THE IMPACT OF EDUCATION ON THE PUBLIC PERCEPTION OF VACCINES: EBV AS CASE STUDY

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Abstract

The goal of this study was to assess the impact of education on the perception and receptivity of vaccines in a college population. Since novel vaccines are continually being introduced to the society, it is important to determine whether these immunizations will be readily accepted and successfully distributed to all individuals. Using the potential development of a vaccine for Epstein- Barr Virus (EBV) as a test case, a pre- and post-unit anonymous survey was given to 67 University of Arizona students during an educational unit on immunology and vaccines which I led. Data from the survey showed that education indeed impacted the students' perceptions and receptivity to vaccines. While general coverage of the immunity, vaccines and EBV resulted in 59% willingness to receive the new EBV vaccine, further specific information about low US incidence of long-term health risks and lack of efficacy in asymptomatic patients resulted in a drop in willingness to 24%. Factors cited as influencing their decision included cost, availability and sufficient information. This data reinforces the importance of understanding how vaccines are perceived in society and how provision of information is critical in shaping a person's point of view toward immunizations and impacting community health.

Introduction

On July 2013, I had the opportunity to travel to Peru with Imaginations Inc.'s Clinical Medicine Internship program. I spent four weeks in Huancayo, a 6-hour drive west from the capital city Lima. As an intern, I volunteered at various clinics and hospitals throughout the weekdays, and traveled to neighboring towns during the weekend. Though my experiences in Huancayo overall solidified my decision to pursue a career in medicine, one particular experience also sparked an interest in public health and an application of the medical science into which I was headed.

On an early Tuesday morning, I had the opportunity to help a nurse, Marisol, distribute vaccines through house visitations in the village of Huari. With a cooler filled with vaccines, syringes, cottons, and gloves, we set out to visit various households. After prodding through dirt paths and fields, we knocked on doors and offered free vaccinations to children. Upon checking on their paperwork, most of the mothers agreed for their children to receive the necessary immunizations. However, some parents refused to vaccinate their children due to worries of negative side effects such as fevers and headaches. Marisol would patiently explain to them the importance of getting these vaccines to protect children from even more harmful diseases. One particular family was so

Photo 1. Fionna Feller distributing an influenza vaccine to a child at the village of Huari, Peru in July 2012.

opposed to immunizations that they immediately balked at Marisol's kind offer of free vaccines and closed their door quickly.

It was then when I realized how important education is in raising health awareness. While new vaccines are continuously being generated, the society may not be ready to accept them due to lack of knowledge regarding the function of vaccines and their important role in helping to improve the health of the general population. Through my experience in Peru, I became inspired to study the impact of education on the public perception of vaccines.

My thesis addresses the role of education in the perception of vaccines. Utilizing the potential development of a vaccine for the Epstein-Barr Virus (EBV) as a test case, my project investigates the hypothesis that knowledge regarding both the function and efficacy of a vaccine will positively impact the willingness of a population to receive a new vaccine. Therefore this thesis includes the following supportive components: a brief background information on the immune system and how vaccines function, a review of the scientific literature to reveal the present knowledge on EBV and the status of the EBV vaccine, its function and efficacy, a synthesis of existent public health policies and effectiveness for vaccination programs, and present public perception of vaccines in general. To test my hypothesis, I will provide an educational unit to a class of UA students covering both vaccines in general and the developmental EBV vaccine in particular, combined with a pre- and post-unit anonymous survey to assess their current perception of vaccines and their receptivity to new vaccines.

Background

The Immune System

The immune system is divided into two major categories: the innate and adaptive immune systems. The innate system is naturally present in healthy individuals and acts as a rapid first-line defense against a broad spectrum of pathogens. This component consists of both physical and chemical barriers such as the skin, epithelial lining in mucosal membranes and anti-microbial chemicals (e.g., low pH and lysozymes), as well as blood proteins and phagocytic cells. Blood proteins include inflammatory molecules, while phagocytic cells include macrophages, natural killer cells, and leukocytes. Upon a novel infection, the innate immune system is activated rapidly. However, subsequent exposure to similar infections will be less detrimental due to the immune system's ability to develop secondary defensive capabilities to fight the pathogens more effectively through its ability to build immunologic memory. This advanced system is called the adaptive immune system or specific immune system because it exhibits high specificity in identifying and fighting certain pathogens. The adaptive immune system is primarily comprised of lymphocytes and their antibody products. Due to the highly specialized functions directed against each pathogen, this immune system requires a longer time to activate (Abbas et al, 1997).

Though the innate and adaptive immune system have two distinct mechanisms of action, it is important to note that they constantly interact with each other. For example, upon infection the innate immune system triggers macrophage activation, which results in endocytosis of the pathogen, presentation of the antigen, and activation of inflammatory responses through release of attracting molecules such as cytokines. These cytokines then trigger the activation of the adaptive immune system by activating lymphocytes specific for that microbial antigen. Thus, the

innate and adaptive immune systems exhibit a bidirectional relationship in that the types of molecules activated in the innate system directly influence the nature of the response by the subsequent adaptive system (Abbas et al, 1997).

The adaptive immune system can be activated both actively and passively. In active immunity, the infected individual actively fights the pathogen after recognizing its foreign antigen. Conversely, in passive immunity the individual has been pre-exposed to the foreign antigen but without having contracted the associated disease. This antigen pre-exposure, also called adoptive transfer, allows the individual to develop some level of immunity before natural infection occurs. For example, passive immunity is vital in the development of life-saving vaccines against lethal snake bites (Abbas et al, 1997).

Specific immunity is further divided into two types, humoral immunity and cell-mediated immunity. Humoral immunity fights extracellular bacteria and is mediated by the B lymphocyte which ultimately leads to the developments of antibodies. On the other hand, cell-mediated immunity is active against intracellular pathogens and involves T lymphocytes, which eliminates foreign microbes by either macrophage activation or lysis of infected cell (Abbas et al, 1997).

The Mechanism of Vaccines

Vaccines enhance the functions of the adaptive immune system by conferring immunologic memory and resistance of the pathogen without infecting the individual with the actual disease first. They function primarily by stimulating production of antibodies, by B lymphocytes, due exposure to dead or weakened forms of the virus or small subcomponents of the virus which contain essential specific identification elements.

