

An Investigation into the Formation of Vaccine Opinions and Attitudes in College Students

By
Bailey L. Reynolds

A THESIS

Submitted to

Oregon State University

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(Honors Scholar)

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Abstract approved: _____

Courtney Campbell

This study sought to understand the commonality of vaccine misconceptions among college students and where individuals feel they are obtaining their vaccine information. An IRB approved survey was used to collect 126 responses from Oregon State University students. Individuals, on average, correctly answered only 54.10% of the statements based on various vaccine misconceptions, suggesting their commonality. It was also found that 65.87% ranked their support of vaccines and their parents perceived vaccine opinion as the exact same value on a one to six scale. This suggests the role perceived parental opinion may play in shaping an individuals' opinion of vaccines. This data was used to suggest methods to help correct these misconceptions such as adding a vaccine literacy section to the HHS 231 required course for undergraduate Oregon State students. The goal of this research was to provide evidence of the commonality of vaccine misconceptions, demonstrate where individuals were gathering this information, and suggest methods to address vaccine hesitancy and the spread of misinformation.

Key words: Vaccines, Misconceptions, Hesitancy, Opinion, Survey

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Honors Baccalaureate of Science in Biology project of Bailey L. Reynolds presented on
October 4, 2019

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I understand that my project will become part of the permanent collection of Oregon State University, Honors College. My signature below authorizes the release of my project to any reader upon request.

Bailey L. Reynolds, Author

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Chapter 1: Introduction

In the mid-morning of an emergency department in Oregon, the state with the highest rate of non-medical exemptions for kindergarteners at a staggering 6.5% (Seither), the grumblings of the medical staff can be heard. A mother has brought in her seven year old son for a prolonged cough. In his chart a note was made that this young boy was unvaccinated. Although taking care of patients is a priority, many of the staff were concerned about this boy's presence in the emergency department. Since he was unvaccinated, no one knew what illness he may have just introduced into the department. As the doctor meets with the patient and his mother, she describes his cough using medical terminology that is generally only used by medical professionals. When asked about this, she states that the internet can make anyone a doctor nowadays.

With the internet at our fingertips, people are turning to the web to make medical decisions and gather their own information. Many individuals are also using the internet to find information on vaccine safety that may not be from reliable sources. People rely heavily on a variety of sources for vaccine information. This raises certain questions as to where people are getting their vaccine information and how the spread of misinformation can be contained. With the most recent measles outbreak so close to home, vaccination efforts and resistance continues to rise. Starting in January 2019, a measles outbreak in Clark County, Washington has a reported 71 confirmed cases as of April 29th, 2019. Another five cases were confirmed in Marion County, Oregon. Measles was declared eradicated from the United States in 2000 but measles cases are on the rise all over the country with many of the cases affecting unvaccinated children under the age of 10 (Lambert). Many are blaming "anti-vaxxers," individuals who choose not to vaccinate,

for the recent outbreaks due to the spread of misinformation. This claim is difficult to prove and regardless, energy must be focused on affirming vaccine safety and understanding where individuals are getting their vaccine information to encourage the spread of accurate information.

College can be considered the first time in an individual's life that they are able to leave home and make their own decisions. Since so many adults are now choosing to not vaccinate their children, many begin to wonder at what point individuals gather the information to make this decision. This study is based off of the assumption that college is a time when individuals are beginning to form their own opinions on their health. By focusing on how college students are gathering their vaccine information and what students understand about vaccine safety, a solution can be introduced that would address the concerns of this population. This is done in the hopes that, in the future, individuals would be supportive of vaccines and choose to vaccinate their children to prevent such widespread outbreaks of contagious diseases.

The central questions of this thesis research concern what the basic level of knowledge regarding vaccine safety and effectiveness among college students is and what are the sources used to gather this information. To accomplish the goals of this study, a literature review was completed to understand past and present concerns of vaccines and how individuals have tried to remediate this problem. Subsequently, a survey was conducted of Oregon State University students that looked to discover what individuals understood about vaccines and their safety, their own personal opinions as well as those of their parents, and where they felt that they were gathering this information from (see appendix A for survey and appendix B for IRB approval). Individuals' understanding of vaccines and perceived sources of vaccine information were

compared. Lastly, individuals rankings of their personal vaccine opinion and the perceived opinion of their parents were compared.

Through the results of this study, it is recommended that a vaccine information section be added to the required HHS 231 course for all Oregon State students. Many students indicated that they had received vaccine information from Introductory Biology courses and that this influenced their vaccine opinions. Making vaccines part of a required OSU course will increase vaccine awareness and allow individuals to spread this information to other peers outside of OSU as well. Furthermore, individuals utilizing Student Health Services should receive a pamphlet on vaccine safety and encourage students to inquire further if they have any hesitancies. This way, individuals feel as though any concerns they may have are met and can feel confident in the vaccines that they are receiving.

This study will focus on an extensive overview of the anti-vaccine movement followed by a discussion of the vaccine questionnaire. Subsequently, the results and analyses of such will be presented. Lastly, this research presents a discussion of further remediation efforts for increasing vaccine safety awareness and preventing the spread of misinformation. This will present conclusions to the research questions and suggestions for further research.

Measles and other contagious diseases previously eradicated from the U.S. are finding holes in the population through unvaccinated communities, leaving vulnerable individuals at a heightened risk. Now is the time to address the vaccine hesitancy and propose remediation efforts to prevent nation-wide epidemics of these deadly diseases.

Chapter 2: Review of Literature

The beginning of the anti-vaccine movement followed shortly after the invention of the first vaccine in the year 1796 by Edward Jenner (“Timeline”). Smallpox, also known as Variola Virus, was the first disease to be successfully eradicated with vaccinations. The last outbreak of smallpox occurred in 1949 and smallpox was declared eradicated in the year 1980 by the U.S. Government (Smallpox). In 1882, the Anti-Vaccination League of America held its first meeting in New York. The first argument cited was that smallpox was not spread from contagion but was spread by filth. Therefore, it was believed that it was not vaccinations that were leading to a decrease in deaths from smallpox, it was better sanitation (“Timeline”).

As vaccines grew to be more common, so did fears. With many individuals starting to believe that vaccines were actually a poison, many resisted them. In the year 1806, United States President Thomas Jefferson received a copy of the research completed by Edward Jenner and proclaimed his admiration and support for his work. Following this, in 1813, James Madison then signed “An Act to Encourage Vaccination” which led to the establishment of the National Vaccine Agency. This also required that the post office allow free postage for packages that contained smallpox vaccination materials that weighed up to 0.5 oz. This act was the first passed that was designed solely to improve the health of the public, yet a strong public opposition to vaccines still prevented the immediate success of this act. Due to the dangerous medical practices that occurred, many were skeptical of the safety and efficacy of vaccines and this fueled the anti-vaccine movement. During the 19th century, medical practices were not regulated as they are today, therefore vaccine hesitancy was apart of a more broad issue of hesitancy to seek and receive medical care of any kind (“Timeline”).

The first vaccine exemptions on record were not introduced until 1898 when Britain passed the British Vaccination Act of 1898. This act allowed for “conscientious objectors” to refrain from receiving vaccines. By the end of 1898, nearly 200,000 vaccine exemptions had been given out and due to this victory for the anti-vaccine movement, anti-vaccinators across Europe and the United States became even more confident and vocal in their opposition of vaccinations (“Timeline”).

The first U.S. Supreme Court case involving vaccines was in the year 1905. The case, *Jacobson vs. Massachusetts*, was a turning point in the determination of the constitutionality of vaccine requirements. Jacobson was challenging the constitutionality of the Cambridge, Massachusetts Board of Health’s ability to require individuals to be vaccinated against smallpox during an epidemic. The Supreme Court upheld the state’s right to require the vaccine (*Mariner*). Although the anti-vaccine movement was, admittedly, not supportive of the ruling of the Supreme Court decision, vaccines continued to become more commonplace in the U.S. With more vaccines being discovered for other diseases and more innovative ways of storing vaccines, vaccines became increasingly easier to acquire. In 1914, Typhoid vaccines became common in the United States (“Timeline”).

