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Impact of Social Media on Pharmaceutical Manufacturer

Tarun*

Analytics and Insights, Tata Consultancy Services, Bangalore, Karnataka, India; tarun.3@tcs.com

Abstract

Now a days, manufacturers in this competitive market are fighting to stay ahead in the race whether they have already launched a product, product is in the market, launching a new product or it is still in a development phase to find out the people's demand. Social media is the platform for everyone now a days to track the activities online and the taste and preferences of the people can be tracked. Likewise the drug manufacturers are also pitching in social media to know about the side effects of the drugs when the drug will come to the market. Even though, they already tested the drug for any side effects but they are keen to know about the genuine feelings of consumers, which are shared on social media, about their drug. This paper delineate the side effects of drugs which are being used by the patients for any particular disorder where we have attempted to capture and analyze the information about some unbridled ramification of these drugs with an assumption that the significant portion of people who are under-treatment have acknowledged their genuine feelings. We have applied sentiment analysis followed by exploratory data analysis by taking non structured reviews into consideration. We have generated a word cloud of side effects which people had mentioned in their reviews. It emphasizes on the side effects of the anti-depressant medication and how they impact the human body. The analysis is very helpful to drug manufacturers as they can understand the genuine feelings of consumers and they can change or modify the drug accordingly.

Keywords: Analytics, Anti-depression, Drugs, Manufacturing, Sentiment, Text Analytics

1. Introduction

In the recent years there is an increasing trend in the drug prescription for the treatment of mental disorders i.e. depression. People generally take multiple medicines in order to normalize the level of their depression such as anxiety, sleep deprivation, loss of interest, anger, energy loss and etc. Below are some of the interesting facts shows the increment in the depression patients published by National health and nutrition examination survey [1,2]:

- Around 70% of the Americans are dependent on prescribed medicines which is highest as ever.
- Prozac is getting famous in American teenagers and adults as they are having it and besides that the other anti-depressant drugs such as Celexa, Effexor, Paxil and Zoloft are being used in astounding numbers.
- 23% of the women use anti-depressant in their 40's and 50's which is highest among the other age group.
- Women are 2½ times more likely to be taking an antidepressant than men.
- 14% of non-Hispanic white people take antidepressants compared with just 4% of non-Hispanic blacks and 3% of Mexican Americans.
- Antidepressant use does not vary by income status. All the drugs available in the market these days in order to treat depression have some or a few life threatening side effects. It is resilient to pick out chemical combinations responsible for a new symptom. Before a new drug enter into the market, it has to pass through certain level of tests and the success or failure of a particular drug may vary from a small group to the entire population. There are some side effects which are published by the manufacturer according to the clinical trials tested on a small group of population. The process of clinical trial of a particular drug is very short which can also give best results to the people who are involved in the process, but it may lead to the wrong conclusions in the later stage when the drug hits the market and doctors start to prescribe it to the population. In the recent years many anti-depressant has been banned from the market such as Seroxat, Prozac nation etc. and government warned people

*Author for correspondence

not to opt for these medicine at least for certain age group of people. There are many programs where the prescription is monitored on regular basis just to make sure of their health and the safety of usage of the drug[3].

Some of the side effects are based on personal experiences of individuals which is exactly the attraction of our research i.e. to gather an information related to the side effects of a particular drug via Social media[4]. It has been proven that Social Media is the most widely used platform where people are leveraged to articulate their minds and emotions which will help others i.e. manufacturers to build a decision. Anyone now a days can be a part of social media to pen down or access information on anything under the sun. Pharmaceutical manufacturers are pitching in web to collect information which is mostly in the form in comment provided by the customer on a particular medicine, forums or direct chat[5]. User provided reviews are very much helpful for the pharmaceutical manufacturers to get a clear picture to their decision process. There are many methods i.e. statistical and linguistic (for example first logical order) which have been applied to the large dataset of consumer reviews or another valuable information i.e. rating and etc. to reach to various analysis. Since people are writing reviews on their feeling after taking the medications, an advantage is taken of the huge amount of information flowing on the web by accessing it via social media platforms and tried to find out the different side effects of the drugs on the different age group[6].

In this paper, a solution is proposed which will help to identify the different sorts of side effects in the people after having the anti-depressant drugs and it will help the pharmaceutical manufacturers to identify the combination of drugs, having more side effects, and they can change the chemical combination accordingly to reduce the side effects. For the analysis, the main problem was to find out the side effects caused by the particular chemical composition. An effort was put in the area of text analytics and tried to focus on those side effects corresponding to the chemical combination. A particular drug is never responsible for any side effects but there are different components which impacts on the human body. Our intention is to find out those components which are having an adverse effects. We have done sentiment analysis on the collected data so that the mood can be identified of an individual while writing a comment. This analysis will be a great help for pharmaceutical manufacturers in terms of providing right chemical combination, capture more market share and customer satisfaction.

