Vaccination drive and cyber threats in India

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ABSTRACT

Misinformation in social network sites (SNS) is increasing alarmingly and is also affected the healthcare sector especially the developing country like India. The public health programs and the life of people itself are under severe threat. The study is focused on the trends in decreasing vaccination rates in the context of the Measles-Rubella (MR) vaccination drive in India. Twitter data, news reports, and social media posts during the MR vaccination program in India are taken into consideration for the analysis. Vaccine hesitancy has become a global challenge for immunization programs. There are many factors related to vaccine Hesitancy. Based on the methods and study, we had concluded the factors affected the immunization program and suggested the measures to overcome the vaccine hesitancy. The vaccine hesitancy is also associated with political, religious, Psychological and Economic factors in India. These are used by the anti-vaccination campaigners for their vested interests. The vested interests can be propagated during any national or International campaigns and it will get much attention during this time. Social media has been used widely to promote the anti-vaccination campaign which is supported by misinformation and also the fake news.

CCS CONCEPTS

• **Information systems → World Wide Web → Web applications → Social networks** → Public Health → *E-Government*

KEYWORDS

Vaccine Hesitancy, Anti-vaccination, Measles-Rubella, Social Media, Immunization

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1. INTRODUCTION

MR vaccination campaign in India is started to achieve the target of sustainable development goals by the United Nations. The government of India partnered with UNICEF, World Health Organization (WHO) and Lions Club International to bring the benefit of MR vaccine to the children of the age of 9 months to 15 years. As per the WHO fact sheet [1], an estimated two to three million child deaths are due to diphtheria, tetanus, pertussis (whooping cough) and measles were prevented every year by immunization. An additional 1.5 million death may be prevented if the vaccination coverage was improved. Around 19.5 million infants were not provided with the routine immunization vaccine. Nearly thirty-six percentage of death due to measles was contributed by India in the year 2015. It comes around 49200 child deaths which may be prevented by vaccination [2]. India is one of the 10 countries need improvement in the vaccination coverage along with Angola, Brazil, the Democratic Republic of the Congo, Ethiopia, Indonesia, Iraq, Nigeria, Pakistan, and South Africa. A social network can trigger vaccine hesitancy and also can share vaccine information for public opinion. Web and social networks can also be used for fighting the vaccine hesitancy [3]. Mass media have received some attention for the promotion of vaccination [4]. According to WHO officials, the death due to measles declined significantly in India after the introduction of the measles vaccine [5]. The effective vaccination campaign will further reduce the chance of child's early death. As per the survey conducted by UNICEF (2009) in India, 25% of parents were not aware that their children could be protected with vaccines. 11% of parents are not aware that their children should get vaccinated. Some are feared about the side effects of the vaccinations [6]. In this paper, we are

focusing on the reasons for vaccine hesitancy in the context of the anti-vaccination campaign in India during MR Vaccination program. As per the Kerala Development report (2008) by the planning commission of India, Kerala is having the highest literacy rate and the Public Health Care system. Despite these factors, the vaccination program conducted between October 3, 2017, and November 3, 2017, faced a setback in some part of the state and government forced to extend the programme schedule [7]. At the same time, Karnataka state achieved 98.83% vaccination rate held in the month of February 2017 as per the reports (2018) from National Rural Health Mission. Karnataka government faced stiff resistance from the anti-vaccination campaign in social media and other media from Tamil Nadu and Kerala [8]. There are many factors influenced the decline in vaccination rate.

'Misinformation is the false or inaccurate information which is deliberately intended to deceive - oxford dictionary'. There will be a hidden agenda on spreading misinformation and social media is an ideal platform to do that. Irrespective of the physical boundary it will reach wherever the network connectivity is available [9]. The misinformation about Ebola that was spread in Washington DC and Miami in twitter was uncontrollable and created chaos [10]. Over the years the misinformation in social media had created damage in the health care programs and it affected the public health to some extent. The increasing vaccine hesitancy among parents is mainly due to the anti-vaccination campaign and quoting misinformation by linking vaccines with various diseases and side effects [11].

2. LITERATURE REVIEW

Even though the world countries being committed to the immunization targets and agenda set by WHO, they are facing with decreased rates of vaccination [12]. Social media plays a vital role in the reduced rate of vaccination [11]. People rely on the online resources for the health information shared by strangers to get rid of the fee of a traditional source of health advice [12]. There is a need of an analytics tool to identify the misleading false information propagators on the Internet [13].

