (DALYs), which are years of good health lost to illness and injury[8]. **Chart 16** presents findings for developed nations on 10 selected risk factors and their prevalence and causative relationships to the 10 diseases and injuries that are the largest burden disease (largest percentage of DALYs) in developed nations. There is significant overlap between the 15 most costly U.S. medical conditions reported by Druss and his colleagues and the 10 conditions that WHO research identifies as causing the largest burden of disease in developed countries. WHO's analysis of their data and medical literature demonstrates significant reduction in the burden of disease through elimination of risk factors. For example, eliminating major controllable non-medical risk factors of tobacco use, alcohol abuse, obesity, and physical inactivity would result in an estimated 32.1% drop in DALYs. Better control of cholesterol and blood pressure would result in an additional 18.5% reduction in DALYs. WHO estimates that elimination of the 20 leading risk factors would add about 5.5 years of HALE to lives of people living in developed countries (p. 44).

B. More Plausible Trend in Biological Morbidity

Recent trends point to an *equilibrium of morbidity*. Studies of disease risk factors and the potential efficacy of a new public health emphasizing individual responsibility for

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[8] The sum of DALYs across all illness and injuries represents the years of Life Expectancy lived in a state of less than good health: It is the difference between Life Expectancy and Health Life Expectancy (HALE) where HALE is that portion of Life Expectancy lived in a state of good health. See the World Health Report 2002 for a complete description of DALY and HALE and how they are calculated.

controlling disease risk factors lend support to a plausible future for biological morbidity interventions that follows James Fries' path of a *compression of morbidity*.

C. Economic Morbidity

In the long-term, economic morbidity is driven by three factors: medical technology and medical care, ethics and personal sensitivities, and, to a lesser extent, healthcare systems.

1. Medical Technology and Medical Care

In the past half century, medical technology has been the most important factor driving medical care costs. Medicine as it is practiced today, with its high-tech gadgets and wide range of interventions, is of a scope, intensity and cost that were unimaginable as little as a half century ago. Looking forward one-half century, we face the same problem: medical care in mid-21st Century may well be so different than today's medicine that we can only guess at its character and cost.

The case for technology continuing to increase the scope, intensity and cost of medical care is strong and historically accurate. We have only to look at all too pervasive evidence such as the recent explosion in the cost of prescription drugs, development of a growing range of human organ transplants, and, to advances on the near-horizon such as a fully implantable mechanical heart, and xeno-transplants to make case for continuing past trends.

Making a case for technology as a driver of less care and lower cost is much more difficult. There is, though, an intriguing argument to be made, particularly over a long-term 25 to 50 year time frame: By shifting focus and scope of medical care from managing the symptoms and physiological consequences of chronic diseases (palliative medical care) to preventing disease and curing disease, medicine could become much less intense and less costly. We can look to medical history of the last fifty years for an example of this virtuous dynamic: The example of the medical history of polio.

The polio paradigm follows treatment of this disease and its per capita incidence and cost from beginning of the 20th Century through the late 1950s. Medical treatment of polio changed enormously over this time. Early in the Century it was only possible to diagnose the disease, but not to treat it. By mid-Century, medical technology advanced to the point of being able to treat the most serious acute-phase problems with palliative care: A mechanical breathing apparatus (iron lung) was used to support patients with paralysis. Finally, in the late1950s science discovered a cheap and effective preventive intervention: Salk and Saban vaccines to inoculate children against the poliomyelitis virus.

While records are not necessarily fully accurate, a good estimate of the incidence of polio until the late 1950s is 21 new cases per year per 100,000 population (Weisbrod 1971). Beginning in the late 1950s, the incidence of polio dropped to almost zero due entirely to the widespread use of Salk and Saban vaccines.

Per capita costs of care are even more difficult to estimate. It seems clear that early in the 20th Century per capita costs were low, since no medical care other than diagnosis was available. Weisbrod estimates the per 100,000 population cost of palliative care in the 1950s (in then current dollars) was about $30,000 per year. He also estimates the ongoing cost of preventive care: Manufacturing, distributing and administering Salk and Saban vaccines to children was projected at $11,000 (currency value same as previous cost estimate) per 100,000 population per year. This information and estimates paints a picture of per capita cost for polio that begins the 20th Century, when only diagnosis was possible, quite low; costs then increased significantly as technology developed relatively expensive palliative care (iron lung); then, per capita costs dropped significantly when science moved beyond palliative care to a simple biological solution (Salk and Saban vaccines) that prevents polio.

