Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 1s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Analyzing medical images to detect adverse drug reactions and toxicity

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Cite this paper as: Tripti Dewangan, Aayush Vaishnaw, (2025) Analyzing medical images to detect adverse drug reactions and toxicity. *Journal of Neonatal Surgery*, 14 (1s), 519-524.

ABSTRACT
It is believed that sentiment analysis is the pinnacle of natural language processing. It can be difficult to analyze and comprehend customer reviews and comments. These days, social media sites like Facebook and Twitter allow users to share their thoughts about a product or movie. Online health community platforms like Daily Strength, Me Help, Patients Like Me, and others also offer health-related conversations. Serious negative effects on human bodies brought on by careless medication use without a prescription are known as adverse drug reactions, or ADRs. In the field of pharmacovigilance, the difficult research problem of automatically detecting adverse drug reactions (ADRs) from social media information has drawn a lot of attention. ADR can benefit from the vast amount of data discussion on social media. Therefore, to address the casual vocabulary and misspellings prevalent in social media, effective machine learning approaches are required. Creating deep learning models to identify and enhance ADR performance is the aim of this study. Numerous approaches and algorithms have been put forth to identify adverse medication reactions. To detect ADR, this research study suggests a more accurate and efficient framework called the "Adverse Drug Effect Aware Recommendation System." This study focuses on reviews of a specific drug reaction that were gathered from Twitter.

Keywords: Pharmacovigilance, ADR, General structure, PV.

1. INTRODUCTION

The medical information community is currently paying close attention to the difficult research topic of automatically monitoring adverse drug reactions (ADRs), which are defined as unfavorable patient outcomes brought on by medicine. Users have been sharing data on social media in recent years. The large amount of data has made it a valuable tool for ADR monitoring [1] and a difficult undertaking for pharmacovigilance professionals. Prescription errors, adverse drug reactions (ADRs), and low-quality medications can have a significant influence on some health care systems by raising costs and negatively affecting patient care. The majority of facts pertaining to drug problems and the need of pharmacovigilance are probably from wealthy nations [5]. However, the lack of medical personnel, inadequate infrastructure, and issues with the availability and quality of medications are likely to cause more issues in low- and middle-income nations. "Science and activities for the detecting, evaluating, understanding and prevention of adverse reactions or any other drug problem" is how Sarker et al. (2014) define pharmacovigilance (PV or PhV), which is frequently associated with drug safety [9]. Pharmakon (Greek for drug) and vigilare (Latin for keeping watch) are the etymological sources (Wikipedia) [2]. The goal of pharmacovigilance is to maintain close monitoring of pharmacological medications [3]. Promoting the equitable and safe use of pharmaceuticals is the primary goal of PV authority, which will improve patient care and public health in general. The COVID-19 pandemic has increased the importance of medications that are essential to maintaining public health since people are utilizing them more often [7]. To demonstrate its increased efficacy, safety, and efficiency, the medication must first go through a number of clinical trial stages before being on sale [15]. COVAXIN and Pfizer's COVID vaccines are currently under monitoring and undergoing human testing. Only a few people have been tested, despite the fact that volunteers have stepped forward to receive the vaccination [15]. Additionally, only a small number of patients have been used in accordance with a predetermined methodology and examined for the chemical for a brief period of time under stringent inclusion and exclusion standards [11]. Pregnant patients, children, and elderly patients with certain conditions are not included in this volunteer sample [14]. As a result, it becomes challenging to identify uncommon Adverse Drug Reactions (ADRs) and research the long-term consequences of medications and drug interactions in such circumstances. The main goal of the suggested approach is to come up with effective ways to evaluate the text that is available on social media [4]. Some of the specific goals of this study are listed below.

The opinions on drug reactions are gathered from social media platforms like Twitter in order to study and forecast them.
To conduct a preliminary data analysis on the viewpoints of drug users gathered from social media.
To categorize medications prescribed for Parkinson's, Alzheimer's, arthritis, and dementia based on internet evaluations.
To use the new deep learning algorithm e to anticipate both positive and negative effects of medications.
To make medication recommendations based on expert evaluations and recommendations.

