Master of Public Health Field Experience Report

High Risk Conditions and Vaccination Gaps in Invasive Pneumococcal Disease Cases in Tennessee, 2011-2016

By

VICTORIA KINLEY REED

MPH Candidate

Submitted in partial fulfillment of the requirements for the degree

MASTER OF PUBLIC HEALTH

Graduate Committee:

Dr. Ellyn Mulcahy

Dr. Jodi McGill

Dr. Natalia Cernicchiaro

Field Experience Site:

Tennessee Emerging Infections Program

February 1, 2017-May 30, 2017

Field Experience Preceptors:

William Schaffner, MD

Dr. Tiffanie Markus, PhD

KANSAS STATE UNIVERSITY

Manhattan, Kansas

2017

Copyright

Abstract

During my four months with the Tennessee Emerging Infections Program (EIP), I was able to consistently grow and apply my knowledge of public health. Vanderbilt University Medical Center was an exceptional place to carry out my Master of Public Health field experience. I was not only exposed to public health in the areas of epidemiology and surveillance, but I also gained valuable experience regarding public health activities performed within a hospital setting. The Infectious Disease physicians, the Emerging Infections Program staff, and all of the Health Policy staff members and students were beyond supportive during my time at Vanderbilt. Through my field experience and my capstone project, I was able to learn specific surveillance methods, extract patient information from medical charts and forms, navigate through pertinent databases, and properly gain informed consent from patients.

I completed a primary project and several minor projects during my time at Vanderbilt. My minor projects consisted of data entry for the surveillance of non-invasive pneumococcal pneumonia (SNiPP) study, data cleaning/auditing for the pneumococcal carriage study, and additional tasks with each team in EIP. My capstone project involved the gram-positive bacterium *Streptococcus pneumoniae.* This pathogen, also known as pneumococcus, causes acute bacterial infections and can easily become life threatening. During this project, I extracted medical information from medical records and databases to conduct a descriptive statistic analysis on *Streptococcus pneumoniae*. The purpose of my project was to evaluate cases of invasive disease, and to investigate underlying conditions and populations that had invasive pneumococcal disease (IPD) due to lack of vaccination.

Table of Contents

List of Boxes

List of Figures

Acknowledgments

I would like to thank Drs. William Schaffner and Tiffanie Markus for allowing me to complete my MPH field experience at Vanderbilt with the Emerging Infections Program. Their willingness and efforts to teach me about surveillance was an incredible opportunity that will have an everlasting effect on my future career. Additionally, I would like to thank Cassie Jones, Brenda Barnes, Dr. Keip Talbot, and Danielle Ndi for their endless assistance on my capstone project during my time at Vanderbilt. I would also like to thank the entire EIP staff for allowing me to learn from them, and for also making me feel at home the very first day.

I would like to thank my major advisor, Dr. Ellyn Mulcahy, for not only assisting me during my field experience, but for going above and beyond in helping me throughout my Kansas State MPH career. I would also like to thank my additional committee members, Dr. Jodi McGill and Dr. Natalia Cernicchiaro, for their assistance, encouragement, and guidance throughout this process.

Finally, I would like to thank my family for always encouraging me to follow my dreams and instilling a hard work ethic in me at an early age. I would also like to say thank you to my sister, Katy, for being beyond supportive, and for also being a great study buddy during my time at Kansas State University.

List of Abbreviations

EIP Emerging Infections Program

CDC Centers for Disease Control and Prevention

TEIP Tennessee Emerging Infections Program

VUMC Vanderbilt University Medical Center

TDH Tennessee Department of Health

SO Surveillance Officer

HPV Human Papillomavirus

ABCs Active Bacterial Core Surveillance

CEDEP Communicable and Environmental Diseases and Emergency Preparedness

CRF Case Report Form

IRB Institutional Review Board

GBS Group B *Streptococcus*

GAS Group A *Streptococcus*

IR Incidence Rate

UAT Urine Antigen Test

ACIP Advisory Committee on Immunization Practices

Chapter 1: Field Experience-Emerging Infections Program, Nashville, TN

In 1995, the Centers for Disease Control and Prevention (CDC) established the Emerging Infections Program (EIP) in response to the growing population, an increase in poverty, and the heightened international travels. The EIP is a network of state health departments and collaborators such as, public health and clinical laboratories, state and federal agencies, academic establishments, and healthcare providers. This program is a resource for surveillance, control, and prevention of infectious diseases (Centers for Disease Control and Prevention, 1994). Box 1.1 shows the objectives of the Emerging Infections Program.

[1]

Box 1.1. Objectives of the Emerging Infections Program (Centers for Disease Control and Prevention, 1994)

Currently there are ten EIP sites in the states of California, Colorado, Connecticut, Georgia, Maryland, Minnesota, New Mexico, New York, Oregon, and Tennessee.

The EIP is divided into four areas of concern consisting of invasive bacterial diseases, food-borne illnesses, healthcare associated infections (HAI), and influenza. Within the invasive bacterial diseases area, there is the Active Bacterial Core Surveillance (ABCs) program, which focuses on the epidemiology and surveillance of invasive bacterial diseases. The invasive bacterial pathogens currently under surveillance include: Group A *Streptococcus* (GAS), Group B *Streptococcus* (GBS), *Haemophilus influenza*, *Neisseria meningitidis*, *Streptococcus pneumoniae*, and Methicillin-Resistant *Staphylococcus aureus* (MRSA). Nationwide there are approximately 39 million people under ABC surveillance (Centers for Disease Control and Prevention, 2017).

The FoodNet segment of EIP is a collaboration project of the CDC, the ten EIP sites, the USDA, and the FDA. The project entails active surveillance of the pathogens, *Salmonella*, *Shigella*, *Campylobacter*, Shiga-toxin producing *Escherichia coli*, *Listeria*, *Yersinia*, *Vibrio*, *Cryptosporidium*, and *Cyclospora*. Well over 15% of the United States population falls within the FoodNet surveillance catchment area (Centers for Disease Control and Prevention, 2017).

The Healthcare Associated Infections-Community Interface (HAIC) program carries out active surveillance healthcare associated infections (HAI) such as, *Clostridium difficile* and other multi-drug resistant gram-negative bacteria (Centers for Disease Control and Prevention, 2017). In addition to this, the Influenza Hospitalization Surveillance Network (Flu-Surv Net) utilizes surveillance data to evaluate the severity of influenza outbreaks and to assess the effectiveness of influenza vaccines. Furthermore, EIP also conducts smaller projects that involve tick-borne

diseases (TickNet) and Human Papillomavirus (HPV-IMPACT) (Centers for Disease Control and Prevention, 2017).

The Tennessee Emerging Infections Program (TEIP) has a close relationship with over 130 statewide laboratories, and collaborates with Vanderbilt Medical Center, the Tennessee Department of Health (TDH), as well as other institutions (Tennessee Department of Health, 2017). TEIP activities are carried out in all 95 counties, covering a population of 6.5 million (Tennessee Department of Health, 2017). During my time with EIP, I had the privilege to not only work with an amazing team at Vanderbilt Medical Center, but I was also able to participate in events and weekly surveillance meetings at the Communicable and Environmental Diseases and Emergency Preparedness (CEDEP) at TDH.

Tennessee Emerging Infections Program-Vanderbilt Medical Center

Projects

The Tennessee Emerging Infections Program participates in three main projects: Active Bacterial Core Surveillance, Flu-Surv NET, and the HPV-IMPACT Project. Additionally, minor programs, TickNET and HAIC, are also conducted onsite. While the EIP team is closely intertwined, all personnel are appointed specific projects and tasks. During my first few weeks at Vanderbilt, I was able to shadow all teams within EIP. Although my major and minor project fell within the ABCs project, I had the opportunity to learn about the additional programs, Flu-Surv NET and HPV IMPACT.

Active Bacterial Core Surveillance

For my capstone project, I used ABCs protocols as well as descriptive statistics to understand and highlight knowledge of these specific invasive bacterial diseases, which will be explained in Chapter 4.

SNiPP:

The Surveillance for non-invasive pneumococcal pneumonia (SNiPP) is part of the ABCs program. Pneumococcal pneumonia is a common bacterial complication of influenza and causes an estimated 400,000 hospitalizations within the United States each year (Centers for Disease Control and Prevention, 2015). As a minor project, I assisted in data entry for the SNiPP project, which will be described in Chapter 3.

Streptococcus pneumoniae:

Among the multiple bacteria that fall within the ABCs category, *Streptococcus pneumoniae* is a gram-positive organism that has recently become a hot topic in the media and healthcare fields. Major clinical conditions of pneumococcal disease are pneumonia, meningitis, and bacteremia (Centers for Disease Control and Prevention, 2015). While adults 65 years and older are at risk for pneumococcal disease, adults and children with immunosuppressant conditions are at the highest risk of infection (Musher et al, 2015). Some studies suggest that children with immunosuppressant illnesses, such as human immunodeficiency virus (HIV) and sickle cell disease, are 50 times more likely to become infected with an invasive disease (Centers for Disease Control and Prevention, 2015). More so, the rate of invasive bacterial disease in adults with HIV infection is estimated to be 174 per 100,000 people (Centers for Disease Control and Prevention, 2015). Consequently, CDC recommends the routine vaccination of adults that are ≥ 65 years and/or those with underlying conditions (Centers for Disease Control and Prevention,

2010). As my primary project, I evaluated populations that had IPD due to lack of vaccinations, which will be discussed further in Chapter 4.

Flu-Surv NET

The TEIP has been involved in influenza surveillance, Flu-Surv NET, since 2003. Influenza is responsible for more than 200,000 hospitalizations and 3,300 to 49,000 deaths annually in the United States (Centers for Disease Control and Prevention, 2017). Yearly, the EIP sites collect critical influenza information that indicate the severity of that particular influenza season, determine mortality and morbidity rates, and also guide recommendations for future influenza seasons (i.e., vaccines and treatments). Adult and pediatric cases are included in the influenza surveillance, which is conducted in eight Tennessee counties, representing approximately 24% of the state's population (Tennessee Department of Health, 2017). All influenza data are sent to the CDC for the Flu View weekly surveillance report. On the first day of my field experience, I was able to sit through a routine flu meeting with the EIP team. During these meetings, influenza morbidity and mortality rates are discussed. More so, team members would discuss unusual influenza cases, and brainstorm for future measures that might prove beneficial. These measures included discussing severity of illness, recognizing high-risk conditions, and discussing influenza vaccination rates among the population in Tennessee. I continued to partake in the numerous influenza meetings held throughout the 2016-2017 influenza season.

HPV-IMPACT

Human Papillomavirus (HPV) is the most common sexually transmitted disease (STDs) in the United States (Centers for Disease Control and Prevention, 2017). Since 2008, Tennessee has been performing population-based surveillance for cervical dysplasia among females ≥ 18 years old that reside in Davidson County. More so, population-based surveillance involves identifying all new cases of HPV in the Tennessee catchment areas. The HPV-IMPACT project was

developed as part of the CDC HPV-IMPACT project to evaluate the epidemiology of cervical cancer precursors in the vaccine era. Currently, there are three licensed vaccines (Cervarix, Gardasil, and Gardasil 9) that prevent certain types of HPV (Centers for Disease Control and Prevention, 2017). Initially, the HPV-IMPACT project caught my attention as a possible capstone project due to my interests in reproductive health. I was able to meet with the team and discuss their roles in the project, how the project impacted vaccine and treatment research, and also where Tennessee fell within the HPV vaccination rates. Unfortunately, there was not an ongoing project for me to assist on at the time, but I continued to stay informed about the HPV-IMPACT program during my time at Vanderbilt.

Tennessee Department of Health

My experience with the Tennessee Department of Health allowed me to grasp a profound knowledge of multiple aspects of public health. The experience aided me in growing and applying my knowledge of public health that I have obtained thus far at Kansas State University. I was able to meet with multiple public health officials and then discuss their major roles in the health of the state. Additionally, I was able to attend weekly surveillance meetings at the Tennessee State Health Department, where I was informed of disease outbreaks and other health issues throughout the state.

Chapter 2: 2017 Data Entry for Surveillance for Non-Invasive Pneumococcal pneumonia (SNiPP) in ABCs

Introduction

Pneumococcal pneumonia is the most common form of pneumococcal disease in adults, and is known to follow influenza infection (Mccullers, 2006). Influenza and pneumococcal diseases are two of the most common illnesses that affect humans today (Mccullers, 2006). Bacterial infections following the influenza viruses are highly common in adults and children (Mccullers, 2006). Influenza viruses allow pneumococci to adhere and invade the host, predisposing the individual to infection (Mccullers, 2006). Pneumococci account for approximately 36% of community-acquired pneumonia (Centers for Disease Control and Prevention, 2015). Over 900,000 adults are diagnosed with pneumococcal pneumonia each year in the United States. Although the case-fatality rate of pneumococcal pneumonia is fairly low, 5%-7%, it can become significantly higher in elderly adults (Centers for Disease Control and Prevention, 2015). Surveillance for non-invasive pneumococcal pneumonia started within the ABCs program in 2013. All possible cases of non-invasive pneumococcal pneumonia, within the catchment area, are submitted to EIP. EIP thus keeps track of these cases and the patient information by the use of a database called REDCap. Surveillance is conducted in hospitals that offer pneumococcal urine antigen tests (UATs). These particular hospitals within the catchment areas are located in Knox, as well as Davidson and surrounding counties.

Although pneumonia can be diagnosed with clinical symptoms and radiological evidence, additional diagnostic tools can be used to provide an early recognition of the specific pathogen, and can thus lead to the appropriate antimicrobial therapy (Couturier, 2014). Urine antigen tests are a rapid and efficient way to test for respiratory diseases, such as pneumococcal pneumonia

(Couturier, 2014). Before the UAT debuted in 2003, blood cultures, sputum stain and cultures, serology, and other tests were used to diagnose pneumococcal illnesses (Couturier, 2014). Unfortunately, these previous diagnostic methods had several disadvantages, such as result time and other limitations regarding the anatomic location of the pathogen (Couturier, 2014). Likewise, the UAT capitalizes the concentration of antigens in the urine specimen of the patient; the specific antigens are detected using an enzyme-linked immunosorbent assay (ELISA) or a lateral flow assay (LFA) (Couturier, 2014). An advantage to this specific test is that is can be conducted by the bedside and results can be ready in a minimum of fifteen minutes (Couturier, 2014). More so, the UAT is FDA approved and can detect 100% of the 23 most important serotypes of pneumococcus (Couturier, 2014).

In 2014, the Advisory Committee on Immunization Practices (ACIP) recommended the routine use of the vaccine series 13-valent pneumococcal conjugate vaccine (PCV 13) and the 23-valent-pneumococcal-polysaccharide vaccine (PPSV 23) (Centers for Disease Control and Prevention, 2015). EIP proposed to use population-based surveillance for SNiPP starting in 2013, before the recommended use of the vaccine series, PCV 13 and PPSV 23. Through a surveillance program, disease burden was recorded in the years following the ACIP recommendation. During my field study, I was able to enter pertinent medical information into the database for the SNiPP project.

Objective

The objective of this data entry was to properly transfer patient medical information from the hard copy of the case report form (CRF) to the electronic form entry. The results from the data entry are used to provide population-based estimates that are easily transmitted to the CDC for future studies and revisions.

