Master of Public Health Field Experience Report

Analysis of the Annual Influenza Vaccination Event Hosted by the Riley County Health Department

by

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MASTER OF PUBLIC HEALTH

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Abstract

This field experience was accomplished during an internship at the Riley County Health Department (RCHD) from October 2017 to April 2018. The internship was performed under the guidance of Andrew Adams, the Public Health Emergency Preparedness Coordinator for RCHD. The purpose of the field experience was to analyze the potential economic benefit and overall outreach success of an annual influenza vaccination event (named "Okt-FLU-ber Fest") provided by RCHD. It is important for RCHD employees to understand the impact these annual clinics have on the community. The main objective of this field experience was to help determine this information for the health department.

A cost-benefit analysis was done by configuring the outgoing cost to both the health department to provide the event and to the public to attend and receive a vaccination. Additionally, the potential averted costs of influenza illness to the public were determined, and these values were compared to assess the potential economic benefit of receiving a flu vaccination at Okt-FLU-ber Fest. The results of the cost-benefit analysis suggested that the flu vaccine provides a substantial potential economic benefit to vaccinated individuals, as well as to Riley County. The results showed that the potential costs averted from not being ill with influenza or having more mild symptoms are greater than the expenses for the vaccination outreach effort.

Additionally, Okt-FLU-ber Fest proved to be successful in terms of reaching the focal target age population of school-aged individuals. Outreach to areas of low median household income and high poverty status proved to be mostly successful. This information will be used to guide the Riley County Health Department in increasing their outreach efforts and ultimately improve the health of the community. The health department can now proceed with future planning for this annual event by targeting certain areas for education efforts, increasing advertisement of the event, and strategically placing mobile clinics.

Subject Keywords: Okt-Flu-Ber Fest, RCHD, cost-benefit analysis, public health

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Chapter 1 - Background

I. Riley County Health Department

The Riley County Health Department (RCHD) serves the community of Riley County, Kansas, and is located at 2030 Tecumseh Rd, Manhattan, KS 66502. The vision of the health department is: "Healthy People in a Healthy Community" and its mission is: "To promote and protect the health and safety of the community through evidence-based practices, prevention, and education" (Riley County Health Department, 2016). Services of the health department include Child Care Licensing, Immunizations, Maternal and Child Health, Reproductive Health Services, and Women Infants and Childhood (WIC) Nutrition (Riley County, Kansas, n.d.).

Riley County had a population of 75,247 people in 2015, which includes Kansas State University students who make up approximately 30% of the population. Of that population, 5.9% or 4,439.57 people are less than five years old, 85.3% or 64,185.69 people are between the ages of 5 and 64, and 8.8% or 6,621.74 people are aged 65 or older. As of 2016, 47% of the population was female and 53% was male. The median household income as of 2016 was $64,609, while the per capita income was $25,087 (U.S. Census Bureau, 2016).

Since 2012, RCHD has hosted an annual event in October where the public can receive an influenza vaccination at the health department's location. This event is referred to as "Okt-FLU-ber Fest" and during the department's most recent event in 2017, 435 vaccinations were administered. In addition to Okt-FLU-ber Fest, the health department provides flu vaccination clinics throughout the county at various locations, as well as in the immunization clinic at the department. The health department held 31 mobile clinics in the 2017-2018 season and 1,030 total flu vaccinations were administered.

II. Okt-FLU-ber Fest

Okt-FLU-ber Fest is an annual outreach event hosted by RCHD. Okt-FLU-ber Fest has been located in various locations throughout its six year history; this year's event was held at the health department, in the last week of October. In previous years, it has been held at the Blue Earth Plaza, at the health department, and at Pottorf Hall in Cico Park. This year's event was held on October 26, 2017. The purpose of the event is to administer a large number of vaccines compared to an average flu clinic. Comparatively, the most vaccinations administered at one of the health department's standard mobile flu clinics in the 2017-2018 season was 129. The

department encourages people to attend by providing activities, snacks, and a free pumpkin with each vaccination, making it particularly appealing to families with children. Okt-FLU-ber Fest 2017 was the sixth annual event hosted by the health department. This event was strategically set to take place on an afternoon when the area school district was closed which allowed more school-aged children, or individuals aged 5-18 years, and their families to attend. An important target population of this outreach event was school-aged children, as that age range tends to have the highest prevalence of influenza (Couch, 2000).

III. Objectives of the Analyses

The main objective of this project was to conduct an analysis of the community influenza vaccination event, Okt-FLU-ber Fest, hosted by RCHD. The cost-benefit analysis was accomplished by determining the average costs to the public to receive a flu vaccination through RCHD, as well as the total cost to the health department to hold these vaccination clinics and outreach events. The potential averted costs from receiving the flu vaccine to the public were determined in order to evaluate the potential economic benefit of the vaccine and Okt-FLU-ber Fest on an individual, county, and societal level.

Graphic Information Systems (GIS) mapping was used to determine the location of each individual vaccinated at Okt-FLU-ber Fest. This information was used to analyze the overall outreach of the health department and to be able to provide a visual representation of the coverage of flu vaccinations at this event. This information will be useful for determining possible areas that were not reached at Okt-FLU-ber Fest. Additionally, GIS mapping was used to analyze the median household income, poverty level, and vehicle access, to ensure areas of greater health inequities are being provided vaccine coverage. Furthermore, the ages of the individuals vaccinated were analyzed. This information was used to determine if the event was successful in reaching the target population.

IV. Seasonal Influenza

Influenza (flu) is a contagious viral illness. Increased incidence of influenza occurs every year through the months of November to March, commonly known as “flu season”. Influenza viruses belong to the *Orthomyxoviridae* family and include three virus types that are infectious to humans: type A, B, and C. Influenza type D does not cause disease in humans and is seen primarily in cattle. Influenza viruses are enveloped, negative sense, single-stranded RNA viruses (Taubenberger & Morens, 2008). Type A is the most common of the three virus types and

typically causes the most severe symptoms and epidemics (Paules & Subbarao, 2017). Endemic or seasonal influenza is caused by type A and B viruses (Chang & Golub, 2011). Influenza is easily spread through aerosol and droplet transmission, such as when an infected individual sneezes or coughs. Fomite transmission can also occur, which happens when an individual touches an object that has been contaminated by an infected individual (Chang & Golub, 2011).

Seasonal influenza is responsible for thousands of deaths and hospital visits annually, worldwide. During an average endemic influenza season in the United States, approximately 200,000 hospitalizations and 36,000 deaths occur. There are several factors that increase the morbidity and mortality risk of influenza in individuals, such as age, pregnancy, immunocompromised state, and medical comorbidity (Paules & Subbarao, 2017). Influenza viruses are some of the most common causes of human respiratory infections, as well as among the most serious due to high morbidity and mortality rates (Taubenberger & Morens, 2008). Along with the staggering morbidity and mortality rates, influenza is responsible for approximately 44 million days of work lost each year in the United States (Carias, et al., 2015). This immense loss of productivity can have negative effects on the economy.

Symptoms of the flu generally appear after an incubation period of 1-2 days and include both systemic and respiratory features, such as fever, chills, headache, anorexia, fatigue, cough, nasal discharge, and sore throat. Ocular symptoms can also occur, such as conjunctivitis (Paules & Subbarao, 2017). Influenza has the potential to progress into more severe conditions, including pulmonary complications, such as bacterial pneumonia, and cardiac complications, such as myocarditis and meningitis (Paules & Subbarao, 2017). Influenza affects individuals of all ages, with prevalence being highest in school-aged children. Disease severity tends to be greatest in infants, the elderly, and the immunocompromised (Couch, 2000). There is a greater risk for these groups of individuals to develop more severe complications following illness from influenza.

The most effective protection against influenza A and B is the inactivated flu vaccine. A different vaccine is produced each year that contains specific strains of influenza. A new vaccine must be produced each year because the virus undergoes antigenic drift, meaning the virus continuously mutates and individuals cannot maintain immunity each flu season (Taubenberger & Morens, 2008). The World Health Organization (WHO) determines recommendations for the strains used in the influenza vaccine each year based on surveillance, laboratory, and clinical studies (Paules & Subbarao, 2017).

The purpose of the influenza vaccine is not necessarily to fully prevent influenza epidemics, but to prevent the serious consequences, such as severe disease, hospitalization, and death. The recommended dosage of the influenza vaccine varies by age group. Healthy school-age children and adults respond best to the vaccine, while preschool children, the elderly, and immunocompromised individuals do not respond as well. However, the vaccine provides protection against serious outcomes such as pneumonia, hospitalization, respiratory disease, congestive heart failure, and death among the elderly. The vaccine also reduces the incidence of complications due to influenza such as ear infections in young children (Couch, 2000).

Oseltamivir phosphate is an antiviral drug used in the treatment and prevention of influenza A and B viruses. Oseltamivir is sold by the brand name "Tamiflu®" and is one of the most commonly used antiviral medications against influenza. Tamiflu®, as well as the other available antiviral drugs, should not be solely relied on to treat or prevent the flu or to take the place of vaccination. Tamiflu® is only effective when used within the first two days after onset of symptoms, it is not effective in influenza A epidemics, and prolonged administration can be expensive. The drug is most effective when used prophylactically in individuals at high risk of serious complications who have not been vaccinated, as well as people with immunodeficiency in conjunction with vaccination (Couch, 2000).