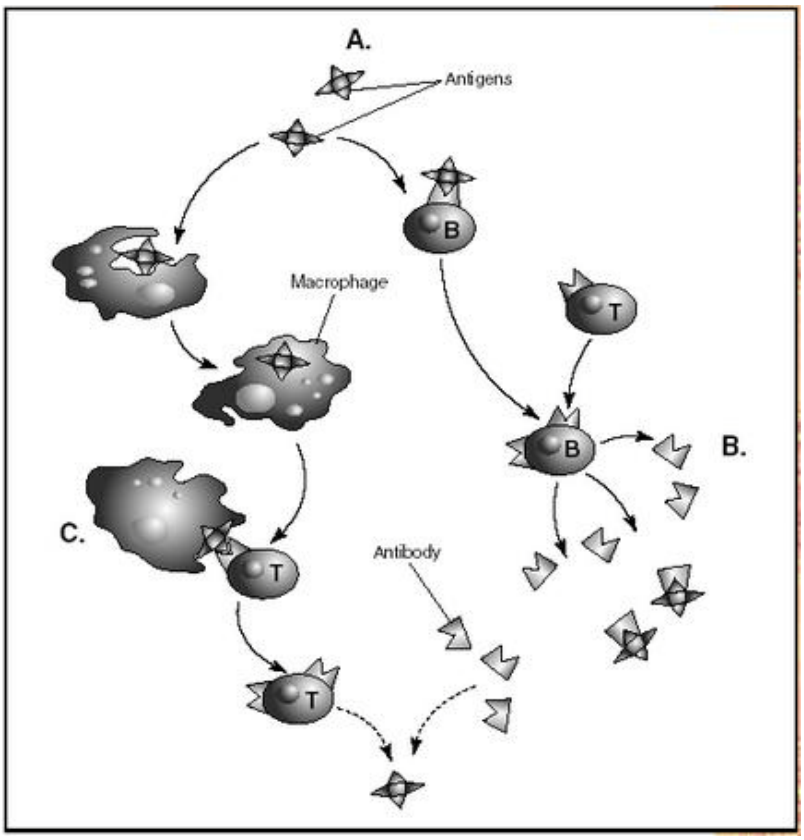


Figure 1. How vaccines function.
(Nester, 1996)

As illustrated in Figure 1, upon immunization, antigens from dead or weakened virus are identified by the immune system, causing activation of B cells (labeled A). With further activation from T cells, B cells stimulate the production of antibodies. The antibodies then eliminate the dead or weakened form of the virus and are now ready to eradicate the same organism in the future (labeled B). When an infection of the same organism occurs, the innate immune system is activated, and macrophages quickly engulf the pathogen and present the antigen to T cells (labeled C). T cells in turn stimulate the adaptive immune system to recruit the same antibodies to neutralize the pathogen (Nester et al, 1996).

There is a large variety of vaccines available to the public, each containing either live, killed, or only parts of the target organism. The organisms in live vaccines are usually attenuated,

or weakened, to protect the recipient from direct infection from the vaccine. Live vaccines are used to fight infections such as cowpox, measles, mumps, chicken pox, and tuberculosis (*Mycobacterium bovis*). In killed vaccines, the target organisms are heat-killed, with the most well-known killed vaccines including immunizations for polio, influenza, cholera, pertussis, and rabies. Sub-unit vaccines are comprised of only distinguishing elements of the organism such as specific proteins or modified form of toxins (called toxoid). Examples include vaccines against tetanus, diphtheria, and hepatitis-B (Ghaffar & Haqqi, 2009).

Epstein-Barr Virus (EBV) as Case Study

In order to study the impact of education on the public perception of vaccines, the development and eventual introduction of the Epstein-Barr virus (EBV) was used as a case study. EBV, a herpes virus, has caused concern in the health community ever since its discovery in 1964. Today, EBV affects nine out of 10 people, although the disease is usually asymptomatic in adolescent patients. However, these patients are prone to develop infectious mononucleosis after infection. The virus is also associated with the long-term development of Hodgkin's lymphoma, non-Hodgkin's lymphoma, Burkitt's lymphoma, and nasopharyngeal lymphoma in the future remote from initial infection. Individuals who had infectious mononucleosis are four times more likely to develop lymphoma (Prescott, 2013).

EBV belongs to genus Lymphocryptovirus and family Herpesveridae. Upon infection, the virus invades and establishes latent infection in memory B-lymphocyte cells, and multiplies in epithelial cells. During a latent infection, the individual is asymptomatic although the virus remains dormant within host cells. Because the latent virus is unable to be eradicated by the immune system, EBV infection persists for a lifetime (WHO).

Due to the lifetime infection, associated potential health risks, and high prevalence of EBV, scientists are currently developing an EBV vaccine. A subunit vaccine developed by GlaxoSmithKline has recently completed phase 2 of clinical trials (Sokal et al, 2007). The vaccine consists of a recombinant glycoprotein found on the surface of EBV virus and an adjuvant, AS04. The second phase of the clinical trials involved 181 subjects at 5 different locations in Belgium from 2001-2003. These subjects were seronegative for markers of EBV infection and between the ages of 16-25. In addition, they were screened for their health histories and current health status (Sokal et al, 2007).

In this double-blind experiment, the subjects were given 3 doses of either vaccine or placebo at 0, 1, and 5 months. Blood samples were collected at 0, 1, 5, 6, and 19 to analyze the levels of anti-gp350 antibody levels. The subjects were also instructed to record any symptoms of infectious mononucleosis (Sokal et al, 2007).

Upon the completion of the study, it was concluded that the gp350 subunit vaccine had a 78.0% efficacy in preventing infectious mononucleosis (Sokal et al, 2007). The probability of contracting infectious mononucleosis was 4.8 times higher among individuals in the placebo group. As shown in Figure 2, vaccinated individuals have higher protection against infectious mononucleosis, and the vaccine was concluded to be active for at least 18 months post-injection. However, prevention of asymptomatic EBV infection did not reach statistical significance; 11 individuals receiving vaccine and 9 receiving placebo still contracted EBV infection. In addition, the study did not conclusively determine that the vaccine could effectively prevent lymphoproliferative disorders, which may lead to Burkitt and Hodgkin lymphomas (Sokal et al, 2007).

It was determined that the vaccine was safe since no significant health risks were observed upon the completion of phase 2 trial. The majority of participants reported local pain, redness, and swelling after 3 doses. Other general symptoms included fatigue and headache (Sokal et al, 2007).

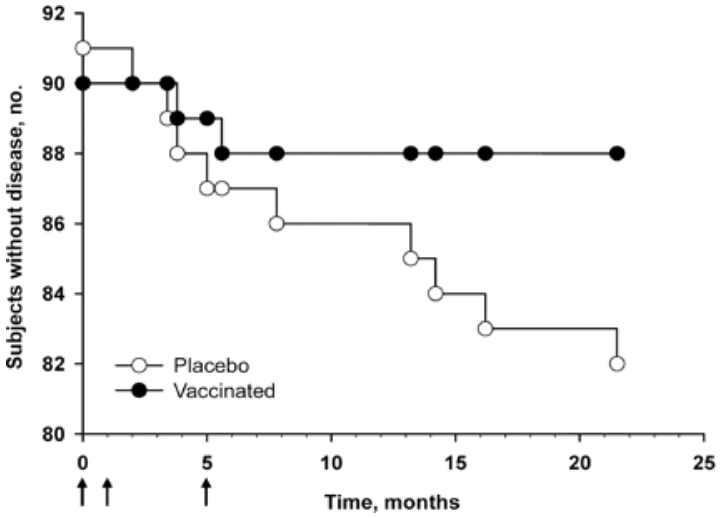


Figure 2. Number of individuals without infectious mononucleosis in vaccinated and unvaccinated groups through 21 months (Sokal et al, 2007).

