UFMDRA: Uterine Fibroid Medicinal Drugs Review Analysis

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Abstract: Nowadays, enormous reviews are posted online by the consumers which provide related and required knowledge to the similar consumers. Such information is very much crucial for decision making and hence trendy among the web users. This information is very essential not only for potential consumers to make decisions but also for forecasting success and sustainability in commercial businesses. Online reviews on medicinal drugs are important for patients, medical representatives and medical industries. Reviewing medicinal drugs is challenging as sentiment analysis provides very little opportunity to discuss it. Collecting the reviews for uterine fibroid medicines from websites and analysing is a challenging process. An efficient Uterine Fibroid Medicinal Drugs Review Analysis (UFMDRA) model is developed with a decision tree algorithm which is trained and tested for different split ratios to obtain 100% accuracy. Experimental analysis results show that the proposed model has better classification performance in terms of accuracy compared to other classifiers.

Keywords: Decision Tree; Medicinal Drugs; Pre-processing; Review Analysis; Uterine Fibroid.

1. Introduction

Most of the women suffer from problems of uterine fibroids which are non-cancerous tumors present around the uterus commonly found in the female pelvis. Presence of these fibroids ranges between 3.3 and 77% and varies with age. Fibroids are very common in childbearing women. The study conducted between July 2015 and August 2017, in a private hospital in the city suburbs, found that 11.6 % of the 4,487 women who visited the gynaecology outpatient department had uterine fibroids [1]. By the age of 50 most of the women have fibroids and underage of 20 [2] fibroids are rare. Studies suggest that this disease affected 60% of reproductive-aged women and during their lifetime 80% of women develop this disease [3, 4].

Fibroids can develop anywhere in the uterus and are classified according to their source of development. Myometrial/ Intramural Fibroids develop in and around the wall of the uterus.
Submucosal Fibroids grow under the surface of the uterine lining. Subserosal Fibroids grow exactly below the external layer of the uterus. Pedunculated Fibroids develop on a long stalk on the external and internal layer of the uterus.

The exact cause of fibroid development is still unidentified and believed to be caused due to a hormone named estrogen. Other reasons that are responsible for uterine fibroid can be age, obesity, eating habits and family history. Also, most of the time it is difficult to detect uterine fibroids through some symptoms unless physical examination is done. Fibroids get shrunk and show no symptoms for the women who are in menopause state. According to a recent study, fibroids shrink in women during premenopausal state also and an already existing fibroid doesn’t increase the threat of developing a cancerous fibroid. Chances of getting other types of cancer in the uterus are also minimal if a woman already has fibroid. Fibroids can be cured by medicines but still in some cases where medication is ineffective, surgery is advised by the doctors. Various surgical procedures can be outlined as Hysterectomy, Myomectomy, Hysteroscopic resection of fibroids, Hysteroscopic morcellation of fibroids.

Doctors prescribe medicines such as Tranexamic Acid, Lupron, Ullipstical, Ulipristal Acetate, Anti–inflammatory medicines such as ibufren, contraceptive pills and gonadotropin for the symptoms and/or shrink of fibroids. People bearing uterine fibroids who consume these medicines may have various side effects. Depending upon their experiences people write their feedback/reviews online on these medicinal drugs. These reviews can be used by other patients who have been prescribed the same medicines to make up their minds about it. Also, these reviews are helpful to pharmaceutical companies and doctors who prescribed those drugs. Reviews are given in terms of comments where the users write their experiences after taking the drug and give some points as rating. But it is observed that sometimes ratings given by users contrast with the comments given by the same users. Therefore, Sentiment Analysis is necessary to find the exact meaning of comments where the comments can be categorized as positive, negative or neutral depending on its sentiment.

Two drugs Tranexamic acid and Lupron have been used in this paper for analysis of user reviews. Different machine learning models are used to classify which drug is best from the users’ perspective. Drug reviews are scraped and collected in comma separated value (csv) format along with ratings provided by the users. Comments of medicine consumers are classified as positive, negative or neutral.

This paper is structured in the following way: Section 2 describes related work, section 3 explains the motivation behind the presented work, the system design and implementation is presented in section 4, obtained results are shown in section 5 and section 6 summarizes the paper.