The remainder of the paper is as follows: Section 2 describes the solution framework whereas Section 3 shows the numerical analysis. The results have been discussed in section 4. Finally, the paper has been concluded with future scope in section 5.

2. Solution Framework

A very few research has been cited on the side effects of drugs using the users data or company website review[7,8]. They have done the text mining to show the bad effect of drugs[3]. A few research is on unsupervised learning model to show the adverse effect of drugs[9]. In this study, we have considered much unstructured data from social media. This study considered one generic name i.e. Sertraline, which is highly prescribed medication for depression and found in many anti-depressant drugs. In order to find the side effects of the drugs, the WebMD[10] data is examined for the best results where people mention their reviews regarding health issues after taking a medications. WebMD[10] provides health news, advice and expertise. It also has a social forum where people discuss about their prescribed medicines and their side effects. The study works on an assumption that people have written the genuine comments and not intend to down-market any medicine and a particular doctor from the fraternity. The data captured consists of 6 sections i.e. the age group of the patient, the review about a drug, rating, gender and onset of the prescribed medication. This data helped us to find out some interesting insights while doing the exploratory data analysis. One of the major analysis is sentiment analysis which help us to straight away find out the reaction of a drug in a broader sense.

A methodology is proposed for this analysis which is represented in Fig 1.

Step 1. The important matrices such as the generic name of the medicine, age group, reviews, ratings, onset period and sentiment has been considered for this analysis as a major parameter to reach to any conclusion.

Step 2. Reviews were selected for a particular therapeutic class i.e. depression through Twitter search API with select keywords using certain filters. The first filter was selected as an anti-depressant medications where the second filter was for a particular drug.

Step 3. This step includes the deep down analysis of the extracted data. The side effects with the help of sentiment analysis and the word cloud has been identified. The motivation behind extracting the dataset on depression was to find out the side effects of the anti-depressant medication so that the frequent side effects could be concluded in the study.

Step 4. A study is done chemical composition of the medicines which are creating side effects in the human body so that the chemical combination can be analyzed in other widely used drug.

Step 5.A classification model was fit to approach the data initially to know the relationship between the different parameters and the corresponding sentiments.

R and Tableau are the tools used in the analysis. R is a highly competitive open source object oriented programming language and R studio open source integrated environment is used whereas Tableau is commercial visualization tool which has the capacity to build highly interactive visuals with many other capabilities.

The next section will describe the numerical analysis based on the reviews of people on social media platform.

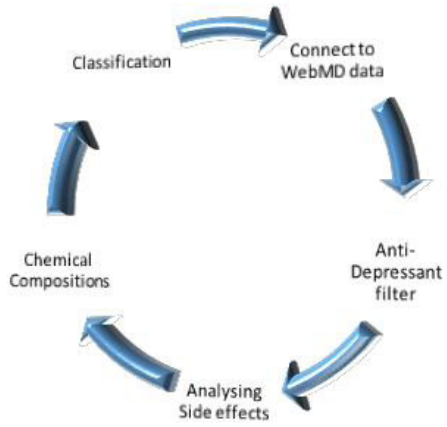

Figure 1. Methodology for sentiments.

3. Numerical Analysis

A study has been done by considering all the common side effects and the chemical combination of Sertraline in the form of a table. Sertraline is one of the famous generic name which contains Sertraline; Zoloft; Dichlorophenyl; N-methyl; 4-tetrahydronaphthalen; amine.

N-methyl as a standalone chemical can cause Diarrhea, nausea, trembling and sexual dysfunction and etc. whereas tetrahydronaphthalen can cause sweating, blue-yellow blindness, painful and difficult urination, swollen glands and fruit like breathing odor. The solution framework out of this problem can be approached by considering the chemical combination of Sertraline and every component causes some or the other side effects. All the combination was broken in different and analyzed if any particular combination was responsible for any side-effect. A study shows the result in the form of numbers. Every combination is more or less responsible for every effect on the human body. Below figure shows the intensity of every combination on particular side-effect. The scale of the color shows the same i.e. the dark zone in the picture shows the high intensity for e.g. N-Methyl causes Bladder pain more than any other combination. Similarly Amine can cause dry skin and etc. The numbers quantify an effect value. These effect value were calculated by processing text analytics on side-effects where these value shows the frequency of side effects in the reviews. The study done can help a manufacturer to identify which combination is responsible in contributing the symptom so that they can optimize their drug accordingly. A study has been done by considering all the common side effects and the chemical combination of Sertraline in the form of a table. Sertraline is one of the famous generic name which contains Sertraline; Zoloft; Dichlorophenyl; N-methyl; 4-tetrahydronaphthalen; amine.

