COMPLIANCE RATES OF RECOMMENDED VACCINES AMONG MIDDLE SCHOOL STUDENTS

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Abstract

This study evaluated the vaccination rates of recommended vaccines in middle school aged adolescence. The study looked at one middle school consisting of students in 6th, 7th, and 8th grades. The recommended vaccines include the human papillomavirus vaccine (HPV) and Meningococcal vaccine (MCV). Vaccination rates of required vaccines were not included in this study. Required vaccines for adolescences in grades 7-12 in the state of Kansas include; Tdap (Tetanus, diphtheria, pertussis), IPV (Polio), MMR (Measles, Mumps, Rubella), Varicella (Chickenpox), and Hepatitis B. This study also does not evaluate the rates of influenza vaccinations which is a recommended annual vaccine.

A sample of 888 students was assessed to compare the compliance rates of one single Kansas school district with data from regional and national reports. This data was collected from USD 475 Junction City Middle School. Gender of the students was not revealed in the collected data, so sex determination between regional and national data was also omitted.

The vaccination rates of HPV and MCV are important for public health. Even though these vaccines are not required, they can prevent very serious diseases among middle school aged children and even into adulthood. Results from this study indicate that vaccine coverage with HPV and MCV are decreased in USD 475 and Kansas when compared to the national data. Future efforts of intervention should be considered to increase the overall compliance of obtaining both vaccines to prevent further disease transmission.

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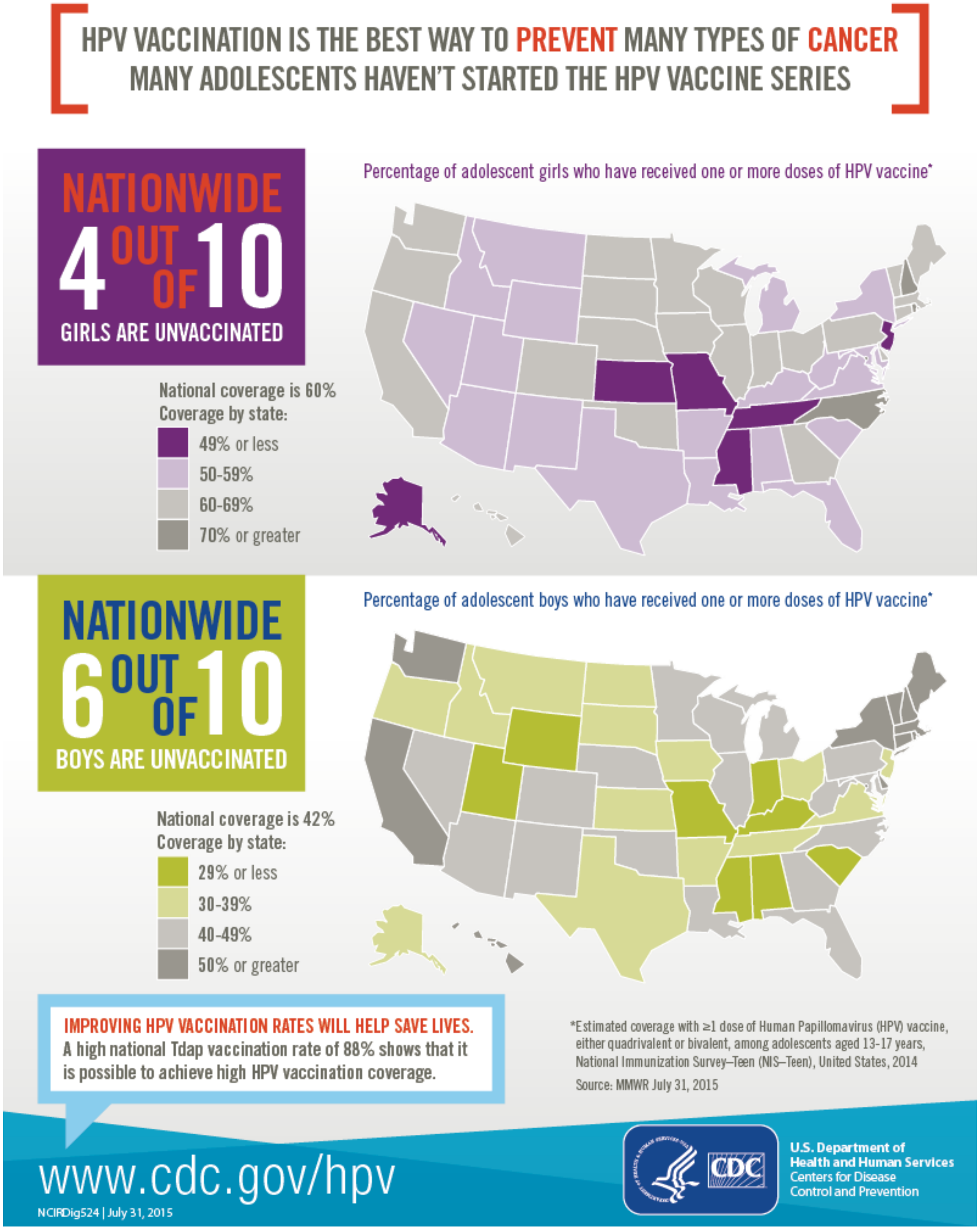
Chapter 1: Introduction

This study focused on the students of Junction City Middle School, USD 475. The purpose of this study was to examine the vaccination rates of HPV and MCV in adolescents aged 13 to 17 years old, and to suggest tactics to raise these rates. The original intent was to gather data from Fort Riley, where the field experience was completed. However, I was unable to receive permission to obtain the student vaccination records.

Colonel Paul Benne, Chief of the Department of Public Health at Fort Riley, voiced concerns regarding the vaccination compliance rate of adolescents on base, particularly the HPV and MCV vaccinations. This information surprised me, considering that these vaccinations are available free of charge to all soldiers and their families.

Kansas has the lowest rate of HPV vaccination for females in the United States. According to the National Immunization Survey, only 38.3% of girls in Kansas are vaccinated for HPV. Less than 49% of girls aged 13-17 have received the first shot (in a three-shot series) to protect against HPV. For males living in Kansas, only 30-39% have received one or more HPV vaccinations in the series. Total United States statistics show that four out of every ten girls and six out of every ten boys between the ages of 13-17 are unprotected against HPV.

Figure 1: Nationwide Low HPV Vaccine Coverage



(www.CDC.gov)

Meningococcal Vaccine (MCV) national average coverage was 79.3% in 2014. According to the National Immunization Survey of Teens, Kansas rates below the national level with 65.1% vaccinated. Kansas is in the bottom 18% of United States average. States with lower coverage rates than Kansas include: Arkansas, Iowa, Missouri, Montana, South Dakota, Alaska, Wyoming, and finally, Mississippi with the lowest, 46% vaccination rate for MCV.

National data indicates that Kansas is on the low end of coverage for both HPV and MCV vaccines. This low percentage is a major concern for public health because these vaccines prevent diseases such as meningococcal disease, which can cause meningitis, and human papillomavirus, which has been linked to cervical cancer. Further research is necessary to determine the reasons for such low coverage, particularly at Fort Riley, Kansas, where the immunizations are free.

As of August 22, 2019, the Kansas Department of Health and Environment (KDHE) released a report showing Kansas vaccination rates for HPV and MCV have improved dramatically. Surveys show teens aged 13-17 have increased rates of HPV immunization from 34.4% in 2014 to 62.3% in 2018. Teens aged 13-17 have increased rates of MCD immunization from 72.1% in 20014 to 73.5% in 2018. KDHE reports this increase in coverage is due to programs dedicated to educating the public as well as health provider intervention (Pankratz, 2019).

Human Papilloma Virus:

There are over 150 viruses in the human papillomavirus family. All HPV viruses are double stranded DNA viruses, each of them differing by the genetic sequence found in the outer capsid protein L1. The name “papillomavirus” stems from the warts seen in many infections including genital warts and cutaneous warts (skin warts). HPV is the cause of many types of cancer, including cervical cancer. Human papillomavirus is the most common sexually transmitted infection in the United States, and possibly the entire world. The virus can be spread through vaginal, anal, and oral sexual interactions. Typically, there are no outwardly apparent signs or symptoms seen with contracting HPV (Human Papillomavirus (HPV), 2017).

The type of HPV that causes genital warts has a different genetic sequence in the capsid protein than the form of HPV that causes cancer. HPV types 16 and 18 are the cause of 70% of all cervical cancers (Epidemiology and Prevention of Vaccine-Preventable Diseases, 2016). Other types of HPV are also the cause of cancers of the vulva, penis, anus, and oropharynx. These cancers take years or decades to develop after the initial exposure to HPV. Types 6 and 11 are the cause of 90% of genital warts outbreaks in the United States (Epidemiology and Prevention of Vaccine-Preventable Diseases, 2016).

There are HPV tests to screen for cervical cancer. However, these tests are available for women aged 30 and over, and screening women under the age of 30 for HPV is not recommended. Women between the ages of 21 and 30 are urged to receive a PAP smear every three years to test for abnormal cervical cells. Women over the age of 30 are advised to receive a PAP smear and HPV test every five years. There are no tests to detect HPV in men (HPV and HPV Testing, 2017).

