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RESEARCH ARTICLE

Role of Mass Media and Public Health Communications in COVID-19 Vaccination

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ABSTRACT:

Vaccines offer life-saving protection against diseases and keep us safe from the harmful effects. The speedy development of vaccines during COVID-19 pandemic has reduced the coronavirus's transmissibility and severity. COVID-19 vaccine development was challenging but the global scientific collaboration and use of resources including extensive funding made it possible. COVID-19 vaccines were deployed in controlled phases for general public use, initially offering them to the first responders and those vulnerable to life threatening effects of virus. However, it was observed that the general population has widespread vaccine hesitancy. Mass media plays a critical role in influencing people's attitudes and practices. A common man cannot comprehend correlation from causation and jumps to conclusions. Media has the power to unite the world on one platform for a common cause. It is a source for the public to seek information, but like a double ended sword, this platform that provides information, also gives misinformation. On one hand, the public uses the media to seek information for vaccine safety and efficacy and on the other hand, to propagate unverified conspiracies against vaccines. In this review, we analyze the role of mass media and public health communications in COVID-19 vaccination from December 11, 2020, to September 15, 2021, and draw scientific inferences. We have discussed vaccine hesitancy and some prominent reasons that instil fear among the public, including the implausible claims of vaccines being the carriers of Radio Frequency Identification (RFID) microchips, impairing the reproductive systems, converting humans to hybrids, and the misconceptions about herd immunity. A consequential role of media was observed in keeping the world updated and motivated by tracking the vaccine number, distribution and deployment through live dashboards. We saw an upward trend in vaccination numbers with media campaigns, social media vaccination surveys, and socio-medico evidence. Thus, we have proposed a model for developing public awareness and health promotion using media as a tool for better distribution and administration of COVID-19 vaccines. With this, health organizations can gain widespread public trust, manage anti-vaccine movements, overcome threats faced due to vaccine conspiracy theories and eventually overcome the COVID-19 and future pandemics.

INTRODUCTION:

Vaccines are among the top ten achievements of public health in the 20th century. With the COVID-19 vaccine being an exemplary example of how far we have come in terms of scientific progress made in vaccines. Following each of the two epidemics: the severe acute respiratory syndrome (SARS) in 2003 and the Middle East respiratory syndrome (MERS) in 2012; both of which were caused by a coronavirus and resulted in high mortality, scientists have been trying to develop vaccines against them. This provided the groundwork for developing the vaccine against SARS-CoV-2, promptly leading to the creation of the vaccine within one year of the pandemic.¹ Moreover, the rapidly evolving pandemic spurred global cooperation and vast funding for vaccine research and development. This worldwide scientific collaboration and prioritization expedited the process. Lastly, due to an increased number of cases, the enrolment for clinical trials quickly filled, hastening the development.

Today, in the USA, the following vaccines are approved by the FDA for SARS-CoV-2 vaccination

1. Pffizer-BioNTech, mRNA vaccines BNT162b2
2. Moderna, mRNA-1273
3. Janssen adenoviral vector vaccine Ad26.COV2.S (also referred to as the Johnson & Johnson vaccine).²

The FDA authorized the emergency production and distribution of SARS-CoV-2 vaccines in December 2020, leading to the development of the first ever mRNA vaccine. The vaccine began being administered in Spring of 2021 in the US, as immunization was deemed to be crucial in developing the populations immunity against the virus.³ The rapid development of the vaccine was met with reluctance from the public despite the sufficient supply and clinical testing. Since March 2021, around 15 million doses of the vaccine have been wastefully discarded.⁴ Despite the highly contagious nature of the Delta and Omicron variants, a segment of the US population remains hesitant to receive the vaccine. Opposition towards immunization brings up concerns for safety, efficacy and long-term impacts. The government vaccine mandate heavily fuelled these concerns, primarily the narrative that the vaccines are more deleterious on health in the long term than the disease itself.

For centuries, mass media has been the foremost source for updated information for people of all ages. It influences the judgment and decision-making of the public through a wide array of tools and factors varying from social media to news channels to print media. Historically, press advertisements, poster exhibitions, and cartoon exhibits have positively impacted the media

campaigns for immunization. On the other hand, it also remains the source that stems up conspiracy theories, false claims, fake news, varied beliefs, regarding safety and efficacy and lack of vaccine distribution transparency assertions. Similarly, in this pandemic, internet media utilized superlatives to sensationalize the false and fake remedies for COVID-19. In a correspondence, this was taken into account and healthcare professionals were emphasized to use the internet and overcome the effects of sensationalistic terms.⁵

Media has become a transformative platform for bringing together critics and opponents of vaccines to express contemporary vaccine policies. It has democratized the access of immunization knowledge for the public and thus, made it difficult to distinguish reputable information from incredible venues. Anything becomes true if validated by repetition in the media or endorsed by celebrities or public figures. Typically, public health publications, web 2.0 interfaces, medical-related television programs, and hospital websites would be the leading sources for immunization information, however with the advent and increased usage of social media sites in the pandemic, as was discussed in our prequel article,⁶ the unverified facts and mythical knowledge available on these sites have become the primary to-go place. The unverified adverse events and erroneous details on vaccine safety are promulgated through social media.⁷