In 1922, many U.S. schools began requiring smallpox vaccinations for children to attend school. Although Britain had already allowed for vaccine exemptions, the U.S. had not followed suit. Many students and families began seeking help from the justice system to receive exemptions for these vaccines. In most cases, it was determined that it was within the power of the police and of the state to have compulsory vaccinations for students to attend school. It is

during this time that tension between the citizens of the United States and the government over vaccine requirements began to rise.

The first licensed vaccine in the U.S. was the licensing of the Measles, Mumps, and Rubella (MMR) vaccine in 1971. In the years 1989-1991, measles sickened over 55,000 Americans and killed 123. In order for a vaccine to be effective in protecting a population from an outbreak, a herd immunity threshold must be met. This means that enough of the population is vaccinated that the disease will not be able to easily spread between individuals. For MMR, the herd immunity threshold is approximately 95%. The CDC reported that most areas experiencing outbreaks among preschool aged children were areas that had less than 50% of these children vaccinated against measles, far below the herd immunity threshold for this vaccine. Of the 123 individuals who died of measles, 90% had never received the measles vaccine (“Timeline”).

In many areas around the world, especially in Europe and America, efforts to vaccinate had led to the achievement of herd immunity for several diseases, a leading goal by the CDC Healthy People 2010 and 2020 objective to prevent infectious disease (“Healthy People - HP2020 - Topic Areas”). This herd immunity is what helps to protect vulnerable populations/individuals such as infants, the elderly, and those that cannot receive vaccines for other medical reasons. In the year 1998, Andrew Wakefield, a British researcher, posted an article that suggested a link between the MMR vaccine and autism in children (Wakefield). It was later discovered that subjects of his paper had been recruited by a lawyer involved in a court case that was suing pharmaceutical companies. Although 10 out of the 12 co-authors of this paper eventually retracted their interpretation of the results, the damage this paper caused was done and would never be reversed (“Timeline”). This article is still cited today, 20 years later, as

a reliable source of information by many vaccine opponents to discourage individuals from vaccinating their children. Many subsequent epidemiological studies have disproven Wakefield's results time and time again. British MMR vaccine rates dropped to approximately 80% after the publishing of this essay which is far below the threshold for herd immunity, leaving vulnerable individuals susceptible ("Timeline").

Individuals against vaccines continued citing Wakefield's work in order to oppose vaccines but governments continued working to eradicate infectious diseases from the world. The Polio Vaccine Act of 1955 supplied \$30 million dollars for the purchase and administration of the polio vaccine to children under the age of 20 and expecting mothers. This act was written in the midst of a polio outbreak (Anderson). In 2004, the six remaining countries with endemic Polio signed the Geneva Declaration on Polio as a commitment to intensify Polio immunization activity to eradicate Polio.

In 2008, after much anti-vaccine activity against the MMR vaccine and the fear that it contained mercury, vaccination rates were at a low. There were a reported 134 cases of measles in 2008 which is more cases than any year since 1996. Of those that were affected, 90% had not been vaccinated. More measles outbreaks continued to occur in 2011 in France and the United States. Only 89% of all two year olds had received one dose of the MMR vaccine, leading to the outbreaks in 2011. With the latest data available from 2017, 91.1% of children 19-35 months had received at least one dose of the MMR vaccine ("FastStats - Immunization"). Although the percentage has increased, there is still a growing population of individuals refraining from vaccinations, leaving opportunities for further outbreaks to occur. These outbreaks led to several states in the United States removing non-medical vaccine exemptions in order for students to

attend school. Currently 47 states allow for religious exemptions and 18 states allow for philosophical or personal belief exemptions (Barraza).

Today, little has changed in terms of the anti-vaccine conversation. Many are still hesitant or fully opposed to vaccines. Some celebrities have come forward with anti-vaccine viewpoints that have been further fueling the anti-vaccine movement. In a 2015 PBS special titled “The Vaccine War”, our own Ashland, Oregon is the target for an example of the anti-vaccine movement. With 16 different diseases now preventable by vaccination, including measles, a growing population of individuals are choosing not to vaccinate or fully vaccinate their children. In 2015, in Ashland, Oregon, 28% of children were attending public school lacking some or all vaccinations. One mother in the special states that she would rather have her children contract a natural illness as *homo sapiens* have done for the last 200,000 years. She states that “getting sick is not a bad thing” (“The Vaccine War”). However, what many fail to realize is that as natural selection has affected human evolution, viruses also succumb to selective pressures. Therefore, viruses and diseases are more deadly now than they have been in the past and will continue to change and evolve to fight our human immune system. Just as one disease is eradicated, another one takes hold (“Viruses and Evolution”).

Measles was declared eradicated from the United States in the year 2000. However, due to record low vaccination rates, many outbreaks have occurred all across the country (“Measles (Rubeola)”). Most recently, beginning January 1, 2019, 71 Measles cases have been identified in Clark County, Washington. Of the 71 who contracted Measles, 61 were unvaccinated, seven were unverified, and only one individual was verified as having received one dose of the MMR vaccine. Measles outbreaks are becoming more frequent across the United States due to

individuals choosing to not vaccinate their children. Of the 71 cases, only five cases were in individuals who were over 18 years old (“Measles Investigation”).

With more and more individuals choosing to not vaccinate their children, communities such as Ashland, Oregon are at an increased risk of having an infectious disease spread throughout. Once an outbreak begins, there is little to do besides quarantine the individuals and vaccinate those that are able to receive the vaccine. In order to understand why people are choosing to not vaccinate their children, it is important to understand where individuals vaccine information is coming from. With college being one of the first times in an individual's life that they can begin to make their own decisions, it seems a clear target as to influencing individual opinions. Whether individuals continue on with the opinions of their parents or gather new information and formulate their own opinions is not well researched, especially in the area of vaccines. Concerning how college students are making their decisions on the safety of vaccines and where they are getting this information from is a point of interest for this study. This study sought to understand and identify common misconceptions of vaccines and find areas where accurate information can be introduced. With the anti-vaccine movement growing, it's important to understand where individuals are gathering information on vaccines which will eventually lead to their choice to vaccinate.

Chapter 3: Results

This study sought to understand college student opinions of vaccines, how these opinions correlated with the perceived opinions of their parents, how well college students actually understood vaccine information, and where they felt they were gathering this information from. This was accomplished by using an IRB approved survey (see appendix A for survey and appendix B for IRB approval form) to gather this data on college students. To accomplish this, 26 professors teaching various courses were contacted by Dr. Courtney Campbell requesting the distribution of a standard message and survey link to their students. This study sought a voluntary response by students. Over the course of several weeks, 126 responses were collected and the data was subsequently analyzed as shown in the following figures and tables.

Question one of the survey was used for the purpose of being able to identify if a representative sample of college students was obtained.