2. PROPOSED METHODOLOGY

Adverse drug impacts are problems brought on by excessive drug usage that can interfere with a person's ability to lead a normal life. To determine if a given medication can be continued or not, these must be determined for every new drug. Accurately predicting adverse drug effects and ensuring appropriate medication recommendations are the primary goals of the suggested study methodology. The online reviews of drug reactions gathered from the drugs.com website are the main subject of this study. These reviews can also be found in the Kaggle repository. Reviews were collected and analyzed to see how users responded to the medications based on their positive and negative perceptions. The general structure of the research technique is depicted in Figure 1 below. The technique has been implemented on the Python platform, and training was conducted using the drug data corpus to learn about the positive and bad side effects of the pharmaceuticals that users have prescribed. To make sure the necessary data is free of noise and repeats, pre-processing has been done first using the reviews of the acquired data to remove undesired terms using the successor variety stemmer algorithm. [12].

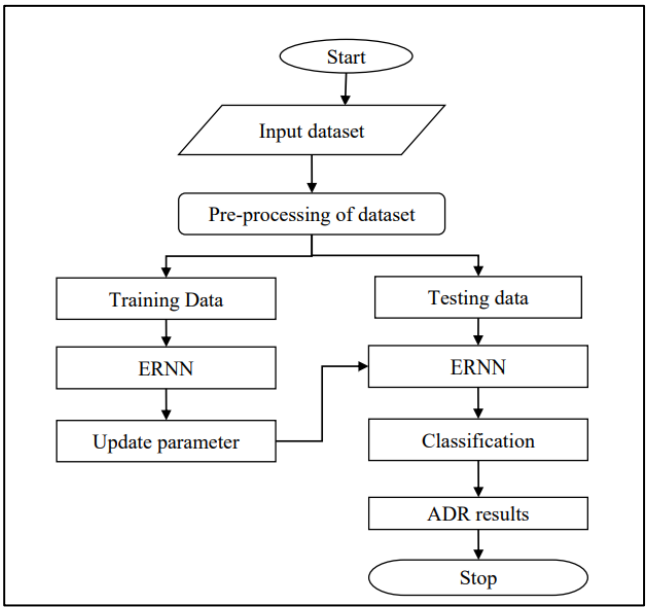

Figure 1: Proposed overflow

Following pre-processing, the dataset was subjected to exploratory data analysis, or EDA. Lastly, the Enhanced Recurrent Neural Network (ERNN) algorithm has been used for classification in order to anticipate the necessary medications. For researchers, medical professionals, and the general public to get knowledge about the safety profiles of medications, trustworthy data sources are essential. Social media platforms allow users to freely create and share a variety of content at any time and from any location. Social media platforms, which are utilized in everyday life, allow for the instantaneous dissemination of a multitude of information, with user-generated material serving as a source of information [6]. To perform ADR on the gathered medication reviews, the acquired data may contain a large number of redundant and inconsistent data points that need to be filtered. The crucial process of conducting preliminary research on data to identify trends and identify abnormalities with the use of summary statistics and graphical representations is known as exploratory data analysis. SMOTE uses the k-nearest neighbor technique to create synthetic data. SMOTE starts by selecting data at random from the minority class, after which it establishes k-nearest neighbors. The random data and the randomly selected k-nearest neighbor will then be used to create synthetic data. Until the minority class achieves the same percentage as the majority class, this procedure is repeated multiple times [13]. To address the data imbalance, the SMOTE technique was employed in this study for the pharmaceuticals data set as part of the suggested research methodology [8].

In recent years, deep learning methods have been widely used to NLP applications. The fields of speech recognition, visual object recognition, object detection, and drug discovery have all made use of these Deep Learning approaches. For sentence

categorization, a number of researchers employed Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), and Long Short-Term Memory (LSTM). Humans have a visual attention system that allows them to watch everything from beginning to end, but its main function is to select the most important information from a large amount of data. The key information is given more weight values and attention mechanisms by deep learning, which makes it more useful for sentiment analysis. Deep learning was used to develop the ADR algorithm in this study [10][16]. The algorithm uses drug reviews as input and then forwards the results to a new algorithm that classifies both positive and negative reviews.

