POLICY FORUM: MEDICINE

Effects of Medical Research on Health Care and the Economy

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One of the most serious problems to face the U.S. health care system and the U.S. economy in the 21st century will be the demographic shift caused by the aging of the "baby boom" cohorts (persons born 1946 to 1963). The federal share (25%) of today's $1 trillion health care bill is projected to grow to 50% of a $1.6 trillion to $2.3 trillion bill in 2015. In a 1997 report to Congress, the American Academy of Actuaries estimated that to maintain Medicare solvency through 2070 immediate benefit cuts of 60% were necessary—equivalent to the elimination of nearly all in-hospital care for people over 65. Without drastic service reductions, Congress must raise Medicare payroll taxes fourfold or return to deficit spending.

This situation cannot be solved by moving seniors into managed care and capping health costs. Current experience with managed care suggests that most real savings from fee-for-service inefficiencies have been achieved, and further major savings as a result of increased efficiency (as opposed to service reductions) are unlikely. This is especially true as health maintenance organizations (HMOs) begin to compete with each other for market share in increasingly saturated markets where they are less able to control expenses by excluding seriously ill and costly patients (*1*). HMO efforts to reduce costs under competitive and market constraints now threaten the quality of care and create dissatisfaction among both patients and physicians. These problems, plus frequent denial of experimental treatments (especially for terminal diseases) and recent cases of major Medicare fraud are causing state attorneys general to increase oversight of operation of managed care plans and for-profit hospitals (*2*).

Solving the problems of rising health costs and population aging requires understanding the complex, and rapidly evolving, relation of new health care technologies and the economy. Many of the factors that could improve health and lower costs in future decades are linked to new research developments in biotechnology. Furthermore, one should not focus only on complex, capital-intensive treatments. Biotechnology also includes efforts to prevent disease or improve health through, for example, enhancement of the micronutrient profile of specific foods (*3, 4*) or addition of antibiotics to control infectious agents that contribute to chronic disease.

We suggest that seven factors will combine to rapidly alter medical knowledge and practice, health delivery and outcomes, and total health costs.

Declining disability among people over 65. The National Long Term Care Survey (*5*) tracked health changes in the Medicare population aged 65+ from 1982 to 1994. The age-adjusted chronic disability prevalence rate declined 1.3% annually over the 13 years. Recent declines in disability rates are consistent with the introduction of new biotechnologies due to the maturation of major areas of biomedical research (for example, better drug treatments of osteoporosis, stroke, Parkinson's disease, and congestive heart failure).

Manton and Singer (*6*) see health costs as less a function of the percentage of elderly in the population, than of the percentage of chronically disabled in the elderly population. What impact will disability decline have on costs? Because chronically disabled individuals over 65 have health costs seven times those of healthy individuals, the crucial ratio is that of Medicare's fiscal burden of disabled elderly to younger workers (age 18 to 64) contributing payroll taxes. If this "dependency ratio" were kept constant for 40 years, that would contribute significantly to keeping the Medicare Trust Fund solvent—even as baby boom cohorts reach eligibility. The dependency ratio can remain steady, and a cost crisis averted, by maintaining at least a 1.5% annual decline in chronic disability prevalence, assuming the cost of reducing disability does not consume most savings.

The changing paradigms of medicine. Conventional economic thinking suggests that new medical technology for improving the health of seniors often increases costs and absorbs savings as a result of better health. But technological advances are defining new paradigms for medicine to which traditional economic theory may not apply. Improved understanding of human biology at the molecular level may make invasive surgery, intensive care units and long-term nursing home care far less necessary. Those costly (and often clinically inadequate) interventions could be replaced by genetically engineered pharmaceuticals and other treatments (such as gene therapy) targeting the molecular basis of disease. Unraveling the human genome may allow us to intervene in many diseases before they become symptomatic.

Thomas (*7*) and Weisbrod (*8*) assessed the technological route, and subsequent cost evolution, for given diseases. In coming decades, a new medical paradigm could lower costs for many diseases as interventions change their outcomes (see figure).

