Research by
Professor Frank R. Lichtenberg

Measuring the Impact of Pharmaceutical Innovation in Australia 1998–2018

Pharmaceutical Innovation Improves Patient Outcomes and Reduces Hospital Demand.

Medicines Australia

Better health through research and innovation

01. The Author

Professor **Frank R. Lichtenberg**

Professor Frank R. Lichtenberg is Courtney C. Brown Professor of Business at the Columbia University Graduate School of Business; a Research Associate of the National Bureau of Economic Research; and a member of the CESifo Research Network. He received a BA with Honors in History from the University of Chicago and an MA and PhD in Economics from the University of Pennsylvania.

Prof. Lichtenberg previously taught at Harvard University, the University of Pennsylvania, and Ecole Polytechnique. He has served as an expert for the Federal Trade Commission, the U.S. Dept. of Justice, and state Attorneys General, and has testified before Congress. He has worked for several U.S. government agencies, including the Department of Justice, the Congressional Budget Office, and the Census Bureau, and been a visiting scholar at the Wissenschaftszentrum Berlin, the University of Munich, and elsewhere.

Some of Professor Lichtenberg's research has examined how the introduction of new technology arising from research and development affects the productivity of companies, industries and nations. He has performed studies of the impact of pharmaceutical innovation on longevity, the effect of computers on productivity in business and government organizations, and the consequences of takeovers and leveraged buyouts for efficiency and employment. His articles have been published in numerous scholarly journals and in the popular press. His book *Corporate Takeovers and Productivity* has been published by MIT Press.

He was awarded the 1998 Schumpeter Prize for his paper, Pharmaceutical Innovation as a Process of Creative Destruction; the 2003 Milken Institute Award for Distinguished Economic Research for the paper, *Pharmaceutical Knowledge-Capital Accumulation and Longevity; and Research! America's 2010 Garfield Economic Impact Award for the paper, The effect of new cancer drug approvals on the life expectancy of American cancer patients, 1978-2004.*

He has been awarded research fellowships, grants, and contracts by the National Science Foundation, the World Health Organization, the National Institute of Standards and Technology, Merck and Co., the Fulbright Commission, the Brookings Institution, the Alfred P. Sloan Foundation, The German Marshall Fund, the American Enterprise Institute, and other organizations.

He has served as a consultant to private organizations and government agencies including the Securities Industry Association, Pfizer, Inc., the Community Preservation Corporation, the RAND Corporation, the New York City Water Board, Touche Ross and Co., The Walt Disney Company, McGraw-Hill, and the National Pharmaceutical Council. He is an affiliate of the economics consulting firm Analysis Group.

02. Acknowledgement

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03. Outcomes

Pharmaceutical innovation improves patient outcomes, reduces hospital demand, and is cost-effective.

About This Report

The development and use of new medicines contribute to long-term economic growth in Australia. New medicines make an important contribution to increased workforce participation and productivity. Medicines Australia wants to work with the Australian Government to ensure that the true value of the investment in medicines through the PBS is captured.

The Impact Of Pharmaceutical Innovation On Premature Mortality And Hospitalization In Australia, 1998-2018 by Professor Frank R. Lichtenberg

analyses the outcomes of pharmaceutical innovation on premature mortality, hospital utilisation, and cancer patient outcomes up to 2018.

Previous research conducted by Professor Lichtenberg reported on the impact of pharmaceutical innovation on premature mortality and hospital separation to 2011, and cancer patient outcomes up until 2007. This report provides outcomes on more recent periods, looking at the impact on premature mortality and hospital separation up until 2015, while cancer patient outcomes are analysed up until 2018.

Patient Outcomes & Hospital Demand

Highlights from this report are:

1
Pharmaceutical innovation is responsible for almost all of the decline in premature (pre-age 90) mortality between 1998 and 2015, and about half of the increase in the mean age at death from cancer between 2008 and 2018.

2
Pharmaceutical innovation is responsible for reducing the days care in hospital. The new medicines launched between 1986 and 2000 were estimated to be responsible for a 7.3% (1.71 million days) reduction in hospital days in the year 2015.

3
The new medicines that were launched during 1987 and 2003 were very cost effective. Overall the cost per life-year gained before age 90 would not have exceeded $5900 AUD. When the effect of new drugs on hospital utilisation is considered, the evidence indicates.