Since the current EBV vaccine has not yet undergone phase 3 of clinical trials, it would be informational to compare it to the development of a similar vaccine that has recently completed clinical trials and approved by FDA. Gardasil is a vaccine for human papillomavirus (HPV), a sexually transmitted infection that is extremely prevalent in the United States population and mirrors that of EBV infection. In addition, similar to EBV, most HPV carriers (up to 90%) are asymptomatic, although long-term risks include cervical, genital, and oropharyngeal cancers (CDC, 2013). Thus, the development of the HPV vaccine Gardasil will be an appropriate model in predicting the outcomes of phase 3 clinical trials and ultimate FDA approval of the EBV vaccine.

Similar to that of the HPV vaccine, phase 3 trials of EBV vaccine would involve thousands of subjects. In the HPV vaccine phase 3 trials over 12,000 women in Europe and Latin America were participants to investigate the efficacy of the vaccine (Castle, 2012). In a double-blind study, seroconversion levels in the blood were measured to determine vaccine activity months after injection. In addition, vaccine efficacy was also measured among individuals who did not receive all three doses of the vaccine. The study also determined if the vaccine affected the development of neoplasia, genital warts, and other long-term risks of HPV infection. The third phase of the EBV vaccine trials would most likely also assess vaccine efficacy in preventing long-term risks of lympho-proliferative disorders. The third phase would also verify the safety of the drug in a larger subject population (Castle, 2012).

If the EBV vaccine successfully completes phase 3 of clinical trials, its developer, GlaxoSmithKline, can then apply for FDA approval. The first step of this process is the submission of Biologics License Application (BLA), in which the risk/benefit assessment and approval of vaccine must be provided by the developers in all disciplines (chemists, microbiologists, biostaticians, etc.). The FDA reviewer team also performs inspections on the proposed manufacturing plant and production process in this application stage. The FDA team may forward the application to non-FDA expert committee Vaccines and Related Biological Products Advisory Committee (VRBPAC) to obtain further insight and opinion on the vaccine approval. The FDA also regulates the extensive labeling of the vaccine product to let the public know of the product's health risks. Furthermore, FDA testing and regulation do not end after the vaccine product obtains approval. For as long as the product is licensed for manufacture, the FDA may periodically request samples of product to ensure the quality, purity, and potency of each vaccine as well as perform inspections of the manufacturing facility. Since not all potential

health risks can be assessed during the three phases of clinical trial, a fourth phase trial is usually conducted after the product is marketed and distributed to the public. FDA utilizes the Vaccine Adverse Event Reporting System (VAERS) to identify any significant health risks observed among the vaccine recipients (FDA).

Methods

The aim of this study was to analyze the impact of education on the perception of vaccine by using EBV as a test case. We composed a 3-part survey that would allow us to study the effect of information on an individual's decision to receive a vaccine or not (please refer to Appendix 1). The survey was completed by 67 University of Arizona students in the PSIO 380 ('Fundamentals of Human Physiology', a course for non-Physiology students) and distributed in two steps during the 50-minute classroom presentations in each of the two discussion sections of the class. In the presentation, students were first given background information about the immune system, EBV, and the new EBV vaccine. Students were then asked to complete the first page of the survey (see Appendix A: Survey Page 1, parts I & II). The first set of questions was designed to gather general information about the students' perception of vaccines and their decision to receive the new EBV vaccine or not with minimal knowledge of the disease and treatment.

Once the first page was completed, the students were given additional and more specific information regarding EBV and its vaccine. We then asked them to complete the second page of the survey (see Appendix A: Survey Page 2, part III), which consisted of questions regarding their willingness to still receive the vaccine and the top three primary reasons why the student

would receive or not receive the vaccine. We concluded the presentation with a discussion and question-and-answer session.

Results

Figures 1, 2, and 3 contain data from first part of the survey given after the general overview of vaccines and EBV and provide a demographic background of the 67 university students who completed the survey. 76% of those surveyed had received some type of vaccine or booster vaccine within the last 10 years, while 75% had received multi-component vaccines. As the efficacy of vaccines often depend of the completion of vaccine series or boosters, it was important to analyze the students' receptivity and willingness to spend more money and time to receive the complete treatment dosage. To this end, we asked if students had received the flu vaccine in recent past. This finding was one factor used to assess the students' receptivity to a vaccine that is affordable and very accessible as the flu vaccine was heavily marketed and readily available at Student Health Center at the university. Given that approximately 63% of students had also received a flu vaccine (Figure 3), we deduced that students would be more likely to obtain a vaccine if it is available on campus and reasonably priced.