The argument for technology ultimately driving costs lower is based on widespread future changes in technology and medicine that follow the course of this polio paradigm. Much of our expensive technology is focused today on diagnostic, palliative, and modestly effective curative care. Relatively little technology is now aimed at prevention or effective cures, particularly the chronic diseases of aging (heart, stroke and cancer) which increasing dominate healthcare spending. Medical research is gaining knowledge of the genetic and physiologic basis of diseases. Aided, in particular, by genetics and the Human Genome Project, we may be entering a new era of understanding life and disease. As this knowledge finds its way in to practical medical applications, there is much more than a hope that prevention and effective cure will increasingly replace palliative and modestly effective curative care for many chronic diseases.

A recent medical report on results of human clinic trials is a good example of this reason for hope that we will see a long-term reversal of the cost-increasing effect of medical technology. In November 2002, The New York Times reported that scientists created a vaccine to prevent cervical cancer (Grady 2002). Cervical cancer affects 470,000 women a year worldwide and kills 225,000. The vaccine prevents disease by endowing immunity to a virus that causes cervical cancer. In the future, by giving it to young women before they become sexually active, as much as 70% of all cervical cancers and pre-cancerous lesions that require on-going medical care will be eliminated. The improvement in health, and the net cost savings from substituting preventive vaccines for palliative and only sometimes curative medical care, is potentially enormous.

Announcements of pre-clinical research results like a vaccine to prevent cervical cancer are common. It is unfortunately true that many announced advances end up not proving effective during human clinical trials. The two recent reports described above, though, demonstrate that science and medical technology is capable of moving from costly diagnostic and palliative treatments to effective preventive and curative treatments. The case for technology lowering costs is that in the long-term this trend will change the scope and intensity of medical care in ways highly beneficial to patients that are imaginable today, but not implemented.

2. Ethics and Personal Sensitivities

The way in which we think about health and healthcare is another significant factor affecting economic morbidity. The fundamental importance of health and healthcare to each of us is captured by medical ethicists Roberto Mordacci and Richard Sobel (Mordacci and Sobel 1999):

> "Health can be seen as a means, a foundation for achievement, as a first achievement itself, and a necessary premise for further achievement…The sick individual suffers isolation, loss of wholeness, loss of certainty, loss of freedom to act, loss of the familiar world; the future is in doubt and all attention is concentrated on the present… When ill, we no longer trust our bodies and …we no longer trust life."

This very emotional and basic drive clearly affects how people think about their health and the healthcare system that provides for their needs.

Individuals' personal sensitivities contribute to development of a healthcare ethic. This national ethic, in turn, affects and constrains government stewardship of national healthcare systems. A national ethic may emphasize individual freedom to access health care, or it may emphasize social solidarity. The high relative cost of the US healthcare system has been ascribed by ethicist Daniel Callahan (Callahan 1998) to a problem of values:

> "We have a system that has believed it could pursue unlimited medical progress to meet all individual needs at an affordable price…"

Callahan challenges us to understand that as long as we in the US (and increasingly in other developed countries) demand "all the care we want - when we want it", costs cannot be constrained and government stewardship has severe limitations to its ability to cost control. Alternatively, an ethic of social solidarity, which builds a meaningful sense of personal willingness to forego medical care for the common good, provides the UK National Health Insurance with legitimate tools to severely constrain healthcare resources and spending. This same end, constraint of services and costs, is also achieved in an authoritarian, and previously in communist systems, that do not allow citizens any option to demand more than is made available to them by their authoritarian leaders.

Expectations and an ethic consistent with natural death might have enormous consequences for the use of medical and social care. The high cost of death that we observe today is consistent with expectations and ethics that usually commit us to "do everything medically possible to stave-off serious illness and death" and a real hope that "death can be conquered". An alternative expectation and ethic than may develop is to recognize aging and death as inevitable and natural. When death occurs, and it will certainly do so for all of us, we could quite clearly recognize that the end-of-life is at hand and choose "death with dignity": This is a death process aimed, not at cure, but at making the inevitable end as peaceful as possible. This change in ethic may change medical care at end-of-life to relatively low cost palliative and supportive care: Much more costly curative care may be foregone.

As important as medical research on aging is for its medical and demographic implications, it is perhaps equally a key to the question of the future course of healthcare ethics and sensitivities. If life expectancy is understood to be malleable, then the hope for potentially limitless life will likely encourage continued medical research and aggressive medical care aimed at "curing" death. If, however, life is increasingly understood to have natural limits then, as these limits are approached, it becomes more likely that peoples' ethics and sensitivities might adjust to accepting end of life as natural and immutable. Aggressive medical care aimed at "curing" end of life diseases may be replaced by supportive care for dying individuals aimed at make their end-of-life experiences as comfortable as possible.