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For predicting the sentiments from the WebMD data through other variables we have done CHAID analysis. In Fig 3, three variables are considered i.e. rating sensations, No of people who found the review helpful and rating effectiveness. To make this analysis more refined, there are some assumptions given below:

Fl	Aggressi..	Bladder Pain	Blister	Breating	Changed Mood	Chest Pain	Diarrhea	Drowsine..	Dry Skin	Fever	Headache	Hives	Itching	Nausea	Nervous Disorder
Amine	4	17	12	15	18	13	16	8	20	10	16	3	6	10	4
Dicholoroph..	10	18	2	15	7	3	5	7	19	15	10	7	17	19	5
N-Methyl	16	20	4	16	10	14	11	14	6	6	20	14	10	18	16
Sertraline	2	12	10	3	12	5	18	8	14	2	3	8	13	9	8
Tetrahydron..	9	13	2	4	4	20	7	4	3	18	14	14	2	14	12
Zoloft	17	10	10	3	5	2	14	8	4	4	9	2	2	4	16

Figure 2. Intensity of each chemical combination on Side-effects.

- People are writing their genuine feelings and sentiments.
- No one had tried to down market or promote any particular medicines available in the market.
- People those who are under-treatment and taking medicine have the same body type and following the doctor's advice.
- The medication have the same effect and side effects on every age group.
- People are having proper meals before taking any drug.
- Every body type is same and not having any disease.

We have also done text analysis and sentiment analysis. We have provided the word cloud to understand the more common and less common side effects among different people. We will discuss all the results in the next section.

4. Result and Discussion

The intention of the approached solution was to produce a result where the impact of social media on pharmaceutical manufacturer and the side effects from the anti-Depressant could be seen. Data was extracted from WebMD which is one of the leading website in providing information on medicine, doctors and other medical aid.

The study was initiated with exploratory data analysis by analyzing the reviews and applied sentiment analysis on the same to make manufacturer understand the combination in details to make the drugs better. In Fig 4 the dispersion of sentiments of the people who are prescribed with anti-depressant pill is mentioned.

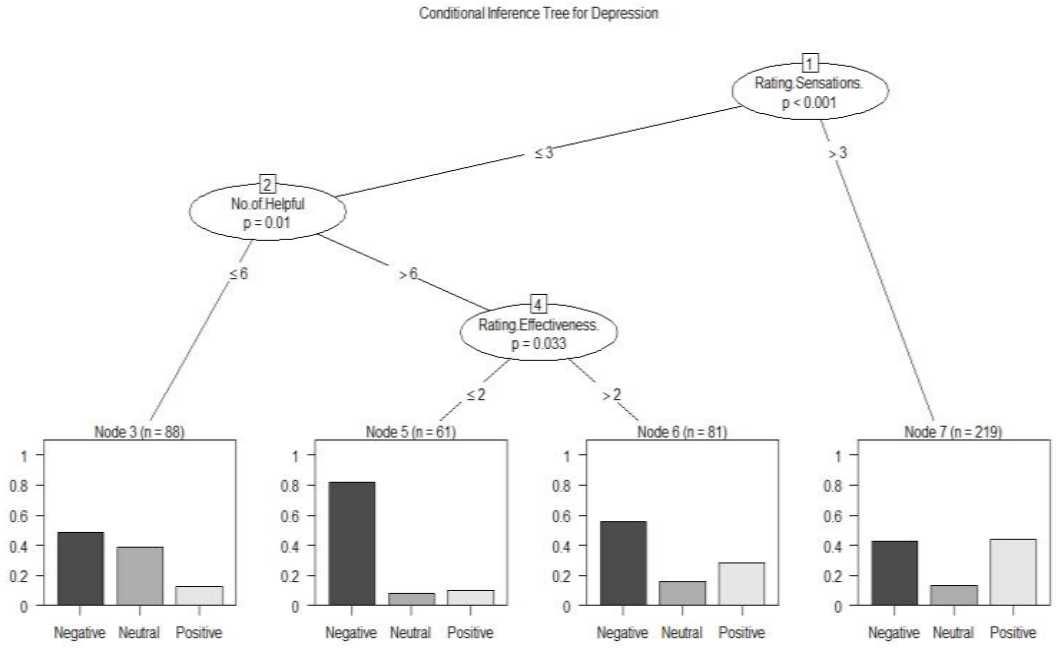

Figure 3. Tree Based Model.

