The causes of this progress are complex and varied. Certainly, the improvement of hygiene conditions, the development of water sanitation systems and the changing of dietary habits, as well as the increasing wealth of the population, have all contributed to reducing mortality and markedly improving health conditions.

The field of medicine has also made enormous progress over the course of the past century. The evolution of biomedical knowledge gave rise to a new branch of medicine, namely pharmacology. The discovery of new drugs and vaccines led to more effective treatments for many diseases, and even to outright cures for many others that were long considered incurable. This Economic Note revisits a few of the most important contributions of the pharmaceutical field over the past century.

The Elimination of Numerous Infectious Diseases

It would be hard to think of an innovation in the field of health care that has saved more lives than vaccines. Before mass immunization, populations lived under the constant threat of being hit by various infectious disease epidemics.

At the start of the 20th century, the main causes of death were diseases like tuberculosis, pneumonia, smallpox, diphtheria, polio, influenza and bronchitis. Polio, for example, was responsible for the paralysis, disability and death of thousands of Canadians during the first half of the century. After the arrival of the vaccine in 1955, polio cases plummeted within a few years and the disease was subsequently eradicated (see Table 1), not only in Canada but also in most regions of the world.

Sulfa drugs, those belonging to the class of sulfonamides discovered in the 1930s, as well as the first antibiotics like penicillin developed in the 1940s, also greatly reduced the number of deaths due to infectious diseases, starting with pneumonia and scarlet fever. In Canada, the mortality rate related to the main contagious diseases fell by more than 80% between the start of the 1920s and the year 1960.

Of course, contagious diseases can appear very suddenly and spread rapidly, the
AIDS epidemic that began in the early 1980s being the perfect example.

Nonetheless, researchers have estimated that the combination of antiretroviral treatments (tritherapy) for patients with HIV/AIDS have saved the equivalent of three million years of life between 1989 and 2003 in the United States. Just in the three years following the introduction of the innovative drug Epivir in 1995, the mortality rate fell by 70%. Thanks to these therapeutic advances, a young 20-year-old adult with HIV/AIDS living in Canada or the United States today can expect to live to the age of 70 and beyond, nearly as long as the rest of the population.

**The Prevention and Treatment of Cardiovascular Disease**

During the first half of the 20th century, bed rest was the standard treatment for people suffering from heart disease. Today, several treatment options are available that save lives and allow these people to remain active.

Drugs like aspirin help dissolve blood clots and re-establish the flow of blood to the heart. Beta-blockers, developed starting in the 1960s, can be prescribed to reduce blood pressure, which in turn reduces the workload of the heart. As for drugs in the statin class like Lipitor, which began appearing in the late 1980s, they help to lower blood cholesterol levels. In serious cases like heart attacks and strokes, patients are treated with thrombolytic drugs that, when administered quickly, can prevent or greatly limit any long-term damage.

All of these drugs have led to significant reductions in patient mortality and morbidity, as numerous studies confirm. Since 1970, the mortality rate from heart disease has fallen by nearly half in the United States (see Figure 1), and a similar trend can be observed in industrialized countries as a whole.

**Increased Efforts to Fight Cancer**

Before the 1950s, the treatment of cancer was essentially in the hands of surgeons, and the hopes of long-term cancer survival were basically nil. As documented by historian and oncologist Siddhartha Mukherjee in his Pulitzer Prize-winning work, the advent of chemotherapy and the pharmacological progress that took place during the second half of the 20th century gradually led to substantial gains in the battle against cancer.

Cancer drugs are the ones that now most attract the attention of pharmaceutical companies. Nearly three times as many innovative oncological drugs were developed between 1990 and 2009 as were launched between 1970 and 1989. Within a period of a few years, a modest initiative primarily financed with public funds became a veritable armada involving thousands of companies and hundreds of billions of dollars of private investment.

