# An Empirical Analysis on Communications about Electronic Nicotine Delivery Systems (ENDS) in Chinese Social Media

Kainan Cui[1,2], Xiaolong Zheng[2], Daniel Zeng[2], and Scott Leischow[3]

[1] The School of Electronic and Information Engineering,
Xi'an Jiaotong University, Xi'an, China
[2] State Key Laboratory of Management and Control for Complex Systems,
Institute of Automation, Chinese Academy of Sciences, Beijing, China
[3] Mayo Clinic in Arizona, Phoenix, USA
kainan.cui@live.cn, xiaolong.zheng@ia.ac.cn

**Abstract.** China, with a smoking population of over 350 million, is the largest potential market for electronic nicotine delivery systems (ENDS). The importance of understanding how ENDS are promoted and discussed in China cannot be overstated. However, related research is sparse. This study aims to explore the nature and extent of discussions around ENDS in Chinese social media, which have the power to influence a massive audience. We collected the data from Sina Weibo, which is one of the most popular Chinese microblogging sites. The dataset, which consisted of 999 messages, was analyzed in terms of polarities, genres and discussion topics. Statistical test and regression analysis were used to explore whether those features of messages will affect the message popularity, which was measured by repost number and comment number. The results of our study showed that 1) The majority of the messages were Pro-ENDS; 2) The number of comments received by messages of different genes varies significantly; 3) Whether a message contains specific topics or not will affect the comment number.

**Keywords:** Electronic nicotine delivery devices, public opinion, advertising and Promotion, social media, micro-blogging systems.

## 1 Introduction

Electronic nicotine delivery systems (ENDS) are battery operated products designed to deliver nicotine by heating nicotine rather than by burning tobacco. Recent years have witnessed tremendous growth in the marketplace of ENDS. China, with a smoking population of over 350 million, is not only the inventor and main provider of ENDS, but also the world's largest potential market for ENDS. Although the market of ENDS in China is still in its infancy, the significance of ENDS on China's tobacco control cannot be overstated.

As inappropriate health claims of ENDS (e.g., ENDS are totally harmless) could misled the public and make damages to the public health [1], such as the marketing

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campaigns targeted to non-tobacco users, especially young people, have raised great public health concerns over nicotine addiction [2] [3] [4], the empirical analysis to understanding how ENDS are promoted and discussed in China and their impact on general public's attentions and perceptions of ENDS is critically needed. With the rapid growing of social media, there were increasing numbers of studies analyzing the content regarding ENDS in western social media sites, e.g. YouTube[5], Twitter [6] and so on. However, related research is sparse in China.

To fill this important research gap and provide implications for ENDS related policy making in China, we conducted a content analysis on one of the most popular Chinese microblogging sites called Sina Weibo. The main purpose of carrying out this study is twofold: 1) understand the polarities, genres and topics of messages about ENDS in Chinese microblogging sites; 2) understand which factors will affect the social media user's attention on messages about ENDS.

The rest of this paper is organized as follows. In Section 2, we begin with a brief introduction to the dataset and methods we used in this study. We report our empirical analysis results and statistical results in Section 3. We conclude our paper by summarizing the findings and discussing several key issues in Section 4.

## 2 Methods

In 27 April, 2013 , We collected 2101 raw messages by submitting the Chinese keyword "电子烟" (English: electronic cigarettes) to the official search engine on Sina Weibo. After refining our sample, 999 messages were left in our sample dataset.

To gain understanding of the polarity and gene of ENDS messages, a team of two graduate students with extensive social media analytics and public health informatics training coded the messages independently. The kappa statistics were calculated to test the inter-coder reliability [7]. The team first classified these messages into pro-ENDS, anti-ENDS or "neutral". This polarity code scheme is adapted from[14]. We extended the scheme, which was used to code videos regarding little cigars/cigarillos, to the context of ENDS discussion. Pro-ENDS was defined as messages that promoted the use of ENDS. Anti-ENDS was defined as messages that expressed negative attitudes towards ENDS and ENDS promotion. Any messages that were not easily classified as either pro-ENDS or anti-ENDS, but included mention about ENDS, were coded as "neutral".

Messages were also classified into the following genres: "advertisements", "consumer's sharing", "news" and "general discussions" by the same set of coders. The Genres were determined based on the recurring themes of current dataset. "Advertisements" refers to messages that promoted a product or service with commercial purposes. "Consumer's sharing" refers to postings that clearly indicated the poster's personal usage and purchase of ENDS. "News" refers to media reports, which usually consists of a news headline and summary. Some messages also contain links to full story. "General discussions" refers to the rest of messages related to ENDS. The kappa value was 0.92 for coding the polarity of messages and 0.95 for coding the genre of messages which indicate high reliability.

