MEDICAL INNOVATION
THE VALUE OF
IN IMMUNE AND INFLAMMATORY
2018 EDITION

MORE THAN
4.7 million
US JOBS SUPPORTED
BY THE
BIOPHARMACEUTICAL
SECTOR

21,000+
ACTIVE CLINICAL TRIALS AROUND THE WORLD

Susan Freeman was diagnosed with plaque psoriasis

100+
IMMUNE DISORDERS IDENTIFIED

Celgene
Committed to improving the lives of patients worldwide®
Health is not a commodity, but a human right and **public good**. By incentivizing **innovation** beyond financial gains, we can bring effective medicines to **every corner** of the globe.

*Dr. Jorge Bermudez*
Vice-President, Health Production and Innovation, Ministry of Health (Brazil)
INTRODUCTION

Chapter 1: Virtuous Cycle of Medical Innovation
Chapter 2: Living Better and Healthier
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Chapter 4: Better Healthcare, Better Outcomes
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Chapter 6: Celgene
INTRODUCTION

Among the technological innovations of the 20th and 21st centuries, medical innovation has been one of the most significant contributions to our ability to live longer, healthier lives.

Medical innovation is turning knowledge about disease mechanisms at the genetic and cellular level into breakthrough therapies that address significant unmet needs. It brings about a virtuous cycle of better health and greater prosperity which, in turn, stimulates additional investment in even more advanced innovations for preventing and treating disease.

In recent years, medical innovation has significantly improved outcomes and quality of life for patients living with chronic, life-long immune and inflammatory disorders. However, more needs to be done to address unmet needs. This sourcebook will take a close look at the unmet need in immune disorders, what is driving innovation and how to ensure the virtuous cycle of innovation continues.

Cindy Custodio was diagnosed with psoriasis and psoriatic arthritis.
Medical innovation is an important contributor to longer and healthier life. In the 21st century, medical innovation is dramatically improving health outcomes, reducing the overall cost of healthcare and stimulating the growth of the global economy – producing a world that may one day be free from immune disorders.

This virtuous cycle of innovation, in turn, stimulates investment in biomedical research to further improve health and create economic value throughout the world.

For people living with chronic diseases, medical innovation success means lower disability rates, increased work productivity, greater mobility, and increased well-being, among other factors. Success is giving people the ability to perform everyday activities. Medical innovation is increasing in the area of immune and inflammatory disorders. To accelerate innovation, the pharmaceutical industry, academia, medical societies, government, patient advocacy groups and others must work together collaboratively to stimulate investment in research as well as generate greater public awareness and enhance patient access.
What is emerging is a more complex understanding of the science... We are understanding the mechanisms of the immune response and how it plays out in pathogenic disease.

Kristine Kuus-Reichel
Director, Immunomics Business Unit, Beckman Coulter
Medical Innovation is a Virtuous Cycle

Access and reimbursement for innovative therapies today make possible the investment in research and development that leads to future medical advances.

Continuous investment of time and resources by biopharmaceutical companies such as Celgene leads to new medical breakthroughs.

Celgene has invested on average 39.3 percent of revenue in research and development during the past five years.

Access and reimbursement for innovative therapies fund investment in future medical advances.


PUVA = photochemotherapy; HIV = human immunodeficiency virus; TNF = tumor necrosis factor; PrEP = pre-exposure prophylaxis; PDE4 = phosphodiesterase-4; JAK = janus kinase; RNAi = ribonucleic acid interface

1970
- PUVA shown effective in psoriasis
- Identification of HIV virus
- Human insulin approved
- First monoclonal antibody approved

1980
- Betaseron approved for multiple sclerosis
- First protease inhibitor for HIV
- TNF blockers approved for rheumatoid arthritis and psoriatic arthritis
- Interleukin therapies for psoriasis
- Human genome sequenced

1990
- Insulin lispro, first rapid-acting insulin
- PDE4 inhibitor for psoriasis and psoriatic arthritis
- Anti-integrin therapies for ulcerative colitis and Crohn’s disease

2000
- PrEP for HIV
- JAK inhibitor for psoriatic arthritis
- Gene therapies, RNAi

2010
- PrEP for HIV
- JAK inhibitor for psoriatic arthritis
- Gene therapies, RNAi

2018 and beyond
- JAK inhibitor for psoriatic arthritis
- Gene therapies, RNAi

*Not an exhaustive list

Source 11: Human insulin approved
- Human genome sequenced

Medicines are Transforming the Treatment of Many Immune and Inflammatory Diseases

**Multiple Sclerosis (MS)**
With the expansion of treatments, including oral medicines, healthcare professionals may have additional options for treating patients with MS, with a treatment goal of optimizing management and potentially slowing disease progression.

**Inflammatory Bowel Disease (IBD)**
With the accumulation of new evidence and the approval of new diagnostic and therapeutic agents, it is anticipated that the management guidelines for IBD will change considerably over even the next few years.

**Plaque Psoriasis (PsO) & Psoriatic Arthritis (PsA)**
New discoveries have led to a broader range of potential treatment options for patients, with varying efficacy-safety profiles, to meet the different needs of patients.

**Rheumatoid Arthritis (RA)**
Therapeutic advances have transformed the RA treatment paradigm over the past 20 years, shifting from a focus on managing symptoms to aiming for slowed disease progression and even disease remission.


Investment in Healthcare R&D Has Risen*; I&I Treatment Options Have Increased

R&D investment in the U.S.

New advances in immune and inflammatory diseases

➢ 32 medicines are in development and three oral disease-modifying medicines are now available for the treatment of multiple sclerosis.

➢ In the past 30 years, over 16 medicines have been approved by the FDA for the treatment of psoriasis.

➢ As of 2018, 24 medicines have been developed for the treatment of IBD (ulcerative colitis and Crohn’s disease).


*R&D spend for PhRMA members only
†Domestic R&D: Expenditures within the United States by all PhRMA member companies.
‡R&D Abroad: Expenditures outside the United States by US-owned PhRMA member companies, and R&D conducted abroad by US divisions of foreign-owned PhRMA member companies.
Innovation Success Story

Innovative HIV treatments lower prevalence and increase life expectancy

A 2017 cohort study found that 20-year-olds who started with antiretroviral therapy in 2013 are predicted to live up to 10 years longer than those who first underwent similar treatment in 1996 – when it first became widely available.

A study showed that antiretroviral therapy prevents the transmission of the disease, by as much as 96%, in heterosexual couples where one partner has HIV.

Our research illustrates a success story of how improved HIV treatments coupled with screening, prevention and treatment of health problems associated with HIV infection can extend the life span of people diagnosed with HIV.