The clinical trial was performed by Prof. Freeman and his team in the UK, which took into account the factors influencing the perspectives of people in regards to COVID-19 vaccination and the effect of information provision in reducing the hesitancy towards the vaccine.⁸ The study provided evidence that providing scientific information regarding the safety and efficacy of vaccination proved beneficial in changing the minds of hesitant public. This paper provides scientific inferences from various studies to convey the right information to the public and also highlights the impacts of media on it. Other studies have also been performed urging medical communities to utilize social media to interact effectively with the public and build their confidence in vaccination, especially targeting the demographics of concern.⁹ The following article outlines how the media is an influential source of gaining information about vaccines and like all biological products, vaccines are not without side effects. Additionally, providing correct information through the media can bring a difference in public's perspectives, speeding the immunization process in this pandemic and future one.

METHODS:

In February, 2022, we conducted an English language only literature search on PubMed using terms “COVID-19” AND “Vaccinations”, as well as “COVID-19 Vaccinations” AND “Media”, “Mass Media”. This search yielded a total of 975 results. We filtered the articles to keep only case reports, clinical studies, clinical trials, clinical trial protocols, introductory journal articles, letter, meta-analysis, observational studies, preprints, randomized

controlled trials, systematic review, and validation studies and were left with 61 articles. Our inclusion criteria were primary literature articles only researching the COVID-19 vaccinations and mass media and with this we were able to narrow down our research focus to 6 articles. After removing pre-prints, and articles that did not include the role of Mass media in COVID-19 vaccinations, we had a total of 3 articles, a letter, a correspondence and a randomized controlled clinical trial.

Number	Author	Publication Type, Sample Size	Features	Remarks
1	Freeman et al., 2021	Randomized Controlled Clinical Trial	Among the 18.4% strongly hesitant clinical study recruits, COVID-19 vaccine hesitancy was reduced, in comparison to the control condition, by personal benefit information (mean difference -1.49, 95% CI -2.16 to -0.82; adjusted p=0.0015)	10% of the population with strong resistance to COVID-19 vaccines showed reduced vaccine hesitancy by providing them with information on personal benefit as opposed to information on collective benefits.
2	Patten et al., 2021	Letter	To build confidence in covid-19 vaccines, the medical and scientific communities need to work together and provide accessible and effective communication to the public	Targeted use of social media can help to maximize the uptake of Covid-19 vaccines.
3	Ottwell et al., 2021	Correspondence	News articles have commonly used sensationalizing terms and superlatives to exaggerate potential benefits of therapies, vaccines, and detection methods for COVID-19 but lack data to support their claims.	Health-care professionals need to use the internet as a tool to combat sensationalistic terms and help combat misinformation regarding COVID-19’s unfounded ‘cures’, ‘miracles’, ‘life-saving’ treatments, and detection methods.

MYTHS ON MEDIA CAUSING VACCINE HESITANCY & THEIR SCIENTIFIC EXPLANATIONS:

Skepticism over origin of vaccine:

The foremost reason behind the unwillingness to get vaccines remains that, “Researchers rushed into the development without determining the safety of vaccines .”¹⁰ Many people were seen citing in the media that the vaccine development takes a considerable time of up to 10-15 years for the development. Yet the COVID-19 was invented over a period of months. This questions the efficacy and

safety of the vaccine. The apprehension of the public was valid and understandable.

With the epidemic of SARS-CoV and MERS-CoV, the coronavirus vaccine development was started with the completion of pre-clinical studies. SANOFI has been nearly successful. Two were in the phase 1 trial; the Chinese Center of Disease Control and Prevention and the USA National institute of Allergy and Infectious Diseases. Two were in phase III; from Institute Pasteur, France and the Novavax. Despite the successful phases of trials and efficacy observed in animal models, the vaccine trials were halted and

never pursued further. This was due to the lack of continuous funding and disappearance of cases required for the further trials. This laid the foundation for vaccine development against SARS-CoV-2.^{11,12} This implies that the technology employed in development of the vaccines has already been worked on and the rapidly increasing number of cases of COVID-19 helped in the swift invention of vaccines.¹³

“Disappearing Needles”:

A video posted by a tik toker on April 18, 2021, demonstrated the ‘disappearance’ of the vaccine needle when the syringe is pulled out after the administration of injection.¹⁴ People took to social media posting, “Disappearing needles!! There soo desperate, come on!!”.¹⁵ Most people stated clearly that the vaccines are fake. They are administering empty injections and some suggested it is a saline or sugar solution. Some pointed out that once the needle disappears into the muscle, the vaccine administer does not push the plunger of the syringe or it is already depressed. After posting on twitter, it received around 20,000 retweets and half million views.¹⁶ This sowed the seed of ‘cynicism’ in the brains of the public.

Many of the healthcare workers took to social media to explain about the mechanism of safety ‘retractable’ syringes also called “vanishpoint syringes”. When the plunger of the syringe is depressed, the needle is automatically retracted back into the barrel to prevent accidental needle stick injuries and infections.¹⁷ The American Society of Pharmacists also employed social media platforms that retractable needles, employment of other safety devices and a needle stick injury log were the requirements according to the Needle Stick Safety and Prevention Act 2000 signed by President Bill Clinton.

