5-2020

Take a Shot: the Effect of a Multicomponent Strategy to Increase Meningitis B Vaccination Rates

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TAKE A SHOT: THE EFFECT OF A MULTICOMPONENT STRATEGY TO INCREASE MENINGITIS B VACCINATION RATES

by

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EVIDENCE-BASED PRACTICE PROJECT REPORT

Submitted to the College of Nursing and Health Professions

of Valparaiso University,

Valparaiso, Indiana

in partial fulfillment of the requirements

For the degree of

DOCTOR OF NURSING PRACTICE

2020

DEDICATION

I would like to dedicate this project to my husband, Rob and my daughter, Gracelyn. You two are the reason for this journey. Thank you for your never-ending support and inspiration. You both are my everything and I could not have done any of this without you. I am eternally grateful for the opportunities you have given me and the chance to better our life. We finally made it! To my best friend and sister, Ashley. You have encouraged me throughout this whole process and more, always having faith in me, even when I lost faith in myself. I could not have done any of this without your voice telling me that this is all worth something in the end. For that I am truly thankful. To my dad, who has always encouraged me to do more and reach the highest level in life. To my in laws, who I consider my parents, Nancy and Bob, thank you for your support, encouragement, and telling me you were proud of me when I needed to hear it the most. You were one of my biggest support systems. I love you all.

ACKNOWLEDGMENTS

I would like to thank my advisor, Dr. Jamie Bump for her endless guidance and encouragement throughout this process. Kelley, my site facilitator, thank you for making this process possible and easy. Your knowledge, ideas, and efforts did not go unnoticed. The staff at the SHC, you welcomed me with open arms and made this project feasible. To my fellow colleagues, thank you for your daily encouragement to get through this process.

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ABSTRACT

Neisseria meningitidis is the major cause of invasive meningococcal disease (IMD) (Peterson et al, 2018). Approximately 10-15 percent of IMD cases result in debility including neurological impairment, amputation, and death (Peterson et al, 2018). Outbreaks of IMD are sporadic and unpredictable. The incidence of IMD varies geographically, but serogroup B has become more prevalent in recent years. Meningitis-B (Men-B) has been the cause of several university outbreaks on different US college campuses since 2013.The purpose of this project was to implement an intervention at a midwestern university student health center to help students understand the risk of the disease and the importance of receiving the Meningococcal vaccination. A determination was made that the health center needed an intervention for education of these students to assist in vaccination uptake. Best practice recommendation from the literature included implementation of a provider reminder to screen and offer the Men-B vaccination, educational efforts, and the initiation of a poster campaign around campus regarding the disease and importance of vaccination. The project implementation included screening eligible participants over 13 weeks at a midwestern university health center. A brightly colored reminder was placed on each of the staff laptops to screen and offer the vaccination to those who met criteria. Posters were placed around campus in areas that students frequently attend. Educational brochures were given to eligible students at the time of their visit and a template in the electronic health record was created to flag patients that have received the vaccine and when they will be due for their second dose. A compliance tracking form was created for the clinic staff (N=5) to fill out daily in order to evaluate project intervention compliance. Data were collected from student charts to determine eligibility as well as vaccine administration post intervention. A chi-square analysis was performed (X^2 (1)=26.112, p<0.05), indicating statistical significance.

CHAPTER 1

INTRODUCTION

Background

Neisseria meningitidis, a gram-negative bacterium, is the major cause of invasive meningococcal disease (IMD) (Peterson et al, 2018). The bacterium is often carried by about 10% of the human population in their pharynx (Peterson, et al, 2018). Approximately 10-15% of IMD cases result in debility including neurological impairment, amputation, and death (Peterson et al, 2018). The disease is transmitted through droplets, such as those from oral or nasal passages through mechanisms such as coughing, sneezing and sharing beverages and food. Those most at risk include young children, adolescents, immunocompromised individuals, and students who attend universities or are living in college dormitories (Peterson et al, 2018; Crum-Cianflone & Sullivan, 2016).

Outbreaks of IMD are sporadic and unpredictable. Since 2013, there have been three university-based outbreaks in the United States (US) (Baker, 2016). In 2017, there were approximately 350 cases of meningococcal disease reported in the US. The highest incidence of the disease occurs in children less than one year old and those between the ages of 16 and 23 years old (CDC, 2019). There are twelve serogroups (subtypes) of meningococcal disease, six (A,B,C,W, X, & Y) are capable of causing epidemics (WHO, 2019). The highest incidence is reported in sub-Saharan Africa, in which epidemics caused by Group A have occurred every 10-12 years. Groups B and C are responsible for most cases in North and South America, Australia, New Zealand, and Europe (WHO, 2019).

Vaccination is the best form of prevention for this disease. Since 1999, a conjugate vaccine has been available against Group C and a quadrivalent vaccine against Group A, C, Y, and W has been available since 2005 (WHO, 2019). Vaccination against Group B has just recently been made available in 2014. It is recommended that children aged 11-12 years old

receive the MenACYW vaccination with a booster dose at 16 years of age. Those that are between the ages of 16-23 years old are recommended to receive the Men-B vaccination (CDC, 2019).

Data from the Literature Supporting Need for the Project

The incidence of IMD varies geographically, but serogroup B has become more prevalent in recent years. Men-B has been the cause of several university outbreaks on different US college campuses since 2013 (Baker, 2016). During February 2019, Rutgers University in New Brunswick, NJ had two undergraduate students test positive for Men-B (CDC, 2019; Rutgers University, 2019). The students tested positive approximately two weeks apart and subsequently, this was deemed an outbreak by the CDC. The students were treated promptly and survived without any complications (Rutgers University, 2019). In addition, during the same time period, another Men-B outbreak involving two students at Columbia University in New York occurred (CDC, 2019; Columbia University, 2019). These students were also hospitalized, treated, and recovered. Other Men-B outbreaks occurred in September 2018 and April 2019 at San Diego University (CDC, 2019; Health & Human Services Agency, 2019). Approximately 30-40% of all IMD cases in the US are caused by the serogroup B (Baker, 2016). The CDC (2019) notes that approximately 10-15 in 100 people that acquire the meningococcal infection will die. They also note that about 1 in 5 survivors will have long-term disabilities from the disease such as deafness, loss of limbs, nervous system debilities, and brain damage. In 2017 the CDC issued its most recent report which stated that there were 350 reported cases of Men-B occurring over multiple age groups, the highest incidence occurring between the ages of 16 and 23 years old (CDC, 2017). Within this study, it was estimated that 65% of those infected were college students. According to the report 43.9% of those students had received information regarding the disease but did not receive the vaccination. During that year, there were a total of 16 deaths in the US related to IMD, three of which occurred in the 16-23-year age group. IMD

remains a major global health threat that can cause major debilities and even death. The disease is largely preventable by vaccination (Crum-Cianflone & Sullivan, 2016).

In addition to the poor health outcomes associated with IMD, there are many costs associated with caring for those who contract the illness. Balada-Llasat (2018) completed a study to compare costs of the many tests associated with a meningitis infection. They found that the average cost to care for one patient with bacterial meningitis is $26,501. These costs include hospitalization, diagnostic testing, and antimicrobial therapy (Balada-Lllasat, 2018). While receiving treatment, patients are typically in droplet isolation until after 24 hours of initial treatment with an effective antibiotic. Antibiotic therapy for the disease typically lasts from seven to fourteen days, depending on the causative bacteria (El Bashir, Laundy, & Booy, 2019).

Although the rates of IMD are low, the severity of illness is high. Neurologic and physical debility are associated with the disease and IMD has a 10-15% mortality rate (Peterson et al, 2018). To prevent infection and debility, as well as lower healthcare costs associated with the disease, vaccination rates need to increase, especially in high risk populations. College-aged students are at increased risk of contracting the illness; therefore, an intervention is necessary to increase vaccination rates in this population.

Data from the Clinical Agency Supporting Need for the Project

The project was implemented in a midwestern university student health center (SHC). The SHC serves a diverse group of students varying in age, race, and ethnicity. During the 2018-2019 school year, the student body was comprised of 71.8% white ethnicity, 9.4% Hispanic, 5.5% Black/African American, and 2.1% were of Asian descent. Additionally, 4.1% were international students, 3.5% multi-racial, 0.1% were American Indian/Alaskan Native, and 3.5% were not reported (University X, 2019). The SHC offers many services to full or part time students including preventative services such as immunizations as well as sick visits (University X, 2019). According to the university, any graduate student enrolled in nine or more credit hours and any undergraduate enrolled in twelve or more credit hours must utilize the university health

insurance plan. However, students can obtain other insurance outside of the SHC, but must waive out of the student insurance plan and provide proof of insurance (University X, 2019). When students use the SHC, immunizations, medications, and physician visits are generally covered in full. The co-pays and deductibles are waived, making healthcare affordable to students (University X, 2019). According to the university insurance plan (2019), the Men-B vaccine would be a covered preventative service, if administered by a preferred provider, including the SHC. Cost, therefore, would not be a barrier to students receiving the vaccine. (University X, 2019).

According to the program director, from May 2018 to May 2019 there were 2,703 total health center visits, making this a frequent place to meet student's healthcare needs (K. Eshenaur, personal communication, 2019). The university did not receive the Men-B vaccination until May 2019. There were only 56 Men-B vaccinations given during May 2019-August 2019 (University X Health Center, 2019). Since there are no current mechanisms for screening for the vaccination, there is no way to know the true vaccination rate. There have been no reported outbreaks of Men-B at this specific university since it was founded in 1859 (Meningitis B Action Project, 2019; K. Eshenaur, personal communication, 2019). Despite no reported outbreaks, the severity of this disease is such that increased vaccination rates are warranted.

Due to the disease severity and increased risk to college students, a decision was made by the Provost of the university to mandate vaccination for all incoming freshman, both living on campus and commuters (K. Eshenaur, personal communication, 2019). While incoming students are mandated to have the vaccination before attendance at the university beginning the 2019-2020 school year, already enrolled students have no such mandate. The rest of the student body remains at risk of disease. Therefore, further vaccination in this population and in this setting is required.

Purpose of the Evidence-Based Practice Project

It is estimated that 30-40% of all IMD cases in the US are caused by the serogroup B (Baker, 2016). Approximately 10-15 in 100 cases of the meningococcal infection result in fatality They also note that about 1 in 5 survivors will have long-term disabilities from the disease such as deafness, loss of limbs, nervous system debilities, and brain damage. College students are at an increased risk of contracting Men-B due to the transmission by respiratory droplets and living in close quarters such as dormitories. There is compelling evidence and support from the CDC and WHO, as well as other agencies to focus efforts on increasing vaccination rates of Men-B due to the severity of the disease. Additionally, there was much support for an intervention focused on increasing Men-B vaccination rates by the site director, identifying an essential need for an intervention to increase Men-B vaccination uptake. The purpose of this EBP project was to influence the college student population at risk, age 23 and under, to receive the Men-B vaccination. By implementing an intervention to promote the immunization, a positive outcome for prevention of disease can be achieved.

PICOT Question

According to Schmidt and Brown (2019) the PICOT format was designed to formulate EBP questions to find the most relevant evidence. The format includes identifying (a) Patient population, (b) Intervention of interest, (c) Comparison of interest, (d) Outcome of interest, and (e) Time utilized. Specifically, this project addressed the following PICOT question: In college students (P), does the implementation of an intervention to educate students on the meningitis disease and importance of vaccination, a vaccination screening and provider reminder, and a campus-wide vaccination campaign (I) as compared to no intervention (C), increase Men-B vaccination rates (O), over thirteen weeks (T) ?.

Significance of the EBP Project

This EBP project aimed to implement an intervention that will help increase the vaccination rates of a potentially fatal disease. Prior to project implementation, immunization

rates for Men-B at the SHC were low and there was no intervention in place to increase rates. Despite the new mandate for all incoming students, the risk of contracting Men-B remained high among the remainder of the student body. According to the CDC (2017), there were approximately 350 cases of Men-B reported in 2017; 65% of those were college students and 43.9% of those students had received the information regarding the disease but did not receive the vaccination. Further intervention was needed to emphasize the risk and prevent this deadly disease. If the intervention is successful, the SHC can utilize it for future immunization practices. This project can prevent mortality and morbidity among college students and their contacts.

CHAPTER 2

EBP MODEL AND REVIEW OF LITERATURE

Evidence-based Practice Model

Overview of EBP Model

For this evidence-based practice (EBP) project, multiple models were reviewed to guide its direction including the Iowa Model of EBP, Advancing Research and Clinical Practice through Close Collaboration (ARCC) model, the Promoting Action on Research Implementation in Health Services (PARIHS) model, the Academic Center for Evidence-Based Practice (ACE) model, and the Stetler Model. The Stetler model was chosen because it utilizes step by step guidelines to direct EBP. The core of the model is critical thinking and use of research findings (Melnyk & Fineout-Overholt, 2015), both which are essential to this project. Critical thinking was necessary to differentiate evidence findings and applying the evidence into a practice setting was the foundation of this project. Utilizing critical thinking was a large part of this EBP project in order to synthesize the evidence to support this project. For a novice leader, the Stetler model was ideal as its use of step by step guidelines was easily understood and applied to this project. Since this EBP project was complex, step by step direction was just what was needed to simplify and direct the activities of the project. The model is user-friendly and designed in a manner that is easy to understand as well as to apply to this EBP project.

The Stetler model was developed to “formulate a series of critical-thinking and decision-making steps designed to facilitate safe and effective use of research findings” (Stetler, 2001, p. 273). According to Melnyk & Fineout-Overholt (2015), the Stetler model has been known to be a “practitioner-oriented model” (p.279) due to its focus on critical thinking as well as its ability for the practitioner to utilize its findings. This model was designed to guide critical thinking as well as decision-making among practitioners as well as aid in effective use of the research findings (Stetler, 2001). The model is divided into five different phases: (1) preparation, (2) validation, (3)

comparative evaluation/decision making, (4) translation/application, and (5) evaluation (Melnyk & Fineout-Overholt, 2015).