"- Adam Trickey, Medical Statistician at the University of Bristol 2017

Supporting References

**Source 1:** Clinical Trials. Phase 2-Phase 4. Available at clinicaltrials.gov. Accessed March 2018. (Cover Slide)

**Source 2:** Autoimmune Disease List AARD. Available at https://www.aard.org/diseaselist/. Accessed March 2018. (Cover Slide)

**Source 3:** TEconomy Partners; for PhRMA. The Economic Impact of the US Biopharmaceutical Industry. Columbus, OH: TEconomy Partners. Available at http://phrma-docs.phrma.org/industryprofile/pdfs/2017industryProfile_TheBiopharmaceuticalIndustriesRole.pdf. Accessed July 2017. (Cover Slide)


**Source 27:** Pharmaceutical Research and Manufacturers of America (PhRMA). 2017 PhRMA Annual Membership Survey. Table 1: Domestic R&D and R&D Abroad. Accessed June 2018.


There are more than 100 types of immune disorders, a cluster of conditions in which the immune system attacks the host’s own body or specific organs.

Immune and inflammatory disorders can manifest at an early age, go undiagnosed for many years, and pose life-long challenges. Their full impact on quality of life can be greatly underappreciated.

We will examine the prevalence and delay in diagnosis associated with several immune disorders, including psoriasis, psoriatic arthritis, multiple sclerosis, Crohn’s disease, ulcerative colitis, and Behçet’s disease. At the same time, we will highlight how innovative treatment options can potentially improve the lives of patients living with these conditions.

Greater awareness and research is still needed to help understand the complexity of these disorders. The toll on patients, society, and the healthcare system is significant, but innovative therapies hold promise and opportunity to address these unmet needs, delivering new benefits for patients.
Patient with Moderate-to-Severe Plaque Psoriasis
Despite our **progress**, we recognize that **more needs to be done** so that we may close the gaps in our knowledge and achieve our **overall goal** of reducing the rising toll of autoimmune disease.

Elias A. Zerhouni, M.D.
Former Director, National Institutes of Health
Autoimmune Disorders are Chronic and May be Disabling

Autoimmune disorders are chronic and potentially disabling disorders in which underlying defects in the immune response lead the body to attack its own organs and tissues.

**Organ-specific autoimmune diseases** are localized to a single organ or tissue.

**Non-organ-specific diseases** are characterized by autoimmune reactions against many different organs and tissues resulting in widespread injury.

**AFFECT approximately 23 to 50 MILLION PEOPLE in the U.S.**

**REPRES**


There are More Than 100 Autoimmune Disorders*

*Not an exhaustive list


Over 168 Million People Worldwide Suffer from One of These Immune and Inflammatory Disorders

*IBD = Inflammatory Bowel Disease (Crohn’s Disease & Ulcerative Colitis): Includes those living in North America and Europe

Nearly 1 in 30 People in the U.S. Live with at Least One of These Immune and Inflammatory Disorders

*IBD = Inflammatory Bowel Disease (Crohn’s Disease & Ulcerative Colitis): Includes those living in North America
†1.9 million people are living with moderate to severe psoriasis

Sources:
Immune Disorders are Often Chronic, Life-long Conditions that Present Early in Life

*According to the American Academy of Dermatology, psoriasis can happen at any age. Most people get psoriasis between 15 and 30 years of age. About 75% of people who will get psoriasis will have it by age 40. Another time when symptoms appear is between 50-60 years of age.


There are Often Delays* in Diagnoses

Average Delay (Years) in Diagnosis After Symptom Onset

- Behçet's Disease (~5 years)
- Psoriatic Arthritis (5 years)
- Multiple Sclerosis (4 years)
- Psoriasis (2 years)
- Crohn's Disease (~7 months)
- Ulcerative Colitis (3 months)

*Diagnostic delays are attributable to differential diagnoses and/or the presence of comorbidities

Significant Comorbidities That May be Associated with Autoimmune Disorders*

*Not an exhaustive list


Autoimmune Diseases May Impose a Variety of Heavy Burdens

HEAVY BURDENS

PHYSICAL MANIFESTATIONS
- Inflammation
- Pain and Stiffness
- Comorbidities

EMOTIONAL TOLL
- Self-consciousness
- Embarrassment
- Isolation

EMPLOYMENT IMPACT
- Disability
- Decreased Productivity
- Unemployment

INCREASED COSTS
- Patients
- Healthcare System
- Economy/Society


Patients with Psoriasis Often Develop Psoriatic Arthritis

Psoriatic Arthritis Patients Experience a Variety of Manifestations of Disease


Crohn’s Disease and Ulcerative Colitis Patients May Experience a Variety of Symptoms During a Flare-Up*

PATIENTS REPORT EXPERIENCING:

- **75%** Abdominal pain
- **74%** Diarrhea
- **63%** Urgency
- **41%** Loss of appetite
- **36%** Weight loss

*An online survey of Crohn’s disease and ulcerative colitis patients reporting a flare-up within the last four years to identify key issues facing patients with IBD. There were a total of 777 respondents.

Source 44: Crohn’s and colitis UK. Taking the IBD Standards forward in Scotland. Results from Watson, AJM. PTU-288 Taking the ibd standards forward in scotland: a national patient survey. BMJ. Available at https://gut.bmj.com/content/64/Suppl_1/A187.1. Accessed June 2018.
Multiple Sclerosis Patients May Suffer a Variety of Comorbidities and the Prevalence Increases with Age

**Age-Specific Prevalence of Common Comorbidities**

<table>
<thead>
<tr>
<th>Comorbidity</th>
<th>20-44 years</th>
<th>45-59 years</th>
<th>≥60 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>9</td>
<td>28</td>
<td>57</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>6</td>
<td>21</td>
<td>35</td>
</tr>
<tr>
<td>Heart Disease</td>
<td>1</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Diabetes</td>
<td>5</td>
<td>10</td>
<td>18</td>
</tr>
</tbody>
</table>

Patients with Autoimmune Disorders are at Increased Risk of Cardiovascular Events

Note: In the general population in the U.S., approximately 0.3% of people suffer a coronary attack, and 0.25% experience a stroke each year.