There are two forms of the influenza vaccine; there is a trivalent vaccine that includes three strains of influenza and a quadrivalent vaccine that contains four influenza strains. The 2017-2018 trivalent vaccine includes the following influenza strains: A/Michigan/45/2015 (H1N1)pdm09-like virus, A/Hong Kong/4801/2014 (H3N2)-like virus, and B/Brisbane/60/2008-like (B/Victoria lineage) virus. The quadrivalent influenza vaccine contains one additional strain to the trivalent vaccine: B/Phuket/3073/2013-like (B/Yamagata lineage) virus (CDC, 2018).

Chapter 2 - Field Experience

I. Learning Objectives

An important learning objective of this field experience was to gain an understanding of the responsibilities and operations of a county health department. This experience will be beneficial for a future career in the field of Public Health. Additionally, I learned how a health department analyzes its impact on the health of a community and determines how to improve in the future to increase overall health and public outreach.

Another learning objective of this project was to understand the economic impact of influenza and the benefit of flu vaccination programs. Due to the continuous mutation of the influenza virus, the efficacy of the vaccine varies each flu season. Thus, it is widely debated how beneficial the vaccine is. I wanted to determine how economically beneficial the vaccine can potentially be, whether by preventing the flu in an individual altogether, decreasing the spread of the virus, or reducing severe complications.

II. Activities Performed

The activities performed during this field experience were associated with an analysis of the Riley County Health Department's flu vaccination outreach event, Okt-FLU-ber Fest. The data gathered for this analysis was collected primarily from documents provided by the immunization clinic sector of the health department. These documents contained the data from Okt-FLU-ber Fest, including the cost of each type of vaccine used, the number of each vaccine administered, and the ages and residence of the individuals that were vaccinated.

In addition to the tasks required for the analyses, I was able to experience and learn about all of the different divisions of RCHD. I attended bi-weekly "Epidemiology Team" meetings, monthly staff meetings, emergency preparedness meetings, and accreditation meetings. Additionally, I had one-on-one meetings with personnel from different departments to learn about the purpose of the department and the responsibilities of their respective position. Furthermore, I learned about the use of different public health programs and databases, such as EpiTrax, an electronic disease surveillance system used in Kansas, and GIS mapping. I was able to see firsthand how these applications are used in a public health setting.

III. Products Developed

Upon completion of the Okt-FLU-ber Fest analysis, I presented the results at a "Leadership Team" meeting. The presentation included the results of the cost-benefit analysis, the distribution of the ages of vaccinated individuals, and the GIS maps showing the outreach success of the event and relationship between health inequities and attendance. The Leadership Team is comprised of supervisors from each program of RCHD. This presentation allowed the employees of the health department to recognize the impact and benefits of this annual event, as well as to determine potential improvements for future events. Additionally, a summary report of the cost-benefit analysis, explaining the economic impact of Okt-FLU-ber Fest 2017, was written and provided for the health department.

The information gained from this field experience and provided to the health department will allow RCHD to assess the impact of their influenza vaccination program and determine potential changes to make in the future. The health department will be able to determine areas that may need increased education efforts in regards to influenza and the flu vaccine. The potential factors contributing to the attendance of the event can be assessed and looked into further to determine if there are, in fact, limitations in attendance. This will allow for potential changes and accommodations to increase attendance and the number of vaccinations administered during the event.

Chapter 3 – Analyses and Results

I. Cost-Benefit Analysis

An analysis was done to assess the cost to the Riley County Health Department (RCHD) for hosting Okt-FLU-ber Fest, as well as the cost to attendees to be vaccinated. The economic benefit of Okt-FLU-ber Fest was measured as the potential costs that the event prevented by administering influenza vaccinations to the public, as well as the total revenue to the health department. The first set of data collected was provided by the health department's immunization clinic. This data lists each vaccine type that was used at the event and how many were administered. The immunization clinic also provided the cost to RCHD to provide each vaccine type.

Table 1. Cost to be Vaccinated

Vaccine Type	# Administered	Price per Dose	Total Cost
Private PF 6-35 m	30	$38	$1,140
Private PF >36 m	274	$38	$10,412
Public PF 6-35 m	22	$18	$369
Public PF >36 m	86	$18	$1,548
317 PF >36 m	18	$0	$0
High Dose	5	$63	$315
Total	**435**		**$13,784**

Table 1 shows each influenza vaccine type that clients were provided at Okt-FLU-ber Fest. The health department provided the following vaccines: Private PF 6-35 m, Private PF >36 m, Public PF 6-35 m, Public PF >36 m, 317 PF >36 m, and High Dose. "Private" and "public" refers to the type of insurance of the individual. "PF" stands for "preservative-free", which means the vaccine does not contain a preservative called thimerosal (CDC, 2017). The "317" vaccine type is federally funded; therefore, there was no cost to the consumers or to the health department for this vaccine. The state supplied 20 total "317" vaccinations for this event for adults without health insurance. "High dose" flu vaccinations are designed for individuals aged 65 or older. The intended age range for each vaccine type is also indicated: "6-35 m" indicates

that the vaccine is intended for children ages 6 months-35 months, and ">36 m" indicates the vaccine is intended for individuals over the age of 36 months. The high dose vaccines were trivalent while the rest were quadrivalent.

The second column in Table 1 represents how many of each vaccine type was administered at the event. The third column indicates the cost per dose of each vaccine type. This is the cost that each consumer paid to receive their particular vaccination. The total costs in the last column were calculated by multiplying the amount of each vaccine administered with its respective cost per dose. Each of the total costs for each vaccine type was added to determine the overall cost of all of the vaccinations administered at the event. This total of $13,784 represents the total cost that the public spent receiving a flu vaccination at Okt-FLU-ber Fest.

Table 2. Cost to RCHD to Purchase Vaccines

Vaccine Type	# Administered	Price per Dose	Total Cost
Private PF 6-35 m	30	$16.53	$495.90
Private PF >36 m	274	$16.53	$4,529.22
Public PF 6-35 m	22	$0	$0
Public PF >36 m	86	$0	$0
317 PF >36 m	18	$0	$0
High Dose	5	$42.44	$212.00
Total	**435**		**$5,237.12**

Table 2 shows the total cost that RCHD spent purchasing the vaccinations to provide at the event. The first two columns of the table are identical to Table 1. The third column, showing price per dose, designates the amount that the health department spent to purchase one dose of each vaccine type. Similar to Table 1, the total costs were calculated by multiplying the price per dose of each vaccine type by the amount administered. Again, the total cost of each vaccine type was added to find the overall total cost that the health department spent purchasing vaccines for Okt-FLU-ber Fest, which was $5,237.32.

Table 3. Cost of Additional Event Supplies to RCHD

Supplies	Cost
Pumpkins	$437
Popcorn	$34
Advertisement	$50
Snacks	$30
Face Painting	$40
Band-Aids	$28.90
Alcohol Wipes	$19.47
Nitrile Gloves	$87.55
Syringe + Needle	$44.15
Total	**$771.07**

Table 3 lists all of the "additional" supplies, which are the supplies that were used at the event besides the vaccines, and how much the health department spent in total. RCHD spent a total of $771.07 for additional supplies to host the event.

Table 4. Cost of Employee Labor to RCHD

Cost of Labor	
Staff	35
Hours	5
Average Hourly Wage	$25.31
Total Cost of Labor	**$4,429.25**

Table 4 shows the "cost of labor", or the cost to the health department to have RCHD employees working the event during normal operative hours. This was done by determining the amount of staff that assisted at the event, the amount of hours that they worked the event, and the average hourly wage of the employees. These three values were multiplied together to determine the total cost to the health department of having 35 employees working the event for five hours at an average wage of $25.31 per hour. The total cost of labor was $4,429.25.

Table 5. Revenue to RCHD

Total Cost to Consumers	Total Cost to RCHD	Total Revenue
$13,784	$10,438.44	**$3,345.56**

Table 5 shows the adjusted revenue to the health department from Okt-FLU-ber Fest. This value is adjusted because it takes into account the total amount spent by the health department, and subtracts that amount from the total revenue of the event. The total cost to the health department was determined by adding the total cost of vaccination purchase, cost of labor, and cost of supplies. The total cost to RCHD for the event was $10,438.44, resulting in a yield of $3,372.56. This positive revenue confirms that the event was economically beneficial to the health department.