Most people who are infected with HPV do not know they have been exposed and may never develop signs or symptoms. There are approximately 79 million Americans currently infected with HPV, with 14 million new cases every year. Between 340,000 and 360,000 Americans seek treatment for genital warts every year. There are likely more cases of genital warts being contracted as not all individuals choose to seek treatment. Over 11,000 women in the United States get cervical cancer each year due to HPV. Approximately 17,600 women and 9,300 men are diagnosed annually with other types of cancer (vaginal, penile, anal, or oropharyngeal) due to human papillomavirus (Human Papillomavirus (HPV), 2017).

Human Papilloma Virus Vaccines:

There are currently three vaccines licensed for HPV in the United States: HPV2, HPV4, and HPV9. Each of these is a non-infectious subunit vaccines. The antigen of these vaccines is derived from the L1 major capsid protein from human papillomavirus. All three vaccines are VLP (virus-like particles), which causes an immune response from the host.

HPV2 is a bivalent vaccine. Its brand name is called Cerverix, created by the company GlaxoSmithKline. Cerverix was approved by the Food and Drug Administration in 2009. This vaccine is recommended only for females ages 9 to 26 years. HPV2 covers HPV type 16 and type 18, the two most common types linked to causing cervical cancer. Each 0.5mL dose of Cerverix contains 20 micrograms of HPV type 16 L1 protein and 20 micrograms of HPV type 18 L1 protein. This vaccine contains no preservatives or antibiotics (Human Papillomavirus (HPV), 2017).

HPV4 is commonly known for its brand name, Gardasil. It is a quadrivalent vaccine created by Merck, approved by the FDA in 2006. HPV4 is approved for males and females as young as 9 years old up to age 26. In addition to protecting against the leading HPV strains for cervical cancer, Gardasil protects against HPV strains 6 and 11, the major cause of genital warts infections. In a 0.5mL dose of Gardasil there are: 20 micrograms of HPV type 6 L1 protein, 40 micrograms of HPV type 11 L1 protein, 40 micrograms of HPV type 16 L1 protein, and 20 micrograms of HPV type 18 L1 protein. Gardasil also contains alum, an aluminum salt adjuvant. Other listed ingredients of Gardasil include Sodium chloride, L-histidine, polysorbate 80, and sodium borate. No preservatives or antibiotics are added to Gardasil (Human Papillomavirus (HPV), 2017).

HPV9 was approved by the FDA in 2014. It was created by Merck and offers the same protection as Gardasil with added protection against other high-cancer-risk strains of HPV. Its brand name is Gardasil9, which covers the same HPV types as the original Gardasil as well as strains 31, 33, 45, 52 and 58 (Human Papillomavirus (HPV), 2017).

All three of these vaccines are known for their effectiveness to create an immune response. Seropositivity of 100% and 91% was sustained for HPV-16/18 antibodies following extended follow-up phase of 9.5 years in randomized control trials (Vincenzo R.D., 2014). 99% of recipients who complete the series of 3 shots produce antibodies after one month of the final injection. Vaccinations are administered intramuscularly. It is recommended that the second shot in the series to be given one to two months after the first dose. The 3rd vaccination should be completed six months after the first shot.

Sexually active individuals who have never been infected with any strain HPV will receive full benefit from this 3-shot-series vaccination. These vaccines have fewer benefits for individuals who have already been infected with HPV, as the vaccine will only protect against the strains of HPV specific to the L1 protein types (Human Papillomavirus (HPV), 2017). For example, if an individual was infected with HPV type 16 L1 protein before being vaccinated, then that individual would not be protected against that specific strain but could be protected from other strains covered by the same vaccine.

Meningococcal Disease:

Meningococcal disease is caused by the bacterium *Neisseria meningitidis*. *N. meningitidis* is an aerobic gram negative diplococcus, with a polysaccharide capsule that creates resistance to phagocytosis. Differences in the polysaccharide capsule create the five serogroups of *Neisseria meningitidis*. These serogroups are known as; A, B, C, W, and Y. The strains that cause the most illness are B, C and Y, reportedly each causing approximately one-third of disease outbreaks (Cohn AC, 2013).

Meningococcal disease is spread by respiratory and throat sections when people are in close contact with one another. Approximately 10% of adults carry *N. meningitidis* in their nasopharynx without causing disease (Epidemiology and Prevention of Vaccine-Preventable Diseases, 2016). Meningococcal disease is commonly spread among individuals who share the same household or living space. Because this disease is easily spread in high density populations, all United States military personnel are required to receive meningococcal vaccination as well as many college students who choose to reside in dormitories. In 20016, Kansas State University mandated vaccination for *N. meningitidis* for all incoming students who would be living in student housing (Kansas State Vaccine Requirements, 2018). A wavier must be signed if the student refuses to be vaccinated.

One form of meningococcal disease is meningitis. This occurs when the meninges of the brain and spinal cord produce an inflammatory response as a result of infection. Approximately a thousand cases of meningitis are diagnosed in the United States are diagnosed each year. Symptoms manifest three to seven days after exposure, and include: headache, fever, neck stiffness, nausea, vomiting, and photophobia. Fatality rate of meningitis is 10-15%. Individuals who recover from meningitis may experience permanent symptoms such as hearing loss or brain damage (Meningococcal Disease, 2017).

Another form of meningococcal disease is meningococcemia. Meningococcemia is a rare form of infection which occurs in 5-20% of individuals with meningococcal disease. It occurs when *Neisseria meningitidis* infects the bloodstream. Lipopolysaccharides of the outer membrane of *N. meningitidis* act as an endotoxin which damages blood vessels and red blood cells. This destruction causes organ hemorrhage, fatal in 40% of meningococcemia cases. Symptoms include: fever, fatigue, cold chills, vomiting, body aches, and in later stages of infection, dark purple rashes. Individuals who survive meningococcemia may require amputations due to severe tissue damage (Meningococcal Disease, 2017).

Aside from the common sequelae of meningococcal disease, *N. meningitidis* may also cause pneumonia, arthritis, otitis media, and in rare cases, epiglottitis. These conditions are diagnosed in 2% to 10% of patients with meningococcal disease, and are still considered serious affects (Meningococcal Disease, 2017).

Meningococcal Vaccines:

The first meningococcal polysaccharide vaccine was approved in the United States in 1971. This vaccine only covered one of the five major strains of ***N. meningitidis*.** In 1981, the first quadrivalent vaccine was approved under the name Menomune. Menomune is a polysaccharide vaccine made by Sanofi Pasteur which covers subtypes A,C,W, and Y and also contains a lactose stabilizer. The quadrivalent polysaccharide vaccine is available in single dose vials and 10-dose vials. Both forms use sterile water as a diluent but the 10-dose formula also contains thimerosal as a preservative. Menomune is given subcutaneously and is approved for individuals two years of age and older. This vaccine has an estimated 85% efficacy through clinical trials involving school-aged children and adults (Cohn AC, 2013). Due to the wide subtype coverage of Menomune, the originally approved *N. meningitidis* vaccine is no longer used.

In recent years, three meningococcal conjugate vaccines have been approved. Menactra, Menveo, and MenHibrix all have a polysaccharide-protein component to elicit a stronger immune response than using the polysaccharide alone (Control and Prevention of Meningococcal Disease, 2001). Both Menactra and Menveo are single component vaccines which cover *N. meningitidis* serogroups A,C,W, and Y. MenHibrix is a combination vaccine which covers serogroups C and Y as well as *Haemophilus Influenzae* type B. All three meningococcal conjugate vaccines are administered intramuscularly.

Menactra was created by Sanofi Pasteur and was approved by the FDA in 2005. This conjugate vaccine uses diphtheria toxoids to combine with the polysaccharides for a stronger immune response. Each 0.5mL dose of vaccine contains 4 micrograms of each A, C, W, and Y meningococcal polysaccharides all suspended in a phosphate buffered saline. Menactra is approved for individuals aged nine months to fifty-five years of age. No preservatives or adjuvants are added to this vaccine (Meningococcal Disease, 2017).

Menveo by Novartis was the second meningococcal conjugate vaccine developed, approved in 2010. This vaccine utilizes CRM197 as a carrier protein for polysaccharide antigens. CRM197 is a mutation of diphtheria toxin with an amino acid substitution to render it non-toxic. Each 0.5mL dose of vaccine contains 10 micrograms of serogroup A and 5 micrograms of each C, W, and Y serogroups all conjugated with CRM197. These antigens are suspended in a phosphate buffered saline solution with no preservatives or adjuvants added. Menveo is approved for individuals two months to fifty-five years of age (Meningococcal Disease, 2017).

MenHibrix was approved in 2012, created by GlaxoSmithKline. This vaccine uses tetanus toxoid as a carrier for polysaccharide antigens. Each dose of MenHibrix contains 5 micrograms of each *N. meningitidis* serogroups C and Y. The vaccine also contains 2.5 micrograms of *H. Influenzae* serotype B bound to tetanus toxoid to create a stronger immune response. Each dose is lyophilized and needs to be reconstituted with 0.9% saline solution before injection. MenHibrix is approved for children 6 weeks to 18 months of age and is approved as a four-series shot (Meningococcal Disease, 2017).

