## CELEBRATION OF SCIENCE

Washington, DC • September 7-9, 2012

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Through rapid advances in biological research and medical innovation, the health care industry has made enormous strides in improving the health and lengthening the lives of Americans as a whole. Life expectancy at birth has risen from age 70 in 1960 to 77 in 2008. The innovations in health care over the course of the century have led to a rapid drop in infant mortality. Fewer people are dying from heart disease. Cancer survival rates are increasing. On the horizon, we are glimpsing advances in medicine, genetics, and biomedical technology that may take us to new heights in slowing aging, preventing inherited diseases, and solving the health riddles that stump us.

These advances of medicine will likely leave the nation with an older population as more people live into their 80s, 90s, and even 100s, and as the baby boomers enter old age. The potential costs of an aging society are well-known, including rising health care costs at a time of shrinking government budgets. The solvency of Medicare is a perennial issue. Yet, thanks to advances in health care and other fields, the well-being of the elderly population has also improved. In but one example, the nursing home population has declined along with disability rates. In 1985, 5.4% of the elderly were in nursing homes. By 1995, the share was down to 4.6%, on an ageadjusted basis.<sup>1</sup> If advances in science and health care continue, people may continue to reach older ages as healthier and more active individuals. As a result, they may work longer and use fewer health care resources, while continuing to give back to society in numerous ways.

The specter of an aging society regularly ignites debate in health policy circles on costs versus benefits. Is it right, some wonder, that older adults in their last year of life consume 24% of Medicare's expenditures? Or is it cost-effective to pay for a cancer drug that will postpone an inevitable death for only a few months? In Britain, for example, the National Institute for Health and Clinical Excellence determines what therapies the National Health Service will cover. It generally recommends against paying for a therapy that costs more than \$31,000 to \$47,000 for each year of life gained, adjusted for quality.

<sup>&</sup>lt;sup>1</sup> David Cutler, "Declining Disability Among the Elderly," *Health Affairs*, vol. 20 (November/December 2001). The figures are age-adjusted to account for the growing number of aged in the population over time.

Yet medical advances, while costly, are proving to be worth it in many instances, according to a vast body of research on cost-effectiveness of medical care. Invariably, most studies using patient-level data find that the benefits of health improvements dominate any additional costs for most new technologies. In addition, recent aggregate analyses by David Cutler and colleagues compared historic gains in life expectancy (about seven years) with the increased health care costs from 1960 to 2000. They find that during that span, the increases in medical spending have provided reasonable value, with the exception of spending increases in medical care for the elderly since 1980.

Comparing the cost versus benefits of particular interventions, Dana Goldman finds that some of the most cost-effective are cancer vaccines and treatment of acute stroke.<sup>2</sup> The latter, for example, would cost \$3 billion to \$4 billion annually after accounting for morbidity and mortality changes at the population level. Yet the cost per additional life year is only \$22,000 (standard estimates put the value of one life year at \$150,000). Therefore, the value is roughly four times the cost. The savings from reduced nursing home care are particularly large. More borderline, but still cost-effective, are telemerase inhibitors (a cancer treatment) and intraventricular cardioverter defibrillators (for heart arrhythmia).

Cancer treatment is among the most expensive medical interventions. It is here that the policy debates about costs are frequently most pronounced. Many say we are losing the war on cancer that Richard Nixon first declared in 1971. After all, cancer is the second-leading cause of death and accounts for approximately one-fourth of all deaths each year.

In many respects, however, we *are* winning that war on cancer. Although cancer still takes the lives of far too many people every year—approximately 556,000 in 2003—the survival rates are lengthening, thanks in part to research and development and a growing understanding of prevention and treatment. As Darius Lakdawalla and colleagues find in their article, "An Economic Evaluation of the War on Cancer," in the short time span between 1988 and 2000, life

<sup>&</sup>lt;sup>2</sup> Dana Goldman et al., "Consequences of Health Trends and Medical Innovation for the Future Elderly," *Health Affairs* (Web exclusive) (September 2005). DOI: 10.1377/hlthaff.W5.R5.

expectancy for cancer patients increased by approximately four years.<sup>3</sup>