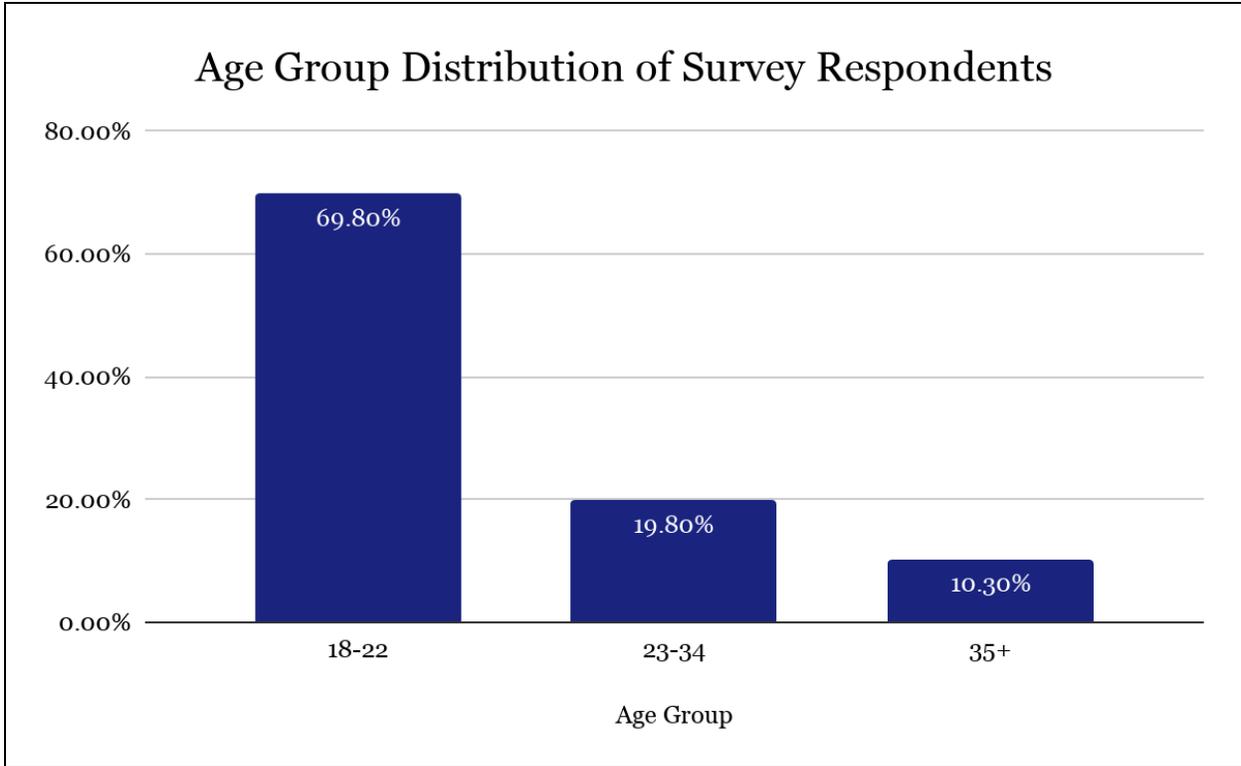


Figure 1. Question 1: "Please check which age group you are in."

Question two was used for the purpose of determining how supportive college students were of vaccines and to compare this answer to what the student believed their parents' opinion of vaccines is.

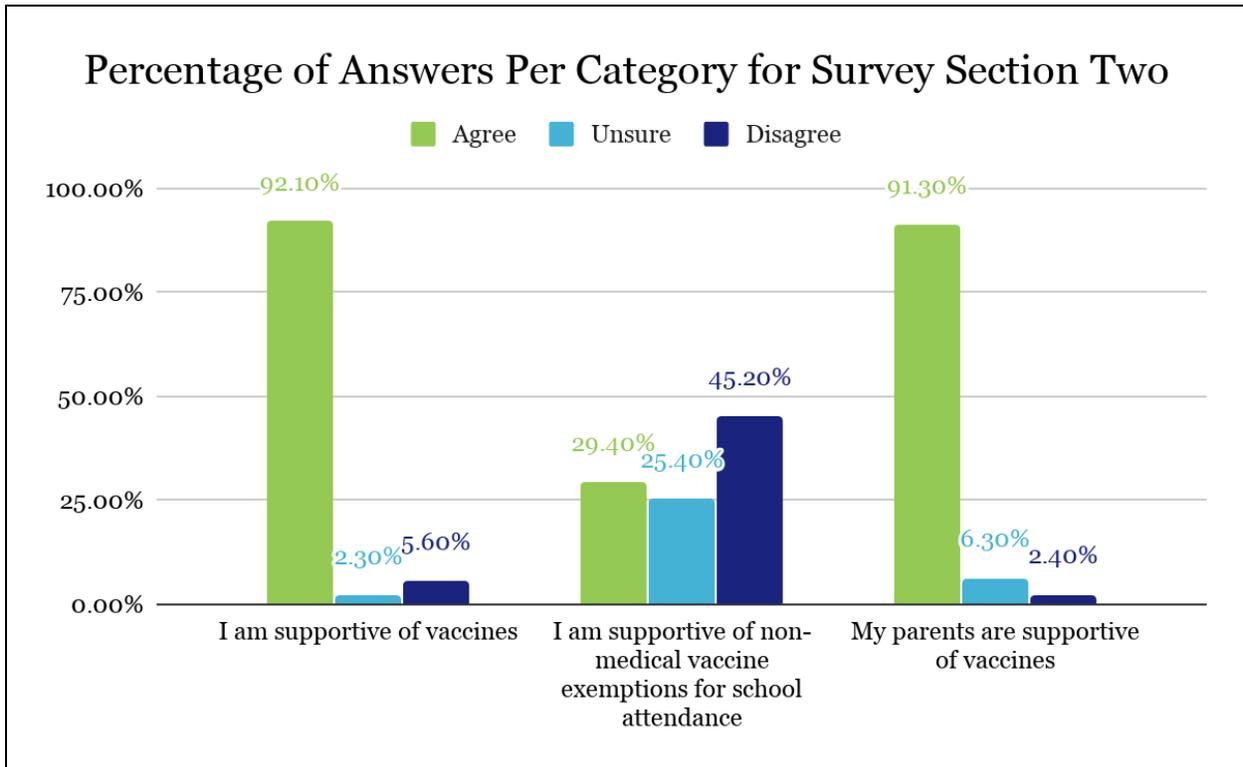


Figure 2. Question 2: “Please respond to the following statements on a scale of 1 to 6 with 6 being strongly agree and 1 being strongly disagree.”

Question three was created for the purpose of determining the demographics of individuals surveyed in terms of their receipt of vaccines. This was also to determine if individuals who had not received vaccines as a child and also those who had received a vaccine exemption from Oregon State were sampled. Statements listed above in numerical order are:

1. “I received vaccinations as a child”
2. “I received some of the OSU required vaccines PRIOR to applying/admission to Oregon State. Ex. MMR, Meningococcal, Varicella, TDAP, Hepatitis B.”

3. “I received the OSU required vaccines ONLY for the purpose of attending Oregon State.
Ex. MMR, Meningococcal, Varicella, TDAP, Hepatitis B.”
4. “I obtained a vaccine exemption from OSU.”
5. “I have received my flu shot this year.”

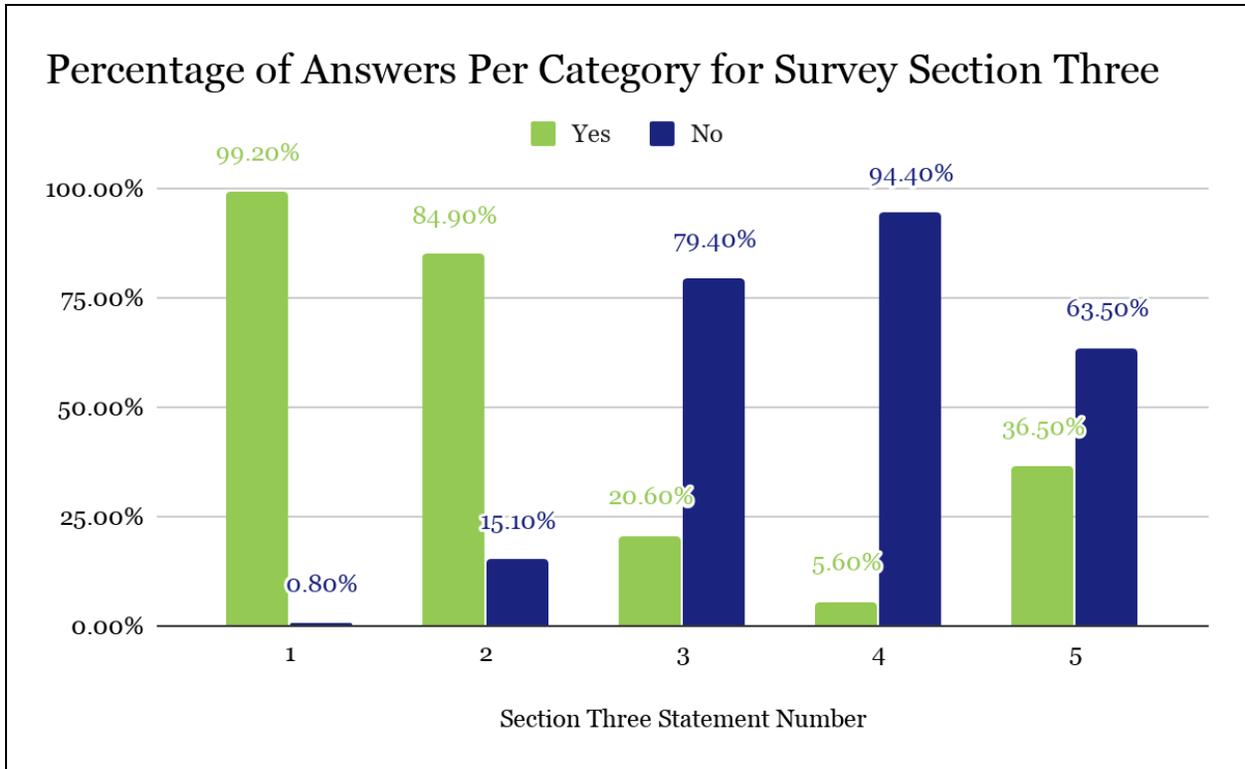


Figure 3. Question 3: “Please select yes or no for the following statements.”