Recent studies have found a decrease in circulating antibodies three to five years after a single injection with Menactra or Menveo. As a result, it is recommended that individuals receive a booster shot at 16 years of age (Meningococcal Disease, 2017). Individuals classified as high risk should be vaccinated every 5 years throughout their lifetime. High risk individuals include microbiologists, military personal, and people traveling or residing in sub-Saharan Africa known as the “meningitis belt”. The Kansas Department of Health and Environment (KDHE) now require students beginning 7^{th} and 11^{th} grade to have one dose of MCV. These changes took effect August 2^{nd}, 2019 (Pankratz, 2019).

Neither the quadrivalent polysaccharide vaccines nor any of the meningococcal conjugate vaccines protect against *N. meningitidis* serogroup B. This strain is rarely identified in outbreaks but is known to cause severe disease and mortality. Serogroup B is a diverse group, which creates a challenge for development of vaccine. There are currently two vaccines for serogroup B available in the United States: Trumenba and Bexsero. Trumenba was created by Pfizer, approved in 2014. This vaccine uses a specific protein on the surface of meningococci, fHBP, as an antigen (Center for Biologics Evaluation and Research, 2018). Bexsero was created by Novartis, approved by the FDA in 2015. This vaccine also uses surface proteins of *N. meningitidis* to create an immune response. The proteins in Bexsero include: fHBP, NHBA, NadA, and PorA. Both Trumenba and Bexsero are administered intramuscularly. Neither vaccine has conformation of effectiveness, being relatively new to consumers (Racloz, 2010). Both Trumenba and Bexsero are approved for individuals 10 through 25 years of age. Vaccination against serotype B is only recommended for situations with high risk of exposure due to limited studies gauging effectiveness and the high cost of either vaccine.

Antimicrobial chemoprophylaxis is strongly recommended in cases of meningococcal outbreak where individuals aren't protected through vaccine. Rifampin, ciprofloxacin, and ceftriaxone are the three most common antibiotics used to stop the spread of meningococcal disease. These drugs are 90-95% effective in reducing the spread of *N. meningitidis*. Anyone living in the same household as an affected individual should seek antimicrobial treatment within 24 hours of contact. Child care centers are high risk locations for the spread of meningococcal disease. Any individual who comes in contact with saliva or respiratory secretions from a person who has been diagnosed with meningococcal disease should seek chemoprophylaxis. Sporadic resistance to these antimicrobials have been seen globally but has been seen rarely in the United States (Meningococcal Disease, 2017).

Standard Operating Procedures for Immunizations at Fort Riley:

These Standard Operating Procedures apply to children and adolescence enrolled in educational facilities at Fort Riley. These facilities include Child Development Service, School Age Service, and Youth Services. These Standard Operating Procedures apply to individuals aged 0 to 18 years of age.

All children enrolled in Fort Riley Schools must have documentation of immunization based on the Advisory Committee on Immunization Practices and the State of Kansas Public Health Services. Documentation is required for all age appropriate immunizations in agreement with the most recent Center for Disease Control immunization guidelines. A current photocopy of student immunization records must be provided by parents. Every immunization needs to include a stamp, date, and signature to confirm the requirements have been met. The educational facility directors are responsible for updating student immunization records and removing old or outdated vaccination records. If a child or adolescent isn't up-to-date on vaccinations at the time of registration, there must be documentation written by a health professional including a schedule to update immunizations in compliance with the guidelines provided by the Center for Disease Control (CDC). Exemptions are allowed for medical reasons only, and must be documented by a physician. Religious exemptions acknowledged by clergy are also considered but is ultimately up to the Chief of the Department of Public Health on the Base of Fort Riley. Parent preference is not considered in immunization exemption. A written waver is required, approved by the Chief of the Department of Public Health, for all legitimate exemptions. Parents of children with approved waivers must be counseled on the possibility that their child could be withdrawn from school in the event of vaccine preventable communicable disease outbreak.

Parents of children or adolescence with negligent immunizations, and without an approved waiver will be given a ten-day notice to update immunizations. Failure to comply within the ten days will result in suspension of the student until all immunizations are up to date. Failure to keep current immunizations could endanger the health of the student as well as other students in the educational facility.

Chapter 2: Methods

During my first meeting with Colonel Benne, I learned of the struggles Fort Riley was facing in compliance rates of non-mandatory immunizations. I agreed to make this topic my priority while completing my field experience at Fort Riley. I contacted many administrators at the middle school requesting documentation of vaccine rates; nevertheless, was denied access to student records even if the data could be anonymized. Due to strict policies, I was unable to obtain clearance for access to data involving children or adolescence on base.

I began to branch my search for data to surrounding school districts. I contacted school officials from USD 383, USD 475, and USD 233. Only one school from USD 475 offered to assist in my request. I collected data from Junction City Middle school to determine which currently enrolled students had been vaccinated for human papilloma virus and/or *N. Meningitidis* as of May 2016. This data set included children from 6^{th} to 8^{th} grade. The presentation of the data did not differentiate based on gender, so all results are non-gender specific. I inquired about creating an optional questionnaire for parents of these students to obtain more information on reasons parents decided to vaccinate or not vaccinate their children. I was denied permission to send out the survey even under circumstances to make the received responses anonymous.

Chapter 3: Results

The data from Junction City Middle School includes adolescence aged 12 to 15 years. The population included 888 students and only considered vaccinations against human papilloma virus and *N. meningitidis.* Students either received HPV2 (Cerverix), HPV4 (Gardasil), or HPV9 (Gardasil 9) immunizations for human papilloma virus and MPSV4 (Menomune), MCV4P (Menactra), or MCV40 (Menevo) immunizations for *N. meningitidis*. Immunizations utilizing Trumenba and Bexsero were not included in this evaluation. In the following table, "HPV1" indicates the individual or group has received at least one or more doses of human papilloma virus immunizations. "HPV2" indicates the individual or group has received at least two doses or more, and "HPV3" indicates the individual or group has completed the recommended series of vaccination for HPV.

Table 1: Number of students from USD 475 middle school vaccinated with first series HPV, second series HPV, and complete HPV series as well as total vaccinated with MCV compared with total unvaccinated population.

Total Population	Total Unvaccinated Population	Total Population with first HPV Immunization	Total Population with second HPV Immunization	Total Population with third HPV Immunization	Total Population with MCV Immunization
888 Students	524 Students	153 Students	62 Students	63 Students	280 Students

Figure 2: Comparison of student immunizations against unvaccinated students.

