Research & Innovations for Development of Pharmaceuticals

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**Previous research** by the same author estimated average R&D costs in the early 2000s at $1.2 billion in constant 2000 dollars (see DiMasi JA, Grabowski HG. The cost of biopharmaceutical R&D: Is biotech different? Managerial and Decision Economics. 2007;28:469-479). That estimate was based on the same underlying survey as the author’s estimates for the 1990s to early 2000s reported here ($800 million in constant 2000 dollars), but updated for changes in the cost of capital.

**Note:** First-in-class medicines are those that use a different mechanism of action from any other already approved medicine.

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* Pharmaceutical Research and Manufacturers of America (PhRMA). PhRMA annual membership survey. Washington, DC: PhRMA; 2016
VALUE OF MEDICINES

**Cancer:** Since peaking in the 1990s, cancer death rates have declined **23%**.\textsuperscript{17} Approximately **83%** of survival gains in cancer are attributable to new treatments, including medicines.\textsuperscript{18}

**Hepatitis C:** Today, a range of treatment options are available offering cure rates upwards of **90%**, with minimal side effects, in as few as 8 weeks.\textsuperscript{20}

**HIV/AIDS:** Since the introduction of highly active antiretroviral treatment (HAART), the HIV/AIDS death rate has dropped **87%**.\textsuperscript{21} As a result of HAART and all the medical innovations that followed, it is estimated that **862,000** premature deaths were avoided in the United States alone.\textsuperscript{22}
Global Spending on Research & Development in Pharmaceuticals
from 2006-2022 (in billion U.S. Dollar)

Research and Development Spending of total revenue 2016, by industrial sector*

Source: EFPIA Key Data 2016- The Pharmaceutical Industry in Figures, page 10
Pharmaceutical industry is a research-based knowledge economy in the development of vaccines and medicines. Global pharmaceutical sale is $856 billion in 2010, and billions of dollars are invested by thousands of scientists in R&D technology and innovations. Nowadays, the cost of developing a single drug amounts to $1.5 billion, as compared to $138 million in 1975.
Pharmaceutical spend per capita in selected countries in 2016 (in US dollars)

This Statistic describes the pharmaceutical spending per capita in selected countries as of 2016. Pharmaceutical spending per capita in Japan stood at around 783 U.S. dollars. In comparison, the United States reported per capita spending of more than 1,100 U.S. dollars.
Global growth in total pharmaceutical R&D spending from 2008 to 2022

This statistic depicts the growth in global pharmaceutical research and development spending from 2008 to 2022. The pharmaceutical industry expenditure on research and development decreased 1.2 percent, between 2011 and 2012.

Allocation of research and development investments in pharmaceutical industry in 2014, by function

This statistic displays the pharmaceutical industry's research and development investment allocation by select functions in 2014. The pharmaceutical industry spent 23.8 percent of research and development investments in the pre-human or pre-clinical stages.

- Uncategorized: 8.90%
- Pharmacovigilance (Phase IV): 16.60%
- Approval: 5.10%
- Phase III*: 28.70%
- Phase II*: 10.70%
- Phase I*: 8.90%
- Clinical trials: 48.30%
- Pre-human/pre-clinical: 0.21%

Number of FDA approvals for new molecular entities (NMEs) in the period 2009-2011

Number of approvals

- Total: 77
- Oncology: 15
- Central nervous system: 13
- Cardiovascular: 10
- Anti-infectives: 8
- Immunology: 7
- Endocrinology: 5
- Gynecology: 5
- Ophthalmology: 3
- Dermatology: 1
- Respiratory: 1
- Other: 9

Source: Food and Drug Administration; ID 262320
RESEARCH & DEVELOPMENT
DRUG DEVELOPMENT PROCESS

Our medicines save and transform the lives of millions in the UK every year, but developing them is a long and complicated process. It can take over 12 years and cost around £1.2bn to develop a new medicine and for every 10–20 medicines identified in the laboratory, only one will reach patients – the others will fail along the way.