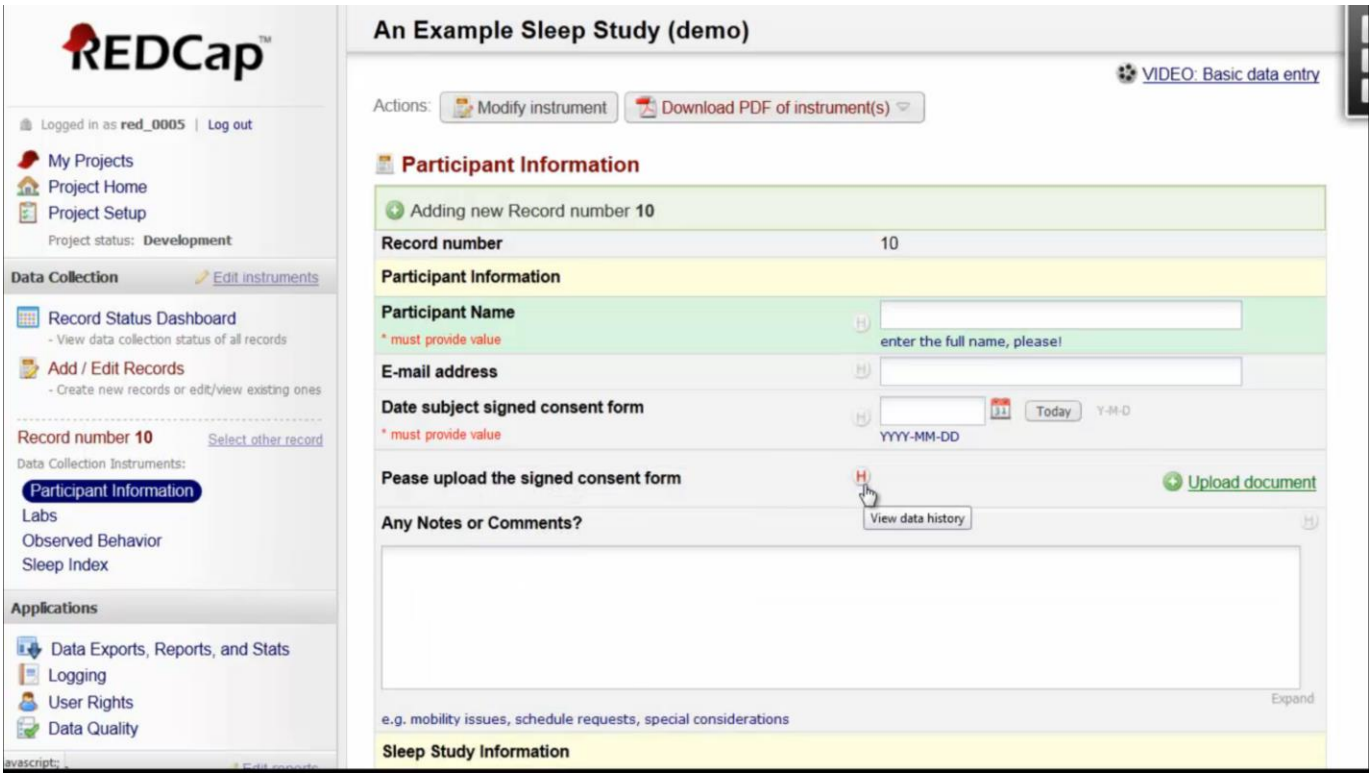
Methods

Database:

SNiPP data is collected from over ten counties in Tennessee. Healthcare facilities, including hospitals and clinics, report the non-invasive pneumococcal pneumonia cases to Tennessee EIP each week. This data is then submitted to a database known as REDCap. REDCap (Research Electronic Data Capture) is a software solution to develop and manage online surveys and databases. REDCap was established by Vanderbilt University, and over 2,000 institutional partners in 100 countries have taken advantage of this software. In 2016, the TN EIP began transferring their data from Microsoft Access to a REDCap platform. The TN EIP has recently finished transferring all ABCs data to REDCap, and has thus begun the data transfer of other programs. REDCap eliminates the manual transmission of data to CDC and allows for a much simpler method of data extraction.

Data Entry:

As one of my minor projects with EIP, I was able to enter SNiPP data into REDCap. The data entered consisted of negative SNiPP cases, meaning these patients were tested for non-invasive pneumococcal pneumonia via a UAT (urine antigen test) but tested negative. I was responsible for entering information regarding the full name, medical identification number, date of birth (if applicable), the hospital identification code, and the result of the UAT. Figure 3.1 shows an example of the database entry within REDCap Patient Tracker.



Results

During the course of my field experience, I entered over 1,000 negative UAT cases into REDCap for the SNiPP program. The catchment hospitals transferred all possible UAT cases to EIP each week, allowing me to submit the UAT negatives into the database each day. Additional EIP personnel submitted the positive cases into the database, REDCap. There are now approximately 7,400 negative UATs cases in the REDCap Patient Tracker. This allowed for the EIP to move forward transmitting these data to the CDC, and conducting further submission and research within the SNiPP program.

Discussion

Pneumococcal pneumonia is a notably common infection nationwide. As such, surveillance is critical so that evaluation of the disease, treatments, and vaccinations can be implemented.

Likewise, it is just as important to enter the negative cases, as it is the positive cases, to ensure proper population-based estimates of the disease. More so, the EIP is analyzing the proportions of pneumonia hospitalizations in those hospitals that perform the UATs and those that do not. This will enlighten the CDC on the efficacy of the UAT at diagnosing pneumococcal pneumonia. I was able to assist in submitting these data into the database at a timely manner, so that the EIP team and the CDC can carry out these necessary studies.

Chapter 3: High Risk Conditions and Vaccination Gaps in Invasive Pneumococcal Disease Cases in Tennessee, 2011-2016

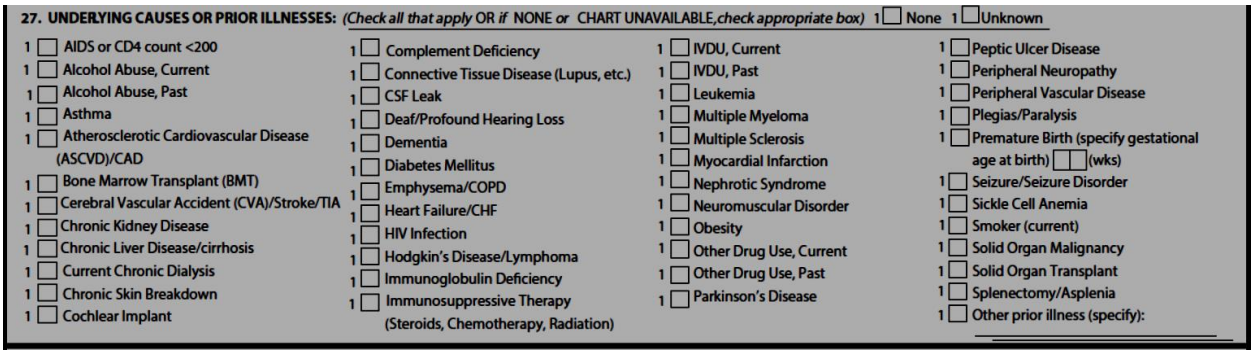
Introduction

The purpose of the Active Bacterial Core Surveillance (ABCs) group is to determine incidence and epidemiological patterns of invasive disease that are due to *Haemophilus influenza*, *Neisseria meningitidis,* Group A *Streptococcus* (GAS), Group B *Streptococcus* (GBS), and *Streptococcus pneumoniae.* Among these bacteria, *Streptococcus pneumoniae,* a gram-positive anaerobic organism, is a public health concern with its potential to be life threatening. Also known as pneumococcus, Pasteur first isolated the organisms in 1881 from the saliva of a rabies positive patient (Baxter, 2016). Following the discovery of pneumococci, studies involving the findings of several serotypes and possible vaccination treatments were conducted. As of 2011, 92 serotypes have been documented. These studies also suggest that pneumococci can be encapsulated, meaning their surface is formed from complex polysaccharides. The capsule, as well as a recently identified protein, provides resistance of phagocytosis allowing the pneumococci to escape (Henriques-Normark, 2013). These encapsulated organisms are antigenic, and also hold the key to classifying pneumococci serotypes (Centers for Disease Control and Prevention, 2015).

Although pneumococci are normal inhabitants of the respiratory tract and can be extracted from the nasopharynx of 5% to 90% of healthy individuals, a significant number of serotypes have been shown to cause serious disease (Centers for Disease Control and Prevention, 2015). In pediatric cases, serotypes 6A, 14, 19F, 23F are heavily prevalent and result in 60% of all infections. However, in adults, serotypes 6A, 3, and 19F account for only 31% of all infections

(Henriques-Normark, 2013). Major clinical illnesses associated with pneumococcus include: pneumonia, bacteremia, meningitis, as well as minor conditions such as otitis media and sinusitis. These infections can be considered invasive, meaning the bacteria invade parts of the body that are normally sterile. Invasive pneumococcal bacteria can cause serious acute illnesses, such as pneumococcus in the bloodstream (bacteremia), meningitis, and in some cases death (Centers for Disease Control and Prevention, 2015). Invasive pneumococcal disease (IPD) is responsible for over 12,000 bacteremia cases, 50% of meningitis cases, and approximately 22,000 deaths in the United States every year (Centers for Disease Control and Prevention, 2014).

Risk factors for IPD have been well documented throughout the years. Both race and age play a significant role in contributing to the risk of pneumococcal disease. Children at an increased risk for IPD include those that are younger than two years of age, and those that have certain immunosuppressant illnesses (Centers for Disease Control and Prevention, 2015). Illnesses such as sickle cell disease, HIV infection, and chronic heart and lung conditions are considered underlying conditions to IPD (Centers for Disease Control and Prevention, 2015). Adults 65 years and older are also at a heightened risk. Other risk factors in adults 19 through 64 years old include: chronic conditions (i.e., diabetes and heart disease), HIV/AIDS, cancer, and chronic smoking (Baxter, 2016). Figure 4.1 shows common underlying conditions associated with IPD that are present on the ABCs case report forms.



27. UNDERLYING CAUSES OR PRIOR ILLNESSES: *(Check all that apply* OR *if* NONE *or* CHART UNAVAILABLE, *check appropriate box)* 1 ☐ None 1 ☐ Unknown

1 ☐ AIDS or CD4 count <200	1 ☐ Complement Deficiency	1 ☐ IVDU, Current	1 ☐ Peptic Ulcer Disease
1 ☐ Alcohol Abuse, Current	1 ☐ Connective Tissue Disease (Lupus, etc.)	1 ☐ IVDU, Past	1 ☐ Peripheral Neuropathy
1 ☐ Alcohol Abuse, Past	1 ☐ CSF Leak	1 ☐ Leukemia	1 ☐ Peripheral Vascular Disease
1 ☐ Asthma	1 ☐ Deaf/Profound Hearing Loss	1 ☐ Multiple Myeloma	1 ☐ Plegias/Paralysis
1 ☐ Atherosclerotic Cardiovascular Disease (ASCVD)/CAD	1 ☐ Dementia	1 ☐ Multiple Sclerosis	1 ☐ Premature Birth (specify gestational age at birth) ☐☐ (wks)
1 ☐ Bone Marrow Transplant (BMT)	1 ☐ Diabetes Mellitus	1 ☐ Myocardial Infarction	1 ☐ Seizure/Seizure Disorder
1 ☐ Cerebral Vascular Accident (CVA)/Stroke/TIA	1 ☐ Emphysema/COPD	1 ☐ Nephrotic Syndrome	1 ☐ Sickle Cell Anemia
1 ☐ Chronic Kidney Disease	1 ☐ Heart Failure/CHF	1 ☐ Neuromuscular Disorder	1 ☐ Smoker (current)
1 ☐ Chronic Liver Disease/cirrhosis	1 ☐ HIV Infection	1 ☐ Obesity	1 ☐ Solid Organ Malignancy
1 ☐ Current Chronic Dialysis	1 ☐ Hodgkin's Disease/Lymphoma	1 ☐ Other Drug Use, Current	1 ☐ Solid Organ Transplant
1 ☐ Chronic Skin Breakdown	1 ☐ Immunoglobulin Deficiency	1 ☐ Other Drug Use, Past	1 ☐ Splenectomy/Asplenia
1 ☐ Cochlear Implant	1 ☐ Immunosuppressive Therapy (Steroids, Chemotherapy, Radiation)	1 ☐ Parkinson's Disease	1 ☐ Other prior illness (specify):

In 1977, the first pneumococcal vaccine was licensed in the United States and the first conjugate vaccine in 2000. PCV 13, an inactivated conjugate vaccine, is normally administered to children two years of age or younger, to adults 65 years and older, and younger adults ≥ 19 years of age with certain immunosuppressant conditions, such as HIV and kidney disease. PPSV 23, an inactivated polysaccharide vaccine, is administered to adults 65 years and older, and to children and younger adults ≥ 19 years of age with certain high-risk conditions, such as diabetes and heart disease. Additionally, PCV 13 combines capsular polysaccharides with a protein carrier; PCV 13 then initiates a T-cell immune response with antibody production (Hayward et al, 2016). Likewise, PPSV 23 contains capsular polysaccharide antigens and these antigens produce a T-cell independent antibody response (Hayward et al, 2016). With the recommended routine use of the pneumococcal conjugate vaccine (PCV 13 or Prevnar 13) and the pneumococcal polysaccharide vaccine (PPSV 23 or Pneumovax) rates of IPD have declined from 100 cases per 100,000 in 1998 to 9 cases per 100,000 in 2015 (Centers for Disease Control and Prevention, 2015). Appendix 2 shows the CDC recommendations for pneumococcal vaccinations by age and by health condition.

For this IPD project, I utilized the ABCs 2011-2016 IPD data within REDCap and Access, to analyze populations of patients with IPD and high-risk conditions. Furthermore, the percentages of the non-vaccinated were analyzed to provide awareness and knowledge of vaccination gaps.

Objective

The objective of this project was to evaluate ABC's data from REDCap and Access to identify the high-risk conditions of patients with IPD that have not received a pneumococcal vaccine.

Methods

Data Collection:

Invasive pneumococcal disease (IPD) data are collected as part of the ABCs program within the TN EIP. These data were analyzed for high-risk conditions and vaccination records. The ABCs surveillance area consists of 20 counties across Tennessee. When possible, ABCs cases are identified from the hospital labs or diagnostic labs: the surveillance officer (SO) will then determine if it meets the appropriate case definition. An IPD case is defined as a positive culture of *Streptococcus pneumoniae* in an adult (aged ≥ 19 years old) with one or more high-risk conditions within the Tennessee catchment areas. The respective age groups include: Group 1 (age 19-49), Group 2 (age 50-64), Group 3 (age 65-84), and Group 4 (age 85 and older). High-risk conditions include, but are not limited to, AIDS, HIV infection, current smoking, and asthma. The SO will collect medical information from confirmed cases via a standardized case report form (CRF). Appendix 1 shows an example of the ABCs CRF.

Data Analysis:

To obtain IPD data for this project, data from 2011-2012 were extracted from Microsoft Access, and data from 2013-2016 were extracted from REDCap. These data included IPD cases in the Tennessee catchment areas for adults ≥ 19 years of age with underlying conditions. All data, consisting of 2,693 IPD cases, were then compiled into one excel worksheet.

Results

From 2011-2016, there were 2,693 confirmed IPD cases within the Tennessee catchment area. To evaluate the most prevalent underlying conditions among these IPD cases and to also evaluate vaccination information, I divided my capstone project into three phases.

