

Review Article

The price of unconsciousness: "The Scientific Development of immunology and anti-vaccine movements".

Comment [EOE1]: The title shall be: **The price of unconsciousness: "Anti-vaccinesmovements andScientificDevelopment of immunology".**

Abstract:

This article presents the narrative about the importance of vaccines in public health to highlight the scientific development required and involved for their production, and their importance for health by exploring events that denote scientific development and unfounded opposition towards the immunization of the population against vaccine-preventable diseases. The corresponding literature review was carried out in online databases using the keywords: vaccines, scientific development, and denial of vaccination, vaccination, and anti-vaccines.

Furthermore, it was found that vaccines, toxoids, and biologicals to prevent contagion or serious forms of infectious disease, whether by viruses or bacteria, are more understood than a century ago. Vaccination aroused along health policies and is recognized as one of the most cost-effective practices on the planet. Although constantly and coupled with the development and implementation of vaccination schemes, some social groups appear to oppose this practice. Being anti-vaccination is often associated to fear, religious beliefs, ignorance, and more frequently, a lack of social awareness of the responsibility to immunize minors and vulnerable groups, especially those with risk factors or comorbidities, including the current pandemic catastrophe due to covid-19. Not getting vaccinated due to the circulation of unreliable information, without scientific bases, puts the human population at risk and is often common among individuals with vulnerabilities in academic and socioeconomic sectors such as poverty, and other types of vaccine-related beliefs.

Keywords: anti-vaccines, scientific development, vaccination refusal, vaccines, vaccination.

Comment [EOE2]: Thekeywordsshould be revised as: Vaccines, Antivaccines, Publichealth, Immunology, Diseases, Scientificdevelopment, Pandemic

Introduction

Vaccination is undoubtedly one of the great achievements of the Twentieth Century. Around the world, multiple immunization campaigns are carried out every year aiming to eradicate many of the diseases that have caused thousands of deaths and also left millions of individuals with significant consequences (e.g. smallpox, measles, and poliomyelitis, ~~for example~~). Each of the anti-vaccine movements curbs the objectives of public health, based mainly on poorly religious and philosophical ideas; thoughts that question its efficacy; unsubstantiated arguments that assign more risk than benefit; and unsubstantiated myths against a reality (1).

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The Global Alliance for Vaccines and Immunization (GAVI), is a public-private organization formed by scientists, health experts, government leaders, and businesses whose goal is to save children's lives and improve health through increased access to immunization in 73 of the poorest countries in the world. It was funded by the Bill Gates and Melinda Gates Foundation, which also promote multiple organizations whose goal is universal immunization.

According to Decade Vaccine Economics, launched by the International Vaccine Access Center (IVAC) of the Johns Hopkins School of Public Health (also a beneficiary of the program), the savings involved in investing per dollar for vaccination were investigated recently (2).

The savings estimated were achieved through the return on investment studies, which justify that the investment in vaccination is much more feasible than its counterpart. It was obtained that for every dollar invested in vaccination (including toxoid, serum, or antitoxin in addition to transportation and maintenance, as well as application material), the return on investment corresponded to 16 dollars. Those findings were also compared with other industry sectors such as cardiovascular disease research, investment in preschool education, public infrastructure, community health workers, and government bonds. Therefore, vaccination is considered a great investment because it prevents diseases and sequelae for life, saves money on the costs of medical care, as well as complications and sequelae on the individual's income variations due to disability or death (2).

Another entity is Vaccine Work, whose goal is to bring together organizations and individuals working on immunization around the world to share their stories in a way that can help everyone understand the importance of vaccination. On a map produced by Vaccine Work, new outbreaks around the world are marked based on information published by the news, governments, and reports from different health organizations. Such a map also traces the outbreaks of vaccine-preventable diseases in the world. Among those that stand out in America are Venezuela, Brazil, and the United States; Italy, Romania, and Ukraine, in the European Union; Nigeria and its surrounding countries in Africa; India, Pakistan, the Philippines, and Australia.

The principle of vaccination is based on inoculation is understood as the process by which the infectious material of a specific disease is introduced into the body through a wound in the skin or mucosa, thus infecting it for our immune system to create antibodies against it, so that the next time we come into contact with that infectious organism our body recognizes it and the disease does not proliferate or decreases its aggressiveness; this being the principle of vaccination (3-5).