These efforts are starting to bear fruit. Since the early 1990s, the age-adjusted cancer mortality rate has been falling in industrialized countries and in much of the rest of the world as well. Economist Frank Lichtenberg of Columbia University recently looked into the connection between

---

**Table 1 — Incidence of Select Vaccine-Preventable Diseases in Canada, Pre-vaccine Era Compared with the Years 2007-2011**

<table>
<thead>
<tr>
<th>Disease</th>
<th>Year vaccine was introduced</th>
<th>Pre-vaccine era*</th>
<th>5-year average annual incidence per 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pertussis (whooping cough)</td>
<td>1943</td>
<td>156.0</td>
<td>3.88</td>
</tr>
<tr>
<td>Diphtheria</td>
<td>1930</td>
<td>84.2</td>
<td>0.006</td>
</tr>
<tr>
<td><em>Haemophilus influenzae type b (Hib)</em>*</td>
<td>1991</td>
<td>30.1</td>
<td>0.49</td>
</tr>
<tr>
<td>Mumps</td>
<td>1969</td>
<td>251.2</td>
<td>1.84</td>
</tr>
<tr>
<td>Paralytic poliomyelitis</td>
<td>1955 (Salk) 1962 (Sabin)</td>
<td>17.5</td>
<td>0</td>
</tr>
<tr>
<td>Measles</td>
<td>1963</td>
<td>372.7</td>
<td>0.6</td>
</tr>
<tr>
<td>Rubella</td>
<td>1969</td>
<td>106.3</td>
<td>0.01</td>
</tr>
</tbody>
</table>

*Five years prior to the introduction of the vaccine, except for the following diseases: mumps, measles and rubella (1950-1954).
**Children 5 years of age or younger.

pharmaceutical innovation and mortality rates for some 60 types of cancer. For the 1990-2009 period, he found that the use of new drugs was responsible for nearly 60% of observed reductions in cancer-related mortality rates.¹⁹

It is without a doubt in the treatment of cancers afflicting children that the most remarkable advances have been made. Since the early 1970s, the mortality rate for these types of cancer have fallen by 3% a year on average in Canada, the United States, Australia and Japan, in large part thanks to pharmacological treatments that were developed and made accessible during this period. Today, over 70% of childhood cancer cases that occur in industrialized countries are cured.²⁰

One of the most striking events in recent decades has been the development of targeted therapies, which are medical treatments targeting certain genes or proteins that contribute to tumour growth. By attacking cancerous cells more directly, these treatments significantly improve patients’ chances of survival, all while reducing the side effects usually associated with chemotherapy.²¹

Since 1970, the mortality rate from heart disease has fallen by nearly half in the United States.

For instance, the arrival on the market of the drug Gleevec in 2001 revolutionized the battle against leukemia (CML). This disease used to be highly lethal and the number of years of survival for a leukemia survivor rarely extended beyond 3 to 6 years. Today, a patient can expect to live over 25 years. Given that the median age at which leukemia is detected is 60, the life expectancy of these patients is comparable to that of the rest of the population.²²

Challenges

Falling mortality rates and higher life expectancy, while remarkable accomplishments, have been accompanied in recent decades by increases in chronic conditions like arthritis and diabetes. Some two million Canadians currently suffer from one form or another of diabetes, and this number is growing.²³

Even though it is not a cure, insulin, discovered in the 1920s by Frederick Banting and subsequently developed by Eli Lilly and Company,²⁴ continues to improve the quality of life of diabetics. Before insulin, the standard treatment consisted in reducing the food intake of sufferers. This treatment replaced a quick death from diabetes with a slow death from starvation.²⁵

Since the discovery of insulin, numerous innovations in the treatment of diabetes have followed. Patients’ options have grown over the past two decades with the discovery of eight new classes of drugs to better treat the disease. There are currently over 180 drugs in the development stage whose purpose is to slow or stop the progression of diabetes, or to reduce the risk of complications.²⁶

Conclusion

For over 100 years, pharmaceutical innovation has literally revolutionized health care, and has given rise to treatments that we could no longer do without.

The progress we have enjoyed over the years is the result of a close collaboration between university and industry researchers. Private, for-profit R&D funding in the biomedical field began to grow at an unprecedented pace in the 1980s, however, and now exceeds funding from the public and non-profit sectors combined.²⁷

With advances in pharmacogenetics and personalized medicine, doctors in the future will increasingly be able to prescribe made-to-measure drugs that take patients’ genetic profiles into account. These innovations will likely further
improve the health of patients while also reducing the risks of toxicity and side effects related to the use of medicines.

**Doctors in the future will increasingly be able to prescribe made-to-measure drugs that take patients’ genetic profiles into account.**

Without pretending that every condition can be treated with drugs or that prevention and other factors are not also important, we must recognize that pharmaceutical research and the therapeutic progress it has entailed continue to be of enormous service to patients.

**References**


