Psychopharmaceuticals Patent Analysis

For

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Abstract

Psychopharmaceutical drugs and related areas of medicine have seen rapid growth during recent years. The reason for this growth is due to the increase in drugs prescribed to treat anxiety, bipolar disorder, sleep disorders etc. In this project, we experimented with several analysis and visualization techniques on Psychopharmaceuticals and related them to the United States patent (USPTO) documents to support various knowledge tasks. This research presents results on the basic analysis of Psychopharmaceutical patents between 1976 and 2007 and citation network analysis. The data has been obtained on individual countries, institutions and technology from the USPTO website. The results demonstrate the potential of information-based discovery and visualization technologies to capture knowledge regarding Psychopharmaceutical performance, transfer of knowledge and trends of development through analyzing the patents.

Objectives

The main objective of this research project is to extract information from the US Patent Office and assess the research and development status of Psychopharmaceuticals. We are also hoping to analyze the growth of Psychopharmaceutical sub-fields, identify interesting historical trends, and the influence of people, countries, and companies relating to Psychopharmaceuticals research and development from 1976 to 2007. We decided to conduct research in this field primarily due to the recent advances in detecting neural activity. After this information is attained, we are hoping to determine which countries in the world are the leading contributors of patented drugs used to treat mental health disorders.

In order to perform this task, we will have to extract relevant information from the Patent Office, and restructure it into our own database. This will allow us to perform a very informative and detailed analysis of the number of patents contributed per country, and which patent information is most useful to other countries. More specifically, we are looking to figure out what countries are referred to/cited most within the information we gather.
Other subjects of that we are hoping to extract data is:

- Number of patents by each country each year
- Number of patents by the developing country each year
- Number of patents each year by category, such as antidepressants, hypnotics, etc.
- Number of patents per state within the US

**Introduction**

There are five major categories of Psychopharmaceuticals drugs: antipsychotics, antidepressants, mood stabilizers, stimulants, and hypnotics.

**Definition of Five Major Categories:**

Antipsychotics are types of drugs are used to treat conditions such as Bipolar Disorder or mania. There are currently two classifications of antipsychotics: first and second generation (Miller 1).

Antidepressants are medicines that are widely used to treat cases of depression, bipolar disorder, or chronic pain, and are intended to improve mood. Common examples of antidepressants include: Zoloft, Lexapro, Cymbalta, and Paxil (Friedman 1).

Hypnotics are drugs taken that are intended to induce and maintain sleep. The most familiar examples of hypnotics include “benzodiazepine agonists” (Goldberg 4).

Stimulants are drugs that are commonly used to enhance performance by stimulating the central nervous system. Common examples of stimulants include: caffeine, ephedrine, and amphetamines (Mayoclinic 6).

Mood stabilizers are psychiatric medicines that may be used to personality disorders, such as Bipolar Disorder. Common examples of mood stabilizers include: lithium carbonate, Depakote, and Lamictal (Ballis 3).
Literary Review

Numerous articles were used to research this project and each of the separate categories of Psychopharmaceutical drugs. Below is a list of the four of the publications we used, and a brief description of each:


This publication gave a background as to how our final paper should be modeled for a patent analysis research paper.


This article gave a background of people living with depression in the United States. It explained side effects of depression, and gave examples of medications that can be used to treat the clinically depressed.


This article gave background information regarding stimulants, and the various effects that these drugs may have on the body.


This article gave background information regarding the diagnosis of Bipolar Disorder, and how types of mood stabilizers and antidepressants and mood stabilizing drugs are used for treatment.

Data Sources

All of the data that was used in this project came directly from The United States Patent and Trademark Office (USTPO). The USPTO website is located at www.uspto.gov.
After extracting the data, we filtered and parsed it and stored it in MySQL database and performed extensive analysis on the data using query, and other methods.

The 5 key words that we have used for extraction of the patents are shown in the table, along with the number of patents extracted.

<table>
<thead>
<tr>
<th>Key word</th>
<th>No: of Patents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antipsychotics</td>
<td>1925</td>
</tr>
<tr>
<td>Antidepressants</td>
<td>5018</td>
</tr>
<tr>
<td>Hypnotics</td>
<td>2640</td>
</tr>
<tr>
<td>Stimulants</td>
<td>5283</td>
</tr>
<tr>
<td>Mood stabilizers</td>
<td>50</td>
</tr>
</tbody>
</table>

We choose these keywords upon extensive research on Psychopharmaceuticals in journals of Psychiatry. And stored in the database in the following format.