The first signs of vaccination which were inoculated by inhaling scabs of patients with smallpox are reported between the 10th and 16th centuries in China and other Asian countries, which were inoculated by inhaling scabs of patients with smallpox. In 1718, Lady Mary Montagu, an aristocrat then in her second marriage to the English ambassador of the Turkish court, and who was also affected by smallpox, reported in her letters from Constantinople (now Istanbul) how the elderly Turks inoculated the population with pus from the infected and thus preventing the disease. Therefore, she decided to put the method into practice with her son; then she managed to do it with the French court and the Royal family in Italy. Although it was successful, it was not approved by the entire population (4,5).

In 1796, Edward Jenner, an English surgeon, observed that cow's milk collectors were infected with a type of cowpox less aggressive to humans from which they obtained immunity; to prove it, he inoculated an eight-year-old boy with secretions from cowpox lesions from a farmer. The boy showed cowpox infection and, after recovering, Jenner now infected him with human smallpox. He succeeded. It was then that the technique spread throughout the rest of Europe, proving that such a dangerous disease could be fought (5,6).

It did not take long for the oppositional ideas to arise, despite having an extremely acceptable result in decreasing the spread and severity of smallpox, religious opponents stopped this great achievement. Edmund Massey, a London reverend, caused prejudice in the masses by defending

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the ideology of divine punishment through disease, justifying the thousands of deaths from smallpox as a consequence of human sin. According to him, vaccination acted against God's decision, so he who chose it shall die, and challenging his decision was unacceptable. In his manuscript "The Dangerous and Sinful Practice of Inoculation" inoculation is cataloged as diabolical (7,8). However, this is not the only case that exemplifies the challenge for progress. This is how we cite the Cutter incident, dating back to 1955 when the hope of the population affected by the poliomyelitis virus was based on a single idea, vaccination. When the efficacy of the vaccine was tested, on April 12, 1955, agreements were signed with various pharmaceutical companies (Eli Lilly, Parke-Davis, Wyeth, Pittman-Moore, and Cutter), which were in charge of producing vaccines and then marketed throughout the world. However, on April 26th, 1955, the unexpected occurred: Cutter laboratories reported serious cases of paralysis in children who had received the vaccine. Therefore, it was decided to withdraw the immunization campaign and analyze the possible causes; despite the fact that 380 thousand doses had already been administered (120 thousand of which had live viruses). In the end, there were 40 thousand cases of poliomyelitis and 5 deaths from it. Under this view, new quality standards had to be implemented to avoid catastrophes of this kind again. Consequently, the mishandling of the product had catastrophic consequences, including the harsh distrust of vaccination; these aspects served as an argument for multiple anti-vaccine organizations to extend their campaign (9).

At the end of the last century, one more event occurred when this issue represented a major public health problem. February 26, 1998, was the day when a wave of international distrust of vaccines was generated, the effects of which reverberate up to this day, 20 years later. In London, the doctor Andrew Wakefield presented a preliminary investigation, published in the prestigious scientific journal *The Lancet*, in which he pointed out that twelve children vaccinated with the MMR vaccine had developed autistic behaviors and severe intestinal inflammation. Vaccination rates dropped significantly in the UK and the rest of the world. This study was later classified as fraudulent, but it was already too late because the wave of diseases controlled by vaccination would return with catastrophic effects that were not seen since the first half of the last century. This action, in addition to the impact on health, gave force to anti-vaccine movements that have been perpetuated, unleashing panic not only in the medical community but also in the general population (10,11).

Among other opponents, we find Sherri Tenpenny, an osteopathic doctor, dedicated to fighting against vaccination. She fervently defends the right to choose whether or not to vaccinate children, claiming that it is a decision inherent to every parent, thus violating the right to health of the individual who is denied the vaccine. She also casts doubt on the authority of health systems by discrediting their information and calling them to use manipulative tactics, threats, and fear, trying to convince everyone that vaccines are not only safe but also unnecessary. Texts written by her are directed towards parents to be able to say no to vaccines, with a different religious or political, ethical, or moral purpose. Some works published by her are "Saying No to Vaccines: A Resource, Guide for All Ages", "FOWL, Bird Flu: It's Not What You Think", "The Risks, the Benefits, the Choices, a Resource Guide for Parents", and "A Healthier You!". In her most recent book, "How to say no to vaccines" she connotes legal arguments to avoid them in different settings; preschoolers or university students, at work, at a nursing home or if part of a vulnerable group, in the army, even for incarcerated people, she assures they can avoid vaccination (12-14).

