e-ISSN: 2637-0611

Available online at
https://journal.uitm.edu.my/ojs/index.php/COS

Compendium of Oral Science 12 (2) 2025, 64 - 79

Compendium of Oral Science

A Netnography on Misinformation and Public Perceptions towards Human Papillomavirus Vaccination for Oral Cancer Prevention in Malaysia

Nurin Atheela Hairudin[1], Nur Syuhada Abdul Majeed[1], Nurul Ain Noorjamal[2], Nuruliza Roslan[3], Eddy Hasrul Hassan[2*]

[1]*Faculty of Dentistry, Universiti Teknologi MARA Sungai Buloh Campus, Jalan Hospital, 47000 Sungai Buloh, Selangor, Malaysia*
[2]*Centre of Preclinical Science Studies, Faculty of Dentistry, Universiti Teknologi MARA Sungai Buloh Campus, Jalan Hospital, 47000 Sungai Buloh, Selangor, Malaysia*
[3]*Department of Medical Sciences I, Faculty of Medicine and Health Sciences, Universiti Sains Islam Malaysia, Persiaran Ilmu, Putra Nilai, 71800 Nilai, Negeri Sembilan, Malaysia*

ARTICLE INFO

Article history:
Received 06 July 2024
Revised 12 October 2024
Accepted 10 January 2025
Online First
Published 01 September 2025

Keywords:
misinformation
public perceptions
HPV vaccine
oral cancer
social listening
Malaysia

DOI:
10.24191/cos.v12i2.8825

ABSTRACT

The amount of repeated misinformation regarding Human Papillomavirus (HPV) vaccination over social media and internet affects general public perception and knowledge about the association between HPV vaccine and oral cancer.

Objective: This study aims to investigate misinformation and public perceptions towards HPV vaccination for oral cancer prevention in Malaysia, focusing specifically on X (formerly Twitter) and Facebook data.

Methods: Adopting a qualitative approach, this study utilizes online ethnographic methods (social listening) to explore discussions, sentiments, and trends surrounding HPV vaccination on X and Facebook from January 2022 to March 2024. Data collection involves monitoring tweets/posts related to HPV vaccination and oral cancer prevention in the Malaysian context. Analytical techniques such as content analysis, sentiment analysis, and thematic coding are employed to identify patterns, themes, and attitudes towards HPV vaccination.

Results: From the 1,399 posts by 547 unique users, findings from the study reveal prevalent misinformation and varied public perceptions towards HPV vaccination on X and Facebook in Malaysia. Content analysis identifies common themes and misconceptions (health, safety, inefficacy, and pharmacology) surrounding HPV vaccination, while sentiment analysis highlights divergent attitudes within the X and Facebook community.

[2*] Corresponding author. *E-mail address*: eddyhasrul@uitm.edu.my

Conclusion: The study provides valuable insights into the prevalence of misinformation and public perceptions towards HPV vaccination for oral cancer prevention on X and Facebook in Malaysia. By understanding the dynamics of online discourse on this platform, policymakers and healthcare professionals can develop targeted interventions to address misinformation, improve vaccine acceptance, and promote public health awareness among X and Facebook users.

1. INTRODUCTION

HPV consists of double-stranded DNA viruses that infect the epithelium. High-risk types (e.g. 6, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, and 59) can cause malignancies that are precursors to cancer (Centers for Disease Control and Prevention [CDC], 2021). In addition to cervical cancer, high-risk HPV infection is linked to less common anogenital cancers such as vulva, vaginal, penis and anal cancer; in fact, these HPV types are capable of causing oropharyngeal cancer (Centers for Disease Control and Prevention [CDC], 2021). Habits of alcohol consumption, betel quid chewing, tobacco smoking as well as other socio-demographic factors; oral intercourse, multiple partners, unprotected contact with someone infected with HPV, immunocompromised individuals and family history of tumors can be the risk factors. Detecting HPV infection is difficult because most HPV infections are asymptomatic (Jo et al., 2022).

Recent studies indicate that human papillomavirus (HPV) infection is a significant risk factor for oral squamous cell carcinoma (OSCC) (Arora et al., 2018). As a result of cervical cancer screening, there has been a decline in cervical cancer over the past few decades, but an increase in oropharyngeal cancer, possibly as a result of changing sexual behaviors, has been detected (Markowitz & Schiller, 2021). Compared to the majority of developed countries, Malaysia has a substantially poorer 5-year survival rate for individuals with oral cancer after receiving surgery and radiation therapy – nearly 50% (Ahmad et al., 2021). The HPV vaccination is a major development in cancer prevention, as it has the potential to significantly lower and potentially eradicate malignancies linked to HPV (Massey et al. 2020). The three FDA-approved vaccines for the prevention of diseases caused by HPV infection are Gardasil, Gardasil 9, and Cervarix (Badgujar et al., 2019). According to Ndon et al. (2023), the main method of prevention for HPV-associated OSCC is HPV vaccinations; however, there are differences in the gender neutrality and coverage of HPV vaccination programmes. Moreover, HPV vaccinations are among the most effective preventative vaccines available and have set several major milestones in human vaccinology (Markowitz & Schiller, 2021).

In recent years, social listening (SL) has emerged as a powerful tool for understanding and analyzing online conversations. As the digital landscape continues to evolve, researchers and organizations recognize the need to tap into the vast amount of data generated by social media platforms, forums, and blogs. SL is a process that uses platforms' algorithms that rely on artificial intelligence (AI) and machine learning to collect information from many online resources in order to determine emotions, opinions and themes in real time (Boatman et al., 2024). Social listening goes beyond mere monitoring; it involves actively analyzing sentiments, trends, and user-generated content to gain insights into consumer behavior, brand perception, and emerging topics. The findings from these SL analyses will provide valuable insights into the perceptions, experiences, and attitudes of individuals towards HPV-related topics within the digital realm.