A study on videos shared in YouTube says that, about 77 percent of the sample videos collected from the YouTube on prostate cancer contained biasing or misinformation or fake content and there is an inverse relation between the popularity of the video content with the misinformation and the expert ratings [14]. The social networks share the news from the mainstream media, fake news sources and the partisan media. Identifying the categories of news sources can prevent spreading of misinformation [15]. There is a need of collaborative effort among social scientists, computer professionals and healthcare professionals along with Internet Service Providers to tackle this situation [16].

The success of immunization depends on the high vaccine effectiveness and adequate uptake of the vaccine. The role of media is very important in a targeted population to be vaccinated in addition to community leaders and healthcare professionals in a vaccination project [17]. The scientific understanding of the project needs to be conveyed through the media regularly and should be included in the communication plan. Incorporation of vaccination campaigns, social mobilization messages [18], peer education, celebrities having influence among the local population [19] and vaccination campaigns in schools and universities will improve the vaccination take up and awareness among people. The communication strength will evolve over time based on the response to change in vaccination coverage levels [20].

Multiple interventions are necessary for the successful campaign of vaccination [21]. Advance announcement of vaccination dates and the repeated remembrance to the non-response would improve the vaccine uptake rate. Training of different professional health workers (HPW) and social workers will also strengthen the vaccination program. The Government should provide sufficient economic support to enhance the vaccination programme [22, 23]. Internet has become too popular and it disseminates large information to common mass within no time. This has also enabled the anti-vaccination agents to propagate their views much easily. So the health workers and Health Care Professionals (HCP) need to be well updated to clear the doubts and concerns raised by the patients. They must be well updated with the data available and counter scientifically with the parents who were vaccine-hesitant. The HCP thus should be enthusiastic and committed [24]. Use of Information Communication Technology (ICT) can reduce the information gap among the communities they are serving [25].

The comments used by both pro- and anti-vaccination propagators are risk related and causation words. They are lesser positive emotion words compared to control comments. Anti-vaccination comments in social media are good at analytical thinking with low authenticity. They refer more on body and health whereas pro-vaccination comments are more authentic [26]. Though people are using a social network for the comments from strangers for medical advice, it is not the substitution for traditional health care [27].

Mitigating the vaccination safety concern is an important factor. If the government and health ministry fail in this aspect, then the vaccination program will get affected. Because of the social media virality [28] nature, the drawbacks in the vaccination program get communicated around the globe within no time. This will affect the immunization program irreversibly. The personal stories about negative consequences in the anti-vaccination web pages created impacts in vaccination program on a large scale. We need well coordinated, innovative and evidence-based pro-vaccine interventions. Multidisciplinary approaches needed for privacy and security issues [29]. The interdisciplinary approach to bring new expertise can alleviate the vaccine acceptance challenges [30, 31].

For the successful vaccination, it is also important to identify the vaccine-hesitant people to understand the reason for the hesitancy and to develop strategies to tackle this. Sometimes Health Care Providers itself may be vaccine-hesitant [32]. If the general practitioners are not well aware of the safety, effectiveness or the importance of vaccination, then they may not be able to effectively address the fear of the patient [33].

Even though the vaccines are safe and effective, as per the global usage, with the major impact on health, the health

organization and authorities are continuously facing the alarming reports of vaccine hesitancy. It depends on some specific vaccine programme [34]. There is a need for global, regional and national level deliberations to tackle this issue. The analysis and strategies followed in different organizations to overcome the decrease in vaccination rate need to be discussed. The responsibility should be assigned to WHO, regional and country advisory committees to tackle this issue [35]. This is to understand and address the complex, context-specific and dynamic nature of vaccine hesitancy. With the improved information technology facility and right to information, there is always a possibility of questions raised by parents for introducing new vaccines. In order to build trust, an open dialogue is essential [36, 37, 38, 39].

There should be some commitment from the people who are benefitting from the vaccine. They must be committed to the wellbeing of the society they live in. When the recipient is a baby, then the guardian or parents should take up the responsibility. The regulatory agencies should also have some fairness in dealing with manufacturers and society. The society must sponsor the research in developing the cross-protective vaccines which will make the society not to take vaccine yearly as they are getting a universal vaccine in advance. By introducing the concept of fairness in the vaccine and vaccination the changes and enhancements will appear faster. The manufacturers are the key players in vaccine production by putting their research over a long period. Finally, they come up with a vaccine with the certification from the regulatory agencies [40, 41, 42]

The vaccination program faces resistance from the anti-vaccination faction because of the emotions and deep rooted beliefs which leads to blind denial. They propagate misleading information, myths, prejudices, and frauds. There are potentially biased pharmaceutical industries which are involved in research and development of vaccines. Similarly, public institutions are also having a research centre. The vaccination process is having success as well as disasters and failures like contaminated vaccines and unsuccessful campaign [43, 44, 45, 46]. Considering both aspects, the achievement of the vaccination program needs collaborative discussion among all stakeholders like industry, academics, government institutions, organizations journals, and public. The open and scientific debate based on comparison and discussing ideas would sterile controversies [47].

