The contribution of pharmaceutical innovation to longevity, improved outcomes and economic growth

Frank Lichtenberg

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- Contribution of new medicines to longevity increase
  - Evidence based on aggregate data
  - Evidence based on patient-level data
- Use of new medicines reduces need for other health care resources
- The impact of new medicines on productivity and ability to work
Today, People Live 10 Years Longer Than in 1960

Life expectancy at birth has increased by more than 10 years in OECD countries since 1960, reflecting a sharp decrease in mortality rates at all ages.

Life expectancy at age 65 in OECD countries stands, on average, at over 20 years for women and close to 17 years for men.

Contribution of innovative drugs to longevity increase in Germany

German life expectancy at birth increased by 1.4 years during the period 2001-2007.

About one-third (0.45 years or 32%) of the increase in life expectancy was due to the replacement of older drugs by newer drugs.

Estimated cost per life-year gained from the use of newer drugs is €11597 (without taking reduced resource used due to medicines into account).

New treatments reduced mortality rates in Canada

Introduction of the new treatments in the last three decades reduced the risk of mortality by 51% for the overall study population.

Recent drug innovation, in particular medications launched after 1990, had a significant beneficial impact on the survival of elderly Canadians.

Substantial contribution by new drugs to improved survival: overall population

Estimated survival curves by drug vintage use.

Ten-year mortality rates by drug vintage category:

- Prior 1970: 7.55%
- 1970-1979: 9.89%
- 1980-1989: 7.09%
- Post-1990: 3.76%

Substantial contribution by new drugs to improved survival: asthma subpopulation

Estimated survival curves by drug vintage use

Ten-year mortality rates by drug vintage category:
- Prior 1970: 11.20%
- 1970-1979: 7.69%
- 1980-1989: 9.53%
- Post-1990: 3.34%

Substantial contribution by new drugs to improved survival: cancer subpopulation

Substantial contribution by new drugs to improved survival: CVD subpopulation

Estimated survival curves by drug vintage use.

Availability of innovative drugs

7 new molecules and 2 new drug classes for treating HIV were introduced 1995-1997

The Amount of Available Innovative HIV Medicines Correlates With Survival

Source: Lichtenberg (2008), Biomedical innovation, longevity, and quality of life, Presentation at Swiss Congress of Health Economics and Health Sciences
Decreasing mortality rates in HIV/AIDS


Increase in life expectancy due to new HIV medicines

Due to new medicines

Dramatically decreasing needs for hospitalization

Drug utilization and hospital utilization by AIDS patients

Cancer
Decreasing cancer mortality rates in Germany

Bösartige Neubildungen (ICD-9: 140-208; ICD-10: C00-C97)

ICD-9, bis 1997
ICD-10, ab 1998

Sterbefälle je 100,000 Einwohner

Zeit


1998 2001 2004

Monoklonale Antikörper
Angiogenese Hemmert
Intoleranz
Trastuzumab
Immunstimulanz
Immunmodulator
Sharp increase in 5-year cancer relative survival rate in the US

All cancer sites US

Year of diagnosis

Chemotherapy innovation contributed by 74% to the increase in the 1-year survival

Cancer survival rates, 1992-2003: actual vs predicted in the absence of chemotherapy innovation

Decreasing cancer mortality despite increasing incidence

Changes of Cancer Incidence and Mortality Rates 2002-2006

<table>
<thead>
<tr>
<th></th>
<th>Cases</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>All cancers but skin melanoma</td>
<td>9.93%</td>
<td>0.37%</td>
</tr>
<tr>
<td>Breast</td>
<td>18.51%</td>
<td>-2.97%</td>
</tr>
<tr>
<td>Prostate</td>
<td>54.25%</td>
<td>1.48%</td>
</tr>
<tr>
<td>Uterus</td>
<td>-1.17%</td>
<td>-9.49%</td>
</tr>
<tr>
<td>Colorectal</td>
<td>8.27%</td>
<td>0.20%</td>
</tr>
<tr>
<td>Stomach</td>
<td>-11.46%</td>
<td>-16.76%</td>
</tr>
<tr>
<td>Lung Female</td>
<td>21.46%</td>
<td>21.11%</td>
</tr>
<tr>
<td>Lung Male</td>
<td>-0.86%</td>
<td>-3.80%</td>
</tr>
</tbody>
</table>

A 1% reduction in cancer mortality is worth nearly $500 billion*

CVD
Decreasing CVD mortality rates in OECD countries

Cerebrovascular diseases as cause of mortality

Deaths per 100,000 population (standardised rates)


OECD Health Data 2009 - Version: November 09
Age-adjusted mortality rates, 1950-2006

Source: Health, United States, 2009, Table 26
CVD mortality rates in Germany and launch of new drugs