The use of tissue plasminogen activator (tPA) to treat acute ischemic stroke is a good example of a recent clinical advance in which technology could produce cost savings (*9*). Using data from the NINDS rt-PA stroke trial, Fagan *et al.* (*9*) found that hospital length of stay was shorter for treated patients, and that more treated than untreated patients were discharged to home (rather than to institutional) care. This increased hospital costs (as a result of hemorrhagic stroke) by $1.7 million per 1000 patients, but decreased rehabilitation and nursing home costs by $6.2 million—a net savings of $4.5 million per 1000 treated stroke patients. Not only do costs decline but quality of life improves—564 quality-adjusted life years were gained per 1000 patients over their remaining life-span.

This first-generation innovation might move stroke therapy from palliation range to a "half-way technology" status (position B in figure) because only a proportion of ischemic stroke cases benefit. A decade from now, however, there may be a "cocktail" of stroke treatments for different stages of the pathological process, such as neuroprotectants to shield nerve cells during a stroke, new clot-dissolving drugs, longer lasting neuroprotectants to prevent secondary pathological events, maintenance therapy (such as blood thinners), and, eventually, drugs to help nerve cells reconnect in the brain.

The paradox of extended longevity. Better therapies, applied earlier, may both in

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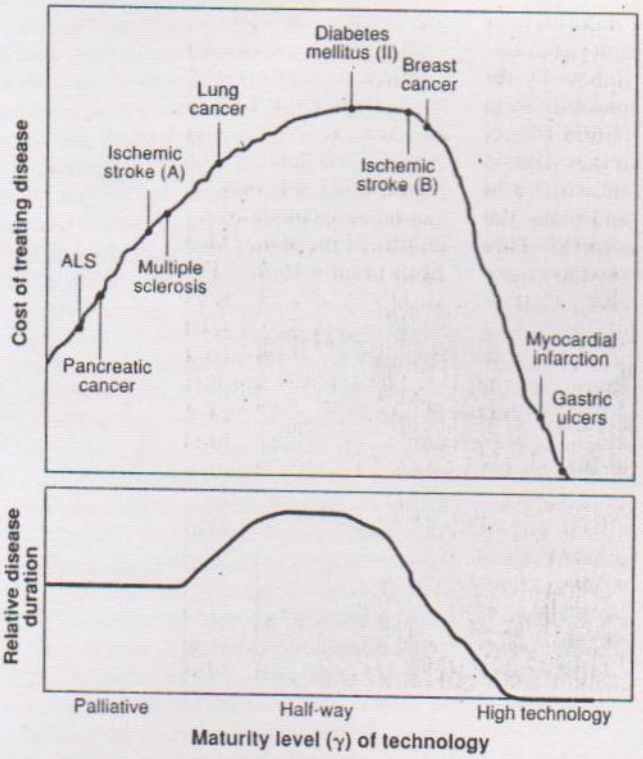
prove function and extend life. Conventional wisdom suggested that more old people, living longer, would increase health costs. Paradoxically, the opposite appears true. Lubitz and Riley *et al.* (*10*) found that health costs in the last 2 years of life declined in persons dying at later ages. Health treatments of a person dying at 67 cost three times as much in the final 2 years of life as of a person dying at age 90.



Evolution of medical technology for selected diseases (*8*).

Thus, if you deposited all the money needed for health care for the rest of your life into an interest-bearing account, at age 65 you would need to deposit less if you live to 85 than if you live to 75. Lower costs in the last 2 years of life, and lower average annual costs, are desirable because Medicare is a pay-as-you-go fund. Evidence suggests that lower health maintenance costs for survivors to age 90 (for example) are due to those persons avoiding the early risk of many chronic diseases (*11*).

Revolution in pharmaceutical R&D methods. Savings resulting from new medical knowledge will be multiplied by the ability to screen promising compounds at rates unimaginable a few years ago. Miniaturization and robotic chemistry, allied with genetics and high-throughput screening and bioinformatics, both provide a clearer picture of drug efficacy before clinical trials and may reduce certain pretrial drug development costs by a factor of 100 or more (*12*). The savings from such streamlined R&D methods, if reinvested in newer technologies or used to lower drug prices in competitive markets, might reduce health costs and produce drug therapies that could replace (along with improved diagnostic imaging procedures) many types of invasive surgery.