Lakdawalla and colleagues also show that the gains have considerably outweighed the associated costs. Specifically, they compared the social value of the survival gains (3.9 years from 1988 to 2000) to their costs, focusing on early detection and improved cancer therapies. In all, the nation spent \$300 billion on cancer research in this time span, with benefits of \$1.9 *trillion*. He and his co-authors determined that the improvements in survival created 23 million additional life years among Americans. An average life year in this scenario was equal to about \$86,000 per individual.<sup>4</sup> Further, despite some contentions, manufacturers and producers of cancer-related interventions reaped only between 5% and 9% of these gains in the form of profits. Clearly, R&D efforts have provided very large returns.

Further, the United States is advancing in this war far faster than more regulated environments such as Europe. U.S. cancer patients experienced greater survival gains than patients in Europe, even considering the higher health costs in the United States. Spending on cancer treatment in the United States rose 49% between 1983 and 1999, compared with a 16% increase in Europe.

U.S. cancer patients diagnosed between 1983 and 1999 survived approximately two years longer than those in Europe.<sup>5</sup> Reviewing data across a longer time span (17 years) than Lakdawalla et al., Tomas Philipson and colleagues in "An Analysis of Whether Higher Health Care Spending in the U.S. Versus Europe Is Worth It" find that between 1983 and 1999, the greater survival gains in the United States compared with Europe were worth \$598 billion of additional value for patients (and society), on average, net of the greater spending increases in

<sup>&</sup>lt;sup>3</sup> Darius Lakdawalla et al., "An Economic Evaluation of the War on Cancer," *Journal of Health Economics* 29 (2010): 333-46.

<sup>&</sup>lt;sup>4</sup> This figure accounts for the fact that patients with a fatal disease are often more willing to pay "anything" to live longer.

<sup>&</sup>lt;sup>5</sup> The exceptions were for colorectal cancer and uterine cancer. To compare the survival gains with those in Europe, they used two data sets, the Surveillance, Epidemiology, and End Results (SEER) database in the United States, and the European Cancer Registry on Survival and Care of Cancer Patients. They used a standard estimate of \$150,000 per life year. Expenditures were calculated from total health expenditures in 10 European countries and the United States. Costs include treatment and prevention (such as screening).

during that time.6

Whether the better outcomes are a result of higher spending is a difficult question, but Philipson and colleagues analyzed the correlations and found that between 1983 and 1999, each \$100 increase in per-capita cancer spending was associated with an additional gain of one year of life expectancy after diagnosis. Further, they found that increased spending explained approximately 28% of the improvements in survival. The correlations between spending and health outcomes were even stronger in more recent years, 1995-1999. Increased screening, quicker access to new drugs, more aggressive treatments (such as with prostate cancer) and new technologies are all possible reasons for the greater survival gains in the United States. Such gains are particularly pronounced in prostate and breast cancer survival compared with Europe. They are relatively smaller for colorectal cancer.

The above estimates look at the aggregate value of population-based cancer advances. Individuals, rightly, feel even more strongly about the benefits of cancer research. Three recent papers quantified the value of health care technology to patients.

Current approaches to valuing health care technology focus exclusively on how a therapy benefits the average patient. Yet, many real-world therapies are modestly effective for the average patient, but extraordinarily effective for a smaller subset of patients who respond most strongly. Lakdawalla and colleagues in "How Cancer Patients Value Hope and the Implications for Cost-Effectiveness Assessments of High-Cost Cancer Therapies" find that cancer patients are willing to gamble on therapies with modest average benefits but significant survival benefits for a "lucky few" patients. Patients were presented with a choice between two therapies—a "hopeful gamble" and a "safe bet."<sup>7</sup> The two options had similar benefits to the average patient. The "safe bet" provided the same benefits to nearly all patients being treated. In contrast, the "hopeful gamble" provided large survival gains to a "lucky few" patients, but at a heightened risk of premature mortality for "unlucky" patients. About three-fourths of cancer

<sup>&</sup>lt;sup>6</sup> Tomas Philipson et al., "An Analysis of Whether Higher Health Care Spending in the U.S. Versus Europe Is Worth It," *Health Affairs* 31 (4) (2012): 667-75.

