Evaluation of Online Sentiment Towards Thrombolytic Stroke Treatment

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I. Introduction

Since its FDA approval in 1996, the thrombolytic use Tissue Plasminogen Activator (tPA) has remained one of the the primary methods of treating Acute Ischemic Stroke (AIS). In the years following its approval, numerous research trials were conducted to determine the efficacy of tPA and other thrombolytic agents. While some of these trials showed positive outcomes in tPA treated groups compared to placebo control groups, some trials focusing on other thrombolytic agents showed harm. While proper grouping of the results of these trials to focus on only IV tPA shows a correlation with positive outcomes, other groupings combining tPA and other thrombolytic agents have shown high rates of Intercranial Hemorrhaging (ICH) and have fueled skepticism over tPA. The discrepancies in these views have caused an online debate between them. This has manifested on many platforms, including podcasts and blogs, but primarily on Twitter. This paper aims to quantify the public sentiment of thrombolytic treatment of AIS using IV tPA.

A. Motivation

While that national average for tPA usage is 5% for patients admitted with AIS, this varies significantly depending on region and hospital size. Some large urban centers have usage rates as high as 15% while in some smaller rural centers, it remains virtually unused. While some specialized physicians are outspoken about the benefits of tPA, others spread scepticism through their interpretation of study results. The sceptics voices have gained a large following which has further discourages tPA usage and resulted in its non-use in some areas. This discrepancy in the quality of treatment has been shown to result in on average worse patient outcomes, and hence is a problem which needs to be clearly identified and addressed.

This, in turn, becomes significant due to both patient well-being and cost. Stroke is the leading cause of permanent disability in many countries and is costly to treat. The majority of the cost arises during rehabilitation, with the average long term treatment being estimated to cost $141 048. This culminated $71 billion in medical costs in the US in 2010. Addressing the gap in tPA perception and bettering treatment is hence a beneficial cause.

This paper aims to quantify the public sentiment of thrombolytic treatment of strokes and attempting to relate this to relate this to observed ER perception statistics.

B. Related Works

While many studies have been conducted around the efficacy of IV tPA, there remains a lack knowledge and research of public sentiment towards the treatment.

The first study proving the efficacy of tPA came in 1995. The National Institute of Neurological Disorders and Stroke performed a clinical trial called the NINDS rt-PA Stroke Study. Half of the patients received tPA, while the other half received a placebo. The results showed that patients who received tPA had a higher rate of recovery from stroke and were more likely to have no disability after three months compared to those who received the placebo. This has been followed by other successful trials such as ECASS III and XXXX.

There have also been studies conducted to identify the regional discrepancies in tPA usage rates and their causes. A study conducted by Schwamm et al. in 2010 found that hospitals located in the Northeastern region of the United States reported higher rates of tPA usage compared to hospitals in other regions of the United States. This study suggested that accessibility to primary stroke centres and specialists was a major factor to this discrepancy. These findings are supported by other papers such as one in 2020 from Christine paul, a behavioural scientist from Newcastle University, which found that there was both a gap in usage between major stroke centers and secondary stroke centers, and a gap in acceptance by emergency physicians.

Machine learning techniques have also been used surrounding tPA to predict when patients are most likely to benefit from the drug. In 2017, research conducted by Fonarow and his colleagues used a machine learning algorithm to identify patients who were most likely to have a successful outcome with a tPA treatment. According to their findings, this study was successful, and the predictions were very accurate.

Despite the research in surrounding fields, there are still gaps in our understanding of the perceived safety of this treatment. This is significant as this gap in perception surrounding tPA has been correlated to usage rates in these physicians. For this reason, Implementing a machine learning model that analyzes twitter sentiments on this topic is therefore the perfect

solution towards data-driven evidence and ultimately a better understanding for the effectiveness of this treatment.

C. Problem Definition

This paper attempts to find a correlation between emergency room usage rates and acceptance of tPA with public sentiment towards the drug. since its approval, tPA has been met by some with scepticism, which a culminated in debate many online platforms. While there exists many blogs and podcasts, a notable example being *The Sceptics Guide to Emergency Medicine* by Ken Milne, a large amount of the online debate occurs on platforms including twitter. Twitter allows for people to share opinions and gain large amounts of impressions making it a useful space to analyze.