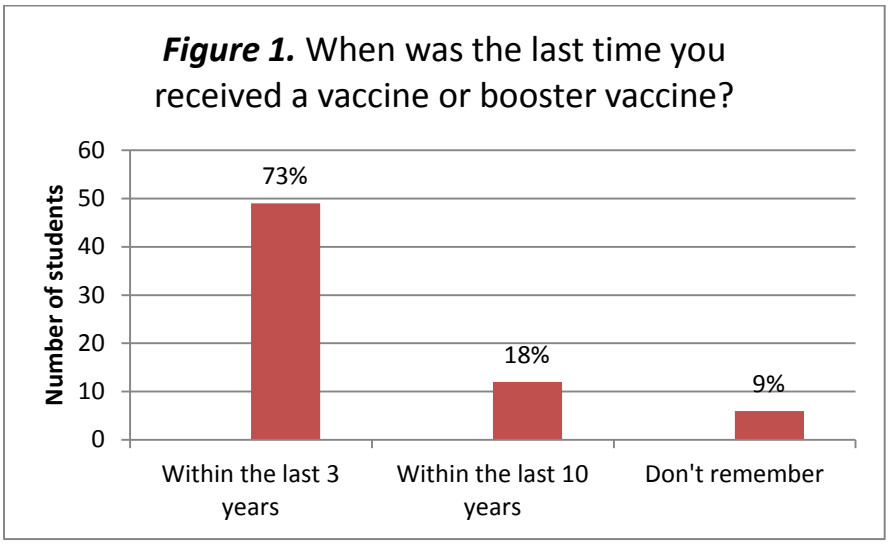
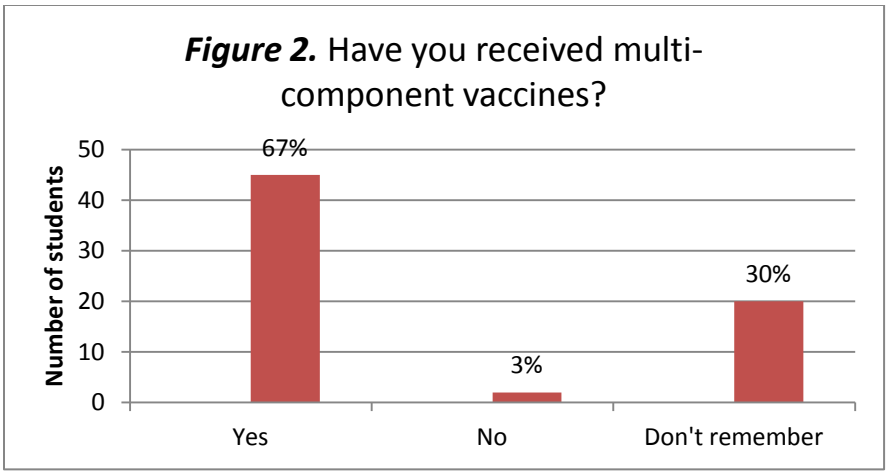
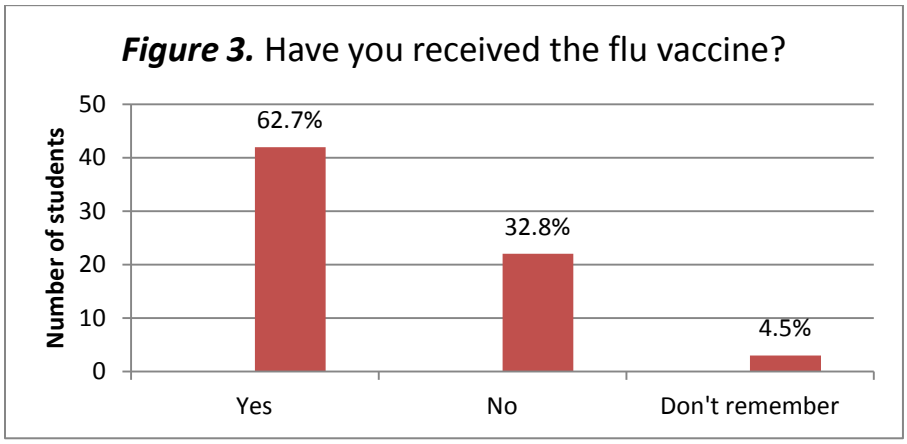
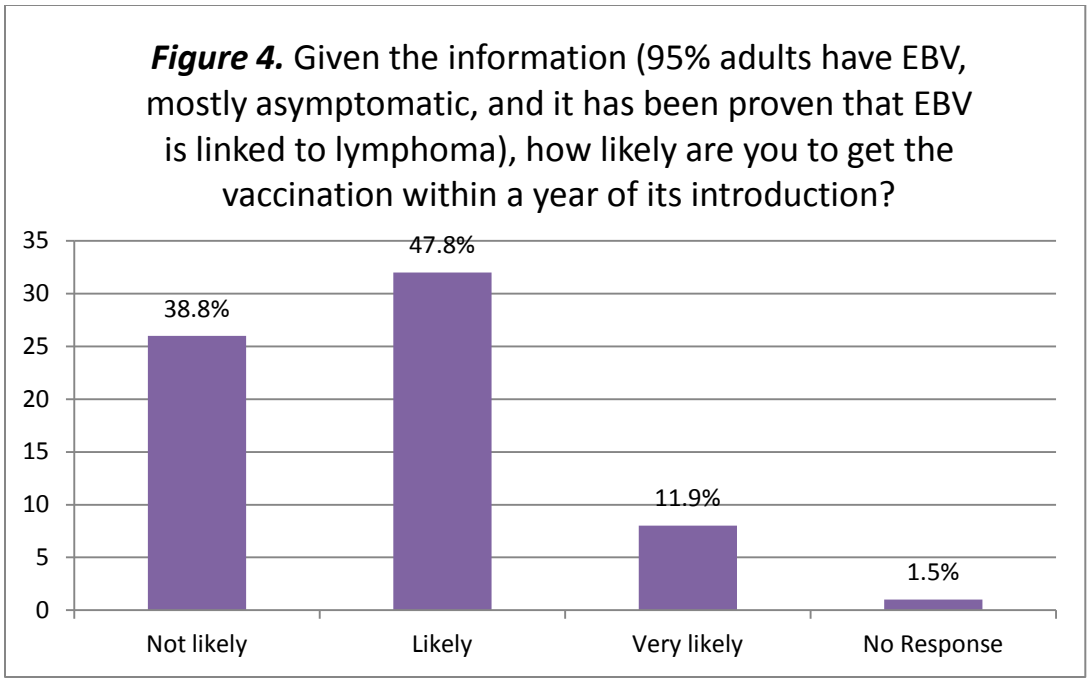


Figure 1. When was the last time you received a vaccine or booster vaccine?

