Research Article

Attitudes of caribbean medical students towards COVID-19 vaccination

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As the COVID-19 pandemic continues to rage on in our world, effective measures to combat the continual spread of the virus have begun to be deployed. The most effective of these measures is the development of the mRNA vaccines manufactured by numerous companies such as Pfizer, Moderna etc. For these vaccines to be maximally effective it is crucial to achieve a sufficient vaccination rate amongst our worldwide populations. Vaccine hesitancy is and always has been a concern in the general population. This study looks at the attitudes of Caribbean Medical students towards the vaccines and attempts to elicit reasons for vaccine hesitancy. Among Caribbean medical students the vast majority believe the vaccine to be effective. A small minority, however, do not believe the vaccine to be effective and state their reasons to be fear of side effects/reactions, belief that covid-19 is not a real threat, lack of trust or lack of access to the vaccine. Caribbean medical students represent a small subset of the population, but results of this study may be extended to the general population. To achieve an acceptable vaccination rate in the general population it is important to understand the reasons for noncompliance. With this understanding comes the opportunity for appropriate education and counseling with a goal of alleviating anxiety surrounding the vaccine.

Among Caribbean medical students the vast majority believe the vaccine to be effective. A small minority, however, do not believe the vaccine to be effective and state their reasons to be fear of side effects/reactions, belief that covid-19 is not a real threat, lack of trust or lack of access to the vaccine. Caribbean medical students represent a small subset of the population, but results of this study may be extended to the general population. To achieve an acceptable vaccination rate in the general population it is important to understand the reasons for noncompliance. With this understanding comes the opportunity for appropriate education and counseling with a goal of alleviating anxiety surrounding the vaccine.

Key words: COVID-19, pandemic, caribbean, medical, school, students, vaccine

INTRODUCTION

The current SARS2-Coronavirus (COVID-19) pandemic has been ongoing for close to two years now and many interventions have been employed to fight it such as wearing masks, social distancing, frequent hand washing, temperature checks, limited capacity in indoor establishments, and now vaccinations. Vaccinations have become the primary hope for a return to a normal life as they confer resistance to reinfection from the virus and even in the instance of infection happening, the risk of a clinically significant disease emerging remains limited (Khoury et al., 2021). Additionally, in places where vaccination rates have reached significant levels, life has returned to normal, without the hospital ICU's being overrun and the need for wide-spread lockdowns (Rossman et al., 2021). It is apparent that vaccinations are the primary solution through which the world can hope to go back to the state it was in prior to this pandemic - a world where people can freely travel from one place to another, a place where hospitals aren't overcrowded with people clasping for life, and a world where

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important elective, health treatments and surgeries can proceed as planned.

Many types of vaccines exist, including live attenuated, killed inactivated, and subunit vaccines. Through the developments of these various vaccine technologies, there have been significant strides in human healthcare. Diseases such as smallpox and polio, which have had devastating consequences on humanity in the past, have been essentially eliminated (Plotkin SA, 2009). Historically, vaccines have been based around the presentation of antigens to the host to create an immunological response to the antigen and thereby confer immunity through the development of memory B-cells. Examples include the live attenuated Mumps, Measles, and Rubella (MMR) vaccine - a live attenuated vaccine is a weakened version of the real virus that greatly reduces pathogenicity. An example of a killed inactivated vaccine is the rabies vaccine, here this vaccine is composed of small pieces of antigens taken from the virus and injected into hosts to generate antibodies that confer defense against the virus (Tlaxca et al., 2015). In the last several decades significant research has been used to create vaccines based on DNA and RNA technology and more recently this research has enabled researchers to develop novel vaccines against SARS-CoV-2 virus.

In terms of vaccine development, the process of isolating an antigen, attenuating, or inactivating it to reduce its pathogenicity is vastly more difficult, time consuming, and resource intensive compared to directly taking the protein code of an antigen to generate the genetic code needed to create DNA and mRNA vaccines (Liu MA, 2019). In the 1990's the development of DNA based vaccines took precedence over mRNA-based vaccines due to DNA molecules being more stable in vivo than mRNA molecules because of the inherent nature of them being double stranded rather than single stranded. Since the early 2000's data has shown that mRNA vaccines elicit a potent immune response in the host, additional benefits of mRNA vaccines relative to the other types of vaccines include better safety as mRNA is a non-infectious, non-integrating biological molecule, with a relatively short in vivo half-life (Pardi et al., 2018). At the present time, four major vaccine types have been developed to battle covid-19 including: AstraZeneca and Johnson & Johnson, both DNA viral vector vaccines, and Pfizer-BioNTech and Moderna, both mRNA vaccines7. The AstraZeneca and Johnson and Johnson DNA viral vector vaccines contain a plasmid of DNA encoding for the SARS-CoV-2 spike protein in an adenovirus vector, while the mRNA vaccines have the mRNA encased in a lipid nanoparticle (Chung et al., 2020, Doerfler W, 2021).