Question four was used to determine individual college student understanding of the various risks of vaccines. Many of these statements are vaccine myths. This study sought to determine which of these (if any) vaccine myths were common among college students. The statements listed above in numerical order are:

1. “Too many vaccines can overwhelm the immune system.”
2. “It is better to space out vaccines than to administer them all at once.”

3. "Vaccines have toxic preservatives in them."
4. "Natural immunity is better than vaccine-induced immunity."
5. "Disease rates have decreased due to better hygiene and nutrition and not vaccines."
6. "Oregon has rates of unvaccinated school children higher than national averages."
7. "I do not need to receive the flu vaccine each year."

Each of the above seven statements had a definitive correct answer of either true or false. The following will discuss the correct answer and supportive evidence for each of the statements. The first statement "too many vaccines can overwhelm the immune system" is based on a common misunderstanding that too many vaccines given at once can overwhelm the immune system, especially in infants. With information found in a CDC article, there have been numerous scientific studies that have shown that receiving multiple vaccines at the same time does not cause any chronic health problems. Recommended vaccines have been tested and proven to be as effective individually as they are together ("Multiple vaccines and the immune system.") The next statement "it is better to space out vaccines than to administer them all at once" was related to the first statement in terms of whether one should follow the CDC guidelines for vaccines or whether it be best to follow an "alternative schedule." An alternative vaccine schedule is one that encourages spreading out vaccine administration to avoid overwhelming the immune system. From the same CDC article that discussed the safety of administering multiple vaccines at once, the efficacy of the CDC recommended schedule is presented. The article discusses how, through the CDC vaccine schedule, an infant is exposed to 320 antigens prior to the age of two in order to protect them from common antigens they are exposed to. It is also mentioned that this number of antigens has not been found to offer an

additional burden on an infants immune system that would be immunosuppressive (“Multiple vaccines and the immune system.”)

Statement three “vaccines contain toxic preservatives in them” is based on a common misconception that, specifically the MMR vaccines, contains toxic levels of a compound containing mercury that can lead to mercury poisoning. Per the CDC, the compound in question is known as thimerosal, also known as ethylmercury. This compound is very different than methylmercury, the compound that causes mercury poisoning. There was never evidence found of any harm caused by the low dose of thimerosal used in multiple dose vaccines (such as the MMR vaccine), however, thimerosal was removed from all childhood vaccines in the United States in 2001 (“Thimerosal in Vaccines.”).

Statement four, “natural immunity is better than vaccine-induced immunity” is based on two separate misconceptions. The first being that the antibodies you are born with, received from your mother while *in utero*, is enough to keep a child immunized. Second is the idea that some would prefer that their child was exposed naturally to an antigen and built up the immunity to the antigen on their own. In a CDC article discussing the various types of immunity, a baby acquires some antibodies through the mothers’ blood prior to birth, known as passive immunity. However, these antibodies are temporary and only last for up to a few months after birth (“Vaccines: Vac-Gen/Immunity Types.”) Furthermore, the CDC discusses how vaccines do have a range of mild side-effects that can occur such as a low grade fever or a sore arm. However, vaccines are continuously monitored and thoroughly tested and the risk of side-effects from a vaccine is notably much safer than the risks of allowing a child to be exposed to a potentially deadly disease so that they can produce natural immunity to the antigen. Therefore, vaccine-induced

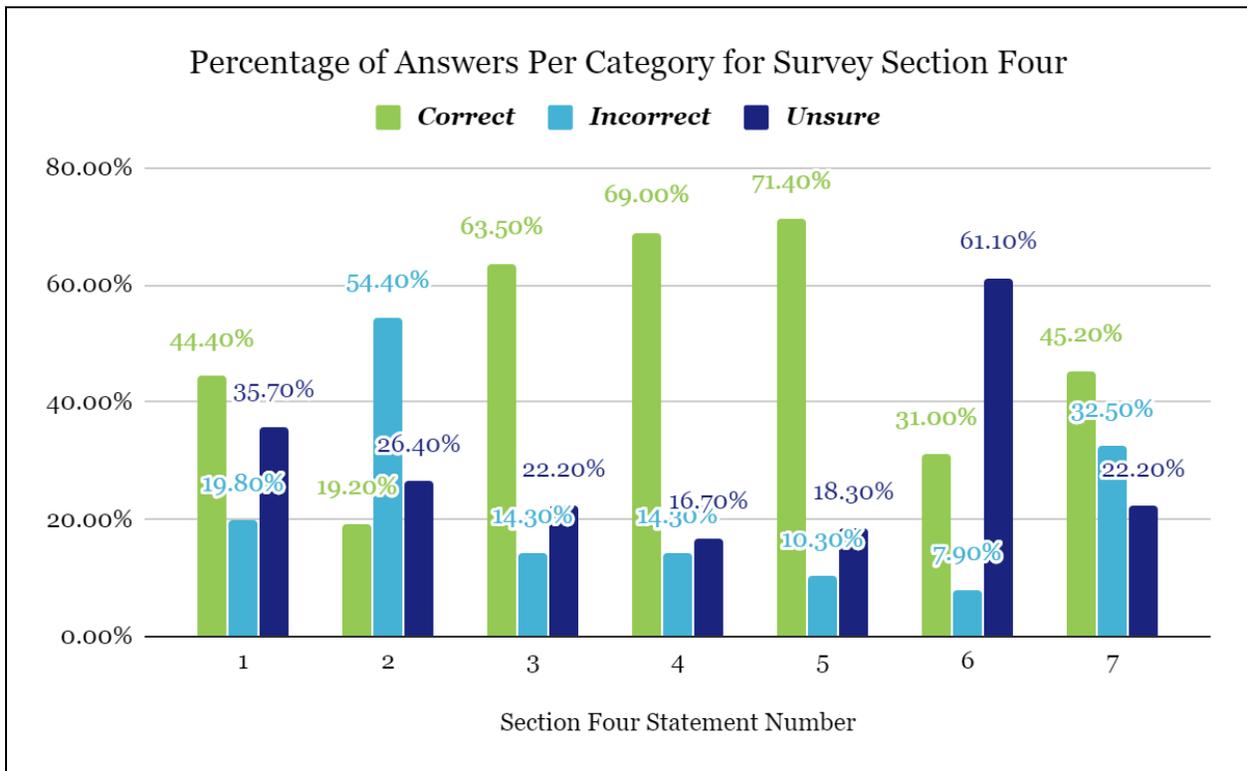
immunity is much safer and more effective than any type of passive or natural immunity (“Vaccines: Vac-Gen/Side Effects.”)

Statement five, “disease rates have decreased due to better hygiene and nutrition and not vaccines” was in relation to a common argument used by the anti-vaccine movement against vaccines. In fact, the statement that disease rates have decreased due to better hygiene was the first argument against vaccines used by the Anti-Vaccination League of America in 1882. As noted by the CDC, better hygiene, clean water, food safety, and a host of other public health improvements did help to reduce disease infections starting in the early 1900’s. However, the elimination of these diseases can only be attributed to mass vaccination efforts starting in 1949. It was not until 1977 that smallpox was declared eradicated worldwide due to a decade long vaccine effort (“Achievements in Public Health, 1900-1999: Control of Infectious Diseases.”)