<sup>&</sup>lt;sup>7</sup> Darius Lakdawalla et al., "How Cancer Patients Value Hope and the Implications for Cost-Effectiveness Assessments of High-Cost Cancer Therapies," *Health Affairs* 31 (4) (2012).

patients preferred the hopeful gamble to the safe bet.<sup>8</sup> Furthermore, they were willing to pay for it. When shown a range of payment amounts and asked to identify the maximum they would be willing to pay, one-fourth were willing to part with \$90,000 to get the "hopeful gamble." On average, patients were willing to pay \$54,362 for this option. This suggests that patients facing death will value the mere possibility of a slightly longer life.

Similarly, Dana Goldman and colleagues in "The Value of Specialty Oncology Drugs" find that patients rarely think twice about higher out-of-pocket costs for specialty cancer drugs.<sup>9</sup> The authors analyzed data from 16,533 insurance claims across 71 private health plans from 1997 to 2005 and found that among those with metastatic cancer (and controlling for income and other factors that could influence spending), a 25% decrease in out-of-pocket costs reduced the number of claims only about 1% to 3%. This suggests that individuals are only minimally sensitive to price under those conditions. There was some indication that patients are slightly more sensitive to out-of-pocket costs when *initiating* therapy, but any sensitivity disappears once treatment begins. The willingness to pay differs little by gender, age or income, although older patients overall value the drugs the most. Overall, patients valued the specialty drugs at four times their actual costs, when comparing the aggregate willingness to pay against aggregate spending. The effect is a little less for drugs taken orally.

The cancer patients in Seth Seabury and co-authors' investigation placed even greater value on cancer therapies than did the subjects of the above study. In "Patients Value Metastatic Cancer Therapy More Highly Than Is Typically Shown Through Traditional Estimates," the authors found that patients with metastatic cancer valued their treatment at a rate that was 25 times higher than its cost.<sup>10</sup> The authors analyzed how patients respond to increases in their out-of-

<sup>&</sup>lt;sup>8</sup> Specifically, in each scenario, participants compared the hopeful therapy to the other therapy, which provided the same average survival but with 100% certainty of death at the average survival time.

<sup>&</sup>lt;sup>9</sup> Dana Goldman et al., "The Value of Specialty Oncology Drugs," Health Services Research 41 (1) (2010): 115-32. The drugs included bevacizumab (Avastin) for colorectal cancer, trastuzumab (Herceptin) for breast cancer, rituximab (Rituxan) for non-Hodgkin's lymphoma, erlotinib (Tarceva) for lung cancer and imatinib mesylate (Gleevec) for myeloid leukemia.

<sup>&</sup>lt;sup>10</sup> Seth Seabury, Dana Goldman, J. Ross Maclean, John Penrod and Darius Lakdawalla, "Patients Value Metastatic Cancer Therapy More Highly Than Is Typically Shown Through Traditional Estimates," *Health Affairs* 31 (4) (2012): 691-99.

pocket treatment costs to infer how much they are willing to pay to gain access to these treatments. In theory, when prices go up, use of therapy should decline. In this case, however, higher prices deterred only a small number of patients from using treatment. This suggests that the vast majority of patients clearly valued the care and were willing to pay for it. The average annual out-of-pocket cost of therapy across all cancers measured was \$7,321. Yet the average value that patients placed on the treatment was \$180,284.<sup>11</sup>

Seabury and co-authors argue that using quality-adjusted life years (QUALYs) as a benchmark in cancer treatment cost-benefit analyses — the most common method of estimation — persistently undervalues treatments because it rarely factors in patients' increasing willingness to pay (value) when facing a terminal illness.

In most policy decisions, the value of a new therapy is typically measured as the ratio between its benefits (in this case the value to the consumer) and its cost, and if that ratio is above a set threshold, then the treatment is considered cost-effective. Given the above findings overall, Goldman and colleagues argue, current cost-effectiveness thresholds, like those used in the health care marketplace, should take into account the value individuals place on these treatments. After all, shouldn't drugs be considered cost-effective if patients are willing to pay more out of pocket for them than the actual cost?