Phase 1: Demographics of Study Population

During the first phase of my main project, I was able to use descriptive statistics to identify the demographic characteristics of my study population. The demographics evaluated involved: gender, age, race, and ethnic origin. For this study population, the total number of IPD cases, 2,693, were analyzed to display the basic demographics. The study population contained 50.50% females and 49.42% males; the additional percentage is unknown due to lack of CRF completion. The age of the population varied; however, the largest proportion (35.54%) of the population was comprised of the 50-64 age group; additional age groups were 19-49, 65-84, and 85+ years as demonstrated in Figure 4.2. Figure 4.3 shows that the Caucasian race had the highest proportion (69.74%) compared to the additional races (African American, American Indian, Asian, Native American/Pacific, Unknown). Finally, the largest ethnic origin of the study population was shown to be Not Hispanic/Latino (74.12%), which is highlighted in Figure 4.4.

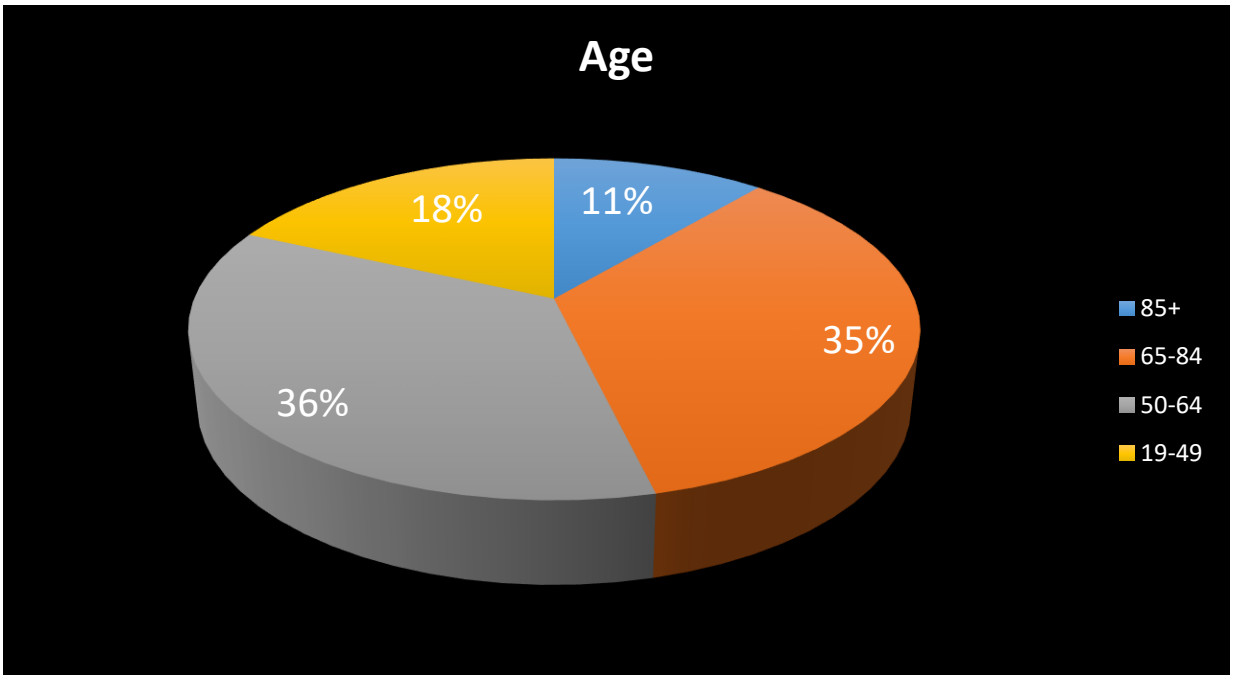


Figure 4.2 Age percentages for study population

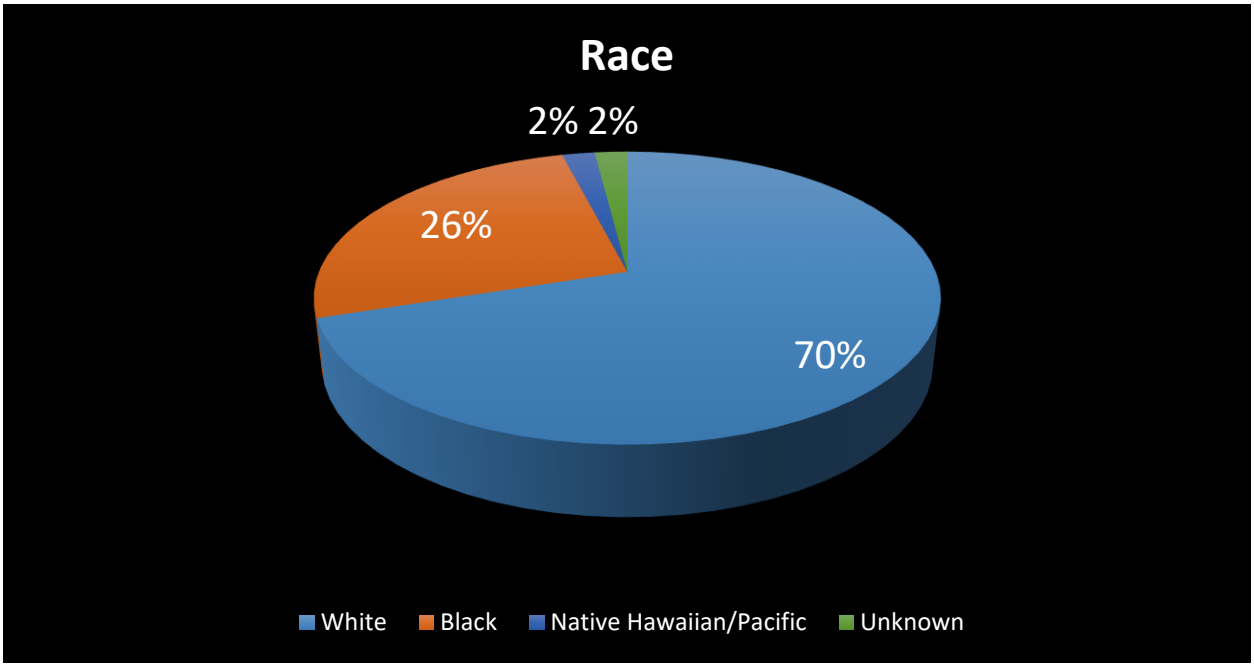


Figure 4.3 Race percentages of study population

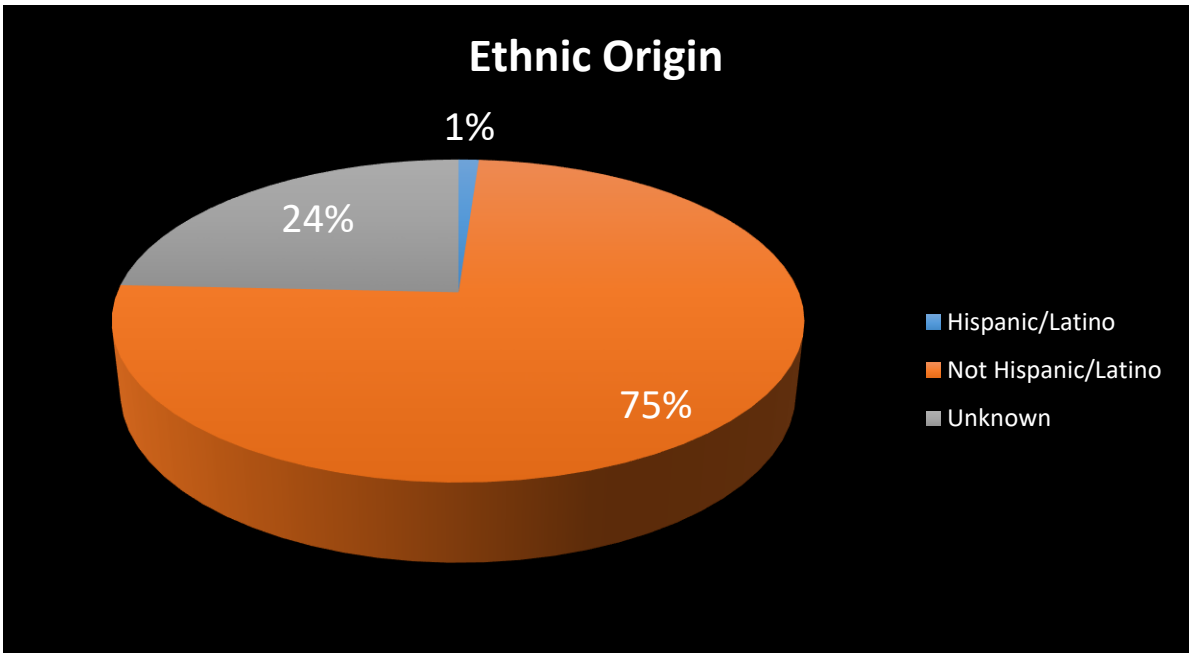


Figure 4.4 Ethnic Origin percentages of study population

Secondly, the hospital and ICU percentages were analyzed within the study population, which was completed by stratifying the age groups and calculating the percentages of hospital and Intensive Care Unit (ICU) admissions. While the hospital admission percentages were relatively high in all age groups, the age group for the 50-64 year olds had the highest hospital admission percentage (99%). Similarly, the ICU percentages for this age group (48%) were also the highest among the age groups. Figure 4.5 demonstrates the hospital and ICU admission percentages for each age group within the study population.

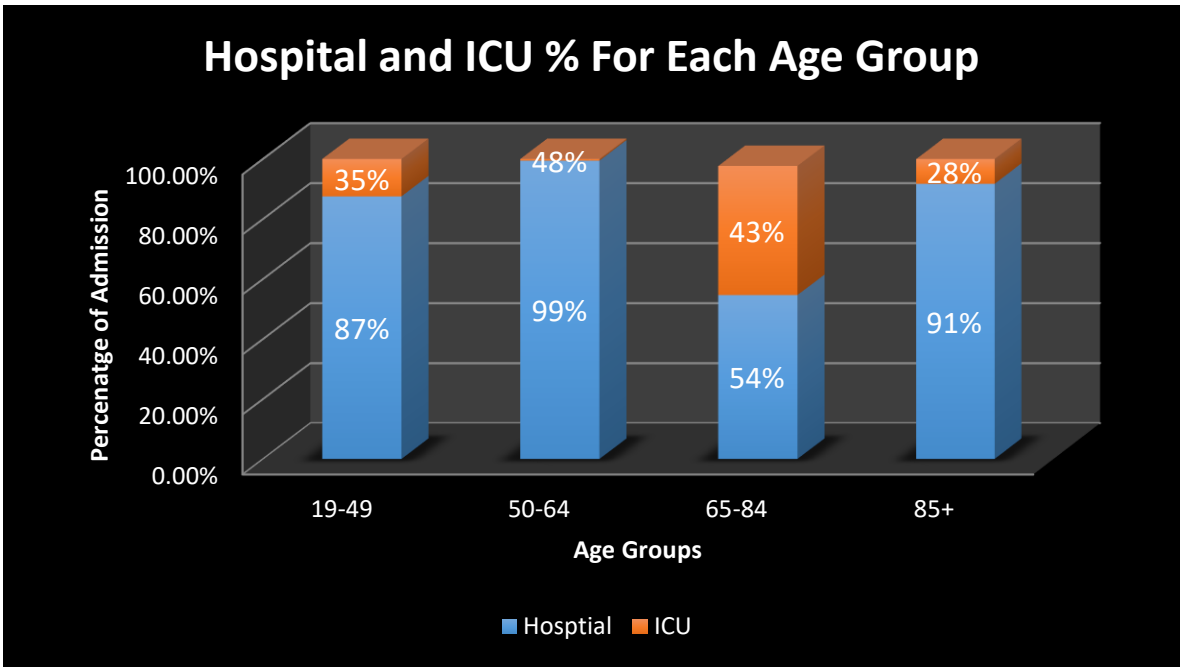


Figure 4.5 Hospital and ICU admission percentages of each age group within the study population

Lastly in phase 1, the underlying conditions for IPD were calculated and identified. Out of the 2,693 IPD cases that met case definition, the five most prevalent underlying conditions were identified. The five most prevalent IPD underlying conditions included: ASCVD (16%), Diabetes (26%), COPD (29%), Smoking (37%), and other illnesses (19%), which can be seen in Figure 4.6. Other illnesses included: colitis, hepatitis C, hypothyroidism, and other illnesses not specified on the case report form.

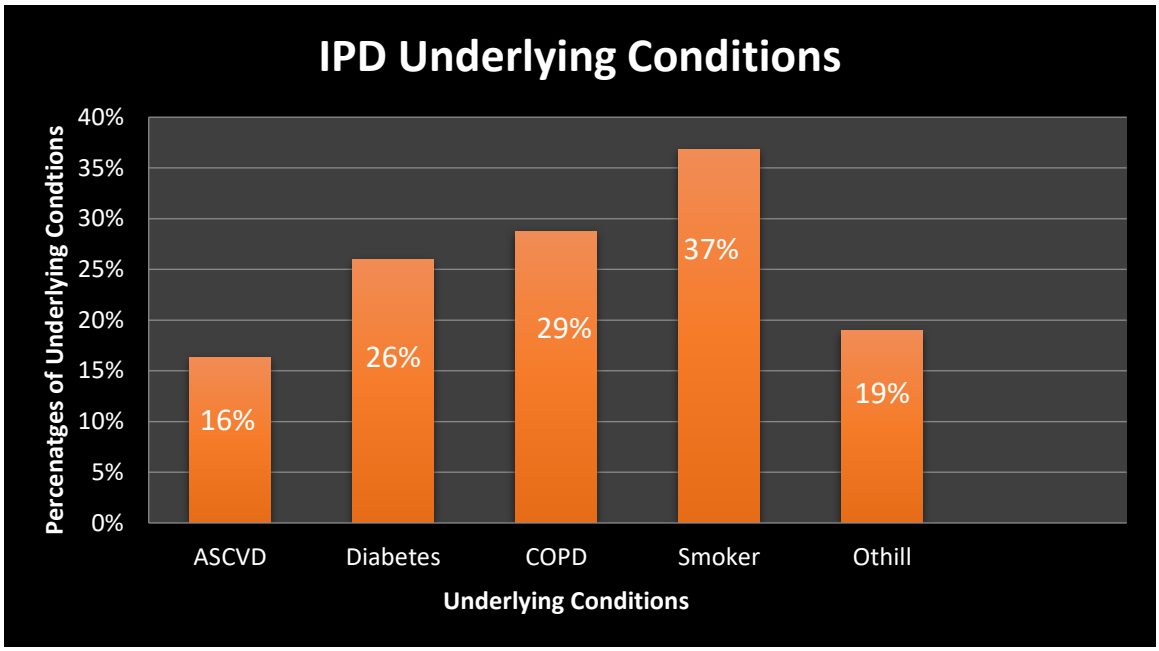


Figure 4.6 Most prevalent Invasive Pneumococcal Disease (IPD) underlying conditions of study population

Phase 2: IPD Underlying Conditions

During the second phase, I continued the use of descriptive statistics and carried out an analysis of the most prevalent underlying conditions for each age group. This was conducted by stratifying the age groups via Microsoft Excel. All ages were stratified into four groups as follows: 19-49, 50-64, 65-84, and ≥ 85 years. These age groups were adjusted so that each group contained a larger study population. The five most prevalent underlying conditions, listed in phase 1, were then analyzed for each age group. For both the youngest age group (19-49) as well as the 50-64 age group, the most prevalent underlying condition was smoking (42% and 51%). The most frequent condition for the group 65-84 was COPD (39%). Finally, ASCVD (30%) was the most common underlying condition for the oldest age group, ≥ 85. Figure 4.7 displays the most prevalent underlying condition for each age group.