The delay in vaccination in middle-income countries is due to poor immunization supply, lack of access to health services and characteristics of family [48]. Sometimes parents also not interested in the vaccination due to the cost involved with it and the lack of knowledge about the benefit of vaccination. In some countries, the family may consist of more number of children in a family which leads to vaccination delay [49]. The delays in vaccine also contribute to the infant morbidity and mortality risk from diseases which are preventable by vaccines. Thus there should be an age-appropriate vaccination indicator as another metric for the measurement of the immunization program's impact [50].

The communicator should be well informed and the communication of risk [51] should be based on accurate data. The big data can be utilized for capturing, storing and analysing the data item of each patient in capturing precision medicine. The information needs to be presented in such a manner that the patient should be understandable without giving any doubts. The HCP should be good communicators. They also can make use of new technological advancements like chat or messages. Listening is also an important aspect to have a fruitful two-way communication [52]. Health communication acts as an emerging area where health education is replacing with behavior and social change [53,54].

Rotavirus (RV) vaccine included in the national immunization program by the recommendation of WHO in Finland (WHO). As per the study, the common cause of severe gastroenteritis among children worldwide is Rotavirus. Almost all children are getting affected by RV gastroenteritis by the age of 5. The RV immunization costs were €2.3 million, which saved €2.2 million as secondary healthcare cost if no immunization is given. Thus the government is saving much on healthcare by providing immunization vaccination to the children under the age of 5[55].

In United States of America, the vaccination rate is going down and the anti-vaccination campaign is going up. It is because of the low incidence of the vaccine preventable diseases. This changed the mind-set of the people from fear of diseases to the side effect of the vaccines [56].

3. METHODOLOGY

Literature Review: Articles are selected from Science direct, pub med databases and random selection by using the keywords "anti-vaccin", "Vaccin", "hesitancy" and "India", we had shortlisted 23 papers based on the results obtained using the above mentioned search keywords. Similarly the reference of the shortlisted papers is also considered for the review.

The MR vaccination campaign in India started in February 2017 and is conducted in a phased manner. We collected the links of the news shared in the social media by giving the search key in the website https://app.buzzsumo.com. That will retrieve the news links and user engagement details in social media like Facebook and Twitter. The selection of this website is mainly due to the fact that it gives the result free of cost and the process is simple. The keywords used are "MR Vaccination" and "measles-rubella" We selected the period from January 2017 to August 2018 because it is the period where the MR vaccination campaign introduced in India in a phased manner to attain the goal of eliminating Measles and Rubella by 2020. The data from the Facebook posts during this period also considered for analysis. In order to gather demographic information, the Government of Kerala Vaccination reports were taken in to consideration. The 'Google Trends' report of this period was also taken for assessing the trends of the MR vaccination campaign on the Internet.

As an initial step we focussed on the Twitter data extracted using the keywords related to the MR vaccination. The sentiment analysis of the Twitter data revealed that there are many factors affecting the vaccination campaign initiated by government. Analysing the Twitter data, it is found that most of the tweets containing the Uniform Resource Location (URL) related to the news about the vaccination. Further assessment of the URL had given the information about the type of catchy headings of

different newspapers, blogs and other social media sites like YouTube and Instagram.

In the second stage, we had extracted the engagements in various social media using the URL https://app.buzzsumo.com. From the obtained result, we had taken only Facebook and Twitter for the study. All other social media platforms have very less number of engagements compared to the Facebook and Twitter. In India, Facebook is the most commonly used social media application. This is mainly due to the fact that a huge data can be shared. Twitter allows a limited number of texts in a tweet. So, comparing to Twitter, Facebook has more number of engagements.

3.1. Twitter Analysis

While considering the Twitter data from the period January 2017 to April 2017 during the first phase and September 2017 to February 2018 during the second phase of immunization campaign in India. Kerala comes under the second phase of the immunization.

The process of Twitter data sentiment analysis is done in a number of steps in sequence. The major actions in the Twitter data analysis is as follows:

- Extracting tweets using Twitter application
- Cleaning the tweets for further analysis
- Getting sentiment score for each tweet
- Segregating positive and negative tweets

The keywords used are #vaccin, #immun, #MRcampaign, #swasthbharath, #routineimmunization, the keywords containing the measles and rubella from MoHFW_INDIA and the tweets containing keywords MR, measles and rubella. We collected ~30000 tweets, after removing retweets we got 1796 tweets by pre-processing the data. It includes the removal of URLs, hash tags and other Twitter handles.