Life Expectancy in Patients with Autoimmune Disorders

**LIFE EXPECTANCY REDUCED BY:**

- **Multiple Sclerosis***
  - 7-14 years

- **Severe Psoriasis†**
  - 3-4 years

- **Psoriatic Arthritis‡**
  - 3 years

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*From a meta-analysis of large cohort disease registries from countries in Europe and North America
†From a retrospective cohort study using the United Kingdom’s General Practice Research Database representing a total of 3,951 patients with severe psoriasis
‡From a cohort of 680 psoriatic patients enrolled in a University of Toronto Psoriatic Arthritis Clinic from 1978 to 2004

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I tend to put off going to the hairdresser. Some of the women who wash hair wear gloves when I come in; people think it’s contagious.
– Psoriasis Patient

It was hard for me to open a marker to write on a white board, hard to answer the phone or type, because I couldn't make a fist, I couldn't grip anything.
– Psoriatic Arthritis Patient

It often takes me a long time to think through decisions, and the limited mobility I do have can feel like I’m moving my limbs through jelly.
– Multiple Sclerosis Patient

Crohn's disease has affected every aspect of my body and life. Beyond the gastrointestinal pain, it has wreaked havoc on my skin, eyes, hair and joints and destroyed my energy level. It has been a driving force behind many family and career decisions. Crohn's has impacted my life in ways many people could never understand.
– Crohn’s Disease Patient

I withdrew into myself. I didn’t want to see anyone, I didn’t want to talk.
– Behçet's Disease Patient
Psoriasis May Substantially Impact Emotional Well-being*  

Percent of patients† with psoriasis who reported:

- Embarrassment: 87%
- Helplessness: 87%
- Anger or Frustration: 89%
- Self-consciousness: 89%
- Concealed Physical Manifestation of their Disease: 83%

*Findings from the National Psoriasis Foundation Survey, 2003-2011, with responses from 5604 psoriasis and/or psoriatic arthritis patients in the general US community.
†Patients may or may not have psoriatic arthritis

Psoriatic Arthritis May Exert a Severe Impact on the Working Lives of Patients*

*The Multinational Assessment of Psoriasis and Psoriatic Arthritis (MAPP) survey included psoriasis and/or psoriatic arthritis patients in North America and Europe, focusing and QoL impacts and unmet treatment needs (N=712 for PsA patients)

Crohn’s Disease and Ulcerative Colitis May Substantially Impact Overall Well-being

People with Inflammatory Bowel Disease (IBD)* reported that the condition:

- Caused worry about availability of toilets when going somewhere new (66%)
- Negatively affected their ability to perform to full potential in an educational setting (52%)
- Prevented them from pursuing relationships (40%)
- Caused them to wake frequently as a result of IBD pain (40%)
- Had gotten in the way of their ability to make or keep friends (29%)

*Includes patients with Crohn’s disease and ulcerative colitis


Multiple Sclerosis Patients May Face Numerous Challenges That Can be Related and Interdependent

Adding to the challenge for patients is that these symptoms can occur with regularity or with variable frequency.

Innovations for Immune and Inflammatory Disorders* Have Increased Over the Past Decade†

*Psoriasis, psoriatic arthritis, multiple sclerosis, Crohn’s disease, and ulcerative colitis
†Selected agents reflect first-in-class; timeline reflects initial approval of agent, with subsequent indications as noted

Note: There are no FDA-approved treatments for Behchet’s Disease.

Rheumatoid Arthritis: An Innovation Story

THEN: During the first half of the 20th century, rheumatoid arthritis treatment regimens included drugs that could provide only symptomatic benefit, analgesics, and physical measures such as bed rest, splinting and physical therapy.

NOW: Biologic disease-modifying antirheumatic drugs target the underlying sources of inflammation, which improves physical functioning and prevents irreversible joint damage, making disease remission possible.

Multiple Sclerosis: The Evolution of Clinical Value for Patients

Since the 1960s, progress has been made in understanding MS and developing treatment options for MS patients:

- Magnetic resonance imaging (MRI) scans further improve diagnostic capabilities.
- Steroid treatments are common.
- Interferon gamma fails clinical trials, but later success with interferon beta.
- Distinct clinical patterns of multiple sclerosis are identified.
- The role of T-cells in pathology is recognized.
- Interferons fully emerge as disease-modifying therapies.
- Greater understanding of cell movement across the blood-brain barrier.
- The role of Th17 cells is uncovered.
- New therapeutic targets in disease begin to emerge.
- The first oral disease-modifying therapy is approved in 2010.
- Now, the average time between onset of MS symptoms and diagnosis is about 4 years.
- For patients, there are now a total of 15 disease-modifying therapies...so far.

Since the 1960s, progress has been made in understanding MS and developing treatment options for MS patients:

- Diagnosis often took seven years.
- Computerized axial tomography (CAT) scans facilitated these diagnoses.
- Chemotherapy and corticosteroids were the common treatments.
- Growing recognition of the role of the immune system.

Vast Majority of Psoriasis and Psoriatic Arthritis Patients Believe There is a Need for Additional Innovative Therapies*

The Multinational Assessment of Psoriasis and Psoriatic Arthritis (MAPP) survey included psoriasis and/or psoriatic arthritis patients in North America and Europe, focusing on QoL impacts and unmet treatment needs (N=3426)

Majority of Psoriatic Arthritis Patients With or Without Psoriasis are Not Receiving Treatment or Only Using Topical Therapy*

*The Multinational Assessment of Psoriasis and Psoriatic Arthritis (MAPP) survey included psoriasis and/or psoriatic arthritis patients in North America and Europe, focusing and QoL impacts and unmet treatment needs (N=3426)

†E.g., cyclosporine, methotrexate, acitretin or fumaric acid esters


59% of patients living with psoriasis +/- PsA, which are systemic diseases, are receiving only topical therapy or no treatment at all.
Patients Discontinue Therapy for a Variety of Reasons*

*A review of medical notes at the Norfolk & Norwich University Hospital between 2002-2008 to determine reasons for discontinuation (N=65)

- **47.8%** Side effects
- **17.4%** Refractory disease
- **13.0%** Achieved remission
- **13.0%** Unknown
- **4.3%** Pregnancy
- **4.3%** Death

**Note:** Percentages do not add up to 100% as patients could name more than one reason for discontinuing therapy

Lois Minta was diagnosed with psoriatic arthritis.
Supporting References


Supporting References


Supporting References


Immune and inflammatory disorders pose a burden for both patients and society

For patients, immune and inflammatory disorders can lead to work-related disability, chronic absenteeism, and losses in overall productivity. These losses are exacerbated when immune and inflammatory diseases strike early in life, with the potential for cumulative, life-long effects on education and careers.

Biopharmaceutical research and development seeks to benefit not only patients, but also society as a whole. Addressing the challenges these disorders pose will benefit the public in a number of ways, including increasing rates of employment and reducing days lost to illness.

As improvements in patient health spur economic growth, these effects are mirrored at a broader level, as jobs in the research arena yield still more jobs in related sectors. Scientific research can serve as an economic engine to drive new opportunities in healthcare and academia.

Ongoing innovation to improve patient treatments simultaneously improves the value these treatments deliver to society.

