The public sentiment towards the uptake of HPV vaccine among Chinese population: A geospatial analysis

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Introduction

Cervical cancer, mainly caused by persistent infection with human papillomavirus (HPV), is ranked as the third most common malignancy after breast cancer and colorectal cancer worldwide (Arbyn et al. 2011; Wang et al. 2020). It is one of the leading causes of cancer deaths in women (Torre et al. 2015). Thanks to the development of medical technology, the HPV vaccination has the potential to reduce cervical cancer incidence around the world by as much as 90% (Lowy and Schiller 2012).

In recent years, the development of social media has overturned the traditional medical communication channels, with more and more people using social media to acquire health-related information and participate in related discussion. Research evidence has shown that social media like Twitter, Facebook and YouTube can play an important role in promoting the HPV vaccines among populations in Western countries. Little is known about the impact of social media on the HPV vaccine uptake among Chinese population.

To better understand how social media would influence people's willingness to the HPV vaccine uptake quantitatively, this study aims to characterize the public sentiment towards the HPV vaccine, and describe the geospatial variation of the public' willingness to take up the vaccine across different provinces in China.

Methods

Data Search

The public sentiment towards the HPV vaccine data was collected from Weibo, Zhihu, and Red Books, which are popular social media platforms, especially heavily used among young people, in China, using the API-based crawler techniques, with keywords and hashtag posts including but not limited to #HPV#, #Cervical Cancer vaccine (translated)#, and #Nine-valent (translated)#.

Data Extraction

The metadata involved includes id, original post contents, time of sending, IP location, number of reposts, number of comments, and number of attitudes (thumbs-up).

Data Analysis

First of all, we classify the collected raw data, i.e., the original posts based on Natural language processing (NLP) algorithm. Intuitively speaking, "so expensive", "so complicated" (translated), etc. are normally considered as negative posts, and "so convenient", "so cheap" (translated), etc. are normally considered as positive posts when priorly labeling the samples before training.

Then we also take different attentional levels of collected posts into consideration, i.e. retweet number, comments number, and attitude numbers, we constructed the sentiment analysis model to measure people's willingness to HPV vaccine uptake.

Further, in the subgroup analysis, sentiment data were further stratified by provinces using IP location, and the percentage of positive attitude were calculated and mapped across different provinces.

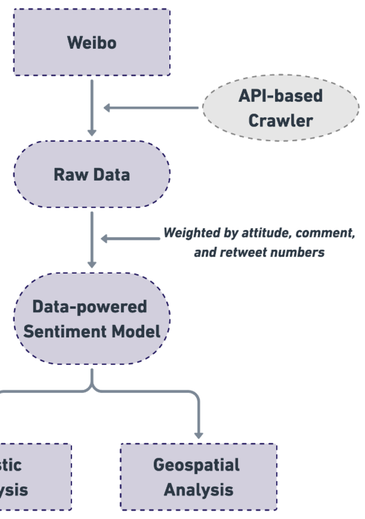

Figure 1. Public Sentiment Data Search and Extraction Process

Results

A total of 229,150 effective original posts from July 1, 2021, to June 30, 2022, containing either of these keywords or hashtags were collected and used in analysis (Figure 1, 2).

The overall sentiment analysis results showed that about 76% of the social media posts demonstrated positive attitudes towards the HPV vaccine (Table 1). The subgroup analysis results showed that the provinces of Guangxi (79.2%), Gansu (77.4%), Heilongjiang (61.2%) had the highest percentages of positive attitudes towards the HPV vaccines, however, there was not significant difference of the public positive sentiment toward the HPV vaccine uptake (Figure 3).

Figure 2. Word Cloud Visualization from 229,150 Effective Original Posts

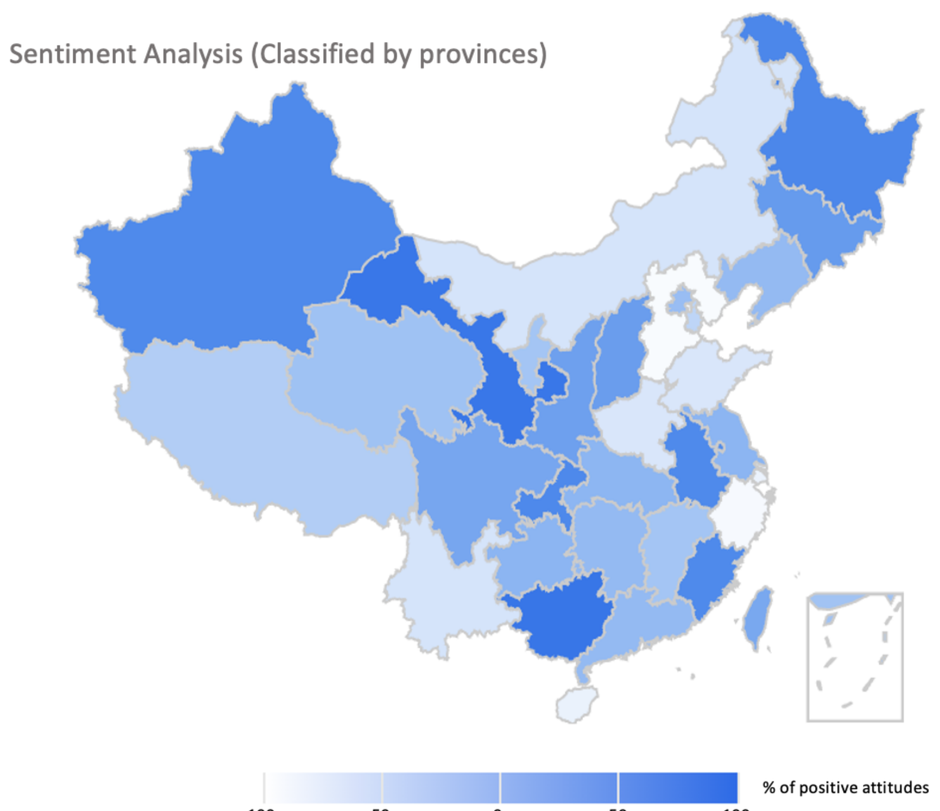

Figure 3. The Geospatial Variation of the Public Positive Sentiment towards the HPV Vaccine Uptake by Province in China

Discussion

- Even though positive sentiment toward the HPV vaccine accounts for the majority, there is indeed negative information about it. One potential explanation is that although vaccination has helped significantly reduce mortality and morbidity, there are still many members of the public who underestimate the infectivity and potential harm of the virus due to cognitive biases, and some question the effectiveness of vaccination, resulting in increased vaccination hesitancy. And the other is the extreme imbalance between supply and demand, which resulted in a great number of noises in constructing sentiment scores.
- The following reasons might account for the insignificant differences in the geospatial analysis: (1) data scarcity; (2) did not take the frequency of posting by Weibo into consideration, i.e. multiple posts of the same user may be included in the analysis, to make an impact to the sentiment score; (3) uneven distribution of the post amount among different regions, etc.

Sentiment Analysis	Positive	Negative
Number of posts	174179	54971

Table 1. The Number of Posts Indicating Public Sentiment towards the HPV Vaccine Uptake in China

Conclusion

As social media become more popular and common among people from all walks of life, within different age groups, the data it generated can indeed help researchers understand and catch the hot searches from time to time. In general, people's sentiments toward this vaccine tend to be positive in China, but 24% of the negative posts also reveal a long way for the policymakers to spread correct and accurate vaccine knowledge among people. Due to the limitation of this study, future studies are needed to validate the findings from this study, in order to provide geographically-tailored HPV vaccine promotion interventions in China.

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