R&D is a continual process and the knowledge and resources we gain along the way drive the next generation of research.

Patients are at the heart of everything we do, that’s why our dedicated team of scientists, doctors and researchers invest years of their lives to find the medicines that could one day save yours.
Spending and Costs
**Drug Development Costs Have Increased**

According to a 2014 study, it costs an average of $2.6 billion in U.S.A to develop one new drug. Less than 12% of the candidate that make it into phase I clinical trials will be approved by the FDA.

*The average cost to develop one new approved drug- including the cost of failures (Constant 2013 Dollars)*

Source: Tufts CSDD10
The Research and Development Process
Development a new medicine takes an average of 10 – 15 years.

Innovation crisis in New Drug discovery

The innovation gap crises in pharma R&D is growing. New molecular entities (NMEs) approved drugs remained flat in the past decade. In the 1990’s, eleven new drugs had reached the “top 100 drugs” while in 2000-2004 only two new drugs approved made it to the top 100 revenue generation. R&D cost is on the rise due to a lengthy clinical trials by FDA for safety. Only one drug candidate out of 13 preclinical candidates is passed (8%). It takes 10-15 yrs for the FDA to pass a new drug.

Source: The Innovation Gap, HIMT 455, Prof. Hughes, March, 2007
Health expenditure as a percentage of gross domestic product in OECD countries in 2012 - 2013

Source: World Bank
OTC* Medicines as a % of the Total Pharmaceutical Market 2010

<table>
<thead>
<tr>
<th>Country</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>18.1</td>
</tr>
<tr>
<td>France</td>
<td>17.8</td>
</tr>
<tr>
<td>Denmark</td>
<td>14.5</td>
</tr>
<tr>
<td>Germany</td>
<td>14.4</td>
</tr>
<tr>
<td>Belgium</td>
<td>13.9</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>12.6</td>
</tr>
<tr>
<td>Ireland</td>
<td>11.9</td>
</tr>
<tr>
<td>Sweden</td>
<td>11.5</td>
</tr>
<tr>
<td>Finland</td>
<td>11.5</td>
</tr>
<tr>
<td>Italy</td>
<td>11.4</td>
</tr>
<tr>
<td>Spain</td>
<td>8.3</td>
</tr>
<tr>
<td>Austria</td>
<td>8.3</td>
</tr>
<tr>
<td>Portugal</td>
<td>8.0</td>
</tr>
</tbody>
</table>

*OTC: Over the counter
Source: AESGP Economic and legal Framework for Non-Prescription Medicines 2011
Declining R&D Success Rates

According to the Bain study [7], during 2000-2002, it took 13 candidates coming out of pre-clinical trials to push 1 product to final launch whereas between 1995 and 2002, only 8 preclinical candidates were required on average to yield one successful drug. The cumulative success rate (probability) of making it successfully across the clinical trials have decreased from the historical 14% to 8% in 2000-2002. Moreover, since the analysis was, Failure rates in clinical trials have increased. (Bain model 2003)

Source: The Innovation Gap, HIMT 455, Prof. Hughes, March, 2007
Roots Causes of the Innovation Gap

“Most of the easy wins have already been made...Now we are into more indirect ways of treating diseases: stopping tumours from growing by preventing their ability to get blood supply ... These are much more complicated.”

Lars Rebien Sorenson, CEO of Norvo Nordisk, BusinessWorld 2004

1. Saturation of low hanging fruits.

Most of pharmaceutical research efforts have focused largely on four major disease areas: central nervous system, cancer, cardiovascular and infectious disease. Increasingly, it will have to search for products in poorly understood and more complex therapeutic areas such as autoimmune diseases and genitourinary conditions.
2. Pharma Industry is in crises.

Aggregate industry portfolio is much riskier than in the previous decade. They estimate that in 1990 a typical target in development had ≈100 scientific citations while in 1999, an average drug candidate had only 8 scientific citations.