2. Related Work

Review analysis in recent years has not provided much information about uterine fibroid medicinal drugs so it is a challenge to analyse its reviews. Recent investigations on medicinal drug reviews recommend that online reviews and blogs are vital sources of information for sufferers, distributors and healthcare professionals. The main challenge is extracting the related
particulars about medicinal drugs from the online sources and investigating them. An ensemble of W-Bayesian Logistic Regression and Support Vector Machine (W-LRSVM) model is proposed by Asha S Manek et. al., to perform review analysis on medicinal drugs [5]. The W-LRSVM model collects the information from the web by using a web crawler. The model was trained by collecting reviews from drug.com for 5 drugs - Escitalopram, Citalopram, Lisinopril, Oxycodone and Lyrica. Lisinopril is used to regulate blood pressure, Citalopram and Escitalopram is used for depression; Oxycodone drug is used to treat severe pain whereas Lyrica drug is for neuropathic pain. The W-LRSVM model outperformed with 97.46% accuracy after training it for different split ratios.

Nowadays, consumers are benefited with online reviews posted on the Web which provides required information highly essential for decision making. This valuable information is important for eventual customers as well as for anticipating benefits and improvement in business. However, in spite of availability of various algorithms, there is no particular method that can provide a solution for analysis of the sentiments. In paper [6], authors proposed a Support Vector Machine (SVM) classification approach for analysis of large movie review data set. The results showed classification performance in terms of reduced error rate and accuracy using Gini Index based feature selection method.

Xuan, J., et al., in paper [7] analysed 328 medical literature of uterine fibroid treatment carried out on western medicines that primarily included leuprolide (GnRH-a), danazol (androgen), gestrinone (progesterone), mifepristone (progesterone receptor antagonist) and other medicines. The collected literature data of uterine fibroid were reviewed and established that the western medicines were used in circumstances like (i) patients having uterine fibroids without symptoms; (ii) patients having normal menstrual cycle of 22–34 days; (iii) patients aged between 25 and 49 years; (iv) patients having uterine of size less than ten weeks of pregnancy, tumour diameter between 2 cm and 5 cm and patients without menopause were also considered. This paper literature observed that among the 328 selected medical literature reports, there were 52 cases (15.9%) of leuprorelin, 60 cases (18.4%) of danazol, 44 cases (13.4%) of gestrinone, and 78 cases (23.8%) of mifepristone. Authors have used data mining technology to examine the prescriptions for uterine fibroids treatment in recent 15 years. The different combinations of drugs, frequency of drug and other prescriptions for the treatment of uterine fibroids were also examined.

Han, Y., Liu and M. and Jing, W., performed aspect-level drug review sentiment analysis by proposing a data set SentiDrugs that contains one or more targets. A proposed Pretraining and Multitask Learning model based on Double BiGRU (PM-DBiGRU) in which the pretrained weight is used to initialize related weight. The target-specific aspect-level drug review is represented by applying two BiGRU networks. Further, the domain knowledge is transferred from the short text-level drug review data set. The PM-DBiGRU model verifies that bidirectional semantic information of target plays an important role for classification of sentiment polarity in drug reviews and domain knowledge improves the aspect-level classification performance [8].

Vijayaraghavan, S. and Basu, D., analyzed reviews of various drugs which have been reviewed in form of texts and have also been given a rating on a scale from 1-10. The proposed system
obtained the data set from a repository of UCI machine learning which had 2 data sets: train and test (split as 75-25%) to investigate the reviews for different conditions and use different words to impact the ratings of the drugs. The authors implemented supervised machine learning classification algorithms for predicting the class of the rating using the textual review by embeddings Term Frequency Inverse Document Frequency (TFIDF) and the Count Vectors (CV). The proposed model performed training on the most popular conditions such as "Birth Control", "Depression" and "Pain" within the data set [9].

3. Motivation

Review analysis identifies many applications and it is very beneficial for reading consumer mindset/ viewpoint about products/services. In the related work section, literature survey has done on quite a few issues of review analysis of medicinal drugs. In contrast, still there is a scope to enhance the opinion detection and classification performance for medicinal drugs. Most of the analysts have experimented on common domains for review analysis such as electronic gadgets, movie shows and restaurants reviews but not much on health and medicinal domains specifically on Uterine fibroid medicines. We focused to overcome this problem by developing an effective method for review analysis using uterine fibroid medicine review data sets. Several drugs are available nowadays for uterine fibroids treatment. But most of the drugs have side effects such as affecting ovary ovulation, intervention with the role of progesterone and estrogen receptor, growth of vascular endothelial in fibroid tissue and size of fibroid enlargement. The vital challenge to analyse reviews of uterine fibroid medicines by scrapping the reviews of consumers and applying proper pre-processing filters, effective code and data transformation methods. The performance of this work shows that analysis of uterine fibroid medicines reviews efficiently improved by training the proposed model with Decision Tree classifier.