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Another similar event occurred in 2011; back then, the US interest in arresting the leader of Al Qaeda, Osama Bin Laden, marked another example of political interests that ended up having repercussions on public health and slowing down the eradication of diseases. In one of the multiple attempts to arrest him, CIA agents were disguised as doctors who were supposedly vaccinating against hepatitis B. These were discovered and it was then that the consequences were more than terrible. When the eradication of poliomyelitis was just a few steps away, the fear of the conspiracy of the West against the countries of the Middle East increased, and culminated in their leaders prohibiting vaccination. Measures taken were too drastic: those who carried the polio vaccine were tortured and killed. It was thus that the WHO decided to suspend the vaccination and therefore the wild poliovirus now spreads through the region leaving thousands affected (15).

In the same way, religious groups of Orthodox Jews in New York have caused, through disinformation about vaccines, new measles outbreaks in the population through PEACH (Parents Educating and Advocating for Children's Health), an organization dedicated to the dissemination of information against vaccination. Among its publications with the greatest impact, "The vaccine Safety Handbook" is found. It is a magazine mainly aimed at parents of the congregation, but also at the entire population as its objective is to gain more followers who encourage this movement, thus ensuring that the population stops being vaccinated, perpetuating their ideology. This journal uses as its source of information sites of highly prestigious health societies such as JAMA (Journal of the American Medical Association) or CDC (Centers for Disease Control and Prevention) but the information it shares is interpreted in its favor, because although the statistics and other data are correct, the way PEACH communicates is partial, using fear as a weapon. While mentioning the hundreds of people affected by adverse reactions to vaccination, this association **forgets** to emphasize the millions of lives that have been saved (16,17).

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Another example is Jenny McCarthy, a former Playboy model, and actress who is one of many public figures representing the anti-vaccine movement. Her activism against vaccination began long after Wakefield's publication in The Lancet. Due to that publication, she associated the MMR (triple viral) vaccine with the supposed autism that her son suffered, and her fight against vaccines began. First, she headed multiple organizations such as "generation rescue" dedicated to disseminating information against vaccination; later she reported that her son had been cured thanks to a strict diet and multiple alternative therapies, such as the use of the hyperbaric chamber. However, it is well known that autism spectrum disorders have no cure; that is why many experts assure that her son was misdiagnosed and suffers from Landau-Kleffner syndrome instead (18, 19, 20, 23).

Within the current panorama, where anti-vaccine movements and migratory movements have provided the propitious environment for the outbreak of new cases of vaccine-preventable diseases, the German government has proposed new legal alternatives. According to Jens Spahn, the German health minister, a vaccination rate of 95% is planned to be achieved by 2020. For this, Germany has considered a series of health policies such as imposing fines of up to 2,500 euros to those parents with school-age children who fail to verify that their children are vaccinated against measles and other diseases. In the same way, those children who have not

been immunized will be prohibited from entering kindergartens and schools. Compulsory immunization will also be extended to migrant shelters, as well as to working personnel in schools, hospitals, and medical centers (21).

Although Mexican anti-vaccine groups are not consolidated as in the rest of the world, the ravages of their activism have undoubtedly hit the country's integrity. With the introduction of vaccination campaigns, it had been previously possible to control the vaccine-preventable diseases, but the guard was lowered and when new measles outbreaks appeared in the world, they ended up also affecting Mexico. The shortages of vaccines and the lack of vaccination awareness have left the population susceptible, which now leads to new and imminent outbreaks.

The **aim** is to denote the scientific development in vaccine production and **challenges posed by antivaccines movements.**

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Methodology. A review was carried out on the internet network in databases; such as [LILACS, IBECs, MEDLINE, Sec. EST Saúde SP, BDENF, BINACIS, CUMED, Index Psicología, PAHO, and SciELO]; using the keywords: vaccines, scientific development, denial of vaccination, vaccination, anti-vaccines.

