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Claire Jensen
University of Missouri-St. Louis, cejz87@mail.umsl.edu

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Claire E. Jensen

B.S. in Nursing, Goldfarb School of Nursing-St. Louis, 2012
B.A. in Business Administration, Webster University-St. Louis, 2005

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Advisory Committee

Nancy Magnuson, DSN, CS, FNP-BC
Chairperson

Lisa E. Merritt, DNP, CPNP-PC/AC, PMHS

Emily D. Doucette, MD, MSPH, FAAFP

Abstract

Immunizations have been proven to control life-threatening diseases. Often Registered Nurses (RNs) administer vaccines but are unsure how to discuss vaccines with vaccine hesitant patients. Missouri's adolescent vaccination rates are below its neighboring states. This initiative's purpose was to increase adolescent vaccine administrations at a Missouri County Health Department (MCHD).

This quality improvement initiative had an observational, cross-sectional, descriptive design. RNs employed at three MCHD clinics attended an adolescent vaccine administration training program (VAT) and completed pre-/post-tests regarding the Advisory Council on Immunization Practices recommendations. Medical record reviews from March 1-April 30, 2018 and March 1-April 30, 2019 compared vaccination rates. Twenty-four RNs (N = 24) attended the VAT, 390 medical records were reviewed. Increases in administrations for specific vaccines at each clinic in 2019 were observed. RN knowledge increased after training (t [23] = -2.34; p = 0.03), however, no difference in RN confidence scores (t [23] = -2.00; p = 0.06) was observed.

A Vaccine Administration Training Program to Increase Adolescent Vaccination Rates

Immunizations have been proven to control life-threatening diseases in adolescents. The Advisory Council on Immunization Practices (ACIP) recommends adolescents receive the Human Papillomavirus (HPV), tetanus, diphtheria, and acellular pertussis (Tdap), and meningococcal vaccines (MenACWY and MenB) (Walker et al., 2018). HPV is one of the most common sexually transmitted infections (STIs) in the United States (US) (Centers for Disease Control and Prevention [CDC], 2017). Infection can lead to cancer of cervix, vulva, penis, oropharynx, or anus (CDC, 2017). Each year, 30,700 HPV related cancers are diagnosed in women and men in the US (CDC, 2017). The Tdap vaccine protects people from diseases with the capacity to cause serious health implications. Tetanus, otherwise known as lockjaw, is a neurological infection caused by a toxin produced by the anaerobic bacterium *Clostridium tetani* and is spread through breaks in the skin (CDC, 2016). This infection causes profound muscle spasms resulting in fractures of long bones, respiratory depression, or cardiac arrhythmias (CDC, 2016). The mortality rate of those who contract tetanus is 10-20% (CDC, 2016). Diphtheria is a highly contagious bacterial infection caused by *Corynebacterium diphtheria*, spread by droplet transmission or secretions from draining wounds (CDC, 2016). Complications include myocarditis, polyneuropathy, temporary paralysis of some muscles including the diaphragm, pulmonary complications including pneumonia and respiratory failure, or coma (CDC, 2016). Acellular pertussis, or whooping cough, is a highly contagious infection caused by the bacterium *Bordetella pertussis*, spread by droplet transmission (CDC, 2016). Pertussis causes a barking cough lasting several weeks, causing difficulty with eating and breathing (CDC, 2016). Infection in the very young or very old may

result in death (CDC, 2016). Infection rates are increasing with 25,827 cases reported in 2004; 48,277 in 2012, resulting in 16 infant deaths; and 32,971 cases in 2013, resulting in 12 infant deaths (CDC, 2016). Meningococcal infection is spread by respiratory and throat secretions and is caused by the bacterium *Nisseria meningitidis* (CDC, 2018). Meningococcal infection can result in meningitis, an infection of the brain, or septicemia, a systemic inflammatory response to infection resulting in multiple organ damage (CDC, 2018). The current mortality rate of meningococcal infection is 15%; up to 40% of those who develop meningococcal sepsis will die (CDC, 2018). Shock, coma, and death can occur within hours. Up to 20% of survivors can suffer permanent hearing loss, limb loss, or brain damage (CDC, 2018). Despite evidence of vaccine protection from serious illness or death, rates for adolescent vaccines are lower in Missouri when compared to the national rate and those of Missouri's neighboring states (Appendix A).