It is not just cancer patients who value these treatments and their potential ability to prolong life. The general population does as well. In their article "Survey Results Show That Adults Are Willing to Pay Higher Insurance Premiums for Generous Coverage of Specialty Drugs," John Romley and co-authors find that individuals were willing to pay an extra \$12.94 per month, on average, in insurance premiums for generous specialty drug coverage, even when they were healthy.<sup>12</sup> This is far higher than the \$5 per month individuals could expect to save with

<sup>&</sup>lt;sup>11</sup> The authors developed a different method of assessing value, one that economists typically use in cost-benefit analyses and is based on consumers' choices when faced with a range of options.<sup>11</sup> They also measure this value in dollars, not QUALYs as most health cost analyses do. This dollar amount is more easily compared with costs of treatment.

<sup>&</sup>lt;sup>12</sup> John Romley et al., "Survey Results Show That Adults Are Willing to Pay Higher Insurance Premiums for Generous Coverage of Specialty Drugs," *Health Affairs* 31 (4) (April 2012).

generous coverage. The value, individuals feel, is in the reduced financial risk that insurance offers.

In other words, individuals were willing to pay \$2.58 in insurance premiums per dollar of higher expected specialty drug costs with a less generous plan. This willingness to pay was slightly higher among those in the bottom two-thirds of the income pyramid, suggesting that high-income individuals felt better able to weather risk or that lower-income individuals believed the "shock" of sudden drug costs could bankrupt them if they were in a plan with high out-of-pocket expenses.

The findings also point to another side of value — in this case, the value of innovation. In the minds of patients, the strides made by health care research are a valuable investment, if an expensive one.

## Conclusion

Clearly, the costs of health care are growing. The question is whether the benefits are growing faster, and some policy analysts have asked whether it is "productive" to spend more on better health care.

But the innovations are proving valuable to many Americans, as evidenced by their willingness to pay for care. Consumers consistently put a higher price tag on health care innovations, particularly in cancer treatment, and they are willing to put their money where their mouth is. Clearly, the \$150,000 per year that various insurance and government agencies place on the value of a human life is an underestimate from the standpoint of most Americans. Certainly a healthy debate on the growing share of the federal deficit that stems from health care spending is worth having. But Americans seem to cherish the innovations that have advanced health and prolonged life.

U.S. citizens have a better chance of surviving most cancers than do their European peers, largely because of scientific progress in treatment and detection. But in other areas of health, there are dark clouds on the horizon. We are falling behind Europe in life expectancy, especially

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at older ages. Americans can expect to live 31 more years after age 50, while Europeans can expect to live 32.5. In fact, it is our health at age 50 that sets up the divergence in longevity. Americans are in overall worse condition at that age. Compared with Europeans, they have more heart disease, diabetes, stroke and hypertension.

Prevention is key to stemming the divergence and improving Americans' health as they age. Goldman examined, for example, the costs and benefits of preventing cardiovascular risk factors such as diabetes, hypertension, obesity and smoking and confirmed that prevention even at older ages — has great social value and would be cost-effective if the right interventions could be found.<sup>13</sup>

He finds, for example, that a person aged 51 or 52 who was successfully treated for diabetes would add 3.1 years, and 1.6 quality-adjusted years, to life. The latter are years with minimal impediments to mobility and daily activities, pain and depression. The individual would save \$34,483 in lifetime medical expenses. Results were similar, though with smaller effects, for the other conditions. The bottom line is that we are increasingly preventing these diseases without increasing average lifetime medical spending, and we are significantly raising the quality of life in the process.

Innovations will continue to improve the treatment of disease, but innovations can also improve the prevention of disease. Preventing diseases among those approaching age 50 reaps returns more quickly than at younger ages. Preventive interventions are likely to be better targeted. And as the above articles suggest, life may be more precious the closer we are to the end of it, and therefore people may work harder to commit themselves to lifestyle changes and other preventive measures.

In the end, the investments in medical science have led to innovations and advances that the American public values. Even though expensive, those investments show solid returns.

<sup>&</sup>lt;sup>13</sup> Dana Goldman, "The Benefits of Risk Factor Prevention in Americans Aged 51 Years and Older," *American Journal of Public Health*, vol. 99 (11) (November 2009).



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