The discussion regarding HPV and HPV vaccination on social media can be positively or negatively influenced by both individual social media users and news media coverage (Ortiz et al., 2019). Anti-vaccine propaganda regarding HPV can have a negative impact on HPV awareness and knowledge, and those who have not been vaccinated yet are more likely to contribute to an infectious disease outbreak (Jo et al., 2022). Furthermore, posts on the anti-vaccine network that promoted conspiracy theories included claims that various parties (such as the government, nonprofit organizations, or industry) aimed to promote HPV vaccination for unethical purposes (Massey et al., 2020). According to the findings of the analysis, social

https://doi.org/10.24191/cos.v12i2.8825

media can be a source of knowledge and conversation regarding HPV and HPV vaccine for many individuals, however the material to which individuals may be exposed is not always thorough, accurate or favorable (Ortiz et al., 2019).

The current study discovered a lack of knowledge concerning HPV and OSCC, including the most prevalent site of occurrence, the relevance of distinguishing from other OSCC, and the availability of vaccination in Malaysia (Arora et al., 2018). HPV vaccinations have shown remarkable effectiveness in clinical trials as well as impact in real-world situations across a wide range of HPV-associated diseases (Markowitz & Schiller, 2021). Regardless of study design, comparative studies revealed a high HPV vaccine efficiency on oral and oropharyngeal HPV infection (Nielsen et al., 2021). However, the usage of HPV vaccine to prevent these cancers has sparked controversy due to the spread of misleading information and false claims on the safety and efficacy of the vaccine (Badgujar et al., 2019). Thus, the aim of this study is to identify contents and frequencies of occurrence of misinformation and misconceptions about HPV vaccine for oral cancer prevention on X and Facebook in Malaysia and to evaluate the reach (audience engagement) of the misinformation and misconceptions about HPV vaccine for oral cancer prevention on X and Facebook.

2. MATERIALS AND METHOD

2.1 Ethical considerations

Ethical exemption approval was granted by Universiti Teknologi MARA (UiTM) Human Research Ethics Advisory Committee [FRC/02/2023(ERP/24/36)] prior to the commencement of the study.

2.2 Study design

Adopting a qualitative approach, this study utilizes online ethnographic methods (social listening) to explore discussions, sentiments, and trends surrounding HPV vaccination on X and Facebook from January 2022 to March 2024. Data collection involves monitoring tweets or posts related to HPV vaccination and oral cancer prevention in the Malaysian context. Analytical techniques such as content analysis, sentiment analysis, and thematic coding are employed to identify patterns, themes, and attitudes towards HPV vaccination for oral cancer prevention.

2.3 Search strategy

The search was done by retrieving tweets and posts posted from January 2022 to March 2024 via X and Facebook application program interface (API) stream through the collaboration with SOCIO (Selangor, MY), a local commercial SL platform. Hashtags has been used including #HPV, #HPVvaccine, #Gardasil, #OralCancer and #MythsVsFacts as well as an English and Malay language filter and retweets-excluding filter. Combinations of Malay and English keywords such as oral, oralcancer, mulut, kansermulut were also included in the filter. Tweets/Posts in languages other than English and Malay were not evaluated. Links to external sites from the tweets/posts were also excluded. Sample does not contain any tweets/posts from private X and Facebook accounts. About 1,399 HPV-vaccine related tweets/posts has been extracted from January 2022 to March 2024 using the hashtags related to HPV (e.g. #HPV, #HPVvaccine, #Gardasil, #OralCancer and #MythsVsFacts).

2.4 Data cleaning

Data collected that contained neither support nor concern were excluded. Any missing data variables (audience engagement, post text, postdate, etc.) were also excluded from analyses.

https://doi.org/10.24191/cos.v12i2.8825

2.5 Themes

Data collected is divided into two main categories, which are support and misinformation. A tweet/post categorized to be supportive or educational if it provides information about HPV infection, treatment, prevention or where to get vaccinated. A tweet/post categorized as misinformation if it raised concern about the HPV vaccine. However, for the tweets/posts that have some degree of misinformation, it was further sub-categorized into specific division(s) of misinformation, including health, safety, inefficacy, and pharmacology.

The first category was health concerns, whether the tweets/posts express fear over adverse side effects, multiple injections and potential risk they see from receiving HPV vaccination. Any mention of certain health issues, such as death, autoimmune disorders, or cancer, fell under this grouping. The second category, safety concern, manipulated whether the tweets/posts concerning the newness of the vaccine and its safety. The Halal issue of the vaccine, increased sexual behavior among adolescents, and the presence of contaminants in the HPV vaccine were also included in this group if mentioned. The third category was inefficacy concern, whether the tweets/posts included false information, including that the HPV vaccine can cause HPV infection or even other HPV-related cancers, the unproven efficacy of the vaccine, and that boys and men do not get cervical cancer, so they do not need the HPV vaccine, were categorized in this group. The fourth category, pharmacology concern, whether tweets/posts mentioned any specific HPV vaccination pharmaceutical manufacturer names and convey negative information. For example, Cervarix, Gardasil 4 and Gardasil 9.

2.6 Data management

All data retrieved were managed using Microsoft Excel and R Studio. This will automate data analyses and lessen the possibility of human error throughout the statistical analysis process.