Figure 1. Vaccinated Age Groups

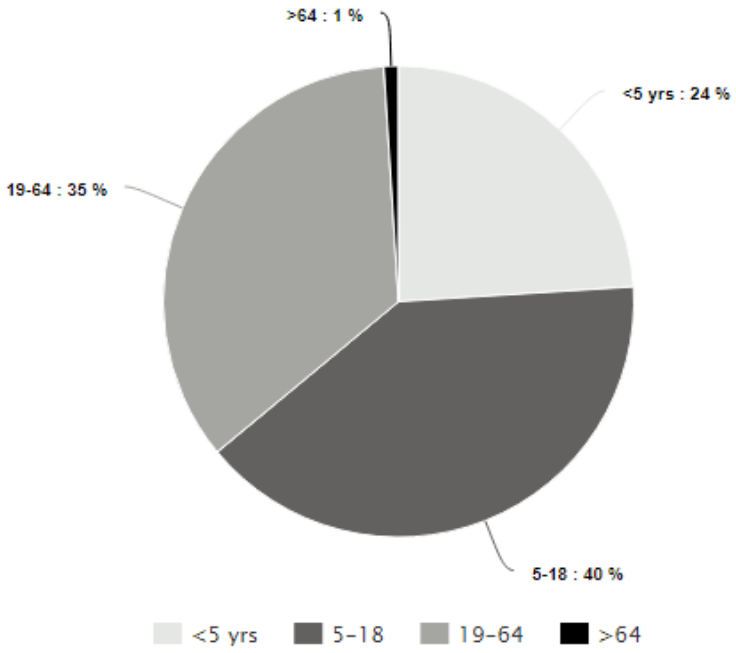


Figure 1 shows the individuals that received a vaccination at Okt-FLU-ber Fest separated into four different age groups. The age groups include: children less than 5 years old and individuals 5-18 years old, 19-64 years old, and greater than 64 years old. The results show that approximately 24% of the Riley County attendees were children under the age of 5, 40% of attendees were individuals aged 5-18 years old, 35% were ages 19-64 years old, and 1% of the

attendees were older than 64 years old. The results of this analysis show that RCHD was successful in reaching the target population of Okt-FLU-ber Fest, which was school-aged children, or individuals aged 5-18 years.

Table 6. Cost of Medical Care

Medical Service	Avg. Cost (no insurance)	Avg. Cost (with insurance)
Outpatient Care	$96	$29
Influenza Virus Test	$41	$12
Tamiflu® Prescription	$107.89	$32.36
Total *Outpatient* Cost	**$244.89**	**$73.36**

Table 6 indicates the potential cost of medical services for an individual with influenza, as influenza illness often results in a doctor's visit and lab work to conclude a diagnosis. Inpatient hospital care is commonly required for those with more severe illness and symptoms. Table 6 includes the estimated cost for individuals in the Riley County area without health insurance, as well as the estimated cost for individuals with health insurance, assuming there is a 70% reimbursement. The costs for "outpatient care" and "influenza virus test" were retrieved from an online database, fairhealthconsumer.org, which provides estimated healthcare expenses based on geographic region. The data retrieved from this database will be used solely for estimation purposes. The "Tamiflu® Prescription" cost without health insurance was retrieved directly from a Walgreens pharmacy in Manhattan, KS. The estimated cost of the prescription with insurance was based on a 70% reimbursement calculation.

The estimated cost of outpatient medical care in Riley County is $96 for an individual with no health insurance, and approximately $29 for an individual with insurance (FAIR Health Consumer, n.d.). The estimated cost for an Influenza A and B virus detection test without insurance is $41, and $12 with insurance (FAIR Health Consumer, n.d.). A 10 day prescription for Tamiflu® 75 mg is $107.89 without insurance, and $32.26 with insurance, assuming a 70% reimbursement. Lastly, the "total outpatient cost" was calculated by adding together the outpatient medical care cost, the cost of the influenza virus test, and the cost of the Tamiflu®

prescription for those without health insurance and those with health insurance, which is $244.89 and $73.36, respectively.

The cost of medical care is only a factor in the total cost spent when ill with influenza. The other factors are discussed in the tables below. These factors represent the costs that are potentially averted when individuals receive a flu vaccination. The flu vaccination is likely to either prevent influenza or suppress the severity of symptoms, which ultimately decreases the amount of associated costs. According to the most recent data from CDC, 2018, individuals ages 65 and older are being hospitalized at significantly higher rates than any other age group.

Figure 2. Laboratory-Confirmed Influenza Hospitalizations (CDC, 2018)

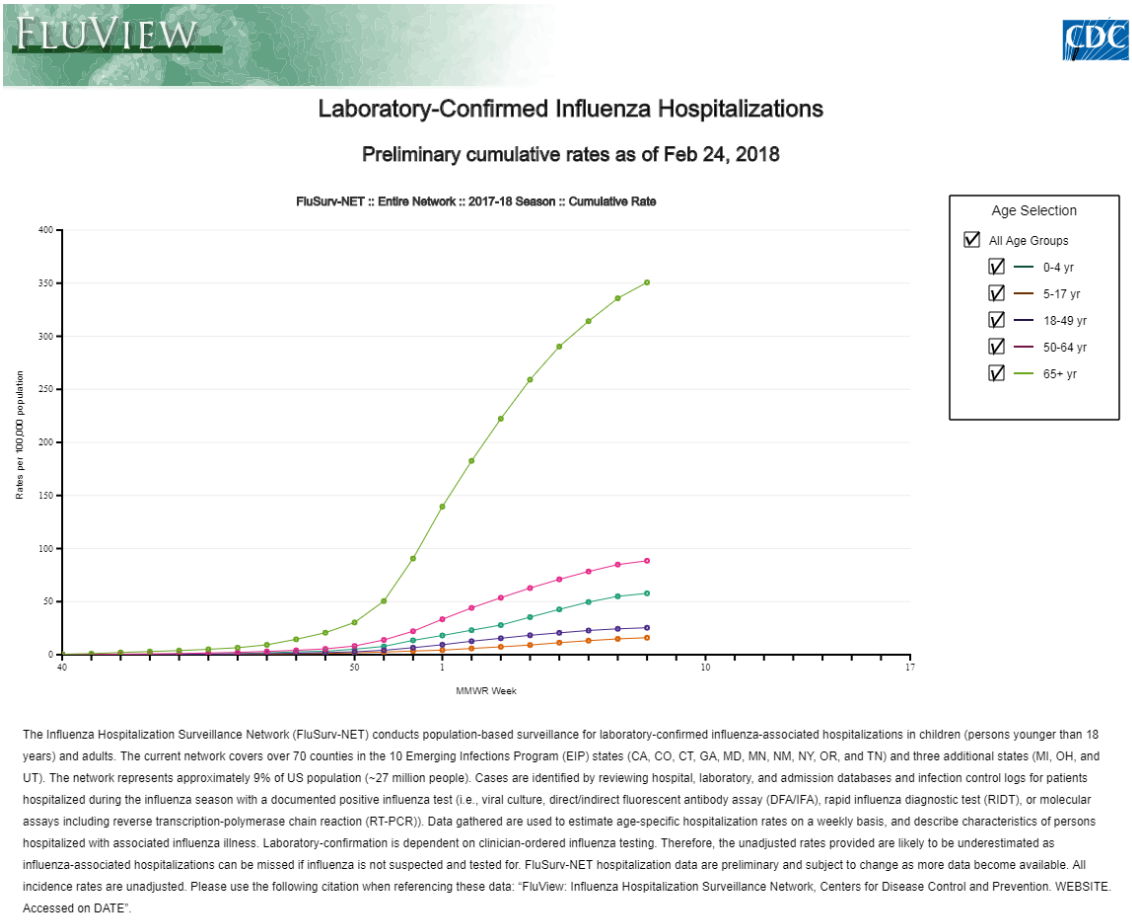


Figure 2 shows data as of February 24, 2018. The data represents the number of influenza-related hospitalizations each week in the United States since October 1, 2017. The age group with the highest rate of hospitalizations is 65 years and older, represented by the green line. Since only 1% of the Okt-FLU-ber Fest attendees were older than 65 years of age, it is

reasonable to assume that most of the attendees would not have been hospitalized if they had been unvaccinated and ill with the flu. Therefore, the estimated cost for inpatient medical care was not factored in to the total potential costs of influenza. This means that the estimated cost of medical care used for this analysis is lower than a realistic cost for individuals requiring inpatient care.

Table 7. Cost of Productivity Loss

Avg. Hourly Salary in Riley County	Avg. Hours of Work Missed per Person	Avg. Income Loss
$11.50	32	**$368**

Table 7 represents the average income loss when an individual is ill with influenza. This was done by taking the average per capita income in Riley County of $25,087 and determining the average hourly salary, which is $11.50 (U.S. Census Bureau, 2016). According to Kaslow, Stanberry, & Le Duc (2014), the average amount of work missed due to influenza is 4 days or 32 hours for an average individual working 40 hours per week. The total productivity loss per person of $368 was calculated by multiplying the average hourly salary by the amount of hours of work missed.

Table 8. Cost of Vaccination & Attendance

Avg. Cost of Vaccination at Event	Avg. Hours of Work Missed to Attend Event	Avg. Hourly Salary	Avg. Cost of Attendance + Vaccination
$31.68	1	$11.50	**$43.18**

Table 8 shows the total average cost per person to attend Okt-FLU-ber Fest and receive a vaccination. The value in the first column is average cost per person to receive a vaccination, which is the average cost per dose of each of the vaccination types. The average cost per dose is $31.68. Additionally, it is estimated that approximately one hour of work is missed, on average, to attend the event. Therefore, the average hourly salary of employees in Riley County at $11.50

was added to the average cost to receive a vaccination. This value of $43.18 represents the total average cost per person to receive a flu vaccination at Okt-FLU-ber Fest.

