Introduction to the Pharmaceutical Industry

University Joins Industry
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Galenicum
Topics to be covered today:

- History
- Drug$ Economics
- R&D. The core of the Industry
- RISK Factors
- Current trends
Introduction

- Develops, produces, & markets medicinal drugs
- Deal in generic &/or brand medications
- They are subject to a variety of laws & regulations regarding the patenting, testing & marketing of drugs
History
Some Important Events

- American Civil War
- Legislation – UK Cruelty to Animals Act (1876); US Federal Food and Drug Act (1906)
- World War 1 - Development of UK regulatory rules
- World War 2 – antibiotics
- Vaccines – Smallpox: Jenner (1796) – eradicated in 1977
- Thalidomide (1960) – report adverse drug reactions
- AIDS (1980s) – fast track approval, “buyer power”
- Viagra (1998)
- Tamiflu – H1N1 (swine flu) pandemic (2009)
- NICE (1999) – the affordability factor
- Vioxx – anti-inflammatory – 1999-2004 due to litigation
- Avandia – Type 2 (non-insulin dependent) diabetes - 1999-2010 also due to litigation
History of the Drugs

- The early days - Egyptians, Greeks, Arabs, China, India
- Plant-derived medicines
  - morphine (1805), quinine (1819), colchicine (1820), pilocarpine (1875)
- Hormones
  - insulin (1921), estradiol (1929), testosterone (1931), “the pill” (1960)
- Antibiotics, Psychoactive drugs (post-1945 to 1960’s)
  - penicillin (1944), streptomycin (1944), valium (1963)
- Treatment of metabolic disorders (1960’s to current day)
  - Search for gene therapies (1990), stem cell-based therapies
  - Stem-cell replacement of a trachea (2008)
DRUG$
Health expenditure as % of govt budget

Abuja Target

<table>
<thead>
<tr>
<th>Income Group</th>
<th>Percentage of government budget (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (36)</td>
<td>10.8</td>
</tr>
<tr>
<td>Lower-middle (53)</td>
<td>9.8</td>
</tr>
<tr>
<td>Upper-middle (56)</td>
<td>11.7</td>
</tr>
<tr>
<td>High (52)</td>
<td>14.0</td>
</tr>
<tr>
<td>Global (197)</td>
<td>11.5</td>
</tr>
</tbody>
</table>
### Table 4.1.5: Total Pharmaceutical Expenditures (2010)

<table>
<thead>
<tr>
<th>Country group (number of countries)</th>
<th>Population</th>
<th>Total Pharmaceutical Expenditure</th>
<th>Per capita (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Millions</td>
<td>Million US$</td>
<td></td>
</tr>
<tr>
<td>WHO region</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Africa (43)</td>
<td>819</td>
<td>$19,464</td>
<td>$10.59</td>
</tr>
<tr>
<td>Americas (35)</td>
<td>923</td>
<td>$436,004</td>
<td>$87.30</td>
</tr>
<tr>
<td>Eastern Mediterranean (19)</td>
<td>573</td>
<td>$20,763</td>
<td>$50.31</td>
</tr>
<tr>
<td>Europe (52)</td>
<td>896</td>
<td>$331,683</td>
<td>$308.48</td>
</tr>
<tr>
<td>South-East Asia (10)</td>
<td>1,783</td>
<td>$41,157</td>
<td>$13.05</td>
</tr>
<tr>
<td>Western Pacific (27)</td>
<td>1,800</td>
<td>$276,362</td>
<td>$37.90</td>
</tr>
<tr>
<td>World Bank income group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-income (49)</td>
<td>1,092</td>
<td>$775,305</td>
<td>$463.59</td>
</tr>
<tr>
<td>Upper-middle-income (55)</td>
<td>2,474</td>
<td>$283,864</td>
<td>$96.78</td>
</tr>
<tr>
<td>Lower-middle-income (50)</td>
<td>2,480</td>
<td>$59,580</td>
<td>$26.28</td>
</tr>
<tr>
<td>Low-Income (32)</td>
<td>749</td>
<td>$6,683</td>
<td>$8.01</td>
</tr>
<tr>
<td>Global</td>
<td>6,795</td>
<td>$1,125,433</td>
<td>$68.78</td>
</tr>
<tr>
<td>Global (186)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

National Health Accounts, 2013
What is a drug?