Increasing public expectations about health at later ages. The over-65 cohort is increasingly knowledgeable about medical issues, because of increased coverage of medical advances by the media and because of their improved education (*13*). A better-educated public will be driven by rising health expectations, especially at later ages, to make behavioral changes identified by biomedical research as improving health. As individual behavior changes, more elderly people will remain active, independent, and out of the formal medical care system (*14*). How behavior affects health is a crucial area of biomedical research.

Labor productivity as a function of improved health. Decreased morbidity will affect the economy by reducing lost work time for patients and their family caretakers, increasing the productivity of the labor force, and extending it in older populations. For example, acute illness costs roughly $103 billion annually in lost labor—not counting caregiver costs or the effects of chronic conditions. Extending the productive years of older individuals makes it more feasible to raise the age of Medicare and Social Security eligibility to protect their solvency (*15*).

Growing importance of biomedical technology to the economy. Beyond its impact on individual health, biotechnology is an important engine of U.S. economic growth in creating jobs and global competitiveness. Biotech industries could experience growth similar to that of the computer industry over the past 20 years, generating hundreds of start-up companies and several hundred thousand new jobs (many highly skilled and well paid), and increase the U.S. gross domestic product (GDP). Increasing the GDP faster than the burden of health care (currently 15% of GDP) will help maintain an affordable ratio even with the coming demand for services by aging boomers.

Some argue that improved biotechnology increases health care demand creases the proportion of the GDP dea... ed to health care. However, demand is not totally elastic. For life-threatening conditions, treatments are often so rigorous that no one undergoes them except under dire necessity. An increasing proportion of GDP spent on health care is not necessarily an adverse outcome if growth of other economic sectors is stimulated, and if some health services purchased represent new products fulfilling previously unmet needs.

It is also possible that the proportion of GDP dedicated to health care might not increase. Sales of biotechnology products in a global market increase U.S. GDP but not domestic health costs. Biotechnology generates numerous applications in non–health care sectors [for example, improving plant genetics and food production, environmental clean-ups (oil-eating bacteria), and development of organic compounds with novel industrial applications] that stimulate economic growth of non-health sectors (*16*). Finally, improved health may increase GDP beyond the health care investments needed to achieve it. The ability to effectively manage osteoarthritis would affect the number of years workers can be productive, or retirees can be physically active, thereby increasing consumption of leisure industries, transportation, and other services and goods.

Looking at health care as a multicomponent dynamic subsystem of the U.S. economy allows us to appreciate the multiplier effects biotechnological innovations may produce to control future costs. However, there may be a 15- to 20-year lag between a scientific observation and its clinical implementation. We must increase investment heavily in biomedical research to realize benefits in time to control the impact of Medicare costs.

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POLICY FORUM: DEMOGRAPHICS

Aging in the Third Millennium

Edward L. Schneider

The aging revolution in the United States in the 20th century was the result of a spectacular 50% increase in life expectancy (*1*). What will happen to our aging society in the 21st century? The answer will depend on our success in improving the health of future older Americans.

A Key Certainty: There Will Be Very Large Numbers of Older Americans

As a result of the aging of current baby boomers and the projected continuing increase in life expectancy, the number of Americans aged 65 and above is projected to increase from 35 million in 2000 to 78 million in 2050 (*2*). Even more impressively, the 4 million Americans aged 85 and above in 2000 is projected by the Census Bureau Middle Series to grow to almost 18 million by the year 2050 (see the figure) (*2*). Many demographers believe that these projections are underestimates (*3*), however, and that the Census Bureau Highest Series projections of 31 million very old Americans by 2050 are closer to the mark (see the figure) (*2*). The future requirements of this group are critical since most Americans will live into their 80s. An increasing older population in the next century does not necessarily present major problems if their economic, health, housing, and transportation needs are anticipated and the appropriate resources are developed.

Another Certainty: Social Security

A presidential commission is currently meeting to examine alternative ways to ensure the solvency of Social Security (*4*). Many options will be explored, including private investment of funds, reductions in cost-of-living adjustments, raising the income cap for Social Security contributions, advancing the age of eligibility, and increasing Social Security tax levels. Because Social Security benefits provide the majority of the income of aged Americans (*5*), this program will undoubtably continue with only minor adjustments.