4. System Design & Implementation

The proposed system for uterine fibroid medicines reviews is carried out in four steps as shown below in Figure 4.1.
4.1 Review Data Collection

The first step in the proposed system is data collection. Data collection is done from the different websites namely drugs.com, everydayhealth.com, askpatients.com and webmd.com. Scraping is used for collecting reviews and ratings from the above websites resulting in our own data set. Python BeautifulSoup is used for web scraping and a total 571 reviews have been scrapped. After scraping, the reviews are collected in a comma separated value (.csv) file to make a data set with drug name, comment given by user and ratings given by user.

4.2 Data Preprocessing

As the data set contains positive, negative and neutral reviews in the comment section and ratings given by users are also present, preprocessing is done. Preprocessing step consists of chopping up character sequence into tokens (tokenization), changing into lower cases, lemmatization, refining by removing stop words and collection of sentiment words. In the rating column missing values are taken care of by replacing with zero (0) values as such cases are very less. Valence Aware Dictionary for Sentiment Reasoning (VADER) Sentiment Analysis technique based on lexicons of sentiment words is used for the proposed system [10]. Each of the words in the lexicon is rated in terms of polarity scores that how much it is positive, negative or neutral. VADER is valence based where intensity of the sentiment is taken into account. Same sentences written in different ways might have different polarity scores that are very well taken care of by VADER. The attributes are extracted and then preprocessed to generate the final data set. The selected attributes for the proposed model is as shown in Table I.
TABLE 1: SELECTED ATTRIBUTES FROM DATA SET FOR THE PROPOSED MODEL

| drugname  | ratingSentimentLabel | cleanReview | vaderSentiment | ratingSentiment |
|-----------|----------------------|-------------|----------------|-----------------|
|           | review               | vaderReviewScore | ratings        | vaderSentimentLabel |

4.3. Data Validation

The validation of preprocessed data generally used for model construction is addressed below. The Split Validation is carried out to assess the performance of a learning operator and the data set is split into training and test. The Split Validation operator can use several types of sampling methods for building the subsets. Cross validation is used to build the proposed model which avoids the sampling bias. The various cross validation methods are k-Fold, Leave One Out Cross Validation (LOOCV), Leave One Group Out Cross Validation (LOGOCV), Nested Cross Validation, Time Series Cross Validation and many more. The proposed system is built by using k-Fold cross validation technique.

4.4. Modeling

The approach of using Machine Learning algorithms is based on the desired result of the algorithm or the type of input available during training of the model. The Machine Learning classifiers used in proposed work are Random Forest (RF), Decision Tree (DT), K-Nearest Neighbor (KNN), Logistic Regression (LR), Naïve Bayes (NB), Support Vector Machine (SVM) and Stochastic Gradient (SGD). The ensemble of Logistic Regression, Decision Tree and Support Vector Machine is also used in different ways to analyze the performance of the proposed model. Classifiers are trained on different train/test split ratios with and without tuning of hyper parameters. For k-fold cross validation, different numbers of splits are taken and analyzed to determine the performance of the model.

5. Results & Performance Analysis

Uterine Fibroid Medicinal Drugs Review Analysis (UFMDRA) model is designed using python programming and performance is evaluated by applying various classifier algorithms. Evaluation related terminology used is accuracy which is calculated by varying the split ratio from 0.7 to 0.9 and k-Fold cross validation. In the review analysis of the UFMDRA model, the terms True Negative (TN), True Positive (TP), False Negative (FN), False Positive (FP) compare results of the algorithms used. Positive and Negative refers to the algorithms prediction while True and False indicates the prediction made respective to the observation.

