Special Series: Scientific Literacy

JMBE Journal of Microbiology & Biology Education

Developing Vaccine Literacy for Urban Health Science Students, the Future Health Workforce

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The 2019 coronavirus disease pandemic underlined a shift in attitudes against vaccines and a rise in hesitancy among some members of the population, despite the overwhelming evidence that vaccinations are one of the most successful and safe health interventions. Research has shown that vaccine hesitancy is complex and can result from an intersectionality of multiple factors. Research has also shown that to tackle vaccine hesitancy in the community, health care workers play a pivotal role, as they are trusted sources who can provide reliable information and can address vaccination concerns for the public. Unfortunately, health care workers are also susceptible to vaccine hesitancy. Thus, to curb these negative attitudes and doubts against vaccinations, we propose to improve vaccine competency among health science students, who are the future health workforce. Here, we propose a comprehensive pedagogical approach that aims to improve the vaccine literacy in this student population in two urban community colleges. The approach includes the use of high-impact pedagogical interventions to achieve three main objectives: (i) to teach students the nature and process of science to have them become "competent outsiders"; (ii) to enhance students' knowledge of the complex science behind emerging infectious diseases and vaccine action, adopting a learner-centered and concept-focused instructional design, and (iii) to address the social, cultural, and historical aspects of vaccine development and the historical and present inequities that characterize this health intervention.

KEYWORDS vaccine literacy, vaccine hesitancy, science literacy, health science, community colleges

PERSPECTIVE

Immunizations are one of modern medicine's most successful and cost-effective public health interventions. They prevent a wide range of infectious diseases and 3.5 to 5 million deaths every year worldwide (1). Unfortunately, in recent years, a shift in attitudes about vaccinations in some portions of the population has led to lower vaccine compliance. The World Health Organization (WHO) reports a decrease in worldwide vaccination coverage from 86% in 2019 to 81% in 2021, and since 2009, a record high number of children under the age of 1 year (an estimated 25 million children) did not receive basic vaccines (2). This has been mirrored by a rise in reemerging infectious diseases (3), which underlines the resistance to vaccination by some members of the population despite the overwhelming evidence that vaccines save lives.

Vaccine hesitancy was defined by the WHO Strategic Advisory Group of Experts on Immunization as "delay in acceptance or refusal of vaccines despite availability of vaccination services" (4). Factors that influence vaccine hesitancy include complacency, convenience, and confidence (4). There is often rejection for the need of vaccines and mistrust in the vaccine industry, while limited access or affordability may make vaccinations inconvenient for others (5). Additionally, the decision whether or not to get vaccinated is also influenced by age, sex, religion, socioeconomic background, health literacy, trust in science, and even the type of media consumed (6–9). The intersectionality of these factors thus results in vaccination compliance discrepancies (8–10). Among communities of color, suspicion and distrust in academic and research institutions are some of the most significant barriers to participation in science and health interventions (11–14). This attitude

Editor Nicole C. Kelp, Colorado State University
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The authors declare no conflict of interest.
Received: 3 March 2023, Accepted: 20 April 2023,
Published: 8 May 2023

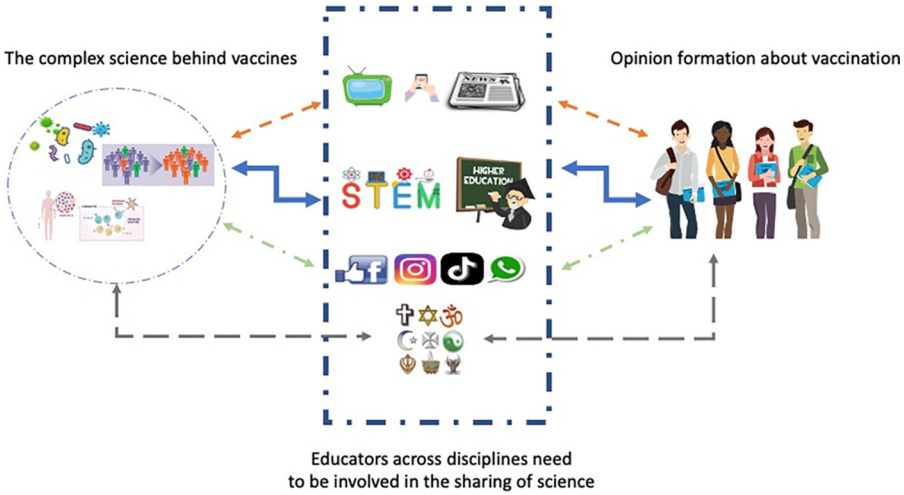

FIG 1. Dimensions to include in developing vaccine literacy.