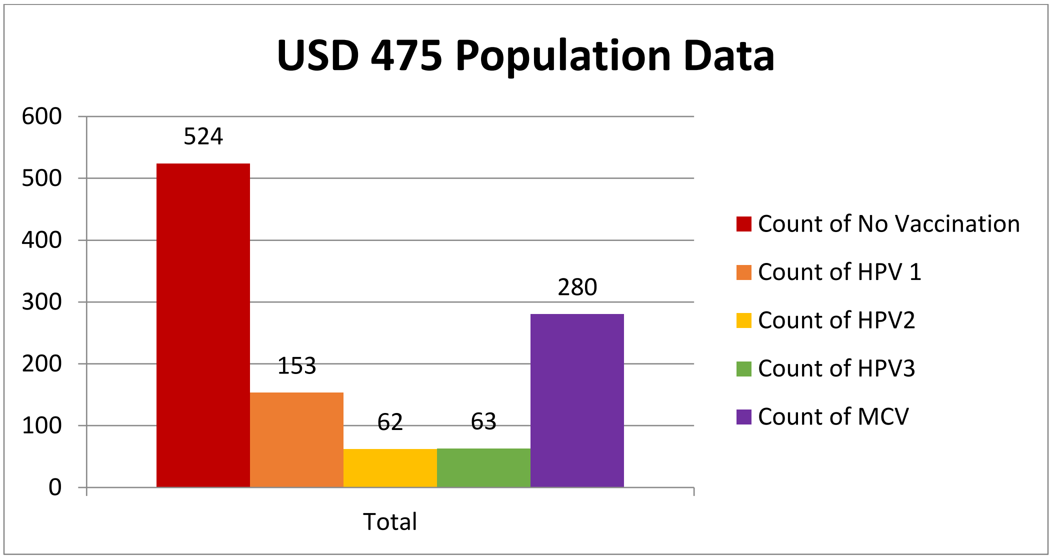
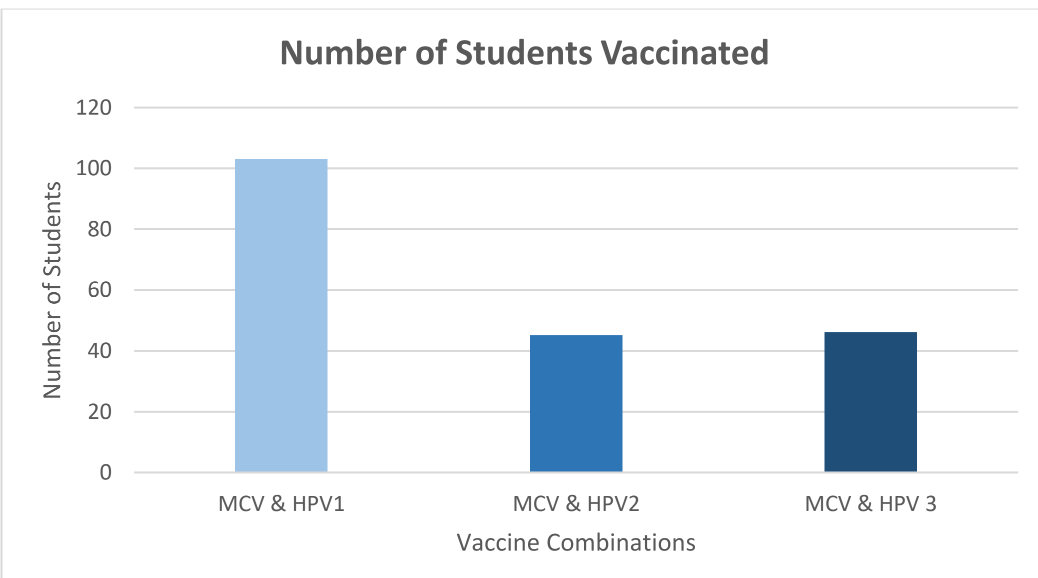
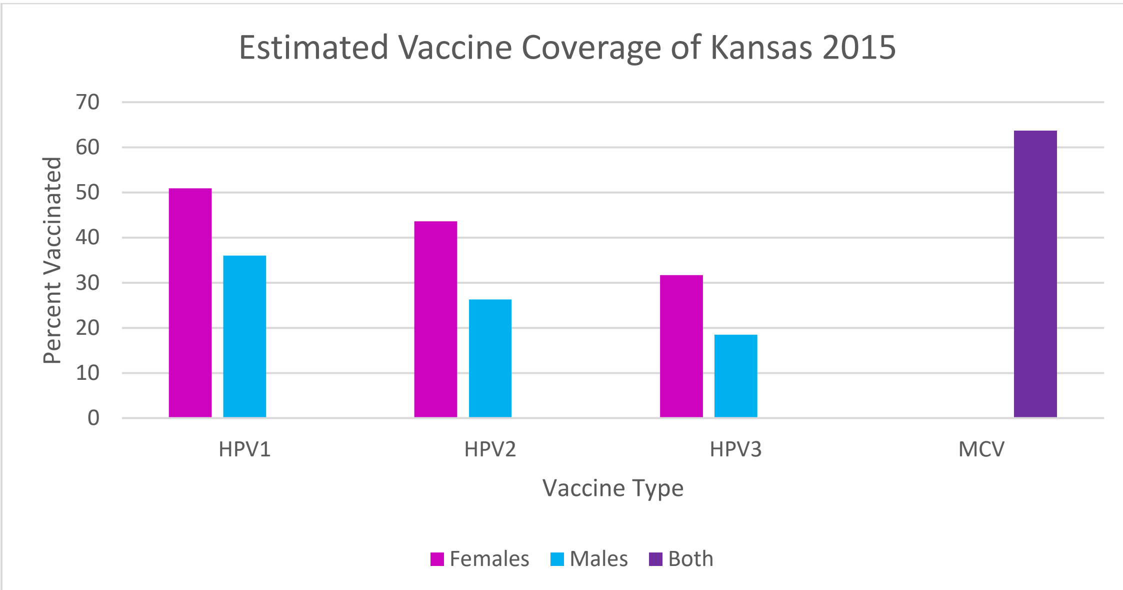


Figure 3: Students vaccinated with both MCV and HPV1, MCV and HPV2, or MCV and HPV3.



Out of the vaccinated population, 103 students were vaccinated with both MCV and HPV1, 45 students were vaccinated with both MCV and HPV2, and 46 students were vaccinated with both MCV and HPV3.

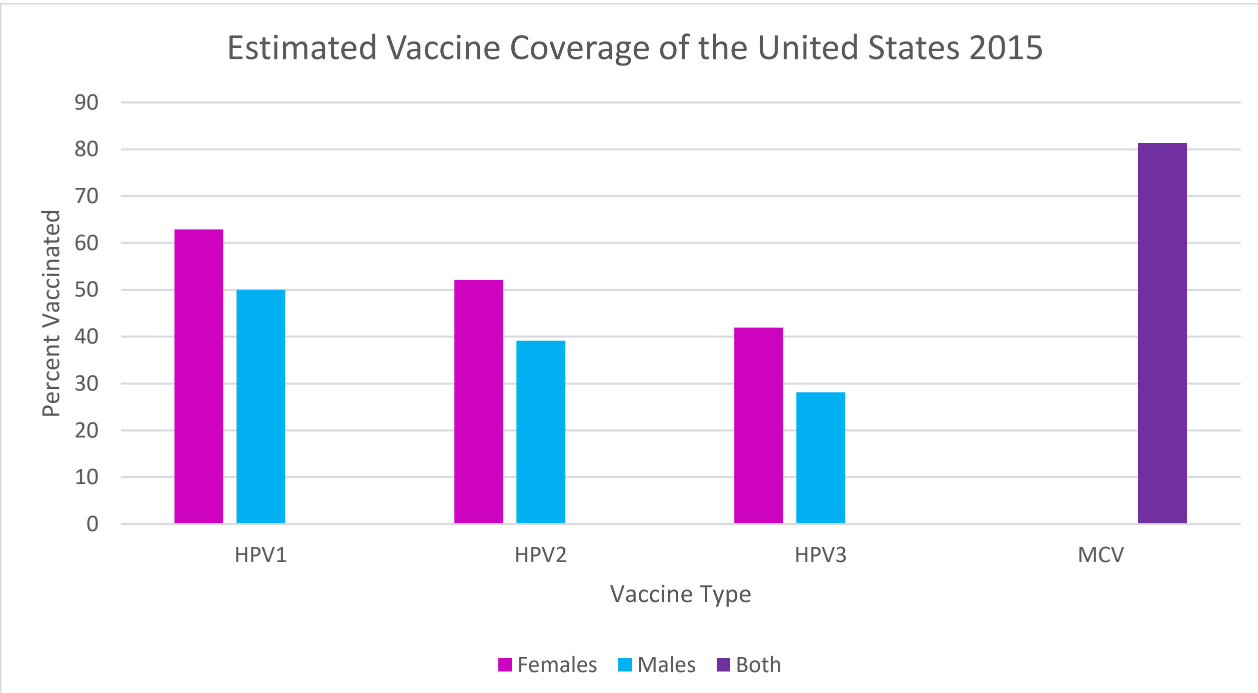
Figure 4: Estimated vaccine coverage for Kansas adolescents aged 13-17 years. From the National Immunization Survey-Teen (NIS-Teen), 2015.



The estimated Kansas data for females in the HPV1, HPV2, and HPV3 groups was taken from a population of 176 individuals; 50.9% of this population was vaccinated with HPV1, 43.6% was vaccinated for HPV2, and 31.7% was vaccinated for HPV3. Females in the HPV1, HPV2, and HPV3 groups have confidence intervals of 8.8, 8.6, and 8.0. The estimated Kansas data for males in the HPV1, HPV2, and HPV3 groups was taken from a population of 199 individuals; 36.0% of this population was vaccinated for HPV1, 26.3% was vaccinated for HPV2, and 18.5% was vaccinated for HPV3. Males in the HPV1, HPV2, and HPV3 groups had confidence intervals of 8.1, 7.4, and 6.7. The MCV data includes strains ACW and Y for males and females combined. The data for the Kansas MCV group was taken from 375 individuals.

63.7% of this population was vaccinated against *N. Meningitidis* with a confidence interval of 5.9.

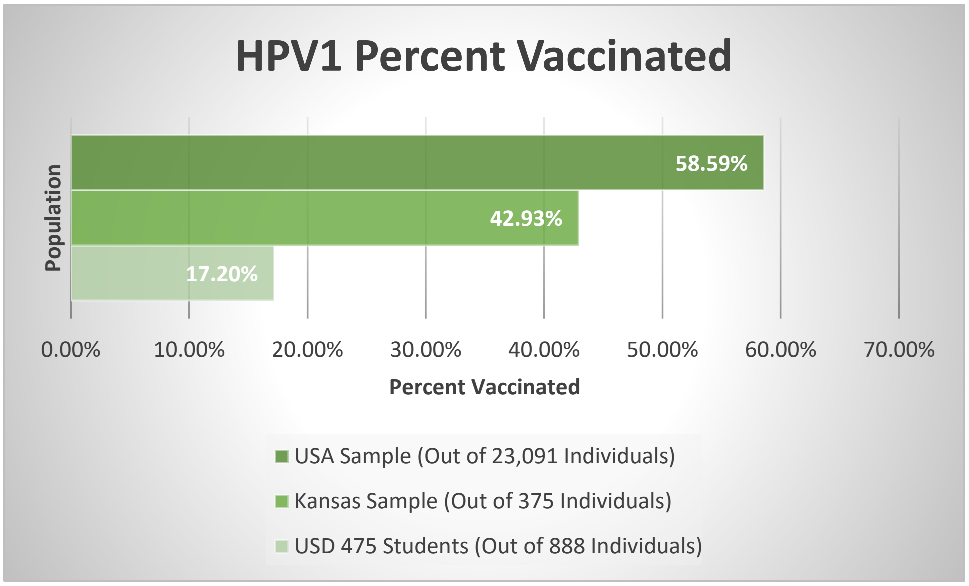
Figure 5: Estimated vaccine coverage for United States adolescents aged 13-17 years. From the National Immunization Survey-Teen (NIS-Teen), 2015.