Some of the potential savings from less aggressive end-of-life care is at risk if expensive medical care is replaced by expensive institutional supportive care for the elderly as they reach the end of their natural lives. This posses yet another challenge to governments and citizens to carefully consider institutional and de-institutionalized options for care of frail elderly.

While ethics and personal sensitivities have enormous long-term consequences for healthcare and healthcare costs, predicting the future course of changing ethics and its affect on healthcare cost is simply not possible. However, improvements in attitude and ethics can only have a positive affect on future healthcare costs.

3. Healthcare Systems

Healthcare systems are the means by which peoples' healthcare needs and expectations are fulfilled. Healthcare systems are by nature of the problem they address, and by design, enormously complicated organizations in need of public stewardship and deeply involved with national political processes.

In the short-term, healthcare systems, their cost, effectiveness, and continuing refinements, are so important to us that they demand and receive a great deal of attention. In the long-term, health care systems are also important, but less so than in the short-term: Their dominant long-term influence is if, and how, a healthcare system constrains costs and services. A private system may constrain costs through negotiations among institutions that provide financing and those that provide care: Services may be constrained by managed care arrangements. Public systems have additional tools. Governments may constrain costs through their budgeting processes: Services may be rationed either explicitly or implicitly through constraining financial and/or material resources. Constraints may be weak and only marginally reduce supply and demand, or they may be strong a significantly reduce costs and healthcare services.

In any healthcare system future, the most important policies will be those that affect the burden of disease (public health), how people think about treating illnesses (ethics and personal sensitivities), the scope and intensity of medical care interventions that are available to treat diseases (medical technology), and universal access to high quality healthcare services. Stewardship of healthcare systems has more effect on the pace of change than on its long-term direction.

4. Future of Economic Morbidity

Our look at the three major factors affecting long term economic morbidity (medical technology and medical care, ethics and personal sensitivities, and healthcare systems) does not point with any certainty towards a future direction. I am hopeful that medical science and emerging medical technology will so drastically change medical care over the next fifty years that the effectiveness of healthcare services will be drastically enhanced and that, at the same time, intensity will be reduced and cost will be at least significantly constrained. However, hope is just a possibility, not a tendency nor a trend. It will likely be many years before those interested in long-term healthcare costs will be able to know with any degree of certainly if, and to what degree, the past trend of an expansion of care may be changing.

VII. Conclusions

It is clear that there *is* an ongoing healthcare cost crisis that will extend into the 21st Century. Concerns that aging populations cause or exacerbate the crisis, though, do not focus on the most important long-term factors. Demography is *not* destiny. The elderly populations of developed countries will continue to grow --- this is a demographic certainty. However, more elderly will not necessarily force healthcare costs higher. Other factors trump the cost consequences of aging. The elderly may live additional years of life in either good or ill health; medical care may continue to increase, or possibly decrease, its scope and intensity; frail elderly may increasingly be cared for in expensive institutional settings or, alternatively, in much less expensive settings.

The single most significant underlying cost-driver is the future course of technology. Technology could continue to expand the scope and intensity of medical care, and drive higher and higher relative cost of care; or there is hope that this trend could be reversed as science and technology turn to effective and efficient cures for costly diseases. Healthcare costs in 2050 depend heavily on these unknown, and currently unknowable, factors.

These conclusions may leave readers feeling that there is little that can be done to affect the future. However, I believe there are sound health policies that can affect the future of healthcare and healthcare costs.

- Government needs to continue significant support for basic medical research and to create effective incentives for development of cost savings and curative technologies. The greatest hope for a low-cost, more-effective future healthcare system lies in the collective creative genius of science and medicine.
- Health promotion needs to be emphasized. Health life style *does* make a difference. Government has an important role to play in explaining and promoting healthy lifestyle; however, this new public health initiative ultimately depends on individuals taking responsibility for their own health.
- Government, religious leaders, and care providers encourage development of an ethic emphasizing non-aggressive end-of-life care for the elderly. This change

can only take place if it becomes increasingly possible to recognize end-of-life and increasingly understood and accepted that “death” cannot be cured.

- Large increases in aged populations will cause large increases in the need to care for frail elderly. Institutional care is very expensive, and usually not as caring and supportive as non-institutional care from family, friends, and other caregivers. Developing a social ethic of de-institutionalized care, where possible, will help control long-term care costs.
- As costs continue to increase, existing pressures on governments to control healthcare costs will only increase. How governments respond and the changes made to their healthcare systems will affect the pace of change and, possibly, the breadth of healthcare available to different communities.

We may not be able to adequately understand the path we are on, but we can know with certainty that what governments, businesses, providers, and individuals do today and in the future will affect healthcare and healthcare costs in mid-21st Century.

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