stems from a long history of abuse in medical and experimental research, which has been well documented (14–17). These past and present mistreatments have resulted in a lack of trust in the sciences, which exacerbates health inequities and compounds the vaccine hesitancy experienced, particularly among communities of color.

Many studies have focused on identifying and curbing vaccine hesitancy (18). Health professionals are key in combating hesitancy, as they are the primary source of health and vaccine information for the general public and can provide reliable guidance (19–21). Unfortunately, studies have also found that health professionals frequently lack adequate knowledge regarding vaccines, lack confidence when delivering vaccine information, or experience vaccine hesitancy themselves (22). The same disparities in vaccine coverage across demographics for the general population are also seen among health care workers, particularly for the 2019 coronavirus disease (COVID-19) (23, 24) and influenza vaccines (25), for which African American and Latino health care workers exhibited the lowest rates of vaccination compared to other groups (23).

Recently, there has been a call to action for a system-level change to foster immune literacy in classrooms and communities (26). This initiative is led by a working group of immunology educators from diverse institutions; they specifically recognize that a greater understanding of immune concepts, including vaccinations, can improve the quality of life. Inspired by the experience of our students, our personal experiences during the COVID pandemic in New York City (NYC) in 2020, and our role as Latina science educators, we became interested in participating in this call to action. In NYC, many health care workers start their careers at The City University of New York (CUNY) (27) community colleges, and a large majority of these health care workers identify as coming from traditionally underrepresented groups (27). Therefore, we propose that it is at this level, and with this student population, that vaccine hesitancy needs to be especially addressed. Focusing on health science majors from two CUNY colleges, Queensborough Community College and LaGuardia Community College, both of which are located in Queens County, one of the most ethnically diverse urban areas in the world would target mostly underrepresented minorities. Both colleges are classified as Hispanic-serving institutions with an open-admission policy, so many students are the first in their families to attend university. A significant part of the student population does not have a strong academic background and comes from low-income families. Our use of a multipronged approach that includes the dimensions shown in Fig. 1 and our joining efforts from multiple disciplines can enhance vaccine literacy for this student population.

Students should learn to evaluate claims by becoming "competent outsiders"

The COVID-19 pandemic underlined the power of online information and social media in spreading misinformation and disinformation, which generated unfounded fear and vaccine hesitancy throughout the population (28–31). Thus, one of the aims of science education is to turn all students into "competent outsiders" (32) capable of evaluating scientific claims successfully (32, 33). This requires understanding how the scientific community produces reliable knowledge, what the criteria of scientific expertise are, and learning the basics of digital media literacy (32). Understanding the nature of science is one of the key competencies that individuals should acquire as part of their education (34). Using the heuristic approach proposed by Osborn and Pimentel (32) will allow the students to evaluate information by determining if (i) the source of information is credible, (ii) the source has expertise to support the claim, and (iii) there is consensus among experts. Understanding the social mechanisms that science uses to establish credibility and consensus can then provide the students with a core scientific competency that will allow them to reliably evaluate claims and arguments made around them. We encourage to use resources created by the American Association for the Advancement of

Science, a collection of annotated research papers for this purpose (35), as well as a list of scientific articles, online sites, and videos (see the supplemental material).