Alissa Walton was diagnosed with psoriatic arthritis
The physical manifestations of immune- and inflammatory-related disorders are not only a burden to the patient, but may be to society in different ways.
Immune Disorders Have an Impact on Work-Related Disability


As Immune and Inflammatory Disorders Often Present at a Young Age, the Lifetime Impact on Education, Career Development and Overall Quality of Life May be Substantial

I’m unable to provide for myself and my partner.
– Crohn’s Disease Patient

I know someday I will not be able to work, and the time is becoming closer.
– Psoriatic Arthritis Patient

Over the years, I have had no choice but to quit jobs because the pain can get unbearable.
– Psoriasis Patient

I’m unable to provide for myself and my partner.
– Crohn’s Disease Patient

I’m sure I am depressed, but I am still functioning. You are working hard to stand still.
– Multiple Sclerosis Patient
Nearly a Third of Psoriasis and Psoriatic Arthritis Patients Miss More Than 10 Work Days Per Month*

Surveyed Patients with Psoriasis and Psoriatic Arthritis:

WORK DAYS MISSED

<table>
<thead>
<tr>
<th>1-5 DAYS</th>
<th>6-10 DAYS</th>
<th>&gt;10 DAYS</th>
</tr>
</thead>
<tbody>
<tr>
<td>62%</td>
<td>6.6%</td>
<td>31%</td>
</tr>
</tbody>
</table>

in a typical month due to disease

*A National Psoriasis Foundation survey of 5,604 patients, conducted from 2003-2011.

Work Impairment is Linked to Disease Severity in Plaque Psoriasis Patients

Percent Impairment While Working Due to Plaque Psoriasis

<table>
<thead>
<tr>
<th>PASI</th>
<th>Mild (n=40)</th>
<th>Moderate (n=41)</th>
<th>Moderate/Severe (n=40)</th>
<th>Severe (n=21)</th>
<th>Total (n=142)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤3</td>
<td>4.2%</td>
<td>15.4%</td>
<td>23.1%</td>
<td>27%</td>
<td>16.2%</td>
</tr>
<tr>
<td>3&lt; PASI ≤12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 PASI ≤2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>&gt;20</td>
<td></td>
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</tbody>
</table>

PASI = Psoriasis Area Severity Index

*A cross-sectional patient survey and retrospective chart review of 142 patients with a physician-confirmed diagnosis of psoriasis conducted at eight Canadian dermatology clinics

Psoriatic Arthritis May Decrease Work Productivity*

*Results from the Work Limitations Questionnaire (WLQ) of 186 eligible psoriatic arthritis patients

Nearly 75% of IBD Patients Report Disease-related Absenteeism in the Past Year

*A total of 4990 IBD patients (63% Crohn’s disease, 33% ulcerative colitis) from 27 countries completed the web-based IMPACT survey.
Employed Multiple Sclerosis Patients May Struggle with Increased Rates of Absenteeism

≈25% of MS patients report missed work days; patients with higher PDDS levels miss more days of work*

*As measured by Patient-Determined Disease Steps (PDDS), a validated measure of patient disability with an emphasis on mobility.

Estimated Economic Burden of These Immune and Inflammatory Disorders is Substantial in the U.S.

$4 \text{ Billion} \quad \text{Psoriatic Arthritis} \quad + \quad $10.9 \text{ Billion} \quad \text{Crohn’s Disease} \quad + \quad $11.2 \text{ Billion} \quad \text{Psoriasis} \quad + \quad $8.1 \text{ Billion} \quad \text{Ulcerative Colitis} \quad + \quad $28 \text{ Billion} \quad \text{Multiple Sclerosis} = $62.2 \text{ Billion (Annually)}

**Note:** All estimates are inclusive of both direct and indirect annual costs.


### Treated Patients Have the Potential to Experience Improvements in Workplace Productivity and Attendance

<table>
<thead>
<tr>
<th>Condition</th>
<th>Improvement Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Psoriasis</strong></td>
<td>After 12 weeks, productivity improvements were ~70% greater in treated patients compared to placebo*</td>
</tr>
<tr>
<td><strong>Psoriatic Arthritis</strong></td>
<td>After 16 weeks, treated patients reported ~20% improvement in productivity compared to placebo†</td>
</tr>
<tr>
<td><strong>Multiple Sclerosis</strong></td>
<td>In patients reporting sickness at baseline, the number of hours worked weekly nearly doubled following a year of treatment‡</td>
</tr>
<tr>
<td><strong>Ulcerative Colitis</strong></td>
<td>Patients in remission following treatment report 3X the fully productive weekly work hours than patients not in remission§</td>
</tr>
<tr>
<td><strong>Crohn’s Disease</strong></td>
<td>After 12 months of treatment, work time missed decreased by nearly 25% ¶</td>
</tr>
</tbody>
</table>

* A multicenter, double-blind trial of 1,230 adults who had a diagnosis of plaque psoriasis for at least 6 months, were candidates for phototherapy or systemic therapy, had a baseline Psoriasis Area and Severity Index (PASI) score of 12 or higher, and had at least 10% body surface area (BSA) involvement with psoriasis at baseline.
† A randomized study of 504 patients with active psoriatic arthritis.
‡ A comprehensive questionnaire distributed to patients in Sweden starting on natalizumab treatment between June 2007 and May 2008, identified via the Swedish National MS registry.
§ Study utilized data from the Active Ulcerative Colitis Trials 1 and 2 of 728 patients.
¶ Multicenter, observational study of patients with confirmed diagnosis of CD and initiated anti-TNF treatment.


Over the last half century, improvements in health have been as valuable [for economic growth] as all other sources of economic growth combined. 

Kevin Murphy, Ph.D. and Robert Topel, Ph.D.*
University of Chicago Economists

*Adapted from William D. Nordhaus
Biopharmaceutical Sector is a Major Job Generator in the 21st Century

More than 800,000 jobs in the U.S. biopharmaceutical sector

Each direct biopharmaceutical job supports nearly 5 additional jobs in other sectors

More than 4.7 million U.S. jobs are supported by the biopharmaceutical sector

The Biopharmaceutical Sector is the Most R&D-intensive Industry in the U.S.

Biopharmaceutical companies invest approximately 12 times the amount of R&D dollars per employee than manufacturing industries overall.