Phase I: Preparation. During this phase, a significant need is defined and a systematic search for pertinent evidence is initiated (Melnyk & Fineout-Overholt, 2015).The preparation phase consists of recognizing high priority issues, identifying key stakeholders, forming a project team, and delineating applicable desired outcomes (Stetler, 2001). This is achieved by selecting research sources, assessing internal evidence, and pursuing systematic reviews.

Phase II: Validation. The validation phase consists of critiquing the literature for applicability and reliability. A table of evidence is created, and evidence is then graded and rated. Statistical and clinical significance is identified, and non-credible sources are eliminated (Stetler, 2001). The decision to continue with the research process is made if there is enough credible evidence. The process ceases if there is insufficient evidence to support practice change.

Phase III: Comparative Evaluation/Decision Making. Cumulative findings are synthesized in phase three. Similarities and differences of the findings are organized among the pieces of evidence. Feasibility of the findings is determined including urgency/risk of current issues/needs, resources, and readiness of the clinical site (Melnyk & Fineout-Overholt, 2015; Stetler, 2001). Evidence is then organized, and decisions are made regarding what findings to use or not to use. If a decision is made to utilize the research findings, it can mean a recommendation for or against a specific practice. If a decision is made not to employ the findings, then further research may be conducted, or it can be delayed until additional research is done by others (Melnyk & Fineout-Overholt, 2015).

Phase IV: Translation/Application. The translation/application phase consists of translating the research findings and applying them to practice. The research is disseminated, and practice changes are made based on current recommendations (Stetler, 2001). A plan is

made, key stakeholders such as staff are educated, and the plan is implemented based on the evidence that was synthesized and met inclusion criteria.

Phase V: Evaluation. The final phase consists of assessing the plan that was implemented. The outcomes are also examined for consistency with the evidence identified in the literature. (Melnyk & Fineout-Overholt, 2015). Stetler (2001) states that formative and summative data must be synthesized during this phase. Formative data includes information related to the actual implementation of the research findings and whether they were used as planned. Summative data evaluates if the goal of the project was met (Stetler, 2001).

Application of EBP Model to DNP Project

Phase I: Preparation. In the first phase of this model, the need for an intervention to increase Men-B vaccinations at a student health center (SHC) was identified by the advanced practice nurse (APN) who also served as the clinical director. Key stakeholders were identified according to the Stetler model including the clinic director, staff nurse, medical assistant, and physician at the university health center. According to the APN, Men-B immunization rates were low. The conversation deemed that a project was needed in order to aid in increasing immunization rates among college students (K. Eshenaur, personal communication, 2019). It was also noted that there were no interventions in place prior to implementation to help increase Men-B immunization rates on this campus. Starting fall 2019, the university planned to increase Men-B vaccination rates over a four- year period, by mandating all incoming students to have had the vaccination prior to attending the university (K. Eshenaur, personal communication, 2019). However, this plan still left many students unprotected and the need for an intervention to increase vaccination rates amongst the remainder of the student body was identified. Supporting evidence on the importance of this vaccination in college students was noted. According to the Centers for Disease Control (CDC) (2017), college campuses are at risk for outbreaks of meningococcal disease due to communal living in close spaces such as dormitories. Although infection rates are low, the risk remains high for neurological debilities,

amputation, and even death if the disease is contracted (Peterson, et al, 2018). After the need for an intervention was recognized, an intensive literature search was performed using key search terms and developed inclusion and exclusion criteria.

Phase II: Validation: Evidence was reviewed and critiqued using the Johns Hopkins Nursing Evidence Based Practice (JHNEBP) appraisal tool. This appraisal tool provided a detailed, yet understandable guide to identify a level and assign a grade to the evidence found. Inclusion and exclusion criteria of (1) not freshman status, (2) under the age of 23, and (3) have not received Men-B vaccine were developed. Evidence-based practice for increasing vaccination rates was identified to support a practice change. The appropriate evidence was then summarized and graded, and a rating level was applied.

Phase III: Comparative Evaluation/Decision making. The appropriate evidence was compared, and similarities were identified. After the evidence from 14 articles was appraised, it was concluded that a laminated reminder should be placed on the staff's workstations to review vaccination history as well as offer the Men-B vaccination, if applicable. It was noted that provider reminders placed in the EHR were also successful; however, it was deemed most feasible by the clinic director, as well as the project leader, to place the laminated reminder on the workstations, rather than place the reminder in each EHR. Educational modalities were also noted to increase vaccination rates and poster campaigns were said to be successful. Educational brochures regarding the Men-B disease, as well as the Men-B vaccination were given to patients while waiting in the examination room and a poster campaign was also placed in multiple locations around campus that are most frequented by students. The process of creating marketing strategies, a provider reminder, and education for students in need of the vaccination was developed with key stakeholders of the SHC. The intervention was deemed feasible by the project manager as well as the clinical director in this specific setting. The decision was made to carry out the evidence-based recommendations.

Phase IV: Translation/Application. The Stetler model was successfully utilized to guide the implementation of this EBP project. This was achieved through the inclusion of key stakeholders in the development of the implementation plan, which was designed based upon the appraisal and synthesis of evidence. Based on the evidence appraised and best practice recommendations, a multicomponent process was created that was deemed feasible by the clinical director of the SHC. Multiple factors were considered during this phase to assess feasibility of implementation of this project. These included the willingness of the providers and staff to acknowledge the reminder, provide the patient with the education, and offer the vaccination. To overcome any barriers, strategies were developed to help the project run without incident. These strategies included staff education with a step-by-step process of the project and their duties within the project. Questions were answered along the way and continued education was given until the interventions ran smoothly within the day to day workflow. Every Wednesday during implementation, the staff had a huddle for one hour to go over processes within the SHC. The project leader attended these huddles to assess project flow and to address any issues the staff may be having.

Phase V: Evaluation. Once data was collected after implementation of the evidence-based practice recommendations, the data was then synthesized to determine the impact of the intervention on meningitis B vaccinations at the SHC based on the Stetler model guidelines. During this period, the Men-B vaccination rates from May 2019 were compared to vaccination rates post intervention, to assess if the primary objective was met, and if the provider prompt, education, and poster campaign did in fact increase vaccination rates. During this phase, a compliance form was created for the SHC staff. The staff were to indicate on the form if the student met eligibility criteria, if education was given, as well as if the vaccine was offered and then given or declined; then the staff were to sign their name.

Strengths and Limitations of EBP Model for DNP Project

Strengths of the Stetler model include that it is focused on critical thinking, which is an essential component of this project. The model is also known for being practitioner oriented and is noted to be useful and user-friendly to APNs (Stetler, 2010). The model incorporates critical thinking during the EBP processes by emphasizing a focus on the heart of the problem as well as the outcomes desired. The Stetler model is also useful because it assesses the strength of the evidence and its ability to be applied in specific settings (Stetler, 2010). The model also focuses on implementation and evaluation related to the desired outcomes (Stetler, 2010). For example, the first portion of this project was identifying the problem of low Men-B vaccination rates at the SHC, searching for relevant evidence on ways to increase vaccination uptake , synthesizing and appraising that evidence, and then applying it to the SHC setting. Desired outcomes of increased vaccination rates were also defined. The evidence found was then implemented and applied at the SHC and the project was then evaluated to see if desired outcomes were met.

While there are many strengths of this EBP model, there are noted weaknesses. According to Stetler (2010), the model has not been tested thoroughly, so it is not differentiated from other EBP models. The model is noted to have many different versions, so finding the most updated version of the model has proven to be challenging. Stetler (2010) also notes that the model is designed for an individual who is experienced with its steps and uses it on a routine basis, so use for this project could prove to be difficult for an inexperienced individual.

Literature Search

Sources Examined for Relevant Evidence

An exhaustive search for evidence was completed using the following search engines: Cumulative Index for Nursing and Allied Health (CINAHL), Medline with Full Text, Nursing &

Allied Health Database, Joanna Briggs Institute EBP Database (JBI), PubMed, and the Cochrane Library.

Keywords that were utilized during the search in CINAHL, Medline with Full Text, Nursing & Allied Health Database, and PubMed included “clinician reminder*” OR “portal message*” OR “reminder* system*”, OR “patient remind*” OR “provider prompt*” OR “healthcare provid* prompt*” AND vaccine* OR immuniz* OR immunis*. The search terms vaccine* OR immuniz* AND remind* were used in JBI as well as the Cochrane Library. Using these search terms, CINAHL yielded 28 results, Medline with Full Text, 66 results, Nursing & Allied Health Database, 271 results, JBI, 18 results, PubMed, 403 results, and the Cochrane Library, 10 results. Due to the overwhelming results of PubMed, an additional limiter, review articles, was applied and yielded 53 results. Duplicate articles were then eliminated from each search. As an additional strategy, three articles were citation chased and reviewed, but were deemed to be not applicable to this project after review.

Inclusion criteria included (a) scholarly, peer reviewed journals, (b) English language, and (c) published between the years 2009-2019. In addition, exclusion criteria were developed to ensure applicability to this EBP project. These criteria included (a) dates outside of the 2009-2019 timeline, and (b) interventions that focused on patient reminders only, as well as (c) articles that did not focus on immunizations. Articles were not required to include the meningococcal vaccine, as interventions to increase vaccine uptake can be generalizable. Once inclusion and exclusion criteria were applied, abstracts were reviewed for adequate recommendations and evidence related to this project. Two additional articles were reviewed through citation chasing to ensure further evidence was not missed. Once data saturation was achieved, 19 articles were then intensely reviewed for adequacy and 14 were chosen for inclusion into this project and appraised critically (See Table 2.1)

Table 2.1

Evidence Summary

Citation (APA)	Purpose	Design	Sample	Measurement	Results/Findings	Level/ Quality
Arditi, C., Rege-Walther, M., Durieux, P., & Burnand, B. (2017). Computer-generated reminders delivered on paper to healthcare professionals: Effects on professional practice and healthcare outcomes (review). Cochrane Database of Systematic Reviews, 7(7), 1-107. doi:10.1002/14651858.CD001175.pub4	Evaluating the effects of automatic computer-generated reminders that are printed and delivered on paper to the healthcare provider related to patient health conditions as well as the providers quality of care.	Systematic Review	35 studies 30 Randomized control trials 5 non-randomized studies	Reminders overall improved quality of care by 6.8% Reminders alone improved the quality of care by 11% Quality of care included the provider utilizing current guidelines and research findings to give the patient up to date recommendations. The reminder would provide the healthcare professional with the most up to date recommendations regarding screenings due for the patient and current recommendations out be given.	The review indicated that computer generated reminders that are delivered on paper improve the quality of care overall. Reminders can be implemented in a variety of settings, so they can be generalized.	Level I/Grade B

Daly, K. L., Halon, P. A., Aronowitz, T., & Ross, G. (2016). A university health initiative to increase human papillomavirus vaccination rates. *The Journal for Nurse Practitioners, 12*(6), e281-e286. doi:10.1016/j.nurpra.2016.02.013	To assist in increasing the acknowledgement of patient's vaccination history by the provider to prevent opportunities for vaccinations being missed.	Quality improvement program At check-in, patients were asked "How many doses of the HPV vaccine have you received in your lifetime". Patients were prompted to respond. The response then automatically generated a graph in the EHR that prompted the provider to acknowledge the vaccine history before moving on	950 eligible visits	EHR reports were monitored for provider acknowledgement of vaccine history as well as provider recommendations for vaccination	158 HPV vaccines were administered to 120 patients This represented at 13-fold increase in the number of vaccines administered as the previous semester only administered 12 Provider acknowledgement of vaccine history was noted to be at 92%	Level V/Grade B
D'Agostino, S. (2016). Utilization of EHR provider prompts to maximize adult pertussis immunization rates. *Journal of Doctoral Nursing Practice, 9*(2), 183-188. doi:10.1891/2380-9418.9.2.183	To assess if pertussis vaccination rates increase with the use of EHR clinical reminders.	Non-randomized intervention-control study Computerized clinical reminder that was visible to the provider when the patient's chart was opened. The reminder required acknowledgement by the provider before allowing to	352 records selected from April 1, 2011-May 1, 2011. Study occurred from September 29, 2011-October 31, 2011-60 intervention and 60 control EHR's were selected	Primary outcome measure was the administration of the pertussis vaccine. Retrospective chart review for baseline (preintervention) and control groups. The EHR was used to record both the intervention and	8.3% of eligible patients received the pertussis vaccination in the intervention group ($p < .01$), compared to 5%, who did not receive the clinical reminder ($p=0.08$) Results indicate that the use of a clinical reminder in the EHR may increase pertussis immunization rates	Level III/ Grade C

		move on to the rest of the visit.		control group's vaccination rates over one month		
Francis, D. B., Cates, J. R., Wagner, K. P. G., Zola, T., Fitter, J. E., & Coyne-Beasley, T. (2017). Communication technologies to improve HPV vaccination initiation and completion: A systematic review. *Patient Education and Counseling, 100*(7), 1280-1286. doi:10.1016/j.pec.2017.02.004	To assess multiple studies that test the effects of communication technology on HPV vaccinations.	Systematic Review	K=12 studies reviewed, cumulative sample size of N=38,945, median N per study=1596 Median age was 16.61 years for participants	All interventions were conducted in healthcare settings with one being on a college campus. Half of the interventions (k=5) targeted parents, k=5 targeted patients, and k=3 targeted providers Multiple interventions including EHR reminder prompts (k=3), text messaging (k=3), automated phone calls (k=3), interactive computer videos (k=2), and email (k=2) were noted.	Two studies targeted providers only and used EHR prompts-studies showed mixed results-one study showed a significantly higher vaccination rate in the intervention group, and one study showed no difference Computer technology prompts for providers and parents appear to increase vaccination rates.	Level I/Grade B
Grivas, P. D., Devata, S., Khoriaty, R., Boonstra, P. S., Ruch, J., McDonnell, K., . . . Worden, F. P. (2017). Low-cost intervention to increase influenza vaccination rate at a	To determine if a best practice alert or a laminated reminder placed in the patient's chart would help	Experimental study	All adult and pediatric patients without influenza vaccination for the 2011-2012	Three provider-directed interventions were employed (a) a "best practice alert" was in the chart and was visible to the provider upon	37.6% increase in adult vaccination rates for the 2011-2012 season and a 56.1% increase in 2012-2013 season. The provider surveys determined that 70% of the providers considered the laminated	Level V/ Grade B

comprehensive cancer center. *Journal of Cancer Education, 32*(4), 871-877. doi:10.1007/s13187-016-1017-2	increase influenza vaccination rates.		and 2012-2013 seasons	entering the patients EHR, (b) a laminated reminder, placed in the patients physical chart and clinical room workstations that prompt the provider to ask about the vaccination, and (c) a bright pink sticker attached to the patient's medication reconciliation list asking if the patient received the vaccination, if not, it asked if they wanted to speak to the provider regarding the vaccination Surveys were given to the provider to determine uptake and satisfaction of the intervention	reminder useful, while 36% considered the "best practice alert" useful. 88% overall support the continuation of the overall intervention.	
Humiston, S. G., Bennett, N. M., Long, C., Eberly, S., Arvelo, L., Stankaitis, J., & Szilagyi, P. G. (2011).	To assess if different interventions such as patient tracking and	Randomized Control Trial (RCT)	3,752 eligible participants 2,004 were placed in the control group	Chi-square tests were used to compare the control and intervention group	64% of participants in the intervention group were vaccinated versus 22% in the control group	Level I/ Grade B