The estimated data for the female population of the United States for HPV1, HPV2, and HPV3 was collected from a sample size of 11,080 individuals; 62.9% of this sample size was vaccinated for HPV1, 52.1% was vaccinated for HPV2, and 41.9% was vaccinated for HPV3. Females of the HPV1, HPV2, and HPV3 groups have confidence intervals of 1.8, 4.1, and 1.8. The estimated data for the male population of the United States for HPV1, HPV2, and HPV3 was taken out of a sample size of 12,011 individuals; 50% of this sample size was vaccinated for

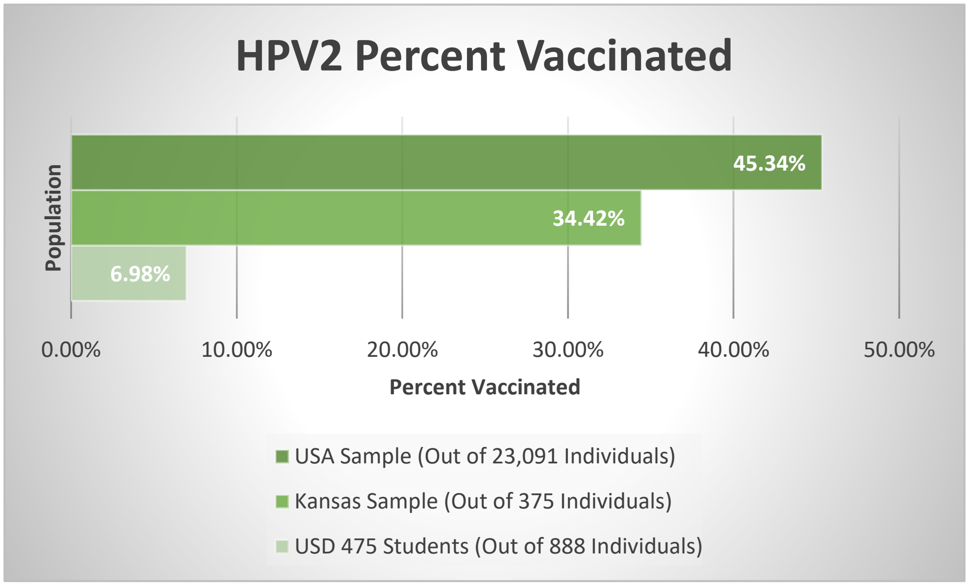
HPV1, 39.1% was vaccinated for HPV2, and 28.1% was vaccinated for HPV3. Males of the HPV1, HPV2, and HPV3 groups have confidence intervals of 1.8, 1.7, and 1.6. The data for MCV in the United States was collected from a sample size of 21,875. 81.3% of this sample size was vaccinated against *N. Meningitidis* with a confidence interval of 1.0.

Figure 6: Vaccination status comparison of USD 475 to regional and national values for HPV1.



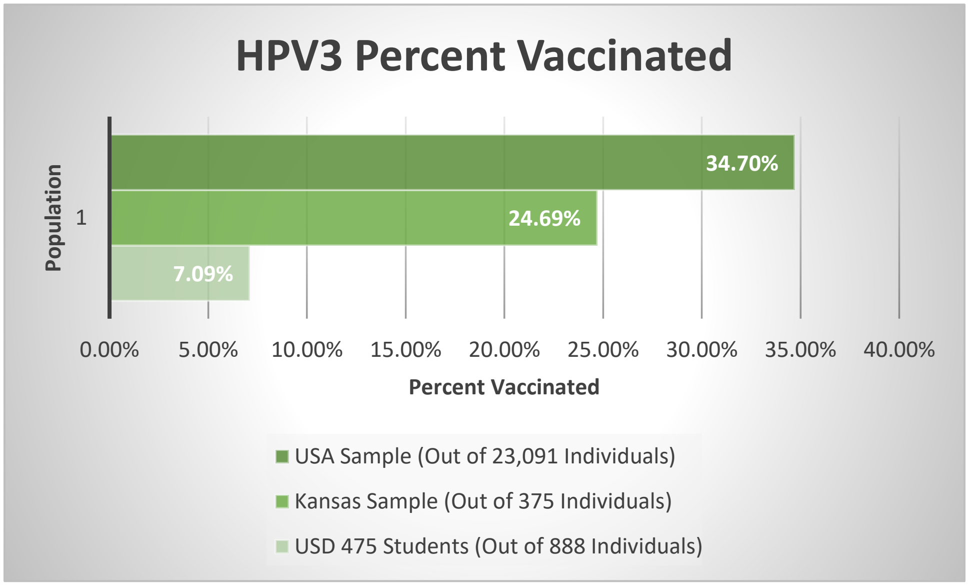
Out of 888 students from USD 475, 153 individuals (17.2%) were vaccinated with at least one series of HPV. Out of 375 individuals from Kansas, 161 (42.93%) were vaccinated with at least one series of HPV. Out of the 23,091 population from the United States, 13,528 individuals (58.59%) were vaccinated with at least one series of HPV.

Figure 7: Vaccination status comparison of USD 475 to regional and national values for HPV2.



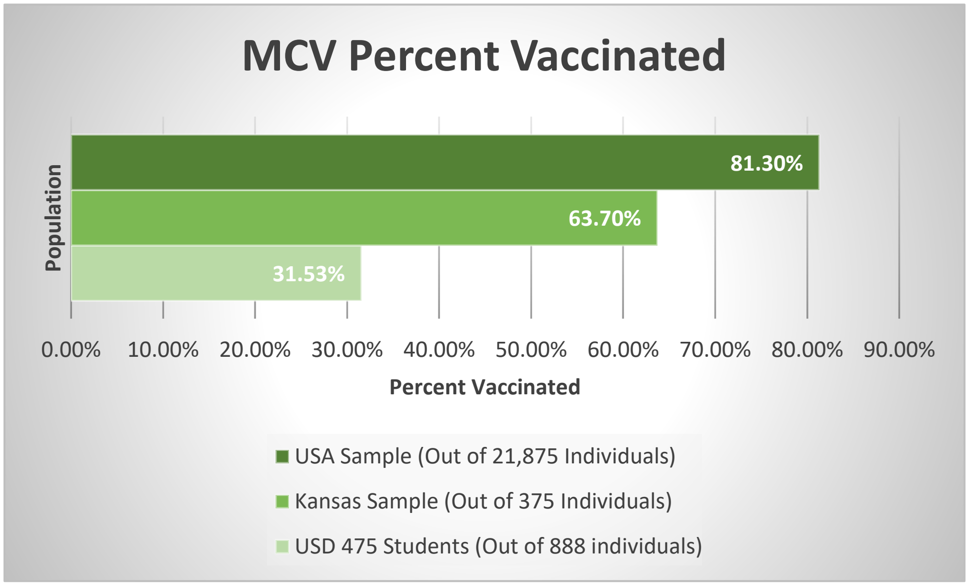
Out of 888 students from USD 475, 62 individuals (6.89%) were vaccinated with at least two series of HPV. Out of 375 individuals from Kansas, 129 (34.42%) were vaccinated with at least two series of HPV. Out of the 23,091 population from the United States, 10,469 individuals (45.34%) were vaccinated with at least two series of HPV.

Figure 8: Vaccination status comparison of UDS 475 to regional and national values for HPV3.



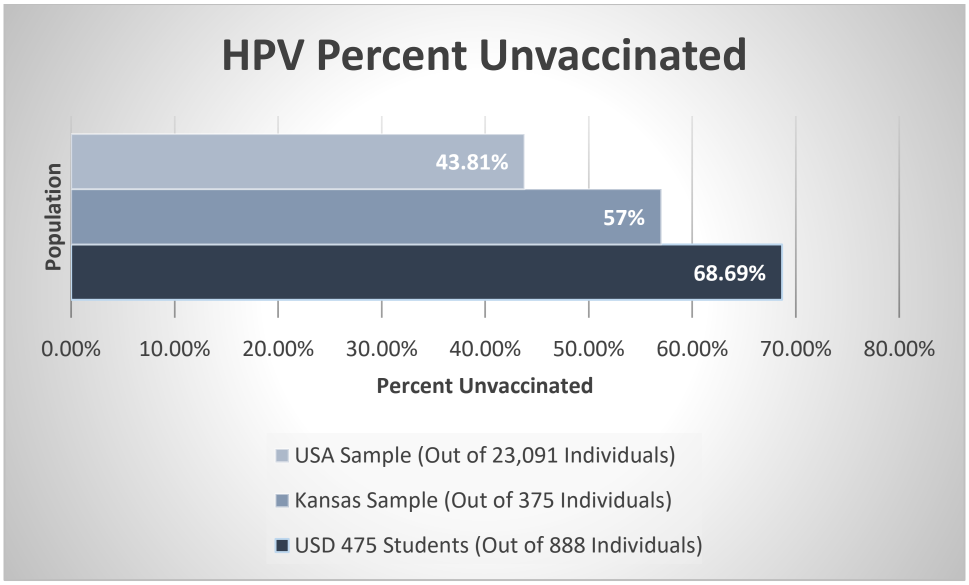
Out of 888 students from USD 475, 63 (7.09%) individuals were vaccinated with all three series of HPV. Out of 375 individuals from Kansas, 93 (24.69%) were vaccinated with all three series of HPV. Out of the 23,091 population from the United States, 8,017 individuals (24.69%) were vaccinated with all three series of HPV.