**Annual Average R&D Investment per Employee by Manufacturing Industry, 2000-2013**

<table>
<thead>
<tr>
<th>Industry</th>
<th>Average R&amp;D Investment per Employee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biopharmaceuticals*</td>
<td>147,281</td>
</tr>
<tr>
<td>Semiconductors*</td>
<td>57,755</td>
</tr>
<tr>
<td>Chemicals</td>
<td>55,717</td>
</tr>
<tr>
<td>Computers and electronics</td>
<td>47,084</td>
</tr>
<tr>
<td>Aerospace*</td>
<td>23,231</td>
</tr>
<tr>
<td>Medical equipment</td>
<td>20,098</td>
</tr>
<tr>
<td>Transportation equipment</td>
<td>16,986</td>
</tr>
<tr>
<td>Petroleum &amp; coal</td>
<td>10,994</td>
</tr>
</tbody>
</table>

*Manufacturing subsectors

**Note:** IP-intensive manufacturing industries are defined as those industries that have a higher rate of R&D investment per employee than the average R&D per employee across all manufacturing industries.

**Source 18:** Celgene data on file.

The Human Genome Project: An Example of High Return on Investment in Basic Science

Why Incentivize the Innovators?

1990-2003
$3.8 billion
U.S. Investment in the Human Genome Project

2010
The Human Genome Project supported more than 310,000 jobs and generated $67 billion in U.S. economic output

Understanding the Human Genome Leads to More Precise Targeting

The Human Genome Project maximizes the potential of innovative medicines via more precise targeting that can improve lives and meaningfully contribute to society.

Before the Human Genome Project, researchers knew the genetic basis of about 60 disorders. Today, they know the basis of nearly 5,000 conditions.

Are now packaged with genomic information that tells doctors to test their patients for genetic variants linked to efficacy, dosages or side-effects.

Across the U.S., Scientific Research Contributes to Significant Economic Activity

In 2013, the biopharmaceutical sector sponsored approximately 6,200 clinical trials of medicines around the United States, involving 1.1 million participants and supporting an estimated $25 billion in economic activity across all 50 states and the District of Columbia.*

*Estimates reflect only those activities occurring at clinical trial sites and exclude more centralized, cross-site functions such as coordination and data analysis. Also excluded are nonclinical R&D such as basic and preclinical research and the significant economic contribution from non-R&D activities of the industry such as manufacturing and distribution.

Scientific Research Contributes to Economic Activity in the U.S. and Around the World

In 2018 the U.S. biopharmaceutical sector is sponsoring 10,700+ active clinical trials supporting tangible economic activity including jobs in research, healthcare, academia, and industry.

Advances in the life sciences will have applications that extend even beyond the improvement of human health. We must do all we can to pave the way for these advances – and we must do it now.

Elias Zerhouni, M.D.
Former Director, National Institutes of Health
Supporting References


Source 18: Celgene data on file.


While healthcare spending continues to grow, relative spending on medicines has decreased, representing only a fraction of total healthcare costs. Further savings might be realized through improvements in access or adherence, resulting in both patient benefits and broader societal savings that go beyond drug costs.

Improved access to affordable healthcare has already shown reductions in projected Medicare spending, and the percentage of U.S. healthcare dollars spent on prescription medications is predicted to remain fairly stable in the coming years. In addition, there is a continuous shift in the market. The savings that occur as medicines become generic can be used towards new innovative therapies that come to market, allowing for the current system to be sustainable in the long term.

At the same time, however, patients face rising costs and other barriers to care that can adversely affect their adherence to therapy. This may drive downstream impact on costs in the healthcare system, as patients become sicker and require additional care. Innovative and efficacious medicines that are accessible to as many patients as possible benefit the long-term health of the healthcare system.
Total Healthcare Expenditure Has Seen Constant Growth Globally, While Spending on Medicines Has Decreased

Pharmaceutical expenditure growth has substantially decreased since 2010 while total healthcare expenditure has continued to grow across developed markets from 1990–2013

Note: Average annual growth in pharmaceutical and total health expenditure per capita, in real terms, average across OECD countries, 1990 to 2013 (or nearest year). Countries include Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.

Call to Action: Across the Healthcare Landscape, Responsible Use of Medicines Can Lead to Potential Savings

Based on estimates from 2012, responsible use of medicines could eliminate up to $213 billion in U.S. healthcare costs annually, which represents 8% of US healthcare spending.


- Total Avoidable Costs: $213
- Nonadherence: $105
- Suboptimal Prescribing*: $87
- Medication Errors: $20
- Mismanaged Polpharmacy in the Elderly: $1

*Category includes delayed evidence-based treatment practice ($40 billion), antibiotic misuse ($35 billion), and suboptimal generic use ($12 billion)

**Studies Show Substantial Value from Improved Use of Medicines**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Improved Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psoriasis</td>
<td>Adherence leads to faster clinical improvement, with a more rapid decrease in the costs of treatment and diminished overall expenditures*</td>
</tr>
<tr>
<td>Psoriatic Arthritis</td>
<td>After 24 weeks, treated patients who did not report workplace absenteeism increased by 12-19%, compared with only 1% in the placebo group†</td>
</tr>
<tr>
<td>Multiple Sclerosis</td>
<td>Improved persistence to medications reduces the likelihood of a patient’s hospital admission and emergency room visits by up to 50%‡</td>
</tr>
<tr>
<td>Ulcerative Colitis</td>
<td>Adherence was associated with 62% lower costs for hospital admissions and 49.8% lower overall total health care costs§</td>
</tr>
<tr>
<td>Crohn’s Disease</td>
<td>Adherent patients resulted in savings of 73% and 90% for all-cause and CD-related medical costs, respectively¶</td>
</tr>
</tbody>
</table>

*Retrospective cohort study involving patients with psoriasis adherent and non-adherent to the prescribed treatment regimen.
†A phase 3, double-blind, placebo-controlled trial of 409 patients with active psoriatic arthritis.
‡A study of 16, 2018 patients with MS who initiated a DMT in a US administrative claims database were followed for 1 year.
§Study included approximately 3.6 million patients enrolled in the Maryland CareFirst BlueCross BlueShield program.
¶Analysis of patients with CD who had at least four infliximab infusions (with the time between consecutive infusions ≤12 weeks for the first four infusions) during the first year following infliximab initiation (index date) were identified from the Integrated Health Care Information Service claims database (2002-2006).

**Sources:**


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4 | BETTER HEALTHCARE, BETTER OUTCOMES
There are advanced technologies which can dramatically lower health care costs and improve quality. The technologies are proven. The associated benefits are known. But there are barriers in the system which impede their implementation. We can change that.

Mitchell Adams
Former Executive Director,
Massachusetts Technology Collaborative
Decreases in Overall Spending for Medicare Beneficiaries are Largely Attributable to Part D Spending on Prescription Drugs

Between 2011-2014

OF TOTAL MEDICARE SPENDING 10% IS TOWARD PART D

BUT THIS ACCOUNTED FOR

MORE THAN 60% OF THE SLOWDOWN IN OVERALL MEDICARE BENEFITS SINCE 2011


Improved Access to Healthcare Through the Affordable Care Act Has Slowed the Projected Growth of Medicare Spending

Congressional Budget Office estimates for Medicare spending in 2020 have been reduced more than $200 billion since January of 2010.