First the reviews are collected from drugs.com, everydayhealth.com, askpatients.com and webmd.com using the scrapping program for 2 uterine fibroid related drugs- Tranexamic acid and Lupron. The next step is to analyse the collected and preprocessed reviews. The reviews of uterine fibroid drugs given as input to the UFMDRA model and performance is compared with different combinations of classifiers depicted in Table II, III and IV.
TABLE 2: PERFORMANCE OF DIFFERENT CLASSIFIERS ON DEFAULT PARAMETERS

| Test Size | Classifiers Used | Accuracy in % |
|-----------|------------------|---------------|
|           | Random Forest (RF) | 98.25         |
|           | Decision Tree (DT) | 100           |
|           | k-Nearest Neighbor (KNN) | 94.76         |
|           | Logistic Regression (LR) | 95.34         |
|           | Naive Bayes (NB) | 98.83         |
|           | Support Vector Machine (SVM) | 94.76         |
|           | Stochastic Gradient (SGD) | 98.25         |

The data set is divided into training and testing data sets first. The proposed system is trained using the training set and the performance is evaluated in terms of accuracy for three test sizes 10%, 20% and 30% using default parameters and after tuning hyperparameters of algorithms as illustrated in Table II and Table III respectively.

TABLE 3: PERFORMANCE OF DIFFERENT CLASSIFIERS AFTER TUNING HYPER PARAMETERS

| Test Size | Classifiers Used | Accuracy in % |
|-----------|------------------|---------------|
|           | Random Forest (RF) | 99.41         |
|           | Decision Tree (DT) | 100           |
|           | k-Nearest Neighbor (KNN) | 96.51         |
|           | Logistic Regression (LR) | 99.41         |
|           | Naive Bayes (NB) | -             |
|           | Support Vector Machine (SVM) | 94.76         |
|           | Stochastic Gradient (SGD) | 100           |
|           | Random Forest (RF) | 98.27         |
|           | Decision Tree (DT) | 100           |
|           | k-Nearest Neighbor (KNN) | 98.27         |
|           | Logistic Regression (LR) | 98.27         |
|           | Naive Bayes (NB) | -             |
|           | Support Vector Machine (SVM) | 98.27         |
|           | Stochastic Gradient (SGD) | 96.55         |

Fig 5.1: Comparison of all Classifiers of various test size with Accuracy with Default Parameters
The graphical analysis of performance of all classifiers shown in fig 5.1 shows that the Decision Tree algorithm outperforms with 100% accuracy in all cases. All the classifiers have shown best results with test size of 20% with not much changes in accuracy for Random Forest Algorithm. There is an increment in accuracy if the test size increased from 10% to 20% for all classifiers but there is an decrement in accuracy if the test size increased from 20% to 30% for all classifiers except Decision Tree algorithm.

![Accuracy of Different Classifiers after Tuning Hyperparameters](image)

**Fig 5.2:** Comparison of all Classifiers of various test size with Accuracy after Tuning Hyperparameters

The graphical analysis of performance of all classifiers after tuning parameters shown in Fig 5.2 shows that the Decision Tree algorithm outperforms with 100% accuracy in all cases irrespective of test sizes. In this case also, there is an increment in accuracy if the test size increased from 10% to 20% for all classifiers but there is not much decrement in accuracy except Support Vector Machine algorithm if the test size increased from 20% to 30%. The graphical analysis shows that Decision Tree out performs with other compared classifiers on the given data set irrespective of test sizes or refinement of hyperparameters.

The reviews of uterine fibroid medicines given to the UFMRA model and performance is compared with different combinations of classifiers like Logistic Regression + KNN, Logistic Regression + SVM, KNN + SVM and Logistic Regression + KNN + SVM. The graphical analysis of performance (i.e Accuracy) is shown in Fig 4. With the ensemble of classifiers, we obtained 96.33% 94.77%, 96.33% and 94.95% for Logistic Regression + KNN, Logistic Regression + SVM, k-N + SVM and Logistic Regression + KNN + SVM classifiers respectively with k-Fold splits equals to 20 as shown in Table IV.
### Table 4: Performance of Ensembled Algorithms

| k-Fold Splits | Logistic Regression + K-Nearest Neighbor (LR+KNN) | Logistic Regression + Support Vector Machine (LR+SVM) | K-Nearest Neighbor + Support Vector Machine (KNN+SVM) | Logistic Regression + K-Nearest Neighbor + Support Vector Machine (LR+KNN+SVM) |
|---------------|-----------------------------------------------|-----------------------------------------------------|--------------------------------------------------|---------------------------------------------------------------------------------|
| 10            | 95.97                                         | 94.74                                               | 95.97                                            | 94.92                                                                           |
| 15            | 96.14                                         | 94.75                                               | 96.14                                            | 94.75                                                                           |
| 20            | 96.33                                         | 94.77                                               | 96.33                                            | 94.95                                                                           |