3. Pharma growth.

Pharma companies show that larger firms enjoyed better productivity overall due to economies of scope.
Diagrammatic depiction of the different models of innovation; the three in the red box are emerging models at the horizon while the others have already been adopted by the industry.

Source: The Innovation Gap, HIMT 455, Prof. Hughes, March, 2007
Innovation Models for Pharma Industry

• **Increased R&D spending**: This strategy was implicit in the increasing R&D costs associated with each drug brought to market.

• **Horizontal consolidation**:  
  1. economies of scale across the entire value chain, from R&D discovery to sales.  
  2. Expiring patents and enervated pipelines.

• **Biotech In-licensing**:  
  i) There is no evidence that biotech can live up to the challenge.  
  ii) Even if biotechnology firms can fill pharm’s pipelines, this will shift the bargaining power and thus the value capture lever to the biotechnology sector.1
New Innovation Models for Improving R&D Productivity

• Outsourcing

There are (4) major market segments in drug discovery: Chemistry, Biology, Screening, and lead-optimization.

The two areas growing fastest are: Lead-optimization and Biology (over 20%/year), and chemistry is growing 10%/year, Screening at 6%/year.

The overall market for outsourced drug discovery in 2005 was $4.1 billion, and is growing at a 15% rate to reach $7.2 billion in 2009.

<table>
<thead>
<tr>
<th>Year</th>
<th>Discovery</th>
<th>Clinical</th>
<th>Total</th>
<th>% Outsourced</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>10%</td>
</tr>
<tr>
<td>2001</td>
<td>2</td>
<td>5</td>
<td>7</td>
<td>24%</td>
</tr>
<tr>
<td>2005</td>
<td>4</td>
<td>9</td>
<td>13</td>
<td>33%</td>
</tr>
<tr>
<td>2009</td>
<td>7</td>
<td>17</td>
<td>24</td>
<td>41%</td>
</tr>
</tbody>
</table>

Outsourced Drug Discovery & Development Expenditures by Type

Source: The Innovation Gap, HIMT 455, Prof. Hughes, March, 2007
Cost of Developing an Innovative Medicine

€ millions

<table>
<thead>
<tr>
<th>Year</th>
<th>Cost (€ millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>149</td>
</tr>
<tr>
<td>1987</td>
<td>344</td>
</tr>
<tr>
<td>2001</td>
<td>868</td>
</tr>
<tr>
<td>2006</td>
<td>1059</td>
</tr>
<tr>
<td>2010</td>
<td>1375</td>
</tr>
</tbody>
</table>

Association of British Pharmaceutical Industry data (March 2012)

Life Cycle of an Innovative Medicine

From concept to product: steps in the genesis of a medicine

10,000 molecules screened
100 molecules tested
10 candidate molecules
1 medicine

<table>
<thead>
<tr>
<th>Research phase</th>
<th>Test phase</th>
<th>Development phase</th>
<th>Administrative Procedures</th>
<th>Commercialisation phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5 years</td>
<td>10 years</td>
<td>15 years</td>
<td>20 years</td>
</tr>
</tbody>
</table>

10 years R&D
2 to 3 years

Patent filing

Patent expiry

Source: LEEM
Evolution of Innovative Medicines

Source: Boston Consulting Group
**Origin of the 25 new chemical and biological entities in the world pharmaceutical market in 2011 - 2015**

Number of new chemical or biological entities developed between 2011 and 2015, by region of origin

![Bar chart showing the number of new chemical or biological entities developed between 2011 and 2015 by region of origin. Europe has 75, United States has 89, Japan has 31, and Other has 31.](http://www.statista.com)

**Source:** Statista, The Statistics Portal - [http://www.statista.com](http://www.statista.com)
More than 7,000 Medicines in Development Globally - 2016

Biopharmaceutical researchers are working on new medicines for many diseases.

Source: Adis R&D Insight Database
Defined as single products which are counted exactly once regardless of the number of indicators pursued.
http://chartpack.phrma.org/2016-perspective/chapter-2/more-than-7-000-medicines-in-development-globally
More than 900 Biologic Medicines in Development in 2013

Biologic medicines—large, complex molecules derived from living cells—frequently represent novel strategies that have the potential to transform the clinical treatment of disease.