Statement six, “Oregon has rates of unvaccinated school children higher than national averages” was targeted to understand how aware Oregon State University students are of the current vaccine resistance state wide. With data collected by the CDC on the percentage of adolescents aged 13-17 who have received specific vaccines, Oregon was below the national average for both the Tdap (tetanus, diphtheria, and pertussis) vaccine and the meningococcal vaccine as of 2017. For the Tdap vaccine, the national average for adolescents is 88.7% with Oregon at only 86.3% coverage. The national average for meningococcal at 85.1% with Oregon at 77.0% coverage (“National, Regional, State, and Selected Local Area Vaccination Coverage Among Adolescents Aged 13–17 Years - United States, 2017 | MMWR.”).

Finally, statement seven, “I do not need to receive the flu vaccine each year” is based on a common misconception that the flu vaccine is the same each year and does not need to be

repeated. The CDC recommends that every individual aged six months or older should receive an age-appropriate flu vaccine every season. The first reason being that the body’s immune response declines over time and it is necessary to be re-vaccinated to protect yourself and others from the flu. Second, due to the high mutation rate of the flu virus, the flu vaccine is reviewed and re-formulated as necessary to best protect against the flu virus each season (“Key Facts About Seasonal Flu Vaccine | CDC.”)



Figures 4. Question 4: “Vaccine Literacy: For each of the following statements, select true, false, or unsure based on your current level of understanding.”

Question five was used to determine what sources college students felt they were getting their vaccine information from. A “3” on the scale used represented a substantial amount, “2” represented a good amount, “1” represented some and “0” represented none.

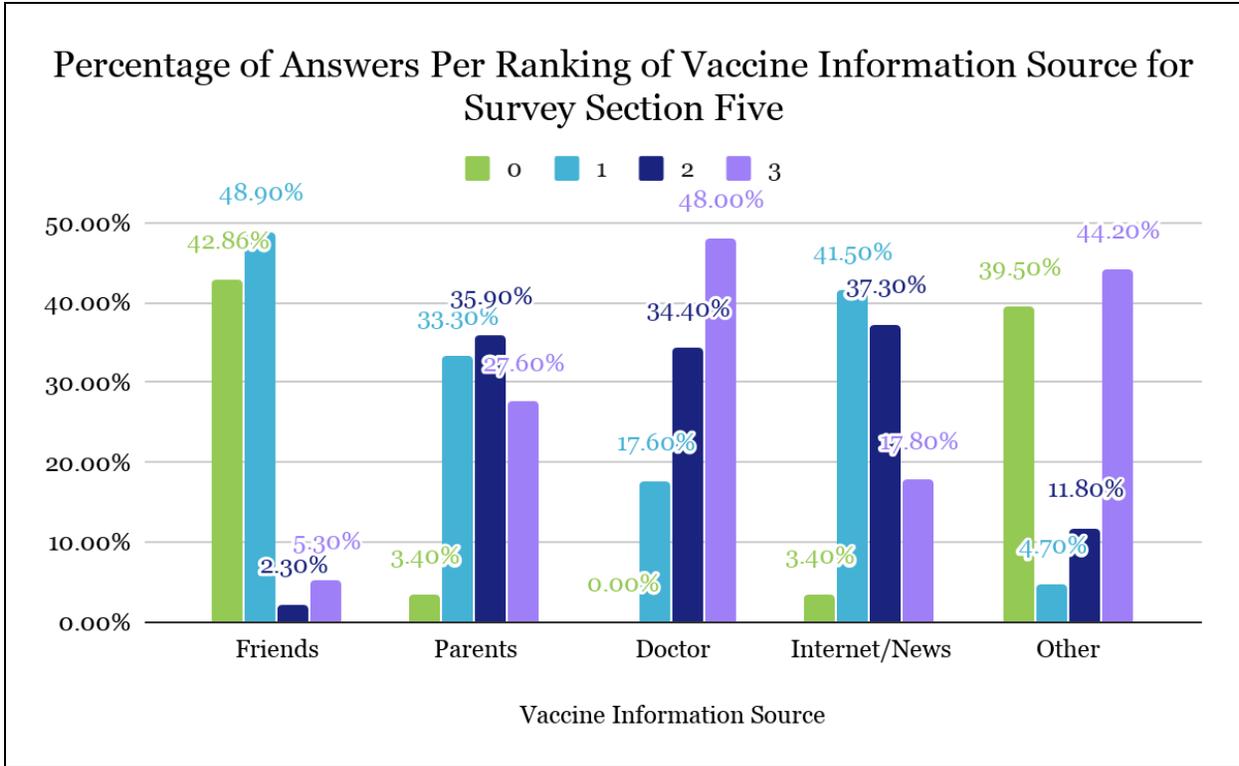


Figure 5. Question 5: “How much information have you received from the following sources? Please select a number from 0 to 3 on the following statements with 3 representing substantial and 0 meaning none.”

Data from question one was compared to answers to the vaccine literacy questions of section four, grouped into “correct, incorrect, or unsure” by age group and overall. This can be read as, individuals in the 18-22 age group answered 59.80% of questions in section four correctly, on average.

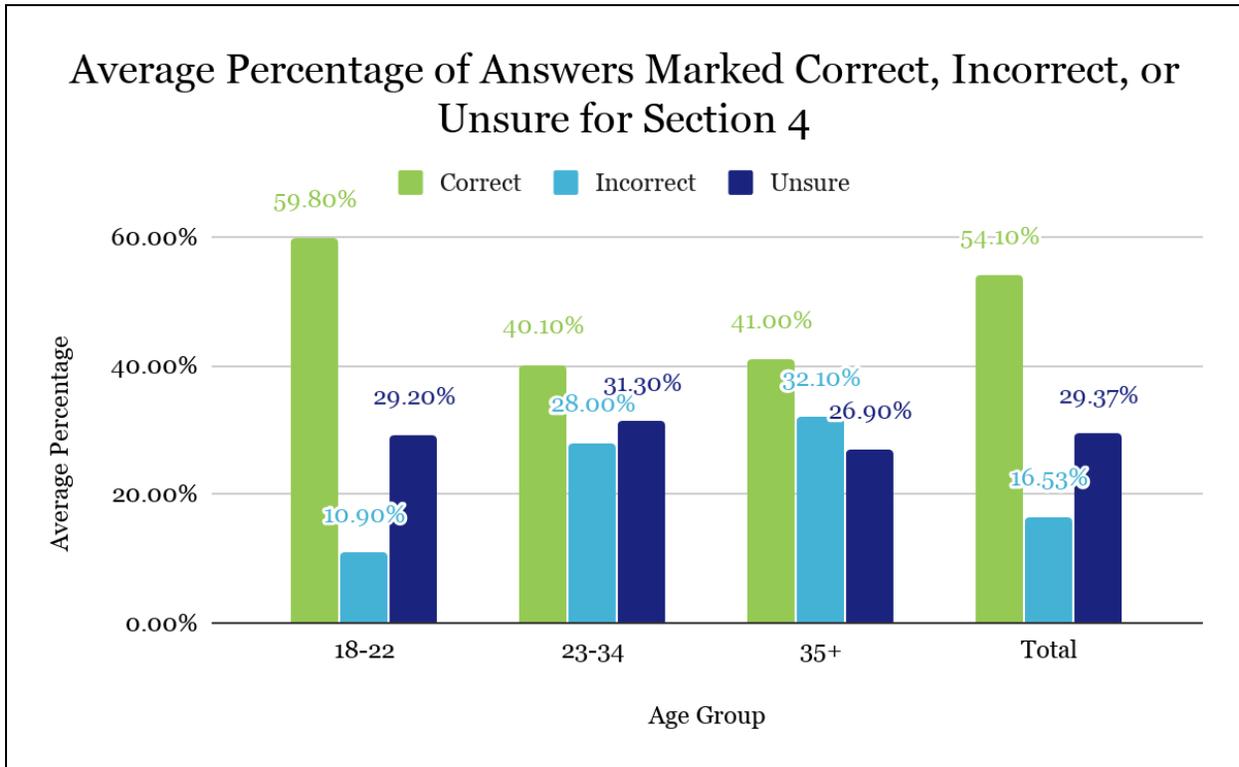


Figure 6. Comparison of the average percentage of answers marked correctly, incorrectly, or unsure for each age group.