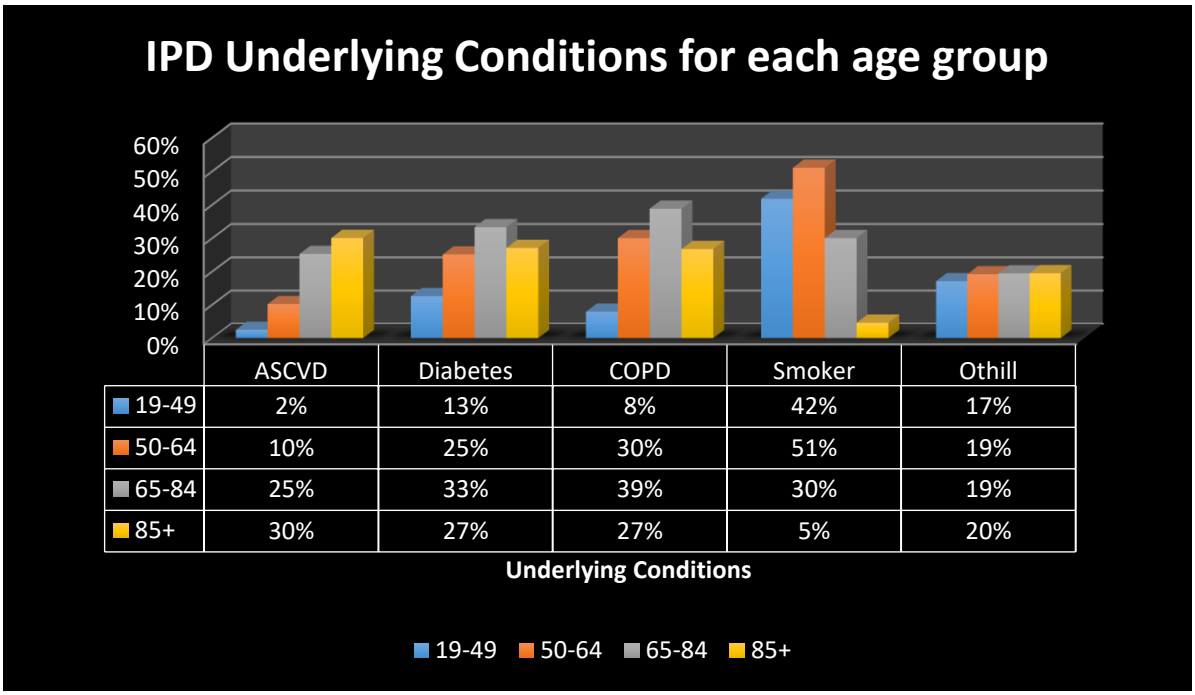


Figure 4.7 Most prevalent underlying conditions for each age group in the study population

Phase 3: Pneumococcal Vaccinations

During the third phase, I analyzed vaccination percentages within each age group. The vaccination percentages were highest within the oldest age groups and lowest within the youngest age groups, as seen in Figure 4.8. The CDC recommends the routine vaccinations of adults 65 years and older, as well as adults 19 years and older with one or more underlying condition (Centers for Disease Control and Prevention, 2015). Secondly, the vaccination percentages for all five underlying conditions within each age group were calculated. This was completed by separating each age group into an individual chart and carrying out the vaccination percentage calculations for all five conditions. The results are displayed in Figures 4.9-4.12 below.

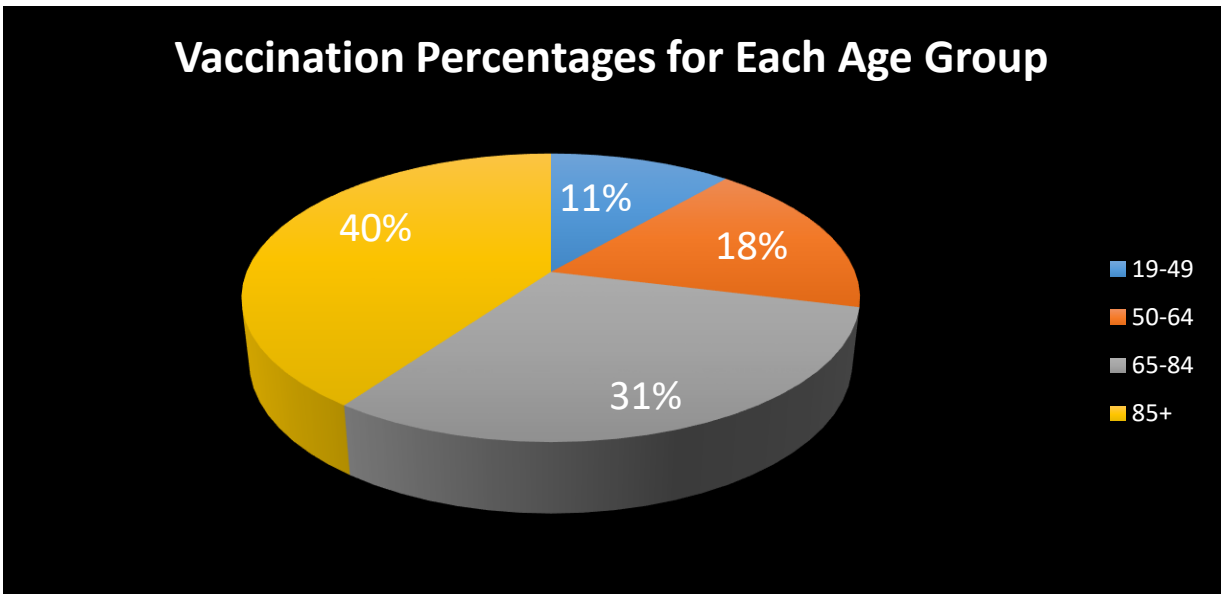


Figure 4.8 Vaccination percentages for each age group within the study population

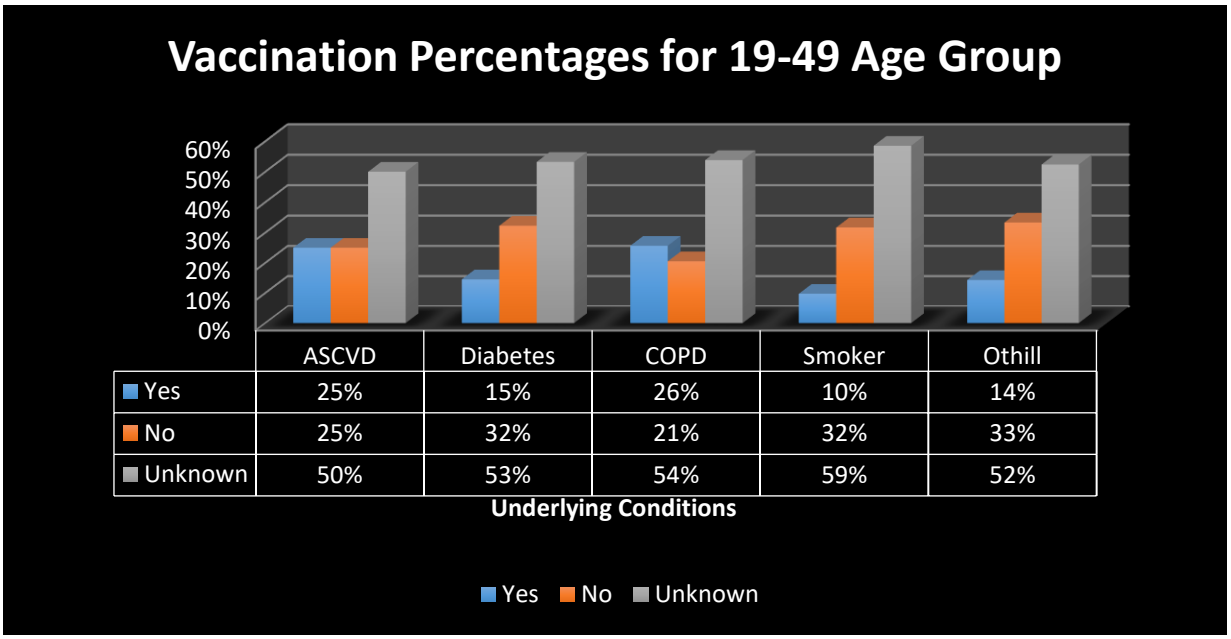


Figure 4.9 Vaccination percentages for age group 19-49 within the study population

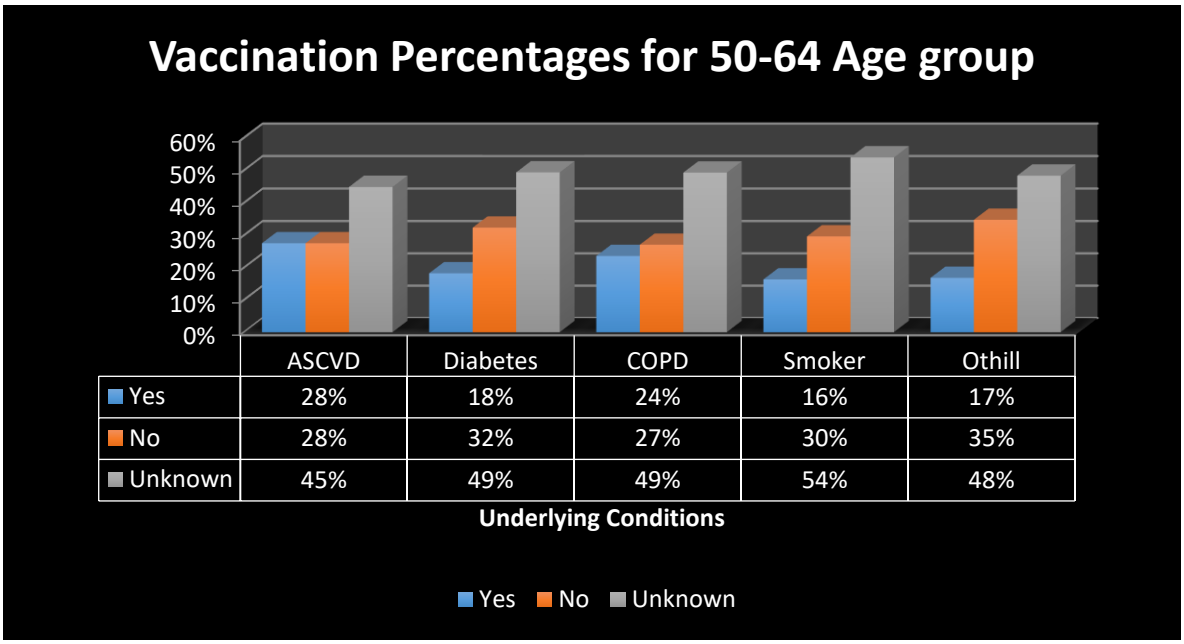


Figure 4.10 Vaccination percentages for age group 50-64 within the study population

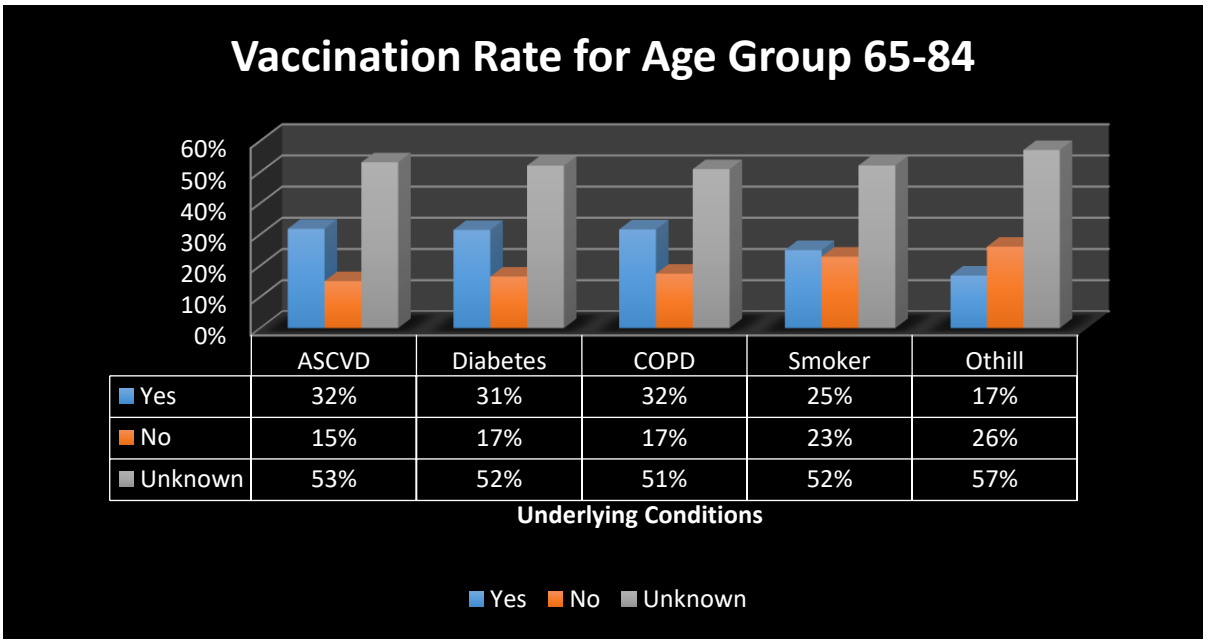


Figure 4.11 Vaccination percentages for age group 65-84 within the study population

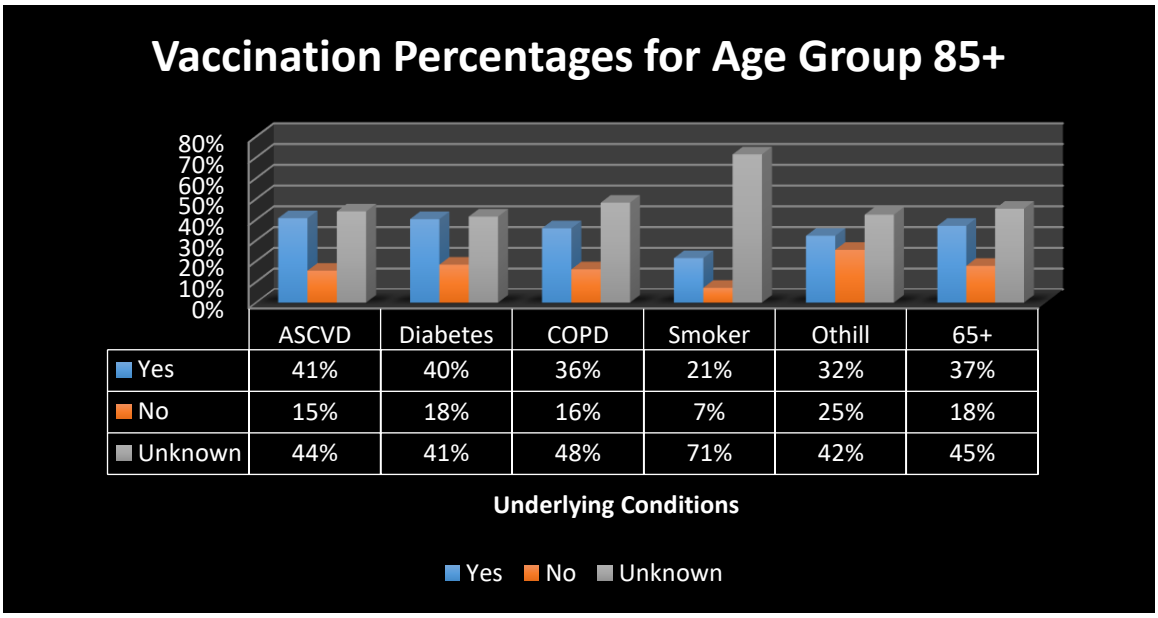


Figure 4.12 Vaccination percentages for age group 85+ within the study population

Next, I analyzed the vaccine types (PCV713 and/or PPSV23) for all age groups, stratifying them by year (2011-2016), as seen in Figure 4.13. Following, I evaluated the percentages of the vaccinated population that received dual vaccines; results show that less than 1.7% of the age group, 65-85, and less than 2.2% of the age group, 19-49, received the recommended dual vaccines. Lastly, I analyzed the percentages of vaccine types within each age group, for each underlying condition, for each individual year (2011-2016). Figures 4.14-4.19 indicate the results based on each year.