#### Fig 5.3: Performance Analysis in terms of Accuracy of different Ensemble of Classifiers

5.1. **Comparison of UFMDRA system with work [11]:**

In paper [11], a combination of context-based sentiment analysis using Ngram and tf-idf word vectorization method approach is presented using Naïve Bayes and Random Classifiers to predict user review emotion with accuracy of 89%. With the Decision Tree classifier, UFMDRA outperformed with 100% accuracy as shown in Table V.

### Table 5: Comparison of UFMDRA with Reference [11]

| Model          | UFMDRA                                                                 | Comparison with Work [11]                                  |
|----------------|------------------------------------------------------------------------|----------------------------------------------------------|
| **Data set**   | Scraping data from online websites: drugs.com, everydayhealth.com, askpatients.com and webmd.com | UCI ML Drug Review & Online Pharmaceutical Review sites |
| **Best Classifier** | Decision Tree                                                          | Naïve Bayes and Random Classifier                      |
| **Accuracy**   | 100%                                                                  | 89%                                                      |
6. Conclusion

In this work, we generated a data set from drugs.com, everydayhealth.com, askpatients.com and webmd.com using the scrapping program for 2 uterine fibroid related drugs - Tranexamic acid and Lupron. We explored seven supervised learning models: Random Forest, Decision Tree-Nearest Neighbour, “Logistic Regression”, “Naive Bayes”, Support Vector Machine and Stochastic Gradient for the purpose of determining the sentiment polarity of uterine fibroid drug reviews. We found that the Decision Tree model performed with the highest accuracy of 100%. In future a work user interface can be designed so that any consumer can easily find the reviews class. The UFMDRA model can be applied to analyse any drug reviews with adding and scrapping more data of uterine fibroid related medicines.

References

[1] http://www.newindianexpress.com/cities/hyderabad/2017/nov/12/uterine-fibroids-widely-prevalent-in-city-study-698910.html
[2] https://www.indiatoday.in/lifestyle/health/story/story/uterine-fibroids/1/390873-300316-2014-09-24
[3] Myers SL, Baird DD, Olshan AF, Herring AH, Schroeder JC, Nylander-French LA, et al. Self-report versus ultrasound measurement of uterine fibroid status. J Womens Health (Larchmt) 2012;21:285–293. [PMC free article] [PubMed] [Google Scholar]
[4] Ryan GL, Syrop CH, Van Voorhis BJ. Role, epidemiology, and natural history of benign uterine mass lesions. Clin Obstet Gynecol. 2005;48:312–324. [PubMed] [Google Scholar]
[5] Manek, A.S., Pandey, K., Shenoy, P.D., Mohan, M.C. and Venugopal, K.R., 2015, December. Classification of drugs reviews using W-LRSVM model. In 2015 Annual IEEE India Conference (INDICON) (pp. 1-6). IEEE.
[6] Manek, A.S., Shenoy, P.D., Mohan, M.C. and Venugopal, K.R., 2017. Aspect term extraction for sentiment analysis in large movie reviews using Gini Index feature selection method and SVM classifier. World wide web, 20(2), pp.135-154.
[7] Xuan, J., Deng, G., Liu, R., Chen, X. and Zheng, Y., 2020. Analysis of medication data of women with uterine fibroids based on data mining technology. Journal of infection and public health, 13(10), pp.1513-1516.
[8] Han, Y., Liu, M. and Jing, W., 2020. Aspect-Level Drug Reviews Sentiment Analysis Based on Double BiGRU and Knowledge Transfer. IEEE Access, 8, pp.21314-21325.
[9] Vijayaraghavan, S. and Basu, D., 2020. Sentiment Analysis in Drug Reviews using Supervised Machine Learning Algorithms. arXiv preprint arXiv:2003.11643.
[10] https://www.nltk.org/_modules/nltk/sentiment/vader.html
[11] Tumu, P., Manchenasetty, V. and Rege, M., 2020. Context based sentiment analysis approach using n-gram and word vectorization methods, Issues in Information Systems, 21(3), pp.59-65.