Source: Chart Pack - Biopharmaceuticals in Perspective (2015)
New Innovation Models for Improving R&D Productivity

• Open Source Innovation

The key attributes of open-source are sharing of information in an incremental, cumulative fashion across companies, institutions, areas of expertise, and platforms of research.

Source: The Innovation Gap, HIMT 455, Prof. Hughes, March, 2007
Need for Continued Medicines Innovation

- HIV/AIDS: Medicines exist (R&D to improve their utility for patients)
- Tuberculosis: Medicines exist (R&D to overcome emerging challenges e.g. drug resistance)
- Malaria: No medicines (R&D to bridge the gap)
- Childhood Diseases: Medicines exist (R&D to improve their utility for patients)
- Respiratory Infections: Medicines exist (R&D to improve their utility for patients)
- Cancers: Medicines exist (R&D to improve their utility for patients)
- Neuropsychiatric Disorders: Medicines exist (R&D to improve their utility for patients)
- Cardiovascular Diseases: Medicines exist (R&D to improve their utility for patients)
- Diabetes: Medicines exist (R&D to improve their utility for patients)
- Respiratory Diseases: Medicines exist (R&D to improve their utility for patients)

Source: IFPMA, The Value of Innovation 2008
Barriers and Potential Solutions

1. Economic Barriers.
2. Coordination and Leadership Barriers
3. Regulation and Intellectual Property
4. Motivation and Availability of Talent

Source: The Innovation Gap, HIMT 455, Prof. Hughes, March, 2007
Open-source’s Potential for the Future

Certain areas such as tropical diseases have benefited from open-source initiatives, but to apply the model more broadly would require substantial changes to how healthcare is funded and perceived. It is not clear that open-source would be substantially better than the innovation produced by traditional pharma, and working outside of IP protection would do little to motivate investment in the projects.
# Benefits of Innovative Medicines

<table>
<thead>
<tr>
<th>Type of Medicine</th>
<th>Benefit</th>
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<tbody>
<tr>
<td><strong>Beta Blockers</strong></td>
<td>23% reduction in long term risk of death</td>
</tr>
<tr>
<td></td>
<td>Improved bypass operation survival rates</td>
</tr>
<tr>
<td><strong>Ace Inhibitors</strong></td>
<td>22% reduction in risk of death from heart attack and stroke</td>
</tr>
<tr>
<td></td>
<td>30% reduction in stroke events</td>
</tr>
<tr>
<td></td>
<td>29% reduction in coronary heart disease events</td>
</tr>
<tr>
<td><strong>Calcium Antagonists</strong></td>
<td>39% reduction in stroke events</td>
</tr>
<tr>
<td></td>
<td>28% reduction in major cardiovascular events</td>
</tr>
<tr>
<td><strong>Statins</strong></td>
<td>60% reduction in risk of heart attack</td>
</tr>
<tr>
<td></td>
<td>30% reduction in risk of death</td>
</tr>
<tr>
<td></td>
<td>17-30% reduction in stroke events</td>
</tr>
<tr>
<td><strong>Combination Therapy</strong></td>
<td>72-80% reduction in risk of death when using a combination of anti-platelets, beta blockers, ACE inhibitors and statins</td>
</tr>
</tbody>
</table>

Top five Pharma Companies
(Rx Sales comparison 2013-2014)