Data from question 2.1 “I am supportive of vaccines,” were compared to answers for question five of the survey. Students were asked to rank five sources of vaccine information on a scale from zero to three on the amount of information they felt they were getting from these sources. An answer of zero represented none, one represented some, two represented a good amount, and three represented substantial information being obtained from this source. A weighted average was calculated for each of the three groups (agree, unsure, disagree) for each

subsection of question five, where students felt they were getting their vaccine information from. Therefore, all individuals who stated they were supportive of vaccines were grouped and a weighted average of their response to the amount of information they gathered from each source was determined. The same was done for those that were unsure or disagreed with vaccines was completed. An example of how to read this chart would be that those that were agreeing with vaccines ranked “Doctor” at a 2.74/3 on average for where they felt they were gathering their vaccine information. This allows for the visualization of where individuals who agree or disagree with vaccines are most commonly gathering a majority of their vaccine information.

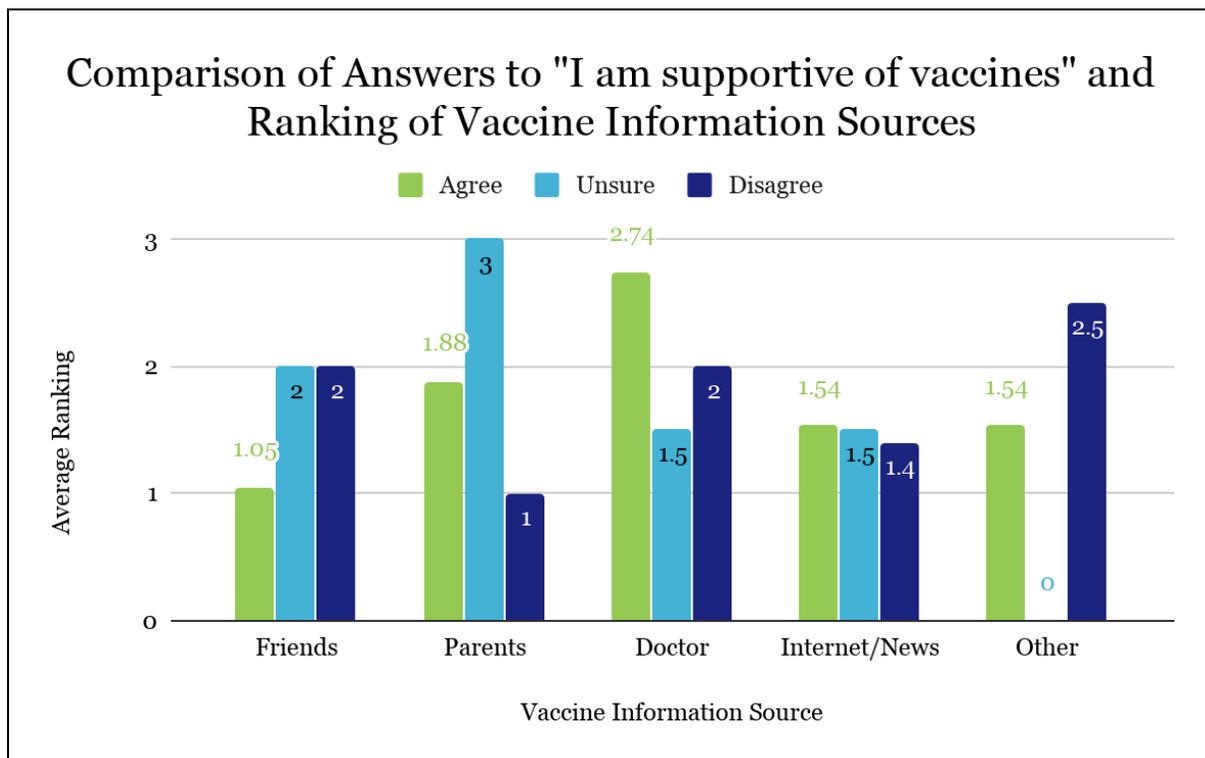


Figure 7. Comparison of answers for “I am supportive of vaccines” (with groupings made of agree, unsure, or disagree) to average rankings for each of the following vaccine sources.

Answers for question 2.3 “my parents are supportive of vaccines (disagree/unsure/agree)” were compared with answers for question 3.1 “I received vaccines as a child.”

Comparing Answers to Question 2.3 and Perceived Parental Support of Vaccines

		No, I did not receive vaccines as a child	Yes, I did receive vaccines as a child
Question 2.3 “My parents are supportive of vaccines”	Disagree	100%	0.8%
	Unsure	0%	6.40%
	Agree	0%	92.80%

Table 1. Comparison of answers for questions 2.3 “my parents are supportive of vaccines” and question 3.1 “I received vaccines as a child.”

Answers to questions 2.1 and 2.3 “I am supportive of vaccines” and “my parents are supportive of vaccines” were analyzed together for the purpose of comparing students opinions of vaccines to the perceived opinions of their parents, as seen in table 2. While completing this analysis, it was also found that 65.87% of individuals ranked their and their parents’ vaccine opinion as exactly the same (example rank of 6 and 6).

Comparing Personal Vaccine Support and Perceived Parental Vaccine Opinion

		Question 2.3 “My parents are supportive of vaccines.”		
		Disagree	Unsure	Agree
Question 2.1 “I am supportive of vaccines”	Disagree	0.8%	1.6%	1.6%
	Unsure	0.0%	0.8%	1.6%
	Agree	0.8%	4.0%	88.7%

Table 2. Comparison of answers for questions 2.1 and 2.3 “I am supportive of vaccines” and “My parents are supportive of vaccines.”

Table 3 analysis was for the use of comparing answers to question 3.5, “I have received my flu shot this year” and question 4.7 “I do not need to receive my flu shot each year.”

Comparing Flu Vaccine Attainment and Answer to Question 4.7 on Flu Vaccine Yearly Necessity

		Question 3.5 “I have received my flu shot this year.”	
		No, I have not received my flu shot this year	Yes, I have received my flu shot this year
Question 4.7 “I do not need to receive my flu shot each year”	Disagree	30.0%	71.7%
	Unsure	26.3%	15.2%
	Agree	43.8%	13.0%

Table 3. This table was used to compare individual answers for question 3.5 “I have received my flu shot this year (yes/no)” and question 4.7 “I do not need to receive my flu shot each year (true/false/unsure).”

Chapter 4: Discussion

This study sought to understand the opinion of college students on vaccines, what resources they feel they use to gain vaccine information, and their current level of understanding of vaccines. The first question in the survey aimed to understand if a representative sample of Oregon State\college students by age had been sampled. This data was used to separate respondents based on age grouping with 18-22 being considered a more traditional college student and 35+ being considered more non-traditional students. The purpose of this was to find if there were any age related variances in vaccine opinion.

The data collected were 69.8% 18-22, 19.8% 23-34, and 10.3% 35+. From data collected for Fall 2018 at Oregon State, 77.6% of students were under the age of 25 and 22.4% were over 25. Therefore, it was concluded that our population sampled was relatively representative of a college student population, specifically the Oregon State student population (“Enrollment and Demographic Reports.”)

For question two, students were asked to rank their agreement for three statements using a one to six scale. For the purpose of making the analysis more readily understandable and for the purpose of being able to draw conclusions from the data, the rankings of one through six were grouped into three categories of disagree, unsure, and agree. Rankings of one and two (meaning strongly disagree or somewhat disagree) will be considered as one category known as “disagree.” An answer of three, which represents unsure, will now represent the group “unsure,” and answers of four, five, and six, representing answers of somewhat agree, agree, and strongly agree, will now be grouped into one category called “agree.” This was completed for the purpose of simplifying the analysis. Limitations of this strategy will be discussed later in this section.