Increasing inner-city adult influenza vaccination rates: A randomized controlled trial. *Public Health Reports (1974-), 126*(2_suppl), 39-47. doi:10.1177/00333549111260S206	outreach and provider reminders influence influenza immunization rates in seniors.		and 1,748 were placed in the intervention group Multiple interventions were implemented including patient tracking, provider reminders, patient reminders and recall, and outreach to patients. Provider reminders included a brightly colored flag included in the patient's chart that read "REMEMBER! This patient needs the influenza vaccine" The form included a field		Combined interventions of patient tracking, recall, outreach, as well as provider reminders increased influenza vaccination rates among seniors, compared with standard-of-care control subjects. The results indicate that it may be generalizable to similar settings.	

			to indicated if the vaccine was administered, or if not, a reason would need to be provided.			
Jaca, A., Mathebula, L., Iweze, A., Pienaar, E., & Wiysonge, C. S. (2018). A systematic review of strategies for reducing missed opportunities for vaccination. *Vaccine, 36*(21), 2921-2927. doi:10.1016/j.vaccine.2018.04.028	To evaluate if missed vaccination rates were affected by different interventions including provider prompts, vaccination reminder cards, patient education, and patient reminders.	Systematic Review of multiple Randomized Control Trials	Six included studies comprised of three RCT's, two cluster randomized trials, and one cohort study. The studies included at total of 92,525 children, adolescents, and adults.	Several interventions were noted among the studies including -placing a missed opportunity for vaccination (MOV) sticker on the charts of children needing immunization -provider prompts -postcards -telephone calls -home visits -brightly colored vaccination reminder card to the front of the medical chart -providers were given chocolate bars labeled "Immunize on time"	Review suggests that the use of provider education and prompts, patient education, patient tracking, and outreach reduce MOV and increase vaccination coverage	Level I/Grade C
Shojania, K., Jennings, A., Mayhew, A., Ramsay, C., Eccles, M., &	To assess the effect of point of care, on screen	Systematic Review	28 studies that included 32 comparisons	Computer reminders achieved a median improvement in	"Computer reminders delivered at the point of care have achieved variable improvements in target behaviors and processes of care"	Level I/Grade B

Grimshaw, J. (2009). The effects of on-screen, point of care computer reminders on processes and outcomes of care. (review). *Cochrane Database of Systematic Reviews,* (3), CD001096-CD001096. doi:10.1002/14651858.CD001096.pub2	computer reminders, delivered to healthcare professionals on outcomes of care.		19 took place in the US in outpatient settings 26 were randomized trials and 6 comparisons were quasi-randomized design	process adherence of 4.2% across all reported process outcomes, 3.2% for vaccinations		
Kaczorowski, J., Goldberg, O., & Mai, V. (2011). Pay-for-performance incentives for preventive care. *Canadian Family Physician, 5*	Identification of the attitudes and strategies of physicians regarding preventative care delivery before and after they participate in The Provider and Patient Reminders in Ontario; Multi-Strategy Prevention Tools (P-PROMPT)	Descriptive study	246 physicians from 24 primary care network/family health network groups, located in 110 different sites.	Pre and Post intervention surveys given to physicians. Pre-intervention survey consisted of 18 questions, each scored on a 7-point Likert scale Information collected on preventive care practices and physician's opinions regarding prevention. Physician demographics were also included.	Physician and patient reminders were noted to be perceived by providers as being useful to their practices.	Level III/Grade B

				Post-intervention survey included the same 18 baseline questions with an additional 13 questions regarding how useful the P-PROMPT tools and services. P-PROMPT services included physician and patient reminders as well as office management tools and administrative database integration.		
Koch, J. A. (2012). Strategies to overcome barriers to pneumococcal vaccination in older adults: An integrative review. *Journal of Gerontological Nursing, 38*(2), 31-39. doi:10.3928/00989134-20110831-03	To assess effective strategies on improving pneumococcal vaccination rates in the older adult population	Integrative Review	11 studies were included in the review including Descriptive studies, RCT's, and Quasi-experimental studies	Multiple studies noted that physician offices that implemented vaccination implementation strategies (prompts on patient charts, immunization tracking systems, and designated vaccination clinics) were associated with increased pneumococcal vaccinations.	System-wide changes such as standing orders, computer-generated provider reminders in combination with patient reminders are needed to increase pneumococcal vaccination uptake	Level V/Grade A

				A descriptive study noted that there were higher percentages of immunization with the pneumococcal vaccine with provider reminders (77%)		
Mohammed, H., McMillan, M., Roberts, C., & Marshall, H. (2019). A systematic review of interventions to improve uptake of pertussis vaccination in pregnancy. *Plos One, 14*(3), 1-14 doi:10.1371/journal.pone.0214538	To obtain evidence regarding improvement of pertussis vaccination rates in pregnant women and effective strategies to improve those rates	Systematic Review	Six studies included -Three were randomized control trials -Two were retrospective studies focused on provider-oriented interventions -One observational prospective study	Two retrospective cohort studies; one included a "best practice alert" to alert providers to offer maternal pertussis vaccination. Post-implementation indicated that immunization rates improved to 97% compared to 48% pre intervention.	Implementation of a "best practice alert" within the EHR has been associated with increased influenza vaccination rates and can be generalized to pertussis vaccinations.	Level I/Grade B
Ruffin, M., Plegue, M., Rockwell, P., Young, A., Patel, D., & Yeazel, M. (2015). Impact of an electronic health record (EHR) reminder on human papillomavirus (HPV)	To assess the effectiveness off an EHR alert to increase HPV vaccination series completion	Retrospective Cohort	Two cohorts(prompted and unprompted) of females between the ages of 9-26 years	Providers received a prompt that the patient was due for the HPV vaccine and indicated which dose they were due for.	Significantly more patients initiated the vaccine in the prompted cohort (34.9%) than in the unprompted cohort (21.5%) ($p<0.001$). The prompted cohort was significantly more likely ($p<0.001$)	Level III/Grade A

vaccine initiation and timely completion. *Journal of the American Board of Family Medicine, 28*(3), 324-333. doi:10.3122/jabfm.2015.03.140082			Total of 5,994 eligible females in the prompted cohort and 9,027 eligible females in the unprompted cohort		to complete the vaccination series than those in the unprompted cohort.	
Tan, L. (. J.). (2018). A review of the key factors to improve adult immunization coverage rates: What can the clinician do? *Vaccine, 36*(36), 5373-5378. doi:10.1016/j.vaccine.2017.07.050	To discuss healthcare providers best practices to improve vaccination rates	Review	Multiple interventions to increase vaccination uptake as well as reducing patient out of pocket costs for vaccinations		Provider reminders that prompt the provider that a patient is due for a specific vaccination can help to increase vaccination rates.	Level V/Grade B
Zimet, G., Dixon, B. E., Xiao, S., Tu, W., Kulkarni, A., Dugan, T., . . . Downs, S. M. (2018). Simple and elaborated clinician reminder prompts for human papillomavirus vaccination: A Randomized clinical trial. *Academic Pediatrics, 18*(2), S66-S71. doi:10.1016/j.acap.2017.11.002	To assess the effects of a simple versus elaborated computerized reminder prompt on the HPV vaccination rate	Randomized clinical trial	29 pediatric HCP's were randomized to 1 of 3 arms of the intervention: a. Usual practice control b. Simple reminder prompt c. Elaborate reminder prompt (included suggestive language for	Control group: ten HCP's saw 301 patients Simple prompt: 8 HCP's saw 124 patients Elaborated prompt saw 223 patients and had a higher rate of HPV vaccination (62%) than the control (45%) adjusted odds ratio, 2.76, 95% CI, 1.07 to 7.14.	An elaborated prompt to healthcare providers significantly increased HPV vaccination uptake than the simple prompt or control group.	Level 1/Grade A

			recommendation of vaccine)	The simple prompt did not retrieve significant results.		

Levels of Evidence

The Johns Hopkins Nursing Evidence-Based Practice (JHNEBP) tool was used to level and rate the evidence for this project. Within this model, evidence falls under five levels labeled I-V and given a quality rating of A-C. Level I evidence includes experimental studies, randomized control trials (RCT), explanatory mixed method designs that include only a level I quantitative study, and systematic reviews of RCTs, with or without meta-analysis. The quality rating of A is considered high quality with consistent and generalizable results. A quality rating of B is considered good quality with reasonably consistent results and a sufficient sample size for the study design. A quality rating of C is considered low quality or with major flaws and little evidence with inconsistent results (Dang & Dearholt, 2017)

According to the tool, level II evidence includes quasi-experimental studies and explanatory mixed method designs that include only a level II quantitative study. This level also includes systematic reviews of a combination of RCTs, quasi-experimental studies, or quasi-experimental studies only, with or without meta-analysis (Dang & Dearholt, 2017). Level III evidence includes nonexperimental studies, exploratory, convergent, or multiphasic mixed methods studies, explanatory mixed method designs that include only a level III quantitative study, qualitative studies, and meta-synthesis. This level also includes systematic reviews of a combination of RCTs, quasi-experimental and nonexperimental studies, or nonexperimental studies only, with or without meta-analysis (Dang & Dearholt, 2017). The quality ratings for levels II and III are the same. Quality rating of A/B is considered high/good quality if the following are found in the studies: (a) transparency, (b) diligence, (c) verification, (d) self-reflection and scrutiny, (e) participant-driven inquiry, and (f) insightful interpretation. A quality rating of C refers to studies that have little contribution to the overall review and few or none of the above features for high/good quality (Dang & Dearholt, 2017).

Level IV evidence includes studies that incorporate the opinion of respected authorities and/or nationally recognized expert committees or consensus panels based on scientific evidence. These include clinical practice guidelines and consensus panels/position statements. Quality ratings for this level are labeled A-C. Quality level A refers to high quality that the material is officially sponsored by a professional, public, or private organization or a government agency. The material has consistent results as well as enough numbers of well-designed studies. Level B refers to good quality and includes a reasonably thorough and appropriate systematic literature search strategy, reasonably consistent results, and enough numbers of well-designed studies. Level C refers to low quality or major flaws in which the material is not sponsored by an official organization or agency and is poorly defined, undefined, or a limited search strategy. Conclusions cannot be drawn at this level (Dang & Dearholt, 2017).

Level V evidence is based on experiential and non-research evidence including literature reviews, integrative reviews, quality improvement, program, or financial evaluation, case reports, and the opinion of recognized experts based on experiential evidence. Quality ratings for this level are labeled A-C as well. For quality improvement, program or financial evaluation studies, level A refers to high quality with clear aims and objectives and consistent results across multiple studies. Level B refers to good quality with clear aims and objectives with consistent results in a single setting. Level C includes studies with unclear or missing objectives, inconsistent results, and recommendations cannot be made (Dang & Dearholt, 2017). Quality ratings for integrative reviews, literature reviews, expert opinion, case reports, community standards, clinician experience, and consumer preference include Level A which refers to high quality. Within this level, evidence of expertise and conclusions can be drawn. Level B refers to good quality meaning the expertise appears to be credible and conclusions drawn are definitive. Level C refers to low quality or major flaws in which expertise is not credible and conclusions cannot be drawn (Dang & Dearholt, 2017).

Appraisal of Relevant Evidence

Level I evidence.

Francis et al (2017) performed a systematic review through a comprehensive search through five databases and required specific inclusion and exclusion criteria. In order to be included in the review, studies had to (a) test the efficacy of an HPV vaccination intervention that focused on initiation of the vaccine, uptake or completion; (b) measure initiation of vaccines, uptake or completion rates as a dependent variable, (c) use computer, internet or mobile technology (text messaging, desktop or laptop computers, interactive videos, internet, or health information technology) in the development or delivery of the intervention; (d) use an experimental design that individuals were randomized to at least one computerized and one comparison condition. Studies excluded from the systematic review included those that included historical controls (Francis et al (2017). Twelve studies were included in the review and each of the studies was summarized for easy access in the review. The studies were explained based on their inclusion criteria (vaccination initiation and completion, vaccination outcomes by target audience; patients, parents, or providers). Nine out of the 12 studies concluded that initiation of the vaccine was higher with communication technology interventions. Telephone calls were noted to have a 16% increase in HPV doses one and two. There was a three percent increase in patients receiving the first dose of the vaccine and one percent increase in dose two, utilizing the central text messaging system. The authors noted a three percent increase in HPV vaccination rates among college students utilizing interactive computerized videos. Series completion was reported in 10 of the 12 studies. There was a 13% increase in completion utilizing EHR prompts and telephone calls and an eight percent and 12% increase with EHR prompts only and telephone calls only respectively (Francis et al, 2017). Studies that targeted patients only were noted to have mixed results. Interactive computer videos were noted to have higher immunization rates on at least one of the outcomes (dose initiation or series completion) (Francis et al, 2017). Studies also showed mixed results when only providers were targeted and

EHR prompts were used. One of the provider-only studies saw that the series completion was significantly higher for the prompt and another study did not show any difference with the prompt (Francis et al, 2017). The authors concluded computer generated prompts as well as reminders are significant interventions in helping providers and parents endorse the HPV vaccine (Francis et al, 2017). Furthermore, Frances et al (2017) note that "given the increasing use of electronic health records to improve vaccination rates, developing and testing interventions that can proactively target providers and patients at the time of appointment should be a high priority" (p. 1285). While the review explained the search strategy as well as the results thoroughly, the authors did not include which specific studies correlated with which results. While the study was useful and Level I evidence due to the systematic review of RCTs, it was rated Grade B based on the JHNEBP criteria, as the reader can draw reasonably consistent conclusions from the results. This study was included due to an eight percent increase in vaccination rates with the provider prompt alone. While it may not have been the highest percentage intervention, it is still deemed relevant for purposes of this EBP project.