Policy Improvement Recommendations

Outcomes from Professor Lichtenberg's research reinforces the need for discussions about the environment for new medicines in Australia. A more sophisticated health evaluation system would lead to better, more transparent policy decisions, and would demonstrate the true net cost/value of the PBS.

This includes improvements with greater data provision and a focus on productivity measures in the Government's Health Policy Research and Data Program.[1] Additionally, reporting in the budget should better reflect the amount of the PBS spent on medicines separately from distribution and dispensing expenditure, and should present net PBS expenditure figures including industry rebates to Government.

4

Due to pharmaceutical innovation, there has been a significant decrease in premature mortality.

The number of years of potential life lost (YLL) reflects the number of years not lived by an individual before a certain age and is a common measure of premature mortality, and this study examined YLL before ages 80, 85, and 90.[2] The study controlled for the overall decline in premature mortality and for the differences between diseases in premature mortality.[3]

The Results

This study found that the number of YLL from all diseases before ages 80, 85, and 90 decreased as the number of drugs listed on the PBS in the years earlier (around 10 to 15 years) increased. Almost all (94%) of the 1998 to 2015 decline in premature mortality rate before age 90 was due to pharmaceutical innovation.

> Almost all (94%) of the 1998 to 2015 decline in premature (pre-age 90) mortality rate was **due to pharmaceutical innovation**.

Pharmaceutical innovation was responsible for a 19% decline in the premature mortality rate before age 85, and a 21% reduction before age 80 between 1998 and 2015. The study found that for one additional new drug listed at least 12 years prior reduced the YLL before age 90 by 2.8%.

The study found that if no new drugs had been listed on the PBS between 1987 and 2003, the estimated number of YLL before the age of 90 would have been 27.2% higher in 2015 than it actually was. New drugs listed on the PBS between 1987 and 2003 reduced the number of YLL by 586,714 and 370,891 before the age of 90 and 85 respectively. Similarly, the number of YLL before the age of 80 was reduced by 194,905.

Premature Mortality Results Infographic

1998-2015 decline in premature mortality per 100,000 population:

	Actual Decline	Decline Due To Pharmaceutical Innovation	Fraction Of Actual Decline Due To Pharmaceutical Innovation
Before Age 80	24.7%	14.0%	56.7%
Before Age 85	24.2%	18.7%	77.3%
Before Age 90	22.6%	21.4%	94.8%

1. Department of Health, 2016, Health Policy Research and Data Program, viewed 12 September 2019: https://www1.health.gov.au/internet/main/publishing.nsf/Content/Health_Policy_Research_and_Data_Program.   2. The World Health Organization (WHO) *Global Burden of Disease* 2010 reference life table used an age threshold of 86 years, and the *WHO Global Health Estimates* uses an age threshold of 91.93 years.   3. The model assessed the number of drugs that could be used to treat a disease rather than the number used. However, drugs can be used to treat multiple diseases so there was no way to determine the number of drugs prescribed in a year to treat a particular disease. The model also did not capture other medical innovations such or medical devices but were determined to be of little consequence by professor Lichtenberg.

Using 2015 as a base year, drugs launched between 1987–2003 reduced YLL in 2015 by:

Before Age 80	195,905 years
Before Age 85	370,891 years
Before Age 90	586,714 years

2.16M
Actual YLL90 in 2015
was 2.16 million

2.74M
This would have been 2.74 million (27.2% higher)
without any new medicines launched during 1987-2003

Pharmaceutical innovation has reduced hospital days.

Professor Lichtenberg analysed the impact of new Australian launches of medicines for treating disease on hospital usage. The analysis looked at the number of hospital days, and the impacts of the listings of new drugs on the length of stay. Looking at hospital days is considered more closely related to hospital expenditure than comparing hospital expenditure with hospital separations.

The Results

The number of hospital days of care decreased as the number of drugs that have ever been launched nine to 15 years earlier and is most closely related to drugs launched 15 years earlier. The research paper estimates that the new drugs which were launched in Australia between 1986 and 2000 reduced the number of hospital days in 2015 by 7.3% (which is 1.71 million days).

The number of hospital days in 2015 was 23.3 million. Professor Lichtenberg's study estimates that if no new drugs were launched between 1986 and 2000, the number of hospital days would have grown by 1.71 million at just over 25 million.