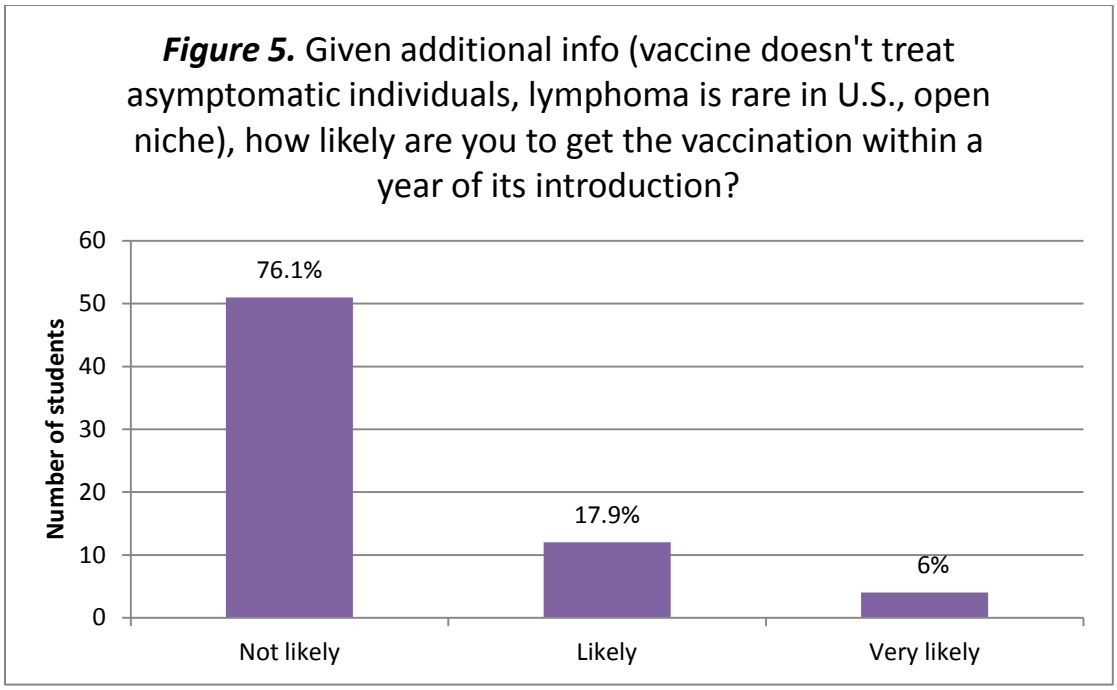


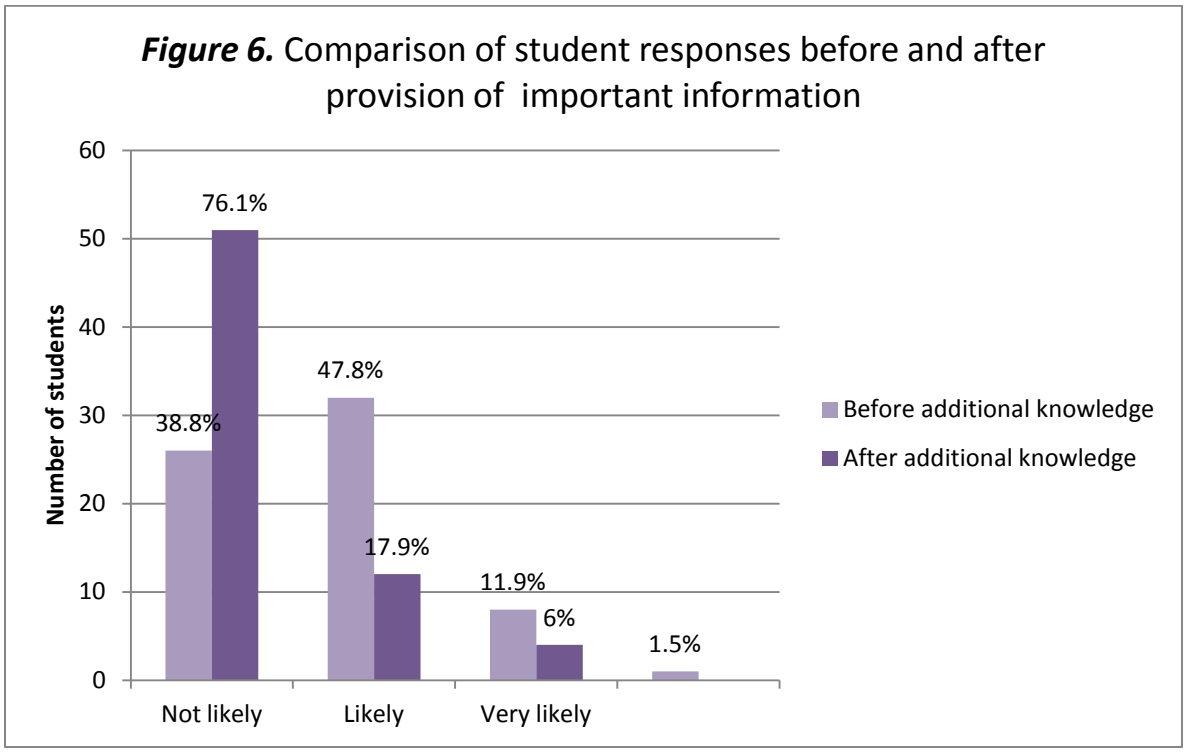


Before the first part of the survey, the students were given general information regarding EBV, such as 95% of adults have contracted the disease though most are asymptomatic, and that EBV has been associated with a long-term risk of lymphoma. Given this general introductory information regarding EBV, approximately 38.8% of students opted to not receive the vaccine, while 59.7% chose (likely + very likely) to obtain the vaccine within a year of its introduction, as shown in Figure 4.



Students were then provided with more critical information such as that the vaccine is ineffective against asymptomatic individuals, that the occurrence of lymphoma in the U.S. is low, and that eliminating a prevalent organism may open up niche for harmful pathogens. After being provided this more specific information, 76.1% of students chose to not to receive the vaccine while 23.9% opted to receive the vaccine (Figure 5). Figure 6 illustrates the drastic change of responses from students after they obtained more specific knowledge about the EBV and the associated vaccine. Data showed that there was an approximate two-fold increase (from 38.8% to 76.1%) increase of students who chose not to receive the vaccine after being provided more important information. This supported our hypothesis that education does indeed impact individuals' perception of immunizations.





Our thesis was also further supported by the fact that the primary reasons students would choose to receive or not receive the EBV vaccine revolved around obtaining enough relevant knowledge to make an informed decision. The top two primary reasons students would choose to

receive the vaccine were that they were worried about the long-term risks and if they simply had an understanding of how the vaccine works and a general knowledge of EBV (52.4% combined, Figure 7). Both options suggested that knowledge played a significant role in influencing the students' decision in receiving vaccinations. Conversely, around 30% of students indicated that they chose to not obtain the EBV vaccine because they simply do not have enough information about the vaccine (possibly due to the fact that it is still in development) (Figure 8). In addition to the 30%, some students chose to fill in their own response (15%), and most of these responses stemmed from additional knowledge garnered during the presentation. The majority of the filled-in responses focused on the idea that the vaccine was ineffective on asymptomatic individuals. Since this information was provided during the presentation, it was concluded that education indeed impacted the students' decision in not receiving the vaccine. Other primary reasons why students chose to not receive the vaccine include worries about negative side effects (33%), the necessity of obtaining boosters (10.6%), high price (9.2%), and possible link between autism and vaccines (2.4%).