Humiston et al (2011) performed an RCT that assessed patient tracking, recall, outreach, and provider prompts to increase influenza vaccination rates in several primary care centers (PCC). The study included a variety of participants of different ethnic and racial backgrounds and comprised an adequate sample size of 170 participants for each group (control and intervention). The control group received the standard of care which consisted of each office's routine immunization practice. The intervention group received patient tracking which consisted of patient chart reviews focused on immunization status by outreach workers and provider reminders that flagged patient charts with a brightly colored paper that stated "REMEMBER! This patient needs influenza vaccine" (Humiston et al, 2011, p 42). The intervention also included patient reminders. These reminders included mailed reminders to patients as well as telephone patient reminders performed by outreach workers. The primary outcome measure was receipt of the influenza vaccination. The intervention group was noted to

have a 62% vaccination rate compared to the control group of 22%. Humiston et al (2011) noted that the intervention group was six times more likely to receive the vaccination than patients in the control group (OR=6.25; 95% CI 5.41, 7.22, p <0.0001). The results were clearly differentiated and easy to follow. While this RCT was concluded to be Level I, Grade A based on JHNEBP criteria, the study focused on a population of senior aged urban residents. However, results are likely to be generalizable to the population for this project. This study was included due to the increase in vaccination rates with provider reminders. While the study utilized patient reminders by mail and telephone calls, these interventions were not applicable to this project because at the SHC, permission was not given for this project for access to the patient's demographic data such as address and telephone number. However, marketing strategies such as posters will be placed around campus to target students who do not utilize the SHC frequently, with the intention to compensate for the inability to contact students directly.

Mohammed, McMillan, Roberts, & Marshall (2019) conducted a systematic review that focused on interventions to improve pertussis vaccination uptake in pregnant patients. Six studies were included in the review that included two RCTs considered moderate or low, as well as two retrospective cohort studies. These studies included provider focused interventions such as an electronic "best practice alert" (Mohammed, McMillan, Roberts & Marshall, 2019, p 6) to the provider to offer the pertussis vaccination to the pregnant mother. Results concluded that there was a significant improvement of vaccination uptake post-intervention: 97% compared to preintervention of 48% (Mohammed, McMillan, Roberts & Marshall, 2019). Two of the RCT studies focused on modalities specific for the pregnant woman that included an affective messaging video and an iBook cognitive messaging intervention without significant results, 6% and 7% respectively (Mohammed, McMillan, Roberts & Marshall, 2019). Further studies also assessed bundled interventions that utilized iPads given to obstetric patients in examination rooms that were pre-populated with education on the importance of maternal immunization. This was paired with implementation of a vaccine champion who kept vaccines stocked in the office

to see if there was a difference in vaccine rates. The results indicated that there was an increase in pertussis vaccinations overall utilizing the multi-component program, but the results were not significant (RR 1.58, 95% CI 0.81, 3.07). This review indicates that a computerized best practice alert is an ideal intervention to aid in increasing uptake of the pertussis vaccination. The results of the review clearly stated recommendations for increasing pertussis vaccination in the pregnant population. While this review focuses on a different population than this project, the results may be generalizable to vaccinations, therefore deemed useful. Based on JHNEBP criteria, this was rated Level I, Grade B as the results were reasonably consistent.

Zimet et al (2017) conducted an RCT that evaluated a simple versus elaborated computerized provider prompt to increase HPV vaccination rates. A simple prompt included a general statement ("vaccines to consider today") (Zimet et al, 2017, p 68) for the provider to assess the vaccinations that should be considered during the visit. The elaborated prompt included a suggested script ("these vaccines are recommended for (patient name), meningococcal to prevent meningitis, HPV to prevent cancer….") (Zimet et al, p 68) prompted to the provider to say during the visit. The authors found that the elaborated prompt increased HPV vaccination rates to 62% as compared to 45% prior to the intervention (OR, 2.74, 95% CI, 1.06-7.05, p=.036). Zimet et al (2017) did account for patient sex and race/ethnicity using an adjusted odds ratio (AOR), still finding significant results for the elaborated prompt (AOR, 2.76' 95% CI, 1.07-7.14). During this study, there was an adequate sample size as well as consistent results making it generalizable to similar settings and given a rating of Level I, grade A based on JHNEBP criteria. This study was utilized for this project due to the significant increase in vaccination rates with the provider prompt which is the primary intervention for this EBP project.

Level III evidence.

Arditi et al (2017) conducted a systematic review that included 35 studies; 30 of which were RCTs and five were nonrandomized studies therefore it is considered level III. This review aimed to assess the effects of a computer-generated reminder to healthcare providers on

healthcare outcomes and provider practices. These outcomes included effect on vaccination rates, test ordering, follow-up rates, prescription rates, and overall compliance rates for the providers (Arditi et al, 2017). The authors performed a systematic search of multiple electronic databases including CINAHL, Medline and Cochrane as well as performing a hand search for relevant studies. The authors included a study flow diagram for readers to visualize their search which was helpful to examine their workflow. Primary outcomes were related to quality of care including percentage of HCP's ordering a specific test or prescription as well as the HCP's compliance with guidelines such as ordering a breast cancer screening for eligible patients or vaccine screenings (Arditi et al, 2017). Secondary outcomes measured were related to patient outcomes such a diabetic glycemic control as well as continuous patient measures such as blood pressure and body mass index (Arditi, 2017). The studies assessed the effect of a computer reminder delivered on paper on the HCP's behavior and compliance of the above primary and secondary outcomes. The authors found that there was an almost seven percent improvement in quality of care outcomes related to a computer -generated reminder delivered on paper as well as a co-intervention which was considered the standard of care, pertaining to test ordering rates, prescriptions, and vaccination rates (Arditi, 2017). The study found that the reminder alone increased quality of care outcomes by 11%. Therefore, it can be concluded and generalizable that a computer-generated reminder delivered on paper can increase HCP's compliance with ordering specific tests as well as vaccinations. However, due to methodological limitations in the review, the evidence included was deemed to be low certainty, so this study was given a Grade C based on JHNEBP criteria. This study was included as a provider reminder delivered on paper is deemed more feasible within the SHC for purposes of this EBP project. The study also had positive results related to provider compliance rates increasing with vaccinations due to the reminder.

D'Agostino (2016) performed a non-randomized intervention control study that is considered level III. This study focused on EHR provider prompts to increase pertussis

immunization rates. Within this study, there were 120 EHR records (60 included in the intervention group and 60 included in the control group) selected for the sample the utilized prompt in the chart to notify the provider to acknowledge the patient's vaccination history (D'Agostino, 2016). The reminder was visible to the HCP clearly once they opened the patient's chart. The primary outcome that was measured was the administration of the pertussis vaccination. A retrospective chart review was completed to assess preintervention vaccination rates (D'Agostino, 2016). Prior to the intervention, pertussis vaccination rates were at 1.4%. HCP's who received the clinical reminder vaccinated 8.3% of eligible patients compared to those who did not receive the reminder who only vaccinated 5% of their eligible patients. The author stated that the results were inconclusive but suggested that the reminder may be an effective strategy if there was a larger sample size of patients and providers as well as increased primary care sites (D'Agostino, 2016). Due to the inconclusive results, this study was given a Grade C, but will still be used as this project could have a higher sample size and the different setting could increase immunization rates with this strategy.

Jaca et al (2018) performed a systematic review that focused on strategies to reduce missed opportunities for vaccination (MOV). The search methods were clearly stated that included RCTs and cohort studies giving this review a level III. The inclusion criteria for this review were inclusion of participants that were: (a) eligible for vaccinations, (b) caregivers of individuals eligible for vaccinations, and (c) healthcare workers responsible for providing immunization services (Jaca et al, 2018). Specific search criteria were explained, and the authors utilized a grading system for each piece of evidence. There were six studies deemed relevant in this review. Outcomes that were measured included decreasing MOV's and increasing vaccination rates. There were multiple interventions discussed in each of the studies including provider prompts with or without tracking. One portion of the intervention included nursing screening EHR's for immunization needs and placing a MOV sticker on the patient's chart in need of a vaccination. The tracking portion of the intervention included the provider

prompt and healthcare workers sending postcards, telephone calls, or performing home visits to remind the patients to receive their vaccinations. Another study utilized a brightly colored vaccination card placed on the front of the patient's chart. Additional interventions in multiple studies included case management following up with patients via telephone, postcards, or home visits when immunizations were due, chocolate bars which were given to physicians that were labeled with "immunize on time" (Jaca et al, 2018, p 2924). The authors indicated that overall, the evidence suggest that patient education, patient tracking, outreach, and provider prompts reduce MOV's and improve vaccination rates. This study deemed the evidence moderate to low due to wide confidence intervals. The authors also noted an increased risk of bias due to outcome assessors unable to be blinded as well as incomplete outcome data (Jaca et al, 2018). The results given may still be applicable to this project as the nurse screened the charts for vaccination status, which will be part of the intervention included in this project. The study also included a brightly colored reminder to the provider on the patients' chart, that the patient needs a vaccination which will be utilized for this project. Telephone calls and postcards are not applicable to this EBP project as permission for access to these items was not granted within the SHC.

Ruffin et al (2015) conducted a retrospective cohort study (level III) that assessed the effect of a computerized prompt versus no prompt in the EHR on HPV vaccinations. There were 6,019 eligible patients for the vaccine in the prompted cohort and 9,096 vaccine eligible patients in the unprompted cohort. The primary outcome measured was initiation and completion of the HPV vaccination series as well as the time between each vaccination (Ruffin et al, 2015). The study indicated that more eligible females initiated the HPV vaccination series in the prompted cohort group (35%) compared to the unprompted group (21.3%). The authors noted that the prompted cohort had significantly higher odds of completing the vaccination series than the unprompted cohort. However, the authors did not offer numerical data regarding that component. Ruffin et al (2015) noted that the prompted cohort patients were significantly more

likely ($p<0.001$) to receive all three doses in the vaccination series on time. Ruffin et al (2015) demonstrated diligence as they gathered multiple studies to retrieve evidence related to the intervention as well as transparency in that the eligibility criteria, study setting, and analytic variables were well described, given this a Grade A. The results were conclusive and generalizable making this an asset to the body of evidence for this project. The study was useful as it shows an increase in vaccination rates with the use of a provider reminder which is the primary intervention for this project.

Shojania et al (2009) conducted a systematic review that concentrated on processes and outcomes of care due to on-screen, point of care reminders. The study yielded 28 studies that met the inclusion criteria of (a) having a reminder system that is routinely used by clinicians, (b) randomized or quasi-randomized design, and (c) at least one outcome consisting of a clinical endpoint or adherence to a care recommendation (Shojania et al, 2009). The study was determined to be level III based on JHNEBP criteria. Primary outcomes measured in this review include process adherence of HCP's in ordering medications, vaccination recommendations, and test ordering. The results concluded that the intervention of on-screen, point of care reminders impacts provider adherence modestly. For instance, medication ordering was increased by 3.3%, adherence to vaccine recommendations was increased by 3.8%, and test ordering by 3.8% (Shojania et al, 2009). The study clearly describes the information found including methods of reporting the effect sizes across groups of studies. Shojania et al (2009) also demonstrated insightful interpretation based on JHNEBP criteria as the data correlated with what was known about the intervention of on-screen computer reminders. The results did not reveal what specific reminder had the best outcome, therefore given a Grade B. The study can be generalized however, therefore was kept for this project due to an increase in provider adherence to vaccination recommendations related to the provider reminder, which is the basis of this project.

Level V evidence.

Daly, Halon, Aronowitz, & Ross (2016) published a quality improvement program that was determined to be level V evidence. The primary objective of the study was to increase HPV vaccination rates among university students. The study was given a Grade B, as the results were consistent in a single setting (university) and scientific evidence is referenced, as there were multiple studies reviewed and interventions from the evidence were utilized. These interventions included (a) prevent missed opportunities to vaccinate by increasing provider acknowledgement of vaccine history, (b) provide a strong recommendation for vaccination at every visit, (c) utilize patient reminder systems, and (d) utilizing marketing strategies on campus (Daly, Halon, Aronowitz, & Ross, 2016). Daly, Halon, Aronowitz, & Ross (2016) noted that 46.5% of total patient visits during the 16-weeks that the study was conducted, met inclusion criteria. During this time period, 158 HPV vaccines were given to 120 individual patients (Daly, Halon, Aronowitz, & Ross, 2016). This demonstrated a 13-fold increase in vaccination rate during this program. The participants were of a variety of race and ethnic backgrounds indicating generalizability in other settings. The provider acknowledged the vaccination history in 92% of the visits (Daly, Halon, Aronowitz, & Ross, 2016).The study did not give a specific, numeric significance level, however 92% was considered significant according to the authors. This study was kept due to the variety of participants as well as the high success rate. This EBP project will utilize providing strong recommendations by the provider for vaccination as well as marketing strategies around campus such as educational posters adapted from the CDC to help increase vaccination rates. The project will not be utilizing patient reminders as access to patient contact information such as email, telephone numbers, and addresses are not permitted.