3. RESULTS

The Python platform was used to implement the study. The medications data set was gathered from the Kaggle repository and is also accessible on the drugs.com website. The unbalanced dataset's balanced data was produced using the SMOTE function. After using SMOTE, the medicines dataset is shown in Figure 2 below.

	uniqueID	drugName	condition	review	rating	date	usefulCount	review_clean	sentiment
0	80520	Mobic	Osteoarthritis	"Reduced my pain by 80% and lets me live a nor...	10	42137	82	reduc pain let live normal life	1
1	171980	Meloxicam	Osteoarthritis	"I have been using Mobic to relieve the pain f...	10	40081	26	use mobic reliev pain spinal fusion march prev...	1
2	138290	Orthovisc	Osteoarthritis	"This is my third round of orthovisc. My great...	8	42285	30	third round orthovisc great fear pain inject w...	1
3	21977	Infliximab	Psoriatic Arthritis	"I have severe psoriatic arthritis and I'...	10	42130	20	sever psoriat arthriti sinc remicad almost yea...	1
4	139852	Euflexxa	Osteoarthritis	"After 3 years of astounding results from Supa...	2	42733	8	year astound result supartz miss inject due ob...	0
...	...	...	...	...	...	...	...	...	...
25840	207132	Westhroid	Hypothyroidism, After Thyroid Removal	"I've been on a combination of Westhroid ...	9	40249	41	combin westhroid natur throid due shortag coup...	1
25841	224376	Levothyroxine	Hypothyroidism, After Thyroid Removal	"I've been on this medicine for more than...	3	41168	35	medicin month feel better tire hair loss exper...	0
25842	187015	Nature-Throid	Hypothyroidism, After Thyroid Removal	"Great med if you can get it. The back order ...	10	40249	106	great med get back order crapola struck right ...	1
25843	47251	Thyroid desiccated	Hypothyroidism, After Thyroid Removal	"Great med if you can get it. The back order ...	10	40249	106	great med get back order crapola struck right ...	1
25844	103564	Synthroid	Hypothyroidism, After Thyroid Removal	"I had my thyroid removed in February 2009 and...	8	40568	61	thyroid remov februari levothroid month ago no...	1

Figure 2: Dataset after SMOTE Technique

The Porter stemmer algorithm is used to pre-process the balanced dataset. For word embeddings, the pre-processed data is routed to embedding layers. This layer's output is used as input for both forward and backward bidirectional layers. The output layer receives the sigmoid function once it has been applied, and it generates binary classification in addition to suggesting medications for conditions including Parkinson's, Alzheimer's, arthritis, dementia, and so forth.

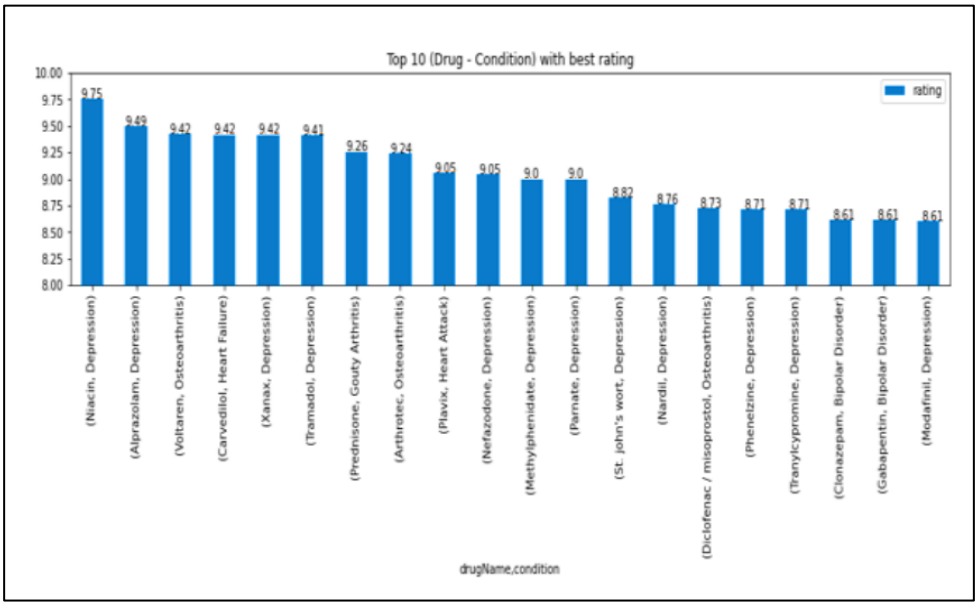

Figure 3: Top 20 Drugs Condition with Best Ratings

The Top 20 drug conditions (diseases) with the highest ratings and the Top 20 medications with the lowest ratings are shown in Figures 3 and 4 below. The Top 20 important medications (together with their best and worst ratings) are also displayed in Figure 5.