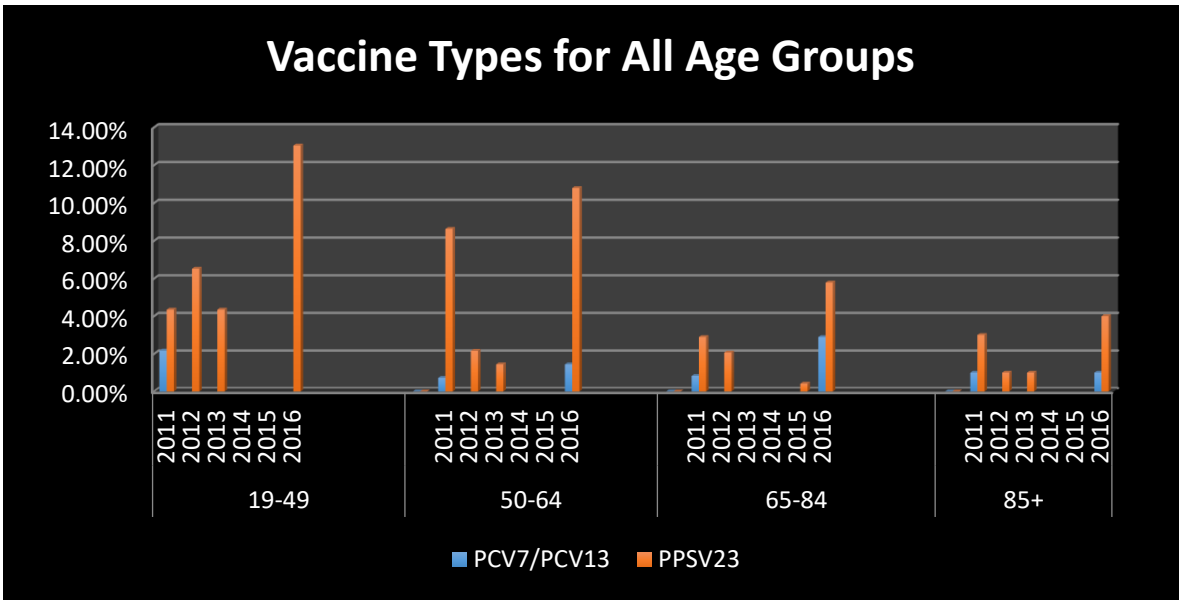


Figure 4.13 The vaccine types for each age group through the years 2011-2016

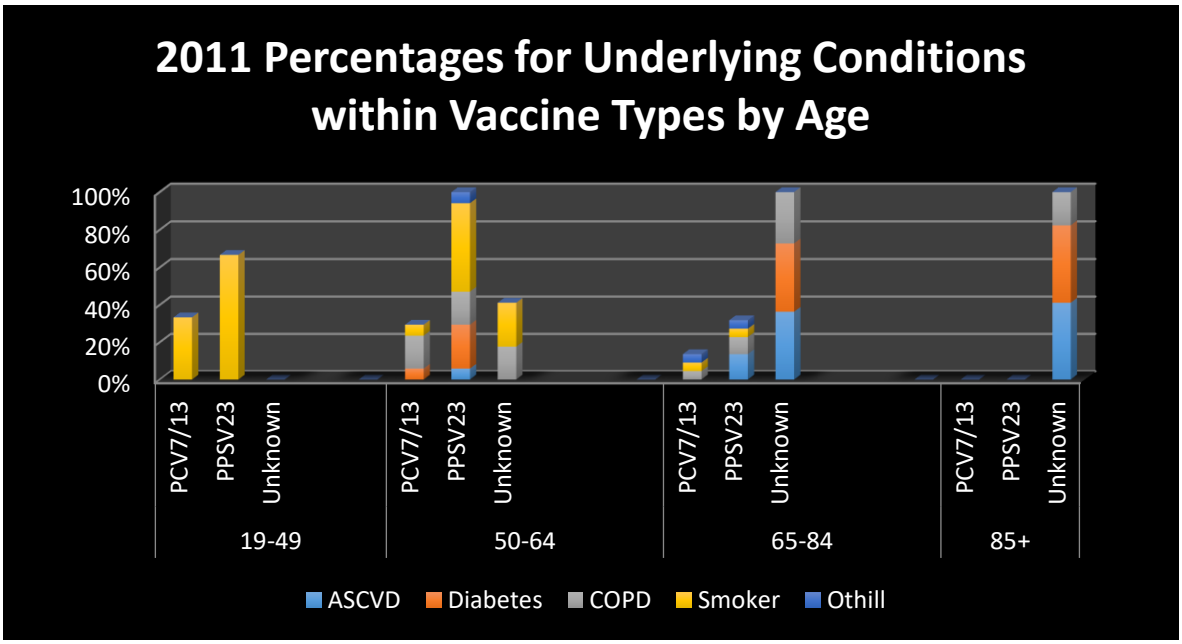


Figure 4.14 The percentage of underlying conditions by vaccine type within each age group for year 2011

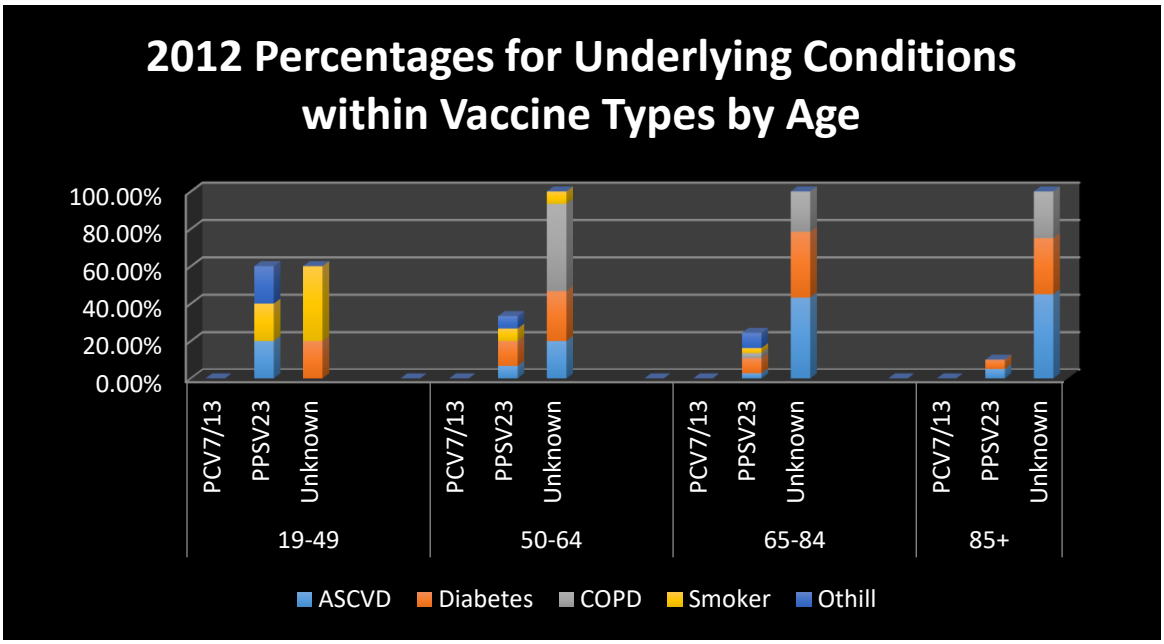


Figure 4.15 The percentage of underlying conditions by vaccine type within each age group for year 2012

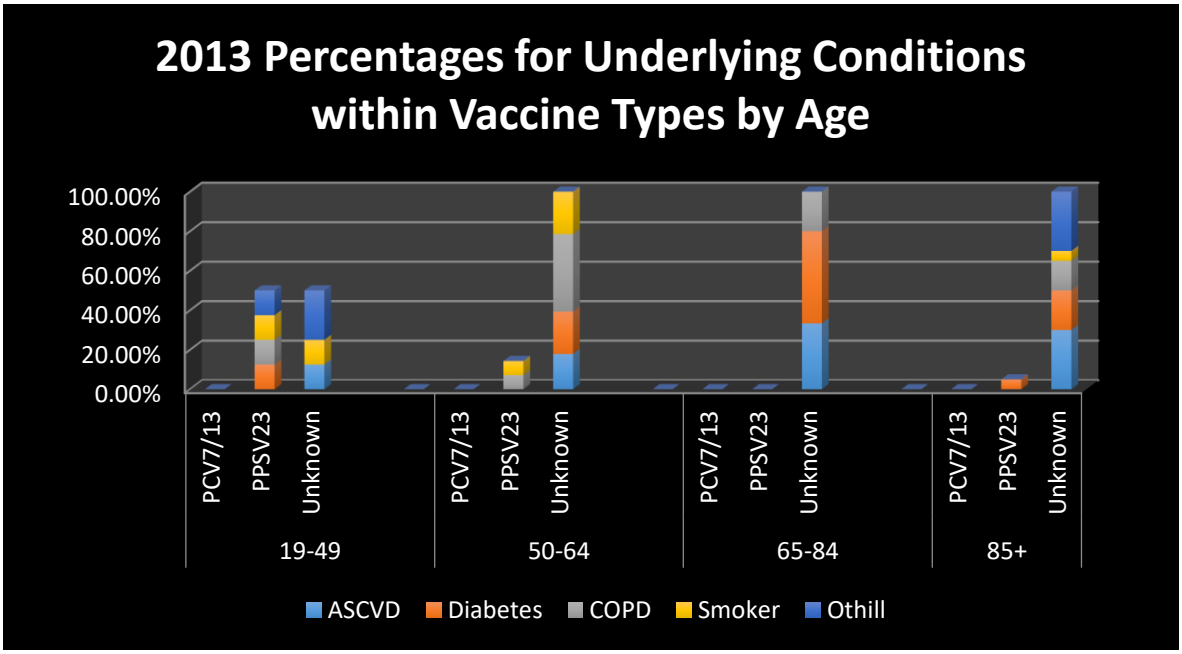


Figure 4.16 The percentage of underlying conditions by vaccine type within each age group for year 2013

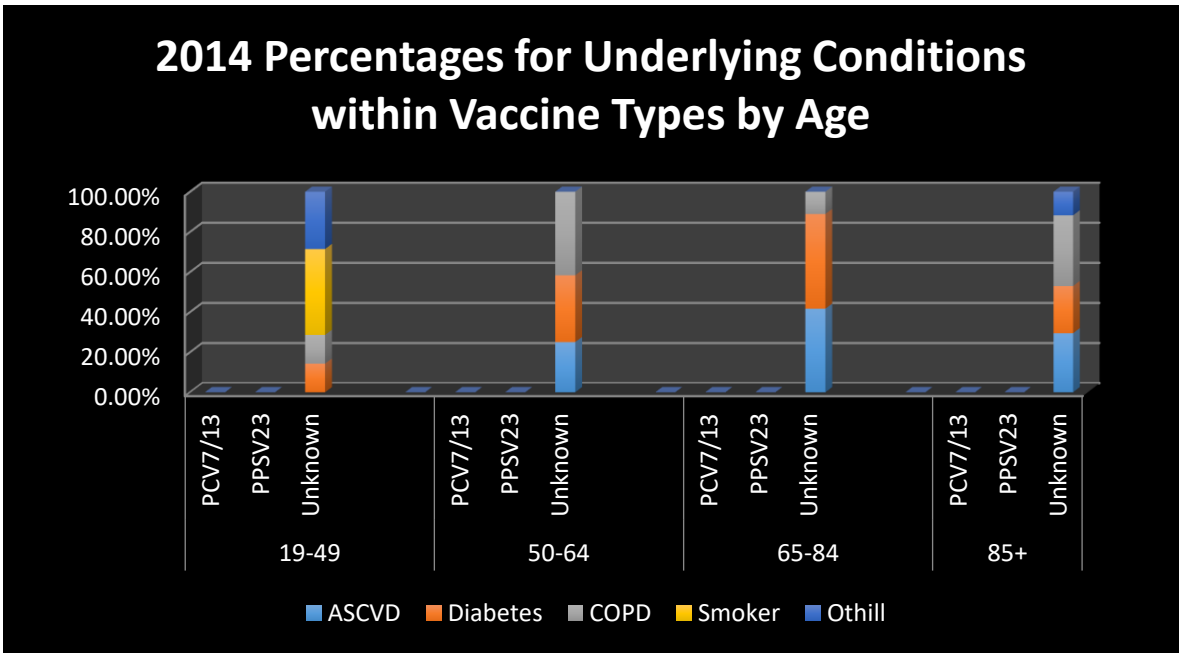


Figure 4.17 The percentage of underlying conditions by vaccine type within each age group for year 2014

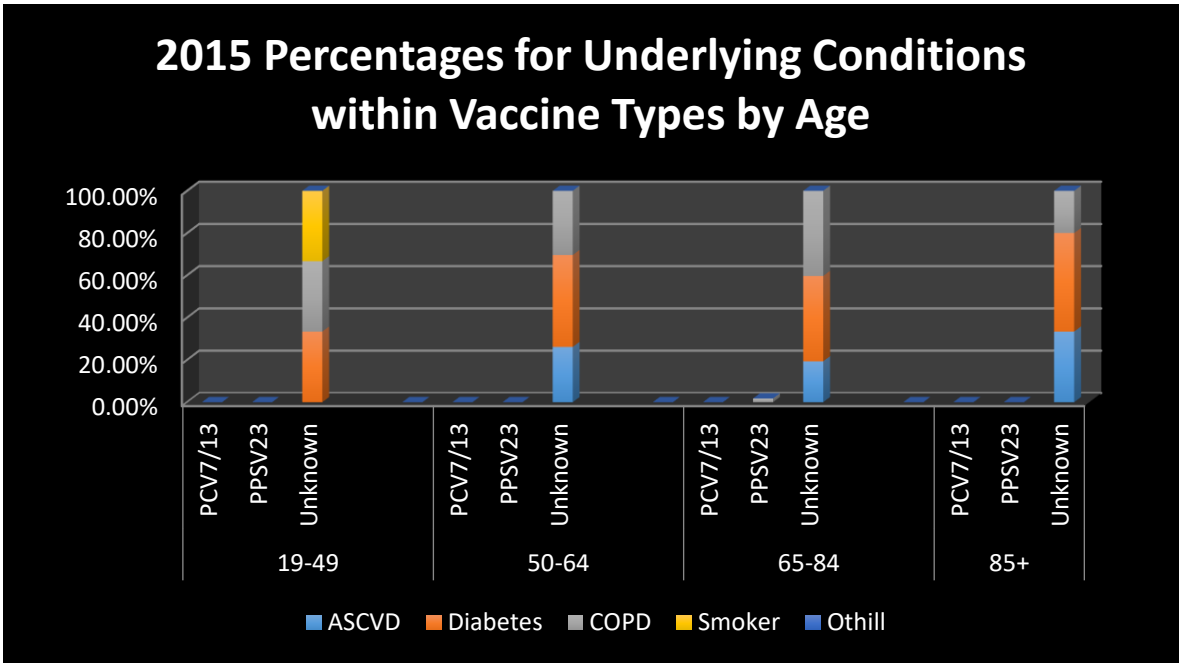


Figure 4.18 The percentage of underlying conditions by vaccine type within each age group for year 2015