Grivas et al (2016) conducted an experimental study as part of a quality improvement project at a cancer center that was determined to be level V evidence. Grivas et al (2016) implemented a quality improvement program to increase influenza vaccination rates. Multiple interventions were employed including a pre-printed vaccination prescription alerting the

providers to address vaccination history, a best practice alert in the EHR, and a laminated reminder on the chart and clinic workstations regarding the vaccine. A bright pink sticker was placed on the patient's medication reconciliation list as well indicating need for vaccination. Educational reminders were placed around the cancer center to remind patients to obtain their influenza vaccine. The study was given a Grade B based on JHNEBP criteria as the aims and objectives were clearly stated and the results were consistent in a single setting (cancer center). Reasonably consistent results were noted as the intervention corresponds to findings from similar studies (Grivas et al, 2016). The results indicated there was a 37.6% increase in adult vaccination rates during the 2011-1012 season , and a 56.1% increase in vaccination rates for the 2012-2013 influenza season (95% CI 40.9-73%). These seasons were compared to previous seasons starting from the 2005-2006 season through 2010-2011 influenza season. The article was kept as it demonstrated clear results that can be generalized to the population specific to this project. Educational marketing strategies will be placed around campus as a reminder to patients to receive their Men-B vaccination. A laminated reminder will also be placed on the computer workstations in the SHC to remind staff to screen for vaccination history and for the providers to educate and offer the vaccination.

Koch (2012) conducted an integrative review, level V evidence, regarding strategies to overcome barriers to the pneumococcal vaccination in older adults. The author researched multiple databases to explore studies relevant to the topic. Exclusion criteria were developed as follows: (a) studies conducted solely outside of the United States, (b) interventions initiated in the emergency room, (c) studies that included barriers without evaluation of an intervention or strategy, and (d) outcomes other than vaccination rates (Koch, 2012). It was noted that there were inconsistent results between two studies in the literature regarding provider reminders to increase pneumococcal vaccinations. However, Koch (2012) surmises that the intervention of provider reminders holds promise to assist in increasing vaccination rates. The author noted that there was evolving evidence that multicomponent interventions such as standing orders,

computer-generated provider reminders, and patient reminders were needed to increase pneumococcal vaccine practices into routine care. This review was given a Grade A based on JHNEBP criteria, as the authors expertise is evident and definitive conclusions can be drawn. Scientific rationale is also a contributor to the grading, as multiple studies were appraised and conclusions regarding the intervention being successful can be drawn. This integrative review was included for this EBP project as there were consistent results in the increase of vaccination rates related to provider reminders which is the primary intervention of the project.

A review deemed level V evidence, conducted by Tan (2017) addressed clinician interventions to improve adult immunization rates. Tan (2017) included interventions in the review that were comprise of (a) enhancing patient access to the vaccine, (b) reducing out of pocket costs for vaccinations, (c) improving community/patient demand, and (d) clinician focused interventions (patient reminder and recall systems, provider reminders, provider assessment and feedback, and standing orders in EHR) The review was determined to be Grade B based on JHNEBP criteria as the author did not provide the studies in which the findings were derived. The review draws definitive conclusions based on the findings. Findings indicated that reminders, such as notes placed in the patient's chart alerting providers, EHR best practice alerts for providers, or memos sent to patients through email or mail can be effective in increasing vaccination rates. Standing orders are also considered to assist in increasing vaccination rates as nurses and other healthcare providers can assess the need for vaccination and administer immediately without the physician directly involved in the interaction (Tan, 2017). There are not many studies reviewed, but Tan (2017) noted positive findings regarding the interventions of provider reminders, patient reminders, and implementation of a standing order protocol. This review was included for this project due to the multiple ways of delivering a provider reminder for vaccinations, that were said to be successful. Education to the patients was also said to be effective. This project is to include a provider reminder on the

provider and staff laptops as well as and educational handout to the patients regarding the specific vaccination.

Construction of Evidence-based Practice

Synthesis of Critically Appraised Literature

After critical review and appraisal of the literature, there were several common themes noted within the studies. The commonalities served to build the best practice recommendation for this project. The studies included for appraisal and synthesis incorporate a theme of provider reminders, best practice alerts, laminated clinician reminders, patient educational efforts, and marketing strategies. Four studies indicated that an on-screen provider reminder to prompt the physician to assess vaccination status in the EHR was noted to increase vaccination rates (Shojania et al, 2011; Ruffin et al, 2015; D'Agostino, 2016; Francis et al, 2017; Zimet et al, 2017). Two studies indicated that multicomponent strategies including the assessment of vaccination status, vaccine education delivered to the patient prior to seeing the provider, a sticker or a paper reminder placed on the patients chart reminding the provider to inquire about the recommended vaccinations (Jaca et al, 2018; Humiston et al, 2011; Tan et al, 2017). One study found that the addition of a marketing strategy such as a poster campaign on campus also impacted vaccination rates (Daly, Halon, Aronowitz, & Ross, 2016).

Francis et al (2017) concluded that a reminder or prompt for the provider appeared to increase HPV vaccination rates by 8% for series completion as it served as a communication tool between the provider and parents or patients. Similarly, D'Agostino (2016) also found that a provider prompt in the EHR that cue's the physician to acknowledge the patient's vaccination history and provide recommendations for vaccination increased pertussis vaccination rates by 8.3% compared to 5%.

Ruffin et al (2015) concluded that a prompted cohort reminder increased HPV vaccination initiation rates (35%) than an unprompted cohort (21.3%). The prompted cohort was noted to have "significantly higher odds of completion when compared with the unprompted

cohort for all levels of covariates" (Ruffin et al, 2015, p 328). Zimet et al (2017) also noted that a prompt in the chart correlates to an increase in HPV vaccination rates. This study focused on a simple prompt that alerted providers to vaccines to be considered during that visit versus an elaborated prompt that consisted of a suggested script and prompted the provider to look at vaccination history and recommend vaccinations based on patient data. The elaborated prompt had a 62% vaccination rate compared to the control group with 45% (Zimet et al, 2017).

A quality improvement program to increase HPV vaccination rates conducted by Daly, Halon, Aronowitz, & Ross (2016) noted that an EHR prompt to give the providers a visual cue to acknowledge the patient's vaccination history. Within the EHR, a hard stop was developed, whereby the provider must click on "yes or no" in order to move on to the patient's chart. This program indicated that there was a significant increase in HPV vaccinations due to the EHR prompt as 158 vaccinations were given to 120 individual patients.

Humiston et al (2011) conducted an RCT to increase adult influenza vaccinations noted that a combination of a paper reminder in the physical chart as well as patient outreach through a letter or a card increased vaccination rates significantly ($p<0.0001$) (Humiston et al, 2011). Likewise, Grivas et al (2016) compared a best practice alert in the chart for patients who had yet to receive the influenza vaccination, as well as a laminated reminder placed on the patient's physical chart. Despite provider feedback stating that the laminated reminder (70%) was more helpful than the best practice alert (36%) (Grivas et al, 2016), the best practice alerts were demonstrated to result in increased vaccination rates. Mohammed, McMillan, Roberts, & Marshall (2019) noted in a systematic review that a best practice alert to the provider in the EHR improved pertussis vaccination uptake in pregnant women to 95% when compared to the 48% prior to the intervention. Tan (2017) also noted that provider reminders including best practice alerts, notes posted in the patients EHR, and memos to the provider can improve immunization rates.

The appraisal and synthesis of these relevant studies indicates that a multicomponent strategy was necessary to increase providers' adherence to vaccination recommendations, as well as increase vaccination rates for multiple preventable diseases. Engaging the provider and the patient was deemed most impactful to the primary outcome of increased vaccination rates. The components of the strategy include different forms of provider reminders at time of patient visit, patient education prior to seeing the provider, and campus-wide vaccination campaigns.

Best Practice Model Recommendation

The best practice recommendation was based on the collected evidence. There is utmost importance to keep patient's up to date with their immunizations. If the public is immunized, then the risk of spreading disease will be decreased, therefore preventing hospitalizations, morbidity, and mortality. Evidence suggests that a multicomponent strategy is essential to increase vaccination rates. The strategy for this EBP project included a brightly colored reminder on each of the five provider laptops utilized by staff at the SHC including the physician, APN, MA, and RN that states "REMEMBER! To offer and order the Men-B vaccination". The MA or the RN assessed the patient's vaccination status and for the following inclusion criteria: (1) not an incoming student, (2) under the age of 23, and (3) have not received Men-B vaccine. Once criteria were met, a CDC educational brochure regarding meningitis and the Men-B vaccine was given to the patient by the MA or RN while they were waiting in the examination room. Once the provider entered the examination room, the provider emphasized the information on the handout and educate the patient. Once this was done, the provider asked the patient if they were interested in the Men-B vaccination, if they said yes, the provider then provided further education and ordered the vaccination. The vaccine was administered by the MA or the RN. If the patient stated "no", then the education from the CDC was emphasized still regarding the increased risk and the student was educated that they could walk in at any time to receive the vaccination. Marketing strategies were also utilized including posters (Appendix B) adapted from the CDC which were placed across campus in key student meeting locations,

including the student union, residence halls, sorority houses, and in the waiting room of the SHC.

CHAPTER 3

IMPLEMENTATION OF PRACTICE CHANGE

Chapter three corresponds to phase IV of the Stetler model: translation/application. Evidence has shown that the application of a multicomponent strategy has had a positive effect on increasing vaccination rates. Jaca et al (2018) assessed the effect of a multicomponent intervention to increase vaccination rates. They note that a nurse would screen the patients charts for vaccination histories no matter the reason for visiting the provider as well as educating the patients prior to the visit regarding the specific vaccinations and disease processes. Once vaccination need was identified, a sticker was placed on the patient's chart indicating the need for a specific vaccination to remind the provider to offer the vaccination as well as educate the patient regarding the vaccinations (Jaca et al, 2018). Similarly, Humiston et al (2011) found that outreach workers in a clinic, tracking patients immunization statuses as well as a paper reminder placed in the patient's physical chart reminding the provider to offer immunization also significantly increased vaccination rates. Tan et al (2017) also identified that a combination of a provider reminder on paper posted in the physical chart or in the EHR as well as education given to the patients prior to their visit also increased vaccination rates. Grivas et al (2016) note that a laminated reminder placed on the patient's physical chart was helpful to providers to prompt them to assess vaccination history and offer due vaccinations. Mohammed, McMillan, Roberts, and Marshall (2019) note that a multicomponent intervention of a best practice alert in the EHR to remind the provider to offer vaccination as well as education in the examination room to the patient via I-Pad on the importance of vaccination also has shown an increase in vaccination rates. Multiple studies indicate that an on-screen provider reminder to prompt the physician to assess vaccination status in the EHR was also noted to have a positive effect on increasing vaccination rates (Shojania et al, 2011; Ruffin et al, 2015; D'Agostino, 2016, Zimet et al, 2017). Furthermore, marketing strategies such as educational posters adapted from the CDC placed in student areas such as bathroom stalls across a college campus as well as

outreach events including wellness fairs have also shown to aid the increase of vaccination rates (Daly, Halon, Aronowitz, & Ross, 2016). The purpose and application of this EBP project was to identify if the use of a provider reminder combined with a poster campaign and education to the students would influence Men-B vaccination rates.

Participants and Setting

The EBP project took place in an SHC at a midwestern university. Within this EBP project, there are many key stakeholders that were an essential part of the implementation of this practice change. At this specific SHC, there was a part-time physician, one full-time APN, one part-time APN, one registered nurse (RN), and a medical assistant (MA). Their participation in this project was essential as the MA and RN were responsible for reviewing vaccination histories and providing the educational brochure to students. The physician and the APN were also essential as they were validating the education, offering the Men-B vaccine to the students, and placing the vaccine order into the EHR if applicable. The eligible patients included (a) non-incoming students, already enrolled in the university, (b) age 23 and under, (c) students who have not yet received the Men-B vaccine previously.

Pre-Intervention Group Characteristics

When speaking with the SHC director, it was noted that beginning Fall 2019 semester, it would be mandatory for all incoming students aged 23 and under to have had the Men-B vaccination prior to attending the university. With that in mind, freshmen as well as first time students were excluded from this EBP project. According to the CDC (2019), young adults aged 16-23 years old are most susceptible to the Men-B disease. For this project, established students 23 years of age and younger were targeted. The students could be undergraduate or graduate students.

Intervention

Evidence suggested that a provider reminder placed on the patient's physical charts, regarding recommendation of vaccinations, increases vaccination rates. Evidence also suggested that a poster campaign as well as education also influences vaccination rates. For this EBP project, a brightly colored reminder placed on each of the clinics five laptop computers, utilized by the MA, RN, physician, and APN's that states "REMEMBER! To offer and order the Men-B vaccination" was implemented. The colors and placement of the reminder on the laptop were changed out every two weeks to keep the staff alert to the reminder. A poster campaign was also utilized in frequently used buildings by the students. For example, the student union, sorority houses, and residence halls had posters placed regarding the Men-B disease and the vaccine. The workflow was reviewed with each staff member. Once a student came in, whether for an already scheduled appointment or walk-in, the MA or RN screened each patient's chart for the specified criteria (a) 23 years of age and under and (b) has not received the Men-B vaccine previously. Once the patient was brought to the examination room by the MA or RN, if the patient met criteria, they were notified that they are eligible to receive the vaccine and they were asked if they would like to receive the vaccination or if they would like more information regarding it. If the student stated yes, then an educational handout with information from the CDC was placed in a box directly outside of the examination room. This signaled to the provider that the student was interested in the vaccination and would prompt them to educate the student. Once in the examination room, the provider gave the student the educational handout and provided education regarding the Men-B disease and vaccination. If they accepted, then the provider ordered the vaccination in the EHR and the immunization was given by the MA or RN. If the patient declined at the beginning of the visit, the MA or RN would give them an educational brochure that also contains information from the CDC about the disease and vaccination to read and take with them. The student was also notified that they could call to make an appointment or walk in to receive the vaccination later if they decided they would like

to receive it. Once the vaccination was given, then a follow up appointment for one month later was made, as the vaccine needs to be given in two doses, one month apart. This was done so that the patient knows to come back to the clinic to finish the vaccine series. In order to assess compliance of the staff with implementing the intervention, pre-printed sheets with columns for the staff to fill in were given (See Appendix B). The columns included date, patient initials, screening done, eligible, not eligible, education given, accept or declined, given, and not given. The staff added the date and patient initials and placed a checkmark in each of the boxes regarding the immunization. These forms were then given to the project manager at the end of each week.