The Major Uncertainty: Health

The issue that will most affect the quality of life for tomorrow's older population is their future health requirements. The health of an aging population will not only directly affect their future health care costs but it will also have enormous consequences for their economic, housing, and transportation needs. We can examine the future needs of older Americans using two scenarios that define the most likely range of future health changes (although other scenarios are possible).

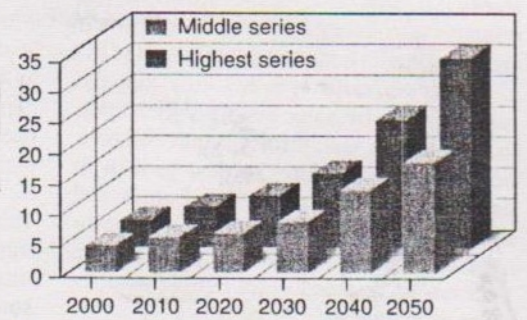
Scenario 1: Through appropriate levels of investment in aging research, disease prevention and treatment, major advances are made in the conquest of the current major causes of disability in the older population. As a result, the average health of a future 85-year-old in the year 2040 resembles that of a current 70-year-old with relatively modest needs for acute and long-term care.

Scenario 2: Current low levels of support for research, prevention, and treatment are sustained. As a result, current health trends, which show small, if any, improvements in the average health of older people, continue (*6*). Even small improvements in the average health of the 85+ age group will be offset by the increasing ages within this cohort, and as a result, the average health of a member of the future 85+ age group in the year 2040 will not be very different from that of a current member of the 85+ age group, with its substantial needs for acute and long-term care.

Medicare Depends on Future Health

Since the inception of Medicare in 1955, the costs of this program have increased exponentially (*7*). It is an age-based entitlement that pays most hospital and physician costs for older Americans. The costs for long-term care, which have grown at least as rapidly, are largely paid by the families of the older person. In the first five decades of the next century, there will be several trends that will place an enormous strain on future Medicare expenditures. First, after a brief respite, health care costs are escalating again, and a 3.3% annual increase in health care costs over the inflation rate is forecasted for at least the upcoming decade (*8*). Second, Medicare will be stressed by the large numbers of eligible older Americans. In 2021, the first of 76 million baby boomers will turn 75; the age when health care costs start to escalate. Third, the Medicare expenditures per enrollee for the fastest growing age group, those 85 and over, are much higher than the costs for those in younger age groups (*9*). Finally, the components of Medicare that are most likely to grow the most rapidly in the future are those most utilized by the rapidly growing oldest age groups: home health care and skilled nursing care. For home health care, the average expenditure per person for individuals aged 85 and over is almost five times higher than for those aged 69 and 70, and for skilled nursing home care it is almost nine times higher (*9*).

Under scenario 1, Medicare costs would rise less steeply because improvements in health would substantially lower costs per enrollee. Periodic readjustments similar to those made in Social Security, but larger in magnitude, should ensure the continued financial health of this entitlement. By contrast, under scenario 2, health care costs will grow substantially in the first two decades of the next millenium (*10*) and then accelerate even more rapidly. Although the small improvements in the average health of older Americans might provide some savings in the cost per older person, those savings will be dwarfed by the vastly larger numbers of older Americans needing health care. This future exponential growth of Medicare costs will place a great strain on federal budgets and will probably lead to one or more of the following results: (i) seniors paying a substantial part of their health care costs through higher premiums, more copayments, and more exclusions; (ii) Medicare changing to a needs-based program, with eligibility limited to poorer older Americans; or (iii) health care rationing on the basis of age.



Aging Boom. The growth of the oldest age groups will surpass current middle census bureau projections (*3*).

Housing and Transportation

Healthy older Americans can continue to live in their homes or relocate to the many retirement communities that will cater to every pocketbook and interest. Those who require ongoing assistance with the activities of daily living and do not have a spouse, child, friend, or significant other

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[illegible] housing. Over the past 20 years, there have been several trends that will undoubtedly continue into the next century. As hospital stays have shortened, sicker older patients have increasingly been transferred to nursing homes. Nursing homes that 20 years ago contained healthy as well as disabled older individuals are being transformed into facilities where substantial medical care is delivered (11). Those with less serious disease and disability are more and more frequently being referred to assisted living facilities, which are being built in increasing numbers (12).