II. Results

Figure 1 depicts that positive sentiment tweets outnumber negative ones, despite some accounts having a high proportion of negative tweets. This trend is consistent in the top 25th percentile of impressions and retweets seen in Figures 2 and 3, indicating that positive tweets have a more significant impact on the community. This could potentially be related to a general increase in tPA usage rates observed during the study period. The general increase in positive tweets since 2009 could be due to the ECASS III trial in 2008, which showed positive results for tPA usage within three hours of onset. This study could also be the reason why there were many positive tweets with a high number of impressions between 2011 and 2013, highlighting its significance in the timeline of tPA usage and stroke treatment.

The period after 2015 is highlighted as a time when the public eye may have shifted away from tPA due to the proven efficacy of EVT. This is evident in the fewer tweets between 2017 and 2019. This period is interesting to note as it suggests that the focus on tPA has lessened in the past couple of years.

However, there is a large spike in 2021-2022. This is likely because of a study asking if Tenecteplase should replace Alteplase for acute thrombolysis. Tecenectepalse (TNK) is a drug commonly used in heart attack treatment, and many emergency physicians are more familiar with it. This familiarity may lead to an increase in TNK usage in stroke treatment. The study concludes that there is no harm in TNK compared to tPA.

References

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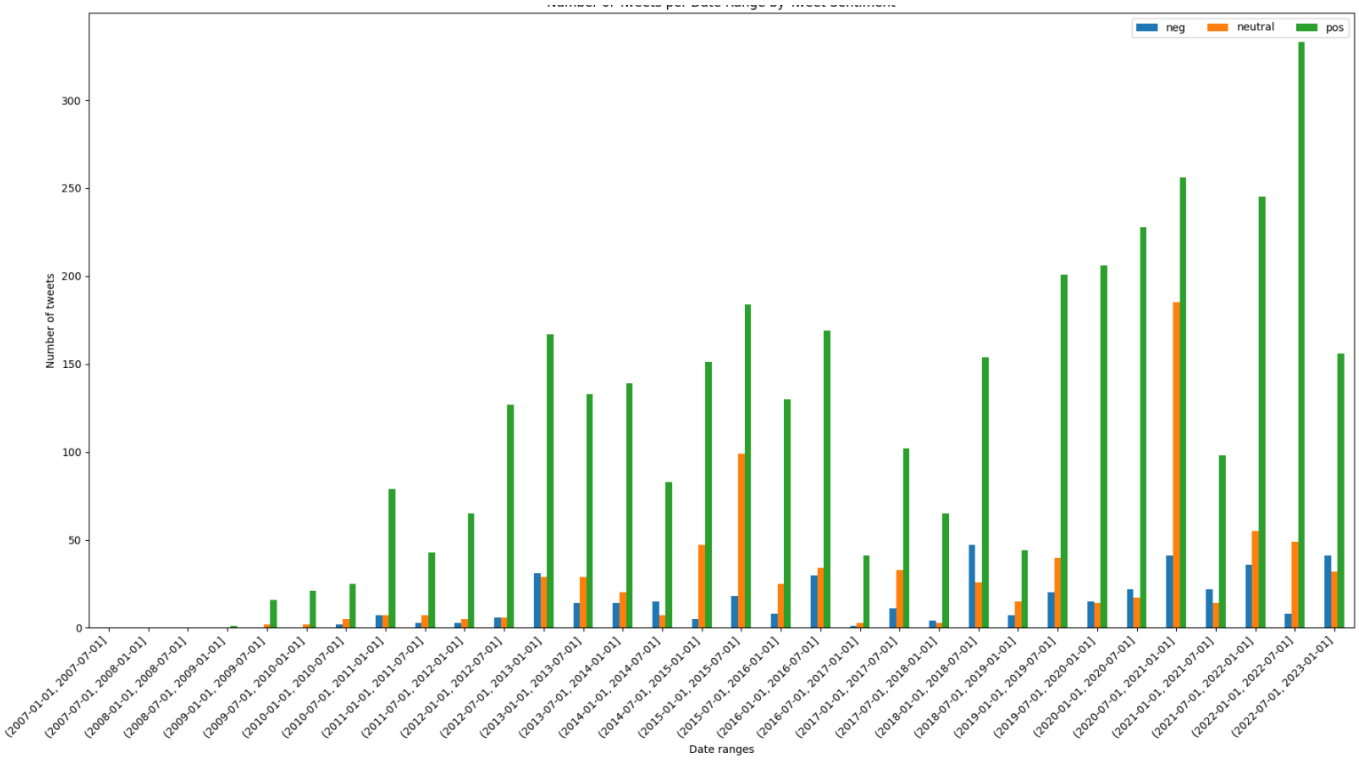