To gain more understanding of the topics discussed in the messages, we developed an issue list based on the recurring themes of current dataset and the previous study about debate of ENDS [8] [9]. There were not only pro-ENDS themes, but also anti-ENDS themes and questions around ENDS. Specifically, the pro-ENDS themes include 1) ENDS are effective to quit smoking, 2) ENDS have health benefits, 3) ENDS are legal to advertise and use, 4) ENDS taste good, 5) ENDS are cheap, 6) ENDS are suitable gifts 7) ENDS have candy flavor. The anti-ENDS themes include 1) ENDS are ineffective to quit smoking, 2) ENDS pose health hazards, 3) ENDS are illegal to advertise and use, 4) ENDS taste bad, 5) ENDS are expensive. The questions of ENDS include 1) Are ENDS effective to quit smoking? 2) Are ENDS healthy? 3) Are ENDS legal? 4) What are ENDS? 5) Where to buy ENDS? 6) Other questions.

In order to compare the popularity of these messages, we performed several statistical tests to assess the distribution of repost number and comment number. In particular, Kruskal-Wallis Test [10] and Mann-Whitney U test [11] were used to analyses differences of message popularity between groups, p values $<0.05$ were considered statistically significant. Logistic regression was used to assess whether topic contained in messages will affect the message popularity.

## 3 Results

Among the 999 messages in our sample, 677 messages were pro-ENDS, whereas 164 were anti-ENDS and 158 were "neutral" messages as shown in Table 1. Regarding the statistics associated with messages, pro-ENDS messages received 941 reposts and 1863 comments, which far exceed the corresponding numbers of anti-ENDS and "neutral" messages. Anti-ENDS messages received 221 reposts and 439 comments, "neutral" messages received 375 reposts and 459 comments.

Regarding the gene of messages, 256 messages were coded as "advertisements", which received 286 reposts and 187 comments as shown in Table 1. 244 messages were coded as "consumers' sharing", which received 220 reposts and 1390 comments. 127 messages were coded as "news", which received 451 reposts and 187 comments. The rest messages were coded as "general discussions", which had 372 messages and received 580 reposts and 997 comments.

**Table 1.** Statistics of messages regarding ENDS by polarities and genes

| | # of messages | # of reposts | # of comments |
|---|---|---|---|
| **Polarity** | | | |
| Pro-ENDS messages | 677 | 941 | 1863 |
| Anti-ENDS messages | 164 | 221 | 439 |
| "Neutral" messages | 158 | 375 | 459 |
| **Gene** | | | |
| Advertisements | 256 | 286 | 187 |
| Consumers' sharing | 244 | 220 | 1390 |
| News | 127 | 451 | 187 |
| General discussions | 372 | 580 | 997 |

Table 2 presents the statistics of topics discussed in the sample. The most mentioned topic was "ENDS are effective to quit smoking", which had 218 messages and received 223 reposts and 738 comments. The topic receiving most reposts was the health benefits of ENDS, which had 264 reposts.

**Table 2.** Statistics of discussed topics about ENDS

| | # of messages | # of reposts | # of comments |
|---|---|---|---|
| **Effectiveness to quit smoking** | | | |
| Effective | 218 | 223 | 738 |
| Ineffective | 29 | 107 | 164 |
| Are ENDS effective? | 16 | 8 | 86 |
| **Health effects of ENDS** | | | |
| Health benefits | 105 | 264 | 214 |
| Health hazards | 33 | 27 | 98 |
| Are ENDS healthy? | 7 | 4 | 18 |
| **Legality of ENDS** | | | |
| Legal | 31 | 17 | 76 |
| Illegal | 81 | 71 | 73 |
| Are ENDS legal? | 3 | 0 | 16 |
| **Taste of ENDS** | | | |
| Taste good | 25 | 9 | 73 |
| Taste bad | 23 | 3 | 119 |
| **Price of ENDS** | | | |
| Cheap | 8 | 11 | 11 |
| Expensive | 6 | 7 | 13 |
| **Others** | | | |
| As gifts | 78 | 166 | 323 |
| Candy flavor | 39 | 20 | 155 |
| What is ENDS? | 11 | 1 | 51 |
| Where to buy ENDS? | 9 | 5 | 50 |
| Other questions | 35 | 4 | 128 |

To assess whether the polarity and gene of messages will affect the popularity of messages, we provide the statistical results comparing the mean of messages' comment number and repost number. The Kruskal-Wallis test results indicate that there was no significant difference in comment number, repost number among messages of different polarities. The results of Mann-Whitney U test show that the comment number of anti-ENDS messages and "neutral" messages are no identical (p-value = 0.02898, Mann-Whitney U test), all of other pairs of comparisons are identical.