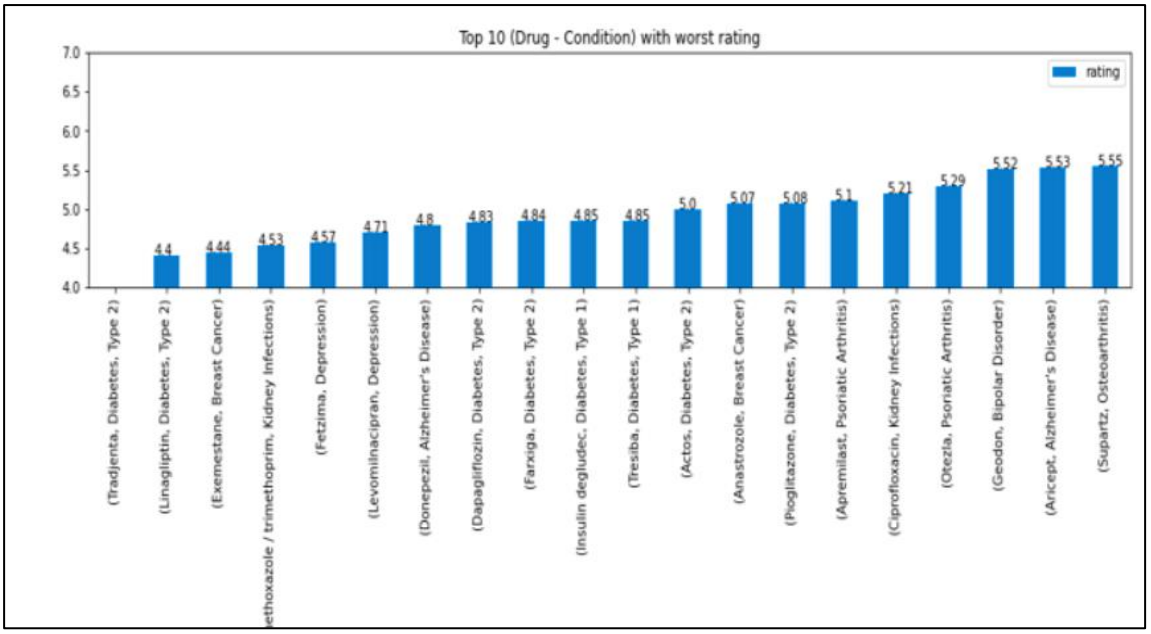

Figure 4: Top 20 Drugs Condition with Worst Ratings

In Figure 5, we illustrate the network lifetime against the different types of attacks. It is accurately demonstrated that the proposed OCKMS has a far longer network lifetime than the current SNMP system.