Table 9. Averted Costs from Okt-FLU-ber Fest

Total Costs per Person For Outpatient Care (without insurance)	Cost Towards Vaccines per person	Averted Costs per Person	Total Averted Societal Costs
$612.89	**$43.18**	**$569.71**	**$17,661.01**

Total Costs per Person For Outpatient Care (with insurance)	Cost Towards Vaccines per person	Averted Costs per Person	Total Averted Societal Costs
$441.36	**$43.18**	**$398.18**	**$2,787.26**

Table 9 shows the total potential costs averted for outpatient care per person by receiving a flu vaccination. The value in the first column is the non-adjusted averted costs per person. This value was determined by adding together the cost of an outpatient medical visit, a Tamiflu® prescription, an influenza virus detection test, and lost income. The top table represents the total cost of lost income and outpatient care for those without health insurance, $612.89, and the bottom table represents the cost of lost income and outpatient care for individuals with health insurance, $441.36.

To calculate the adjusted averted costs per person, the total cost per person spent towards attending the event and receiving a vaccine at Okt-FLU-ber Fest, $43.18, was subtracted from the cost of outpatient care. The value of the averted costs per person is $569.71 for those without insurance and $398.18 for those with insurance. According to the CDC Foundation (2018), 5% to 20% of the United States population becomes ill with influenza each year, on average. Applying this statistic of 5%-20% to the 435 Okt-FLU-ber Fest attendees would result in an estimate of 21 to 87 people becoming ill with influenza had they not been vaccinated. The CDC also estimates that the vaccine efficacy (VE) of the influenza vaccine for the 2017-2018 flu

season is currently 36% (CDC, 2018). Therefore, after taking the range of individuals that would benefit most from the vaccine (21 and 87) and multiplying by 0.36, between 7 and 31 people that received a vaccination from Okt-FLU-ber Fest fully benefit from being vaccinated, assuming the current data for the United States population applies to the population of Okt-FLU-ber Fest attendees. This provides a total of $2,787.26-$17,661.01 in societal costs averted from Okt-FLU-ber Fest.

Table 10. Averted Costs to Riley County

Averted Costs per Person	Vaccines Administered to Riley County Residents	Cost to RCHD to Host Event	Adjusted Averted Costs to Riley County
$398.18 - $569.71	**342**	**$10,438.44**	**$2,263.30-$13,276.97**

Table 10 shows the total adjusted averted costs to Riley County. This value was found by taking the range of averted costs per person of $398.18-$569.71 and multiplying it by the amount of vaccines administered to Riley County residents, which was 342 of the 435 total vaccines administered, and subtracting the cost to the health department to host the event, $10,438.44. The total range of averted costs to the county was $2,263.30-$13,276.97 after adjusting for the VE and affected population (5-20%). This shows that Okt-FLU-ber Fest is economically beneficial to Riley County during flu season.

Table 11. Averted Costs from Okt-FLU-ber Fest 2016

	2016
Length	3 hours
# Vaccinations Administered	357
RCHD Revenue	$2,644.02
Averted Costs to Public	**~$1,390**

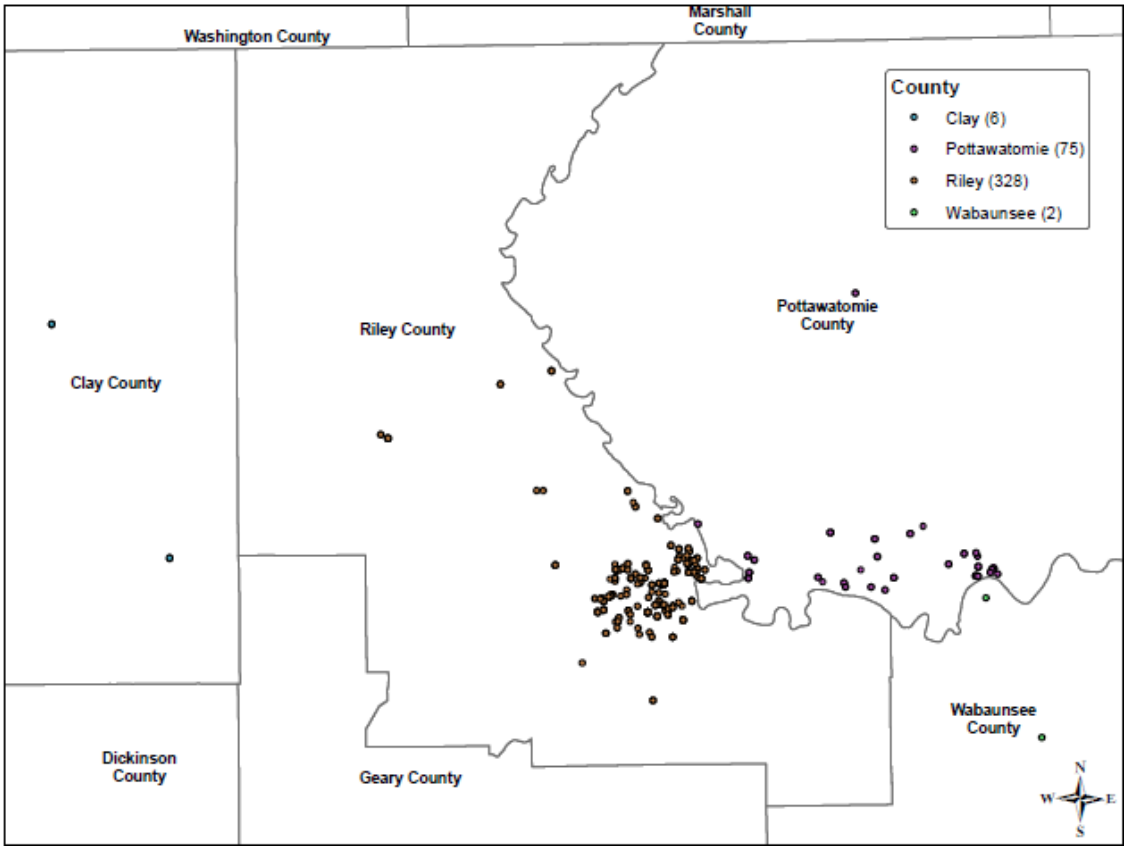
Table 10 shows the averted costs to the public from Okt-FLU-ber Fest from the previous year, 2016. The event in 2016 was held for 3 hours as opposed to 5 hours and therefore 357

vaccines were administered, which is 78 less than this year's event. This comparison between the events in 2016 and 2017 also shows that the event in 2016 cost less to the health department, but had $701.54 less in revenue. Most importantly, the event in 2017 had a potential of $1,390 more in averted costs to the public due to the increased number of vaccinations administered. This information will be helpful for the health department to plan the length of the event in the future as it was shown to be beneficial to hold the event for a longer period of time.

II. Outreach Analysis

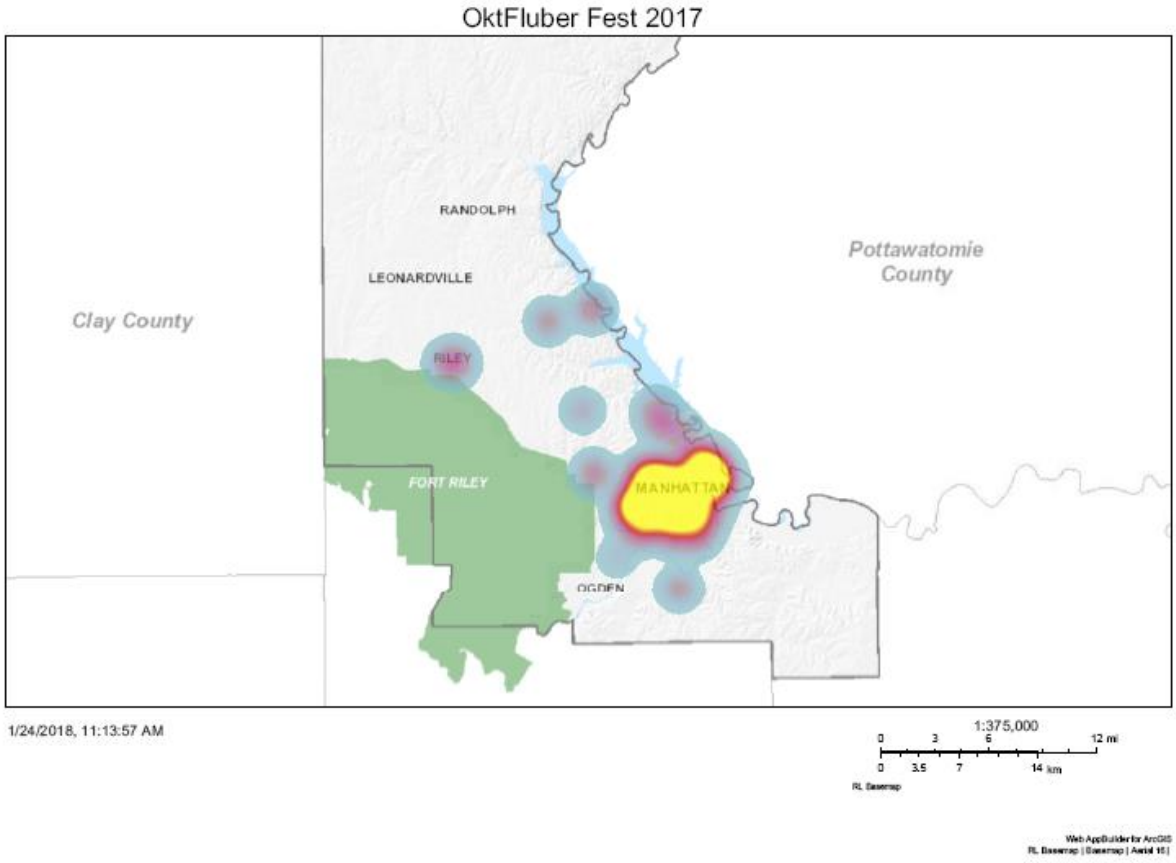
Geographic Information Systems (GIS) was used to create a visual depiction of the location of Riley County Okt-FLU-ber Fest attendees, as well as the relationship between the location of the attendees and possible health inequities. Health inequity refers to a type of health inequality where the difference in health between groups is unjust. Socioeconomic status is a significant health inequity, as those with low socioeconomic status tend to suffer more from health related problems and have less access to health care than those with high socioeconomic status. Poverty status and household income are important factors of socioeconomic status. Often, having access to a vehicle is a result of socioeconomic status, and is important in accomplishing tasks such as getting to work or accessing health care (Arcaya, M. C., Arcaya, A. L., & Subramanian, 2015). The objective of this analysis was to determine the outreach success of the health department in areas of greater health inequity. The analysis of possible inequities focused on Manhattan residents because that is where most of the attendees were from.