Still, many suggested “We trust the system” is blind faith, not sound science and questioned the ‘system trustors’ for receiving the vaccine at this stage.

Control over Humans:

A comment on Facebook received around 173,000 views. It stated that the vaccine is ‘implanting’ stuff into recipients.¹⁴ This gave rise to another theory that the government is trying to insert “microchips” into the humans to control and track. On Facebook, a video of 3.49 min duration was shared around 27100 times, which demonstrated that a Radio Frequency Identification chip (RFID) microchips will be inserted through injections.¹⁸

The video was manipulated and formulated by the compilation of short clips of Bill and Melinda Gates and Jack Ma made in 2017.¹⁹ The reality was that The Gates Foundation was working on finding ways to digitize the data of tested, recovered and vaccinated individuals by utilizing the ‘digital

certificates.’ By it, they were implying human-implantable ‘QUANTUM-DOT TATTOOS,’ an ink to record testing without a database at the time of administration. Media platform was utilized to interview Mr. Gates and clarify the details. A YouGovpoll conducted in May revealed that 24% independent, and 44% Republicans firmly believed that Mr. Gates wants to use a mass vaccination campaign against COVID-19 to implant microchips in people that would be used to track people with a digital ID.²⁰

In addition to the ‘chip implanting theory’, there were widespread discussions that mRNA vaccines are nanotechnology employed to turn ‘humans’ into ‘hybrids’ by changing the DNA. This was a fear that it is a toxin with no detoxification possible. The lipid emulsifying lipid particles enclose the RNA to enhance the absorption through lipid bilayers of the cell and does enter the nucleus, where DNA resides. They debunked that ‘lipid nanoparticles’ ease the entry and are not ‘Nano robots’ to replace the DNA.

Adverse Effects on Health:

According to the CDC, the common side effects seen with COVID-19 vaccine are headaches, soreness in the arm and low-grade fevers.

Some women started posting online about earlier, painful and heavier periods following the vaccination. Without concrete evidence, this discussion and posts fuelled up globally creating ambiguity among side effects mentioned by CDC. The apprehension went up to the point that rumors about vaccine producing infertility started surfacing. It spurred a debate over the ethical principles and physicians recommending the vaccine knowing it can cause infertility. People started questioning the government for violating the autonomy by unknowingly introducing the world to a ‘new contraceptive’ to keep the population in check. In many developing nations, where social media is utilized and followed religiously, women denied getting vaccinated. It also fed a new conspiracy story of “vaccines resulting in miscarriages” and scared away pregnant women from the vaccine. As COVID-19 associated mortality is already high in pregnant women, it generated dire consequences. Many scientific papers were accessible in the media which proved these claims as baseless and wrong:

- Menstrual cycles are affected by stress, anxiety, weight changes and change in medications. Dr. Kate Clancy, Associate Professor at University of Illinois and Katie Lee, a postdoctoral scholar at the Washington University launched a social media survey, which is undergoing IRB approval for the scientific publication.²¹ The thread was

launched on social media on February 24, which received around 1.1k comments, and 1.4k retweets. They have collected more than 140000 reports from people regarding the changes in menstruation.²²

- The linkage of mRNA vaccines with infertility stems from the 'syncytin-1,' a protein in the placenta of mammals that shares the genetic makeup with 'spike' protein on coronavirus and antibodies in vaccines target both the spike protein and syncytin-1 protein. This remains a fabrication as both proteins are structurally different. A study using the in vitro fertilization frozen embryo transfer (FET) as a model was published by Dr. Morris on June 1, 2021 which revealed that seropositivity from either the infection or immunization did not prevent embryo implantation. This was detected by beta-HCG levels, gestational sac visualization on vaginal ultrasound, and identification of heart tones at two time points at least one week apart.²³ Moreover, fever can also cause a transient decrease with sperm count and fever does occur after the vaccine. This, if present, will be a temporary change.
- Two studies substantiated the fact that the 'mRNA' vaccines are safe in pregnant and breastfeeding women as recommended by the American College of Obstetricians and Gynecologists (ACOG) and the Society for Maternal-Fetal Medicine (SMFM). A prospective cohort study stated that robust humoral immune response was seen in pregnant and lactating women with vaccination rather than natural infection. Antibodies generated were detected in both umbilical cord blood and breast milk samples.²⁴ Another study published in JAMA pediatrics as a preprint (no peer review) demonstrated that no mRNA vaccine in milk fat layer or milk supernatant at any point was detected making it safe for lactating mother.²⁵

Launching fact checker and vaccine tracker:

When the social media implausible claims led to the formation of doubts in the minds of the public about the newly developed vaccine. At this point, the media came forward as the 'savior' and 'motivator'

for the public. Fact checkers and myth debunkers were launched by the Center of Disease Control (CDC), World Health Organization (WHO) and Food and Drug Administration (FDA). The esteemed figures like Mr. Gates approached the media for an open invitation for questions and gave a full explanation of the studies his foundation was funding. John Hopkins Medicine introduced a page about 'COVID-19 Vaccines: Myth Versus Fact' on their website.²⁶ Health line published a 'Doctors Debunk 9 Popular COVID-19 Vaccine Myths and Conspiracy Theories'.²⁷ CDC with animated figures started explaining each myth in an interesting and convincing way, 'Bust Common Myths and Learn the Facts'.²⁸ In addition, print media played a crucial role. All the rumors with the evidence-based explanations were printed and pasted on walls of hospitals, subway stations and grocery stores. The advertisements during road and air travel were also found to be crucial for consolidating the significance of vaccines in preventing community spread.