2.7 Statistical analyses

In this study, statistical analyses primarily involved descriptive statistics to characterize the qualitative data obtained through SL, including frequencies, percentages, and thematic coding to identify prevalent themes and patterns within the online discussions related to HPV vaccine for oral cancer prevention. Additionally, inferential statistics such as content analysis or sentiment analysis were employed to quantify the sentiment or tone of the discussions.

3. RESULTS

3.1 Frequency of misinformation

From the 1,399 posts by 547 unique users, approximately 11% (n=1) of the retrospective content analysis of HPV-related content on X in 2022 included misinformation about the HPV vaccine, whereas 88.9% (n=8) of the content on Facebook had the same misinformation. In 2023, 10% (n=10) of Facebook posts and 38% (n=6) of X tweets contained misinformation regarding the HPV vaccine. But during the first two months of 2024, there was no HPV-related misinformation on X, and there were false posts on Facebook in 100% of the posts. Table 1 shows the number of tweets and posts on HPV vaccine by year, by supportive versus misinformation.

https://doi.org/10.24191/cos.v12i2.8825

Table 1. Number (Percentage) of support versus misinformation HPV vaccine tweets/posts between 2022 to 2024

Month	Total No.	Support n (%)		Misinformation n (%)	
		X	Facebook	X	Facebook
Total	193	73	93	7	20
January 2022 - December 2022	54	31 (68.89)	14 (31.11)	1 (11.11)	8 (88.89)
January 2023 - December 2023	84	23 (33.82)	45 (66.18)	6 (37.50)	10 (62.50)
January 2024 - March 2024	55	19 (35.85)	34 (65.15)	0 (0.00)	2 (100.00)

3.2 Posts related to oral cancer

Table 2 shows the only Facebook post that mentioned about the ability of HPV vaccine in preventing oral cancer.

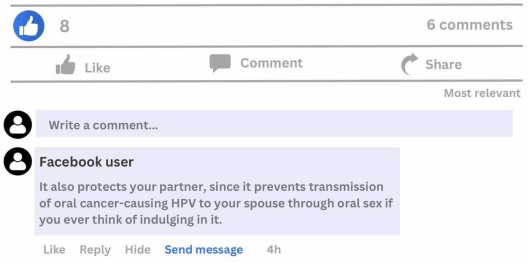

Table 2. HPV-related posts concern of preventing oral cancer

Platform	Post	Type of post	Sentiment
Facebook	It also protects your partner, since it prevents transmission of oral cancer-causing HPV to your spouse through oral sex if you ever think of indulging in it.	Replies and comments	Positive

3.3 Types of Misinformation

Among the subcategories of misinformation tweets or posts from X and Facebook, tweets and posts containing health-related concerns (57.14%, n=16/28) were the most frequently occurring (Table 3) with adverse side effects as commonly identified in the literature. Misinformation concerning the vaccine inefficacy accounts for (32.14%, n=9/28). The least common tweets/posts contained misinformation about safety and pharma with both approximately 10.71% (n=3/28) of tweets and posts.

https://doi.org/10.24191/cos.v12i2.8825

Table 3. Categories of concern-related tweets/posts about HPV vaccine

Type of Concern	Definition and Example tweet/post	Number of tweets/posts, n (%)
Health	Vaccine has adverse side effects, multiple injections and potential risk causing death, autoimmune disorders, or cancer, fell under this grouping Examples: *"Tak tau ke cerita dia kena halau dgn India tahun 2006 ..sbb vaksin 1st dia...hpv ..bermasalah..anak gadis alami masalah haid.."* *"masa Form1 dulu aku kena cucuk HPV pun ada juga kesan sampingan."* *"Xpcaya dah vaksin2 ni. Anak sdara amik vksin hpv smpi skrg dpt aefi sakit kulit xsembuh2"*	16 (57.14)
Safety	The newness and safety of the HPV vaccine, its Halal issue, increased sexual behavior among adolescents, and the presence of contaminants Example: *"Aku dah cucuk, mak aku dah cucuk, ayah aku dah cucuk. Kitorng cucuk je 3 dos, alhamdulillah masih sihat. Tapi kalau nak suh ke 4, 5, 6, tak apa la. Aku ni bukan nye suka sangat kena cucuk ?? Vaksin HPV pon aku tak cucuk lagi sbb takut jarum Huhu"*	1 (3.57)
Inefficacy	HPV vaccine can cause HPV infection or even other HPV-related cancers, the unproven efficacy of the vaccine, and that boys and men do not get cervical cancer, so they do not need the HPV vaccine Examples: *"HPV takde ujian nak kesan kat lelaki."* *"l was diagnosed with Human virus (HPV) 1years ago and I met a doctor he told me there is no cure."*	9 (32.14)
Pharma	Any specific HPV vaccination pharmaceutical manufacturer names (Cervarix, Gardasil 4, Gardasil 9) and convey negative information. Example: *"Dia pernah gagal buat vaksin hpv kat india , afrika ...tahun 2006 ..."*	2 (7.14)

3.4 Audience Engagement

Based on Table 4, Facebook has a higher number of original posts as compared to X with 44.81% and 8.26%, respectively. However, X has a special feature of retweeting or reposting an original tweet with a percentage of 88.77% (n=419). Facebook shows higher numbers of replies compared to X with replies count difference of 470 showing high engagement rates of users in Facebook.