Database Design (USPTO)
Analysis

The intent of the initial analysis was to analyze Psychopharmaceuticals patent data on both at small and large scale from 1976-2007. The graph to the left illustrates the total number of psycho pharmaceutical patents issued during this time frame. It is apparent that the US is the world leader with followed by Germany and Canada. With this information in mind, we decided to analyze the Top 10 countries further. Since 1976 the United States has produced 1,516 patents, followed by France with 141, and Great Britain with 129, making up 65.20%, 6.06%, and 5.55% of the total patents issued respectively. The table below gives the approximate number of patents issues, and the likewise percentage of the total patents issued of top ten countries.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Patents</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>United States</td>
<td>1516</td>
<td>65.20%</td>
</tr>
<tr>
<td>2</td>
<td>France</td>
<td>141</td>
<td>6.06%</td>
</tr>
<tr>
<td>3</td>
<td>Great Britain</td>
<td>129</td>
<td>5.55%</td>
</tr>
<tr>
<td>4</td>
<td>Germany</td>
<td>111</td>
<td>4.77%</td>
</tr>
<tr>
<td>5</td>
<td>Japan</td>
<td>107</td>
<td>4.60%</td>
</tr>
<tr>
<td>6</td>
<td>Denmark</td>
<td>74</td>
<td>3.18%</td>
</tr>
<tr>
<td>7</td>
<td>Canada</td>
<td>34</td>
<td>1.46%</td>
</tr>
<tr>
<td>8</td>
<td>Switzerland</td>
<td>29</td>
<td>1.25%</td>
</tr>
<tr>
<td>9</td>
<td>Italy</td>
<td>26</td>
<td>1.12%</td>
</tr>
<tr>
<td>10</td>
<td>Sweden</td>
<td>25</td>
<td>1.08%</td>
</tr>
</tbody>
</table>
With that information in mind, we also wanted to assess patent data within the United States. We were determined to configure the leading patent issuers, and found that New Jersey, New York, and California were the leaders in this field.

Since 1976, New Jersey has produced 383 patents, New York has produced 217 patents, and California has produced 148. These three states make up 25.2%, 14.31%, and 9.76% respectively.

**Assignee Analysis**

Our further analysis was on overall top assignees for the patents. We have done this analysis in two ways; both including and excluding the United States. Hoechst-Roussel is the leading patent producer in global assignees followed by Neurogen Corp. and Merck & Co.

In the non-United States assignees Novo Nordisk corp. is the leading followed by John Wyeth & Brother, Ltd.
Yearly Analysis

After the initial analysis we were focused on historical trends of the patents. So, we consider starting off with number of patents per country per year. The United States is the leading producer and followed by Germany and Japan. Considering the US historical trends there was large growth in this area during late 90’s and early 00’s since highest number of patents were filed during this period. Even for Germany this trend applies. From the graph we can say this area got more recognized in late 90’s.

Next we considered units as assignees that are number of patents per year per assignee. From the graph we see that Hoechst-Roussel is the leader and during 1992 to 1998, as they filed many patents. We can also see that there was gradual increase in filing of patents in from 1992-1998, as all top assignees have most number of patents filed during that particular time frame.
Technology Analysis

Antidepressants

To analyze further we first decided to determine the top company assignees for each of the five categories; antidepressants, antipsychotics, hypnotics, mood stabilizers, and stimulants. In the antidepressant field, Hoechst-Roussel Pharmaceuticals was the leader with 58 patents, followed by Pfizer Inc with 50 patents, and Eli Lilly with 48 patents. These three companies respectively produced 16.91%, 14.58%, and 13.99% of total antidepressant patents issued during the time frame of 1976-2007. We next decided to analyze antidepressant patents by year by country. The top five countries producing antidepressants were: The United States, Germany, England, Japan, and France. Over this time period the United States has been the leading producer, and saw strong growth between 2002-2006. In fact in 2006, over 70 patents were issued alone; there was however, a slight decline in 2007. The remaining countries have remained produced a relatively similar number of patents each under 10 per year. In 1989, Germany was the only non-US country to produce over ten patents in a year.

Antipsychotics

In the antipsychotic field, The US companies, Neurogen Corporation, Hoechst-Roussel Pharmaceuticals, and Warner-Lambert Company were the top producers. Neurogen produced 53 patents, followed by 34 from Hoechst-Roussel, and Warner-Lambert with
31. These companies respectively contributed 24.65%, 15.81%, and 14.42% of the total antipsychotic patents issued.