Media also launched vaccine tracking devices. The numbers have a deep impact on decision making. Hence, increasing the number of individuals getting vaccination without harmful effects can turn out to be a great motivator for the rest. The websites also kept the public updated on vaccine trials and new vaccines in the making. Public health non-profit organization, The Milken Institute, formulated a new resource to keep an updated track on COVID-19 treatments and vaccine tracker. The sourcing is from credible media sources, journals and WHO.²⁹ WHO also has its own tracker on their website which enlists and keeps track of each vaccine in the pipeline.³⁰ It is updated twice a week. 'CDC COVID-19 Vaccine tracker' is a principal source to look for remaining apprised with latest data. In addition, 'our world in data' provides an updated percentage of vaccine receivers throughout the world.³¹ It gives information regarding the partially and fully vaccinated individuals' region wise. John Hopkins, the pioneer in launching the tracking system for COVID-19 cases and deaths, has also an updated vaccination rollout information available.³² This information has great consequences on driving the vaccine campaign and serving a crucial source for research. Here is an example (Figure 1):

Number of People Vaccinated - USA vs. World (Partial and Full)

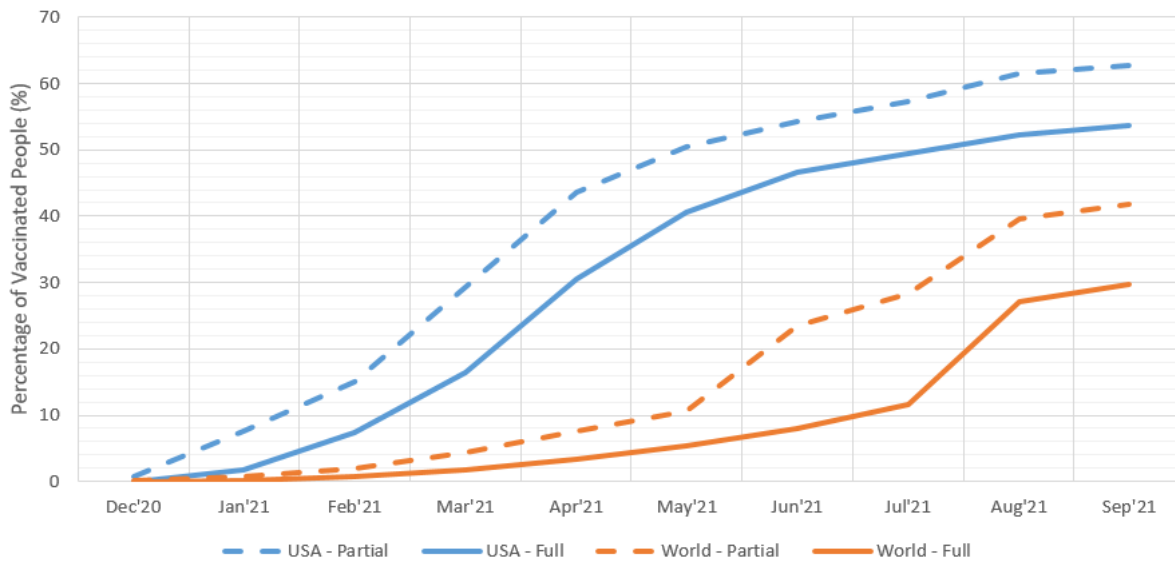


Figure 1: Graphical representation of new COVID-19 vaccinations (Partial and Full) per month from Dec 11, 2020 - Sep 15, 2021). Source: A global database of COVID-19 vaccinations.

“Vaccines”, hindrance for herd immunity:

Ever since the beginning of the pandemic, the world has been looking at the herd immunity (community immunity) to drop the transmission rate and protect the vulnerable population like infants, and immunocompromised individuals. Herd immunity is dependent on R0 and COVID-19 has R0 of 2-3. This means that around 50-67% of the population needs to be immunized for the development of herd immunity. With the development of the vaccine, the hope for herd immunity was revived. However, the variants have changed the situation in the world. As the delta variant has R0 of 6-7 and Omicron has R0 of 7 or >, around 85-86% of the population needs to be immunized for herd immunity.³³ In addition, the SARS-CoV-2 virus keeps on mutating and evading the human immune responses to a certain degree. For this, transmission blocking vaccines are a must. With the breakthrough infections occurring with the variants and vaccine, transmission rate still is high. In such circumstances, the herd immunity threshold looks far off. At this point, it is crucial for the media to emphasize the significance of vaccines in limiting transmission and preventing hospitalizations and death.