Map 1. Residence of Individuals Vaccinated at Okt-FLU-ber Fest



Map 1 shows the location of each individual that was vaccinated at Okt-FLU-ber Fest. Each plot on the map represents the place of residence of each attendee based on the home address that they provided. Most of the attendees are from Riley County, and several from Pottawatomie County. There were also individuals from Wabaunsee County and Clay County.

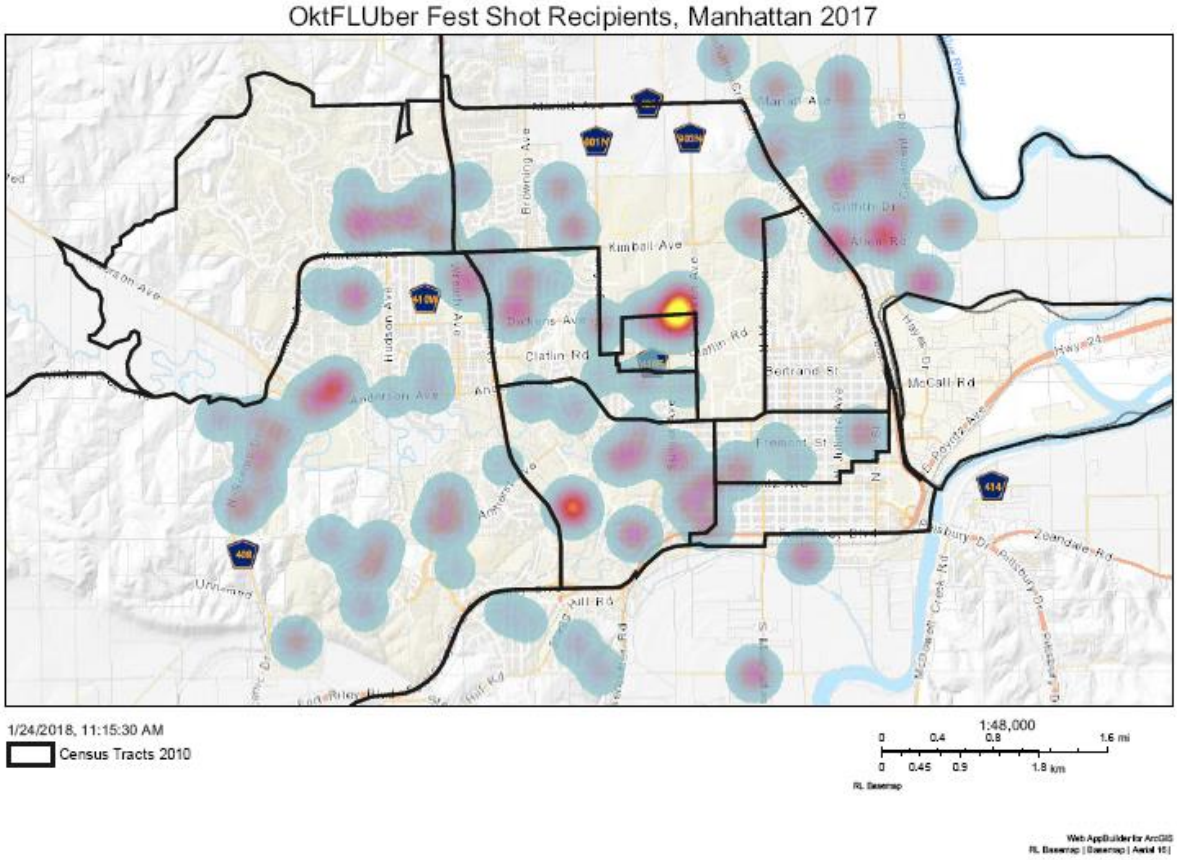
Map 2. Residence of Individuals Vaccinated at Okt-FLU-ber Fest in Riley County, KS



Map 2 is a heat map that represents the location of Riley County residents vaccinated at Okt-FLU-ber Fes. Of the 435 total attendees, 342 were Riley County residents. The heat map is used to show the concentration or relative amount of individuals from each location that attended Okt-FLU-ber Fest. The blue areas indicate less concentration or fewer attendees from the area. The yellow area indicates the most concentration or the most attendees, which was Manhattan. The pink or red areas represent concentrations in-between that of the blue and yellow areas.

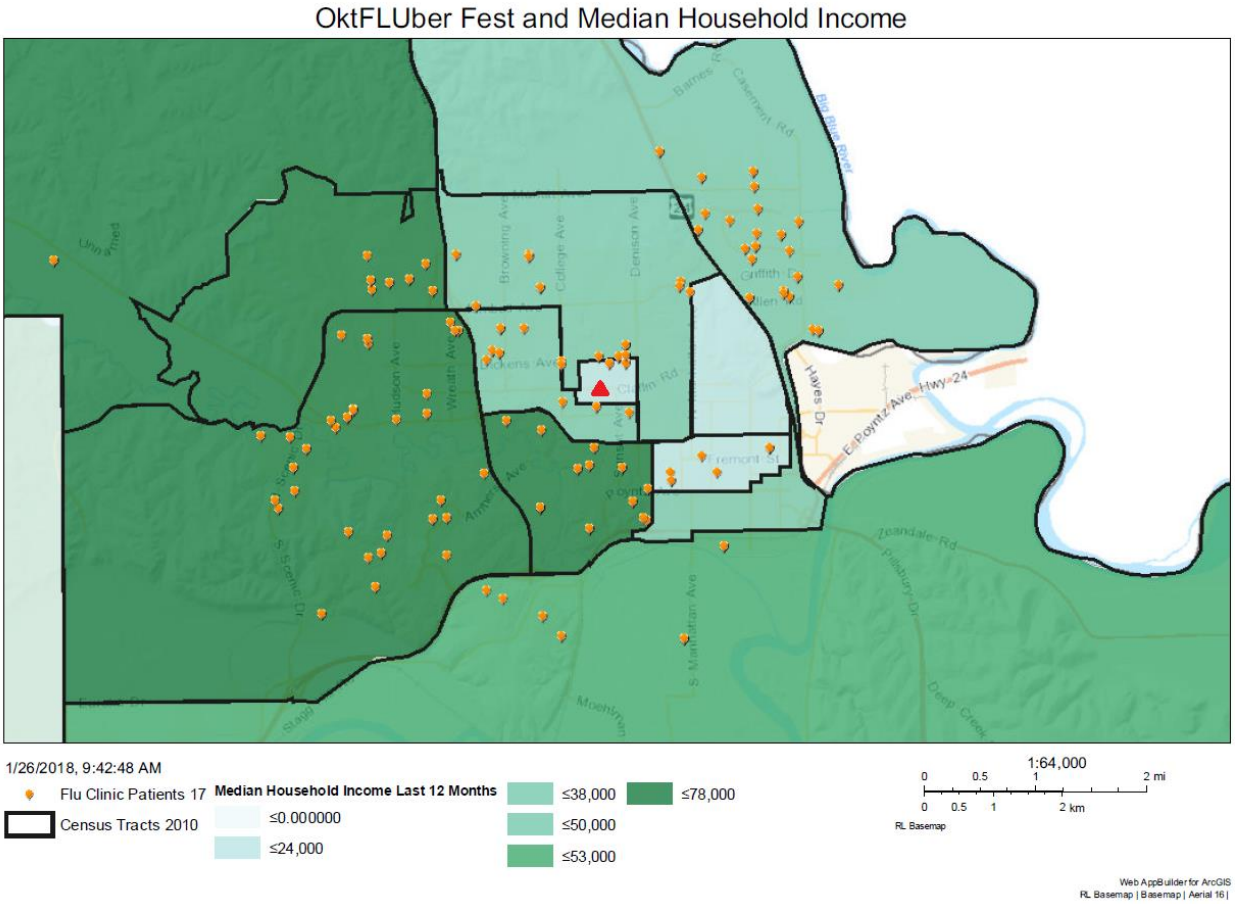
This information will be useful for the health department to determine future flu clinic locations and where to increase education efforts, based on areas of low attendance. Additionally, since the majority of the population of Riley County resides in Manhattan, it makes sense that most of the attendance was from this area. The map also shows that the area with the least attendance was in the northern part of the county.