Table 4. Number and percentage breakdown of posts from year 2022 to 2024

Platform	Type	Number of posts, n	Percentage (%)
X	Original	39	8.26
	Retweet/ reposts	419	88.77
	Reply	14	2.97
Facebook	Original	393	44.81
	Reply	484	55.19

https://doi.org/10.24191/cos.v12i2.8825

3.5 Demographic

Based on Table 5, most of the HPV-related posts in Facebook and Twitter/X did not mention gender with 98.27% (n=853/868) and 85.23% (n=401/470), respectively. Approximately on Twitter/X, there are 24 posts by males and 45 posts by females, while on Facebook, males have made 6 posts while females have made 9 posts related to HPV vaccination.

Table 5. Percentage of males and females who shared posts on X and Facebook

Platform	Gender	Count	Percentage (%)
X	Male	24	5.11
	Female	45	9.57
	Unknown	401	85.32
Facebook	Male	6	0.69
	Female	9	1.04
	Unknown	853	98.27

Based on Table 6, on Twitter/X, there have been 5 misinformation-related posts from males, none from females and 2 posts from unknown gender. On Facebook, there are no misinformation-related posts from males and females, but 20 posts are from unknown gender.

Table 6. Gender distribution of misinformation-related posts on Twitter/X and Facebook

Platform	Gender	Count	Percentage (%)
X	Male	5	18.52
	Female	0	0.00
	Unknown	2	7.41
Facebook	Male	0	0.00
	Female	0	0.00
	Unknown	20	74.07

https://doi.org/10.24191/cos.v12i2.8825

3.6 States

Based on Table 7, Selangor recorded the highest user tweets and posts in X and Facebook with n=504, while Terengganu has the least users with less than 1% (n=6).

Table 7. Top states in Malaysia that people tweeted from X and Facebook

States	Count	Percentage (%)
Sabah	13	1.59
Sarawak	37	4.53
Johor	82	10.06
Melaka	9	1.10
Selangor	504	61.84
Kuala Lumpur	91	11.17
Pahang	9	1.10
Terengganu	6	0.74
Kelantan	8	0.98
Perak	9	1.10
Kedah	7	0.86
Perlis	14	1.72
Pulau Pinang	26	3.19
TOTAL	**815**	

https://doi.org/10.24191/cos.v12i2.8825

Table 8 shows the percentage of misinformation tweets/posts from Selangor which is the highest compared to the other states with 21.33% (n=16).

Table 8. Number (Percentage) of misinformation tweet/post from each state in Malaysia

States	Count, n		Percentage of misinformation (%)
	Support	Misinformation	
Sabah	2	0	0.00
Sarawak	1	0	0.00
Johor	11	3	4.00
Melaka	0	1	1.33
Selangor	19	16	21.33
Kuala Lumpur	10	5	6.67
Pahang	1	0	0.00
Terengganu	0	0	0.00
Kelantan	1	0	0.00
Perak	1	0	0.00
Kedah	0	0	0.00
Perlis	1	2	2.67
Pulau Pinang	1	0	0.00
TOTAL	**75**		

4. DISCUSSION

In comparison to the other states, Selangor accounts for the majority of misinformation tweets and posts related to the HPV vaccine on X and Facebook. The frequency of misinformation was relatively low compared to support or pro-vaccine tweets or posts within the 2 years and 3 months period of data included in this study. Based on findings, it was observed that the types of misinformation most frequently encountered were related to the health category which concerns adverse effects of the vaccine, with the inefficacy category coming in second place. When it comes to vaccine hesitancy, fear of side effects is an important issue and this demonstrates how easily this fear may transform into inaccurate medical information and exaggerated side effect stories (Skafle et al., 2022). Facebook shows higher audience engagement in terms of replies compared to X and this corresponds to the existing research related to misinformation frequency in Facebook. According to Maritza et al. (2023), Facebook has an impact on public health because it exploits the practice of sharing information without first confirming its legitimacy and distorts it, risking the safety of its users. Luo et al. (2021) stated that women spent more time on social media than men, and this correlates with our findings that females possess a higher percentage of gender who share posts on Twitter/X and Facebook compared to males.

https://doi.org/10.24191/cos.v12i2.8825

A tweet/post was classified as support if it included information about HPV infection, treatment or prevention, and neutral if it merely mentioned HPV in general. A tweet/post is classified as misinformation if it raises concerns about the HPV vaccine. Four main categories of HPV vaccine misinformation have been analyzed which include health, safety, inefficacy and pharma. Health-related issues such as adverse side effects and potential risk were the main concern of the users with over 50% of misinformation tweets and posts related to this issue and this health-related vaccine misinformation corresponds to existing research. According to Kornides et al. (2021), health-related misinformation was by far the most prevalent category of misinformation, accounting for 60% of the posts that contained misinformation. Misinformation posts about vaccinations emphasized the seriousness and vulnerability of vaccine-related injuries in relation to health beliefs. Severity posts focus on dangerous side effects, illnesses and even death in addition to possible unknown long-term effects (Massey et al., 2020). In a study conducted by Schelbar et al. (2024), the participants conveyed concerns over the possible adverse side effects of HPV vaccination on their child, stressing the necessity for medical professionals to address vaccine side effects during consultation. We believe that a post that is too general or unclear could allow social media users to interpret the threat in their own way. Research has shown that social media users who are exposed to posts about the HPV vaccine are more likely to remember the drawbacks of the vaccine rather than remembering its benefits (Margolis et al., 2019). Such vagueness can make a statement more psychologically threatening because it allows individuals to imagine a wide range of possibilities, often leading to an exaggerated perception of risk. Unfortunately, this may spread false information about the HPV vaccine.