Even if we ignore the effect of new drugs on hospital utilisation, the drugs launched during 1987 and 2003 were very cost effective, overall; the cost per life-year gained before age 90 would not have exceeded about $5900 AUD. When the effect of new drugs on hospital utilisation is taken into account, the evidence indicates that in the long run pharmaceutical innovation was cost saving as well as life-year saving.

The new medicines which were launched in Australia between 1986 and 2000 **reduced the number of hospital days in 2015 by 7.3%**

23.3M

Number of Hospital days in 2015

25M

Number of Hospital days without any new drugs launched (1986-2000)

7.3%

higher

Cancer survival rates increased as a result of pharmaceutical innovation.

Professor Lichtenberg investigated the effect of pharmaceutical innovation on survival from all types of cancer. The five-year relative survival rate was used as one measure of cancer survival. It shows the probability of (%) of being alive for at least five years after a cancer diagnosis. The other measure was the mean age of cancer deaths.

Professor Lichtenberg estimated the effect of the number of new drugs launched for treating cancer at each site (breast, lung, etc.) on the five-year relative survival rate, and on the mean age of cancer deaths over a ten-year period.

The Results

About 44% of the increase in the survival rate for cancer patients from 2001–2005 to 2011-2015 was due to the launch of new cancer drugs. The launch of these new cancer drugs was also responsible for almost half (48%) of the 2008 to 2018 increase in mean age at death from cancer.

> Almost half (48%) of the increase in mean age at death from cancer between 2008 and 2018 was **due to the launch of new cancer drugs.**

The five-year survival rate of patients diagnosed during 2011 and 2015 increased 6.8 percentage points from 2001-2005 to 2011-2015 (from 62.1% to 68.9%). This study estimates that about 44% of this increase was due to new cancer drugs launched between 2006 and 2016.

The greater the number of cancer drugs that had ever been launched up until five years prior, the higher the survival rate of individuals diagnosed in the following four-year period. The five-year time lag is likely due to very few of these patients being treated with newly launched drugs.

This study also found that launches of cancer drugs had a significant impact on the mean age at death from cancer. Cancer drugs launched between 1998 and 2008 reduced the number of cancer deaths in 2018 by 7.8%. Almost half (48%) of the increase in the mean age at death from cancer between 2008 and 2018 was due to the launch of new cancer drugs.

It is estimated that new cancer drugs launched during 2004 and 2013 reduced the number of YLL before the age of 85 by 11.4%, before the age of 75 by 13.0%, and before the age of 65 by 14.4%. One additional drug for a cancer is estimated to have reduced the number of deaths from that cancer by 2.5% after 10 years.

The report estimates that new cancer drugs launched during 2004 and 2013 reduced the number of years of life lost for each age group:

YLL 65	**14.4%**
YYL 75	**13.0%**
YYL 85	**11.4%**

44% of the increase in the five-year cancer survival rate between 2001-2005 (62.1%) and 2011-2015 (68.9%) was due to the launch of new cancer drugs.

Almost half (48%) of the 2009-2018 increase (1.06 years) in mean age at death from cancer was due to the launch of new cancer drugs.

Cancer drugs launched during 1998-2008 **reduced the number of cancer deaths in 2018 by 7.8%**

Pharmaceutical innovation delivered a net **financial benefit to the health system.**

The differences between the realised outcomes with pharmaceutical innovation and the estimated outcomes without pharmaceutical innovation were used to quantify the cost-savings of new medicines. When the effect of new drugs on hospital utilisation is taken into account, the evidence indicates that in the long run pharmaceutical innovation was cost-saving as well as life-year saving.

> The evidence indicates that, in the long run, pharmaceutical innovation **was cost-saving as well as life-year saving**

As mentioned earlier, it was estimated that if no new drugs had been launched between 1986 and 2000, the number of hospital days in 2015 would have been 7.3% higher than it actually was. It is therefore reasonable to assume that hospital expenditure would also have been 7.3% higher than it actually was.

Hospital expenditure (patient curative and rehabilitative care) was $47.5 billion AUD in 2015. The study estimates that new drugs listed between 1986 and 2000 reduced expenditure on hospitals by an estimated $3.47 billion AUD in the year 2015. This figure is 71% higher than the expenditure on new drugs launched between 1986 and 2000.