Figure 9: Vaccination status comparison of USD 475 to regional and national values for MCV.



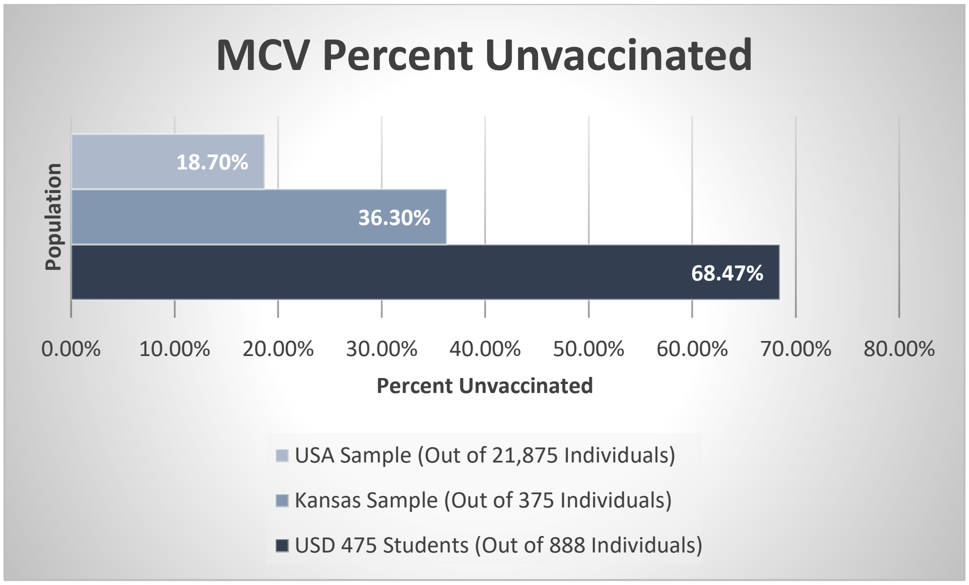
Out of 888 students from USD 475, 280 (31.53%) individuals were vaccinated with MCV. Out of 375 individuals from Kansas, 239 (63.70%) were vaccinated with MCV. Out of the 21,875 population from the United States, 17,784 individuals (81.30%) were vaccinated with MCV.

Figure 10: Comparison of unvaccinated populations between USD 475, regional, and national values for HPV.



Out of 888 students from USD 475, 610 (68.69%) individuals had not received any protection for HPV. Out of 375 individuals from Kansas, 214 (57%) had not received any protection for HPV. Out of the 23,091 population from the United States, 10,116 (43.81%) individuals had received no protection for HPV.

Figure 11: Comparison of unvaccinated populations between USD 475, regional, and national values for MCV.



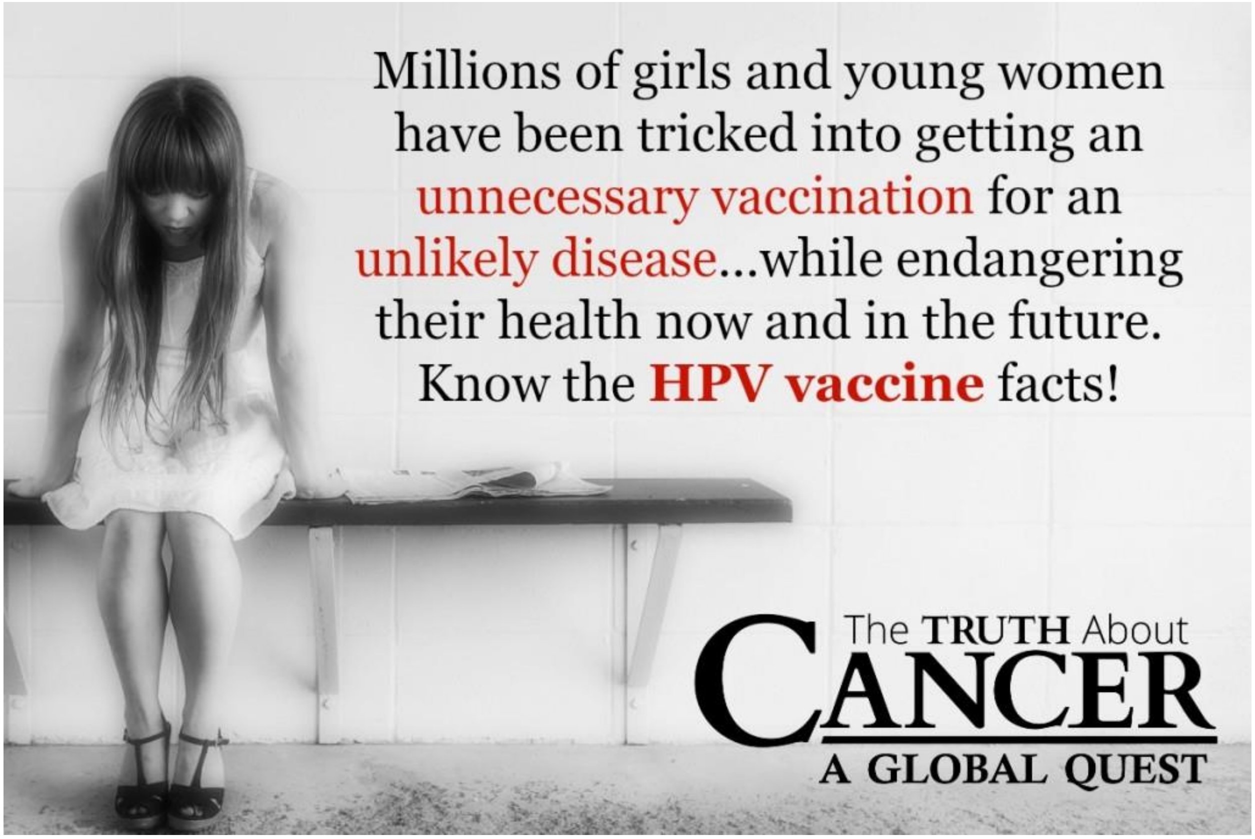
Out of 888 students from USD 475, 608 (68.47%) individuals had not been vaccinated with MCV. Out of 375 individuals from Kansas, 130 (36.3%) had not been vaccinated with MCV. Out of the 21,875 population from the United States, 4,090 (18.7%) individuals had not been vaccinated with MCV.

Chapter 4: Discussion

Comparing the vaccination data from the CDC and USD 475, it is apparent that Kansas is lacking in HPV and MCV immunization coverage. Many parents may deny certain vaccinations for their children due to socioeconomic, medical, religious, and even philosophical reasons. Vaccine exemptions vary by state. All 50 states allow for medical exemption, 45 states allow for religious exemption, and 16 states have philosophical exemptions (NCSL, 2019). States that allow philosophical exemptions include: Arizona, Arkansas, Colorado, Idaho, Louisiana, Michigan, Minnesota, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Texas, Utah, Washington, and Wisconsin (NCSL, 2019). Legally, Kansas only recognizes medical and religious exemptions. Legislation needs to change in order to increase these immunization rates to improve the health of individuals as well as others through herd immunity.

HPV vaccines have less compliance rates than meningococcal vaccines. There are a number of reasons why this is an issue across the United States. The primary objection is that parents tend to associate HPV vaccines with sex, and don't want their adolescent children to be vaccinated for diseases only acquired through intercourse (McCarthy, 2015). According to the Youth Risk Behavior Survey (1991-2015), despite parental intention, nearly half of all high school students have had sexual intercourse. Educational programs should be put forth to change the public perception of these immunizations.

Figure 12: An example of anti-vaccine propaganda. This image came from an anti-vaccine Facebook group.



False information is spread by social media, and believed by untrained individuals. Many images, as shown above in Figure 12, flood the internet daily. This image is cited by, "The Truth About Cancer: A Global Quest" which is a documentary filled with falsities and conspiracy theories. The producer, Ty Bollinger, believes the medical profession is only interested in profiting off of sick individuals and administering medications to make people ill (The Truth About Cancer, 2017). Mr. Bollinger also advocates the idea that cancer is curable with a healthy lifestyle and natural remedies such as green tea. No scientific data exists to back up his claims, but his message is effective to his unknowing audience. He claims the entire scientific community is lying. This type of information is dangerous to the public, as it causes distrust in the medical profession and government organizations such as the CDC and the FDA (The Truth About Cancer, 2017). It is important to educate the general public to recognize false claims in order to increase health compliance and regain trust in the scientific community.