These new vaccines have proven to be effective against covid-19, but their availability in different parts of the world remains controversial, with developed nations having received a disproportionate number of doses relative to developing nations. Data shows that 51% of the populations from the highest income nations have received at least one dose of a covid-19 vaccine while in low-income countries it is barely 1% of the population (Tracking global COVID-19 vaccine equity, unpublished observation). As the push towards booster doses of covid-19 vaccine continues to grow in the high-income countries, the availability of these crucial vaccines in low-income countries is not expected to undergo major change. When comparing the covid-19 orders for vaccines versus population sizes, the results speak for themselves. High income nations represent 65% of global vaccine orders, yet they only account for 16% of global population in contrast, middle income countries represent 26% of global covid-19 vaccine orders, yet they represent a tremendous 75% of the global population. This inequality in vaccine access globally is driving the disparity in global vaccination rates leading to negative disease outcomes for all. This remains a key issue to be targeted as more and more variants continue to emerge from places where covid-19 vaccination rates are low (Choi EM, 2021).

The data is clear that covid-19 vaccination reduces chances of getting SAR2-coronavirus pneumonia and leads to reduced case-fatality rates among cases of vaccinated people that do catch coronavirus (Liang et al., 2021). Interestingly, however, vaccine hesitancy remains large in many parts of the world and among specific groups of people. This hesitancy is not a new phenomenon as it has been present well before this current pandemic started and will likely continue to be present well into the future (MacDonald NE, 2015). Data has shown that this hesitancy emerges from fears surrounding lack of knowledge about these vaccines, concerns for potential adverse reactions, and apprehension for potential future side-effects (Abrams et al., 2021). Unfortunately, vaccine hesitancy remains a significant blow in the face of public guidelines driven by distrust of institutional authorities. However, education, availability, and persistence are powerful tools that remain in the tool chest of public health officials in the promotion of vaccine uptake for all (MacDonald NE, 2015).

Caribbean medical students represent a subset of the total healthcare professional population and the attitudes as well as the beliefs of the medical students can directly be applied to the healthcare population at large. Much like how athletes in professional sports can become an image for the sport itself, healthcare workers serve as the image for the healthcare system tremendously. When healthcare workers fail to follow guidelines for best healthcare practices, there can be a disconnect between the message healthcare groups seek to deliver and the message that is received by the population of patients (Baker DW, 2020). Cognitive dissonance goes beyond skin color, education, age, and political association – everyone is prone to falling trap to it. Due to this, it is important to occasionally look at the trends that are present among groups of individuals in their attitudes and beliefs to gain an understanding for; why those attitudes and beliefs have emerged, how pervasive they are among that population of people, and if significant, what secondary variables are perhaps driving these trends in attitudes.

The purpose of the present study is to determine the attitudes Caribbean medical students have towards receiving the covid-19 vaccination. Today's medical students are tomorrow's physicians, and it is important to understand where this group of individuals stand as a cohort towards vaccination among themselves and the greater population as well as to understand what thoughts or beliefs are driving these attitudes. Identifying hesitancies among future healthcare providers who are a group of people that are highly educated in vaccinology can illuminate trends in attitudes among the greater population. Furthermore,

this data can help determine specific approaches to take to reduce vaccine hesitancy in the future. This is particularly important as the trend of booster covid-19 vaccinations has begun to take hold. It is important to employ measures that will lead to the greatest vaccine uptake among both the healthcare and greater population to confer the largest protection to the most amount of people possible; thereby, reducing hospitalizations, stopping the spread of the virus, and bringing the entire world back to where it was prior to this pandemic.