Major segment is not happy with these prescription as 51.45% are having negative views on it whereas 30.51% are happily consuming these drugs and we can assume that they are finding it useful.

Similarly Fig 5 shows the onset period with the polarity as it is visible that negative are more than positive in every onset date which means that it mostly produces a side effect. Apparently in Fig 5, it is analyzed that negative sentiments are more than positive sentiments in every onset. In less than one month, positive sentiments are 7.57% with 12.69% negative. Similarly in less than 6 months, positive sentiments are 9.13% with 13.14% of negative sentiments. It is visible that people find some relief initially when they are prescribed with any anti-depressant drug but eventually it affects people when they continue it for years as percentage of positives are curtailing down with increased onset date.

The sentiments have also been analyzed through CHAID analysis in Fig 3 which is helpful for pharmaceutical manufacturer to identify the distribution of sentiments by incorporating the other variables i.e. ease of use, Helpful, effectiveness and sensations. According to Fig 3, If the rating sensation is less than equals to 3 then it will jump to No. of helpful and if the rating is less than equals to 6 then the result will be Node 3 i.e. Negative will rise followed by neutral and positive but if the score is more than 6 then it will move to rating effectiveness and if the rating in effectiveness is less than equals to 2, then result will move to Node 5 and Negative will rise even more, neutral will curtail and positive remains same as it was in Node 3. The value of positive and neutral is increased unlike negative in Node 6 as the rating effectiveness is more than 2. Node 7 shows the straight answer i.e. Positive is more than negative and

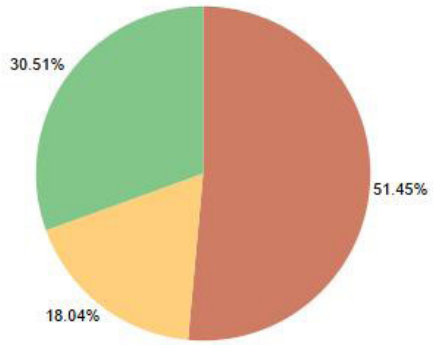

Figure 4. Distribution of sentiments.

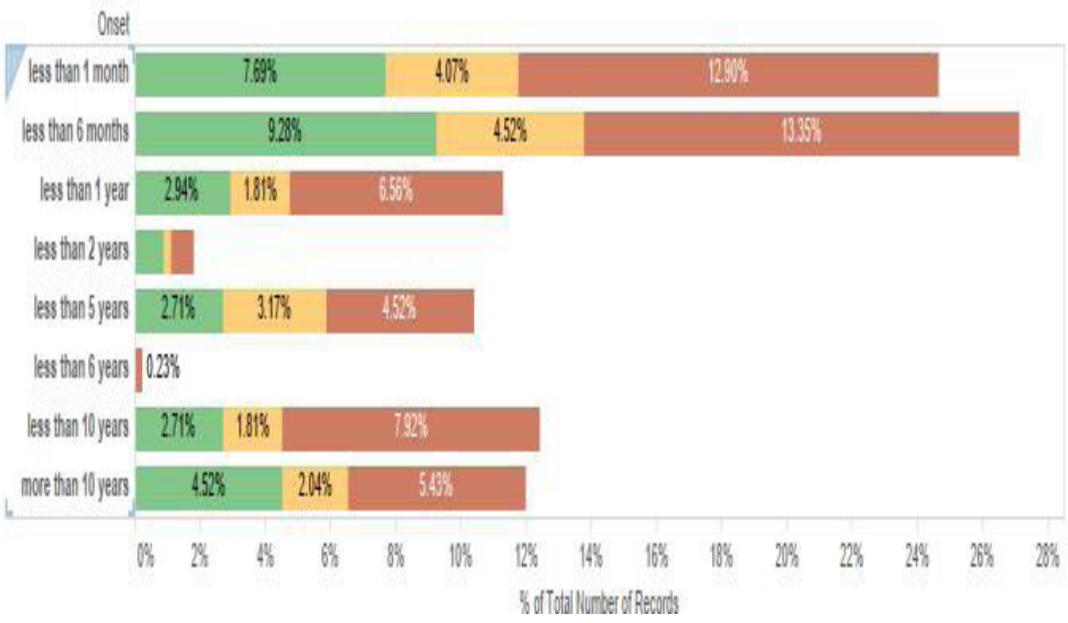

Figure 5. Onset with the polarity.

neutral where the rating sensation is more than 3. It means that all the variables contains some significant relationship with each other and sentiments are highly impacted by the ratings. We have done the analysis on the overall sentiments of consumers. The social media data has been further analyzed on the basis of other variables like ease of use, effectiveness and sensations.