Source: Evaluate Pharma, Evaluate Ltd. www.evaluate.com
<table>
<thead>
<tr>
<th></th>
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<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Johnson &amp; Johnson (U.S.)</td>
<td>70,074</td>
<td>-5.73</td>
<td>31,430</td>
<td>44.85</td>
<td>9,046</td>
<td>72.61</td>
<td>21.99</td>
<td>11,266</td>
<td>35.84</td>
<td>551</td>
</tr>
<tr>
<td>2</td>
<td>F. Hoffmann-La Roche AG (Switzerland)</td>
<td>50,111</td>
<td>-3.50</td>
<td>38,855</td>
<td>77.54</td>
<td>9,972</td>
<td>71.29</td>
<td>18.81</td>
<td>19,632</td>
<td>50.53</td>
<td>546</td>
</tr>
<tr>
<td>3</td>
<td>Pfizer Inc. (U.S.)</td>
<td>48,851</td>
<td>-1.52</td>
<td>48,851</td>
<td>100.00</td>
<td>7,690</td>
<td>81.65</td>
<td>14.25</td>
<td>13,233</td>
<td>27.09</td>
<td>499</td>
</tr>
<tr>
<td>4</td>
<td>Novartis AG (Switzerland)</td>
<td>49,414</td>
<td>-5.30</td>
<td>30,445</td>
<td>61.61</td>
<td>8,935</td>
<td>83.80</td>
<td>36.01</td>
<td>9,494</td>
<td>31.18</td>
<td>416</td>
</tr>
<tr>
<td>5</td>
<td>Bayer AG (Germany)</td>
<td>51,407</td>
<td>-6.44</td>
<td>15,253</td>
<td>29.67</td>
<td>4,751</td>
<td>86.51</td>
<td>8.85</td>
<td>5,144</td>
<td>33.72</td>
<td>440</td>
</tr>
<tr>
<td>6</td>
<td>Merck &amp; Co., Inc. (U.S.)</td>
<td>39,498</td>
<td>-6.48</td>
<td>34,782</td>
<td>88.06</td>
<td>6,704</td>
<td>86.33</td>
<td>11.29</td>
<td>8,540</td>
<td>24.55</td>
<td>581</td>
</tr>
<tr>
<td>7</td>
<td>GlaxoSmithKline plc (U.K.)</td>
<td>36,566</td>
<td>-3.54</td>
<td>36,566</td>
<td>100.00</td>
<td>5,441</td>
<td>89.10</td>
<td>32.96</td>
<td>7,863</td>
<td>21.50</td>
<td>361</td>
</tr>
<tr>
<td>8</td>
<td>Sanofi (France)</td>
<td>34,542</td>
<td>8.99</td>
<td>34,542</td>
<td>100.00</td>
<td>5,082</td>
<td>84.64</td>
<td>13.06</td>
<td>10,038</td>
<td>29.06</td>
<td>299</td>
</tr>
<tr>
<td>9</td>
<td>Gilead Sciences, Inc. (U.S.)</td>
<td>32,639</td>
<td>31.13</td>
<td>32,639</td>
<td>100.00</td>
<td>3,014</td>
<td>32.00</td>
<td>55.48</td>
<td>22,599</td>
<td>69.24</td>
<td>4,080</td>
</tr>
<tr>
<td>10</td>
<td>AstraZeneca plc (U.K.)</td>
<td>23,641</td>
<td>-9.40</td>
<td>23,641</td>
<td>100.00</td>
<td>5,997</td>
<td>87.11</td>
<td>10.52</td>
<td>10,907</td>
<td>46.14</td>
<td>393</td>
</tr>
</tbody>
</table>

Sources: SEC filings and annual reports.
Top five Pharma Companies
(R&D spend comparison 2013-2014)

Source: Evaluate Pharma, Evaluate Ltd. www.evaluate.com
A decade of Advances
(2004-2014)

2004
- First anti-angiogenic medicine for cancer
- New Rx for most common form of lung cancer

2005
- First new kidney cancer Rx in over a decade
- 3 new therapies for diabetes

2006
- First vaccine for the prevention of cervical cancer
- First Rx for chronic chest pain in 20 years
- First once-a-day HIV medicine

2007
- New class of medicines to treat high blood pressure
- First treatment for fibromyalgia

2008
- A new type of treatment for Crohn’s disease
- The first Rx for symptoms of Huntington’s disease

2009
- First treatment for peripheral T-cell lymphoma
- First new Rx for gout in 40 years