Projected Medicare Spending in 2020:
- As of January 2010: $1,038 Billion
- As of March 2015: $829 Billion

U.S. National Health Expenditure Dollars: Increased Spending, but Projected Allocations Remain Consistent

**2016 NHE: $3,337.2 Billion**
- 32% Hospital Care
- 29% Physician & Clinical
- 20% Home Health
- 10% Other
- 3% Prescription Drugs
- 1% R&D
- 1% Nursing Care

**Projected 2026 NHE: $5,696.2 Billion**
- 32% Hospital Care
- 19% Physician & Clinical
- 11% Home Health
- 5% Other
- 5% Prescription Drugs
- 3% R&D
- 3% Nursing Care

Prescription Growth Has Been Lower or on Par with Other Components of Healthcare Spending

Year-Over-Year Growth in Spending


Total Net Spending Growth on Medicines is Falling Due to Decreased Spending on New Brands and Increased Generic Competition

Net Spending Growth by Product Type US $Bn

Declining Medicine Costs Due to Patent Expirations

Traditional medicine costs are declining due to patent expirations, creating room for new specialty medicines

Real Net Per Capita Medicine Spending and Growth by Product Type (U.S.$)

Traditional medicine costs are declining due to patent expirations, creating room for new specialty medicines.

Net Spending Growth on Medicines was 0.6% in 2017; Expected to Average 2-5% Through 2022

Growth will be driven by innovation and offset by slower price growth and patent expirations.

Multiple Sources Show Medicine Spending Growth Slowed in 2017

|---|
Forecasts of Specialty Drug Spending Have Been Overstated

An analysis of annual drug trend reports found that inconsistent definitions of specialty medicines can bias spending projections.

*Forecast vs. Actual Growth in Specialty Medication Spending From a Major Pharmacy Benefits Management Company*

<table>
<thead>
<tr>
<th>Year</th>
<th>Forecasted 2 years prior</th>
<th>Forecasted 1 year prior</th>
<th>As reported for year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>24%</td>
<td>27%</td>
<td>17%</td>
</tr>
<tr>
<td>2012</td>
<td>27%</td>
<td>17%</td>
<td>18%</td>
</tr>
<tr>
<td>2013</td>
<td>19%</td>
<td>18%</td>
<td>14%</td>
</tr>
</tbody>
</table>

*As reported in annual Drug Trend Reports from Express Scripts.

Additional Cost Savings to the Healthcare System are Realized Once New Medicines Become Generic

Average time to develop a new medicine: at least 10 years

Average time on market before generic entry: 12.5 years†

*Brand drug market share generally declines rapidly after generic entry
†For brand medicines with more than $250 million in annual sales in 2008 dollars, which account for 82% of the brand medicines analyzed


As Innovator Brands Lose Exclusivity, Generics Account for an Increasing Percentage of Total Prescriptions

Percent Share of Prescriptions

**Chart Notes:** Includes all prescriptions dispensed through retail pharmacies, including independent and chain drug stores, food store pharmacies and mail order as well as long-term care facilities. Generics include branded and unbranded generic medicines. Prescription counts are not adjusted for length of therapy. 90-day and 30-day prescriptions are both counted as one prescription.

*Data is from IQVIA 2018; All other data from IMS 2017*


Generic Medicines Generated $253 Billion in Savings for Patients and the Health System in 2016

Recent generic entries have exhibited steeper and faster price reductions compared to earlier generic entries.

“"The savings created by generic copies free up resources to invest in new treatments – creating headroom for innovation – and resulting in significant progress against some of the most costly and challenging diseases.""

– Pharmaceutical Research and Manufacturers of America (PhRMA)


Innovator Brands that Become Generics Reduce Costs for the Healthcare System

### Innovator Brands

**INCREASED COMPETITION AMONG INNOVATOR BRANDS**

**FROM NEW HEPATITIS C THERAPIES**

**RESULTED IN ~50% DECREASE IN TREATMENT COST**

**FROM WHEN HEPATITIS C TREATMENT FIRST REACHED THE MARKET**

### Generics

<table>
<thead>
<tr>
<th>Category</th>
<th>Savings (in Billions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mental Health</td>
<td>$44 Billion</td>
</tr>
<tr>
<td>Hypertension</td>
<td>$29 Billion</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>$28 Billion</td>
</tr>
<tr>
<td>Antiulcerants</td>
<td>$22 Billion</td>
</tr>
<tr>
<td>Nervous System Disorders</td>
<td>$16 Billion</td>
</tr>
<tr>
<td>Pain</td>
<td>$13 Billion</td>
</tr>
<tr>
<td>Cancer Anti-Nauseants</td>
<td>$11.8 Billion</td>
</tr>
<tr>
<td>Oncology</td>
<td>$10 Billion</td>
</tr>
<tr>
<td>Anticoagulants</td>
<td>$9.1 Billion</td>
</tr>
<tr>
<td>Antibacterials</td>
<td>$8.8 Billion</td>
</tr>
<tr>
<td>Respiratory</td>
<td>$7.4 Billion</td>
</tr>
<tr>
<td>Diabetes</td>
<td>$5.5 Billion</td>
</tr>
</tbody>
</table>

**2016 Savings from Generics in Billions**

Generic mental health, hypertension, cholesterol and ulcer medications account for half of the savings in the last 10 years.

Generic competition saved the U.S. healthcare system $1.67 trillion from 2007-2016.


Loss of Exclusivity Continues to Drive Substantial Price Decreases and Projected Savings in the Next Five Years

Lower Brand Invoice Spending Due to Loss of Exclusivity

Chart notes: Lower brand spending based on invoice prices. Historic impacts from QuintilesIMS National Sales Perspectives, forecast impacts are modeled by projecting individual products sales growth to the point of patent expiry and then modeling expected impact based on historical analogues and actual data for in-progress events.

*Estimated numbers based on projections

Patients in the U.S. are Facing Rising Out-of-pocket Costs and Other Barriers to Care

Percent of Plans with Deductibles on Prescription Medicines

<table>
<thead>
<tr>
<th>Year</th>
<th>2012</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deductibles</td>
<td>23%</td>
<td>46%</td>
</tr>
</tbody>
</table>

The Use of Four or More Cost Sharing Tiers is Becoming More Common on Employer Plans

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tiers</td>
<td>3%</td>
<td>5%</td>
<td>7%</td>
<td>13%</td>
<td>14%</td>
<td>20%</td>
<td>23%</td>
<td>32%</td>
</tr>
</tbody>
</table>


Plans Often Charge Patients a Percentage of a Medicine’s Total Cost Rather Than Fixed-dollar Copays

In the most frequently purchased type of Health Insurance Exchange plan, coinsurance for certain medicines is common.