Figure 1: Wordcloud from the Twitter data

We used 'Syuzhet' package in R language for sentiment analysis. 'Syuzhet' breaks the sentiments into 10 different emotions, namely - anger, anticipation, disgust, fear, joy, sadness, surprise, trust, negative and positive. We got 13.2% positive, 12.03% negative and 74.78% neutral sentiment. The sentiment is analysed based on the keywords in English.

There are many types of Twitter data which are having religious, cultural and other behavioural aspects. The sentiment analysis shows that most of the tweets are neutral. Normally health care associated texts will have more number of negative sentiments. It is more or less related to the religious sentiments. The anti-vaccine propagators having vested interests rely on religion to spread their views. The tweets we collected contained the use of the religion and other fear mongering tweets.

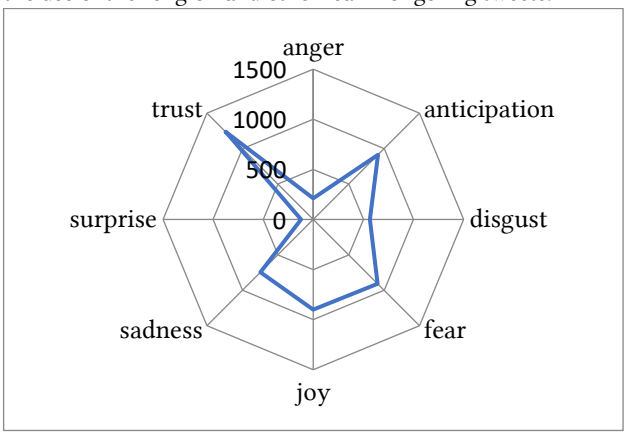

Figure 2: Sentiment analysis of Twitter data on MR vaccine campaign

Most of the tweets contain URL of the news which is containing negative sentiment news. The news about the Adverse Event Following Immunization (AEFI), vaccination related with religious text, anti-vaccination campaign from other countries and the conspiracies in vaccine ingredients. Such kind of news is focusing some particular religion and invoking vaccine hesitancy among the people belonging to that particular religion. Other set of people propagating the side effects of the vaccine and creating negative sentiments against a particular system of medicine. Based on the sentiment analysis of the Twitter data the fear sentiment in figure 2 is more than joy. More the negative sentiment more impact on the user. The text containing more fear sentiment will have more social media engagement. This behaviour is made use by the anti-vaccination campaigners for propagating their agenda. Normally such kind of people will look for opportunities to spread misinformation. The circulation of the misinformation by such people will have some other motives and the people will fall prey in that agenda.

3.2. Google Trends during the Vaccination Campaign

The search history in Google trends shows that during the MR vaccination campaign in India, the MR vaccination searches increased much during the announcement of the program till the end of the campaign. The peaks in the graph in figure 3 shows an increased search since the announcement of the program by government in each phase. The searches are mainly about the MR

vaccination and its side effects. The graph is created from the data obtained from the 'Google Trends' application by giving the keyword 'MR Vaccination'. This application will give the trending searches across the globe. We can also get the region wise search results using this application. Google Trends also gives the top searches on the topic of interest. The searches in the Internet are mainly concerned with the conspiracies. It is the natural behaviour of the people to search such conspiracies especially when it is dealing with health care of their in-laws.