Under scenario 1, it is likely that the vast majority of older people will remain in their homes with the assistance of home health care. Therefore, modest growth in the number of future nursing homes and assisted living facilities may suffice to take care of the moderately increased numbers of disabled older people who require more intensive care.

Under scenario 2, the demands for home health care and for admission to nursing homes and assisted living facilities by large numbers of frail elderly people would be enormous. The modest reimbursements available under Medicaid today provide few financial incentives to build nursing homes for low- or middle-income Americans. As a result, the small number of nursing homes that are now being constructed or will be constructed in the future will be largely for affluent Americans. Today, most of the assisted living facilities that are being built are for middle- and upper-income people, and they vary in their ability to take care of sick older Americans. As the number of disabled older Americans increases rapidly, nursing homes will become semi-acute hospitals with long waiting lists. Home health care services will have to expand rapidly to meet burgeoning demand. Assisted living facilities will be the sole remaining recourse for millions of disabled, frail, older Americans who can no longer live independently in their homes. Future assisted living facilities will resemble our current nursing homes in the intensity of medical services that they will be forced to provide. Nursing home capacity for Medicaid-eligible patients will be severely strained, and the costs of assisted living facilities will be beyond the means of poor, disabled, older Americans. If they do not have relatives, significant others, or friends to take care of them, we may face the gruesome prospect of poor, disabled, homeless older Americans living out the end of their lives on city streets and in parks.

One of the critical abilities that defines the independence of an older person is the ability to drive a motor vehicle. Unfortu[illegible] mobile accidents ([illegible]). The accident rate per mile driven by people in older age groups is comparable with the notoriously bad rates for those aged [illegible] and under ([illegible]). However, dangerous driving is more a function of the [illegible] sensory impairments that accompany age-related diseases (14) than of the chronological age of the driver.

Under scenario 1, the improvement in the health of older Americans should result in decreased cognitive and sensory impairment. This should improve the safety of older drivers and allow additional millions of older Americans to remain independent. Under scenario 2, transportation resources will be severely taxed to maintain the independence of seniors, because there will be enormous numbers of older disabled people needing transportation. In urban areas, needs for transportation services may overwhelm existing resources and require the development and funding of additional specialized shuttle services. In rural areas, it may be impossible to provide necessary services to large numbers of frail older Americans.

The Economic Status of Older Americans

Since the introduction of Medicare in 1966, the burden of health care costs for older Americans has shifted to this federal entitlement. Under scenario 1, the economic status of older Americans will not be substantially affected. They may have increases in their out-of-pocket health care [illegible] should not place an undue stress on [illegible] economic welfare. Under scenario 2, we could see a drastic change in the wealth of older Americans. The additional health care, housing, and transportation [illegible] could result in many millions of older Americans moving below the poverty line.

Investment in Research

If our nation is serious about averting the future exponential growth of health care, housing, and transportation costs for the elderly, we must start now by providing adequate funding for the prevention and effective treatment of the chronic diseases that afflict the older population. A quantum increase in research on chronic diseases is necessary before we can make a dent in the projected growth of health care costs related to an aging population. In 1998, approximately $1 billion was spent by the federal government on aging research (15). By comparison, a third of the more than $1.146 trillion spent on U.S. health care (16) was spent on health care services for older Americans. No corporation that spent a mere 0.3% of its revenues [illegible] tive marketplace. It is time for [illegible] to invest appropriate levels of [illegible] search to prevent the diseases of aging [illegible] invest a reasonable percentage of [illegible] Medicare budget in research now [illegible] [illegible] consequences of millions of ailing and impoverished elders.

By applying today's biomedical technology to the diseases of aging, future newborn children could be screened for genes that predispose them to the chronic diseases of aging, and their environments could be altered to permit successful healthy transitions throughout life. This could enable all of us to look forward to independent, productive, healthy lifespans with little dependency and disability. We then might have the pleasing prospect of living lives like the perfectly constructed "one-hoss shay" of Oliver Wendell Holmes, which, after lasting exactly 100 years, collapsed in a single day (17).

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