The second survey question was based upon individual vaccine opinions as well as perceived opinion of their parents. This question also assessed individual support of non-medical vaccine exemptions. Overall for the study, 93.54% of respondents ranked their opinion of vaccines as a four, five, or six, which was grouped into an “agree” category. For non-medical vaccine exemptions for school attendance, 45.2% disagree and 29.4% agreed with the use of these exemptions. This suggests there is less support for non-medical vaccine exemptions for school attendance among college students. Lastly, for parental opinion on vaccines, 93.1% agreed and felt that their parents were supportive of vaccines. However, it must be noted that this is a perceived opinion because the answer is based on what the student thought their parents opinion was. Furthermore, 2.4% of individuals disagreed with that statement and felt their parents were not supportive of vaccines. This suggests that a majority of college students sampled were themselves supportive of vaccines and a majority also felt that their parents were supportive of vaccines.

Survey question three sought to understand the demographics of individuals who responded to the survey in terms of vaccine attainment. The first question was to understand if individuals whose parents chose not to vaccinate them as a child were involved in the survey. With only 1/126 respondents stating that they did not receive vaccines as a child, it was concluded that the study was lacking in representation of individuals whose parents chose not to vaccinate them while growing up. Therefore, no further analysis could be completed on this aspect of the survey. Furthermore, 84.9% of individuals stated that they got some of the required vaccines (Ex. MMR, Meningococcal, Varicella, TDAP, Hepatitis B) prior to admissions to OSU and only 20.6% received the required vaccines for the purpose of OSU attendance only. Seven

out of 126 respondents (5.56%) stated that they had received a vaccine exemption from OSU, however, the study did not inquire on the type of exemption obtained, whether medical or personal belief/religious exemption. Lastly, 63.4% of individuals stated that they had not received their flu shot this year. The answer to this question was later correlated to an individual's response to question 4.7 (I do not need to receive a flu shot each year true/false/unsure) which will be further discussed.

Question four involved common misconceptions in order to determine how much college students understood about vaccines. The purpose of these questions was to determine the level of knowledge about vaccines or vaccine misinformation that college students have that could be corrected through suggested measures. The answers to these questions were true, false, or unsure. Each question had a definitive correct answer (either true or false) and evidence for information for determination of the correct answer for each statement can be found in the second chapter of this thesis. All statements had a correct answer of false except for statement six "Oregon has rates of unvaccinated school children higher than national averages," which is a true statement. As seen in figure four of the results section, question 4.2 ("It is better to space out vaccines than to administer them all at once") received the incorrect response the most amount of times with 54.4% of individuals that answered this question stating the incorrect answer and only 19.2% answering correctly. The basis of this question was the common misconception that individuals should follow an "alternative vaccine schedule" by spacing out the administration of vaccines as opposed to following the CDC recommended schedule. However, after reviewing the survey question, it is noted that the wording of this statement was likely unclear and confusing to respondents and is being taken as an error on the side of question wording. Furthermore, the

question was not worded in a way to accurately assess the target misconception, supporting its removal from the following analysis. Three other questions had less than 50% of individuals with the overall correct answer, one of which was question 4.1 (44.4% correct) : “Too many vaccines can overwhelm the immune system,” also based on the misconception that you should space out your vaccines and that administering too many vaccines at once can weaken the immune system. The next question with less than 50% of respondents answering correctly (31.0% correct) was statement 4.6: “Oregon has rates of unvaccinated school children higher than the national average.” The last question with less than 50% of respondents answering correctly was 4.7 (45.2% correct): “I do not need to receive the flu vaccine each year.” Answers to 4.7 were correlated with individual answers to question 3.5 from the previous section which stated “I received my flu vaccine this year.” Data for this correlation can be found in table 3 of the results section. Lastly, from this section of the survey, we can see the need for increased vaccine safety education due to the several questions that had less than 50% of respondents selecting the correct answer.

Question five sought to determine where students felt they were obtaining their vaccine information. Forty eight percent of respondents indicated that they got a substantial amount of their vaccine information from their physician (as indicated by ranking “doctor” as a three on the zero to three scale used) followed by 44.19% of individuals stating they obtained a substantial amount of their vaccine information from “other” sources. Furthermore, 27.6% of individuals stated they received a substantial amount of vaccine information from their parents, 17.80% reported substantial information from the internet/news and lastly, 5.30% reported a substantial amount of information from their friends. This data suggests that most people report attaining the

most information from their doctor, which is a positive sign as physicians have the best knowledge to educate on vaccines.

Lastly, question six was an optional question that individuals could answer regarding any other source they felt they had gotten adequate vaccine information from or any other vaccine concerns they had. Many individuals discussed other places where they gathered information from and many stated science classes at OSU. These were some of the most common words used in this section. It was also determined that all eight individuals who listed OSU class/science classes as an alternative source of vaccine information stated that were strongly supportive of vaccines.

Further comparisons were completed to analyze the number of overall questions individuals answered correctly or incorrectly by age group and overall. For this analysis, statement two of question four (“It is better to space out vaccines than to administer them all at once”) was omitted due to the high percentage of individuals answering the question incorrectly, which was discussed earlier in this section. Therefore, to determine the average percentage of statements answered correctly, this statement was omitted and only six of the seven statements were included in this count. As can be seen from figure six of the results section, the age group 18-22 answered the highest percentage of answers correctly with, on average, individuals answering 59.8% of the questions correctly. The 23-34 and 35+ age groups answered 40.1% and 41.0%, on average, of questions correctly. This may suggest that vaccine information efforts may need to be more targeted to more “non-traditional” students however, ideally, individuals would have the knowledge of these statements and therefore, it is still suggested that vaccine education be target to all college students equally. Furthermore, as discussed earlier, only seven

respondents of the survey were a part of the 35+ age group, therefore not enough individuals are involved in this sample to make accurate conclusions. On average, individuals answered 54.10% of the statements correctly. This suggests the need for increased vaccine education on these topics.

Figure seven in the results section compared answers to question 2.1 “I am supportive of vaccines” and their responses to where they felt they were gathering their vaccine information from. For individuals who reported that they were supportive of vaccines, these individuals most often ranked “doctor” as a source of a substantial amount of their vaccine information. Individuals who agreed with vaccines also reported the least amount of their vaccine information came from their friends. Individuals who were not supportive of vaccines ranked, on average, “other” sources as the place where they received the majority of their vaccine information. Individuals who disagreed with vaccines reported that, on average, the least amount of their vaccine information was received from their parents.

An analysis was completed to compare answers to question 2.3 “my parents are supportive of vaccines” and question 3.1 “I received vaccines as a child.” A generalization made by this study initially was that individuals who do not support vaccines are unlikely to vaccinate themselves and their future children and that is why accurate vaccine education is necessary. This analysis sought to support this assumption. It was also found that 100% of students who subjectively felt their parents were unsupportive of vaccines had not received vaccines as a child. However, as discussed earlier, there was only one respondent who stated they had not received vaccines as a child. Therefore, no conclusion can be drawn from this point of the data. For individuals that felt their parents were likely supportive of vaccines, 92.80% stated that they had

received vaccines as a child. The high percentage of individuals that perceived their parents support of vaccines while also reporting they had received vaccines as a child provides evidence in support of the assumption that if someone is supportive of vaccines, they are more likely to choose to vaccinate. Therefore, accurate vaccine safety knowledge will hopefully make an individual more supportive of vaccines and encourage them to vaccinate.

Question 2.1 “I am supportive of vaccines” and question 2.3 “my parents are supportive of vaccines” aimed to determine if there was any correlation between an individuals’ opinion of vaccines and what they felt their parents opinion of vaccines was. Those that stated they disagreed with vaccines and that they felt their parents disagreed with vaccines represented 0.8% of respondents. However, those that were supportive of vaccines and felt that their parents were supportive of vaccines represented 88.7% of the individuals surveyed. This could suggest a possible correlation between individuals who were raised by parents they felt were supportive of vaccines and subsequently being supportive themselves, however, this cannot be confirmed because this study relied on students' perceived parental vaccine opinion. Still, it can be suggested that there is a possible link between parental vaccine support and their children subsequently being supportive of vaccines.