2010
- 2 new multiple sclerosis drugs
- First therapeutic cancer vaccine

2011
- First lupus drug in 50 years
- 2 new personalized medicines

2012
- First drug to target root cause of cystic fibrosis
- First drug to treat Cushing’s disease

2013
- 2 new personalized medicines to treat the most dangerous forms of skin cancer
- A new oral treatment for multiple sclerosis

2014
- Oral treatments for hepatitis C provide cure rates upwards of 90%
- 17 new drugs to treat patients with rare diseases
- 7,000 medicines in development around the world

HIV/AIDS: Decline in Death Rates

The number of US AIDS deaths decreased dramatically following the introduction of highly active antiretroviral treatment (HAART).\(^1\) As a result of HAART and all the important medical innovations that followed, it is estimated that over 862,000 premature deaths have been avoided in the United States alone.\(^2\)

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*Diagram: Actual vs Projected Death Rates for HIV/AIDS in the United States*

- **Y-axis:** Annual Mortality Rate
  - 9%
  - 8%
  - 7%
  - 6%
  - 5%
  - 4%
  - 3%
  - 2%
  - 1%
- **X-axis:** Year
  - 1988
  - 1990
  - 1992
  - 1994
  - 1996
  - 1998
  - 2000
  - 2002
  - 2004
  - 2006
  - 2008
  - 2010

**Legend:**
- **Green Area:** 862,000 Premature Deaths Avoided
- **Blue Area:** Actual Mortality

*Sources: CDC\(^1\); Truven Health Analytics\(^2\)*
HIV/AIDS: Treatment Advances Build Over Time

Dramatic declines in death rates did not occur with one single breakthrough, but rather through a series of advances providing important treatment options for patients over time.

Source: Boston HealthCare
Cancers: Decline in Death Rates

Since peaking in the 1990s, cancer death rates have declined nearly 22 percent. Approximately 83% of survival gains in cancer are attributable to new treatments, including medicines.

Percent Change by Decade in US Death Rates from Cancer

Source: NCI¹⁴, Sun E, et al
Rare Diseases: Drug Approvals for Rare Diseases Have Increased

Rare diseases are those that affect 200,000 or fewer people in the United States. The FDA has approved more than 500 orphan drugs since the passage of the Orphan Drug Act in 1983.

*Number of Drug Approvals for Rare Diseases*

Potential First – in – Class Medicines in the Pipeline

An average of 70% of drugs across the pipeline are potential first – in – class medicines.

Source: Analysis Group
Average lifetime Returns from Newly Introduced Medicines Have Declined in Recent Years

The R&D investments required to bring medicines to patients in the future rely on revenues from existing approved innovative medicines. Continued declines in average lifetime revenues from new medicines could reduce companies ability to maintain their historically high levels of innovation.

Average Present Value of lifetime Sales of Medicines, by when they were introduced

A medicine is defined as a novel active substance, ie, a molecular or biologic entity or combination product in which at least one element had not previously been approved by the Food and Drug Administration. Sales are global sales net of rebates and discounts.

Source: Berndt E, et al
Setbacks in Alzheimer's Disease Research Provide Stepping Stones for Future Innovation

Since 1998, 123 medicines in development for the treatment of Alzheimer's disease have not made it through clinical trials, with only 4 gaining FDA approval. These setbacks highlight the complexity of the R&D process. Though disappointing, they provide important knowledge to fuel future research.

Cancer Researchers Build on Knowledge Gained from Setbacks in Order to Inform Future Advances

Developing a new cancer medicine is a complex process, fraught with setbacks, but these so called “failures” are not wasted efforts. Researchers learn from them to inform future study and direct research efforts.

“The scientific process is thoughtful, deliberate, and sometimes slow, but each advance, while helping patients, now also points toward new research questions and unexplored opportunities.”