“A Chemical Substance that Interacts with a Living System and Produces a Biological Response”
What criteria MUST new drugs meet?

- Drugs must address a **new need** or provide a significant “**added benefit”** over an existing medicine.
- Drugs must also meet five criteria:
  - **Must be safe, effective, of high quality**
  - ...**cost effective** (1980s)
  - ...............**affordable** (1990s)
  - .................**REALLY affordable** (2000+)


Classification of Drug Types

- Ethical drugs
- Generic drugs (no longer under patent)
- “Prescription Only” vs “Over the Counter”
- “Off Label” applications
- Orphan drugs
- Biotechnology products
- Counterfeit drugs
- Street drugs!
Economics
Economics of the Pharmaceutical Industry

- Worldwide revenues > $980 billion/year
- Sales for the 10 largest drug companies: $297 billion in 2013
- Greater than 5000 companies worldwide
- Top 5 companies have market shares about 4 - 5%
- US = Largest markets (40% of worldwide sales)
The companies in 2013

<table>
<thead>
<tr>
<th>Company</th>
<th>$Billions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pfizer</td>
<td>48</td>
</tr>
<tr>
<td>Novartis</td>
<td>47</td>
</tr>
<tr>
<td>Roche</td>
<td>39</td>
</tr>
<tr>
<td>MSD</td>
<td>37</td>
</tr>
<tr>
<td>Sanofi</td>
<td>37</td>
</tr>
<tr>
<td>GSK</td>
<td>33</td>
</tr>
<tr>
<td>Jonhson &amp; Jonhson</td>
<td>28</td>
</tr>
<tr>
<td>AstraZeneca</td>
<td>25</td>
</tr>
<tr>
<td>Lilly</td>
<td>21</td>
</tr>
<tr>
<td>AbbVie</td>
<td>18</td>
</tr>
</tbody>
</table>
Economics

- 18.6% profit margin in 2013
- 16.4% in 2000

Largest of any industry

4 times greater than average return of all fortune 500 companies

8 out of 25 most profitable U.S. companies are pharmaceutical companies
Mergers and Acquisitions

Drug company mergers

- Pfizer-Warner-Lambert, Upjohn-Pharmacia, Glaxo-Wellcome-SmithKline Beecham, etc.

Pfizer acquired Pharmacia in 7/02 for $60 billion to become the world’s most powerful drug conglomerate. In 2015, Pfizer acquires Hospira
Who pays the party?

- 55% out-of-pocket
- 25% private insurance
- 17% medicaid
- 3% Other (VA, Workman’s Comp, IHS, etc..)
Where Prescription Money Go

- Research and development
  - Preclinical testing - 6%
  - Clinical testing - 6%
- Manufacturing and distribution - 24%
- Sales and marketing - 26%
- Administrative / miscellaneous expenses - 12%
- Taxes - 9%
- Net profit - 17%
R&D. The core of the Industry
The “Pay Off”......to the companies

- R&D = 15 to 25 % of sales turnover
- Patent protection – 20 years from filing
- On average, 11yrs. of *productive* market life
  - *Losec* - $2.7Bn in 1998; *Nexium* (single enantiomer) $7.7Bn in 2008
  - *Lipitor* - $1Bn in 1998; **$13.8Bn in 2008**
Cost of launching an NCE continues to rise

<table>
<thead>
<tr>
<th>Industry (n=20) $M</th>
<th>25th percentile</th>
<th>75th percentile</th>
<th>Average</th>
<th>Standard deviation</th>
<th>Standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>782</td>
<td>1235</td>
<td>1064</td>
<td>311</td>
<td>70</td>
</tr>
</tbody>
</table>

Source: CMR International © THOMSON REUTERS
Pharmaceutical Industry Facts

- Revenues from approved drugs (1 of 5 to 10,000) must cover the “dry holes” of non approved compounds.
- Average cost of bringing a drug to market is 1000 million dollars.
- Average approval time is 12 to 15 years.
- Time to recoup investment is shrinking- generic drugs and limited patent life.
Pharma Industry: Innovators vs. Generics