The higher reach of the audience on both platforms, X and Facebook is concerning as many people rely on social media for information. These users might become accustomed to only seeing brief news updates and visually appealing teasers that link to original articles, since they might primarily rely on social media for their news consumption (Kožuh & Čakš, 2021). However, using social media as the primary source of news is linked to lower trust in news (Kalogeropoulos et al., 2019). Nowadays, young people have frequent and easy access to news sources on online platforms, but they must be cautious about the reliability of the sources from which information is derived (Majerczak & Strzelecki, 2022). Therefore, parents and teachers should play a significant role in educating them in verifying sources available online.

According to Internet Users Survey 2020 (IUS) from Malaysians Communications and Multimedia Commission (MCMC), getting information online is the fifth most frequent online activity among Internet users, a decrease from 85.5% in 2018 to 74.3% in 2020. Reading E-books, journals and other online publications is more well-liked. According to the survey, the proportion of online readers on the Internet increased from 56.3% in 2018 to 68.3% in 2020. Facebook continues to be the most popular social media platform in Malaysia, however its usage among Internet users fell from 97.3% in 2018 to 91.7% in 2020. Other applications including X/Twitter, Instagram and Youtube have seen a surge in usage. Youtube has the most significant increase in users from 48.3% in 2018 to 80.6% in 2020. While X/Twitter users increased from 23.8% to 37.1% within the same time period, Instagram users increased from 57% in 2018 to 63.1% in 2020.

We discovered that the misinformation posts regarding HPV often lack gender specificity, making it more relatable to a wider audience and potentially increasing its virality and spread across different demographics. However, it might be difficult to identify users' demographics behind their social media accounts because of the platform's privacy policy or users' choices to disclose their information (Burel et al., 2021).

Findings in this study also revealed only one post that discussed the ability of HPV vaccination in preventing oral cancer, specifically on Facebook. The limited discussion on this context could be from several factors. Lack of awareness could be the main reason for lack of discussion on HPV vaccination in preventing oral cancer. While females, students, singles, and urban residents typically have good knowledge about HPV, males, those in rural areas, and married individuals require greater awareness of

https://doi.org/10.24191/cos.v12i2.8825

the topic (Badgujar et al., 2019). According to a study by Verhees et al. (2021), among those who were aware of HPV, only 29.2% were knowledgeable about its connection to oropharyngeal cancer (OPC). Lack of visibility also can influence the users' knowledge on HPV vaccination in preventing oral cancer. This is where social media algorithms tend to prioritize content based on popularity and its engagement. We hypothesize that if the post is related to the ability of the HPV vaccine in preventing oral cancer and does not have as much engagement as other trending topics, this may lead to reduced visibility of POV-related posts on users' feed. Stigma and taboos discussing sexually transmitted infections (STIs) and oral cancers have led to a limited discussion about HPV's role in preventing oral cancer on social media. The belief that the vaccine could increase the likelihood of a child engaging in sexual activity was linked to mentioning social media as a source of information about the vaccine (McKenzie et al., 2023). Some individuals also can be discouraged to have an open dialogue on STIs and HPV vaccine causing them to feel uncomfortable discussing it openly. A study conducted by McKenzie (2019) also reveals that social media platforms could provide them more comfortable space for concerned parents to seek information about HPV vaccine. Malaysia's Muslim majority culture creates barriers to sexual and reproductive health information, support and practices due to sex-related sensitivities, limiting open discussions within families and society (Wong et al., 2020). Therefore, it is crucial for us to inform the healthcare providers about HPV vaccination to educate, spread awareness and underscore the significance of knowing HPV's role in preventing oral squamous cell carcinoma (OSCC) or oral cancer, alongside highlighting behaviors that increase the risk of contracting HPV infection. This approach will ensure that healthcare professionals are equipped with necessary knowledge to effectively communicate the importance of HPV vaccination and oral cancer prevention to their patients.

The COVID-19 pandemic has influenced public perceptions of vaccines in general. The response to COVID-19 pandemic may alter public perceptions towards other vaccines available for other diseases (Paguio et al., 2020). The pandemic has led to widespread misinformation on COVID-19 vaccines, particularly on social media, which can reduce trust in vaccines. This misinformation can extend skepticism to other vaccines, such as the HPV vaccine. The pandemic has impacted individuals' perceptions on vaccines in general, making it crucial to be cautious about the spread of false information. X/Twitter and Facebook are reported to dominate the low credibility sources during the early COVID-19 pandemic, outperforming the traditional news and media sources (Brennan et al., 2020). A study conducted by Machado et al. (2021), social media misinformation and disinformation regarding COVID-19 heightens vaccine hesitancy, lowers immunization rates, and results in avoidable fatalities, especially for particular demographic groups.

The pandemic's strain on healthcare systems may indirectly impact routine vaccine delivery. In several European countries, the COVID-19 pandemic has caused severe disruptions to the healthcare system, including a decrease in delivery of HPV vaccines (Gountas et al., 2023). The pandemic has disrupted routine immunization programs, leading to missed opportunities for HPV vaccination, causing hesitancy or delays. Lockdowns, restrictions, and concerns about healthcare facilities have made it difficult for individuals to obtain the vaccine. This is also supported by Boucher et al. (2023) where COVID-19 pandemic has an impact on routine vaccination programmes due to delays in children vaccination and school- and community-based immunization programmes. WHO and UNICEF reported that the COVID-19 pandemic has prevented 1.6 million girls and 23 million children worldwide from receiving their planned COVID-19 and HPV immunization in 2020. The Ministry of Health Malaysia (MOH) predicts that 225,000 13-year-old schoolgirls may have missed or received incomplete HPV vaccination doses in 2020 and 2021 (Rao et al., 2022). The National HPV Immunization Program is the only option for teenage girls aged 13 to receive a free HPV vaccine. However, MOH was unable to provide additional vaccinations at government clinics due to shortage of healthcare workers from 2020 to 2021 (Rao et al., 2022). Reduced access to healthcare services may have contributed to delays or missed doses, leading to lower vaccination rates. Fortunately, the Malaysian Ministry of Health (MOH) announced that the goal of the MOH is to finish the catch-up vaccination against the human papillomavirus for the 2021 cohort of Form One girls who were not

https://doi.org/10.24191/cos.v12i2.8825

vaccinated because of supply issues worldwide. As of January 2023, an estimated 567,151 eligible girls who have not yet received the vaccine and this decision was made in considering this. The MOH intends to immunize the cohorts of 2022 and 2023 in accordance with this year's vaccine stocks (Codeblue, 2023).