MATERIALS AND METHODS

A multi-centered survey questionnaire was created and distributed during the COVID-19 pandemic from July 15th, 2021, to August 20th, 2021, via social media sent to second, third and fourth-year students across a multitude of Caribbean Medical Schools, including but not limited to Medical University of the Americas (MUA), St. George University (SGU), Ross University, American University of Antigua (AUA), SABA University School of Medicine, St. Xavier's University and St. Matthews University. The survey was collected using classmates, co-students, friends' circles, and social media platforms such as Facebook school groups, Twitter, Instagram, and Snapchat. The survey covers the subjective experience of Caribbean Medical Students who are currently studying, amidst clinical rotations or finishing their fourth year. The survey included 11 questions and a total of 134 responses were collected. Databases used to collect literature studies were PubMed, Google Scholar, JSTOR, MEDLINE, and Mendeley. The above-mentioned database search was performed using keywords include 'COVID-19' 'Caribbean Medical Students' 'attitudes toward vaccination' 'Covid-19 Pandemic' and 'Medical Students view on vaccination'.

Survey questions:

● Did you receive the COVID-19 Vaccine?

● If yes, which COVID- 19 vaccine did you receive?

● If not, why did you not receive the vaccine?

● What side effects did you experience from the vaccine? (Check all that apply)

● Do you believe the vaccine to be effective?

● On a scale of 1-10 how important do you think it is to get the vaccine?

● Which Caribbean medical school do/did you attend?

● Did your school mandate for you to be vaccinated before returning to campus?

● If yes, would you still have chosen to get vaccinated if they did not?

● Do you think getting the COVID-19 vaccine should be mandatory for all in the healthcare field?

This paper is not in need of any ethical approval as it involves the analysis of anonymous datasets which involve proper retrieval of informed consent.

RESULTS

We collected 134 complete questionnaires containing 11 questions about Caribbean Medical students' attitudes toward the Covid-19 vaccination. The estimated response rate was 100% based on 11 online survey questionnaires. It showed us that 92.5% of the respondents have been vaccinated (Table 1). Of these, 53.7% said that they received the Pfizer vaccine, with the next highest 21.6% said they received the Moderna, 14.2% received the AstraZeneca, 3. % received the J&J, and 7.5% made up of those that had not received the vaccine yet (Figure 1). From Figure 2, from those that did not receive the vaccine 46.2% identified their reason to be fear of side effects or an allergic reaction. Whereas 23.1% believe that Covid-19 is not a real threat, and both lack of trust and lack of access to it was stated by the same 15.4%. Of the people that took the Pfizer vaccine most complained of fatigue at 49 people, then 28 and 29 people said they felt fever and chills, respectively. Four people had nausea and vomiting, 2 had runny noses or cough and 1 had shortness of breath. Those that took Moderna complained most of fatigue with 21 people, then 18 and 15 people for fever and chills, respectively. Cough or runny nose was experienced by 3 people and nausea and vomiting by 2. AstraZeneca and J&J vaccines both had fever as their most common complaint at 16 and 4 people, respectively. This was followed by fatigue at 12 and 4 respondents. Of those that took AstraZeneca 2 had nausea and vomiting and cough or runny nose, while 1 had a sore throat and 1 had shortness of breath. Of those that took J&J, 3 people had coughs or runny noses and 1 had nausea and vomiting (Table 1). Moderna was chosen by 11.2% to be the most effective and AstraZeneca at 2.3%. There was a majority vote at 70.9% of respondents ranking 10/10 of the importance of getting vaccinated. The highest percentage of respondents were seen to be from SGU at 67.9%, with second highest at 20.1% from MUA (Figures 3 and 4). A majority 82.1% of students said that their school mandated getting vaccinated before returning to school, and 87.4% stated they still would have chosen to get vaccinated even if it was not mandated. Finally, 79.1% stated that getting the Covid-19 vaccine should be mandatory for all healthcare workers (Table 1).
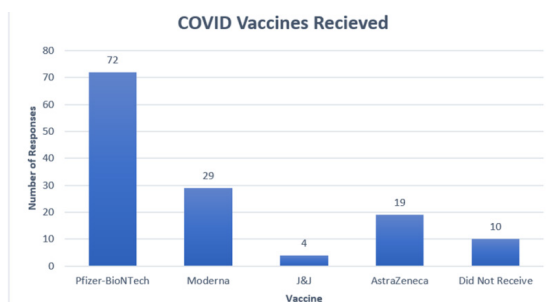

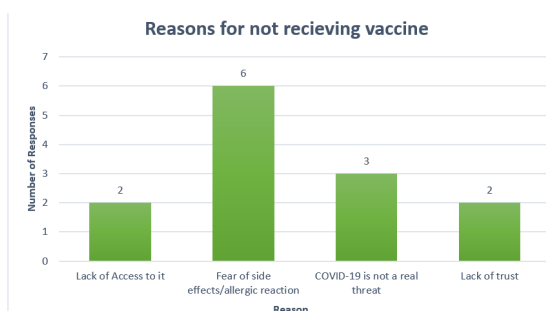**Figure 1.** Shows which COVID Vaccine was received by students.