Generic

Innovator

Except BQ

Pharma Industry: Innovators vs. Generics

Generic

Innovator

Except BQ
Pharmaceutical Industry Facts Generics

- High competition
- Price Pressure
- Short product lifecycle
- Same regulatory requirements
Pharmaceutical Industry Facts: Generics

Cetirizine Generic Price Decline

Source: Wavedata
R&D for Pharmaceuticals and Other Industries (% of Sales)

- Research-based Pharmaceutical Companies*: 20.8%
  - Industrial Sector Comparison:
    - Drugs and Medicine*: 12.0%
    - Office Equipment and Services: 7.6%
    - Electrical and Electronics: 6.0%
    - Telecommunications: 5.1%
    - Leisure Time Products: 4.9%
    - Automotive: 4.1%
    - Aerospace and Defense: 3.7%
    - Metals and Mining: 0.9%
    - Paper and Forest Products: 0.9%

*“Research-based Pharmaceutical Companies” Based on Ethical Pharmaceutical Sales and Ethical Pharmaceuticals R&D Only as Tabulated by PhRMA; “Drugs and Medicine” Sector as Tabulated by Standard & Poor’s Compustat, a Division of McGraw-Hill

Source: PhRMA, 1999, Based on Data From PhRMA Annual Survey and Standard & Poor’s Compustat, a Division of McGraw-Hill
Compound Success Rates: 1 in 10,000 Reach FDA Approval

Discovery (2–10 Years)

Preclinical Testing
Laboratory and Animal Testing

Phase I
20–80 Healthy Volunteers Used to Determine Safety and Dosage

Phase II
100–300 Patient Volunteers Used to Look for Efficacy and Side Effects

Phase III
1,000–5,000 Patient Volunteers Used to Monitor Adverse Reactions to Long-term Use

FDA Review/Approval

Additional Postmarketing Testing

Compound Success Rates by Stage

5,000–10,000 Screened

250 Enter Preclinical Testing

5 Enter Clinical Testing

1 Approved by the FDA

Source: PhRMA, Based on Data From the Tufts Center for the Study of Drug Development, 1995
## Top 10 Therapies - sales in 2008 (US$Bn)

<table>
<thead>
<tr>
<th>Therapy</th>
<th>2008 sales</th>
<th>% share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oncology agents</td>
<td>45.8</td>
<td>6.4</td>
</tr>
<tr>
<td>Lipid regulators</td>
<td>34.2</td>
<td>4.8</td>
</tr>
<tr>
<td>Respiratory agents</td>
<td>30.7</td>
<td>4.3</td>
</tr>
<tr>
<td>Acid pump inhibitors</td>
<td>26.7</td>
<td>3.8</td>
</tr>
<tr>
<td>Antidiabetics</td>
<td>26.0</td>
<td>3.7</td>
</tr>
<tr>
<td>Antipsychotics</td>
<td>22.4</td>
<td>3.1</td>
</tr>
<tr>
<td>Angiotensin antagonists</td>
<td>21.6</td>
<td>3.0</td>
</tr>
<tr>
<td>Antidepressants</td>
<td>20.4</td>
<td>2.9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>US$227.8Bn</strong></td>
<td><strong>32.1%</strong></td>
</tr>
</tbody>
</table>
Decreasing Costs

- Formularies
- Generics
- Volume discounts/mail order prescriptions
- Patient activism - e.g., AIDS/ACT UP
Drug Reimbursement Systems

- Copayments
  - income variation
  - exempted groups

- Cost-sharing

- Expenditure limits

- Positive and negative prescribing lists

- Therapeutic efficacy categories
What is the cost if pharmaceutical manufacturers did not create revolutionary drugs........
COST of Uncured Disease States

Figure 5
Prevalence, Cost, and Medicines in Development for Selected Major Diseases in the United States