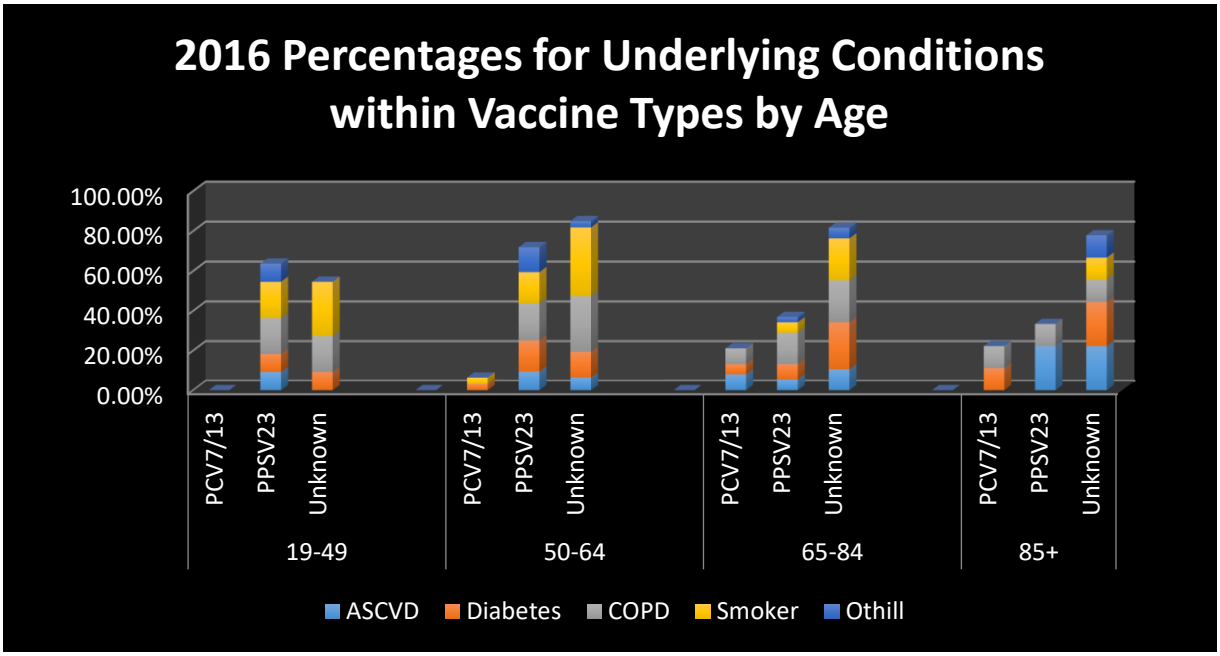


Figure 4.19 The percentage of underlying conditions by vaccine type within each age group for year 2016

Discussion

Study Analysis:

The analyses that were conducted for this study shed light on various underlying conditions associated with IPD, and also on vaccination gaps within those conditions and certain age groups. The data presented shows that the five most prevalent underlying conditions correlated with IPD are as follows: ASCVD, diabetes, COPD, smoking, and other illnesses. Each age group exhibited a distinctive underlying condition, with smoking being the most prevalent in the youngest two age groups. In comparison, the CDC recognizes HIV/AIDs, diabetes, heart/liver disease, smoking and asthma as the most prevalent underlying conditions nationally.

The vaccination percentages among the younger age groups were considerably lower when compared to the older age groups. This was considered to be a possibility due to the ACIP

recommendation that adults 65 years and older should be vaccinated for pneumococcal disease, and the lack of education relating to vaccination protocol for those with high-risk conditions. While the recommendations from CDC include the routine vaccinations of adults 65 years and older, as well as adults 19 years and older with specific underlying conditions, this observational study portrays that a large proportion of the younger age groups are unvaccinated. In retrospect, vaccination rates in adults are drastically low and show that only 20% of individuals with a high risk of pneumonia are vaccinated (Centers for Disease Control and Prevention, MMWR, 2016). More so, only 14.2% of adults have received the Tdap vaccine that protects them from tetanus, diphtheria, and pertussis (Centers for Disease Control and Prevention, MMWR, 2016). From this, the age groups were separated for analysis of each high-risk condition and the vaccination rates within. For all age groups, it was evident that the majority of patients were unaware of their vaccination status, and well over 40% of all high-risk condition patients in the study population marked "unknown" for their vaccination status. Finally, the analysis of vaccination types concluded that the most prevalent vaccine in all age groups, from years 2011-2016, was the vaccination type PPSV23. Unfortunately, there was little information established for years 2014 and 2015, leading to an inaccurate explanation. The reasoning behind the lack of information gathered in the years 2014 and 2015 is unknown. Additionally, the proportions of those that received the recommended both vaccines were extraordinarily low in all age groups. This was surprising given that the ACIP recommends that all adults 65 years of age and older and/or those adults with specific underlying conditions follow through with both vaccines. Recently, there are no studies that explain why the dual vaccination rates are low.

The data presented explains the presence of specific underlying conditions and vaccination gaps within certain age groups. It is apparent that some patients with underlying conditions, and

specifically the younger age groups, go unvaccinated. More so, it is evident that there are low percentages of dual vaccinations, which the CDC recommends. Since the introduction of these vaccinations, IPD has drastically declined in all age groups. Figures 4.22 and 4.23 explain the trend of IPD through the years 1998-2015 and how vaccinations have impacted this disease. It can be concluded that the trend of IPD rates declining, in both these specific age and condition groups, can and will likely continue if patient education on vaccinations is made a priority by all healthcare providers.

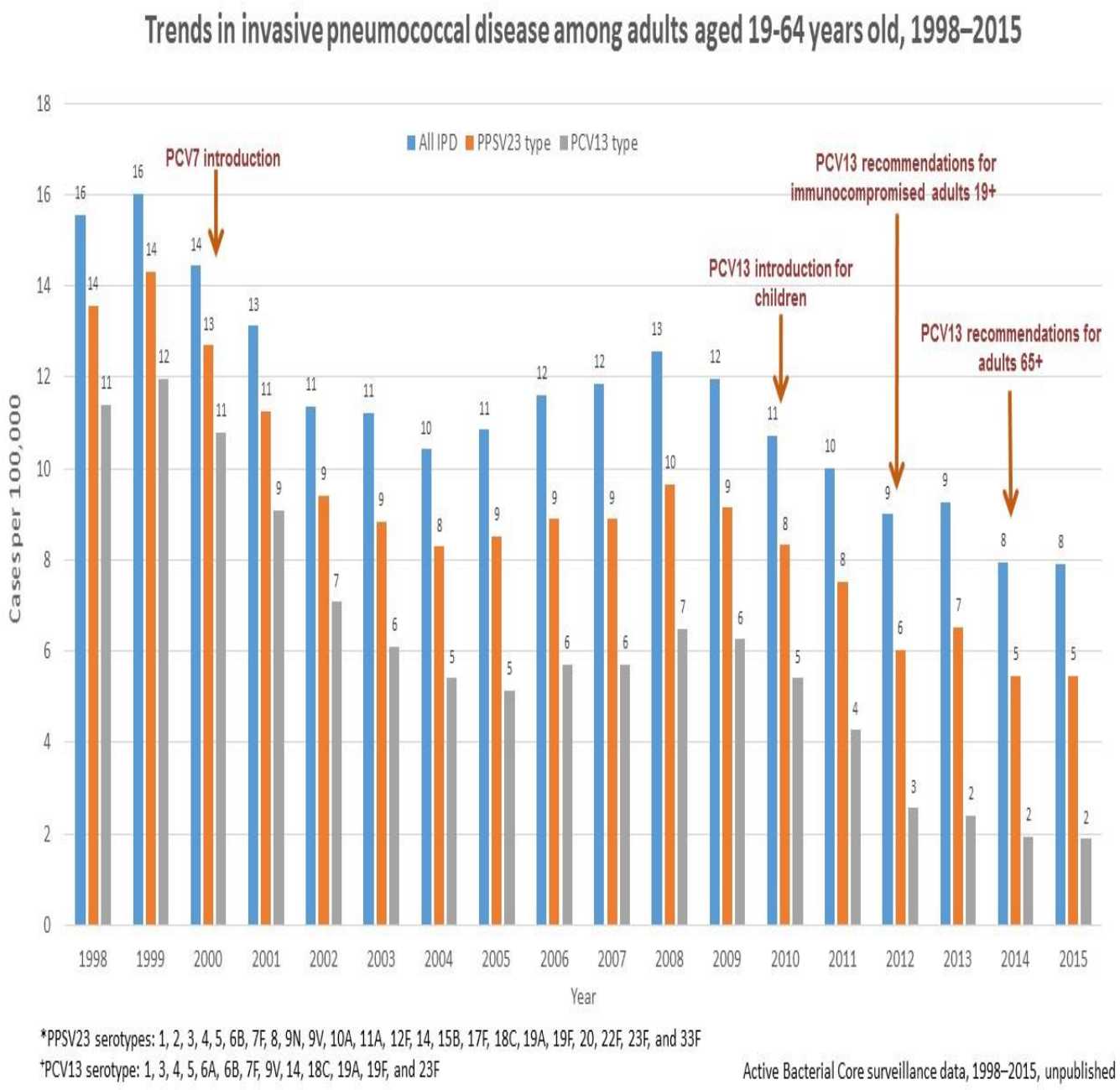


Figure 4.20 Trends in IPD among adults 19-64 years of age, 1998-2015

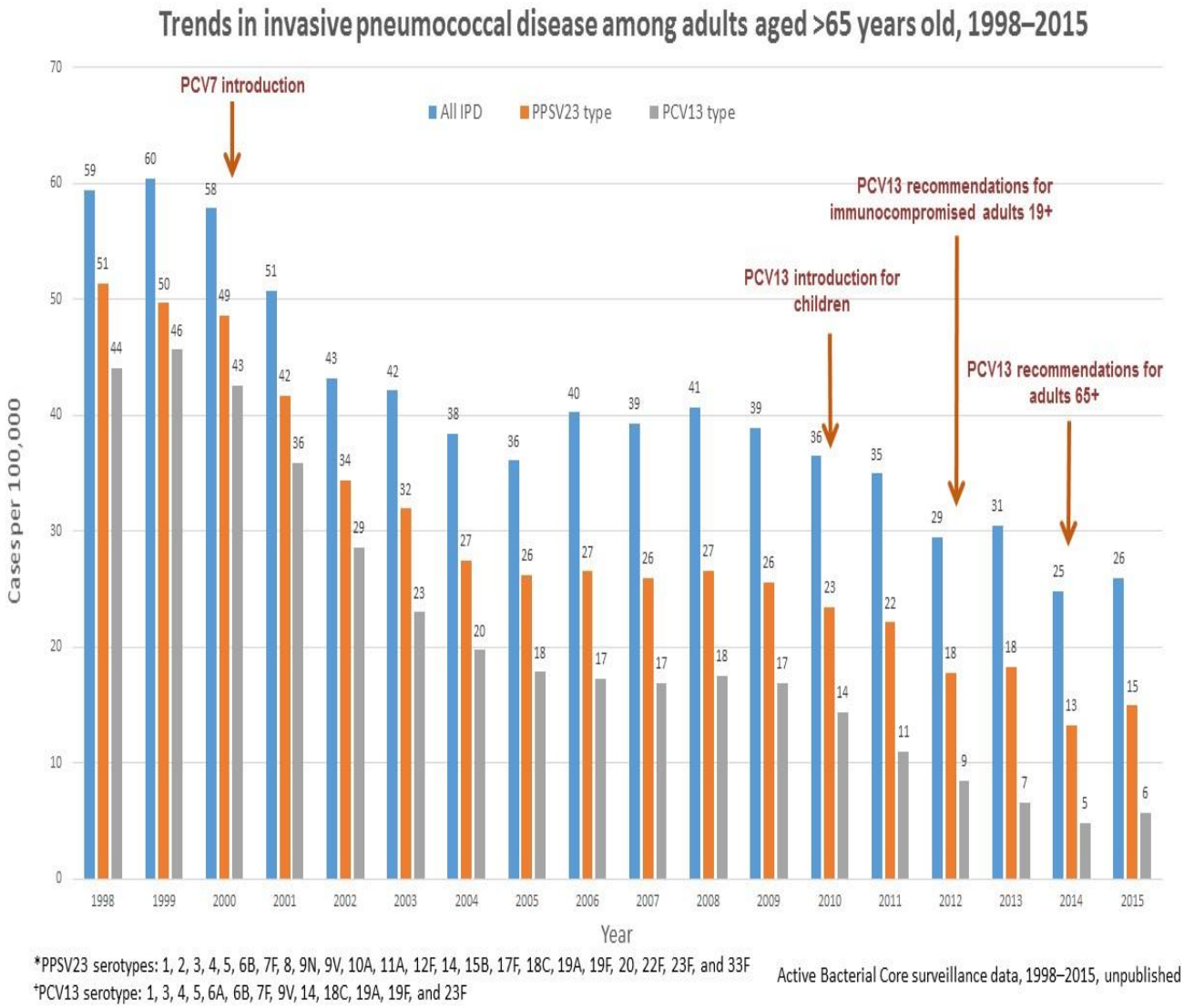


Figure 4.21 Trends in IPD in adults 65 years and older, 1998-2015

Vaccination Limitations

Although the most recent pneumococcal vaccination, PPSV 23, can reduce the chances of IPD by 78% and the chances of pneumococcal pneumonia by 82%, ACIP reevaluates these recommendations every few years (Hayward et al, 2015). In 2014, ACIP recommended the sequential use of PCV 13 and PPSV 23 due to the concern of the persistent burden in elderly adults (Hayward et al, 2015). This recommendation insists on adults 65 years and older on getting vaccinated with one dose of PCV 13 and then one dose of PPSV 23 one year later (Centers for Disease Control and Prevention, 2014). More so, it is important to note that adults should only receive one dose of PCV 13, but can receive more than one dose of PPSV 23, depending on the age and underlying condition status of the individual (Centers for Disease Control and Prevention, 2014). Unfortunately, research supports that the PPSV 23 vaccination efficacy is not as high in adults, 65 years and older, and adults with certain underlying conditions (Musher et al, 2015). This is one motive behind the ACIP recommendation of the dual vaccination.

In this study, IPD prevalence, certain high-risk conditions associated with the illness, and vaccination gaps within the study population were analyzed. As this study population consisted of individuals with certain high-risk conditions that were diagnosed with IPD, it is evident that some of these individuals were properly vaccinated with PCV 13 and/or PPSV 23. However, this study reveals the significant vaccination gaps and the lack of the recommended dual vaccination within the majority of the population. Although some individuals were properly vaccinated with either PCV 13 or PPSV 23, the majority failed to follow the recommendation of the dual pneumococcal vaccination, which can explain the high IPD incidence in those that received one of the vaccine types. Although the efficacy of PPSV 23 is lower in adults, 65 years

and older, and those adults with certain high-risk conditions, research suggests that use of the dual vaccinations can significantly reduce the chances of pneumococcus illness (Musher et al, 2015). ACIP will reevaluate these pneumococcal vaccination recommendations in 2018 (Centers for Disease Control and Prevention, 2014).