Figure 2. Displays students' reason for not receiving the vaccine-13 responses.
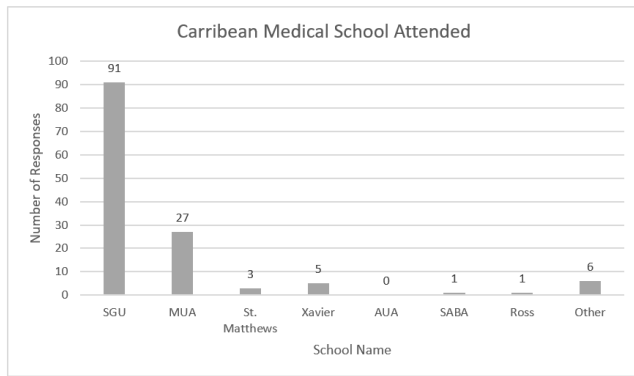
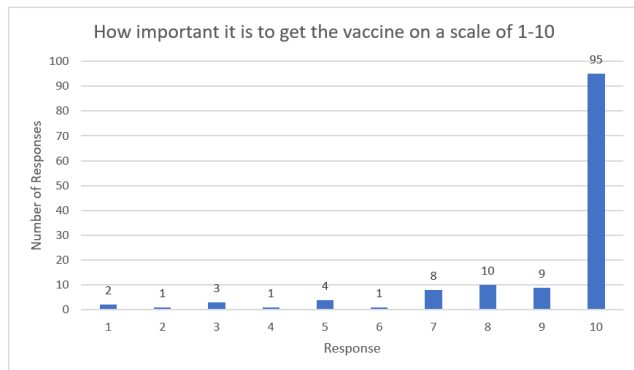**Figure 3.** Shows which Caribbean Medical School respondents attended.

Figure 4. Displays student response to how important it is to get the COVID vaccine-on a scale of 1-10.

Table 1. Student response to questions regarding the COVID Vaccine.

Did you receive the covid-19 vaccine?	Total n	Percentage %
Yes	124	92.5
No	9	6.7
Not yet, but would like to receive	1	0.7
What side effects did you experience from the vaccine?		
Pfizer-BioNTech -72 Total		
Fever	28	38.8
Chills	29	40.2
Fatigue	49	68
Nausea and vomiting	4	5.5
Loss of taste	0	0
Sore throat	0	0
SOB	1	1.3
Cough/Runny Nose	2	2.7
Moderna – 29 Total		
Fever	18	62
Chills	15	51.7
Fatigue	21	72.4
Nausea and vomiting	2	6.8
Loss of taste	0	0
Sore throat	0	0
SOB	0	0
Cough/Runny nose	3	10.3
J&J – 4 Total		
Fever	4	100
Chills	3	75
Fatigue	4	100
Nausea and Vomiting	1	25
Loss of taste	0	0
Sore Throat	0	0
SOB	0	0
Cough/Runny Nose	3	75
AstraZeneca – 19 Total		
Fever	16	84.2
Chills	10	52.6
Fatigue	12	63.1
Nausea and Vomiting	2	10.5
Loss of Taste	0	0
Sore Throat	1	5.2
SOB	1	5.2
Cough/Runny Nose	2	10.5
Do you believe the vaccine to be effective?		
Yes	119	88.8
No	13	9.7
Unsure	2	1.5
Did your school mandate for you to be vaccinated before returning to campus?		
Yes	110	82.1
No	24	17.9
Do you think getting the COVID-19 vaccine should be mandatory for all in the healthcare field?		
Yes	106	79.1
No	23	17.2
Other response	5	3.7

DISCUSSION

Main findings of this study

The study demonstrates that most Caribbean medical students surveyed not only believe in vaccination to be an efficacious proactive measure against Covid-19 infections but should also be an imperative standard within the healthcare community. Almost 90% of students believed the vaccine to be effective (Table 1). Furthermore, 79.1% of all students surveyed also believed that the Covid-19 vaccine should be mandated for all healthcare workers across all professions (Table 1).