Even if we ignore the cost saving effects that new drugs have had on hospital utilisation, there is further evidence that pharmaceutical innovation is highly cost-effective in Australia. The World Health Organisation (WHO) considers interventions that avert one disability-adjusted life-year (DALY) for less than average per capita income for a given country to be very cost effective.[4]

Australia's per capita GDP in 2015 was $83,145 AUD. Using the WHO threshold for cost-effectiveness it is clear that the new drugs launched between 1987 and 2003 can be considered very cost effective, even if we completely ignore the effects of these drugs on hospital utilisation and expenditure.

If the drugs launched during 1987-2003 had no effect on other medical expenditure in 2015, the cost per life-year gained would not have exceeded:

AGE 90	$5,900 AUD
AGE 85	$9,400 AUD
AGE 80	$17,800 AUD
AUSTRALIA PER CAPITA GDP	$83,145 AUD (WHO THRESHOLD)

Hospital Expenditure in 2015:
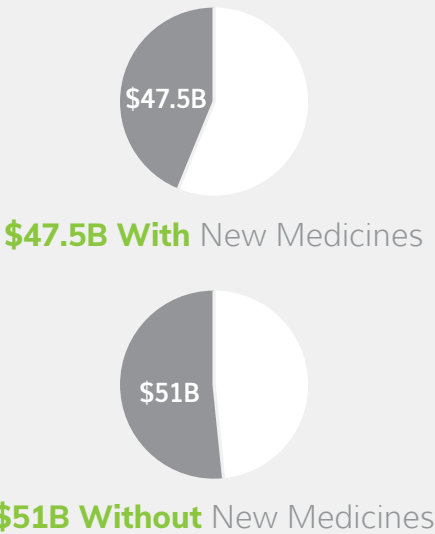
$47.5B

$47.5B With New Medicines

$51B

$51B Without New Medicines

04. Key Policy Issues

Impact and outcome reporting can enable better investment decisions.

There is an opportunity to quantify the outcomes of investments

Professor Lichtenberg's research demonstrates the improved health outcomes of pharmaceutical innovation in Australia. The research also quantifies how pharmaceutical innovation is not only life-saving but also cost-saving, highlighting the long-term importance of investment in listing new medicines on the PBS.

As a historical analysis, this study highlights the importance of further integrating the benefits of the investments in listing medicines on the PBS to the broader health system. One way to do this is through including the broader impact into the cost effectiveness analysis of new medicines.

Expanding the criteria for assessing the cost effectiveness of health interventions provides information on the wider outcomes delivered. This is meaningful to governments as it would provide additional information on where investments deliver greatest outcomes for society which would support funding decisions.

Medicines Australia has identified methods to improve outcomes reporting

Medicines Australia has a view that outcome reporting could be improved to provide greater insights to the Government. Two possible solutions are identified to better quantify economic, social and patient outcomes of Government investments. These are to:

- include better productivity measures as part of the Government's reporting and evaluation of health program funding; and

- facilitate industry access, through Medicines Australia, to the enterprise data warehouse operated by the Department, in line with Clause 11.4 of the 2017 Strategic Agreement to enable monitoring of the sustainability of the innovator medicines sector in Australia.

Budget reporting of pharmaceutical innovation can be improved.

Current reporting under-estimates the value of pharmaceutical innovation

Professor Lichtenberg's research outlines the critical role of the PBS in Australia's modern system to provide access to new effective medicines. However, there are concerns about the ongoing projected expenditure of the PBS, and questions relating to its practicality in keeping pace with an aging population and the development of new therapies.

Increases and an ageing population, increased use of transformational therapies and Government listing of new medicines, all contribute to projected increased costs. However, what is not outlined is how these medicines can lead to reduced cost pressure with the health system such as in public and private hospitals as demonstrated by the Lichtenberg study. Additionally, rebates arising from Special Pricing Arrangements with industry skew PBS headline expenditure figures in the budget.

Medicines Australia have identified important opportunities to improve PBS budget reporting

Medicines Australia has previously called for changes to budget reporting to better reflect the factors that influence PBS expenditure and the outcomes it delivers. These changes are expected to provide more clarity and information about the true costs and savings of the PBS. The approaches that have been considered are to:

- report the amount of the PBS spent on medicines separately from distribution and dispensing expenditure; and

- report headline PBS expenditure (excluding rebates) and net PBS expenditure (including industry rebates to Government) in the budget.

This information will provide Government with clarity on the actual expenditure on the PBS and what outcomes this delivers within the healthcare system.
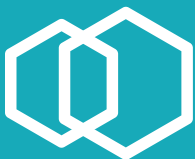
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