Polarization and Opinion Shifts in HPV Vaccine Discourse on Twitter(X)

Keywords: Social media, HPV vaccine, Network analysis, Twitter, Polarization

Extended Abstract

The sharing of vaccine-related information on social media has intensified the long-standing issue of vaccine hesitancy [1]. This tendency became even more pronounced in the context of COVID-19 vaccine information which has been termed an “infodemic” [2]. An illustrative case of vaccine hesitancy can be seen in the human papillomavirus (HPV) vaccination program in Japan. In Japan, HPV vaccination was introduced into the national immunization program for girls aged 12-16 years in April of 2013. However, in June of 2013, in response to reports of possible adverse reactions to the vaccine, the Japanese government temporarily suspended its proactive recommendation for HPV vaccination. After years of debate over its benefits and safety, the Japanese government reinstated its proactive recommendation for free HPV vaccination in 2022, and in 2023 introduced the highly effective 9-valent vaccine offering broader protection. These developments represent a renewed effort to reduce the incidence of cervical cancer among women. Thus, in Japan, public opinion on HPV vaccination experienced a major shift over the decade following 2013.

Research on public opinion regarding HPV vaccination in Japan has been conducted from various perspectives, including public health. The period of major opinion shifts since 2013 coincides with the rapid spread of Twitter use in Japan, making social media a particularly important resource for analysis. Previous research on Twitter discourse about HPV vaccine has shown that pro- and anti-vaccine users were roughly balanced in 2016, with pro-vaccine voices becoming dominant in 2017 [3]. However, the factors driving this shift remain unclear, as their yearly analysis could not capture the detailed dynamics around 2015 when opinions were rapidly changing.

This study aims to address this gap by focusing on the transitional period between 2014 and 2016, with the objective of clarifying the factors underlying the observed change in public opinion. Specifically, we collected approximately 710,000 Japanese tweets containing the keywords related to the HPV vaccine during this period. Using this dataset, we will construct monthly retweet networks to analyze the evolution of interactions between pro- and anti-vaccine groups. This approach allows us to move beyond yearly trends and capture finer-grained temporal dynamics in opinion polarization. All data analyzed in this study were obtained exclusively from publicly available posts on Twitter, in accordance with the platform’s terms of service. No personally identifiable information was accessed, and the study was conducted solely for academic research purposes.

Our preliminary analysis revealed that, despite an overall decline in tweet volume in 2015, the proportion of pro-vaccine content increased sharply. This pattern suggests that anti-vaccine activity may have temporarily subsided, while latent pro-vaccine supporters became more active. Furthermore, when constructing annual retweet networks, we observed the emergence of clearly opposing communities, with 2015 marking a turning point (Fig.1). In this research, we extend our analysis by applying the community detection and conducting

micro-level tracking of influential users to clarify how pro-vaccine discourse emerged and gained momentum.

The findings of this study contribute to the growing body of literature on health communication in the digital era. By illuminating how public health–related information spreads on social media and how opinion shifts occur, we provide valuable insights into the processes of opinion formation in online contexts. Ultimately, our results have practical implications for the design of effective communication strategies that promote accurate information dissemination, counter misinformation, and enhance vaccine acceptance in the future.

Acknowledgment

This work was supported by JSPS KAKENHI Grant Numbers 23K27850, 23K28192.

References

[1] Eve Dube, Caroline Laberge, Maryse Guay, Paul Bramadat, Real Roy and Julie A. Bettinger. “Vaccine hesitancy”. Human Vaccine and Immunotherapeutics, Volume 9, Issue 8 (2013), pp. 1763-1773

[2] John Zarocostas. “How to fight an infodemic”. Lancet, Volume 395, Issue 10225 (2020), pp. 676

[3] Dongwoo Lim, Fujio Toriumi, Mikihito Tanaka. “Conflicts and Changes in Pros and Cons on Twitter in Japan over HPV Vaccine”. In Proc. The 36th Annual Conference of the Japanese Society for Artificial Intelligence (2022), pp. 2B6-GS-10-04.

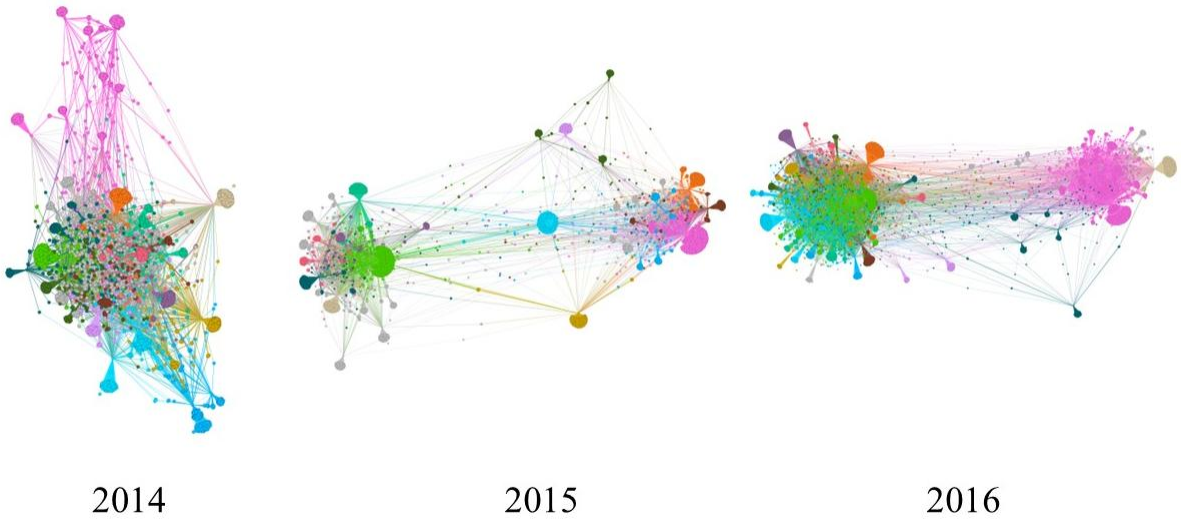

Figure 1. **Retweet networks on HPV vaccination in Japan for 2014, 2015, and 2016.** Each node represents a Twitter user, and edges indicate retweet relationships. Colors denote communities detected by the Louvain method. The networks were visualized using Gephi with the ForceAtlas2 layout.