Map 3. Residence of Individuals Vaccinated at Okt-FLU-ber Fest in Manhattan, KS



Map 3 should be interpreted the same as Map 2 in regards to the concentration in each area. However, Map 3 represents only the city of Manhattan, as opposed to all of Riley County. Map 3 shows that the area of least attendance was in the northeast part of Manhattan and around the Kansas State University campus.

Map 4. Median Household Income in Manhattan, KS



*There is an error in the key. The values representing each color aside from the lowest value should indicate a greater-than-or-equal-to sign.

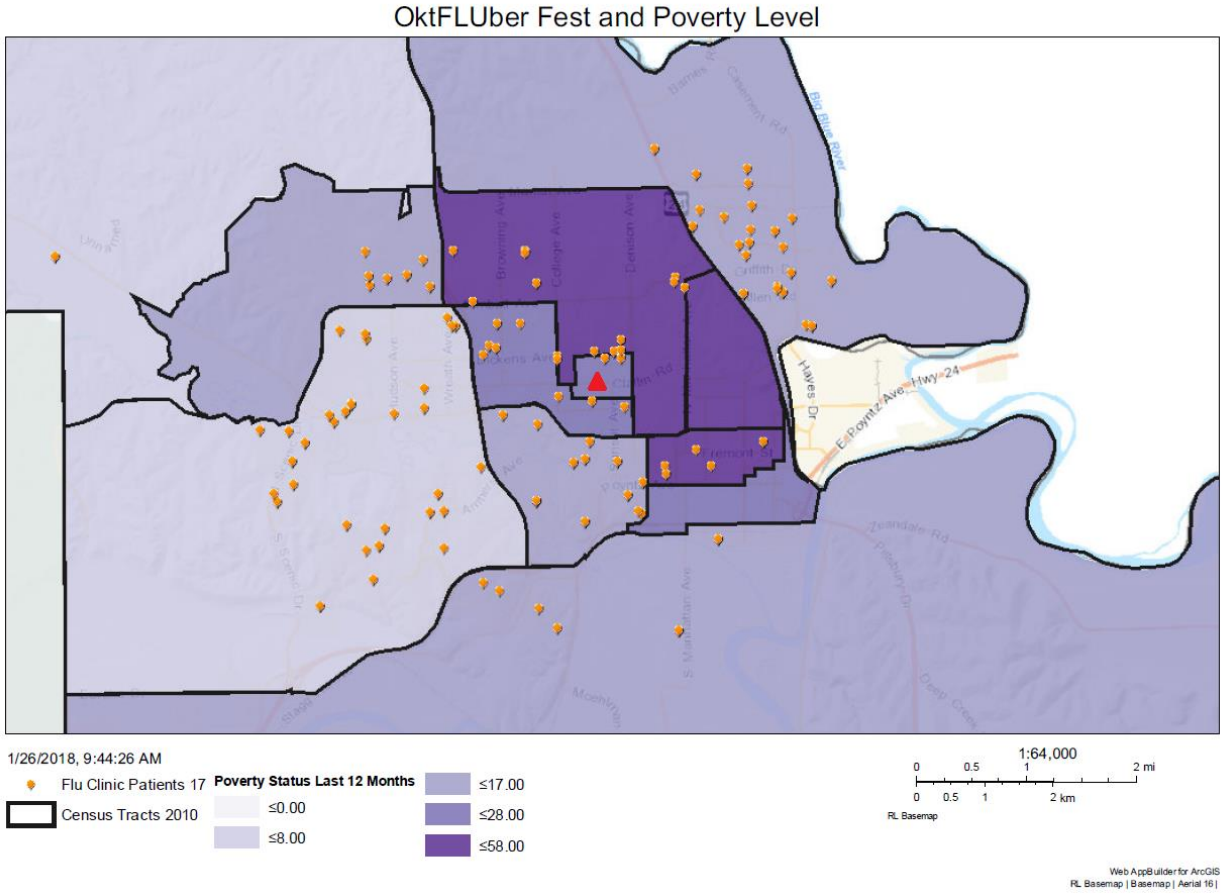
Map 4 represents the relationship between individuals from Manhattan that attended Okt-FLU-ber Fest and median household income. This comparison was done to determine the health department's success in reaching areas of the community with low income. Each of the orange plots on the map represents the location of each Manhattan resident that was vaccinated at the event. The location of Okt-FLU-ber Fest is indicated by the red triangle. The different shades of green represent the median household income for each area, as described in the key. The lighter shades correspond with a lower median household income and the darker shades correspond with a higher median household income.

It is interpreted from this map that RCHD was successful in terms of outreach to areas of Manhattan with lower household income. In particular, there was a lot of attendance from the northeast region of the map, which is a concentrated area of low income. The large area of lower income north of the event location that has little attendance is the location of Kansas State

University. This area contains a lot of students in the population. It is likely that low attendance in this area is correlated with the large college student population, as many students are not Manhattan residents or are under their parents' health insurance, and thus received a vaccination elsewhere.

The map indicates that there was no attendance from one of the census tracts in the southeast region of the map. This area is heavily populated and therefore it should be looked into further why there was no attendance, so changes can be made in the future to increase attendance from this area. The census tract east of the event location that had no attendance is comprised of mainly businesses and has a lower population which most likely explains the lack of attendance.

Map 5. Poverty Level in Manhattan, KS



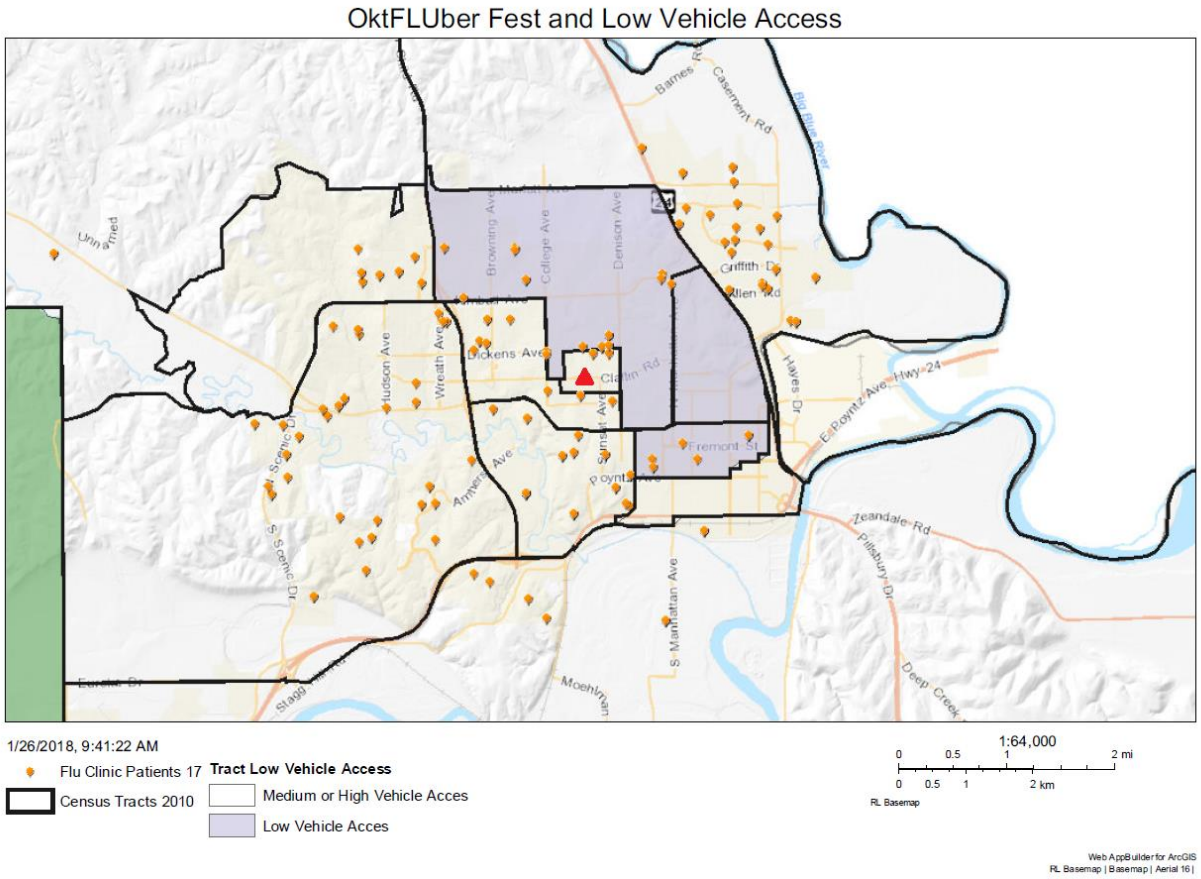
*There is an error in the key. The values representing each color aside from the lowest value should indicate a greater-than-or-equal-to sign.

Map 5 depicts the relationship between Okt-FLU-ber Fest attendees from Manhattan and poverty status. The comparison was analyzed to determine attendance at Okt-FLU-ber Fest from

areas of higher poverty status. The different shades of purple represent the amount of poverty status in each area. The darker shades indicate higher poverty status and the lighter shades indicate less poverty in those areas. Each of the orange plots on the map represents the location of each Manhattan resident that was vaccinated at the event. The location of Okt-FLU-ber Fest is indicated by the red triangle.