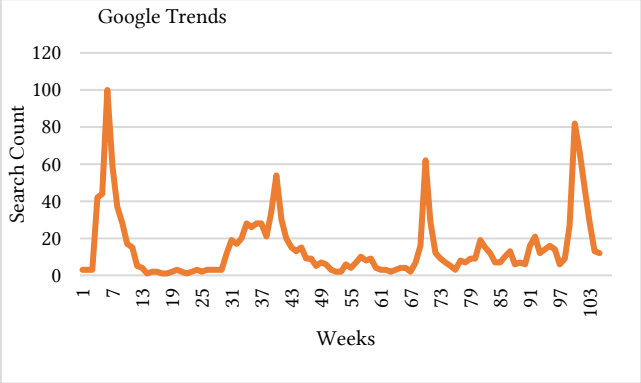

Figure 3: Google Trends during the period January 2017 to December 2018

3.3. Analysis of Social media engagements

The website https://app.buzzsumo.com retrieved 185 articles using the keywords "MR Vaccination" and "measles-rubella". After removing the duplicate results, we got 179 articles and it is used for analysis. The website retrieved the links which are having at least 5 engagements in social media. We selected the social media engagements of Facebook and Twitter because other social media engagements are having only minimal engagements compared to Facebook and Twitter. The media links are analysed manually to classify according to the variables chosen after the literature survey. Awareness and General Information class of news are having more social engagements among all other variables identified. The data which are not coming under the variable selected is classified as General Information and is containing the public information like the statistics of the immunization, media briefing by health officials and other government authorities, the announcement of the immunization schedule, etc. The articles which are having the reports of the after effects of immunization are classified as AEFI. This is one of the major factors which are pulling off the parents from immunization of their children. Accessibility related with the inability of parents to reach the vaccination centre due to many factors like far off places, more number of children, fear of losing their daily bread if they miss their one day job, etc. Political factors include the decisions taken by some regional parties on vaccination programs, comments against vaccination, favouring some other system of medicine instead of vaccination, allegation against the ruling government by the opposition on the failure in vaccination, etc. Fear of vaccines includes the pain during injection and the information received about the after effects of the vaccination, etc. Some people refrain from vaccination because of religious sentiments. Such articles are categorized under religious category. The people working for the vaccine hesitancy are informed about the impacts of their acts by the government authorities with the consequences. Some videos are also shared along with news articles stating the legality of spreading the misinformation. Such news articles are classified as Legal.

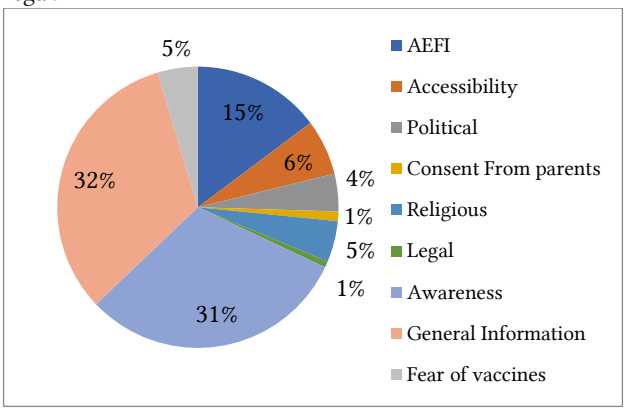

Figure 4: Social media engagement and the article category

Some news articles are stated that the government authorities are not taken consent from parents before the implementation of vaccination campaign. They are classified as consent from parents.

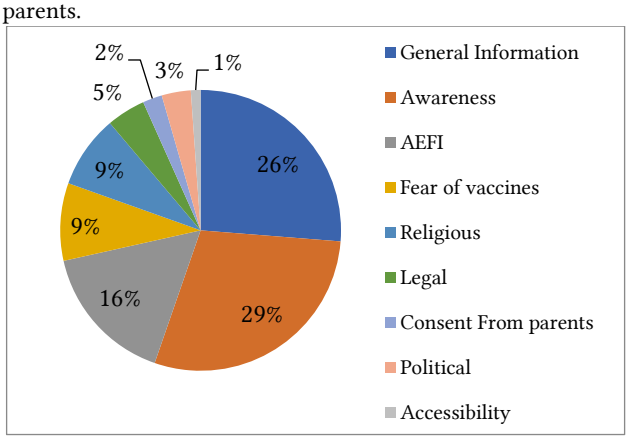

Figure 5: Article category based on variables

More cases reported on AEFI and are shared largely over social media. Comparing social media engagement and articles shared, we can see that social engagement and the number of articles don't have any relationships. The accessibility of immunization to the children is reflected in only two news links but the social engagement is about 19 percent next to the AEFI. Religious news articles are 9 percent next to AEFI but the social engagement is 5 percent which is fifth among the social engagements.

YouTube is having a major share in social media engagement. Only the top 17 articles based on social media engagements and the number of articles is considered for comparison. Video sharing

website is taken over the 27 percentage share of the social media engagement. There are 86 links containing the MR vaccination details shared in social media. The videos are the easy method of spreading the misinformation in social media than the text messages. The images will influence the people more than the texts. The fear and the hatred can be induced more through the video.

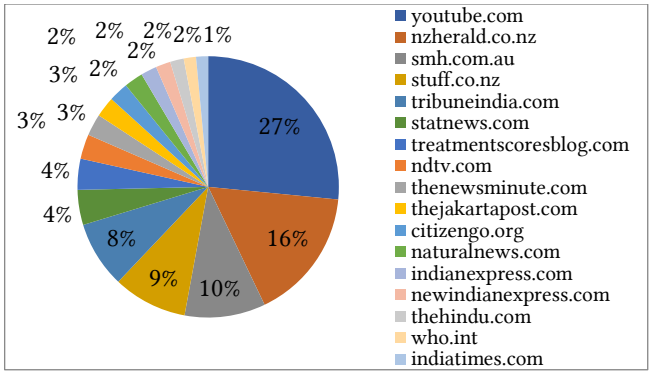

Figure 6: The websites of the most shared links based on social media engagement and Number of articles

4. Discussion

Based on the literature review, Facebook posts, News articles and government reports, there are many factors associated with the vaccine hesitancy. People are following twitter and other easily accessible social media websites to get knowledge about the vaccines. 72326 engagements are observed out of 179 articles from Facebook and Twitter. This is as per the data extracted using the website https://app.buzzsumo.com. Looking in to the data, we observed that there is a major share of Facebook engagement compared to Twitter.