Some states are implementing HPV and MCV vaccination mandates for public school entry. Virginia, Rhode Island, and Washington D.C. currently require students to be vaccinated with at least the first series of HPV prevention upon entering sixth grade (Tompa, Rachel, 2015). Other states have introduced state legislations to require the vaccines, unfortunately, most have not passed. In 2009, Kansas denied requiring the HPV vaccine for public school entry with the following statement, "Resolution would urge the U.S. Food and Drug Administration to use caution in approving new vaccines such as Gardasil which has had a number of health problems including some deaths associated with the use of this vaccine" (HPV Vaccine: State Legislation and statutes, 2017). From 2006 to 2015, more than 80 million doses of HPV vaccination were administered to U.S. citizens. Between these years, 117 deaths have reported to the Vaccine Adverse Event Reporting System (VAERS) related to the HPV vaccine (FAQs About HPV Safety, 2015). The CDC has investigated each of these cases and concluded there to be no proof of causal death by the HPV vaccine. State legislatures should be well informed with science-based evidence for any progress to occur.

According to the CDC's Task Force on Community Prevention Services, there are three intervention strategies that successfully combat low vaccination statuses: Increase community demand for vaccination, increase access to vaccination services, and health provider-based interventions (Ventola, 2016) . Out of these three tactics, the principal influence in poor vaccine compliance is a lack of health provider-based interventions. In many cases non-mandatory vaccines are disregarded and the information does not get received by patients. Health professionals may consider recommending the first series of HPV vaccinations to be given with the Tdap booster. The first dose of meningococcal conjugate vaccine is also often administered at that time.

Vaccination exemptions vary state by state and can include; medical, religious, and philosophical reasons. Medical exemptions are extremely rare and make up less than 0.5% of the U.S. population. According to the National Conference of State Legislatures, religious exemptions are recognized in 48 states and 20 states allow philosophical exemptions (NCSL, 2019). In order to increase vaccination coverage for all vaccines, state legislatures may want to reconsider certain exemptions. Healthy People 2020 suggests 80% of American adolescents be vaccinated for HPV by 2020 (Sexually Transmitted Diseases., 2014). The United States is falling short of this goal locally and nationally.

In order to make vaccinations mandatory, state representatives and members of the senate vote for these changes. Recently there has been pushback from the public. There are many arguments for and against vaccine mandates, and this issue tend to fall along partisan lines. Some individuals believe vaccine mandates are giving the government too much power and infringing on individual rights. State representatives vote in reflection of the people. This makes passing vaccine mandates very difficult because the general population doesn’t always agree. On June 27th, 2019, protests emerged in Topeka, Kansas when lawmakers suggested mandates for meningococcal vaccinations. The opposing side outnumbered mandate supporters three to one (Shorman, 2019). Increasing vaccine mandates will only occur by increasing education programs and having more supporters attend these hearings.

Chapter 5: Conclusion

Study Limitations:

There were many limitations to this study. Data was scheduled to be collected from Fort Riley Middle School. However, due to security regulations at Fort Riley, the student information was not available for release to me or Colonel Benne. The project scope was intended to gain insight on the low vaccine compliance at Fort Riley, which seemed to perplex workers at the Department of Public Health, since Human Papilloma Virus and Meningococcal immunizations are offered free of charge for soldiers and their families.

It was difficult to obtain data from other schools as well. Student information was requested from six middle schools in Kansas. One school granted permission to view current student vaccination records in 2016. Comparison of records from a single school district to the records from the state of Kansas and the USA may not be an accurate representation of vaccine rates in the area.

Recommendations:

Improved record keeping and communication in the Department of Public Health at Fort Riley would benefit future MPH students. During my field experience, I noticed a few obstructions in Fort Riley record keeping. For example, there were rotations where health officials were unaware that I would be joining them on specific days. I was often told to read literature about Fort Riley until an assignment became available. There were delays in obtaining permission to drive on base, even though the field experience had been scheduled months in advance. Increased organization could lead to an improved relationship between graduate students and the medical professionals at Fort Riley.

Education:

Public Health Day is an event that occurs annually on Fort Riley. In the summer of 2015, I took part in it. My task was to talk to soldiers and hand out pamphlets containing information on burn pits in Iraq, which can negatively affect lung health. This event presents an opportunity to communicate with soldiers, since attendance was mandatory and each squad has a sheet that needs to be signed by each branch of the Public Health Department indicating that soldiers had received the health-related information. Public Health Day would be a perfect opportunity to discuss vaccine compliance with soldiers and inform them on immunizations such as HPV and MCV. It's important for soldiers to know these vaccines are easily available to them and their families. As stated previously, a lack in health provider-based interventions is one of the leading causes of poor vaccination compliance. The Department of Public Health at Fort Riley could greatly increase vaccination rates among the Army personnel by improving educational efforts.

Chapter 6: Field Experience

Background:

To fulfill the requirements for the Masters of Public Health Program at Kansas State University, the field experience was completed at the Department of Public Health on Fort Riley. Colonel Paul Benne was the mentor for the six week program, while Ms. Kris Bourland provided substantial assistance. Rotations were divided into seven sections of the Fort Riley Health Department: Veterinary Services, Environmental Health, Industrial Hygiene, Occupational Health, Army Public Health Nursing, Army Wellness Center, and the Army Hearing Program. A total of 240 contact hours was spent working with the Department of Public Health.

Rotations:

The Veterinary Services rotation focused on animal preventive medicine and food sanitation/ inspections. The majority of time was spent at the Fort Riley Veterinary Treatment Facility. Major topics of concern were: identifying zoonotic diseases such as rabies, evaluating animals for disease, treatment or management of diseased animals, veterinary involvement for bite cases, and child development center animal inspections. Occasionally, food inspections of Fort Riley's commissaries would be conducted under this rotation. Highlighted topics for these inspections included; orientation to food safety codes, laws, and regulations; inspection of food products on receipt and in storage; determining if storage containers met regulation standards; evaluation of packaging, and identifying unsanitary conditions in food storage facilities.

The Environmental Health department was broken into five sections: food service sanitation and inspections, water quality and surveillance, disease vector surveillance, hospital waste management, and child development center sanitation and inspections. Food Service and Sanitation inspected all restaurants on Fort Riley. This section focused on food safety codes, laws, regulations, and inspection procedures. Water Quality Surveillance tested water at specific facilities on base. Water samples were collected and properly transported to the lab in the health department. Educational topics included; orientation to water quality codes, laws, and regulations in addition to collection, processing, and lab analysis of water samples. Vector Surveillance focused on procedures regarding collection of mosquitos for testing at Fort Riley, and proper identification of mosquito species. Data was collected on the types of diseases transmitted by mosquitos. Hospital Waste Management focused on waste management codes, laws, and regulations within Fort Riley. Child Development Center Sanitations and Inspections included an unscheduled checkup of a local development center followed by a written report to indicate the facility passed inspection.

The Industrial Hygiene rotation focused on workplace safety and surveying. Assessments of specific workplace environments were completed by the department. One assessment involved measuring occupational noise exposure in aircraft hangars, and to verify that every soldier was wearing the proper hearing protection. Another assessment was completed regarding a building with no air conditioning in mid-June. Ventilation to that building was compromised, so the Industrial Hygiene department sent workers home until they could the airflow was restored. The rotation also included a review of standards for: confined spaces, air contaminants such as mold and bacteria, asbestos, lead, radiation, and workplace ergonomics.

The Occupational Health rotation focused on medical surveillance of soldiers. The section included; vision and hearing checks, immunizations, physicals, tuberculosis screening, and reproductive health. Soldiers and their family members are encouraged to utilize these services. Many cases involved STI screening and overall physicals. This section of the Public Health Department focused on educating patients during medical appointments to improve overall health at Fort Riley.

The Army Public Health Nursing rotation introduced exposure to Army regulations and Standard Operating Procedures regarding health, wellness, and prevention of communicable diseases. Three major operations were covered during this section. One was to conduct on-site daycare inspections which included; record reviews, classroom walk-throughs, and documentation of findings. Another was determination of fundamental competency in the preventable disease surveillance and prevention process. Students assisted in entering reports into the Disease Reporting System internet (DRSi), which is a database that investigates communicable illness. The last area involved attending meetings with community partners such as Nurse-Family Partnership and Maternal Child Health.

The Army Wellness Center rotation covered several objectives for improvement of the health of active duty soldiers, retirees, family members, and civilians. Health assessment reviews, physical fitness exercise tests, metabolic testing, stress management, tobacco education, and behavior change were all included in this section of field experience. Clients were tested on treadmills to estimate overall fitness. Resting metabolic rate was measured to assess an adequate calorie intake for each person. A device called the BOD POD measured BMI, body fat percent, and overall body composition to improve health evaluations of Army personnel. Lectures were given explaining behavioral change mechanisms, including decreasing alcohol and tobacco intake.

The Army Hearing Program identified hearing hazards and explained how medical screening and workplace surveillance can assist in preventing hearing loss. An audiologist was the mentor of the rotation. Hearing tests were conducted on Army professionals who had been exposed to dangerous hearing environments such as working in helicopter hangers. Patients entered a sound proof room and wore headphones which produced faint beeps ranging in tone. The patient held a device with two buttons, which indicated the respective left or right based on which side a sound was heard. The information was sent to a computer where the audiologist diagnosed overall hearing performance. Results were discussed with the individual by the audiologist, who suggested additional medical intervention when necessary.

Figure 13: Members of the Fort Riley Health Department. Photo taken by Stefanie Campbell.