The pandemic's focus on COVID-19 prevention and treatment may have diverted resources from routine vaccinations like HPV vaccine. As a result of the response to COVID-19 and changes in health behaviour during pandemics, vaccination programmes for other diseases may become less important, and evaluating their effectiveness may become more challenging (Paguio et al., 2020). The pandemic's shift in health behaviors and risk perceptions could potentially influence individuals' decisions regarding HPV vaccination. It is alarming that more efforts need to be directed towards boosting parental trust on vaccination since over 11% of pediatricians reported seeing an increase in HPV vaccine reluctance since the start of COVID-19 pandemic (Ryan et al., 2023). However, in a research conducted by Schelbar et al. (2023), parents' perception towards HPV vaccine remained minimally altered despite decreased vaccination rates during COVID-19 pandemic. In contrast, a study conducted by Schelbar et al. (2024) demonstrated that more individuals started and did not finish their HPV vaccine series compared to COVID-19 vaccine series due to shorter interval (2 weeks) compared to 5 months for HPV vaccine series. However, Schelbar et al. (2024) also found that there was no correlation between HPV vaccination status and the impact of pandemic events on individuals' HPV vaccine perceptions.

In the Malaysian context, policymakers and healthcare professionals can take several actions to address the limited discussion about the HPV vaccine's role in preventing oral cancer on social media and in a broader public discourse. They can run comprehensive public education campaigns aimed to raise awareness about HPV and its link to various cancers including oral cancer together with the importance of getting HPV vaccine. Based on a study conducted by Verhees et al. (2021), only 29% of the Dutch population were knowledgeable about the relation of HPV and oropharyngeal cancer (OPC) among those who are aware of HPV. Another study by Lorenzo-Pouso et al. (2022) reveals that there is low level of awareness and understanding regarding HPV, HPV-related illnesses, and the HPV vaccination among Spanish women. In addition, a study by Roslan et al. (2024) reveals poor knowledge of HPV and oral cancer among patients at UiTM Faculty of Dentistry. These campaigns should emphasize on the effectiveness and the safety of the vaccine in preventing not only cervical cancer but also oral cancer. Policymakers and healthcare professionals can collaborate with social media platforms to promote accurate and reliable information about HPV vaccination in preventing oral cancer. This is probably due to lack of trust in them and limited scientific understanding contributing to dissemination of misinformation on social media (Chowdury et al., 2021). This can involve implementing strategies to prioritize trustworthy content, combat misinformation and increase the visibility of the discussions about HPV vaccination on social media platforms. Engagement with influencers, celebrities or other influential figures also can be done by policymakers and healthcare professionals in order to amplify messages about HPV vaccination and oral cancer prevention. Several initiatives that find success have employed social media platforms in distributing information, increasing awareness, knowledge and HPV vaccine acceptance (Ortiz et al. 2019). This can help in reaching a broader audience about HPV vaccination on social media. By implementing these strategies, policymakers and healthcare professionals can play a proactive role in addressing the limited discussions on HPV vaccination in preventing oral cancer.

4.1 Limitations and recommendations

There are several limitations to acknowledge in this study that can be addressed in future research. (1) We restricted our analysis only to Twitter/X and Facebook from January 2022 until March 2024. This is due to restriction to the API system and there is limited access to historical data before the year of 2022. Future studies might look into other social media platforms like Instagram and Tiktok as well, since their audiences are growing. (2) With the usage of numerous search terms, we can expand on our findings in a broader, more comprehensive study of false information regarding the HPV vaccine on various social media

https://doi.org/10.24191/cos.v12i2.8825

platforms. (3) An additional weakness of our study is that a more thorough examination would be necessary to ascertain the intentions of the author to analyze the distinction between posts containing support and misinformation.

5. CONCLUSION

The study provides valuable insights into the prevalence of misinformation and public perceptions towards HPV vaccination for oral cancer prevention on X and Facebook in Malaysia. Malaysian awareness towards HPV vaccine in oral cancer prevention remains low, despite widespread use of the internet and social media, which provide easy access to news and information. Misinformation about HPV vaccines continues to circulate on social media, and it has increased since the COVID-19 pandemic began. The spread of vaccine skepticism via social media poses a severe global threat to public health. By understanding the dynamics of online discourse on this platform, policymakers and healthcare professionals need to create targeted interventions to combat misinformation, increase vaccine acceptance, and promote public health awareness among X and Facebook users. This is to raise their understanding regarding the HPV vaccine for oral cancer prevention, as social media has become a primary source of health-related information.

ACKNOWLEDGMENTS/FUNDING

We extend our sincere gratitude to the dedicated team at SOCIO Intelligence Sdn. Bhd. for their invaluable assistance in data retrieval for this research endeavour.

CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted in the absence of any self-benefits, commercial, or financial conflicts and declare the absence of conflicting interests with the funders.