While evidence supported the use of a paper reminder, the use of a reminder in the EHR was also supported. This specific EHR system was unable to create a reminder for the initial dose of the vaccination, but there was a reminder that was able to be created for the second dose one month after the first dose. Validation needed to be completed as this was new to the facility. This was completed over a period of three weeks by creating the reminder within the EHR system and the staff assessing to make sure that the reminder popped up for each eligible patient that received the vaccination. Once the MA or RN assessed if the patient would accept the Men-B vaccination, they went into the EHR and click into a drop-down box named “indication” and would choose “immunization”. This flagged the chart that the patient was given the immunization. This flag was essential to this project as it allowed the project manager to run a report for these specific students to assess compliance of staff with the intervention as well as assess if the patient received the vaccination. This was placed under the chief complaint in the EHR for ease of the staff to locate it. Once this was clicked, then the staff clicked a template to the left of the chart called “Healthwatcher”. This template within the EHR showed student risk factors and what vaccinations they may be due for based on manually placed criteria placed into the set- up of the template. Once the staff clicked on “Healthwatcher”, they clicked “manage plans”, chose the specific provider they were going to see, and then they clicked “assign

Meningococcal B". They then clicked a start date, which would be the date of the visit, clicked "assign" and clicked "finish". This then assigned the Men-B plan to this patient. Within this plan, the staff could then schedule the students follow up appointment for their second dose of the vaccination. Even if they did not set up an appointment that day, the EHR still populated a reminder one month later which notified the student that they were due for the second dose of the vaccination. If the student declined the vaccination, they still received an educational brochure, but the staff then clicked "risk factor" on the left side of the chart, clicked "add new", and then clicked "Men-B susceptible". They then clicked "current" under status as this was a current risk factor for the patient, and then the staff placed a reason the patient declined the vaccination in the comments section. They then clicked a checkmark to save the information. This then notified staff that they have not received the Men-B vaccination and were at risk for the disease. The staff had to click "risk factor" in the chart to assess the students risk factors. The compliance form was kept to assess compliance of education given by the staff and to keep track of patients that accepted or declined the vaccination. Throughout the implementation process, it was noted that not all the patients that either received the vaccination or declined and listed as a "risk factor", were included in the many different reports that were ran. Therefore, it was essential to keep the compliance form for the staff to be filled out. A form was printed with a detailed list of the process for the staff, so they would have a reference (See Appendix A).

Comparison

Data from the SHC noted that from May 2018 to May 2019 there were 2,703 total health center visits. There were no Men-B vaccinations given during this time as it was not available or required at the time. The quadrivalent vaccine however, that targets Meningitis A, C, W, and Y, was required beginning last year. There were 113 quadrivalent vaccinations given, but most were international students or students that were new to the area from other states who did not have the vaccination yet (K. Eshenaur, personal communication, 2019). Most high schools were requiring this vaccination during that time, so many were not administered at the university

(K. Eshenaur, personal communication, 2019). This EBP project aimed to provide awareness regarding Men-B disease as well as the vaccination. This project also aimed to increase Men-B vaccination rates among already established students.

Outcomes

The primary outcome of this EBP project was for students to be adequately screened for risk of Men-B disease and for the eligible students to be vaccinated. Pre-printed sheets were used to assess compliance of staff with the intervention of the paper reminder. Once the EHR reminder was validated and implemented, a weekly report was conducted weekly by the project manager to assess staff compliance with the intervention. The report included student charts that were flagged “immunization” by the staff in the beginning of the visit as well as “risk factor” if the patient declined the vaccination.

Time

The project ran over 13 weeks beginning September 3, 2019 and ended on December 4, 2019. This timeline provided enough time to obtain an adequate sample size of eligible students. This period was a demanding time at the SHC as it is during cold and influenza season, so opportunities for vaccinations were evident.

Protection of Human Subjects

Patient anonymity was maintained as the staff only placed patient initials and not full names on the pre-printed compliance sheets. Once data was obtained by the project manager from the pre-printed sheets, they were then shredded. Once the EHR reminder was implemented, reports were run in the EHR to assess compliance of staff with intervention modalities as well as assessment of Men-B vaccination rates. Patient anonymity was also maintained as the EHR was password protected and reports were only conducted at the SHC in a private location in the clinic. The demographic information as well as any student information

never left the building and were not shared with anyone except the program director and essential staff. A confidentiality statement was also signed at the beginning of this project for the SHC.

CHAPTER 4

FINDINGS

The purpose of this EBP project was to increase Men-B vaccination rates by using identified best practices which included provider reminders, patient education, and a campus-wide awareness campaign. The aim was to answer the following PICOT question: In college students, does the implementation of an intervention to educate students on the meningitis disease and importance of vaccination, a vaccination screening and provider reminder, and a campus-wide vaccination campaign, as compared to no intervention, increase Men-B vaccination rates, over thirteen weeks? After the implementation of this project, it was determined that Men-B vaccination rates were, in fact, noted to be increased after the thirteen-week period.

Participants

Students that visited the SHC were the participants in this project and varied in age, ethnicity, and grade level. The SHC began administering the Men-B vaccination on May 21, 2019. Prior to implementation of this EBP project, 258 students met eligibility requirements. Of those 258, 56 received Men-B vaccinations. The demographics of these students included 24 freshmen (42.%), 9 sophomores (16%), 8 juniors (14.2%), 0 seniors (0%), and 15 graduate (26.7%) students. The students were of various ethnic and racial backgrounds including 15 Caucasian (26.7%), 1 African American (1.7%), 3 Hispanic (5.3%), 11 Asian (19.6%), and Other (46.4%). Gender was also included in the demographic analysis, 25 females (44.6%) and 31 males (55.3%).

This project began on September 3, 2019 and ended on December 4, 2019. During this 13-week period, there were a total of 896 students seen at the SHC, with ages ranging from 16 to 61 years of age. Of this student population, there were 267 students within the eligible age range of 16-23 years old and 109 were deemed eligible (within age range, had not previously received the vaccine, no freshman status) for the vaccination. Of these 109 eligible students, 70

received the vaccination. These students were composed of sophomores (n=34, 48.6%), Juniors (n= 18, 25.7%), Seniors (n= 9, 12.9%), and graduate students (n= 9, 12.9%). Racial demographics included 52 Caucasian students(72.3%), 2 African American (2.9%), 3 Hispanic (4.3%), 2 Asian (2.9%),1 American/Alaskan native (1.4%), 1 Chinese (1.4%), and 9 other or unknown ethnicities (12.9%). Of those who received the vaccine, 41 were female (58.6%) and 29 were male (41.4%).

Of those students who received both the provider reminder and vaccination education, 27 did not opt to be vaccinated. These students were comprised of 12 sophomores (44.4%), 7 juniors (25.9%), 2 seniors (7.4%), and 6 graduate students (22.2%). These students were of varying races; 10 Caucasian (37%), 1 African American (3.7%), 4 Hispanic (14.8%), 2 Asian (7.4%), and 10 other or unknown ethnicities (37%). This group of students was comprised of 14 females (51.9%) and 13 males (48.1%).

During the implementation period, it was noted that some students did not receive the vaccination education. These students consisted of 3 sophomores (25%), 3 juniors (25%), 1 senior (8.3%), and 5 graduate students (41.7%). These students were also of varying races; 5 Caucasian (41.7%), 1 African American (8.3%), 2 Asian (16.7%), and 4 other or unknown (33.3%). There were 5 females (41.7%) and 7 males (58.3%). The demographics of the students pre- and post-intervention are summarized in Table 4.1.

Changes in Outcomes

Statistical Testing and Significance

A chi-square test of independence was calculated to compare results of the pre-intervention group and the post-intervention group. It was determined that the intervention, including provider reminder and vaccine education, had a statistically significant positive impact on the uptake of the Men-B vaccine as compared to the pre-intervention period (X^2 (1)=26.112, p<0.05). For those participants who only received a provider reminder, there was also noted to be a statistically positive impact on vaccination uptake as determined with a chi-square test of

independence (X^2 (1)= 26.828, p<0.05). However, education alone was found to have no statistical impact on vaccination uptake (X^2 (1)= 2.619, p>0.05).

Findings

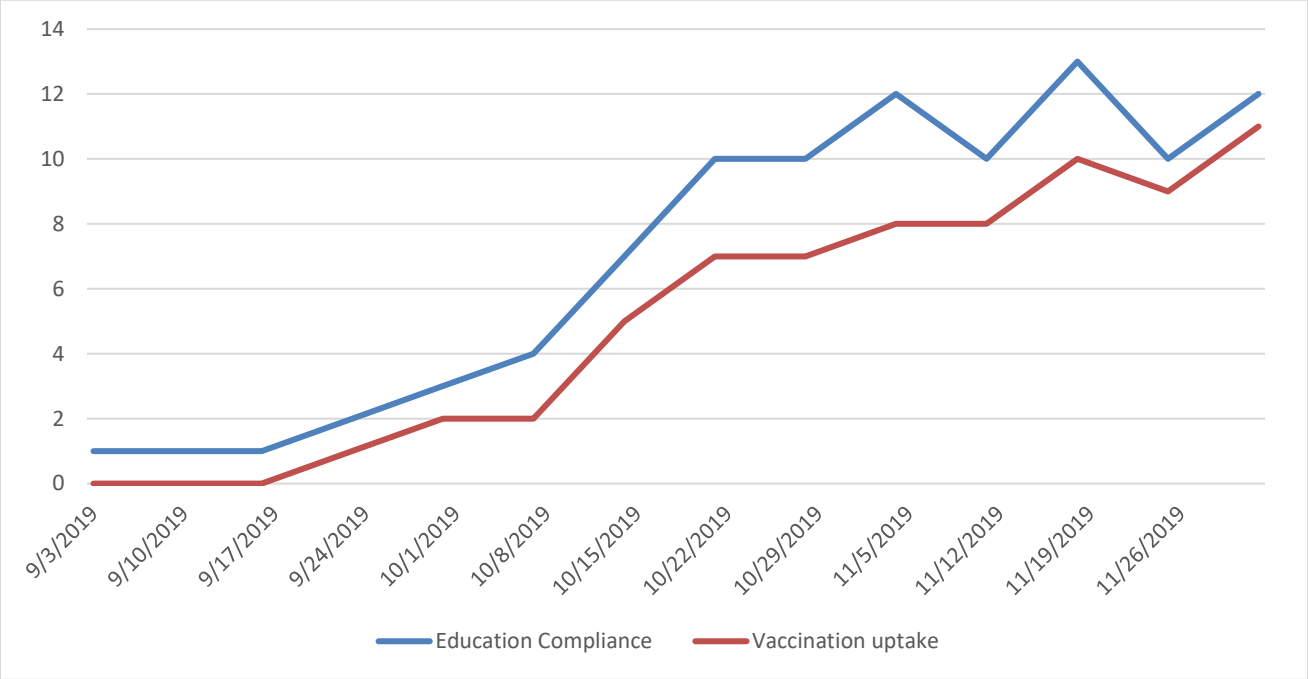
Primary outcome.

The primary intended outcome of this EBP project implementation was to increase Men-B vaccination rates at a midwestern university SHC through a multicomponent strategy. A provider reminder was created and placed on each of the clinic's five laptops to serve as a reminder for clinicians and providers to offer and order the Men-B vaccination. Educational brochures were provided to those eligible students regarding the Men-B disease, risk factors, and vaccination information. A poster campaign was also implemented in buildings that students frequented around campus, such as the student union, sorority houses, and the SHC lobby. After a chi square analysis was completed, it was noted the project primary outcome was met (X^2 (1)= 26.112, p<0.05). There were more Men-B vaccinations given during implementation than pre-intervention (n=70, n=56 respectively). With regards to the provider reminder alone, there was a statistically significant finding (X^2 (1)= 26.828, p<0.05), indicating that the provider reminder had a positive effect on vaccination rates. When a chi square analysis was run on education alone, there was not a significant statistical finding (X^2 (1)= 2.619, p>0.05), indicating that education alone may not influence Men-B vaccination rates.

Secondary outcomes

The clinic staff were trained to follow the EBP project protocol. Their compliance was integral to successful implementation. Therefore, it was deemed important to monitor staff compliance to the protocol implementation. Weekly audits were completed by the project manager. During the beginning weeks of implementation, it was noted that staff were not compliant with the protocol. The compliance form provided was not completed indicating that there were twelve eligible students during the first three weeks that did not receive the education. During week one, there were four eligible students that were missed who did not

receive the education. During week two, five eligible students were missed, and week three, three eligible students were missed. After a meeting with the staff for discussion on the importance of compliance, staff were receptive and compliance rates went up to 100%. The project manager was able to assist in screening once per week to help the staff during this busy time.



While there were 70 students who received the vaccination, there were 27 that did not. An inquiry was made by the clinician as to why students who opted to not receive the vaccination did not. Some explanations given by the students include that they needed to speak to their parents prior to receiving it, they did not want another vaccination if it was not required, they were feeling ill at the time and wanted to wait, or simply wanted to think about it.