Krankheiten des Kreislaufsystems (ICD-9: 390-459; ICD-10: I00-I99)
### Top 10 (ranked by no. of standard units) CVD drugs in 2005 Switzerland vs. Austria

<table>
<thead>
<tr>
<th>SWITZERLAND (N=1,903,135)</th>
<th>AUSTRIA (N=1,890,382)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HYDROCHLOROTHIAZIDE</strong></td>
<td><strong>HYDROCHLOROTHIAZIDE</strong></td>
</tr>
<tr>
<td>1959</td>
<td>1959</td>
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<tr>
<td>3%</td>
<td>6%</td>
</tr>
<tr>
<td>C9D ANGIOTEN-II ANTAG, COMB</td>
<td>C9B ACE INHIBITORS COMBINAT</td>
</tr>
<tr>
<td><strong>HEPARIN</strong></td>
<td><strong>METOPROLOL</strong></td>
</tr>
<tr>
<td>1910</td>
<td>1975</td>
</tr>
<tr>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>C5B VARICOSE THERAPY, TOPICAL</td>
<td>C7A B-BLOCKING AGENTS, PLAIN</td>
</tr>
<tr>
<td><strong>ATORVASTATIN</strong></td>
<td><strong>AMLODIPINE</strong></td>
</tr>
<tr>
<td>1997</td>
<td>1990</td>
</tr>
<tr>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>C10A CHOLEST&amp;TRIGLY. REGULATOR</td>
<td>C8A CALCIUM ANTAGONIST PLAIN</td>
</tr>
<tr>
<td><strong>METOPROLOL</strong></td>
<td><strong>CRATAEGUS</strong></td>
</tr>
<tr>
<td>1975</td>
<td>.</td>
</tr>
<tr>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>C7A B-BLOCKING AGENTS, PLAIN</td>
<td>C1X ALL OTHER CARDIAC PREPS</td>
</tr>
<tr>
<td><strong>HYDROCHLOROTHIAZIDE</strong></td>
<td><strong>FUROSEMIDE</strong></td>
</tr>
<tr>
<td>1959</td>
<td>1964</td>
</tr>
<tr>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>C9B ACE INHIBITORS COMBINAT</td>
<td>C3A DIURETICS</td>
</tr>
<tr>
<td><strong>TORASEMIDE</strong></td>
<td><strong>BISOPROLOL</strong></td>
</tr>
<tr>
<td>1992</td>
<td>1986</td>
</tr>
<tr>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>C3A DIURETICS</td>
<td>C7A B-BLOCKING AGENTS, PLAIN</td>
</tr>
<tr>
<td><strong>AMLODIPINE</strong></td>
<td><strong>GINKGO</strong></td>
</tr>
<tr>
<td>1990</td>
<td>1965</td>
</tr>
<tr>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>C8A CALCIUM ANTAGONIST PLAIN</td>
<td>C4A CEREBR/PERIPH VASOTHERAP</td>
</tr>
<tr>
<td><strong>ATENOLOL</strong></td>
<td><strong>SIMVASTATIN</strong></td>
</tr>
<tr>
<td>1976</td>
<td>1988</td>
</tr>
<tr>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>C7A B-BLOCKING AGENTS, PLAIN</td>
<td>C10A CHOLEST&amp;TRIGLY. REGULATOR</td>
</tr>
<tr>
<td><strong>SIMVASTATIN</strong></td>
<td><strong>HEPARIN</strong></td>
</tr>
<tr>
<td>1988</td>
<td>1910</td>
</tr>
<tr>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>C10A CHOLEST&amp;TRIGLY. REGULATOR</td>
<td>C5B VARICOSE THERAPY, TOPICAL</td>
</tr>
</tbody>
</table>
Post-1995 cardiovascular Standard Units (Sus) as a percentage of total SUs in 2004, by country

<table>
<thead>
<tr>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>20%</td>
</tr>
<tr>
<td>Canada</td>
<td>16%</td>
</tr>
<tr>
<td>Norway</td>
<td>14%</td>
</tr>
<tr>
<td>Italy</td>
<td>13%</td>
</tr>
<tr>
<td>United States</td>
<td>13%</td>
</tr>
<tr>
<td>Switzerland</td>
<td>11%</td>
</tr>
<tr>
<td>Spain</td>
<td>11%</td>
</tr>
<tr>
<td>Turkey</td>
<td>11%</td>
</tr>
<tr>
<td>Belgium</td>
<td>11%</td>
</tr>
<tr>
<td>Finland</td>
<td>9%</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>8%</td>
</tr>
<tr>
<td>Korea</td>
<td>8%</td>
</tr>
<tr>
<td>Japan</td>
<td>8%</td>
</tr>
<tr>
<td>France</td>
<td>8%</td>
</tr>
<tr>
<td>Germany</td>
<td>7%</td>
</tr>
<tr>
<td>New Zealand</td>
<td>5%</td>
</tr>
<tr>
<td>Austria</td>
<td>5%</td>
</tr>
<tr>
<td>Slovak Republic</td>
<td>1%</td>
</tr>
<tr>
<td>Hungary</td>
<td>1%</td>
</tr>
<tr>
<td>Poland</td>
<td>1%</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>1%</td>
</tr>
</tbody>
</table>
Use of newer CVD drugs implies lower mortality rates and reduced costs

Use of newer cardiovascular drugs has reduced hospitalization, average length of stay and age-adjusted cardiovascular mortality rate.