Study Limitations:

One limitation of this study is the incompletion of case report forms (CRFs) and immunization/vaccination records. These forms were critical components in the study; however, an extensive number was discarded during the study due to incompletion by the patient. Several CRFs were left incomplete by patients or their health care providers due to unknown reasons. If these forms had been completed accurately, it would have allowed for a larger study population.

Additionally, the lack of communication between healthcare providers and patients was evident. A number of CRFs were left unmarked or "unknown" due to the lack of knowledge and understanding of what vaccines the patient was receiving or had received in the past. More so, it was understood that several patients, especially in older age groups, had difficulty reading and understanding the case report forms they were obligated to fill out. It is my full belief that educating the patient on the administered vaccinations, and assisting them with understanding the questions on the CRFs would have greatly increased the number of completed cases for this study, which likely would have impacted my findings.

Future Studies:

First of all, a larger study population should be incorporated to this study to provide a more accurate estimate. Additionally, the comparison of pneumococcus vaccination rates among all ten EIP states would be interesting to evaluate. Variables, such as hospital/ICU rates, vaccination rates, insurance types (Medicare/Medicaid vs. Private), and case fatality rates,

among a similar study population could be investigated and later compared to all EIP states. Since Tennessee had the highest IPD rates among all EIP sites in 2014, this data could provide insight on how the state is improving or not improving on decreasing IPD cases.

Another possible study could include pregnant women with one or more of the IPD underlying conditions and their vaccination rates. While there are ongoing studies involving the efficacy of the vaccination for pregnant women and their infants, it would be compelling to assess their specific vaccination rates, since women of childbearing age are significantly younger than the current recommended vaccination age. Finally, a more in depth study to measure the risk of the recurrence of IPD within certain underlying conditions could be conducted. This would allow for specific underlying conditions to surface as increased risks for recurrence of disease; healthcare providers could better educate patients on their risks of IPD.

Chapter 4: Conclusion

My field experience at the Tennessee Emerging Infections Program provided me with an in depth knowledge of a variety of public health methods, specifically population based surveillance. It was during my four months at EIP that I became knowledgeable in surveillance methods, database management, and other techniques that are used in the public health field. Through both my minor projects and my capstone project, I was able to put my acquired knowledge to test, and learn and grow from my experience and inexperience. Additionally, being able to apply what I learned in the MPH program thus far was exciting. Applying what I knew and adding to that knowledge allowed me to understand my strengths, but also identify the areas in which I can improve.

The SNiPP database entry project gave me a prospective of different software used within public health. I was able to shadow and learn from staff members that worked specifically with these databases. More so, it provided me with the skills necessary to extract medical information from case report forms and other medical records. By entering the negative UATs, the CDC, EIP, and local hospitals and clinics will have an in depth understanding of non-invasive pneumococcal pneumonia prevalence and diagnostic methods.

My work with *Streptococcus pneumoniae* brought awareness to high-risk conditions in multiple age groups, vaccination rates, and vaccination gaps among those with certain underlying conditions and age groups. Through this project I was able to learn additional surveillance techniques and management of databases.

Chapter 5: Core Area Competencies

Biostatistics

This course allowed me to further my understanding of data analysis, which became a significant contributor for my major project. Through my field experience, I relied on the use of software, such as Excel, in several activities, and also incorporated descriptive statistics into my capstone project.

Environmental Health

This course allowed me to acknowledge the link between disease prevalence and our environment. While extracting medical information from patient records, I was able to identify that some illnesses resulted from the patient's environment (i.e. occupation) and not necessarily their behaviors or genetics. I was able to recognize occupational illnesses, such as Mesothelioma, that were associated with a few CRF's within my study.

Epidemiology

This course gave me an exceptional amount of information that contributed to my understanding and participation in disease surveillance. During my major project, I was able to efficiently and effectively set up a design plan and protocol for my study. More so, I was able to identify risk factors and vaccination gaps associated with the specific disease.

Health Service Administration

This course allowed me to have an accurate understanding of our health care system. As I extracted information from medical records and case report forms, I recalled the rules and regulations, such as HIPAA, that ensure the patient's confidentiality. My understanding of

health insurance, more specifically Medicare and Medicaid, allowed me to have a better understanding of a patient's care services, and also aided in numerous surveillance studies.

Social and Behavioral Science

This course gave me an increased understanding of high-risk behaviors and conditions, and also how our demographics play a key role in our health and health services. Through my field experience, I was able to acknowledge the health disparities that are common in our health care system. Additionally, I had the opportunity to recognize that certain behaviors and conditions in society reflect back to our own health.

Bibliography

Baxter, R., Lee, A., Aukes, L., Snow, V., Fireman, B., Atkinson, B., Klein, N. (2016) Risk of Underlying Chronic Medical Conditions for Invasive Pneumococcal Disease in Adults. *Vaccine.* 34(36), (4293-4297).

Centers for Disease Control and Prevention. (1994). Addressing Emerging Infectious Disease Threats: a prevention strategy for the United States. Executive Summary. MMWR Recomm Rep, 1-18.

Centers for Disease Control and Prevention. (2015). Pneumococcal Disease: About Pneumococcal. Retrieved May 1, 2017, from http://www.cdc.gov/pneumococcal/clinicians/streptococcus-pneumoniae.html.

Centers for Disease Control and Prevention (2010). Updates Recommendations for Prevention of Invasive Pneumococcal Disease Among Adults Using the 23-Valent Pneumococcal Polysaccharide Vaccine (PPSV23). Retreived June 25, 2017, from https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5934a3.htm.

Centers for Disease Control and Prevention (2014). Manual for the Surveillance of Vaccine-Preventable Diseases. Retrieved June 20, 2017 from https://www.cdc.gov/vaccines/pubs/surv-manual/chpt11-pneumo.html

Couturier, M R, et al. "Urine antigen tests for the diagnosis of respiratory infections: legionellosis, histoplasmosis, pneumococcal pneumonia." *Clinics in laboratory medicine.*, U.S. National Library of Medicine, June 2014, www.ncbi.nlm.nih.gov/pubmed/24856525. Accessed 27 Sept. 2017.

Hayward, Starla, et al. "Is 13-Valent Pneumococcal Conjugate Vaccine (PCV13) Combined With 23-Valent Pneumococcal Polysaccharide Vaccine (PPSV23) Superior to PPSV23 Alone for Reducing Incidence or Severity of Pneumonia in Older Adults? A Clin-IQ." *Journal of Patient-Centered Research and Reviews*, vol. 3, no. 2, 2016, pp. 111–115., doi:10.17294/2330-0698.1214.

Henriques-Normark, Birgitta, and Elaine I. Tuomanen. "The Pneumococcus: Epidemiology, Microbiology, and Pathogenesis." *Cold Spring Harbor Perspectives in Medicine*. Cold Spring Harbor Laboratory Press, July 2013. Web. 08 Aug. 2017.

Mccullers, J. A. "Insights into the Interaction between Influenza Virus and Pneumococcus." *Clinical Microbiology Reviews*, vol. 19, no. 3, Jan. 2006, pp. 571–582., doi:10.1128/cmr.00058-05.

Musher, Daniel M., and Maria B. Rodriguez-Barradas. "Why the recent ACIP recommendations regarding conjugate pneumococcal vaccine in adults may be irrelevant." *Human Vaccines & Immunotherapeutics*, vol. 12, no. 2, 2015, pp. 331–335., doi:10.1080/21645515.2015.1098794.

Tennessee Department of Health (2017). Emerging Infections Programs, (1-4). Retrieved May 1, 2017, from http://www.tn.gov/health/article/emerging-infections-programs.

Appendix 1

– ACTIVE BACTERIAL CORE SURVEILLANCE CASE REPORT –

Patient's Name: _____ (Last, First, MI.) Phone No.:( ) _____

Address: _____ (Number, Street, Apt. No.) Patient Chart No.: _____

_____ (City, State) _____ (Zip Code) Hospital: _____

– Patient identifier information is not transmitted to CDC –

DEPARTMENT OF HEALTH AND HUMAN SERVICES
CENTERS FOR DISEASE CONTROL
AND PREVENTION
ATLANTA, GA 30333

2017 Active Bacterial Core Surveillance (ABCs) Case Report

A Core Component of the Emerging Infections Program Network

– SHADED AREAS FOR OFFICE USE ONLY –

1. STATE: *(Patient Residence)* ☐☐

2. STATE I.D.: ☐☐☐☐☐☐☐

3a. Was a culture performed? 1 ☐ Yes, Positive 2 ☐ Yes, Negative 3 ☐ No

3b. DATE FIRST POSITIVE CULTURE COLLECTED Mo. ☐☐ Day ☐☐ Year ☐☐☐☐

3c. DATE FIRST POSITIVE Culture Independent Diagnostic Test (CIDT, e.g. PCR) COLLECTED Mo. ☐☐ Day ☐☐ Year ☐☐☐☐

3d. TYPE OF CIDT: 1 ☐ Biofire Meningitis Panel 9 ☐ Unknown 2 ☐ Other _____

4. Date reported to EIP site: Mo. ☐☐ Day ☐☐ Year ☐☐☐☐

5. CRF Status: 1 ☐ Complete 3 ☐ Edited & Correct 2 ☐ Incomplete 4 ☐ Chart unavailable after 3 requests

6. COUNTY: *(Residence of Patient)* _____

7a. HOSPITAL/LAB I.D. WHERE CULTURE IDENTIFIED: ☐☐☐☐☐

7b. HOSPITAL I.D. WHERE PATIENT TREATED: ☐☐☐☐☐

8. DATE OF BIRTH: Mo. ☐☐ Day ☐☐ Year ☐☐☐☐

9a. AGE: ☐☐☐

9b. Is age in day/mo/yr? 1 ☐ Days 2 ☐ Mos. 3 ☐ Yrs.

10. SEX: 1 ☐ Male 2 ☐ Female

11a. ETHNIC ORIGIN: 1 ☐ Hispanic or Latino 2 ☐ Not Hispanic or Latino 9 ☐ Unknown

11b. RACE: *(Check all that apply)* 1 ☐ White 1 ☐ Asian 1 ☐ Black 1 ☐ Native Hawaiian or Other Pacific Islander 1 ☐ American Indian or Alaska Native 1 ☐ Unknown

12a. BACTERIAL SPECIES ISOLATED FROM ANY NORMALLY STERILE SITE:
1 ☐ *Neisseria meningitidis* 3 ☐ Group B *Streptococcus* 5 ☐ Group A *Streptococcus*
2 ☐ *Haemophilus influenzae* 4 ☐ *Listeria monocytogenes* 6 ☐ *Streptococcus pneumoniae*

12b. OTHER BACTERIAL SPECIES ISOLATED FROM ANY NORMALLY STERILE SITE: *(specify)* _____

13. STERILE SITES FROM WHICH ORGANISM ISOLATED: *(Check all that apply)*
1 ☐ Blood 1 ☐ CSF 1 ☐ Peritoneal fluid 1 ☐ Bone 1 ☐ Muscle/Fascia/Tendon 1 ☐ Joint 1 ☐ Pleural fluid
1 ☐ Pericardial fluid 1 ☐ Other normally sterile site (specify) _____ 1 ☐ Internal body site *(specify)* _____

13b. CIDT STERILE SITE FROM WHICH ORGANISM WAS DETECTED: 1 ☐ CSF 1 ☐ Other _____

14. OTHER SITES FROM WHICH ORGANISM ISOLATED: *(Check all that apply)*
1 ☐ Placenta 1 ☐ Wound 1 ☐ Sinus
1 ☐ Amniotic fluid 1 ☐ Middle ear

INFLUENZA 15. Did this patient have a positive flu test 10 days prior to or following any ABCs positive culture? 1 ☐ Yes 2 ☐ No 9 ☐ Unknown

16. WAS PATIENT HOSPITALIZED? 1 ☐ Yes 2 ☐ No
If YES, date of admission: Mo. ☐☐ Day ☐☐ Year ☐☐☐☐
Date of discharge: Mo. ☐☐ Day ☐☐ Year ☐☐☐☐

17. If patient was hospitalized, was this patient admitted to the ICU during hospitalization? 1 ☐ Yes 2 ☐ No 9 ☐ Unknown

18a. Where was the patient a resident at time of initial culture?
1 ☐ Private residence 4 ☐ Homeless 7 ☐ Non-medical ward
2 ☐ Long term care facility 5 ☐ Incarcerated 8 ☐ Other *(specify)* _____
3 ☐ Long term acute care facility 6 ☐ College dormitory 9 ☐ Unknown

18b. If resident of a facility, what was the name of the facility? _____
Facility ID: _____

19a. Was patient transferred from another hospital? 1 ☐ Yes 2 ☐ No 9 ☐ Unknown

19b. If YES, hospital I.D.: ☐☐☐☐☐

20a. WEIGHT: _____lbs_____ oz OR _____ kg OR ☐ Unknown

20b. HEIGHT: _____ft _____in OR _____ cm OR ☐ Unknown

20c. BMI: ___ ___ . ___ OR ☐ Unknown

21. TYPE OF INSURANCE: *(Check all that apply)*
1 ☐ Private 1 ☐ Military 1 ☐ Other *(specify)* _____
1 ☐ Medicare 1 ☐ Indian Health Service (IHS) 1 ☐ Uninsured
1 ☐ Medicaid/state assistance program 1 ☐ Incarcerated 1 ☐ Unknown

22. OUTCOME: 1 ☐ Survived 2 ☐ Died 9 ☐ Unknown

23. If patient died, was the culture obtained on autopsy? 1 ☐ Yes 2 ☐ No 9 ☐ Unknown

22a. If survived, patient discharged to: 1 ☐ Home 2 ☐ LTC/SNF 3 ☐ LTACH 4 ☐ Other _____ 9 ☐ Unknown

If discharged to LTC/SNF or LTACH, what is the Facility ID _____

24a. At time of first positive culture, patient was: 1 ☐ Pregnant 2 ☐ Postpartum 3 ☐ Neither 9 ☐ Unknown

24b. If pregnant or postpartum, what was the outcome of fetus:
1 ☐ Survived, no apparent illness 4 ☐ Abortion/stillbirth 9 ☐ Unknown
2 ☐ Survived, clinical infection 5 ☐ Induced abortion
3 ☐ Live birth/neonatal death 6 ☐ Still pregnant

24c. ☐ Mark if this is a HiNSES fetal death with placenta and/or amniotic fluid isolate, a stillbirth, or neonate <22 wks gestation.