Fig. 1. Sentiment Graph for full Dataset

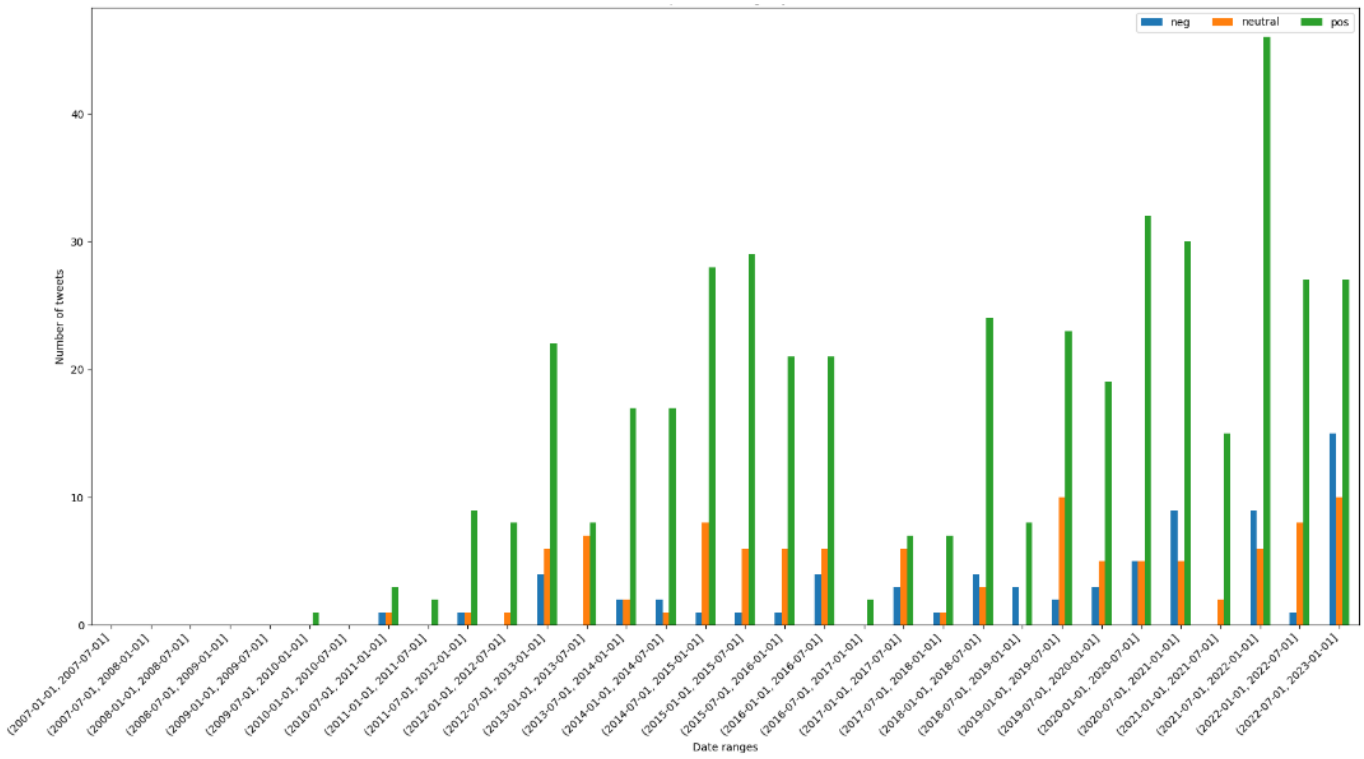

Fig. 2. Sentiment Graph for 25% of tweets with the highest amount of retweets