When it comes to the gene of messages, the mean comment number among "advertisement" messages, "consumers' share" messages, "news" messages and "general discussion messages" were significantly different (p-value < 2.2e-16, Kruskal-Wallis test). As shown in Fig. 1, the slopes of the best fit line among genes vary significantly. The slope of "consumers' share" messages was 5.7 whereas the slope of

"advertisement" messages was 0.73. More specially, the mean comment number of "consumers' share" messages was significantly different with "advertisement" messages (p-value < 2.2e-16, Mann-Whitney U), "news" messages (p-value < 2.2e-16, Mann-Whitney U) and "general discussion" messages (p-value = 2.687e-13, Mann-Whitney U). The mean comment number of both "advertisement messages and "news" messages were significantly different with "general discussion" messages. We did not observed significant difference in repost number among messages of different genes.

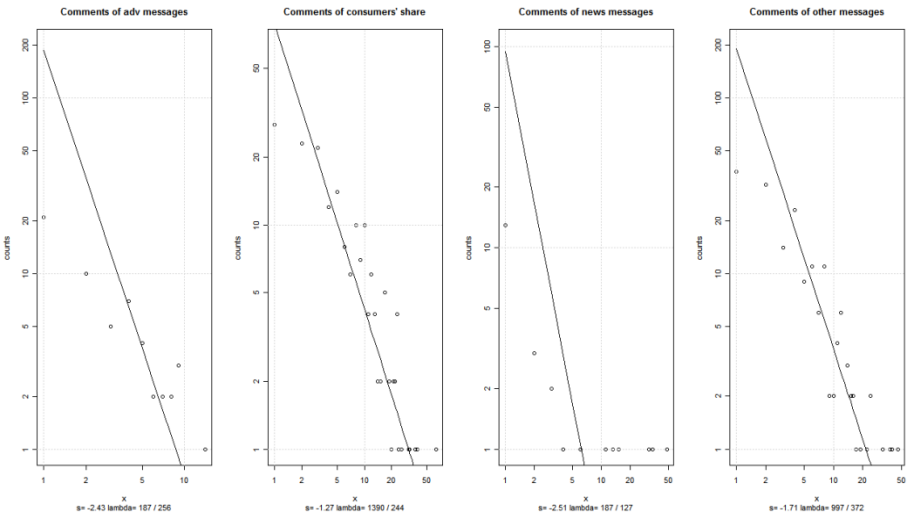


**Fig. 1.** The comment number distribution of messages by different genes

To investigate the impact of topics discussed in messages on the message popularity, we performed two linear regression analyses. The first regression model included all of the topics which were treated as binary variables. After performing the first analysis, we advanced the regression model by dropping those topic variables whose coefficient was not significant in the first model. The second regression included three topic variables as shown in Formula 1.

$$y = \beta_0 + \beta_1 pt_3 + \beta_2 at_2 + \beta_3 at_3 + \varepsilon \quad (1)$$

Regression analysis results showed that the pt_3 ("ENDS are suitable gifts"), at_2 ("ENDS are ineffective to quit smoking") and at_3 ("ENDS are Illegal") contributed significantly to the prediction of comment number as shown in Table 3. Among the three topics, "ENDS are suitable gifts" and "ENDS are ineffective to quit smoking" will arise more comments whereas "ENDS are illegal" will suppress the discussions.

**Table 3.** Regression analysis results of using topic predict comment number

| | # of messages |
|---|---|
| Constant | 2.7139*** |
| | (0.2081) |
| Pt_3 | 1.4271* |
| | (0.7024) |
| At_2 | 2.9412** |
| | (1.1198) |
| At_3 | -1.8127** |
| | (0.6805) |
| **R-squared** | 0.01891 |
| No. observation | 999 |

## 4 Conclusions

In our research, we have investigated nature and extent of discussions around ENDS in Chinese social media. To the best of our knowledge, this is the first study to document the content and popularity of discussions concerning ENDS on Chinese microblogging sites. The majority of messages in our sample expressed positive attitudes towards the ENDS and ENDS industry. We found both "advertisement" messages and "consumers' share" messages in our sample, which means social media is a communication platform for both the EDNS vendor and ENDS consumer. A variety of topics were discussed in the social media, there are not only pro-ENDS theme, but also anti-ENDS theme and question about ENDS. This result is a reflection of the heated debate about ENDS and possible regulations.

Regarding the popularity of messages, the gene of a message and the topics discussed in a message only influenced the comment number. The polarity of messages affected neither the comment number nor the repost number. "Consumer's share" messages received the most comments while "advertisement" messages received the least comments. This could be explained by the fact that "consumer's share" messages are usually more credible than "advertisement" messages. Social media users are more likely to interact with the users who share their own experience.

One of the limitations in this study is that microblogging is dynamic by nature [12][13]. The message stream changes rapidly, which may affect the representativeness of sample. We need to further analyze and monitor the discussions regarding ENDS to validate our findings. Further, although our dataset was collected from one of the most popular social media websites in China, it is likely that the sample was not representative of ENDS messages in other social media services. It would be beneficial to conduct further research that expands the scope of this analysis to additional social media websites in China.

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