This belief of vaccine efficacy seems to stem, at least in part, from the top-down approach dictated by the student's institutions. Of those surveyed, 82.1% indicated that their school mandated the vaccine to resume education in person (Table 1). This cannot however explain the entire willingness to get vaccinated as a larger portion of students (87.4%) had intentions to get vaccinated independent of whether their institution mandated it. As such, the vaccine efficacy appears to be generally, in high regard amongst most medical students. This is a result you would generally expect in students entering the healthcare field. It seems intuitive to assume that healthcare workers that are recommending the vaccine for the public would likely be willing to take the vaccine themselves. Yet,

previous studies have shown that this is not always the case (Shekhar et al., 2021).

What is already known about this study?

Vaccine hesitancy has previously been evaluated amongst American allopathic medical students. The study found that up to 26% of students would be unwilling to get vaccinated against Covid-19 even with FDA approval (Lucia et al., 2021). This is despite 98% of these students agreeing that vaccine development was important to decrease community spread (Rimmer A, 2021). That number seems lower than expected considering a fair amount of these students will soon be entering hospitals, or currently are helping treat patients while on clinical rotations. Notably, the vaccine approval rate was higher amongst clinical students as opposed to preclinical medical students (Lucia et al., 2021). This may imply a close relationship with exposure to the frontline of healthcare and higher belief in vaccine efficacy.

It has previously been proposed that if vaccine hesitancy amongst healthcare workers does not improve, mandating vaccines may be justified and required (Rimmer A, 2021, Mittelman M, 2021, Gostin et al., 2021). The importance of achieving a high vaccine rate amongst healthcare workers is not a novel idea in medicine (Loulergue et al., 2009). As mentioned previously, almost 80% of Caribbean medical students surveyed believe vaccines should be required (Table 1). In North America, certain medical facilities began mandating the vaccine amongst their employees as far back as April 2021 (Stokel-Walker C, 2021). Within medicine itself, many universities have begun mandating vaccines as the push for returning in person education is paramount to training doctors effectively (Thind et al., 2021). As mentioned previously, 84% of respondents within this study were mandated the vaccine to resume in person education (Table 1). This is a trend not limited to Caribbean universities (Michaka KJ, 2021).

What this study adds + future implications?

A cross-sectional international study on enabling and preventative factors of Covid-19 vaccine uptake show that verified positive information from governments regarding both the safety and efficacy of the vaccines are essential for achieving high vaccination rates (Burke PF, 2021). This same correlation on the importance of trust and vaccine uptake was seen amongst American medical students (Lucia et al., 2021). An extension of that trust within the governmental systems naturally encompasses the main healthcare presence at the forefront of the pandemic: medical doctors. As such, achieving a high vaccination rate amongst medical doctors is an essential step in encouraging the general population to get vaccinated.

To first accomplish this, further research needs to be obtained about healthcare hesitance to the Covid-19 vaccine. As such, it is imperative to understand why students, who are the future of the healthcare field, are possibly resistant to the vaccine. Studies have previously looked at the medical students' hesitancy for the vaccine around the world including America, Italy, and Egypt (Lucia et al., 2021, Pitini, 2021, Saied et al., 2021). This study, however, is the first one to look specifically at Caribbean medical universities, significant contributors to the collection of physicians working in America. Caribbean medical graduates also make up the largest % of graduates

that work directly in primary care (van Zanten and Boulet, 2013). Primary care physicians are often the ground force for promoting vaccines amongst the public. As such, physicians need to be prepared to answer all questions about both vaccine efficacy and all the possible side effects to eliminate patient doubts (Kernéis et al., 2017).

The nearly 80% of Caribbean medical students that felt Covid-19 vaccination should be mandatory for healthcare workers is in stark contrast to a study published in January 2021 where only about 1/3rd of healthcare workers were even willing to take the vaccine once it became available16. This number was notably higher amongst direct healthcare workers i.e., those interacting directly with patients) with the willingness rising to 49% (Shekhar et al., 2021). This effect was also seen in Israel where a study showed only a + 3% increase in vaccine uptake when comparing physicians to the public. The same study showed the vaccine uptake amongst nurses was surprisingly even lower than the general population (Dror et al., 2020). In the world of the pandemic, however, 12 months can make a large difference when it comes to general belief of vaccine efficacy, worries about their side effects, and rising external pressure to get vaccinated. It is not inconceivable to think these numbers may have risen since the previous studies were posted.