Figure 4.1 Pre and Post Intervention Grade Level Outcomes

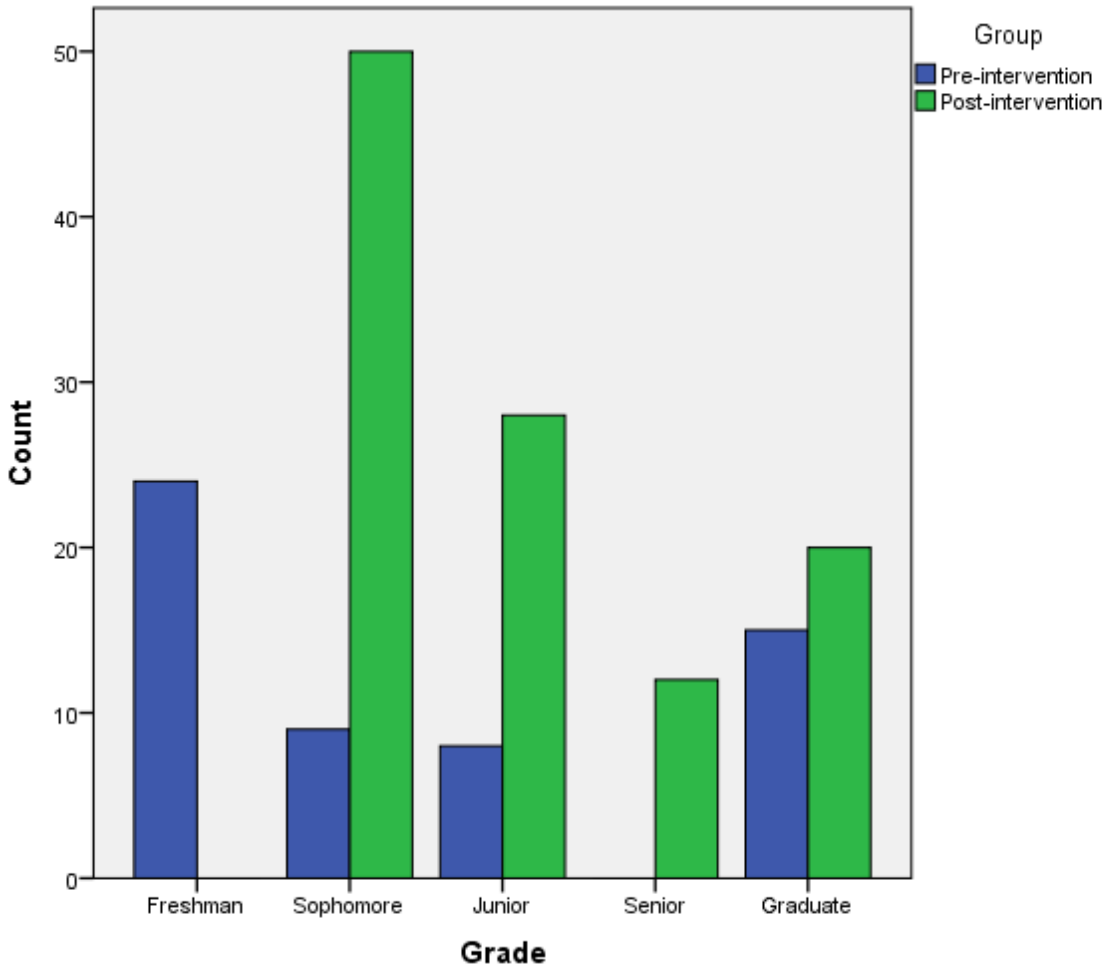


Figure 4.2 Pre and Post Intervention Gender Outcomes

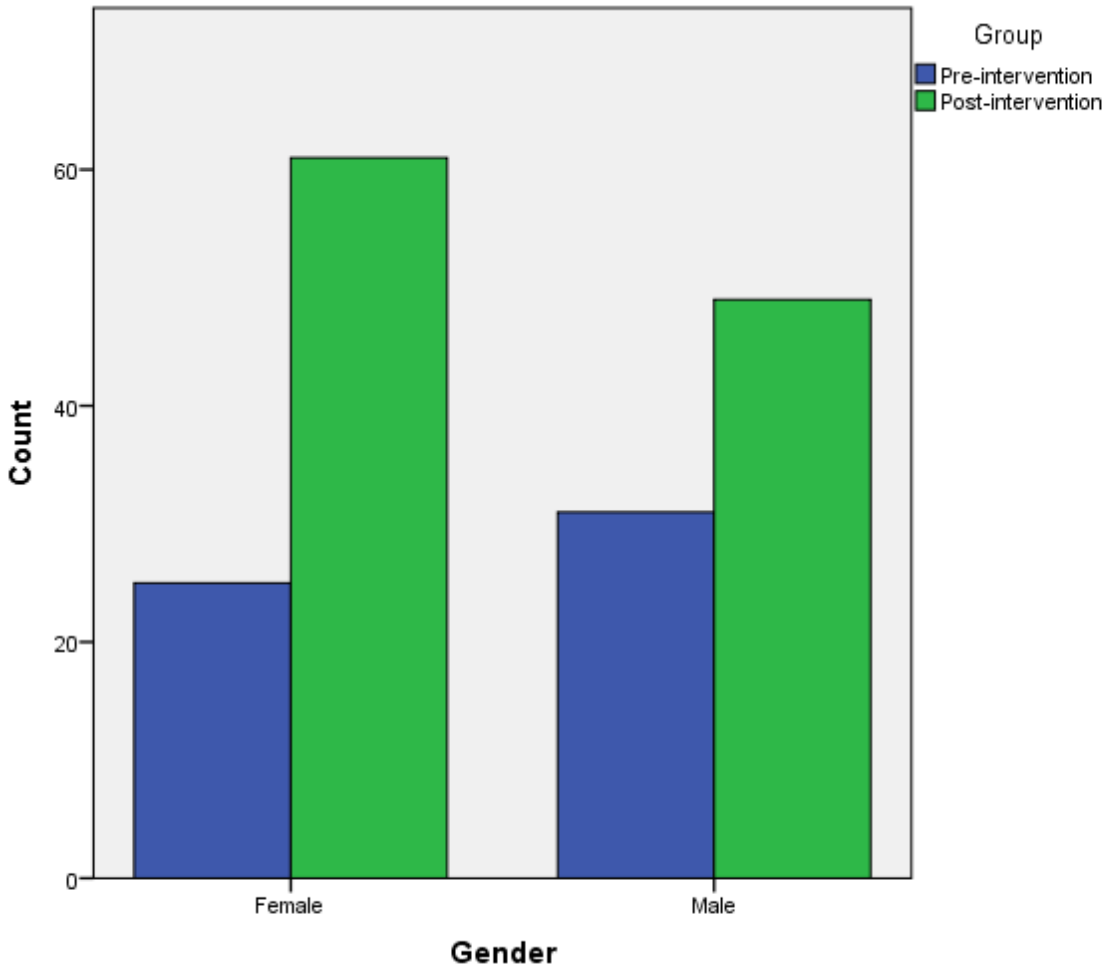


Figure 4.3 Pre and Post Intervention Ethnic Outcomes

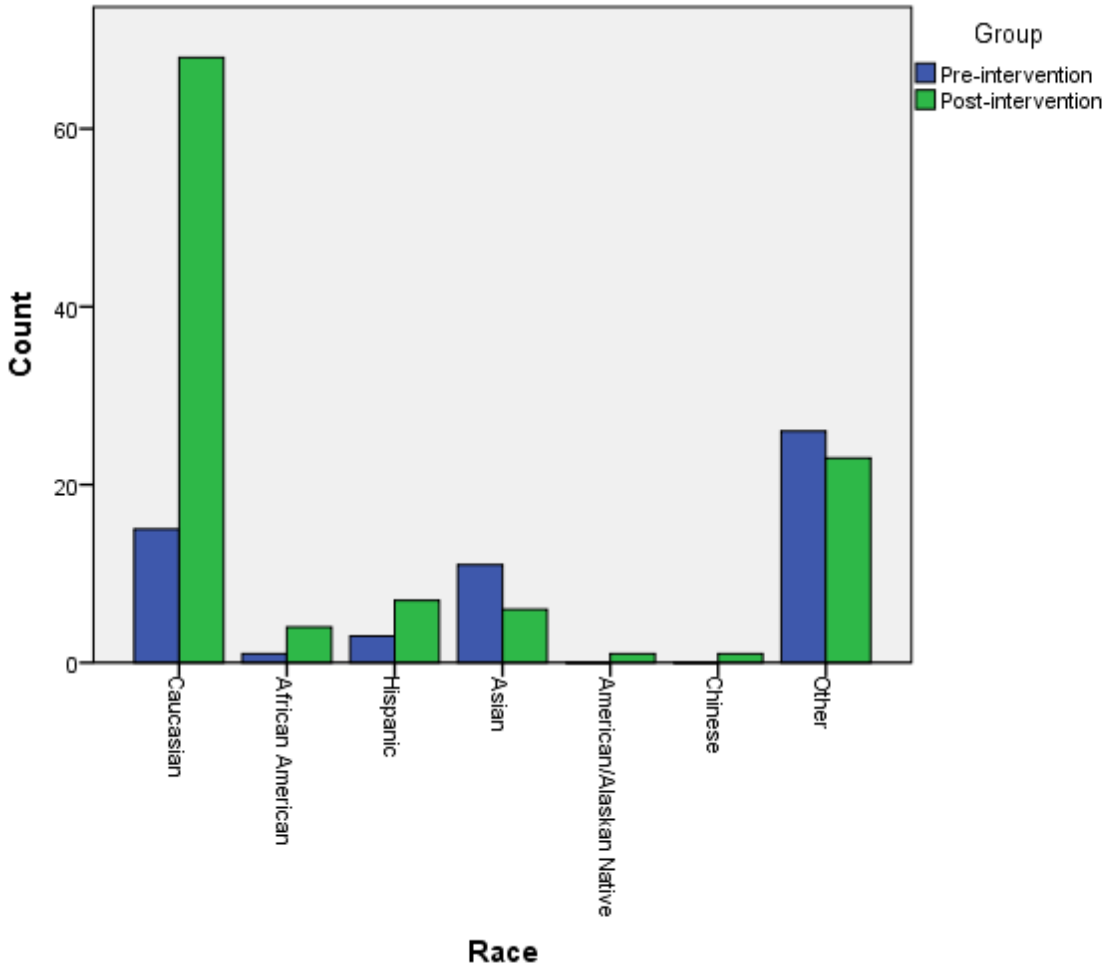


Table 4.1

Demographics of the Students

	Pre-Intervention *n* (%)	Post-Intervention *n* (%)	Total *N(%)*
Gender			
Female	25 (44.6)	41 (58.6)	66 (51.6)
Male	31 (55.4)	29 (41.4)	60 (48.4)
Race			
Caucasian	15 (26.8)	52 (72.3)	67 (49.5)
African American	1 (1.8)	2 (2.9)	3 (2.3)
Hispanic	3 (5.4)	3 (4.3)	6 (4.8)
Asian	11 (19.6)	2 (2.9)	13 (11.2)
Amer/Alask Native	0 (0)	1 (1.4)	1 (1.4)
Chinese	0 (0)	1 (1.4)	1 (1.4)
Other	26 (46.4)	9 (12.9)	35 (29.6)
Grade			
Freshman	24 (42.9)	0 (0)	24 (42.9)
Sophomore	9 (16.1)	34 (47.2)	43 (31.6)
Junior	8 (14.3)	18 (25)	26 (19.6)
Senior	0 (0)	9 (12.5)	9 (12.5)
Graduate	15 (26.8)	9 (12.5)	24 (19.6)

CHAPTER 5

DISCUSSION

The purpose of this EBP project was to determine if a multicomponent strategy would increase Men-B vaccination rates at a midwestern university SHC. There was no intervention in place prior to implementation. The intervention consisted of a provider reminder placed on each of the five staff laptops in the SHC, educational brochures regarding Men-B disease and vaccination were given to the eligible students who visited the SHC during the 13-week intervention period as well as a poster campaign around campus. The explanation of findings the strengths and limitations of this EBP project, and the evaluation of the EBP model utilized with this EBP project implementation will be discussed in this chapter.

Explanation of Findings

The purpose of this EBP implementation was to determine if a multicomponent intervention, including a clinician reminder, patient education, and a campus-wide campaign would increase Men-B vaccination rates at a small, midwestern university SHC. The project was implemented over 13 weeks in the Fall of 2019. It was determined that the implementation did increase Men-B vaccination uptake in the population of focus. The EBP was successful in increasing Men-B vaccination rates.

Pre-intervention, there were 258 students who visited the SHC who were eligible for the Men-B vaccine. Of those, 56 (22%) received the vaccination compared to 70 students out of 109 eligible students (64%) receiving the vaccination post-intervention. (X^2 (1)=26.112, p<0.05). A 40% increase in the Men-B vaccination rates at the SHC was noted. Similar results were noted in a study by Humiston et al (2011) in which provider reminders were utilized in order to increase vaccination uptake. The control group was noted to have a 22% vaccination rate and the intervention group was noted to have a 62% vaccination rate. A chi-square analysis was conducted on the provider reminder (X^2(1)=26.828, p<0.05) indicating a statistical significance. These findings indicate that a provider reminder alone could assist in increasing vaccination

uptake. Similarly, a study performed by Arditi (2017) noted an 11% increase in vaccination rates with a provider reminder alone. Zimet et al (2017) also noted in their study of an elaborated prompt to the provider to screen and offer recommended vaccinations, resulted in a 62% vaccination rate compared to a 45% vaccination rate prior to the intervention. The findings demonstrated from this EBP project were consistent with the findings identified from the literature review. A chi-square analysis was conducted on those participants who only received the education as an intervention ($X^2(1)=2.619$, $p>0.05$), which was not statistically significant, indicating that education alone may not be enough to increase vaccination uptake. This result could have occurred because there was not a process included in project implementation to assess if education had an impact on the students reasoning for accepting or declining the vaccination such as a post-visit survey or questionnaire.

Strengths and Limitations of the DNP Project

Strengths

Perhaps the greatest strength of this EBP implementation is the impact on vaccination uptake amongst this high-risk patient population. Meningococcal disease can be fatal if contracted, so vaccination is essential. Education of clinic staff and their involvement in this EBP project was another strength. The staff were able to learn more about the disease and the importance of vaccination during this process. Additionally, the ability to utilize an EHR during the implementation was a strength. Francis et al (2017) note that utilizing EHR's as well as interventions that specifically target providers should be a priority to help improve vaccination rates. The EHR was an essential part of the implementation process in this EBP project. It allowed for reports to be developed regarding vaccinations received and declined during the 13-week time period. This also allowed the project manager to assess compliance with the vaccination protocol. Lastly, the staff at the SHC were essential to this project as they were on the front lines of implementation. Their duty was to screen patients for eligibility, provide education, offer and administer the vaccination if the student accepted it. They were also

responsible for entering the acceptance or declination of the vaccine into the EHR, which assisted with data collection.