25. If patient <1 month of age, indicate gestational age and birth weight. If pregnant, indicate gestational age of fetus, only.
Gestational age: ☐☐ *(wks)* Birth weight: ☐☐☐☐ *(gms)*

26. TYPES OF INFECTION CAUSED BY ORGANISM: *(Check all that apply)*
1 ☐ Bacteremia without Focus
1 ☐ Meningitis
1 ☐ Otitis media
1 ☐ Pneumonia
1 ☐ Cellulitis
1 ☐ Epiglottitis
1 ☐ Hemolytic uremic syndrome (HUS)
1 ☐ Abscess (not skin)
1 ☐ Peritonitis
1 ☐ Pericarditis
1 ☐ Septic abortion
1 ☐ Chorioamnionitis
1 ☐ Septic arthritis
1 ☐ Osteomyelitis
1 ☐ Empyema
1 ☐ Endocarditis
1 ☐ Endometritis
1 ☐ STSS
1 ☐ Necrotizing fasciitis
1 ☐ Puerperal sepsis
1 ☐ Septic shock
1 ☐ Other *(specify)* _____
1 ☐ Unknown

CDC 52.15A REV. 10-2015 – ACTIVE BACTERIAL CORE SURVEILLANCE CASE REPORT – Page 1 of 2

– IMPORTANT – PLEASE COMPLETE THE BACK OF THIS FORM –

27. UNDERLYING CAUSES OR PRIOR ILLNESSES: *(Check all that apply* OR *if* NONE *or* CHART UNAVAILABLE,*check appropriate box)* 1☐ None 1☐ Unknown

1☐ AIDS or CD4 count <200
1☐ Alcohol Abuse, Current
1☐ Alcohol Abuse, Past
1☐ Asthma
1☐ Atherosclerotic Cardiovascular Disease (ASCVD)/CAD
1☐ Bone Marrow Transplant (BMT)
1☐ Cerebral Vascular Accident (CVA)/Stroke/TIA
1☐ Chronic Kidney Disease
1☐ Chronic Liver Disease/cirrhosis
1☐ Current Chronic Dialysis
1☐ Chronic Skin Breakdown
1☐ Cochlear Implant
1☐ Complement Deficiency
1☐ Connective Tissue Disease (Lupus, etc.) CSF Leak
1☐ Deaf/Profound Hearing Loss
1☐ Dementia
1☐ Diabetes Mellitus
1☐ Emphysema/COPD
1☐ Heart Failure/CHF
1☐ HIV Infection
1☐ Hodgkin's Disease/Lymphoma
1☐ Immunoglobulin Deficiency
1☐ Immunosuppressive Therapy (Steroids, etc.)
1☐ Eculizumab (Soliris) - *N.men. cases only*
1☐ IVDU, Current
1☐ IVDU, Past
1☐ Leukemia
1☐ Multiple Myeloma
1☐ Multiple Sclerosis
1☐ Myocardial Infarction
1☐ Nephrotic Syndrome
1☐ Neuromuscular Disorder
1☐ Obesity
1☐ Other Drug Use, Current
1☐ Other Drug Use, Past
1☐ Parkinson's Disease
1☐ Peptic Ulcer Disease
1☐ Peripheral Neuropathy
1☐ Peripheral Vascular Disease
1☐ Plegias/Paralysis
1☐ Premature Birth (specify gestational age at birth) ☐☐ (wks)
1☐ Seizure/Seizure Disorder
1☐ Sickle Cell Anemia
1☐ Smoker (current)
1☐ Solid Organ Malignancy
1☐ Solid Organ Transplant
1☐ Splenectomy/Asplenia
1☐ Other prior illness (specify): _____

– IMPORTANT – PLEASE COMPLETE FOR THE RELEVANT ORGANISM –

HAEMOPHILUS INFLUENZAE

28a. What was the serotype? 1☐ b 2☐ Not Typeable 3☐ a 4☐ c 5☐ d 6☐ e 7☐ f 8☐ Other *(specify)* _____ 9☐ Not Tested or Unknown

28b. If <15 years of age and serotype 'b' or 'unknown' did patient receive *Haemophilus influenzae* b vaccine? 1☐ Yes 2☐ No 9☐ Unknown **If YES, please complete the list below.**

DOSE	DATE GIVEN Mo.	Day	Year	VACCINE NAME	MANUFACTURER	LOT NUMBER
1						
2						
3						
4						

28c. Were records obtained to verify vaccination history? *(<5 years of age with Hib/unknown serotype, only)*
1☐ Yes 2☐ No

If YES, what was the source of the information? *(Check all that apply)*
1☐ Vaccine Registry
1☐ Healthcare Provider
1☐ Other *(specify)* _____

NEISSERIA MENINGITIDIS

29. What was the serogroup? 1☐ A 2☐ B 3☐ C 4☐ Y 5☐ W135 6☐ Not Groupable 8☐ Other _____ 9☐ Unknown

30. Is patient currently attending college?
1☐ Yes 2☐ No 9☐ Unknown

31. Did patient receive meningococcal vaccine? 1☐ Yes 2☐ No 9☐ Unknown **If YES, complete the table**

DOSE	TYPE	DATE GIVEN Mo.	Day	Year	NAME	MANUFACTURER	LOT NUMBER
1							
2							
3							
4							
5							
6							

Type Codes: 1= ACWY conjugate (Menactra, Menveo, MenHibrix) 2= ACWY polysaccharide (Menomune) 3= B (Bexsero, Trumenba) 9= Unknown

STREPTOCOCCUS PNEUMONIAE

32. Did patient receive pneumococcal vaccine?
1☐ Yes 2☐ No 9☐ Unknown

If YES, please note which pneumococcal vaccine was received: *(Check all that apply)*

1☐ Prevnar®, 7-valent Pneumococcal Conjugate Vaccine (PCV7)
1☐ Prevnar-13®, 13-valent Pneumococcal Conjugate Vaccine (PCV13)
1☐ Pneumovax®, 23-valent Pneumococcal Polysaccharide Vaccine (PPV23)
1☐ Vaccine type not specified

If between ≥2 months and<5 years of age and an isolate is available for serotyping, please complete the Invasive Pneumococcal Disease in Children expanded form.

31b. If survived, did patient have any of the following sequelae evident upon discharge? (check all that apply) 1☐ None 1☐ Unknown
1☐ Hearing deficits 1☐ Amputation (digit) 1☐ Amputation (limb) 1☐ Seizures 1☐ Paralysis or spasticity 1☐ Skin Scarring/necrosis 1☐ *Other (specify)* _____

GROUP A STREPTOCOCCUS *(#33–35 refer to the 14 days prior to first positive culture)*

33. Did the patient have surgery or any skin incision? 1☐ Yes 2☐ No 9☐ Unknown

If YES, date of surgery or skin incision: Mo. ☐☐ Day ☐☐ Year ☐☐☐☐
9☐ Unknown date

34. Did the patient deliver a baby *(vaginal or C-section)*?
1☐ Yes 2☐ No 9☐ Unknown

If YES, date of delivery: Mo. ☐☐ Day ☐☐ Year ☐☐☐☐
9☐ Unknown date

35. Did patient have:
1☐ Varicella
1☐ Penetrating trauma
1☐ Blunt trauma
1☐ Surgical wound *(post operative)*
1☐ Burns

If YES to any of the above, record the number of days prior to the first positive culture *(if > 1, use the most recent skin injury)*
1☐ 0-7 days 2☐ 8-14 days 9☐ Unknown days

36. COMMENTS: _____

– SURVEILLANCE OFFICE USE ONLY –

37. Was case first identified through audit? 1☐ Yes 2☐ No 9☐ Unknown

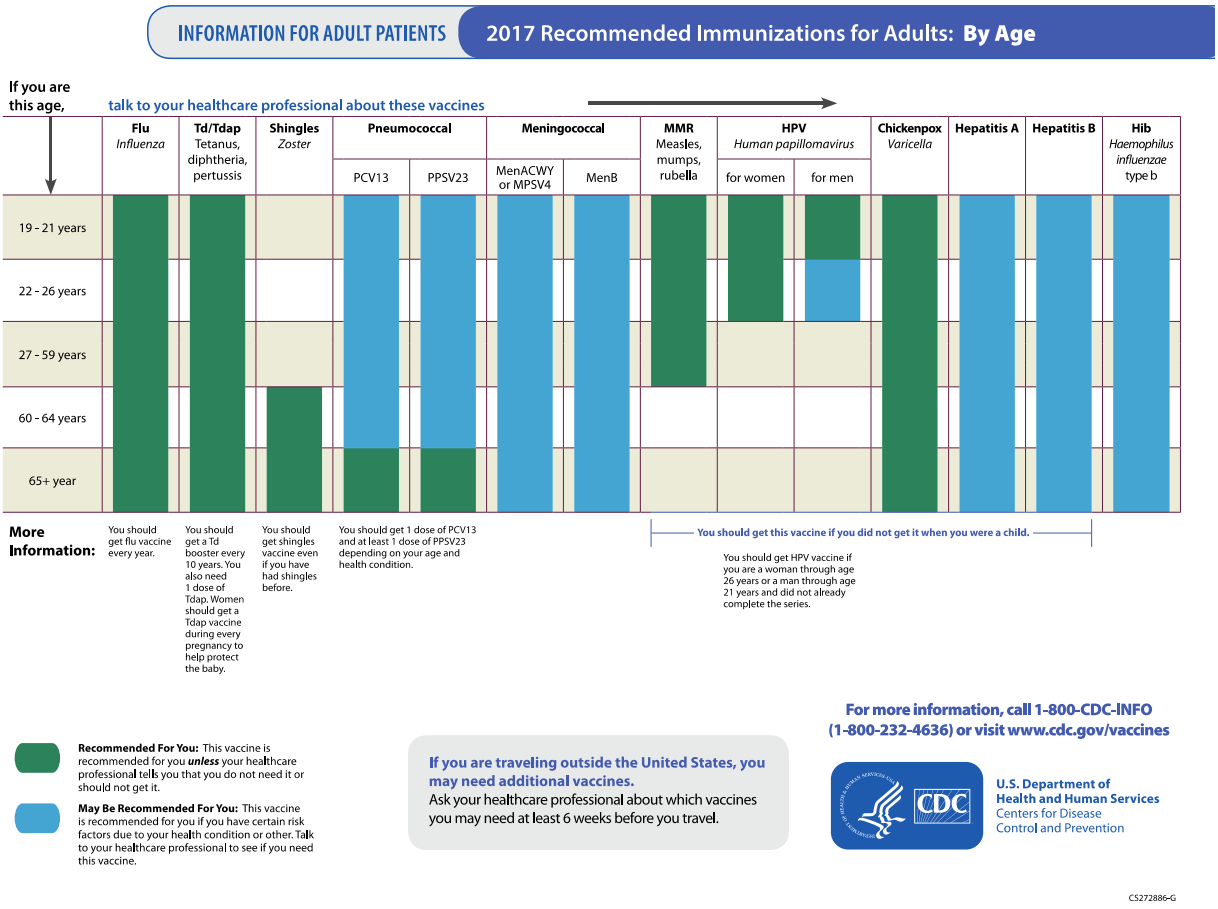
38. Does this case have recurrent disease with the same pathogen? 1☐ Yes 2☐ No 9☐ Unknown
If YES, previous (1st) state I.D.: ☐☐☐☐☐☐☐

39. Initials of S.O.: _____

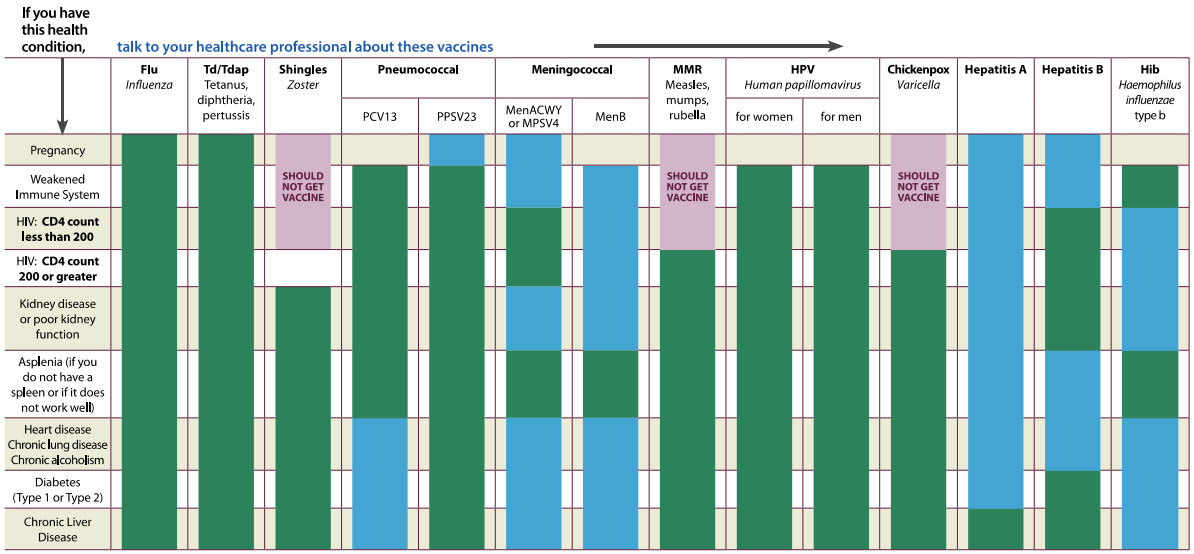
Submitted By: _____ Phone No. : ( ) _____ Date: ____/____/____

Physician's Name: _____ Phone No. : ( ) _____

Appendix 2


INFORMATION FOR ADULT PATIENTS
2017 Recommended Immunizations for Adults: By Age
If you are this age,
talk to your healthcare professional about these vaccines
Flu Influenza
Td/Tdap Tetanus, diphtheria, pertussis
Shingles Zoster
Pneumococcal
PCV13
PPSV23
Meningococcal
MenACWY or MPSV4
MenB
MMR Measles, mumps, rubella
HPV Human papillomavirus
for women
for men
Chickenpox Varicella
Hepatitis A
Hepatitis B
Hib Haemophilus influenzae type b
19 - 21 years
22 - 26 years
27 - 59 years
60 - 64 years
65+ year
More Information:
You should get flu vaccine every year.
You should get a Td booster every 10 years. You also need 1 dose of Tdap. Women should get a Tdap vaccine during every pregnancy to help protect the baby.
You should get shingles vaccine even if you have had shingles before.
You should get 1 dose of PCV13 and at least 1 dose of PPSV23 depending on your age and health condition.
You should get this vaccine if you did not get it when you were a child.
You should get HPV vaccine if you are a woman through age 26 years or a man through age 21 years and did not already complete the series.
Recommended For You: This vaccine is recommended for you unless your healthcare professional tells you that you do not need it or should not get it.
May Be Recommended For You: This vaccine is recommended for you if you have certain risk factors due to your health condition or other. Talk to your healthcare professional to see if you need this vaccine.
If you are traveling outside the United States, you may need additional vaccines.
Ask your healthcare professional about which vaccines you may need at least 6 weeks before you travel.
For more information, call 1-800-CDC-INFO (1-800-232-4636) or visit www.cdc.gov/vaccines
CDC
U.S. Department of Health and Human Services
Centers for Disease Control and Prevention
CS272886-G

INFORMATION FOR ADULT PATIENTS | **2017 Recommended Immunizations for Adults: By Health Condition**



More Information:

You should get flu vaccine every year.

You should get a Td booster every 10 years. You also need 1 dose of Tdap vaccine. Women should get Tdap vaccine during every pregnancy.

You should get shingles vaccine if you are age 60 years or older, even if you have had shingles before.

You should get 1 dose of PCV13 and at least 1 dose of PPSV23 depending on your age and health condition.

You should get this vaccine if you did not get it when you were a child.

You should get HPV vaccine if you are a woman through age 26 years or a man through age 21 years and did not already complete the series.

You should get Hib vaccine if you do not have a spleen, have sickle cell disease, or received a bone marrow transplant.

For more information, call 1-800-CDC-INFO (1-800-232-4636) or visit www.cdc.gov/vaccines

Recommended For You: This vaccine is recommended for you ***unless*** your healthcare professional tells you that you do not need it or should not get it.

May Be Recommended For You: This vaccine is recommended for you if you have certain other risk factors due to your age, health condition or other. Talk to your healthcare professional to see if you need this vaccine.

YOU SHOULD NOT GET THIS VACCINE

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

CS272886-G