— Clifford A. Hudis, MD, FACP
Chief, Breast Medicine Service, Memorial Sloan Kettering Cancer Center;
Professor, Weill Cornell Medical College

<table>
<thead>
<tr>
<th>Cancer Type</th>
<th>Unsuccessful Attempts</th>
<th>New Drugs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MELANOMA</strong></td>
<td>96</td>
<td>7</td>
</tr>
<tr>
<td><strong>BRAIN CANCER</strong></td>
<td>75</td>
<td>3</td>
</tr>
<tr>
<td><strong>LUNG CANCER</strong></td>
<td>167</td>
<td>10</td>
</tr>
</tbody>
</table>

*Setbacks and advances from 1998-2014

Source: PhRMA
## Total Pharmaceutical Market in the Arab World 2009

<table>
<thead>
<tr>
<th>Country</th>
<th>Total Market (US$ million)</th>
<th>Share of local companies %</th>
<th>No. of Manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>KSA</td>
<td>3,130</td>
<td>25%</td>
<td>17</td>
</tr>
<tr>
<td>Egypt</td>
<td>2,550</td>
<td>94%</td>
<td>85</td>
</tr>
<tr>
<td>Iraq</td>
<td>1,400</td>
<td>10%</td>
<td>10</td>
</tr>
<tr>
<td>UAE</td>
<td>762</td>
<td>20%</td>
<td>7</td>
</tr>
<tr>
<td>Algeria</td>
<td>1,345</td>
<td>48%</td>
<td>34</td>
</tr>
<tr>
<td>Morocco</td>
<td>1,174</td>
<td>93%</td>
<td>31</td>
</tr>
<tr>
<td>Syria</td>
<td>930</td>
<td>93%</td>
<td>62</td>
</tr>
<tr>
<td>Tunisia</td>
<td>655</td>
<td>48%</td>
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</tr>
<tr>
<td>Yemen</td>
<td>626</td>
<td>15%</td>
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</tr>
<tr>
<td>Libya</td>
<td>563</td>
<td>3.66%</td>
<td>1</td>
</tr>
<tr>
<td>Lebanon</td>
<td>470</td>
<td>12%</td>
<td>6</td>
</tr>
<tr>
<td>Sudan</td>
<td>406</td>
<td>49%</td>
<td>16</td>
</tr>
<tr>
<td><strong>Jordan</strong></td>
<td><strong>386</strong></td>
<td><strong>29%</strong></td>
<td><strong>16</strong></td>
</tr>
<tr>
<td>Kuwait</td>
<td>315</td>
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<tr>
<td>Oman</td>
<td>235</td>
<td>10.50%</td>
<td>2</td>
</tr>
<tr>
<td>Qatar</td>
<td>170</td>
<td>0.0%</td>
<td>0</td>
</tr>
<tr>
<td>Bahrain</td>
<td>170</td>
<td>0.0%</td>
<td>0</td>
</tr>
<tr>
<td>Palestine</td>
<td>95</td>
<td>21%</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>15,382</strong></td>
<td></td>
<td><strong>327</strong></td>
</tr>
</tbody>
</table>