<table>
<thead>
<tr>
<th>Uncured Disease</th>
<th>Approximate Annual Economic Cost ($Billions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alzheimer's Disease</td>
<td>$100.0</td>
</tr>
<tr>
<td>Arthritis</td>
<td>$54.6</td>
</tr>
<tr>
<td>Asthma</td>
<td>$6.2</td>
</tr>
<tr>
<td>Cancer</td>
<td>$107.0</td>
</tr>
<tr>
<td>Congestive Heart Failure</td>
<td>$20.2</td>
</tr>
<tr>
<td>Coronary Heart Disease</td>
<td>$95.6</td>
</tr>
<tr>
<td>Depression</td>
<td>$53.0</td>
</tr>
<tr>
<td>Diabetes</td>
<td>$98.2</td>
</tr>
<tr>
<td>Hypertensive Disease</td>
<td>$31.7</td>
</tr>
<tr>
<td>Osteoporosis</td>
<td>$13.8</td>
</tr>
<tr>
<td>Schizophrenia</td>
<td>$23.0</td>
</tr>
<tr>
<td>Stroke</td>
<td>$43.3</td>
</tr>
</tbody>
</table>

Source: Compiled by PhRMA, 2000.
The “Pay Off”……to us

- Massive contributions to health, quality of life, reduced child mortality, life expectancy
- Vaccines have eradicated major disease – smallpox; vaccines for malaria and pneumonia soon…….? 
- But costs and accessibility to healthcare are becoming major social and geopolitical issues
- And, is there something seedy about making money out of illness?
- What will happen into the future?
RISK Factors
$2.5 Billion annual sales in 2003
   - #1 arthritis and acute pain medicine outside the US
   - #2 in the US

Use >18 months will cause heart attack and stoke

Voluntarily withdraw worldwide (Sep 30, 2004)

Share price dropped from $45.07 to $33.00 (one day)

$27 billion in market cap was erased
9,650 Vioxx liability lawsuits has been filed (Dec 31, 2005)

19,100 plaintiffs has involved (Dec 31, 2005)

The company spent $285 Million in legal defense during 2005

Increase the reserve amount to $685 Million for legal fees through 2006 and 2007 (Dec 2005)

Unpredictable outcomes in lawsuits, substantial damages, fines, criminal penalties
Other Risk Factors

- Failure in developing and acquiring commercially successful products

- Failure in regulatory approval

- Competition from other products
  1) More efficiency
  2) price pressure

- Unexpected future changes in government laws and regulations
Too many companies, too few products

Molecules Losing Exclusivity in Germany and USA 2008-2015

Source: Newport Horizon Premium™ © THOMSON REUTERS
Current Trends
Arthritis
- 21% of adults (non-institutionalized) in the U.S. (2003)

Cancer
- 23 million suffering worldwide. Estimated of 1.37 million people in the US were diagnosed with cancer in 2005
- about 1 in 3 lifetime risk; 38% of women and 43% of men
- The average cost of cancer treatment is well over $100,000 per person.
- Estimated $280 billion spent on treatment drugs for cancer annually. More than $100 Billions in US

Diabetes
- Estimated 18.2 million people in the United States, or 6.3% of the population (2005)
- 165 million cases worldwide (2003)
- $132 billion spent in direct and indirect costs in America (2002)

Heart Disease
- 25 million adults in the US
US NCE Approvals 2001-2007

Source: Newport Horizon Premium™ © THOMSON REUTERS
Current pipeline activity looks to continue the trend

![Bar chart showing pipeline activity in Phase III, Pre-Registration, and Registered stages for US and Germany.]

Source: Thomson Pharma © THOMSON REUTERS
It includes many job opportunities of pharmacists:

- Drug discovery
- Manufacturing
- Marketing
- Medical information
- Product development
- Quality assurance
- Training & development

- Sales
- Regulatory
- Project management
- Health outcomes research
- Legal (e.g. IP)
- Information technology
- Scientific communications
Jobs Opportunities in Pharmaceutical Industry

It includes many job opportunities of pharmacists:

- Patience
- Attention to detail
- Decisiveness
- Independence
- Excellent IT skills
- Numerical skills
- Analytical skills
- Teamworking skills
- Languages
Jobs Opportunities in Pharmaceutical Industry

Solution selling

- Focus on other party problems
- Be solution to the problems
- No problems by yourself
thank you!