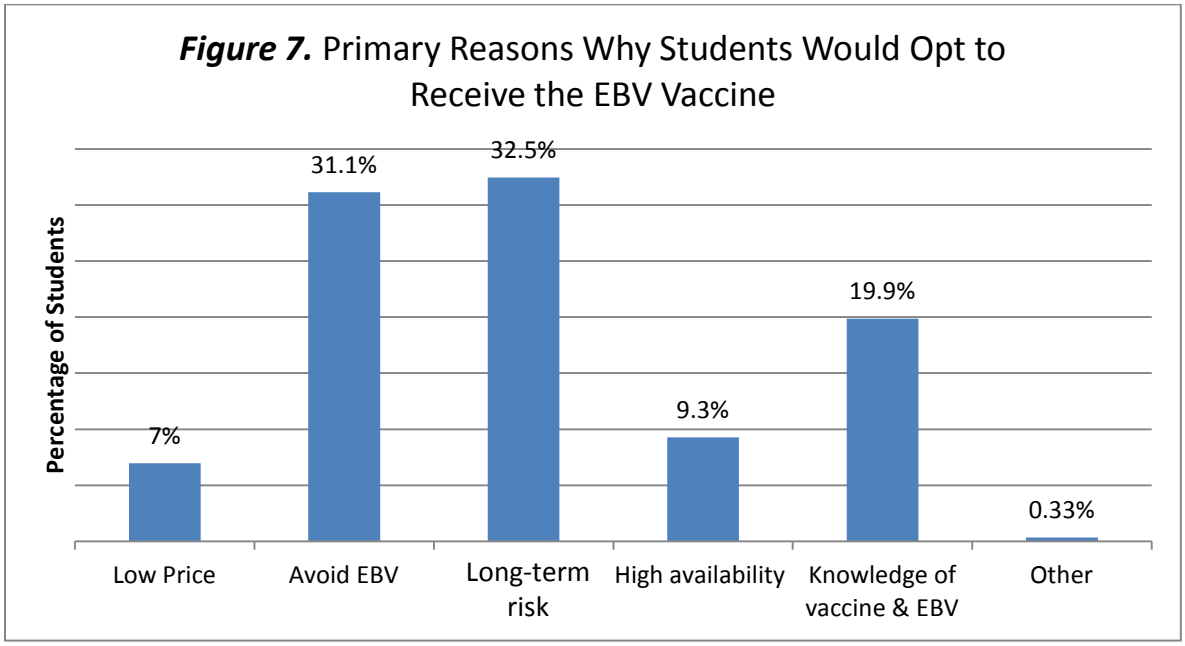


Figure 7. Primary Reasons Why Students Would Opt to Receive the EBV Vaccine

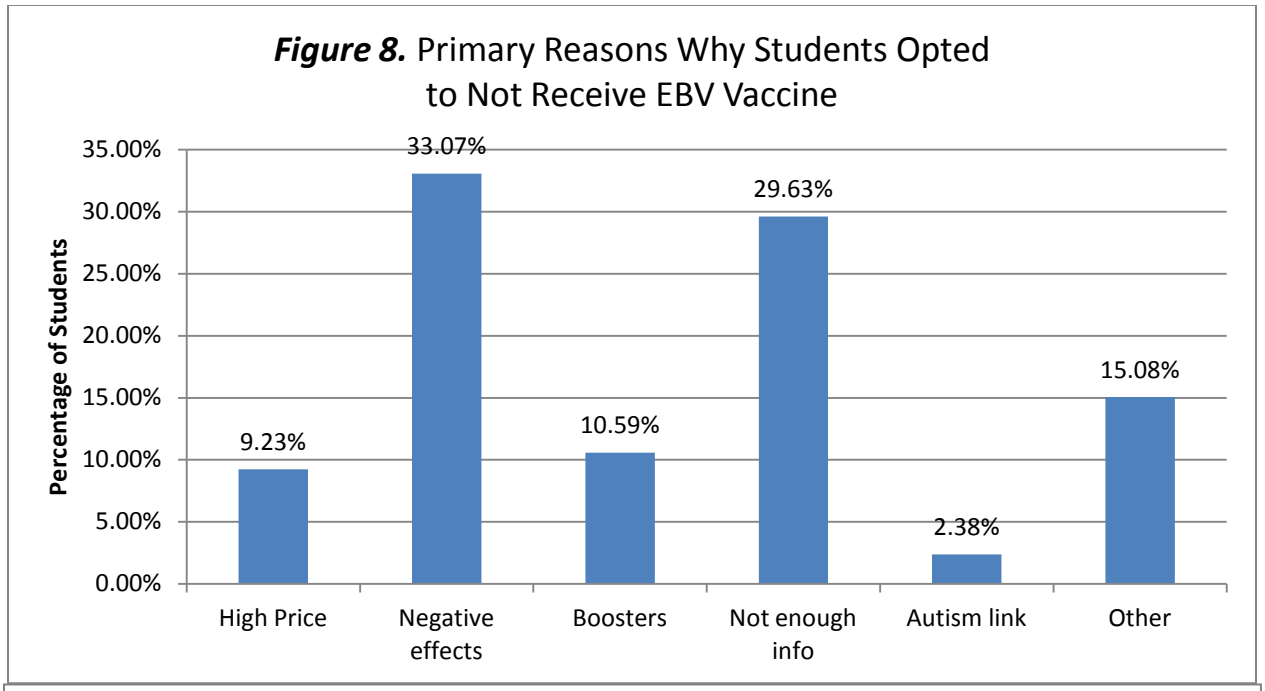
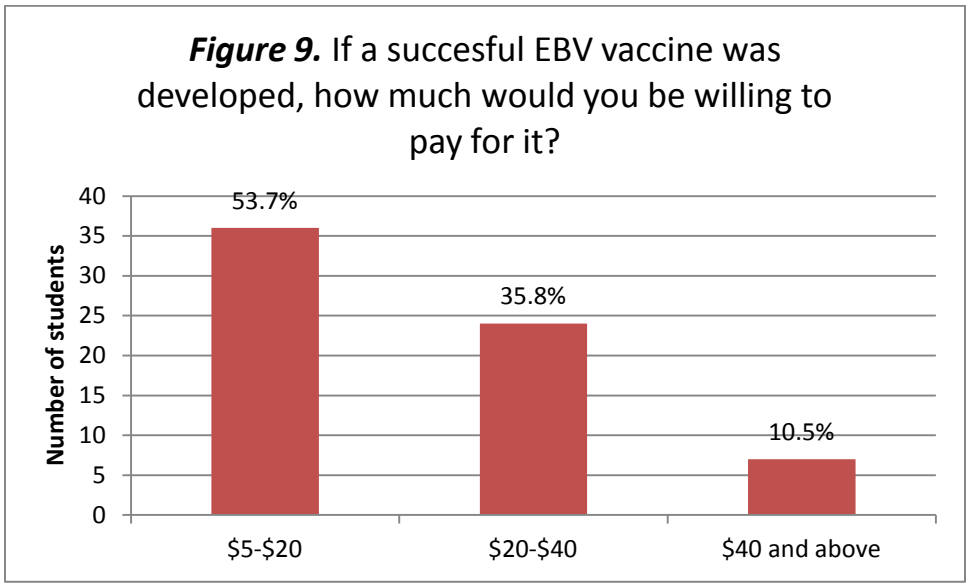


Figure 8. **Write-in responses in "Other" category**

- Vaccine is ineffective if individual is asymptomatic (11)
- Risks of EBV infection are not high enough (4)
- Vaccine is not necessary (3)
- Vaccine will not be beneficial because 95% of individuals are already infected with EBV (2)
- Need to see vaccine safety and reliability for more than 1 year after its introduction (2)
- Body's natural immune system should be able to fight infection without vaccines (1)
- Risk of opening up niche to harmful pathogens (1)

The survey also examined how the price of vaccines affected students' decision in receiving the treatment. We determined that roughly 54% of students would be willing to obtain the immunization if it is priced under $20 (Figure 9). Only 35.7% of students would pay for the vaccine if it is priced between $20-40 and 10.5% would be willing to pay over $40. Since the participants of the survey were college students, the economic status of students should be taken into consideration. College students are already financially burdened in paying for tuition, books, commute, and many other costs. In contrast, individuals in older age groups with stable careers

are more likely to be willing to pay more money for the vaccine. Thus, the results of this particular survey question will vary depending on the epidemiology of the group.