The digital divide and the divide in the accessibility of the medical facilities played a major role in the aversion of people taking immunization. The people living in the remote places are hesitant to take their children to vaccination by losing their one day job. Sometimes people are not aware about the importance of vaccination. Even in the cities, the people are falling prey to the anti-vaccination campaign because of many factors that are convinced by them with some proofs. There are cases where the people not vaccinated in their childhood living healthy. That was mainly due to the herd immunity. Similarly, some sort of fear is injected in the common man by showcasing the news that was appeared regarding the nexus between government officials and the medicine manufacturing industries. The motivation behind the vaccine hesitancy is initiated by many factors. Some of the factors affecting the vaccination programs and other health campaigns are discussed in detail as follows:

4.1. Social Factors

According to agenda setting theory, media coverage increases the severity of the issue and it will create a negative impact on the mass initiatives by the government in vaccination program [57]. Though the paper published in the Lancet Journal by Wakefield, et al. in 1998, which is withdrawn due to the fake findings and claiming that MMR is associated with Autism. The claims in the article are still spreading in the blogs and other social media platforms. There were many incidents of after vaccine related complications in Kerala, India and even the case of death. Though Dr Ajay Khera, Deputy Commissioner, Child Health and Immunization said that the death is not due to immunization. The family denied the autopsy of the child died after the immunization. So the actual cause of death could not be identified [58]. The digital revolution happened due to the proliferation of mobile technology and the Internet. This is resulted in easy accessibility of information to a large mass of people in India. Due to the lack of adequate cyber awareness among the common people in India, it is easy to spread the misinformation through the social media platform and the propaganda behind it. This has been worked well with many instances in India. The anti-vaccination campaign is also such instances where the people are misled with fake information and stayed away from taking the vaccination.

4.2. Psychological Factors

Based on behavioural psychology, behaviours are acquired through conditioning. Fear of vaccine may be due to multiple reasons may be fear of injection, fear of after effects, etc. The fear of vaccine is common among the young age people. Some are get fear due to the expressions of other vaccinating patients. So care must be taken to isolate the vaccinating patients from others and even the sounds should also be sealed [59]. Hate of modern medicine and Chemical hesitancy is another factor which leads to vaccine hesitancy. Looking in to the searches from the Google Trends, we can see that the searches are more related with the after effects of vaccine and the side effects of the vaccine. Some parents may be hesitant to subject their children to vaccination due to this fear. It is the responsibility of healthcare workers and the government to take measures to reduce the fear among such people. While implementing a vaccination program, government should anticipate such negative sentiments in social media and other Internet resources. Currently there are many blogs and vlogs (Video blogs) which are having misinformation about vaccines. This information is shared largely in the social media applications like Facebook and WhatsApp. Government is taking many measures to curb the spread of such information but still that is not effective.

4.3. Political Factors

The corruptions in the Health Department are another factor leading to vaccine hesitancy in India. Two former officials of Health Department in Kerala found guilty in procuring vaccines [60]. This kind of news will create a negative impression on the vaccination. The anti-vaccine campaigners propagate the illegal nexus between manufacturers and the regulatory authorities. Even the political leaders are involved in propagating the anti-vaccination campaign. One of the elected members of Legislative Assembly was commented against vaccination in Kerala [61]. The political leaders and the elected members were involved in functions organized by the anti-vaccine campaigners in India. The

awareness among political leaders about the vaccines and their affinity towards some views are also affecting the vaccination campaigns. They are being the influencers; the comments by them in public domain may have created some impact on the minds of people. Similarly the corruptions in the medical departments in purchasing the medicines also had worsened the situation. That was created discussions and heated debates between government and the opposition parties. So the fringe elements had utilized this opportunity to propagate their views by taking cue from such incidents. During the vaccination campaign, anti- vaccine campaigners flooded such news in the social media and other communicating medium. The rivalry between the systems of medicines will also lead to spreading the misinformation [62]. The traditional healthcare providers are the main propagators anti-vaccination in Kerala. Government had taken action against them for propagating false information.