This paper ultimately aims to gain information about the average Caribbean student's view of the COVID-19 vaccine. The questions created were designed to identify the percentage of students that have gotten the vaccine, the side effects they experienced, which vaccine they have gotten, and if applicable, their reasons for not getting the vaccine. As COVID-19 continues to overwhelm health resources across the world, it is imperative that high vaccination rates are quickly obtained to prevent deaths and further mutation/evolution of the virus that will prolong this pandemic. This evolution has already been seen. Currently the delta variant of COVID-19 is "the predominant variant of the virus in the United States" (CDC, unpublished observation). It even infects vaccinated individuals at a notable rate. Despite this, current COVID vaccines have proved to be effective in reducing the rates of infection and greatly reducing hospitalizations. Unvaccinated individuals are 29x more likely to be hospitalized with COVID, and 5x more likely to be infected with COVID compared to fully vaccinated individuals (Griffin et al., 2021).

To effectively encourage those unvaccinated to receive the vaccine we must understand the reasons that these individuals may have for their abstinence. In this way we can better educate and hopefully alleviate some of the concerns that the unvaccinated may have. Beyond this paper, further research can broaden the focus to nursing students, who have previously been recorded as having lower vaccine uptake than their doctoral counterparts once in the workforce (Dror et al., 2020), and beyond that to all healthcare workers. Once these reasons for hesitancy are more fleshed out, the next steps need to investigate effectively increasing education of vaccines. Medical students are the future healthcare practitioners of our world and understanding the hesitation of some of our brightest, may allow us to extend this knowledge to the general population.

LIMITATIONS

The study did not ask subjects to verify which dose they had gotten. Lack of availability has led to the mixing of vaccinations in certain parts of the world. Thus, for example, someone could have initially gotten a Pfizer vaccine, followed by a Moderna on their second dose. The questionnaire did not allow for such individuals to accurately report which vaccine they got in cases such as these. Another question that may have been helpful is to include the option of temporary muscle and joint soreness as a side effect of the vaccine. An independent analysis reported these to be some of the most prominent regular side effects experienced by patients taking the Moderna vaccine (Wadman M, 2020). An additional evaluation worth looking into is the degree to which students' research vaccines outside of their mandatory medical education. As new data emerges daily, a regular upkeep of information would require more independent academic research to stay on top of. Additionally, a notable aspect this study failed to capitalize on, especially with the recent prevalence of mandatory vaccinations, is the degree to which medical students would consider leaving their profession if they were required to get vaccinated. This has many imperative implications to the current day where hospitals are regularly losing staff due to their vaccine policy (Stokel-Walker C, 2021). Further limitations stem from the population source for the study. Most participants arise from 2 universities: St. George's University (SGU) and Medical Universities of the Americas (MUA). This may naturally limit generalizability of these results to the rest of Caribbean medical students (Lucia et al., 2021).

CONCLUSION & FUTURE IMPLICATIONS

The present survey was distributed to Caribbean medical students regarding their attitudes surrounding Covid-19 vaccinations, and the results show an overwhelming support for the effectiveness of the vaccine, along with widespread support for mandatory vaccination of healthcare workers. These results are stronger than those reported at American Allopathic medical schools, and the reasons behind why this variance is present remain to be unfounded. These results are, however, encouraging seeing as it shows the unequivocal support among this cohort of future healthcare leaders for the effectiveness of one the most powerful tools created thus far to combat the ongoing Covid-19 pandemic.

Vaccinations remain at the forefront in the battle to leave this Covid-19 pandemic and return to life prior to this catastrophic health crisis, and additionally they serve as a strong mechanism through which we can put a halt to the emergence of new strains of coronavirus. In this battle to end the pandemic it is important for healthcare providers including medical students, to have a unified front in how they deliver their message regarding vaccinations. For this message to be effective it is crucial a consensus is reached within the community regarding their stance regarding vaccinations. Therefore, it is paramount that the source of these doubts is identified to foster a unified message to be delivered to the public so the continuation of advocacy can be made for widespread vaccination.

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