**Hypnotics**

In the hypnotic category, American Home Products Corp, Warner-Lambert Company, and Hoechst-Roussel Pharmaceuticals were the top assignees. American Home Products and Warner-Lambert each produced 18 patents, followed by Hoechst-Roussel with 17. These companies produced 16.51% and 15.60% of the total hypnotic patents issued. The top five hypnotic patent producing countries from 1876-2007 was: The United States, Germany, England, Japan, and France. The US has produced the greatest number of hypnotic patents issued, however has not had any consistent growth. The number of patents produced has been very volatile, and has provided extreme highs followed by extreme lows. In 2006, the US produced a record high number of patents at 14. No other country has been as nearly as successful, with each country producing on average less than two patents per year.
Mood Stabilizers

Hoechst-Roussel Pharmaceuticals was the leading patent producer, followed by American Hoechst Corporation, and Elan Pharmaceuticals International. These companies respectively produced 24, 13, and 12 patents, making up 25.81%, 13.98%, and 12.90% of the total mood stabilizer patents issued over this time frame. The leading countries producing mood stabilizer patents were: France, Japan, England, Germany, and The United States. This field is very competitive, as each country has had similar trends in both growth and decline over time. It is also the only category where the United States is not the leader in total patents issued. 2006 has thus been the top year for total mood stabilizer patents issued.

Stimulants
The top stimulant assignees are Novo Nordisk, Hoechst Roussel Pharmaceuticals, and Pfizer Inc. These companies have respectively produced 31, 24, and 24 total patents, making up 19.87% and 15.38% of the total stimulant patents issued from 1976-2007. The top five countries producing stimulant patents are: The United States, Germany, England, Japan and France. 1976 was the United States’ highest producing year, with a total of 20 patents issued. No other country has been as nearly able to produce as many patents, with each country producing less than five totals per year.

**Citation Network Analysis**

A large amount of important information and knowledge is embedded in patent citations. Our group has computed and summarized the citation information for different analytical units: countries, institutions and technology fields. Based on such citation information, we applied existing network drawing algorithms to generate a visual network of patent citation. Such a network can be used to visually present the transfer of knowledge among different patents. The citation networks presented in this section are derived from the entire set of patents in the data set, which covers Psychopharmaceuticals -related patents from 1976 to 2007. The networks presented in this section are generated by an open source graph drawing software, NET DRAW

**Country citation**

The Psychopharmaceuticals -related patent citation networks among countries are presented in this section. The most complete citation network among countries is presented in the Figures below. Due to complexity of the diagram our group just considered top 30 countries in our database.

In this section we covered two types of citation network one with United States and one without United States. Following are observations from the citation network.
- United States (US) dominated most of the citations and the US patents intensively interacted with patents of most of the other countries.
- Japan (JP) and Ireland are leading countries whose patents have interacted with patents of United States.
- We can also observe from the citation network that Most of the countries patents like Great Britain, France, and Belgium etc. have cited their own country patents, which show that there is not much of interaction with regards to research between countries.
- We can also find local citation networks between Sbvenia and Hungary, Switzerland and Germany.
- In the citation network without United States we can observe that network is scattered diagram and there not much of interaction of patents between countries.

**Institution citation network**

The top 30 institutions that own the greatest number of patents in the Psychopharmaceuticals area are presented in Table. Similarly to the country citation network two levels of citation networks have been presented one with United States assignees and one without United States assignees.
Following are some of the observations from the citation network.

- We can see that not much of interaction of the patent research is taking place, so it is a scattered diagram.
- There are many local networks and most they are citing themselves.
- Patents of Neurogen, Eli Lily and sepracor corp. form a local network. And in United States Neurogen is the largest in patent producer.
- Outside United States Elan Phrama Corp patents have largely cited by University of Rochester.

Lessons Learned

Overall, the patent analysis project was a very interesting and informational. We became very knowledgeable with regards to the growth of the separate Psychopharmaceutical categories. We found that the most difficulty came with extracting patents on the “mood stimulants” category. This was difficult because it is a relatively new term, and is a hybrid of the other four categories, therefore only providing 50 patents since 1976. We also noticed that there were very few co-author pharmaceuticals as well.
References


http://www.sleepfoundation.org/site/c.hUI[XKjM0lxF/b.2421169/k.2494/Sleep_Aids__All_You_Ever_Wanted_to_Knowbut_Were_Too_Tired_to_Ask.htm, May 2008.


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