Another hurdle to herd immunity is the uneven roll-out of vaccines in the world and vast traveling. Many scientists believe that a perfectly coordinated global campaign could have been successful in wiping the pandemic. However, due to economic and cultural differences, disparities in distribution were evident. Countries like Israel, UK and USA lead the game by far as compared to other countries. Many countries could not afford to

undergo the mass vaccination of their population in such a short duration. By mid-August, USA has acquired around 800 million doses of at least 6 vaccines in development. The UK bought around 340 million doses, about 5 for each person.³⁴ Certain middle-income countries like Brazil and Indonesia started buying the vaccine doses by themselves. China and Russia shipped numerous doses of their manufactured vaccines to the majority of the world. Gavi, a Geneva-based funder of vaccines, along with Coalition for Epidemic Preparedness Innovations CEPI and the World Health Organization founded a joint fund called COVAX facility to buy and secure vaccine doses for low and middle-income countries. Despite efforts, wealthier countries did not participate in it. Hoarding of vaccines prolongs the pandemic and ‘nationalism’ of vaccines hindered herd immunity. The unfair scramble further creates differences, affects the collaboration among countries, exacerbates health inequalities and flare economic and social disparities already apparent in the society due to the bad pandemic handling.

Vaccines as ‘super spreaders’ of variants:

During the month of May, when the variants like beta, delta and gamma started growing in the world, other dubious claims surfaced. Social media users endorsed that vaccination was the reason behind the emergence of new variants. It started after the interview given by Luc Montagnier in the French documentary "Hold-Up." He is a French virologist and received a Nobel prize in medicine in 2008 for the discovery of HIV. He stated that SARS-CoV-2 does not abate on encountering the

antibodies in the vaccine and discovers newer ways to evade the immune response. This creates mutations and produces variants.

However, the fact is that the immune system of viruses produces mutations in the epitomes when exposed to vaccination for survival selection. Peter Stilov, an associate professor of biochemistry leading the SARS-CoV-2 variant sequencing efforts in West Virginia cleared that “selection is not the cause of new variants; it merely selects the better versions at survival”.³⁵ It is a well-known fact that when the virus is widely circulating in a community, it has higher chances of replicating and subsequently, development of mutations and variants.

Further, the Bear week at Provincetown’s annual gathering of men from July 3-17, 2021 augmented the already circulating rumor of vaccines being the source of variants and super spreaders of infections. It is the event when the population surges by 60000 individuals, due to gatherings of tourists from all over the US. Vaccination coverage among

Massachusetts residents was 69% at the time. Two weeks prior to this gathering, 14-day incidence of COVID-19 was zero cases and by July 17, it had increased to 177 cases per 100,000 persons per day in residents of the town. The Delta variant was identified in 70% of the cases.³⁶ The cycle threshold values (cycle number or cycle threshold required to amplify the particle to be detected) were found to be similar in both vaccinated and unvaccinated.³⁷ It resulted in a tremendous increase in the number of people talking against the vaccine in the media (Figure 2, 3). The study results inform and emphasize on the need of masking and social distancing. It does not imply that vaccinated individuals are ‘super spreaders.’ Vaccinated are not as likely or more likely to spread the virus as unvaccinated as the study relates that delta viral loads drop more quickly in vaccinated, virus particles in nasopharynx many not be infectious and finally that the virus is detected in the nasopharynx whereas vaccine impacts the lungs more significantly.

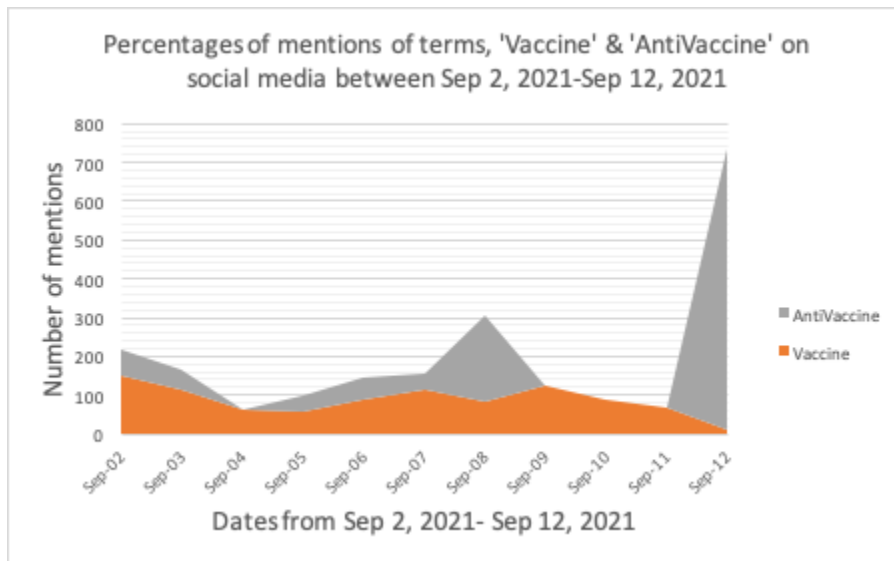


Figure 2: Number of mentions of terms, ‘Vaccine’ and ‘Anti-Vaccine’ on Social Media including Facebook, Twitter and Instagram by using Awario tool between Sep 2, 2021 to Sep 12, 2021