AUTHORS' CONTRIBUTIONS

All authors participated in designing the study. Nurin Atheela Hairudin and Nur Syuhada Abdul Majeed conducted the literature search and data extraction. All authors contributed to the data analysis and synthesis of data. All authors reviewed and critically contributed to the drafting of the manuscript. All authors have approved the final version of the manuscript.

REFERENCES

Ahmad, P., Nawaz, R., Qurban, M., Shaikh, G. M., Mohamed, R. N., Nagarajappa, A. K., Asif, J. A., & Alam, M. K. (2021). Risk factors associated with the mortality rate of oral squamous cell carcinoma patients: A 10-year retrospective study. *Medicine (Baltimore), 100*(36), e27127. https://doi.org/10.1097/MD.0000000000027127.

Arora, S., Ramachandra, S. S., & Squier, C. (2018). Knowledge about human papillomavirus (HPV) related oral cancers among oral health professionals in university setting–A cross sectional study. *Journal of oral biology and craniofacial research,8*(1), 35-9. https://doi.org/10.1016/j.jobcr.2017.12.002.

Badgujar, V. B., Ahmad Fadzil, F. S., Balbir Singh, H. K., Sami, F., Badgujar, S., & Ansari, M. T. (2019).Knowledge, understanding, attitude, perception and views on HPV infection and vaccination among health care students and professionals in Malaysia. *Human Vaccines & Immunotherapeutics, 15*(1), 156-162. https://doi.org/10.1080/21645515.2018.1518843.

Boucher, J. C., Kim, S.Y., Jessiman-Perreault, G., Edwards, J., Smith, H., Frenette, N., Badami, A., & Scott, L. A. (2023). HPV vaccine narratives on Twitter during the COVID-19 pandemic: a social network, thematic, and sentiment analysis. *BMC Public Health 23*(1), 694. https://doi.org/10.1186/s12889-023-15615-w.

Burel, G., Farrell, T., & Alani, H. (2021). Demographics and topics impact on the co-spread of COVID-19 misinformation and fact-checks on Twitter. *Information processing & management, 58*(6), 102732. https://doi.org/10.1016/j.ipm.2021.102732.

Chowdhury, N., Khalid, A., & Turin, T. C. (2021). Understanding misinformation infodemic during public health emergencies due to large-scale disease outbreaks: A rapid review. *Journal of Public Health, 31*(4), 553-573. https://doi.org/10.1007/s10389-021-01565-3.

CodeBlue. MOH Prioritising HPV Catch-Up Vaccination For 2021 Cohort [Internet]. Social Health Analytics Sdn Bhd; 2023 March [cited 2024 March 30]. Available from: https://codeblue.galencentre.org/2023/03/21/moh-prioritising-hpv-catch-up-vaccination-for-2021-cohort/

Gountas, I., Favre-Bulle, A., Saxena, K., Wilcock, J., Collings, H., Salomonsson, S., Skroumpelos, A., & Sabale, U. (2023). Impact of the COVID-19 Pandemic on HPV Vaccinations in Switzerland and Greece: Road to Recovery. *Vaccines, 11*(2), 258. https://doi.org/10.3390/vaccines11020258.

Jo, S., Pituch, K. A., & Howe, N. (2022) The Relationships Between Social Media and Human Papillomavirus Awareness and Knowledge: Cross-sectional Study. *JMIR Public Health and Surveillance, 8*(9), e37274. https://doi.org/10.2196/37274.

Kalogeropoulos, A., Suiter, J., Udris, L., & Eisenegger, M. (2019). News Media Trust and News Consumption: Factors Related to Trust in News in 35 Countries. *International Journal of Communication* [Internet]. 2019 Aug 12;13(0):22. Available from: https://ijoc.org/index.php/ijoc/article/view/10141/2745.

Kornides, M. L., Badlis, S., Head, K. J., Putt, M., Cappella, J., & Gonzalez-Hernadez, G. (2023). Exploring content of misinformation about HPV vaccine on twitter. *Journal Behavioral Medicine, 46*(1-2), 239-252. https://doi.org/10.1007/s10865-022-00342-1.

Kožuh, I., & Čakš, P. (2021). Explaining News Trust in Social Media News during the COVID-19 Pandemic-The Role of a Need for Cognition and News Engagement. *International Journal of Environmental Research and Public Health, 18*(24), 12986. https://doi.org/10.3390/ijerph182412986.

Majerczak, P., & Strzelecki, A. (2022). Trust, Media Credibility, Social Ties, and the Intention to Share towards Information Verification in an Age of Fake News. *Behavioral Sciences (Basel), 12*(2), 51. https://doi.org/10.3390/bs12020051.

Lorenzo-Pouso, A. I., Mariño-Méndez, H., Varela-Ponte, C., Pérez-Sayáns, M., Palmeiro-Fernández, G., González-Palanca, S., & Daley, E. M. (2022). Awareness Levels of the Link Between Oropharyngeal Cancer and HPV Infection Among Spanish Women: a Hospital-Based Cross-sectional Study. *Journal of cancer education: the official journal of the American Association for Cancer Education, 37*(2), 296–303. https://doi.org/10.1007/s13187-020-01811-4.

Luo, T., Chen, W., & Liao, Y. (2021). Social media use in China before and during COVID-19: Preliminary results from an online retrospective survey. *Journal of Psychiatric Research, 140*, 35-38. https://doi.org/10.1016/j.jpsychires.2021.05.057.