Students' knowledge about immunology and the science of vaccines should be further developed across multiple science courses

As argued recently, immune literacy (to include vaccine literacy) is required for making health care-related decisions, advocating for evidence-based policies, and combating the spread of misinformation (26). It is pivotal that health and natural science students have a thorough understanding of the body's physiological reactions to infectious diseases and the mechanism of action of vaccines. Instead of adhering to the teacher-center model of the "tyranny of content" (36), typical of undergraduate science courses like Anatomy and Physiology and Microbiology, we propose to adopt a learner-centered and concept-focused instructional design (26). Core immune and vaccine literacy concepts and competencies should be identified, and active learning strategies to address them should be developed. In Anatomy and Physiology, we propose to focus on the mechanism of action of vaccines in the context of adaptive immunity and expand on topics such as the development and history of vaccines, types of vaccines, and common adjuvants used. To promote student's engagement, clinical cases of specific pathogens and their corresponding vaccines can be studied. An existing collaboration with the NYC Health and Hospitals system could provide experiential learning opportunities for health science students, as they could use historical and current national data to match or correlate with what is happening in NYC hospitals. In microbiology, climate change and human activity can be presented as possible drivers for the emergence of new infectious threats. Students need to learn how vaccines contribute to fighting emerging pathogens. Therefore, they should learn to identify strategies for surveillance of emerging pathogens focusing on state-of-the-art technology for detection, as well as the need for the surveillance to be done equitably and fairly. An additional benefit would be for the students to present these research findings at local or regional conferences.

Social and historical contexts of vaccine literacy need to be addressed

Race, religion, socioeconomic, and political views, among other factors, play important roles in how information is obtained and processed and how opinions are formed. For communities of color, distrust in medical and scientific research, which is completely justified, drives in large part vaccine hesitancy (37, 38). The mistrust can be attributed to centuries of unethical research practices rooted in the systemic racism of our nation. Some of the better-known examples of these abuses include Marion J. Sims using enslaved women to study vesico-vaginal fistulae (16) and the 1930s Tuskegee experiments by the U.S. Public Health Service on the progression of untreated syphilis. The experimenters, for years, failed to treat the infected patients, even when penicillin became the safe and easy treatment against this disease (12, 15). As a result of this distrust and pervasive racial factors, communities of color are underrepresented in scientific research and vaccine and clinical trials (37, 38) and face higher barriers to vaccine access (39), which then continues to magnify health inequities across the population. To attempt to bridge this gap and to build trust, the community must openly discuss this history. Health science students and future health professionals should know about the abuse and experimentation of vulnerable subjects, so that rather than dismissing fears about vaccinations or health interventions as invalid, those who know what has happened in the past may be able to address the hesitancy people may experience now (40). This context of vaccine literacy should be emphasized across all courses but could be more thoroughly addressed in a medical ethics course, which is a requirement for the health science major. As part of this module, students can look at the historical development of vaccines and the impacts of racial, socioeconomic, and political factors on the process of vaccine development. Students need to consider the ethical responsibilities of scientists and health care professionals in maintaining standards of research design and treatment. The students should explore the long-term social and moral implications of such ethical misconduct.

To consider current health disparities, we propose to develop a vaccine literacy component in a statistics course, which is also a requirement for the health science major. This course introduces descriptive statistics, probability, distributions, sampling, confidence intervals, and tests of hypotheses. Students can learn about these key concepts through the lens of publicly available data on cases, incidence, and vaccination rates for a range of diseases from the WHO, Centers for Disease Control and Prevention, and the New York State Health Department. Students can be given the tools to be able to evaluate the data and research firsthand potential inequities. Recent pandemics and emerging epidemics painfully highlight the need for general science literacy. We strongly believe that to achieve immune and vaccine literacy for all citizens, health care workers at every level will play a vital role. Therefore, educating the future health care workforce is critical. To create equitable opportunities for all, we are proposing a broad and strategic approach focused on community college health science students that not only recognizes the inequalities of our health system but also aims to narrow them. The strategies presented here for community college undergraduate health science courses can be used as scaffolds for building a tailored approach for other educational and community settings. The goal is to follow the call to action for improving immune literacy by providing these health science students with key science and vaccine

competencies, while addressing the racial, social, and historical inequities that have and continue to plague this health intervention.

SUPPLEMENTAL MATERIAL

Supplemental material is available online only.

SUPPLEMENTAL FILE 1, XLSX file, 0.02 MB.

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