The results of this map are similar to those of the map with median household income, (Map 4). Again, attendance rate was low in the high poverty status region where Kansas State University students are located. There was a lot of attendance from areas of higher poverty status, except for the census tract in the southeast region area that showed no attendance.

Map 6. Vehicle Access in Manhattan, KS



Map 6 shows the relationship between Okt-FLU-ber Fest attendees from Manhattan and vehicle access. This comparison was done to see if there is a correlation between attendance at the event and vehicle access. Each of the orange plots on the map represents the location of each Manhattan resident that was vaccinated at the event. The location of Okt-FLU-ber Fest is

indicated by the red triangle. The darker color indicates areas of low vehicle access and the lighter color indicates medium or high vehicle access. The map depicts a potential relationship between low vehicle access and low attendance. Having access to a vehicle is a potential factor in whether or not an individual will travel to a location that is further than their personal perception of "walking distance".

Additionally, most of the region of low vehicle access is comprised of Kansas State University students, many of whom do not have access to a vehicle. This correlation would be worth looking into by the health department to determine if vehicle access is a factor in the low rate of attendance from this area that is heavily populated by students. It would be useful for the health department to know if individuals from this area are not attending because of low vehicle access or if it is due to other reasons. The map also shows that the census tract with no attendance is not correlated with vehicle access, as this area is not indicated as having low vehicle access. Therefore, vehicle access is likely not a factor in the lack of attendance from this area and increases the need to further assess this.

Chapter 4 – Discussion/Conclusion

The results showed that receiving an influenza vaccination is economically beneficial on an individual, county, and societal level. The averted costs represent the amount an individual could potentially save by not suffering from common outcomes of the flu, such as outpatient care, virus detection tests, and antiviral prescriptions. The results show the total amount of potential averted costs to the attendees, $2,787.26-$17,661.01. Additionally, the results show the amount of potential averted costs to Riley County specifically, which was $2,263.30-$13,276.97. This shows that Okt-FLU-ber Fest could be very economically beneficial to the county during flu season. Furthermore, the cost-benefit analysis showed that the event is economically beneficial to the Riley County Health Department. The total revenue to the health department from the event is approximately $3,345.56.

The comparison between the events in 2016 and 2017 showed that the most recent event had additional potential averted costs to the public of Riley County. The event in 2017 administered 78 more vaccines than the event in 2016, increasing the amount of vaccinated and individuals and potential averted costs in the county. This increase in administered vaccines could be due to the event in 2017 being held for two hours longer than in 2016. This information will be helpful for the health department to plan the length of the event in the future as it has proved beneficial to hold the event for a longer period of time.

There are possible limitations to the cost-benefit analysis. First and foremost, the vaccine efficacy (VE) of the 2017-2018 flu vaccine is an early-season estimate and has the potential to change at the end of the flu season. Additionally, influenza is not a reportable disease and therefore the attack rate of individuals in the unvaccinated population cannot be precisely determined.

Map 1 shows a visual depiction of where the individuals that received a vaccination at Okt-FLU-ber Fest reside. This map concludes that most of the individuals that attended the event were from Riley County. More specifically, Map 2 shows that most of the individuals that attended from Riley County were Manhattan residents. This information will be useful for the health department to determine future flu clinic locations and where to increase education efforts, based on areas of low attendance. The areas of particularly low attendance include the northern part of the county and the southeast region of Manhattan. RCHD can make it a priority to host

mobile clinics in these areas for future flu seasons to ensure outreach to individuals in those areas.

Map 4 represents the correlation between attendance at Okt-FLU-ber Fest and median household income in Manhattan. It was interpreted from the results of this map that the health department was successful in reaching individuals from low income areas. Income is a potential health inequity, as it often determines if individuals receive preventive care, such as immunizations. Therefore, it is important for the health department to provide vaccine coverage to these individuals.

Map 5 was used to depict the relationship between poverty level in Manhattan and Okt-FLU-ber Fest attendance. Similar to Map 4, the results showed that the health department was overall successful in reaching populations with of higher poverty status. It was expected for poverty level and median household income to show similar results. As with income, poverty level is a major potential health inequity and it is important for the health department to provide coverage to these individuals. To potentially increase attendance in areas with low household income and poverty status, RCHD could offer more 317 vaccines for adults without health insurance, as well as educate these individuals on the economic benefit of the vaccine.

Similarly, Map 6 shows the correlation between vehicle access and attendance at Okt-FLU-ber Fest. The map depicts a potential correlation between low vehicle access and low attendance. Vehicle access is a potential factor in whether or not an individual is able to access health care; therefore, it is reasonable that fewer individuals attended the event from areas where there is less accessibility to vehicles. Again, providing mobile flu clinics in these areas of low vehicle access could be beneficial in ensuring vaccine coverage. Additionally, RCHD could work with The Flint Hills Area Transportation Agency (aTa Bus) to schedule routes from these areas to Okt-FLU-ber Fest to enable individuals without vehicle access to attend.

It may be beneficial for RCHD to increase advertising for Okt-FLU-ber Fest in these areas of low attendance, particularly the census tract in the southeast region of Manhattan that had no attendee. The Flint Hills Breadbasket and the Douglas Center could be beneficial locations for future clinics to ensure vaccine coverage in this area. The analysis of the ages of the individuals vaccinated showed that the health department was successful in reaching their key target population: individuals between the ages of 5 and 18. Influenza is most prevalent among

individuals age 5-18 years, and thus that is a beneficial population to target for the flu vaccine. Almost half of all the attendees were in this age group.

In conclusion, Okt-FLU-ber Fest was successful overall in terms of outreach to the target age population and areas of greater health inequity. The event is economically beneficial to the health department, the individuals that receive a vaccine, and the public of Riley County. Moving forward, the health department will utilize this data for planning this annual event in the future. Additionally, this information can be used for the health department to plan other events, such as their mobile immunization clinics and annual "BugAPalooza" event, which is an educational event including, but not limited to, bug bite prevention, outdoor safety, and hand hygiene. Vaccination for tetanus, diphtheria, and pertussis (Tdap) is also offered at BugAPalooza.

Chapter 5 - Culminating Experience

Table 12. Summary of MPH Foundational Competencies

Competency	**Description**
3. Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software, as appropriate.	Graphic Information Systems (GIS) was used to interpret quantitative and qualitative data regarding Okt-FLU-ber Fest attendees.
4. Interpret results of data analysis for public health research, policy or practice.	Data from Okt-FLU-ber Fest was collected and the results were analyzed in order for the Riley County Health Department to improve the event in the future to benefit the community.
7. Assess population needs, assets and capacities that affect communities' health.	Potential health inequities in the community were assessed such as low income, poverty status, and low vehicle access. The relationship between these factors and attendance at Okt-FLU-ber Fest was evaluated.
11. Select methods to evaluate public health programs.	Okt-FLU-ber Fest, a public health program, was evaluated based on a cost-benefit analysis and outreach success in the community.
21. Perform effectively on interprofessional teams.	Internship/field experience required working with Riley County Health Department employees.

The activities performed in this field experience incorporated five of the 22 MPH Foundational Competencies. The five integrated competencies are as follows:

1. (3.) Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software, as appropriate.

Graphic Information Systems (GIS) was heavily utilized in this analysis to interpret the data of Okt-FLU-ber Fest. GIS is used to visualize, analyze, and interpret data to understand relationships, patterns, and trends. The use of GIS mapping promotes better decision making for organizations (What is GIS, n.d.). From this analysis, GIS will allow the health department to make decisions about future events, such as location of the events and location of increased education efforts. GIS was used to analyze the data both quantitatively and qualitatively. The

GIS maps showed the quantitative data of each analyzed factor, such as percentage of uninsured adults and income. The maps were used to analyze data qualitatively by layering these factors together with the plots of each resident that attended the event, which allowed for determining if there were any relationships between attendance and possible health inequities.

2. (4.) Interpret results of data analysis for public health research, policy or practice

The main tasks required for this project were to collect data, analyze the data, and interpret the results in order to enable the Riley County Health Department to improve their influenza outreach event. I gathered the records containing all of the necessary information to assess Okt-FLU-ber Fest. I analyzed the data in these records and determined the economic benefit and impact on the community of the event. This information will be used by the health department to determine any changes that need to be made to this annual event in the future, such as location, use of resources, and outreach strategies. The goal of the department by making these changes and improving their flu prevention outreach is to ultimately improve the health of the community.

3. (7.) Assess population needs, assets and capacities that affect communities' health

A large part of the analysis was to assess the outreach success of the event, specifically in areas with possible health inequities. The health inequities that were examined included poverty status, low household income, and low vehicle access. GIS mapping was used to assess the attendance rate of these particular areas in Manhattan. It is important for the health department to acknowledge if health inequities are contributing to a lack of attendance at Okt-FLU-ber Fest so future planning for the event can be made to better accommodate these individuals.

4. (11.) Select methods to evaluate public health programs

The purpose of this project was to evaluate a public health program provided by the Riley County Health Department, Okt-FLU-ber Fest. The goal of this annual event is to increase the number of influenza vaccinations administered in Riley County, and ultimately, to decrease the incidence and/or severity of influenza in the county during flu season. Thus, Okt-FLU-ber Fest is considered a public health program. I evaluated Okt-FLU-ber Fest based on cost-benefit and outreach success to allow the health department to improve the event in the future and benefit the health of the community.