A final analysis that was completed was to compare answers to question 3.5 “I have received my flu shot this year” and question 4.7 “I do not need to receive my flu shot each year.” This was completed to support the notion that those with accurate vaccine information and understanding are more likely to choose to vaccinate. The most common answer for individuals who reported they had not received their vaccine this year was “agree” to the statement “I do not need to receive my flu shot each year” (43.8%). As discussed earlier, the CDC recommends that

all individuals six months and older receive a flu shot each flu season, suggesting that those who had not received their flu shot and felt you did not need your flu shot each year may be unaware of this information. However, still 30.0% of individuals who had not received their flu shot each year understood that they do need to receive a flu vaccine by disagreeing with the statement. Furthermore, individuals who answered yes, they had received their flu shot this year were more likely to disagree with the statement that they did not need to receive their flu shot each year. This was confirmed with 71.7% of individuals who had received their flu shot correctly answering that everyone should receive their flu shot every year.

Chapter 5: Conclusion

This study sought to answer several key questions to understand college student vaccine opinion. These questions include: Where are college students gathering their vaccine information? How are college students responding to common misconceptions about vaccines? This information was synthesized into key points that can then be used to address vaccine hesitancy and individual concerns about vaccines from the spread of misinformation. First, it was determined that vaccine misconceptions were common among college students with many individuals answering incorrectly in the fourth section on vaccine literacy. On average, individuals answered only 54.1% of statements correctly. Next, it was found that many individuals who did not receive their flu vaccine this year did not believe they needed to receive it every year (43.8%). This incorrect belief that you do not need to receive your flu vaccine each year likely does not encourage individuals to receive their flu vaccine. Next, it was determined that many individuals felt that a substantial amount of their vaccine information was coming from their doctor (48%) and many also felt that a substantial amount of their vaccine information came from “other” sources. Individuals who answered the optional 6th question stated that the “other source” they received vaccine information from was OSU science classes. It was also noted that individuals who felt that their parents were supportive of vaccines reported having received vaccines as a child. This suggests a link between the assumption used for this study that if individuals are supportive of vaccines, they will be more likely to vaccinate their children. Of participants that stated they had received their vaccines as a child, 92.80% felt that their parents were likely supportive of vaccines.

It was also found that individuals who agreed with vaccines also felt that their parents were likely supportive of vaccines (88.7%). Although a link cannot be confirmed due to the subjective rankings of a respondents' parents' opinion, it can be thought that a connection may exist between vaccine opinion and perceived parental opinion. Furthermore, 65.87% of individuals surveyed ranked their opinion and their parents perceived opinion as exactly the same value on the one to six scale used. This also suggests there may be a relationship between perceived parental opinion and personal vaccine opinion.

Some suggestions that could be used to help address vaccine hesitancy would be to add a vaccine section to the curriculum of the required HHS 231 course that all undergraduate students must meet. This would allow vaccine information to reach a wider audience. Furthermore, as can already be seen at some locations in Student Health Services (SHS), encouraging students to get their flu vaccines and offering them information on vaccine safety should be further advertised. The main point to be taken from this study is that student opinion of vaccine is often similar to their perceived opinion of their parents vaccine support. Offering students vaccine information in several outlets can encourage students to gather further information on vaccines and discourage the spread of misinformation.

Some limitations of this study were the sample size. A voluntary response sample was sought due to difficulty in being able to randomly sample individuals. If a larger sample size was obtained, the responses could then be sampled from but it was not determined that a large enough sample size was obtained to utilize this method. Although a representative-like sample of the OSU population was obtained, better representation in each of the age groups (specifically 35+) would have allowed more analysis to be done to determine if there were age differences in

individual opinions. Some trends were noted in the data but determined that the sample size of only seven for 35+ was not enough to make definitive conclusions between age groups. Furthermore, 24 professors were contacted but this further limits the sample size to individuals in these classes. Another limitation of this study would be possible misunderstanding of the wording of several of the statements. For example, the questions in section four, “it is better to space out vaccines than to administer them all at once” may have been confusing to individuals. Another limitation of this study is that it was not feasible to specifically ask participant parents about their vaccine opinions. Some individuals may have asked their parents what their vaccine opinions are or others may have just inferred from past experiences.

A final limitation of this study was the necessity to group responses of one through six for section two of the survey into three distinct groups of agree, disagree, or unsure. The limitations of this is due to someone reporting that they “somewhat agree” and someone reporting “strongly agree” to the same statement are now grouped into the same category, even though they may have different strength of their views. This was done to analyze the data and draw more clear conclusions. In a repeat survey, instead of having individuals scale their responses from one to six, an agree/disagree/unsure format would be used.

Areas of further research would be to use more open ended questions to further see what thoughts students have on vaccines and what other misconceptions are common. Conversely, research could look at comparing parents and students opinions before and after the student has received some type of pamphlet or lesson on vaccine information and see if the students opinion wavers at all from their initial opinion of vaccines. More information could be obtained to look closely at age specific vaccine opinion differences. Since the current target for the overall

vaccine campaign is trying to encourage parents to vaccinate their school age children, looking at age specific differences could give some insight into why parents may choose not to vaccinate.

In conclusion, this study sought to understand college student vaccine opinion and commonality of vaccine misconceptions. To prevent outbreaks from affecting more vulnerable populations, vaccine hesitancy and the spread of misinformation must be addressed.

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- Disease rates have decreased due to better hygiene and nutrition and not vaccines.

True	False	Unsure
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- Oregon has rates of unvaccinated school children higher than national averages.

True	False	Unsure
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- I do not need to receive the flu vaccine each year.

True	False	Unsure
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5. Vaccine information: Please circle a number from 0-3 on the following statements with 3 representing substantial and 0 being none.

- How much information on vaccines have you received from the following sources?

Friends				
3	2	1	0	
Parents				
3	2	1	0	
Doctor				
3	2	1	0	
Internet/news				
3	2	1	0	
Other (if so, please specify)				
3	2	1	0	

6. (Optional) In the following section, please provide any positive/negative experiences you have had with vaccines and any hesitations you may have about vaccines.

Appendix B



Oregon State University
Research Office

Human Research Protection Program
& Institutional Review Board
8308 Kerr Administration Bldg, Corvallis OR 97331
(541) 737-8008
IRB@oregonstate.edu
<http://research.oregonstate.edu/irb>

Date of Notification	09/07/2018		
Notification Type	Approval Notice		
Submission Type	Initial Application	Study Number	8647
Principal Investigator	Courtney Campbell		
Study Team Members	Bailey Reynolds		
Study Title	An Investigation into the Formation of Vaccine Opinions and Attitudes in College Students		
Review Level	FLEX		
Waiver(s)	Documentation of Informed Consent		
Risk Level for Adults	Minimal Risk		
Risk Level for Children	Study does not involve children		
Funding Source	None	Cayuse Number	N/A

APPROVAL DATE: 09/07/2018

EXPIRATION DATE: 09/06/2023

A new application will be required in order to extend the study beyond this expiration date.

Comments:

The above referenced study was reviewed and approved by the OSU Institutional Review Board (IRB). The IRB has determined that the protocol meets the minimum criteria for approval under the applicable regulations, state laws, and local policies.

This proposal has not been evaluated for scientific merit, except to weigh the risk to the human subjects in relation to potential benefits.

Adding any of the following elements will invalidate the FLEX determination and require the submission of a project revision:

- Increase in risk
- Federal funding or a plan for future federal sponsorship (e.g., proof of concept studies for federal RFPs, pilot studies intended to support a federal grant application, training and program project grants, no-cost extensions)
- Research funded or otherwise regulated by a [federal agency that has signed on to the Common Rule](#), including all agencies within the Department of Health and Human Services
- FDA-regulated research
- NIH-issued or pending Certificate of Confidentiality
- Prisoners or parolees as subjects
- Contractual obligations or restrictions that require the application of the Common Rule or which require annual review by an IRB
- Classified research
- Clinical interventions