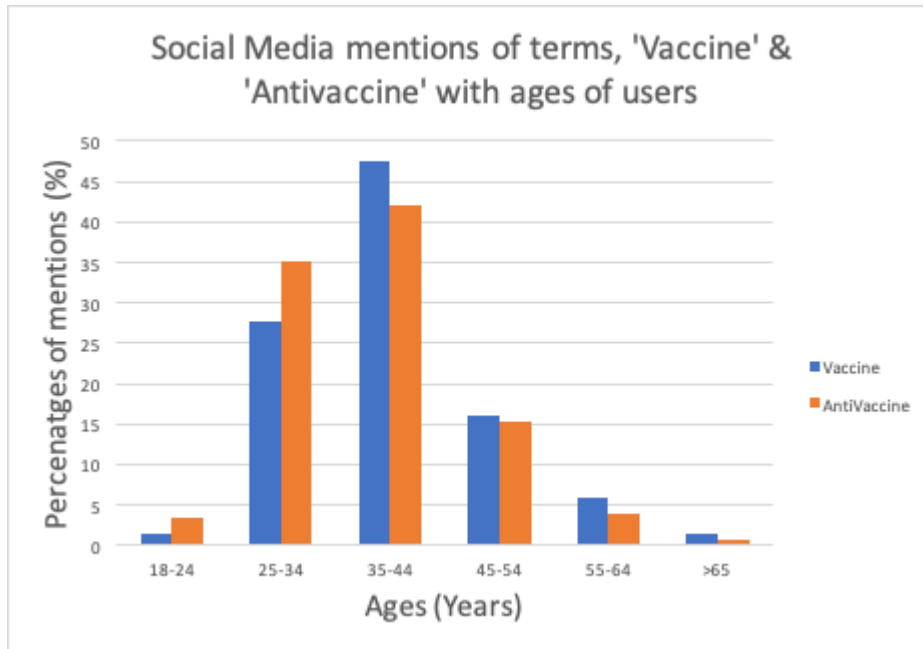


Figure 3: Percentages of Social Media mentions of terms, 'Vaccine' and 'Anti-Vaccine' with ages of users. Social Media platforms used were "Facebook, 'Twitter,' and 'Instagram' by using the tool Awario between Sep 4, 2021 to Sep 11, 2021

8. Children and vaccine:

Children account for one-quarter of new cases arising in the US. Around 28 million children are in the age-group authorized to receive the vaccine. A survey performed in September revealed that only 34% of the parents were in favor of getting their kids vaccinated which decreased to 27% in the month of October. According to the survey, 35% raised the apprehension of information-related barriers to vaccination.³⁸ Like discussed, vaccine hesitancy arises from safety concerns, particularly if in case of kids. They are concerned about the long-term adverse effects which have not been tested. Similar to the myth promulgated through social media, parents worry about the negative impact on their kid's fertility in the future. Some are scared by the increased number of cases of myocarditis among adolescents and they are multiplying the risk for their kids. In case of varicella, only 34% were immunized and by 2018, the number increased to 90%. It took around a decade for parents to become familiarized with the vaccine and observe its effects over a period of time. The mandate by states for all school-going children for the vaccine also contributed to an increase in immunization.

A video was posted on a website made by Vaccine Safety Research Foundation, an anti-vaccine group by veteran Silicon Valley entrepreneur Steve Kirsch, which was shared on Facebook and YouTube. It showed a young girl enjoying and celebrating with the family with a quick turnover to become agonized with pain, having a tube in nose and intravenous line in hand and shaking uncontrollably. Her mother has publicly declared the condition of the girl to be a post-vaccination effect.³⁹ The social media puts mothers in a group where they get surrounded by other mothers with similar views which puts a reinforcement to their beliefs. The anti-vaccine groups further bombard them with limited cases of vaccine-associated adverse effects taking place. They also keep them trapped with the emotional debate on increasing alliance between corrupted government and profit-oriented pharmaceutical companies. An effective way for counteracting this has always been to give full information from trusted sources beforehand. Here, scientific media can make a commendable difference. Like, the media has used the campaign for kids by demonstrating the Big Bird from Sesame Street getting vaccinated.⁴⁰ The children's media has been used in the polio and MMR vaccines campaigns and have proved beneficial.

Table 2: Summary of Myths, and misinformation regarding COVID-19 vaccination and explanation with scientific evidences