Source: AUPAM
## FORecast SAEls $0.25 - $1.0BN Incremental in the Next 5 Years

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Asia Pacific $2.2Bn incremental</td>
<td>Philippines</td>
<td>$3.0Bn</td>
<td>3.8%</td>
</tr>
<tr>
<td></td>
<td>Malaysia</td>
<td>$1.6Bn</td>
<td>8.3%</td>
</tr>
<tr>
<td></td>
<td>Bangladesh</td>
<td>$1.3Bn</td>
<td>10.4%</td>
</tr>
<tr>
<td>Latin America $2.5Bn incremental</td>
<td>Chile</td>
<td>$2.3Bn</td>
<td>8.2%</td>
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<tr>
<td></td>
<td>Peru</td>
<td>$1.5Bn</td>
<td>7.8%</td>
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<tr>
<td></td>
<td>Ecuador</td>
<td>$1.3Bn</td>
<td>8.6%</td>
</tr>
<tr>
<td>East Europe $0.8Bn incremental</td>
<td>Kazakhstan</td>
<td>$1.3Bn</td>
<td>10.3%</td>
</tr>
<tr>
<td>Middle East $1.7Bn incremental</td>
<td>Iran</td>
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<tr>
<td></td>
<td>U.A.E</td>
<td>$1.3Bn</td>
<td>8.9%</td>
</tr>
<tr>
<td></td>
<td>Lebanon</td>
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<td>6.6%</td>
</tr>
<tr>
<td>Africa $1.9Bn incremental</td>
<td>Morocco</td>
<td>$1.2Bn</td>
<td>4.5%</td>
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<td>Tunisia</td>
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<td>10.0%</td>
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<tr>
<td></td>
<td>Ghana</td>
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<td>12.4%</td>
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<tr>
<td></td>
<td>Kenya</td>
<td>$0.5Bn</td>
<td>16.9%</td>
</tr>
<tr>
<td></td>
<td>Ethiopia</td>
<td>$0.4Bn</td>
<td>10.0%</td>
</tr>
</tbody>
</table>

Source: IMS Health Global Market Prognosis, May 2013, at ex-manufacturer price levels. LCS: Contains Audited + Unaudited data

Africa’s potential will reward commitment, engagement and a business model that strengthens the path to market and patient.
Average consumption per Capita in the Arab World ($)
Average consumption per Capita in the Whole World ($) in 2009

Source: AUPAM
Ranking of the 20 countries with the highest life expectancy as of 2015

This statistic represents a ranking of the 20 countries with the highest life expectancy as of 2015. Switzerland was the country with the fifth highest life expectancy worldwide. As of that year, people in Switzerland can expect to live 83 years.

Source: http://www.statista.com/2015
This statistic shows a ranking of 20 countries with the lowest life expectancy for people born as of 2015. People who were born in Guinea-Bissau that year had a life expectancy of about 55.5 years. As it can be seen, Africa includes the countries with the shortest life expectancy worldwide.
Impact of Ageing on Public Expenditure


Source: http://www.statista.com/
Healthcare Tomorrow: Summary

• Research and development of new medicines offers an ageing population hope of a longer healthy life, well beyond that of previous generations. For example, there are currently nearly 900 medicines in development to combat cancer, 300 for two of the leading causes of death heart disease and stroke, and 235 for diabetes and related conditions.

• Research based pharmaceutical companies are the engines of medicines innovation. They have discovered and developed over 90% of all new medicines made available to patients worldwide over the last twenty years.

• The discovery, development, testing and gaining of regulatory approval for new medicines has become an even more highly complex, lengthy, risky and expensive process. Each success is built on many, many prior failures. On average only one or two of every 10,000 promising molecules will successfully pass extensive tests and stringent regulatory requirements and go on to be approved as medicines, which are suitable for use in patients. The cost of researching and developing a new medicine has gone from €149 million in 1975 to almost €1.4 billion today.
Healthcare Tomorrow: Summary

• It takes an average of 12 to 15 years to develop a new medicine from the time it is discovered to when it passes the regulatory standards of safety, quality and efficacy and is available to patients. Once on the market the average medicine has only 8 to 10 years of effective patent protection remaining before facing generic competition. Only three out of ten marketed medicines produce revenues that match or exceed their R&D costs before they lose patent protection.

• The European pharmaceutical industry employs over 115,000 people in R&D at a total cost of over €27.4 billion.

• Innovation is central to the creation of the knowledge based economy of the 21st century. In Ireland pharmaceutical industry R&D is responsible for 20% of all business R&D.

• If innovation is to flourish then it must be rewarded. In addition to escalating R&D costs and regulatory issues, the austerity measures introduced by EU countries is impacting on the sector.

• Emerging economies such as Brazil, China and India are experiencing rapid growth in both the market and research environments, which is leading to an increasing number of pharmaceutical companies, including European ones, deciding to locate new R&D facilities outside Europe.
my motto: ICID
Initiate, Create
Innovate, Disseminate

Thank you For Listening