Discussion

A glance at the history of vaccines is enough to gauge their positive impact on human health. Without them, there would still be smallpox outbreaks, and human beings still could suffer the horrors of massive diseases such as rabies, hepatitis A, B, or C.

Scientific and technological development has led to the generation of new treatments, new diagnosing methods, and prevention, with greater veracity each time; it is prudent to recognize that science advances and, with it, the growth of life expectancy at birth is inevitable.

On weakness of the argument of the anti-vaccine movement on the association between vaccines with the component Thimerosal (49.6% ethylmercury) which is in a concentration that varies from 0.003 to 0.01% in vaccines (22). ~~Since 2013~~, García-Fernández et al. (2013) have shown that research carried out indicates that the only reactions after the application of vaccines that contain Thimerosal are mild reactions, such as inflammation and redness in the area of application. However, some studies show the toxicity of other components that contain mercury, such as methylmercury (23, 24).

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Scientific evidence has shown that **ASD** is related to the existence of several factors such as genetic and environmental. In the same way, it has been denied that the vaccines exceed the levels of Thimerosal permitted by international law; these doses are evaluated during their development and distribution (25).

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In 2014, Yoshimasu and Kiyohara demonstrated that exposure to ethylmercury in the embryonic state and during childhood does not lead to a risk for the development of ASD from vaccines; it is rather more significantly related to genetic factors, exposure to inorganic and organic mercury in the environment, as well as the lifestyle of the mother and family, such as smoking and alcoholism, which have shown an important role in the incidence of ASD (26).

Under this perspective, it is the responsibility of the Health Systems to inform and raise awareness among the population about the safety of vaccines, whether single or multi-dose and

clarify that Thimerosal is not associated with ASD. On the contrary, vaccines prevent bacterial diseases that could cause death; therefore, they can improve the quality of life of an individual.

It is worth mentioning that problems such as climate change, the disproportionate increase in environmental pollution, and the detriment of the quality of water, air, and soils, especially due to the presence of heavy metals such as mercury (27) in plastics and agrochemicals, as well as the use of anti-flame substances in furniture, walls, and interior decoration; all this added to the poor nutritional status of women during pregnancy and in early childhood, are the factors most responsible for several health effects in children's health, as well as in the general population's.

As Cardoso et al. (2021) claim, "It is necessary to evoke more knowledge in the Mexican population to generate interest in health advances, as is the vaccine for covid-19. This will help the population become more familiar with all the current advances in the health systems and raise awareness in the population so that they can decide correctly about their health and make the appropriate decisions or be attentive to non-positive results. The experience with the current pandemic can be used as a guide so that the scientific community is prepared, so that it not only recognizes the outbreak but also in the same way as a community it must be aware of the impact that its actions have on the prevention of new outbreaks, being informed and having reflective and thoughtful reasoning to be able to reduce the damages produced by future unforeseen events. ~~A slow thought would pay negative results~~"(28).

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Finally, as confirmed in their conclusion by Calderón., et al, 2019 "Vaccines represent the main way to prevent infectious diseases, reducing the morbidity and mortality of infectious diseases, being the most effective therapeutic intervention in terms of the cost-benefit ratio in the control of these diseases" (29).

To sum up, these shall be the questions for ourselves, what has been the impact on individuals' health who have not received the anti-covid-19 vaccine? How many infectious cases and deaths could have been avoided by expedite immunization campaigns, vaccinating the local and global population with the anti-covid-19 vaccine?

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Conclusions

The impact on public health caused by the anti-vaccine movement and the circulation of murky information leads to the denial of vaccination without scientific basis to the human population with deficiencies and vulnerabilities associated with academic, socioeconomic poverty, religious beliefs, and negative results in health.

Not having assertive information on public health towards the population can cause fear in the vulnerable population; especially individuals with hindrances in the socio-economical aspect regardless of their level of education and with the lack of awareness regarding the importance of getting vaccinated, especially in the face of the current pandemic due to covid-19. The anti-vaccination movement has had a persistent and increasing negative impact, where the risk is imminently negative.

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Data in health institutions regarding cases during the 3rd wave of covid-19 in Mexico show that people who reach hospitalization, and who mostly come to perish, are not vaccinated.

Ethics Statement. This article does not contain any studies performed with human participants or animals.

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