4.4. Religious Factors

Religious beliefs in society also refrains people from taking vaccination [63]. Though most of the prominent religious leaders are campaigned for vaccination, the vaccination rate stood below 50 percent in some districts of Kerala as per the reports by the Kerala Health Department. So the government compelled to extend the vaccination program. Government warned the anti-vaccination campaign activists of taking necessary legal action. Many of the social activists forwarded the complaints against the anti-vaccine movement in social media. There are other clerics who were clearly stated that it is against a particular religion [64] and it is for population control. Depopulation agenda related article got five percentage social media engagement. Another claim is that the vaccine is developed from Israel and the vaccine is for Muslim genocide [65]. In some places the HCPs were manhandled and the vaccination program went back foot. Government took more rigorous effort to tackle this situation by taking legal action against the responsible people. The vaccination campaign was also extended to achieve the vaccination target.

Table 1: Summary of strategies followed for vaccine hesitancy by government in Social Media and the challenges faced

Actions	Strategies followed	Challenges faced
Involvement of the Governmental and Non-Governmental Organizations(NGOs) in the Awareness through Social media	Government authorities briefed the proceedings regularly through the social media Police and other enforcement agencies are continuously informed about the consequences about spreading the fake news through the social media The NGOs and other independent social workers continuously shared the importance of vaccination through the social media Awareness on the adverse events after immunization	Behavioural instinct of people to share the sensational news on immunization adverse events Lack of technological intervention to prevent fake news/ messages Emotional factors influences the parents after getting the news about the adverse events after immunization
Involvement of celebrities and Influencers in promoting the vaccination campaign	Involvement of public figures in the campaign through social media and other mass media Involvement of religious leaders in the campaign to tackle the religious sentiments Teachers to influence the children to alleviate fear and inculcate the knowledge about the importance of vaccination Youth groups to involve in curbing the spread of fake messages	Orthodox religious leaders influence the people by quoting the holy books and spread fear among them Fake news about the population control by such groups Modern medicine haters spread the fake messages on the Adverse Events After Immunization
Communication through mass media and other public events	Use of Social media for briefing the importance of immunization Plays which are briefing the importance of vaccination Use of posters, brochures, stickers and public announcements	The use of videos and other fake information made huge impact in the initial stage of the immunization program The videos and the speech by some religious leaders against vaccination campaign influenced people from some sector The delay from the health authorities in delivering the counter arguments on such information made situation worse in the initial stage of vaccination

5. LIMITATIONS AND FUTURE STUDIES

The study is based on the literature review, Facebook articles, Twitter articles, and blogs. We are not explored the social media like WhatsApp which is one of the major social networking media reaching large mass. We considered the links shared in social media for the analysis but most often the data shared may be in the text form generated by the user. The study focused on the MR vaccination campaign for a stipulated period. The behavioural analysis of a user is not considered by taking the duration of the involvement of a user [66]. The tool used for the data extraction may not be considering the linguistic variation of the search term. We considered only English articles, considering the multilingualism of India this study is lacking adequate data. The English penetration in India is less than ten percent [67]. More advanced statistical method should be employed to cater the challenges of the limitations in existing system [68]. Actual impact of the social media may not be able to assess through the analysis of the social media engagement. Because the fake information spread through social media gets leverage by the word of mouth [69].

6. CONCLUSION

Social media play a crucial role in spreading the anti-vaccination campaign across the world. Earlier the anti-vaccination campaign restricted to a limited group and limited people. It is because the medium to spread the campaign was very limited. With the emergence of social media, the scenario changed and the spread

of misinformation got much pace than earlier. The viral nature of the social media made it difficult to prevent the spread of misinformation effectively. The study and analysis of consequences and the regulation of the spread of misinformation become much more complicated due to freedom of expression across the world nations. Facebook is now under critical observation and it is controlling the misinformation which is against the vaccination campaign. This is resulted in increased movement of misinformation through the WhatsApp as reported by the Wall Street Journal. 300 million Facebook users are the medium of spreading anti-vaccine misinformation. [70]