Sr. No	Myths, Misinformation, & Unverified facts	Social & Print Media Statements	Debunkers & Explanations with Scientific evidence
1	Rushed development of vaccine: Safety Issues	“Researchers rushed into the development without determining the safety of vaccines” ¹⁰	Vaccine development started with MERS and SARS epidemics and phase 1 clinical trials were completed. 2 of them were in phase III when they were halted, due to disappearance of virus. ¹²
2	Disappearing Needles	On Tiktok, there were videos demonstrating that syringe needles disappeared in the arm when syringes were pulled out after a vaccine shot. ¹⁴	Retractable syringes explained; When the plunger of the syringe is depressed, the needle is automatically retracted back into the barrel to prevent accidental needle stick injuries and infections. ¹⁷
3	Microchips insertion	Vaccine is ‘implanting’ stuff into recipients, a video demonstrating insertion of Radio Frequency Identification chip (RFID) microchips through injections shared on Facebook. ^{14,18}	The video was manipulated and formulated by the compilation of short clips of Bill and Melinda Gates and Jack Ma made in 2017. The Gates Foundation was demonstrating ways to digitize the data of tested, recovered and vaccinated individuals by utilizing the ‘digital certificates’ through the use of human-implantable ‘QUANTUM-DOT TATTOOS.’ ¹⁹
4	Adverse Effect on Menstrual Cycle	Women posted online about earlier, painful and heavier periods following the vaccination, which created ambiguity in the adverse effects on the CDC website without any scientific or concrete evidence.	Temporary side effects, and can be the result of various other factors such as stress, anxiety, weight changes and change in medications. Also, observed with smallpox and influenza vaccination.
5	Vaccine producing Infertility & Sterility	Vaccines were portrayed as a “new contraceptive” introduced by the governments to keep the population of the world under check and it started an ethical debate for physicians prescribing and advocating it to the patients. There is protein in the placenta of mammals ‘syncytin-1,’ that shares the genetic makeup with ‘spike’ protein on coronavirus and antibodies in vaccine target both. ²³	The studies have demonstrated that seropositivity from either the infection or immunization did not prevent embryo implantation, nor affect the early pregnancy development. Fever causes a transient decrease with sperm count and fever does occur after the vaccine, which can produce a temporary change in fertility. ⁴⁴
6	Avoid in pregnancy & Breastfeeding	The vaccine affects the fetus, results in miscarriages and should be avoided in pregnancy. It is also secreted in breast milk and produces dire effects in the growing babies.	Vaccines are introduced into muscles and mRNA is degraded rapidly after inciting the immune response and therefore, does not cross the placental barrier. The studies have shown that Antibodies generated were detected in both umbilical

			cord blood and breast milk samples protecting fetus and babies. ^{24,25}
7	Vaccines, hindrance for herd immunity	The world has been looking at the herd immunity to drop the transmission rate since the advent of the pandemic. There were claims that natural immunity is the only way to achieve it and thus, a message is circulating to avoid vaccines for herd immunity.	Omicron has an R0 of 3-7. Therefore, 85-86% of the population needs to be immunized for herd immunity. The SARS-CoV-2 virus keeps on mutating and evading the human immune responses to a certain degree. The herd immunity achievability is far off. Vaccines are required to prevent hospitalizations and limit transmission. ³³
8	Vaccines, 'super spreaders' of variants	Social media users endorsed that vaccination is the reason behind the emergence of new variants. The statement was misinterpreted that the SARS-CoV-2 does not abate on encountering the antibodies in the vaccine and discovers newer ways to evade the immune response. This creates mutations and produces variants.	The immune system of viruses produces mutations in the epitomes when exposed to vaccination for survival selection, which explains that some versions survive and are not the cause for variants. The fact is when the virus is widely circulating in a community, it has higher chances of replicating and subsequently, development of mutations and variants. ³⁵
9	Vaccine not abolishing the disease	The Bear week at Provincetown's annual gathering of men showed the vaccinations causing and spreading the disease. It resulted in a tremendous increase in the number of people talking against the vaccine in the media. ³⁶	Vaccinated are not as likely or more likely to spread the virus as unvaccinated as the data collected from the Bear week by CDC COVID-19 Vaccine Breakthrough Case Investigations Team concluded that delta viral loads drop more quickly in vaccinated, virus particles in nasopharynx many not be infectious and finally that the virus is detected in the nasopharynx whereas vaccine impacts the lungs more significantly. ³⁷
10	Seizures & Myocarditis in Children	A video posted on an anti-vaccine website made by Vaccine Safety Research Foundation showed a young girl enjoying and celebrating with the family developing uncontrollable shaking, agonizing pain, and lying with an ETT and OGT after vaccination. The rumors that it affects fertility, and produces myocarditis. ³⁹	FDA studied and demonstrated the side effects of the vaccine for the children before approval and authorization. The data is still being collected and it has been found from the nationwide mass vaccination that vaccine is associated with an excess risk of myocarditis; however, the risk intensifies with COVID-19 infection. ⁴⁵

DISCUSSION:

The COVID-19 pandemic still remains an evolving outbreak. An integral part of bringing this and future pandemics under control, is to focus on the public attitude towards vaccination. Conspiracy theories and fallacious, pseudo-scientific beliefs are detrimental to controlling COVID-19. In the present

day, the media holds a responsibility, as it influences the public. It is that powerful tool that has the capability to mould the public opinions from 'against' to 'for', regarding any healthcare measures through creating awareness and promotion while mitigating and preventing debatable contexts from spreading.

Here are the few things that the media needs to adapt to avert the controversies and enforce the immunization in any pandemic or epidemic in an effective way:

Public Awareness Campaign:

To achieve 'community immunity,' the media provides a significant platform for addressing hesitancy, reluctance and mistrust in vaccines. Rene Najara, an epidemiologist and editor of the History of Vaccines project at the College of Physicians of Philadelphia mentioned social media together with politics and international travel as hindering obstacles.⁴¹ Many countries in Asia did create coronavirus mascots to encourage the vaccination. New Year was marked with 'vaccine perishing the virus' animated wishes spreading through social media and providing hope for the upcoming year.^{42,43}

-A large campaign led by the media is required to boost up the vaccination rate in the US and world. It means a campaign led by the medical professionals consisting of doctors and nurses, explaining about the role of vaccines and answering the questions should be done. Various broadcasts in languages like English, Spanish, Chinese, Tagalog, French, Vietnamese, German, Korean, Portuguese, Italian, and Arabic are required particularly from doctors with translators.