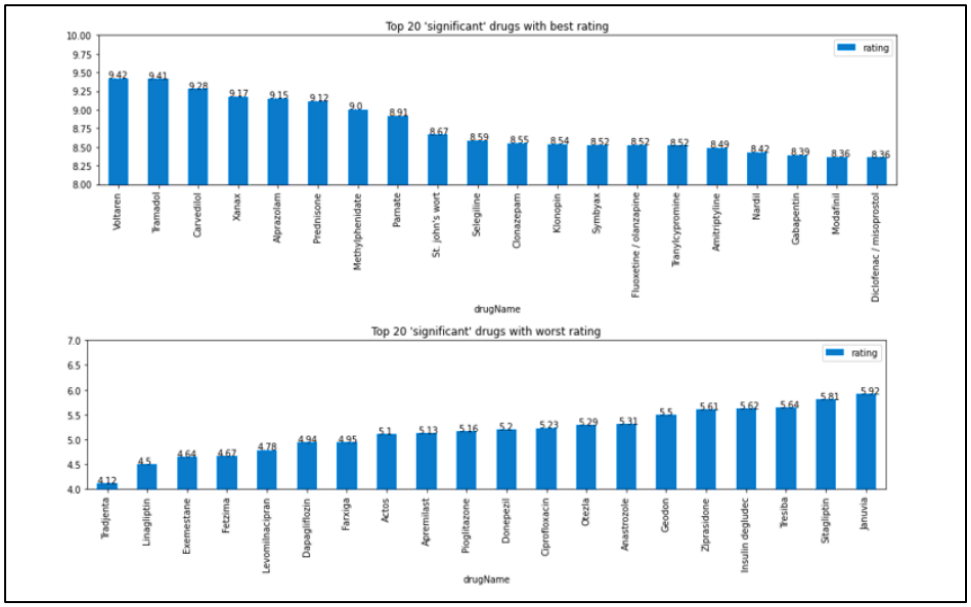

Figure 5: Top 20 'Significant' Drugs with Best and Worst Ratings

In order to classify the drug adversary effect database and determine the likelihood of diseases and their associated drug effects occurring, the ERNN algorithm has been used to predict drug effects knowledge by calculating the similarity between the input and training samples. Accuracy, precision, recall, and F-Measure are the measures that have been used to compare and validate the performance of the suggested methodology.

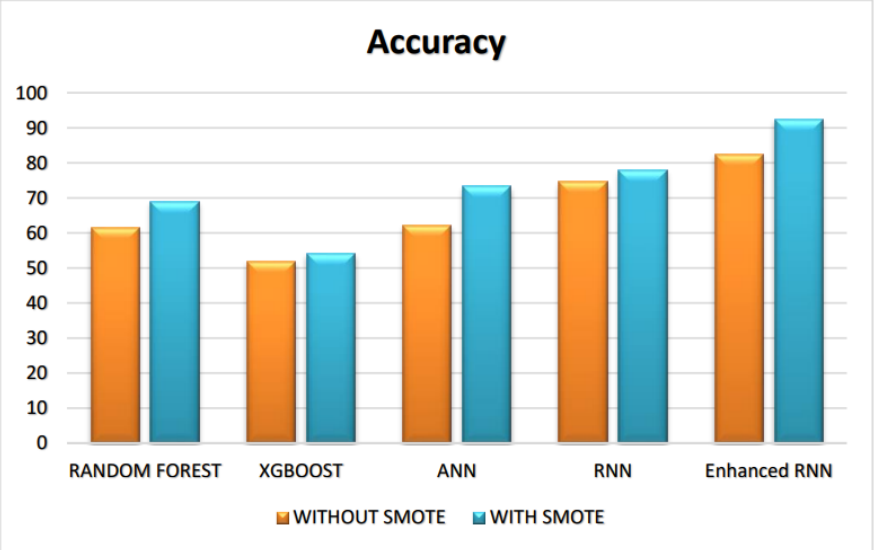

Figure 6: presents the accuracy comparison for the number of data set in specified datasets

Random forest, XGBoost, ANN, RNN, and ERNN are among the techniques that are used. Consideration has been given to the accuracy value on the y-axis and the quantity of data on the x-axis. The graph shows that the suggested ERNN offers a greater accuracy rate than the earlier techniques. According to the output, the suggested deep learning system outperforms the current approach in terms of improved ADR review outcomes and increased accuracy rates. It is evident from Figure 6 that the suggested ERNN method has a superior accuracy rate of 92.45%. The current techniques, random forest and boosting, achieve 78.09%, 73.35%, 54.27%, and 69.07%, respectively.

4. CONCLUSION

The majority of machine learning methods have only been utilized to identify the adverse drug reactions (ADRs) of breast cancer and cardiovascular disorders. The COVID-19 epidemic has made it even more important to identify adverse medication responses in elderly patients. This is a difficult research problem as well. To get over the drawbacks of the present techniques for determining the ADR, this study suggests a unique Enhanced Recurrent Neural Network (ERNN). Additionally, it uses a deep learning model—which has been shown to be more effective than RNN—to detect the ADR of older adults to conditions like Alzheimer's, arthritis, dementia, Parkinson's, and so forth. In order to forecast the binary categorization of positive and negative reactions, this technique has been constructed using the well-trained Bidirectional RNN. Additionally, it suggests the top medications for senior citizens based on professional recommendations.

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