The decrease in expenditure on cardiovascular hospital stays is about 3.7 times as large as in per capita increase for cardiovascular drugs.

New drugs and decreasing consumption of other health care resources
Increase in drug vintage index 1991-2004
Use of newer drugs reduced consumption of health care resources

States that had larger increases in drug vintage had smaller increases in the number of hospital and nursing-home admissions.

Costs for admissions inverted

Patient-level evidence about the relationship between use of newer drugs and cost of events

People consuming newer drugs had significantly fewer hospital stays and decreased costs for all non-drug medical expenditures.

**Reducing the age of the drug results in a substantial net reduction in the total cost of treating the condition.**

Branded vs generic drugs

Since reducing the age of the drug results in a substantial net reduction in the total cost of treating the condition, *if only generic drugs were used* instead of actual mix of 60% branded and 40% generic, *costs would increase*.

Estimates indicate that *denying people access to branded drugs would increase* total treatment costs, *not reduce them*, and *would lead to worse outcomes*.

The impact of pharmaceutical use on hospital care and overall medical expenditures

Number of hospital bed-days declined most rapidly for those diagnoses with the greatest increase in the total number of drugs prescribed and the greatest change in the distribution of drugs.

An increase of 100 prescriptions is associated with 16.3 fewer hospital days

The effect of drug vintage on activity limitations and perceived health status

People who used newer drugs had better post-treatment health than people using older drugs for the same condition.

They were more likely to survive, their perceived health status was higher, and they experienced fewer activity, social, and physical limitations.

Cost impact of PPI Therapeutic substitution in British Columbia

Medically unnecessary drug switching by compliance with TS policy appears to be independently associated with higher overall health care resources.

The impact of reference pricing on switching behaviour and health care utilisation: the case of statins in Germany

Switching occurred significantly more often in patients with low-income

**Switching behaviour after RP implementation**

*P<0.0001

The impact of reference pricing on switching behaviour and health care utilisation: the case of statins in Germany

Patients initially on atorvastatin discontinued to a larger extent than other.

Non adherence and discontinuation in patients previously treated with Atorva and other statins

Link to productivity and ability to work
Cumulative number of drugs approved for three conditions relative to the cumulative number of drugs approved for that condition in 1975.

Availability of new drugs and Americans' ability to work

- The probability of being unable to work, limited in work, and having ever been hospitalized, and the number of work-loss days and restricted-activity days, are all inversely related to the stock of drugs approved 3 to 5 years earlier.
- The estimates imply that the growth in the lagged stock of all drugs reduced the unconditional probability of being unable to work due to the 47 sample conditions by 1.8% per year during the period 1982-1996.
Have new drugs increased society’s ability to produce goods and services?

The estimated benefit of the new drugs, in terms of the value of the increase in workforce participation and hours, is almost nine times as great as the estimated cost of the new drugs.

If no new drugs had been introduced during 1982-1996, the probability of being unable to work in 1996 would have been 29% higher than it actually was—5.2% instead of 4.0%.

Has pharmaceutical innovation reduced Social Security Disability growth?

Summary

- Contribution of new medicines to longevity increase
  - Evidence based on aggregate data
  - Evidence based on patient-level data
- Use of new medicines reduces need for other health care resources
- The impact of new medicines on productivity and ability to work
Patients In Germany and UK Get Access To New Medicines Most Quickly

![Average time intervals between marketing authorization and patient access for EMEA medicines](chart.png)

**Note:** Medicines with EU marketing authorisation (MA) from 1 January 2006 to 31 December 2008 (the complete database includes 69 new medicines of which 65 are considered in the study period 2006-2008).

Source: EFPIA, Patients W.A.I.T. Indicator, 2009 report (see www.efpia.eu for detailed information)
Articles

- The Impact of Drug Vintage on Patient Survival: A Patient-Level Analysis Using Quebec’s Provincial Health Plan Data

- The quality of medical care, behavioral risk factors, and longevity growth

- Availability of New Drugs and Americans’ Ability to Work

- Has pharmaceutical innovation reduced Social Security Disability growth?

- The contribution of pharmaceutical innovation to longevity growth in Germany and France, 2001-2007
O VALOR DO MEDICAMENTO PARA A SOCIEDADE
THE VALUE OF MEDICINES TO SOCIETY