The study was initiated by taking one generic name Sertraline which is widely prescribed by the doctors to the new or old patients. Since Sertraline is very famous, effort was put in the direction to find out "why people prefer this?" and considered 3 parameters i.e. ease of use, effectiveness and sensations where people had rated on the scale of 1 to 5. Fig 6 shows that Sertraline is easy to use and it is rated as 4.3/5 with low sensations i.e. 3.5. This study will help the pharmaceutical manufacturer to manufacture of drugs with such a chemical combination which is easy to use with less sensations.

Another focus of this study is to find out the side effects of Sertraline which is a generic name and the word cloud was generated based on the reviews from WebMD website. Fig 7 below shows the more common side effects in the people after consuming sertraline such as unusual behavior, mood change, skin rash, diarrhea, difficulty with breathing, chest pain and etc. The size here show the frequency of these side effects in out term document matrix. On the contrary there are some less common side effects shown in Fig 8, such as unusual facial movements or postures, weight gain, hair loss, Dyspepsia, bloating, Overactive reflexes, thirst confusion, blurred vision etc.

This above in-depth analysis proves that there are some chemical combination like Amine, N-Methyl, Sertraline, and Zoloft etc. which impacts human body differently in the form of sweating, headache, dry throat and mouth, Anxiety etc. also the polarity of people are measured with the help of sentiment analy-

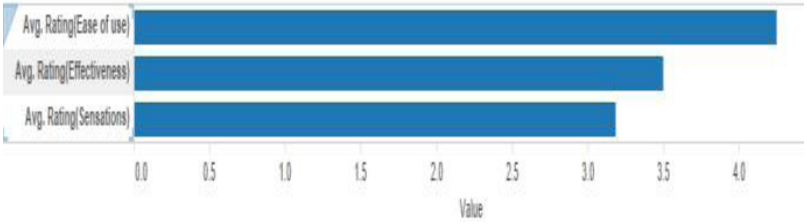

Figure 6. Average rating of Sertraline.

Figure 7. More Common Side effects.

Figure 8. Less Common Side effects.

sis where it was identified that majority of the people aren't happy with drug consumption whereas the polarity changes when the onset time increases to 1 year, 5 year or more than 10 years. Also the ratings were aggregated and concluded that these drugs are easy to use, but the effectiveness and sensations are less. The side-effects were categorized in more common and less common i.e. unusual behavior, sores, welting, blisters, skin rash hives or itching and dizziness, nervousness, dryness or mouth, sweating, aggression respectively.

5. Conclusion

The work we have done basically shows the power of social media and how it affects positively on manufacturers and people as to stay ahead of the curve in this competitive market, one should understand the demand of the market be it a consumer goods like mobile, car etc. Social media channels provides the platform to the manufacturer to analyze the demand of the market for manufacturing the next gen products by eradicate the error and challenges in the previous versions. In this study we can conclude that depression is rapidly increasing in the society in all the age groups and comparatively females are using more anti-depressant drugs than men. The side-effects of Sertraline (Generic Name) has been mentioned in the form of word cloud and also the study was drilled down in terms of its chemical compositions where many side-effect were noticed. There are variation in people's sentiments and most of the people are talking negative about Sertraline.

This work is just a preliminary demonstration of how Social media has impacted the pharmaceutical manufacturer and people now share a same bridge to discuss about their prescription and feeling after taking medications. The targeted patients are suffering from depression and shared their experiences on WebMD which is a leading website for providing information on different medical aspects.

The side effects are shown which helped pharmaceutical manufacturer to understand the customer context behind consumption and conversation about the product. The study suggested to pharmaceutical manufacturer that which chemical combination should be preferred for anti-depressant drugs.

By plugging in various factors i.e. Ease of use, effectiveness and sensations, we can predict social media activity. It helps in deciding what to choose and what it can cause.

In future this study will not decipher the impact of any medicine for depressed but will deep dive into other social media platform like Facebook, twitter, instagram and etc. The text and the image what people write and post has got the power to show the internal polarity of a human being. The study in future will analyze the text of individuals and predict the depression rate with the help of social media which will help pharmaceutical brands to manufacture perfect combination of drugs for different segments of people.

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