Cost Sharing in Specialty Tiers of 2016 Silver Plans*

**COINSURANCE** can make a patient’s out-of-pocket costs difficult to predict – and potentially much higher – than fixed-dollar copays.

* Silver Plans are shown here because they account for a majority of Health Insurance Exchange enrollment. Plans subject different medicines to different levels of cost sharing, or “tiers”. Medicines assigned to a “specialty tier” typically require the highest level of cost sharing.


Cost-sharing Shifts an Increasing Burden to Patients

Average Changes in Consumer Cost-sharing for Health Plans Sold in the Affordable Care Act Insurance Marketplaces 2015–2016

- Co-payments for non-preferred-brand drugs: 13.6%
- General annual deductibles: 10.3%
- Out-of-pocket limits: 7.1%

High Cost-sharing is Associated with Reductions in Use of Medicine

Percentage Change in Adherence from Doubling Medicine Copays from 1997–2000*

*Based on information from claims database

Step Therapy May Further Limit Access to Prescribed Medicines: A Case Study in IBD

Step therapy: An obstacle course to optimal health

In a survey* of 2,600 IBD patients:

40% indicated they had been subject to step therapy

of those:

- 58% of patients were required to fail two or more drugs before having access to the originally prescribed drug
- 60% were unable to have a doctor intervene to stop the step therapy process on their behalf
- 59% were delayed from their optimal treatment plan for over three months
- 94% believe step therapy to be a barrier to timely and appropriate care
- 32% were delayed for over 7 months

*National survey performed by the Crohn’s & Colitis Foundation. 2,602 respondents were surveyed in December 2016.

Medicines should reach as many people as possible; we need ideas from stakeholders in the fields of health and innovation to make this a reality.

Shiba Phurailatpam
Director of the Asia Pacific Network of People Living with HIV
ACCELERATING INNOVATION IN IMMUNE AND INFLAMMATORY DISORDERS

WHAT MUST BE DONE TO REALIZE THE FULL PROMISE OF INNOVATION?

Although the pace of progress is accelerating, scientists are just beginning to understand immune and inflammatory disorders. Additional research is needed to unravel the complexities of these conditions, but clues from genetics and the immune system have yielded a global pipeline rich in potential first-in-class therapies, with the promise of precision medicines tailored to individual patient needs.

However, even though progress has been made, there remains a need to accelerate medical innovation throughout the world. This is critical to ensuring further progress in medicine and innovation in immune and inflammatory disorders, with subsequent improvements in quality of life, prosperity and progress.

Life science companies, academic institutions, government, medical societies, patient advocacy groups, and the media, among others, need to work as a collaborative ecosystem to foster greater understanding about immune and inflammatory disorders and stimulate investment in the virtuous cycle of medical innovation.

Jennifer Spear was diagnosed with psoriasis and psoriatic arthritis.
Today, no area in biomedicine research is more vibrant than immunology and those who suffer from autoimmune diseases stand to benefit.

Sam Hawgood, MBBS

Chancellor, University of California, San Francisco
A MAJOR PARADOX

The potential of science is greater than ever ...

but the outlook for investment has never been more uncertain

R&D Investment $\equiv$ Longer, Better, Healthier Lives
Pace of Medical Progress in Immune and Inflammatory Disorders is Accelerating

Genomic and proteomic technology
The development of genomic and proteomic technologies provides an ability to identify novel bio-signatures to diagnose, classify and guide therapeutic decision making in patients with immune and inflammatory disorders.

Identification of genes that cause the diseases
Researchers are identifying genes that predispose individuals to develop immune and inflammatory disorders and studying how these genes initiate disease process or exacerbate symptoms, including the impact of environmental factors on genes. Epigenetic strategies to modify the expression of specific genes is an emerging tool to alter the course of pathologies driven by the dysregulation of gene expression.

Biomarker identification and development
Identification of biomarkers (i.e., clinical signs or lab tests) will allow for earlier and more accurate diagnosis, better prediction of disease flare-ups, and improved monitoring of disease progression and response to treatment. Identification of many biomarkers is needed as some biomarkers may be common in a variety of immune and inflammatory disorders, while others may be unique and disease-specific.

Identification of cellular pathways and new drug targets
Researchers have been exploring inter- and intracellular pathways that decrease the production of anti-inflammatory mediators, as well as identifying novel drug targets in an effort to discover and develop innovative treatments for immune and inflammatory diseases and their related sequelae.
Maximizing the Promise of Science: 7,000+ Medicines in Development Globally in 2016

Biopharmaceutical researchers are working on new medicines* for many diseases, including:

<table>
<thead>
<tr>
<th>Disease</th>
<th>Number of Medicines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancer</td>
<td>836</td>
</tr>
<tr>
<td>Rare Diseases</td>
<td>566</td>
</tr>
<tr>
<td>Neurological Disorders</td>
<td>420</td>
</tr>
<tr>
<td>Autoimmune Diseases</td>
<td>311</td>
</tr>
<tr>
<td>Heart Disease &amp; Stroke</td>
<td>190</td>
</tr>
<tr>
<td>Diabetes</td>
<td>171</td>
</tr>
<tr>
<td>Mental Health Disorders</td>
<td>135</td>
</tr>
<tr>
<td>Alzheimer's Diseases</td>
<td>77</td>
</tr>
</tbody>
</table>

*Defined as single products that are counted exactly once regardless of the number of indications pursued

An Average of 74% of Drugs in the Biopharmaceutical Industry Clinical Pipeline are Potential First-in-class Medicines

The Biopharmaceutical Industry Pipeline is Active with Numerous Treatments* in Development for Immune and Inflammatory Disorders

*Some of the treatments are being studied in multiple indications
† Includes topical treatments


Biopharmaceutical Companies Conduct the Vast Majority of Research to Translate Early Research into New Medicines

While basic research is often initiated in government and academia, it is biopharmaceutical firms that provide the necessary critical mass, expertise and experience needed to develop new medicines.

2015* Biopharmaceutical R&D Investment:
$75.3 Billion (est.)

2015 NIH Research Spending:
$29.6 Billion

In addition to basic research and biopharmaceutical related research, NIH supports applied research on medical devices, diagnostics, prevention and other areas.

*Latest public data available for biopharmaceutical R&D investment


Biopharmaceutical Companies are Committed to Advancing Precision Medicine

In recent years, we have seen remarkable advances in targeted therapy, and the R&D pipeline has never been more promising.