The survey also analyzed the effect of false/unvalidated link between autism-vaccine on students' decision to receive the EBV vaccine. In 1999, *The Lancet* published a study that proposed a link between MMR vaccine and development of autism in children (Wakefield, 1999). The study received significant media attention and caused public panic especially in Europe. However, since its publication, many scientists have determined that the study was flawed and that there was no known observed link between MMR vaccine and austim. Though the CDC, American Academy of Pediatrics, and Institute of Medicine have officially stated that the study was baseless, public distrust in vaccines still exists in some groups (CDC, 2011). Thus, an analysis of the effect of this study on the students' decision to receive vaccines would be insightful. We found that 67.1% of the students have at least heard about the study, but only 14.9% of them have read follow-up papers about it (Figure 10). Approximately 30% of the

students answered that they were not familiar with the study. We concluded that though most students were aware of the study, more information could be made available to ensure public understanding of the false study. In addition, another follow-up survey question examined how this autism study affected the students' decision in obtaining the EBV vaccine (Figure 11). The results of this study showed that 67% of students chose not to receive the EBV vaccine after being provided information about the autism study. However, we realized that this question had significant limitations. Since this question was asked after the presentation of critical information, the students' decision to receive or not receive the vaccine was influenced more by their knowledge about EBV and the vaccine instead of only being based on the autism study.

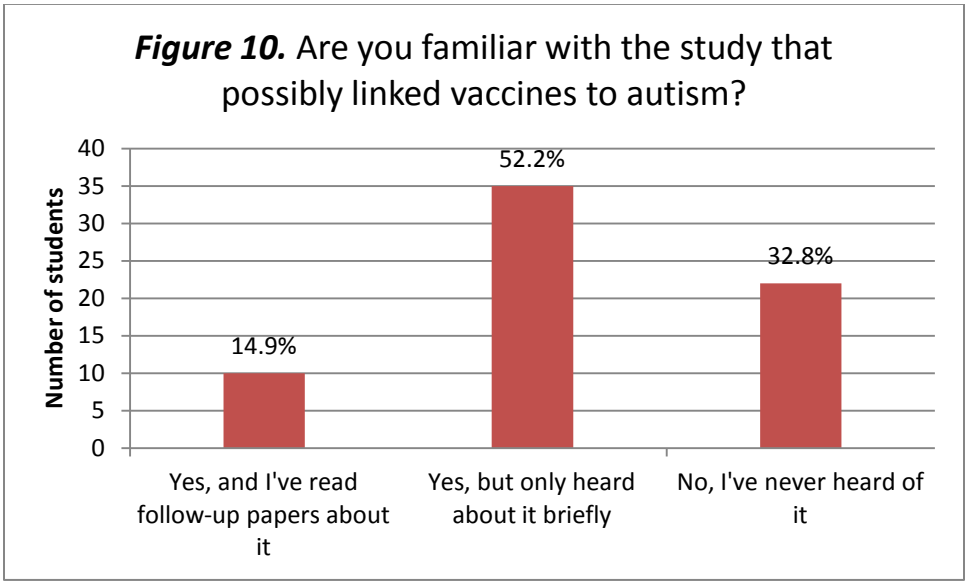
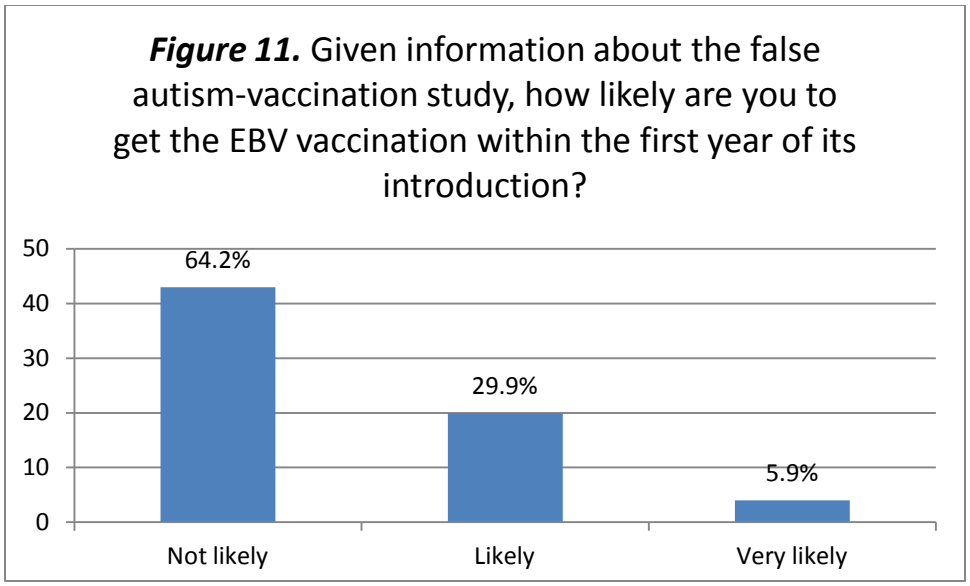


Figure 10. Are you familiar with the study that possibly linked vaccines to autism?



Discussion

As shown by the results, we concluded that education strongly impacted a person's perception of vaccines. After the students were provided with more important information, many of them changed their opinions in receiving the vaccine or not, as shown in Figure 6. The impact of limited education can also be seen in the larger scale of society. For example, public distrust regarding vaccines due to the MMR vaccine-autism study still exists today even though the study has been officially retracted after being proven false many years ago. This study not only resulted in public distrust to MMR vaccine, but produced a negative general stigma to all immunizations. A news article recently published by The Arizona Republic (Midey, 2013) revealed multiple confessions of concerned parents choosing to not vaccinate their children due to health and safety concerns to vaccines like MMR and DPT, both of which have been proven effective and safe by more than a decade's worth of data (Ehreth, 2003).

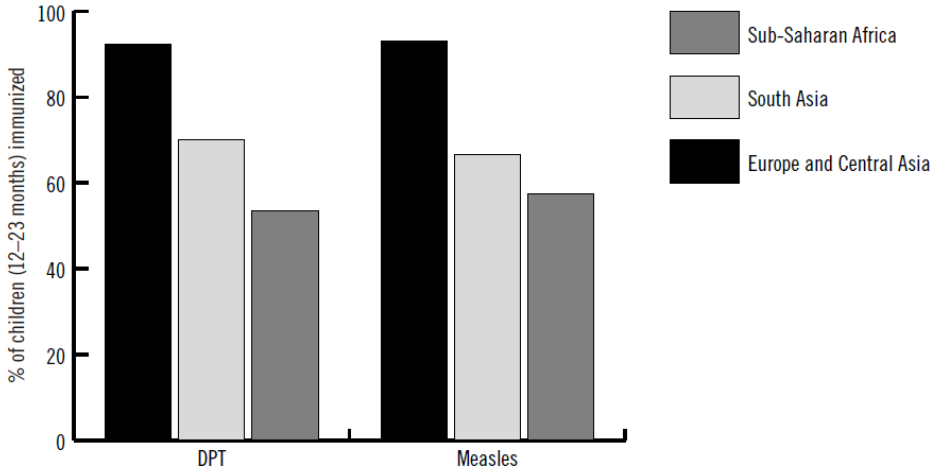
Skepticism towards vaccines among parents can also be seen in the increasing immunization exemptions in students as young as kindergarteners. In 2004-2005, 11,277

entering kindergarteners obtained medical exemptions, and in 2010-2011, the number of medical exemptions in the same cohort increased to 13,952; and the 7 year total was over 86,000 exemptions approved for kindergarteners (Stadlin et al, 2012). Though parents who choose to not vaccinate their kids are fundamentally concerned for the health of their children, the provision of more education regarding the diseases that the vaccines would prevent and knowledge about herd immunity could potentially influence them to make an informed decision to vaccinate their children. Although some vaccine exemptions were granted for legitimate medical reasons, these exemptions need to be monitored and regulated to prevent incidents of outbreaks (Stadlin et al, 2012).