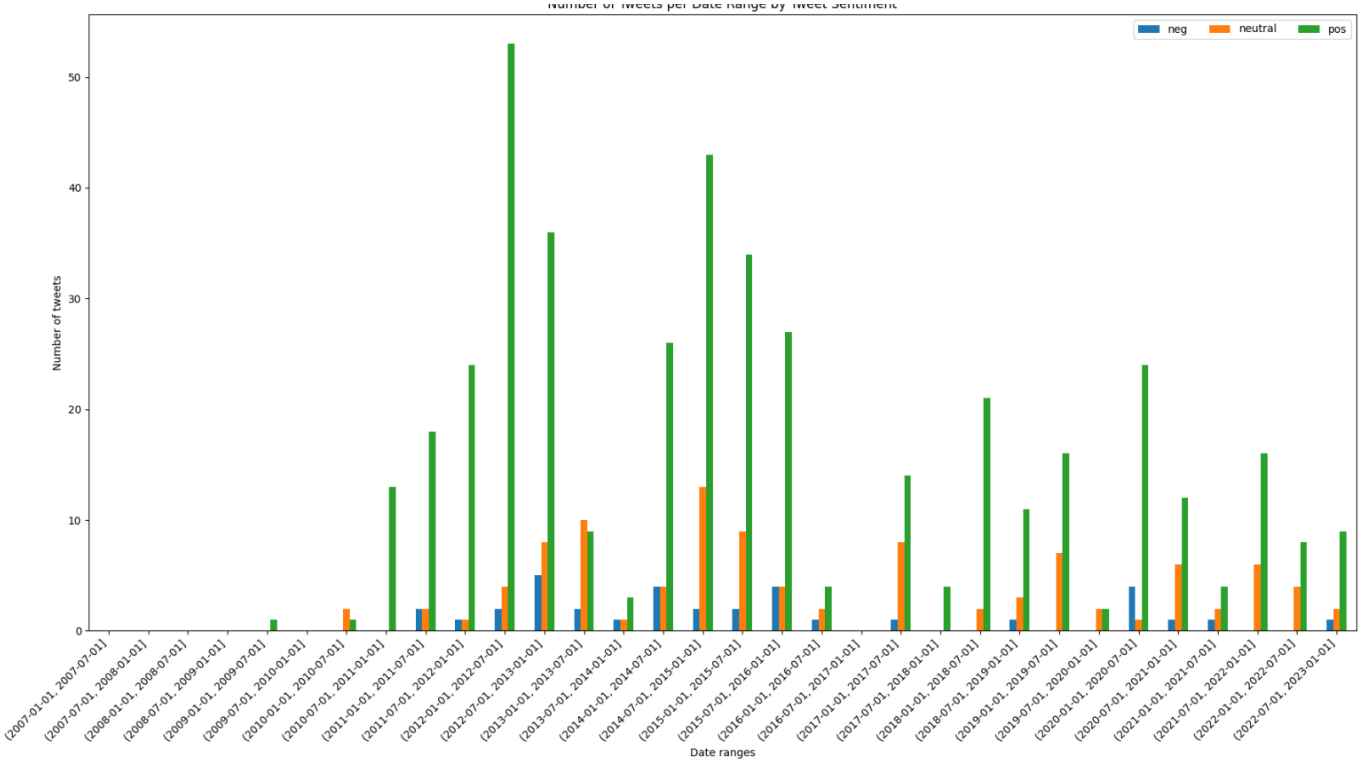

Fig. 3. Sentiment Graph for 25% of tweets with the highest amount of impressions