-Additional animated advertisements for influencing the audience towards vaccination should be done by formulating public relations and health promotion units.

-All these campaigns should be centralized, linked to the United States Department of Health and Human Services and funded by the government.

-Health Webinars can help mitigate the misnomers regarding vaccines and ameliorate the compliance.

Source of Updated Information:

Most of the ambiguities arise and spread in the form of rumors due to the lack of a 'reliable source' to go to. It is, therefore, imperative that vaccine information through media should be available only through a few limited 'authorized websites.' Rest of the hospital websites, social media and news websites should have the links to automatically redirect to a few authorized websites/pages, run by agencies directly linked with vaccine discovery, manufacturing and approval like FDA. Scientific Immunization Advisory Bodies should oversee all the media lead campaigns.

-It is crucial that people should be allowed to post their queries and answers should be given by medical/ scientific persons.

-Digital toolkits should be established before the FDA gives full approval and available for the general public to view the complete diagrams for

vaccine development, safety and efficacy with data. It should also have a section for frequently asked questions.

-Introduce applications on phones to update the people with vaccine data, percentage of vaccines administered, information regarding nearby centers, help with booking appointments and updated data about the adverse reactions and side effects taking place with each kind of vaccine.

Revealing 'missing context' and Elucidating 'misinformation':

Media is a globally used resource. It has transformed the world into a global village and is also a big source of 'metastasizing' the 'misinformation,' By highlighting the decontextualized and fragmented information as the real info, and publicizing the contradictory statements, it is well known to cause much online harm. To challenge free speech for preventing the damage will always remain a debate and hence, we need ways to combat the situation. It is suggested that after broadcasting conflicting news, the media should refrain from making a judgment and put in the references from authenticated websites, as mentioned above, for people to refer to. Public figures without scientific knowledge should refrain from making statements online. Thorough explanation of vague videos posted online should be revealed.

Fact checkers and Myth debunkers:

In the vaccination era against COVID-19, conspiracy theories, and myths have created doubts in the minds of people. The hopes and trust of the public on scientists and government has been shattered severely secondary to these surreal facts circulating on the social media. 'Myth busting' and 'infotainment' are essential to overcome the viral rumors and fake news which can prove hazardous for the public. Different platforms of media should be utilized to debunk the myths surfacing. Print media should be used to paste all the myth debunkers at prominent public places to enhance the knowledge regarding all the misinformation. Credible fact checkers can prove to be powerful signals for social media and can help improve their publicity further. All the fact checking labels employed should be from health institutions and research universities. Myth debunking sheets should have references from papers with significant endorsing data.

Managing Anti-Vaccine Movements:

When COVID-19 vaccine started rolling out in the public, the anti-vaccine movement against it sped up as well. The search for the anti-vaccine book became the highest sought search on amazon and Barnes & Noble websites. The Republican Congressmen from at least 40 states were found

backing bills to restrict COVID-19 vaccine mandate and passport. Vaccine adverse reporting system, a platform designed to report adverse effects, was utilized by the anti-vaccine activists to sway people away from the vaccination including promoting fake deaths claims. Many people started the slogans, 'catch this cold' as a way towards true immunity. The Anti-Vaccine Propaganda spread through the organizations like Children's Health Defense led by Robert F. Kennedy, Jr. and the Informed Consent Action Network led by activist Del Bigtree has created a distrust of scientific and research organizations. To prevent the spread of anti-vaccine movement, certain measures should be adopted:

- Aggressive vaccine campaign to counteract all the misleading built by anti-vaccine groups
- Banning the unverified content sharing by anti-vaccine organizations and flagging them on the media widely
- Aggressively responding to risk vs benefit claims established by the anti-vaccine groups
- Promoting the vaccine industry in producing effective vaccines over the period of years and eradicating the various diseases with immunization.
- Adding truthful disclaimers stating the information is unverified and based on speculation for all the content posted online by anti-vaccine groups by regulatory authorities.

CONCLUSIONS:

After more than two years, the COVID-19 pandemic still remains a threat worldwide. The only possible solution is mass vaccination at a rate that

can help us combat the spread of disease and control the rate of hospitalizations. Mass media has a significant and chief role in the public awareness, influencing the attitude towards vaccines, elucidating the misinformation and improving the percentage of vaccination globally. In this article, we discussed the positive and negative impacts of media in the vaccination campaigns and proposed the steps that can be taken to employ media in a better way during the vaccination development, distribution and administration. A well-devised strategic plan for authorization, delivery, and inoculation is essential to maintain scientific integrity, public trust and enhance compliance. And this plan should be formulated beforehand, scrutinized at different levels and evaluated with frequent feedback for the media to effectively execute the immunization process in the world.

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