Table 2: Summary of MPH Foundational Competencies

	Number and Competency	Description
4.	Interpret results of data analysis for public health research, policy or practice	Data collected from USD 475 was interpreted and compared to state and national data from the CDC. A need for intervention was recognized based on decreased immunization rates.
7.	Assess population needs, assets and capacities that affect communities' health	Meetings with Colonel Benne discussing low rates of HPV and MCD immunization at Fort Riley. Tobacco use and alcohol abuse was also discussed from the 2014 Community Health Assessment of Fort Riley
18.	Select communication strategies for different audiences and sectors	Discussed burn pit exposures in Iraq to soldiers of various ranks. Communication between soldiers and civilians as well as health professionals and individuals with minimal health literacy.
19.	Communicate audience-appropriate public health content, both in writing and through oral presentation	An article was written for the Army Public Health Nursing Team discussing alcohol abuse and intervention strategies. An oral presentation was given on the topic of alcohol abuse at Fort Riley.
21.	Perform effectively on inter-professional teams	Seven rotations at Fort Riley working with public health professionals. Each rotation had a new team to work with. Also worked in teams of other graduate students from K-State.

Table 3: MPH Foundational Competencies Course Mapping

22 Public Health Foundational Competencies Course Mapping	MPH 701	MPH 720	MPH 754	MPH 806	MPH 818
Evidence-based Approaches to Public Health					
1. Apply epidemiological methods to the breadth of settings and situations in public health practice	x		x		
2. Select quantitative and qualitative data collection methods appropriate for a given public health context	x	x	x		
3. Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software, as appropriate	x	x	x		
4. Interpret results of data analysis for public health research, policy or practice	x		x		
Public Health and Health Care Systems					
5. Compare the organization, structure and function of health care, public health and regulatory systems across national and international settings		x			
6. Discuss the means by which structural bias, social inequities and racism undermine health and create challenges to achieving health equity at organizational, community and societal levels					x
Planning and Management to Promote Health					
7. Assess population needs, assets and capacities that affect communities' health		x		x	
8. Apply awareness of cultural values and practices to the design or implementation of public health policies or programs					x
9. Design a population-based policy, program, project or intervention			x		
10. Explain basic principles and tools of budget and resource management		x	x		
11. Select methods to evaluate public health programs	x	x	x		
Policy in Public Health					
12. Discuss multiple dimensions of the policy-making process, including the roles of ethics and evidence		x	x	x	
13. Propose strategies to identify stakeholders and build coalitions and partnerships for influencing public health outcomes		x		x	
14. Advocate for political, social or economic policies and programs that will improve health in diverse populations		x			x
15. Evaluate policies for their impact on public health and health equity		x		x	
Leadership					

22 Public Health Foundational Competencies Course Mapping	MPH 701	MPH 720	MPH 754	MPH 806	MPH 818
16. Apply principles of leadership, governance and management, which include creating a vision, empowering others, fostering collaboration and guiding decision making		x			x
17. Apply negotiation and mediation skills to address organizational or community challenges		x			
Communication					
18. Select communication strategies for different audiences and sectors	MC 750, FNDH 880 or KIN 796				
19. Communicate audience-appropriate public health content, both in writing and through oral presentation	MC 750, FNDH 880 or KIN 796				
20. Describe the importance of cultural competence in communicating public health content		x			x
Interprofessional Practice					
21. Perform effectively on interprofessional teams		x			x
Systems Thinking					
22. Apply systems thinking tools to a public health issue			x	x	

References

Center for Biologics Evaluation and Research. "Approved Products - TRUMENBA." *U S Food and Drug Administration Home Page*, Center for Biologics Evaluation and Research, 2018, www.fda.gov/BiologicsBloodVaccines/Vaccines/ApprovedProducts/ucm421020.htm.

Cohn AC, MacNeil JR, Clark TA, et al. Prevention and control of meningococcal disease: recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Recomm Rep* 2013;62(RR-2):1–28.

"Control and Prevention of Meningococcal Disease: Recommendations of the Advisory Committee on Immunization Practices (ACIP)." *Centers for Disease Control and Prevention*, Centers for Disease Control and Prevention, 2001, www.cdc.gov/mmwr/preview/mmwrhtml/00046263.htm.

Dr. Rachel Tompa / Fred Hutch News Service. "HPV Vaccines Work – so Why Do so Few States Require Them?" *Fred Hutch*, 14 July 2015, www.fredhutch.org/en/news/center-news/2015/07/why-few states-require-HPV-vaccines.html.

"Epidemiology and Prevention of Vaccine-Preventable Diseases" *Centers for Disease Control and Prevention*, Centers for Disease Control and Prevention, 30 Dec. 2016, www.cdc.gov/vaccines/pubs/pinkbook/index.html.

"FAQs about HPV Safety | Vaccine Safety | CDC." *Centers for Disease Control and Prevention*, Centers for Disease Control and Prevention, 2015, www.cdc.gov/vaccinesafety/vaccines/hpv/hpv-safety-faqs.html.

"HPV and HPV Testing." *American Cancer Society*, 2017, www.cancer.org/cancer/cancer-causes/infectious-agents/hpv/hpv-and-hpv-testing.html.

"HPV VACCINE: STATE LEGISLATION AND STATUTES." *NCSL*, 2017, www.ncsl.org/research/health/hpv-vaccine-state-legislation-and-statutes.aspx.

"Human Papillomavirus (HPV)." *Centers for Disease Control and Prevention*, Centers for Disease Control and Prevention, 24 Aug. 2017, https://www.cdc.gov/vaccines/pubs/pinkbook/hpv.html

"Kansas State Vaccine Requirements – National Vaccine Information Center." *National Vaccine Information Center (NVIC)*, 2018, www.nvic.org/Vaccine-Laws/state-vaccine-requirements/kansas.aspx.

McCarthy, MD Claire. “Why Public Schools Should Require the HPV Vaccine.” *Harvard Health Blog*, 14 Sept. 2015, www.health.harvard.edu/blog/why-public-schools-should-require-the-hpvvaccine201509148268.

“Meningococcal Disease.” *Centers for Disease Control and Prevention*, Centers for Disease Control and Prevention, 2017, www.cdc.gov/vaccines/pubs/pinkbook/mening.html.

“National, Regional, State, and Selected Local Area Vaccination Coverage Among Adolescents Aged 13 17 Years - United States, 2014.” *Centers for Disease Control and Prevention*, Centers for Disease Control and Prevention, 31 July 2015, www.cdc.gov/mmwr/preview/mmwrhtml/mm6429a3.htm.

NCSL. “States With Religious and Philosophical Exemptions From School Immunization Requirements.” *Http://Www.ncsl.org/*, 14 June 2019, www.ncsl.org/research/health/school-immunization-exemption-state-laws.aspx.

Pankratz , Kristi. “Hep A and Meningococcal Vaccines to Be Required for 2019-20 School Year.” *Kdheks.gov*, 18 July 2019, khap2.kdhe.state.ks.us/NewsRelease/PDFs/7-18-19%20vaccine%20requirements.pdf.

Racloz, V N, and S J Luiz. “The Elusive Meningococcal Meningitis Serogroup: a Systematic Review of Serogroup B Epidemiology.” *BMC Infectious Diseases.*, U.S. National Library of Medicine, 17 June 2010, www.ncbi.nlm.nih.gov/pubmed/20565757.

“Sexually Transmitted Diseases.” *Sexually Transmitted Diseases | Healthy People 2020*, 2014 www.healthypeople.gov/2020/topics-objectives/topic/sexually-transmitted diseases/objectives.

Shorman, Jonathan. “Vaccine Opponents Demand Kansas Drop Plan to Expand Required Child Immunizations.” *Kansas*, The Wichita Eagle, 27 June 2019, www.kansas.com/news/politics-government/article232018057.html.

"STATES WITH RELIGIOUS AND PHILOSOPHICAL EXEMPTIONS FROM SCHOOL IMMUNIZATION REQUIREMENTS." *NCSL*, 2017, www.ncsl.org/research/health/school immunization-exemption-state-laws.aspx.

"'The Truth About Cancer' Series Is Untruthful About Cancer." *Science-Based Medicine*, 29 Jan. 2017, www.sciencebasedmedicine.org/the-truth-about-cancer-series-is-untruthful-about cancer/.

"Vaccination Coverage Among Children in Kindergarten - United States, 2013–14 School Year." *Centers for Disease Control and Prevention*, Centers for Disease Control and Prevention, 17 Oct. 2014, www.cdc.gov/mmwr/preview/mmwrhtml/mm6341a1.htm.

Ventola, C. Lee. "Immunization in the United States: Recommendations, Barriers, and Measures to Improve Compliance: Part 1: Childhood Vaccinations." *Pharmacy and Therapeutics*, MediMedia USA, Inc., July 2016, www.ncbi.nlm.nih.gov/pmc/articles/PMC4927017/.

Vincenzo, R. D., Conte, C., Ricci, C., Scambia, G., & Capelli, G. (2014). Long-term efficacy and safety of human papillomavirus vaccination. *International Journal of Women's Health*, *6*, 999-1010. http://dx.doi.org.er.lib.k-state.edu/10.2147/IJWH.S50365

"What Is HPV?" *Centers for Disease Control and Prevention*, Centers for Disease Control and Prevention, 20 Dec. 2016, www.cdc.gov/hpv/parents/whatishpv.html.