Malaysian Communications and Multimedia Commission (MCMC) (2020). Internet Users Survey 2020 at https://www.mcmc.gov.my/skmmgovmy/media/General/pdf/IUS-2020-Report.pdf

Margolis, M. A., Brewer, N. T., Shah, P. D., Calo, W. A., & Gilkey, M. B. (2019). Stories about HPV vaccine in social media, traditional media, and conversations. *Preventive Medicine, 118*, 251–256. https://doi.org/10.1016/j.ypmed.2018.11.005.

Markowitz, L. E., & Schiller, J. T. (2021). Human papillomavirus vaccines. *The Journal of Infectious Diseases, 224*(Supplement_4), S367-S378. https://doi.org/10.1093/infdis/jiaa621.

Maritza, E., Pilar del, M., Pilar del, M., Ignacio, C., & Alexander, G. (2023). Examining the Widespread Dissemination of Fake News on Facebook: Political Instability and Health Panic. *Journal of Internet Services and Information Security, 13*(3), 01-15. https://doi.org/10.58346/JISIS.2023.I3.001.

Massey, P. M., Kearney, M. D., Hauer, M. K., Selvan, P., Koku, E., & Leader, A. E. (2020). Dimensions of Misinformation About the HPV Vaccine on Instagram: Content and Network Analysis of Social Media Characteristics. *Journal of Medical Internet Research, 22*(12), e21451. https://doi.org/10.2196/21451.

National Center for Immunization and Respiratory Diseases [NCIRD] (2019). Human Papillomavirus. Centers for Disease Control and Prevention. https://www.cdc.gov/vaccines/pubs/pinkbook/hpv.html.

Ndon, S., Singh, A., Ha, P. K., Aswani, J., Chan, J. Y., & Xu, M. J. (2023). Human Papillomavirus-Associated Oropharyngeal Cancer: Global Epidemiology and Public Policy Implications. *Cancers (Basel), 15*(16), 4080. https://doi.org/10.3390/cancers15164080.

Nielsen, K. J., Jakobsen, K. K., Jensen, J. S., Grønhøj, C., & Von Buchwald, C. (2021). The Effect of Prophylactic HPV Vaccines on Oral and Oropharyngeal HPV Infection-A Systematic Review. *Viruses, 13*(7), 1339. https://doi.org/10.3390/v13071339.

Ortiz, R. R., Smith, A., & Coyne-Beasley, T. (2019). A systematic literature review to examine the potential for social media to impact HPV vaccine uptake and awareness, knowledge, and attitudes about HPV and HPV vaccination. *Human Vaccines & Immunotherapeutics, 15*(7-8), 1465-1475. https://doi.org/10.1080/21645515.2019.1581543.

Paguio, J. A., Yao, J. S., & Dee, E. C. (2020). Silver Lining of COVID-19: Heightened Global Interest in Pneumococcal and Influenza Vaccines, an Infodemiology Study. *Vaccine, 38*(34), 5430–5435. https://doi.org/ 10.1016/j.vaccine.2020.06.069.

Rao, S. R., Kampan, N., Chew, K. T., & Shafiee, M. N. (2022). The impact of the COVID-19 pandemic on the national HPV immunization program in Malaysia. *Frontiers in public health, 10*, 907720. https://doi.org/10.3389/fpubh.2022.907720.

Roslan, N., Mohd Adnan, M., Abdul Rahman, N., Md Bohari, N., & Hassan, E. (2024). Knowledge and Awareness of Human Papillomavirus Vaccination for Oral Cancer Prevention among Dental Practitioners, Students, and Patients at UiTM Faculty of Dentistry, Malaysia. *Compendium Of Oral Science, 11*(1), 68-78. https://doi.org/10.24191/cos.v11i1.26040.

Ryan, G. W., Miotto, M. B., McReynolds, C., Lemon, S. C., Pbert, L., & Trivedi, M. (2023). Pediatricians' perspectives on COVID-19 and HPV vaccine hesitancy. *Human vaccines & immunotherapeutics, 19*(2), 2225388. https://doi.org/10.1080/21645515.2023.2225388.

Schelbar, N., Ward, C. N., Phillips, E., Herr, M. J., Acevedo, S., Conner, H., Greiner, A., & Corriveau, E. (2024). Impact of COVID-19 pandemic and vaccine perceptions on HPV vaccine hesitancy. *American journal of otolaryngology, 45*(2), 104172. https://doi.org/10.1016/j.amjoto.2023.104172.

Skafle, I., Nordahl-Hansen, A., Quintana, D. S., Wynn, R., & Gabarron, E. (2022). Misinformation About COVID-19 Vaccines on Social Media: Rapid Review. *Journal of Medical Internet Research, 24*(8), e37367. https://doi.org/10.2196/37367.

Verhees, F., Demers, I., Schouten, L. J., Lechner, M., Speel, E. M., & Kremer, B. (2021). Public awareness of the association between human papillomavirus and oropharyngeal cancer. *European journal of public health, 31*(5), 1021–1025. https://doi.org/10.1093/eurpub/ckab081.

WHO. UNICEF immunization coverage estimates, 2020 revision. (2021). Available online at: https://www.who.int/docs/default-source/immunization/immunization-coverage/wuenic_notes.pdf?sfvrsn=88ff590d_6

Wong, L. P., Wong, P. F., Megat Hashim, M. M. A. A., Han, L., Lin, Y., Hu, Z., Zhao, Q., & Zimet, G. D. (2020). Multidimensional social and cultural norms influencing HPV vaccine hesitancy in Asia. *Human vaccines & immunotherapeutics, 16*(7), 1611–1622. https://doi.org/10.1080/21645515.2020.1756670.