However, the stigma against vaccinations is not only observed among parents. Organizations such as the Vaccine Liberation Front actively campaigns against the false dangers of immunizations and provides contact information for physicians who accept non-vaccinated patients (Cassel). The volunteer organization also provides vaccine exemption forms for school and employment. Clearly, the impact of limited education on vaccine could lead to extreme distrust of general immunizations that have otherwise been proven reliable, effective, and safe for more than 10 years.

It should also be noted that many communities do not receive necessary vaccinations for reasons other than a conscious decision to deny them. For example, only around half of the sub-Saharan Africa community has received the DPT vaccine as of 2002 (Figure 12, Bloom et al, 2005). On the other hand, the DPT vaccine is widely available and often required for employment in developed countries like the United States. This disparity is due to a number of factors such as the unavailability of vaccines in rural regions, expensive cost of the treatments, and the political state of the nation (Bloom et al, 2005).

Figure 12. Disparities in immunizations



Source: World Bank, Washington DC (2004). Data are for 2002.

The benefits of vaccines have been well-researched and well-documented throughout decades of scientific research. Vaccines have not only decreased mortality rates from vaccine-preventable diseases, but have also increased the quality of life by creating a healthier and more economically-productive society. Therefore, proper education regarding these benefits should be enhanced to continue the positive ripple effect of vaccinations.

Since the end of World War II, immunizations have made a significant impact on reducing the mortality rate of various diseases such as smallpox, polio, and diphtheria. For example, before the introduction of the polio vaccine, over 300,000 individuals died from polio in the 1980's. Successful development and implementation of the polio vaccine has reduced the mortality rate from polio to 2,000 by 2002 (Bloom et al, 2005). Smallpox, which originally killed two million people per year, has essentially been eradicated after global immunizations took place in late 1970's (Bloom et al, 2005). For over 20 years, these vaccines have consistently been proven to be safe and effective in preventing potentially lethal diseases.

Vaccines do not only reduce mortality rates, but also produce a healthier and more prosperous community overall. Cooperation to receive proper vaccines maintains herd immunity and minimizes outbreaks of vaccine-preventable diseases in crowded communities, such as schools, workplaces, and overpopulated cities, leading to a healthier society in general (Ehreth, 2003). In addition, immunizations have also yielded economic benefits. Several studies have shown that vaccinated children are healthier and better able to participate and learn in schools, and healthier workers exhibit increased productivity and attendance in the workplace (Bloom et al, 2005). It was also determined that an increase of one year in life expectancy improved labor productivity by 4% (Bloom et al, 2005). In addition, another cost-effectiveness study has shown that vaccines have saved countries billions of dollars by controlling the spread of vaccine-preventable infectious diseases. For example, around $100 million GDP is lost annually in sub-Saharan Africa due to malarial infections (Ehreth, 2003). The study also concluded that for every dollar spent on distributing MMR vaccine, over $23 is saved in direct medical care costs in treating the disease (Ehreth, 2003). Indeed, the benefits of vaccines go beyond just decreasing morbidity rates. Immunizations directly and indirectly enhance the overall health and economic success of a community.

It is clear that vaccines have an invaluable positive impact on society. Thus, providing education that would encourage uninformed individuals to receive proper vaccinations is essential to maintain the health and economic prosperity of communities. This thesis study has shown that education directly influences individuals to make an informed decision about receiving a necessary vaccine. The same approach could be applied in a larger scale through health awareness programs or vaccine campaigns. By providing relevant education, vaccine compliance among the distrustful communities could be enhanced. Indeed, with the aid of

increased education, vaccines will no longer be falsely viewed as a health hazard or monetary burden, but as an invaluable investment that will positively benefit their recipients.

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Appendix 1

VACCINE SURVEY
PAGE 1

Part I

- When was the last time you received a vaccine or booster vaccine?
  □Within the last 3 years □Within the last 10 years □Don't remember
- Have you received multi-component vaccines?
  □Yes □No □Don't Remember
- Have you received a flu vaccine?
  □Yes □No □Don't Remember
- Are you familiar with the study that possibly linked vaccines to autism?
  □Yes, and I've read follow-up papers about it.
  □Yes, but only heard about briefly.
  □No, I've never heard of it.

Part II

Scientists are currently developing a vaccine against Epstein-Barr Virus (EBV). EBV is extremely common in the United States. It is estimated that 95% of adults have the EBV, though most are asymptomatic. It has been proven that EBV patients are more likely to develop lymphoma in their lifetime.

- Given the information above, how likely are you to get the vaccination within a year of its introduction?
  □Not likely □Likely □Very likely

Appendix 1, Continued

VACCINE SURVEY CONTINUED
PAGE 2

The EBV vaccine currently in development is in its final stages of clinical trials. The vaccine has been proven successful with a small group of people, although it has been determined that the vaccine is not effective against asymptomatic EBV patients. Most adults in the U.S. are asymptomatic for the disease. In addition, the occurrence of lymphoma, a known EBV risk, is relatively low in the U.S. (only 10-15%, compared to 97% in certain regions of Africa). Some researchers are also concerned that eliminating such a prevalent organism from our flora might open up niches to harmful pathogens, ultimately causing more harm than good to the society.

- Given the information above, how likely are you to get the vaccination within a year of its introduction?
  □Not likely □Likely □Very likely
- If a successful EBV vaccine was developed, how much would you you willing to pay for it?
  □$5-$20 □$20-$40 □$40 and above

In 1998, a scientific journal published a study that linked vaccines to autism in children. Although the CDC and many researchers have proved this link to be false, many are still skeptical about the possible risks of vaccinations.

- Given the information above, how likely are you to get the EBV vaccination within a year of its introduction?
  □Not likely □Likely □Very likely

Rank your top three reasons why would **not** get the new EBV vaccine, with 1 being the most significant.

___ High price

___ Potential negative side effects/diseases

___The necessity of obtaining boosters

___Not knowing enough general information about the vaccine and EBV

___Possible vaccine-autism link

___ Other: _____

Rank your top three reasons why would **receive** new EBV vaccine, with 1 being the most significant.

___ Low price

___ Avoid contracting EBV

___ Afraid of long-term risks of infection (such as developing lymphoma)

___ High availability: available at nearby drug stores, etc

___An understanding about how the vaccine works and general knowledge of EBV

___ Other: _____