In order to fight vaccine hesitancy and anti-vaccination campaign, there should be interdisciplinary interactions in the Society. The government should be able to communicate the importance of the vaccination and at the same time there should be a strong action against the anti-vaccination campaigners. The study shows that mere regulatory measurement not enough to tackle this, along with that government should be able to counter their arguments with facts and figures about the vaccination. This will create a positive sign on the vaccination rates. The vaccination rate increased after doctors and social workers talked about the importance of vaccination and countering the claims of the anti-vaccination campaigners. In order to have high vaccination rate, there should be fairness among government regulatory agencies and manufacturer. This will create a faith in the minds of people. If there is any irregularity in the relation between any of these entities, then whole process of vaccination will be affected. The regulation of spread of misinformation in social media and effective use of vaccination in the society needs a collaborative effort from the media, manufacturer, government and Judiciary. Our research currently restricted to social media and detailed study needs to be done with the social media contents to get more factors which are not covered in this study. Our main aim was to find out the reason for the decline in the MR vaccination rate in Kerala especially in some region of the state. The study reveals that there is significant decrease in the vaccination rate due to many factors. We are considered Kerala for case study because it is one of the most literate state and one of the states which are having a history of good health care facilities compared to any other states in India. There should be a good interaction between Government, Manufacturers, Regulatory bodies and people. If something adverse is happened after vaccination, then entire process of vaccination programme will be affected and the result will be very tragic. The fear of vaccine came above the fear of vaccine preventable diseases in all parts of the world. This will not only affect the herd immunity but also the health care programs of WHO and other government organizations.

7. POLICY RECOMMENDATIONS

Going through the literature review, social media engagements, health information reports and the news article we were able to list out some of the measures to overcome vaccination hesitancy and improvement in vaccination rates.

7.1. Interdisciplinary approach in vaccination program

The vaccination program should be planned by incorporating all the stakeholders to effectively implement in all the areas. The usage of media, people from all the disciplines, usage of hoardings, training, etc. will enhance the vaccination outcome. Social media and other mass Medias are helpful in spreading the importance of the message in a timely manner. The mobile phone proliferation in India is very high. This will enable easy communication even in remote areas also. The involvement of schools and NGOs can help to give better awareness among the students and thus creating more volunteers coming up automatically.

7.2. Regulatory measures to counter the anti-vaccine campaign

The inactiveness by the government on the misinformation and other fake messages in social media are the main cause of rising anti-vaccination campaign. The freedom of expression is misused for halting the government run vaccination programs. A strict action on such fringe elements will curb the spreading of the misinformation to some extent. During the vaccination campaign in Kerala, such groups started spreading rumours on the vaccination and the government had taken action against them. That prevented further spreading of misinformation to a large extent and the vaccination rate had picked up.

7.3. Involvement of government in vaccine research and development

Normally the anti-vaccine campaigners are accusing that the Multinational Companies are responsible for the population control and having other vested interests in the vaccine production. Involvement of government in the research and development of vaccines will improve the faith in vaccine among people and the cost of vaccines may also be reduced.

7.4. Preparing the statistics of the after vaccination effects

Normally people are concerned about the AEFI. The government can take note of the statistics on vaccination and the outcome can be put in the public portals and can be communicated through the social media. Normally people are more panicked in the delay in getting appropriate reason about the AEFI. Prompt delivery of the information about the AEFI will reduce the mental stress among parents after immunization of their children. More turn out in the immunization program will enhance the willingness of the parents to immunize their children.

7.5. Educating health care professionals

Sometimes the HCPs also having fear in vaccination or they were not fully educated about the vaccination. They should be fully aware about the AEFI and other details about the vaccine and should be able to convince the parents about any concerns in the vaccination. Any unconvincing reply from the HCP will enhance the stress level of the parent.

7.6. Involvement of celebrities and other influencers in vaccination campaign

Celebrities and other influencers like religious leaders and politicians can help in the successful vaccination program. The anti-vaccine campaigners are mainly focusing on selected texts from the religious texts to substantiate their views in anti-vaccination drive. This is spread through the closed groups in WhatsApp and Facebook. So the orthodox religious people will stay away from the vaccination and they will spread this message among their peer group also. The religious leaders can influence such people and make them stay away from such anti-vaccination campaign. The celebrities can influence a large group of people and their fans group can spread the message in social media to curb the fake messages and misinformation.

7.7. Open discussion with the anti-vaccine campaigners in visual media

If the anti-vaccine campaigners are exposed in the mainstream media by giving fit reply to their version against vaccination will solve the problem to some extent. Such a discussion in a news channel in Malayalam exposed an established traditional medical practitioner and government moved legally against him [71]. By sharing such video contents in the social media like YouTube and Facebook will make people more alert. Government or NGOs can caution the people about misinformation or fake news.

7.8. Consent from parents before vaccination program

One of the major concerns shared on not vaccinating the child was that, HCPs were not taken the consent from parents. Parents were misled by the anti-vaccination campaign and they were informed that the vaccination is for population control and the vaccine contains the extract from the animal which is against a particular religion.

Though the scrutinizing of the social media is against the freedom of expression and there is less clear cut segregation of the hatred or wilful violation in the eyes of law, there are limitations in taking action against social media posts. The Facebook has taken action against the accounts spreading misinformation which are testified as vaccine hoaxes by WHO.

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