Limitations

At the onset of this EBP project development, it was noted that the university was mandating the Men-B vaccine for all freshman students beginning August 2019. Due to this mandate, freshman students were excluded as participants. However, during implementation it was noted that many freshman students who visited the SHC had not received the Men-B vaccine. This was a limitation in terms of demonstrating the true significance of this project, as it was noted the interventions also resulted in vaccination uptake. Staff compliance was also considered a limitation for this project, especially in the first few weeks of implementation. The staff were to fill out a form to measure their compliance with the intervention. During the early stages of implementation, the staff admitted that they were not compliant with filling out the form or with performing the intervention. Due to this, there may have been missed opportunities to offer and educate about the vaccination. Another limitation of the project was that there was not a way to assess if the education had any impact on the students. Throughout the literature review that was conducted prior to implementation, best practice did not indicate a means of conducting surveys or questionnaires as part of the evaluation process. This would have been beneficial to this project to see if education may have led to future students' decision to vaccinate. While a campus-wide poster campaign was also implemented, there was no developed mechanism to capture the impact of this piece of the EBP project implementation.

Implications for the Future

The primary objective of this EBP project was to increase Men-B vaccination rates based on evidence depicted in the extensive literature review. The objective was met through the implementation of a provider reminder, educational brochures, and a poster campaign at a midwestern university college campus SHC. The findings included a statistically significant increase in Men-B vaccination rates when compared to the three months prior to

implementation. Since the data indicated an increase in vaccination rates, implications for the future are discussed.

Practice. An increase in Men-B vaccination rates post implementation of this EBP project suggests that continuation of the intervention of a provider reminder is essential. Even though there was not a statistically significant increase in vaccination rates due to the education, this was considered an essential part of the implementation. Students need to know the signs and symptoms of disease as well as the risks and benefits of the vaccination. A post-visit survey or questionnaire would be helpful for future EBP projects to assess if the education given had an impact on whether the student accepted the vaccination. Since statistical significance was associated with the provider reminder aspect of the project, efforts should be continued to increase Men-B vaccination uptake in practice. College students 23 years of age or under continue to be at risk for the Men-B disease and continuous attempts for vaccination should be implemented. The APRN is an essential component to such a strategy in the role of education and utilizing their platform as a means of campaign. Future projects could utilize various forms of campaign by the APRN including social media, email, and even telehealth to advise the at-risk population of the importance of vaccination.

Theory. The Stetler Model served as the driving force for this EBP project. The model is divided into five different phases: (1) preparation, (2) validation, (3) comparative evaluation/decision making, (4) translation/application, and (5) evaluation (Melnyk & Fineout-Overholt, 2015). Prior to implementation, the preparation phase was followed according to the model. This included identifying a need for an increase in Men-B vaccination rates with key stakeholders. This also included performing a literature search to find the best evidence related to vaccination uptake. During the validation phase, evidence was reviewed and critiqued using the JHNEBP appraisal tool. The third phase of the model included comparing evidence and identifying similarities between them. The evidence showed that a provider reminder paired with educational modalities and a poster campaign was best practice to increase vaccination uptake.

Translation and application of the evidence was relayed during the fourth phase by educating the staff of the SHC of the workflow with educational brochures, a provider reminder placed on each of the five clinic laptops, and placing posters around campus regarding the disease and vaccine. During the final phase of the model, data were evaluated for statistical findings. This model was essential to this project as it provided a step by step guide that was easily followed throughout the process. The model would be beneficial to practitioners in the future who can utilize a step by step process.

Research. Throughout the preparation phase of the project, an intensive literature search was conducted to find the most up to date evidence for increasing vaccination uptake. The search concluded that best practice should include a multicomponent approach. This approach included a provider reminder to offer and order the vaccination, educational efforts, and a poster campaign around campus. The search was aimed at vaccination uptake among college students since this was the specific population for this EBP project. Future research is implicated to address the best mode of education to use with college students. Even though the educational effort was not noted to be statistically significant related to this project, education is still needed, and nursing research should be focused on what college students would be most receptive to. Reasons for not receiving the vaccination among the population at the SHC included that they did not want another shot if it was not required, they needed to speak with their parents, they were feeling ill at the time, or they simply did not want to receive the vaccination. Mandating the vaccination amongst this high-risk population should be included at every university. Students need to understand fully the risks involved of not receiving the vaccine. Further campaigns should focus on the mortality rate of Men-B as well as the consequences of contracting the disease such as neurological impairment. Further implementation should be acquired through additional provider reminders. Ruffin et al (2015) and Shojania (2009) indicate that point of care reminders utilized in the EHR are useful when

trying to increase vaccination uptake. Further research should be conducted to fully understand the content of these reminders and when they will display on the chart.

Education. Further implications are needed with regards to APRN education and the Men-B disease and vaccination. The APRN role serves as an essential part of this process to educate college students who are at increased risk for Men-B disease and to encourage the process of vaccination. In order to provide education, they need to be educated as well. This could be done through seminars, conferences, and continuing education focused on vaccination uptake in general. Educational efforts for the future for the APRN to utilize may include further brochures, posters, emails, use of social media, text messages, and even letters through the mail. Education needs to be implicated when healthcare is involved. The APRN and patients, especially students need to be taught the importance of vaccination and disease prevention.

Conclusion

The provider reminder incorporated into this project resulted in a statistically significant result indicating a positive outcome on Men-B vaccination rates. Despite the educational efforts, this aspect of the project did not result in statistical significance. However, attempts to educate students regarding the Men-B disease and vaccination are essential to promoting healthy practices and vaccination uptake. The primary outcome of this EBP project was met overall by increasing Men-B vaccination rates. The disease can be fatal if contracted and the best defense is vaccination in this vulnerable group of college students. The APN role is essential to this practice of education and offering the vaccination to eligible students. The APN serves many roles, especially the educator and the facilitator for the vaccination. The SHC should continue with the provider reminder as well as educational efforts. Ruffin et al (2015) notes that providers who receive a prompt to offer a vaccination and follow through are more likely to have patients receive the recommended vaccination and complete the whole series of the vaccination if needed. A multicomponent strategy is essential for increased vaccination uptake. APN's are the champions in health promotion and strategy. They are on the front lines and need to advocate to their

patients, especially the most vulnerable populations, the importance of vaccination and disease prevention.

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BIOGRAPHICAL MATERIAL

Valerie M. Cline

Mrs. Cline graduated with an Associate of Science degree in Nursing from Ivy Tech Community College in 2009. She received her Bachelor of Science in Nursing from Valparaiso University in 2013. She has been employed at St. Catherine Hospital in East Chicago, IN since 2008. She began as an RN fellow and then became a registered nurse in 2009, with a focus on medical/surgical and orthopedic nursing. During that time, she also received training on the intermediate care unit (IMCU). Valerie is currently attending Valparaiso University to obtain the Doctor of Nursing Practice (DNP) degree with an anticipated graduation date of May 2020. She also became a member of Sigma Theta Tau International-Zeta Epsilon chapter in 2018. Her evidence-based practice project focused on a multicomponent approach to increasing meningococcal B vaccinations among college students. She is a firm believer in preventative medicine, and she hopes to focus on women’s health upon graduation and board certification.

ACRONYM LIST

ACE: Academic Center for Evidence-Based Practice

AOR: Adjusted odds ratio

APN: Advanced Practice Nurse

ARCC: Advancing Research and Clinical Practice through Close Collaboration

CDC: Center for Disease Control

CINAHL: Cumulative Index for Nursing and Allied Health

EBP: Evidence-Based Practice

EHR: Electronic Health Record

IMD: Invasive Meningococcal Disease

JBI: Joanna Briggs Institute EBP Database

HCP: Health Care Provider

HPV: Human Papillomavirus

JHNEBP: John's Hopkins Nursing Evidence Based Practice

MA: Medical Assistant

Men-B: Meningitis B

MOV: Missed opportunities for vaccination

PARIHS: Promoting Action on Research Implementation in Health Services Framework

P-PROMPT: The Provider and Patient Reminders in Ontario; Multi-Strategy Prevention

RN: Registered Nurse

SHC: Student Health Center

U.S.: United States

Appendix A

Meningitis B Vaccination Process

MA & RN:

Screening: 23 years of age and under
Has not received Men-B previously

If meets criteria: notify them that they meet criteria for Men-B vaccination and offer vaccine If they are accepting the vaccine or thinking about it, place **RED** educational brochure outside of door to remind the provider to offer vaccination and educate, if they decline, give them **PURPLE** brochure

Providers: please educate in the exam room , order vaccine if applicable

MA & RN:

If patient **accepts**:

- Click on Indication (under chief complaint), choose Immunization
- Click Health Watcher
    - Manage plans
    - Choose provider
    - Click assign Meningococcal B
    - Click include start date and frequency
    - Click assign
    - Click finish

If patient **declines**:

- Click on risk factor in left menu
- Click add new (+)
- Click Men-B susceptible
- Click status: Current
- In comment, put reason for not receiving, then click checkmark to save

*When you open the chart, if Health-watcher reminder pops up that patient is overdue, that means that the patient received the Men-B vaccine already. It will show the date that it was given. It will also pop up when the patient is due for their second dose.
*If patient receives the vaccine, try to get them to schedule their 1- month appointment for 2nd dose
*Please fill out Men-B compliance form even if they declined it, or have already received it, but meet criteria (if they have already had it, write that on the sheet, if they are freshmen, place an F at the end of the row)

Appendix B

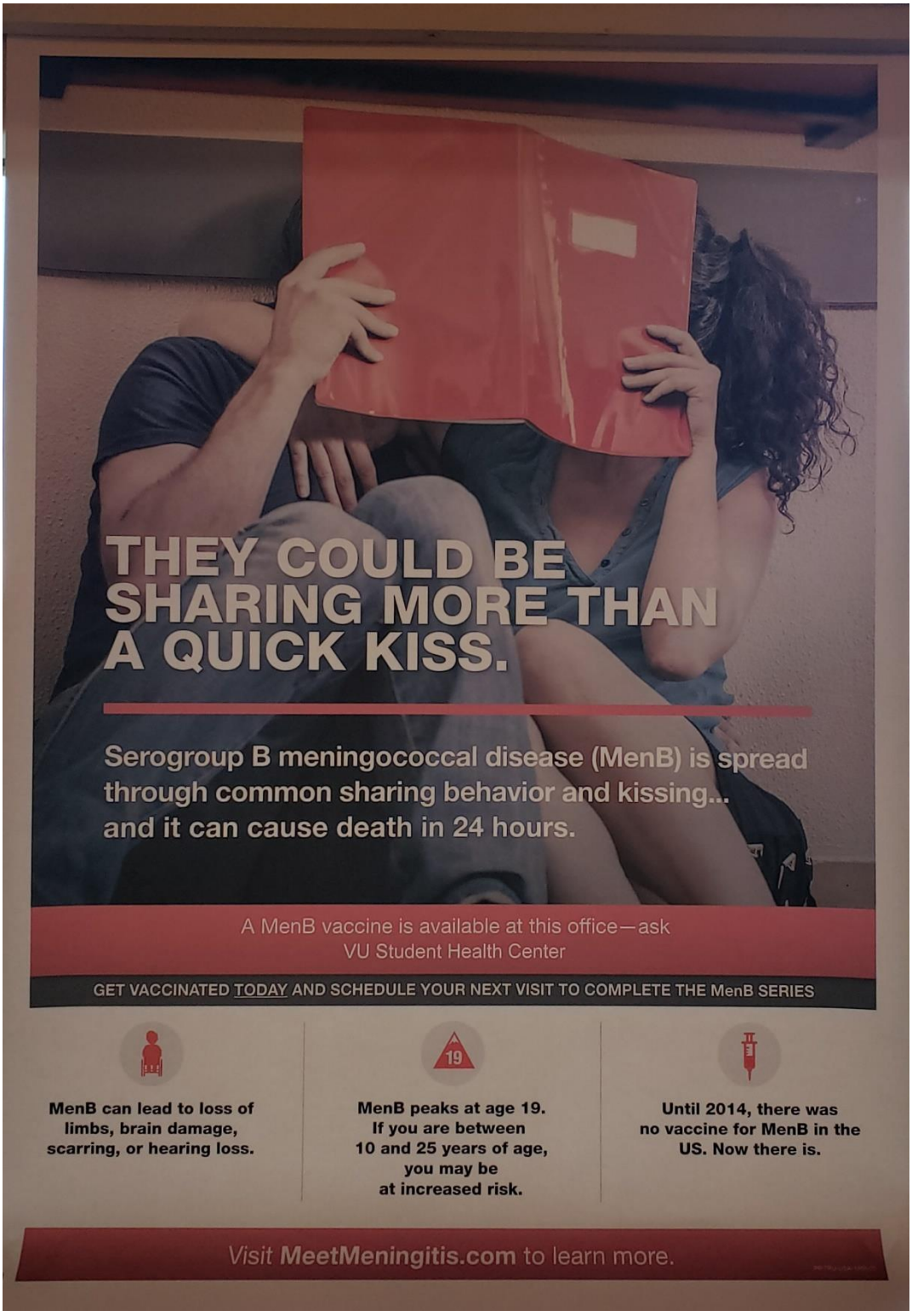
Date	Pt initials	Screening completed	Eligible	Non-eligible	Education given	Accepted	Declined	Staff initials

Appendix C

Appendix D


YOU KNOW ABOUT MENINGITIS,
but have you received the Meningitis B vaccine to help prevent it? Few people have.
IT TAKES TWO TYPES OF MENINGITIS VACCINES — MenACWY and MenB — to be fully immunized against meningococcal disease, one of the most common types of bacterial meningitis.
Few people have received both vaccines.
Don't take a chance. Ask your doctor today.
MeningitisB Action Project
a joint initiative by The Kimberly Coffey Foundation and The Emily Stillman Foundation

Appendix E


THEY COULD BE SHARING MORE THAN A QUICK KISS.
Serogroup B meningococcal disease (MenB) is spread through common sharing behavior and kissing... and it can cause death in 24 hours.
A MenB vaccine is available at this office—ask VU Student Health Center
GET VACCINATED TODAY AND SCHEDULE YOUR NEXT VISIT TO COMPLETE THE MenB SERIES
MenB can lead to loss of limbs, brain damage, scarring, or hearing loss.
MenB peaks at age 19. If you are between 10 and 25 years of age, you may be at increased risk.
Until 2014, there was no vaccine for MenB in the US. Now there is.
Visit MeetMeningitis.com to learn more.