5. (21.) Perform effectively on interprofessional teams

This field experience was completed during a six month internship at the Riley County Health Department. During the internship, I was required to dress and act professionally as a temporary member of the health department professional team. I also had my own workspace, where I was expected to complete the tasks for my project. I attended several meetings with staff members, where I was able to interact with and observe the duties of the employees. This included meetings with the department's "Epidemiology Team", all-staff meetings, and emergency preparedness meetings. I attended a "Leadership Team" meeting where I presented my findings for the Okt-FLU-ber Fest analyses. The employees in attendance at this meeting were supervisors from each program of the health department. I met with employees individually as well to learn about their position and what their respective program does for the county, including the Family Connections Supervisor, the Child Care Facilitator/Manager, and the Senior GIS Analyst.

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Appendix 1- Economic Impact Report

The Economic Impact of Okt-FLU-ber Fest 2017

Okt-FLU-ber Fest 2017, held on October 26, was the sixth annual event hosted by the Riley County Health Department. Okt-FLU-ber Fest is a family-friendly influenza vaccination event, with the goal to provide a large number of flu shots to children and their families throughout the community. There were a total of 435 flu vaccinations administered at Okt-FLU-ber Fest 2017, making it the most successful of this annual event to date. A cost-benefit analysis of this vaccination program was conducted to determine the economic benefit of the event at an individual, community, and societal level.

Table 1. Cost to Attendees to Receive Vaccination

Vaccine Type	# Administered	Price per Dose	Total Cost
Private PF 6-35 m	30	$38	$1,140
Private PF >36 m	274	$38	$10,412
Public PF 6-35 m	22	$18	$369
Public PF >36 m	86	$18	$1,548
317 PF >36 m	18	$0	$0
High Dose	5	$63	$315
Total	**435**		**$13,784**

Table 1 shows the breakdown of each vaccine type provided at Okt-FLU-ber Fest, the number administered of each type, and the out-of-pocket price for attendees to be vaccinated. A total of $13,784 was spent by the 435 attendees to receive an influenza vaccination at Okt-FLU-ber Fest. Taking the average cost of vaccination per person, plus the cost of lost income to attend the event (assuming approximately one hour of work is missed), gives an estimated cost of $43.18 for each person to attend Okt-FLU-ber Fest and to be vaccinated.

Table 2. Averted Costs from Okt-FLU-ber Fest (without health insurance)

Total Costs per Person For Outpatient Care & Lost Income	Cost Towards Vaccines per person	Averted Costs per Person	Total Averted Societal Costs
$612.89	**$43.18**	**$569.71**	**$17,661.01**

Table 3. Averted Costs from Okt-FLU-ber Fest (with health insurance)

Total Costs per Person For Outpatient Care & Lost Income	Cost Towards Vaccines per person	Averted Costs per Person	Total Averted Societal Costs
$441.36	**$43.18**	**$398.18**	**$2,787.26**

Table 2 shows the amount of potential averted costs to the Okt-FLU-ber Fest attendees for being vaccinated against the flu for those without health insurance, and Table 3 represents the averted costs for those with health insurance. The first column is the calculation of potential outpatient care costs, including a doctor's visit, lab work, and an antiviral prescription, and the potential cost of lost income from missed work. The averted cost per person is the total potential

cost of medical care and lost income per person, minus the average cost per person to attend Okt-FLU-ber Fest and be vaccinated. The potential costs averted for each person is in the range of $398.18-$569.71. The total potential societal costs averted for 435 administered vaccinations is $2,787.26-$17,661.01.

Table 10. Averted Costs to Riley County

Averted Costs per Person	Vaccines Administered to Riley County Residents	Cost to RCHD to Host Event	Adjusted Averted Costs to Riley County
$398.18 - $569.71	**342**	**$10,438.44**	**$2,263.30-$13,276.97**

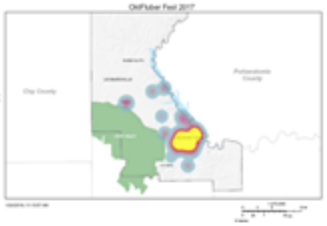
Table 10 shows the amount of averted costs to Riley County. Of the 435 vaccinations administered at Okt-FLU-ber Fest, 342 of them were Riley County residents. After adjusting for the amount that the health department spent to host Okt-FLU-ber Fest (which includes supplies, purchase of vaccines, and cost of labor), the total averted costs to the county are between $125,739.12 and $184,402.38.

Appendix 2- Presentation to RCHD Leadership Team

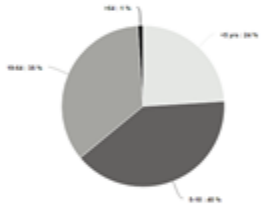
Analysis of Okt-FLU-ber Fest 2017

Location of Attendees: Event Outreach

- Total Vaccinations: 435
- Riley County Residents: 342
- Manhattan Residents: 339



Age Distribution of Attendees



<5 yrs: 24%

5-18 yrs: 40%

19-64 yrs: 35%

>64 yrs: 1%

Cost to Attendees

Avg: $31.68/person

Vaccine Type	# Administered	Price per Dose	Total Cost
Private PF 6-35 m	30	$38	$1,140
Private PF >36 m	274	$38	$10,412
Public PF 6-35 m	22	$18	$369
Public PF >36 m	86	$18	$1,548
317 PF >36 m	18	$0	$0
High Dose	5	$63	$315
Total	435		$13,784

Cost to RCHD

Vaccine Type	# Administered	Price per Dose	Total Cost
Private PF 6-35 m	30	$16.53	$495.90
Private PF >36 m	274	$16.53	$4,529.22
Public PF 6-35 m	22	$0	$0
Public PF >36 m	86	$0	$0
317 PF >36 m	18	$0	$0
High Dose	5	$42.44	$212.00
Total	435		$5,237.12

Cost to RCHD

Supplies	Cost
Pumpkins	$437
Popcorn	$34
Advertisement	$50
Snacks	$30
Face Painting	$40
Band-Aids	$28.90
Alcohol Wipes	$19.47
Nitrile Gloves	$87.55
Syringe + Needle	$44.15
Total	$771.07

Cost of Labor	
Staff	35
Hours	5
Hourly Wage	$25.31
Cost of Labor	$4,429.25

Revenue

Total Cost to RCHD:
- Cost of Vaccines
- Cost of Labor
- Cost of Supplies

Total Cost to Consumer	Total Cost to RCHD	Revenue
$13,784	$10,438.44	$3,345.56

The Cost of Influenza: Medical Care

Medical Service	Avg. Cost (no insurance)	Avg. Cost (w/ insurance)
Medical Care (Outpatient)	$96	$29
Influenza Virus Test	$41	$12
Tamiflu Prescription	$107.89	$32.36
Total Outpatient Cost	$244.89	$73.36

Inpatient Medical care not included

(Fair Health Consumer, n.d.)

The Cost of Influenza: Lost Income

Avg. Hourly Salary in Riley County	Avg. Hours of Work Missed per Person	Avg. Lost Income
$11.50	32	$368

(Kaslow, Stanberry, & Le Duc 2014)

Cost to Attend Okt-FLU-ber Fest

Avg. Cost of Vaccination at Event	Avg. Hours of Work Missed to Attend Event	Avg. Hourly Salary	Avg. Cost of Attendance + Vaccination
$31.68	1	$11.50	$43.18

Averted Cost to Attendees

$398.18 - $569.71
(per person)

$173,208.30 - $247,823.85
(total for 435 attendees)

Total Costs per Person For Outpatient Care (without insurance) + Lost Income	Cost Towards Vaccines per person	Averted Costs per Person	Total Averted Costs to Attendees (x435)
$612.89	$43.18	$569.71	$247,823.85

Total Costs per Person For Outpatient Care (with insurance) + Lost Income	Cost Towards Vaccines per person	Averted Costs per Person	Total Averted Costs to Attendees (x435)
$441.36	$43.18	$398.18	$173,208.30

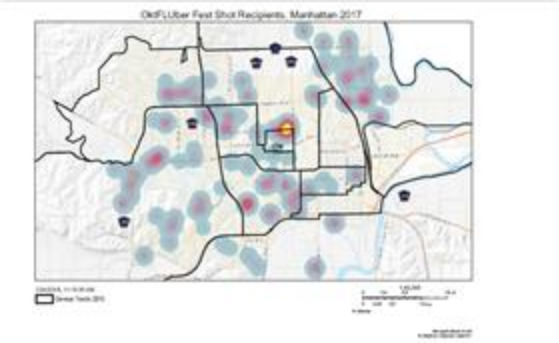
Averted Cost to Riley County

Averted Costs per Person	Vaccines Administered to Riley County Residents	Cost to RCHD to Host Event	Adjusted Averted Costs to Riley County
$398.18 - $569.71	342	$10,438.44	$125,739.12 - $184,402.38

Compare: 2016 to 2017

2016	
Length	3 hours
# Vaccinations Administered	357
RCHD Revenue	$2,644.02
Averted Costs to Public	$142,150.26 - $203,386.47

Conclusion
- 78 more vaccinations administered in 2017 than 2016
- $31,058.04 - $44,437.38 more in potential costs averted to the public in 2017 than 2016



Median household income and attendance

Poverty level and attendance

Low vehicle access and attendance

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