**2016**

MORE THAN
25% OF NEW MEDICINES approved by FDA were PRECISION MEDICINES

**IN THE PIPELINE***

42% OF NEW MEDICINES have potential to be PRECISION MEDICINES

*Across the entire biopharmaceutical industry

Over Time, Ongoing Research and Use of a Medicine May Reveal Additional Value

With additional research and approvals, greater value may be realized over time:
- Earlier use
- Use in combination with other agents
- Use in specific sub-populations of patients using diagnostics
- Use in other disease indications

Increasing Competition Within Therapeutic Categories

The pace of competition has substantially increased and, as a result, the time that a medicine is the only therapy available in its pharmacologic class has declined.

**Time Between Approval of First- and Second-in-class Medicines in a Pharmacologic Class**

![Bar chart showing the median number of years between approval of first and second medicines in a class.]

- **1970s**: Median Number of Years = 10.2
- **2005-2011**: Median Number of Years = 2.3

- **1/2** of second medicines in a class were approved within 2.3 years of the first medicine’s approval.
- **1/4** were approved within just 4 months.


Drug Development Costs Continue to Climb

The average cost to develop one new approved therapy 
**more than tripled** between the late 1990s and 2014

---

**Drug Development Costs**

- **$140m**
- **$320m**
- **$800m**
- **$1.2b**
- **$2.6b**

- **Mid-1970s**
- **Mid-1980s**
- **Late 1990s**
- **Early 2000s**
- **2014**

---

**Note:** Drug development costs data from various sources


Society Benefits from New Treatments and Lower Costs in the Future

Innovative therapies have a limited time in their lifecycle to recapture investment and fund future innovation.

<table>
<thead>
<tr>
<th>DISCOVERY AND DEVELOPMENT</th>
<th>FDA REVIEW</th>
<th>INNOVATOR EXCLUSIVITY</th>
<th>GENERIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPEXIMATELY 5,000 to 10,000 COMPOUNDS</td>
<td>5 COMPOUNDS</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>~3-6 YEARS Preclinical</td>
<td>~6-7 YEARS Clinical Trials</td>
<td>~0.5-2 YEARS FDA Review</td>
<td>~5 - 10.5 YEARS FDA-Approved Therapy</td>
</tr>
</tbody>
</table>


A Collaborative Ecosystem is Necessary to Accelerate Innovation in Immune and Inflammatory Disorders

**LIFE SCIENCES COMPANIES**
Continued commitment to R&D, collaboration with academic researchers, public awareness efforts, unmet needs assessment

**ACADEMIC INSTITUTIONS**
Increased focus on collaboration to identify gene markers, new cellular pathways, etc.

**GOVERNMENT RESEARCH**
Greater allocation of funding for research

**PATIENT ADVOCACY ORGANIZATIONS**
Awareness and unmet needs clarification

**MEDIA**
Greater public awareness and recognition

**MEDICAL INNOVATION**
Best practice sharing
We’re making progress but much more needs to be done to accelerate innovation in immune and inflammatory disorders. Today’s investments in healthcare and R&D can create a better, more healthy and potentially disease-free world in some conditions.
This is the most exciting time in the history of medicine. If we can make some radical changes to accommodate the enormous opportunities, there will be better health at lower costs for many generations to come.

Eric Topol, M.D.  
Author, The Creative Destruction of Medicine
Supporting References


Passion, innovation, and courage have been in the company’s genes since its founding. Celgene’s unwavering focus on medical innovation underscores its position in a healthcare ecosystem that has delivered longer, healthier lives to patients.

From helping patients obtain their medications to using cutting-edge scientific technology to discover new treatments, Celgene’s entrepreneurial spirit, collaborative culture, and commitment to rare diseases creates a unique platform for transforming patient outcomes. At every level, it is growing and evolving.

Celgene has become a leader in discovering, developing, and delivering innovative medicines to patients with unmet needs, by digging deeper to resolve unanswered scientific questions, and working tirelessly to improve the lives of patients worldwide.
Celgene exemplifies what it means to **put patients first**. From its research and development focused on bringing **innovative therapies** to those with **high unmet disease needs**, to its continued commitment to support patients and their families through their journeys, the patient has and continues to be the **focal point** of Celgene.

Susan Gorky  
*Patient Advocacy*
Delivering on Our Commitment to Bringing New Treatment Options to Patients in Need

Over the past 5 years, Celgene has invested an average of 39.3 percent* of total revenue on research and development. In fact, over the same period, Celgene committed $18.7 billion to research and development (R&D). Celgene also ranked #3 in R&D intensity† according to the 2017 EU Industrial R&D Investment Scoreboard.

*Based on U.S. Generally Accepted Accounting Principles.
†R&D intensity is defined as the ratio between R&D investment and net sales of a given company or group of companies
‡In Generally Accepted Accounting Principles.
Sustaining a Deep and Diverse Group of Innovative Centers of Excellence

Protein Homeostasis; Biologics
San Diego, CA

Immuno-Oncology Research; Research Informatics/Knowledge Utilization
Seattle, WA

Medicinal Chemistry; Inflammation & Immunology
Cambridge, MA

Inflammation & Immunology
San Diego, CA

Nonclinical & Early Clinical Development
Summit, NJ

Research Informatics/Knowledge Utilization; EU Clinical Operations; Tissue Bank
Seville, Spain (CITRE)

Translational Development Epigenetics; Quanticel Research
San Francisco, CA
Changing the Course of Immune and Inflammatory Disorders by Focusing on the Drivers of Disease and Supporting Patient Access

Scientific knowledge has now advanced to the point where it is possible to create medicines that have the potential to modify the immune and inflammatory systems.

Instead of developing treatments that represent incremental improvements over current standards of care, we are looking to take on diseases where, many times, patients are faced with limited treatment options.

For many conditions, normal activities and routines can help change their outlook on life, to say nothing of the productivity that results from those patients who are able to return to the workplace as active contributors to the economy.

Celgene remains committed to supporting patients by not just developing cutting-edge therapies, but also by addressing other potential barriers that can prevent patients from fully realizing the benefits of innovation.
The Celgene Immune and Inflammatory Pipeline is Deep and Robust

Inflammation & Immunology

Psoriatic Arthritis
apremilast

Psoriasis
apremilast

Psoriasis
CC-90006

Idiopathic Pulmonary Fibrosis
CC-90001

Systemic Lupus Erythematosus
CC-220

Eosinophilic Esophagitis
RPC4046

Behçet's Disease
apremilast

Relapsing Multiple Sclerosis
ozanimod

Crohn's Disease
ozanimod

Ulcerative Colitis
ozanimod

Ulcerative Colitis
apremilast

LEGEND

Ph 1
Ph 2
Ph 3
Post-Approval Research

The best way to predict the future is to invent it.

Alan Kay
American Computer Scientist
Supporting References