Healthcare providers at a Missouri county health department (MCHD) followed vaccination guidelines distributed by the ACIP. While the MCHD had a policy regarding registered nurses (RNs) following the ACIP guidelines, there was no formal training or annual competency program for RN vaccination knowledge and skills. The National Council for the State Boards of Nursing (NCSBN, 2005) published a position paper for ongoing nurse competencies regarding patient safety and best practice. The American Nurses Association (ANA) also provide support in their 2014 position statement for professional role competence. Competence was the responsibility of any entity interacting with nursing, including RNs, employers, professional organizations, regulatory bodies, and any other key stakeholders (ANA, 2014).

The purpose of this quality improvement initiative was to increase the number of vaccine administrations in the adolescent population while minimizing the number of missed opportunities at the MCHD. A vaccine administration training (VAT) program was developed for the RNs at the MCHD. Vaccine administration rates were then compared between 2018, prior to the VAT and again in 2019 after the VAT. The specific questions of study were: In adolescents aged 11-18 years who visited the walk-in clinic at the MCHD from March 1-April 30, 2018 and March 1-April 30, 2019:

1. What was the number of vaccine administrations for Tdap, HPV, MenACWY, and MenB vaccination among adolescents?
2. What was the difference in vaccine administration between each of the three participating clinics in the MCHD?
3. What was the rate in RN knowledge of the ACIP recommendations score pre-VAT when compared to post-VAT?
4. What was the rate in RN confidence scores pre-VAT when compared to post-VAT?

Review of Literature

A literature search included the databases of Summon, PubMed, CINAHL, and the Google Scholar. The key words used were *yearly, annual, competency, training, vaccine, immunize, confidence, outcome,* and *nurse*. The literature search included publications from 2005 through 2018. The search was filtered for full text articles published in English, journal articles, and scholarly peer-reviewed publications. Publications were excluded if educational studies were related to nursing student competency. Reference lists of included articles were mined for additional resources.

RNs administered vaccines but were often unsure about how to have a conversation with those who question vaccines. Public health nurses tended to be knowledgeable about vaccines and their administration (Buxton et al., 2013; Nikola et al., 2011). Factors reported to strengthen nurse vaccine competence included continuing education, willingness to develop as vaccine providers, and a creativity to manage difficult conversations regarding vaccinations (Nikola, Rapola, Hulpi, & Leino-Kilpi, 2009). Additionally, communication training to improve immunization acceptance has been an important feature cited in the literature (Kufel, Williams, & Weber, 2017; Strohfus et al., 2016). Specific training for RNs regarding vaccine administration recommendations and communication techniques may have been of value to increase vaccination rates.

Vaccine training has been shown to increase healthcare provider knowledge and vaccine rates in the community they serve. Uskun, Basar Uskun, Uysalgenc, and Yagiz (2008) implemented a face-to-face training program for 229 primary healthcare workers in Isparta, Turkey. The investigators found after training, provider knowledge significantly improved ($P<0.01$) and immunization rates increased in the community ($P<0.001$) (Uskun et al., 2008). Strohfus et al. (2016) provided vaccine training for 178 medical assistants, licensed practical nurses, RNs, nurse practitioners, and physicians. In this study, the investigators performed pre-test, post-test, and 12-month post-test assessments as well as compared pre-training/post-training vaccine rates at the participants' respective clinics (Strohfus et al., 2016). Overall knowledge increased 7.8% and vaccine rates increased 10.3% by 18 months after training (Strohfus et al., 2016). RNs scored highest among all job types on pre, post, and 12-month post-tests (Strohfus et

al., 2016). This demonstrates RNs' high level of knowledge and efficacy when handling vaccines and their effectiveness as key drivers in correct vaccine handling and maintaining immunization rates.

Training to address vaccine communication specifically has been shown to increase provider confidence, knowledge, and communication skills. Vyas, Galal, Rogan, and Boyce (2018) conducted a training program for 180 pharmacy students to address vaccine hesitancy. The program consisted of two patient interaction simulations with 16-point rubric addressing communication skills; pre-test, post-test, performance feedback, and formal coursework on addressing vaccine hesitancy (Vyas et al., 2018). Post-test results showed improvement in confidence, communication skills, and strategies for responding to vaccine hesitant parents (Vyas et al., 2018). Vaccine communication training provides healthcare workers with the skills necessary to address patient concerns and misconceptions in order to increase understanding of the benefits of vaccination.

In 1966, Donabedian introduced his S-P-O framework for quality improvement in healthcare (Brosnan, 2017). This model examines Structures, Processes, and Outcomes in order to make necessary improvements for the health of populations (Brosnan, 2017). Structures are administrative aspects contributing to care such as facilities, equipment, training, or number and experience of staff (Brosnan, 2017). Processes are what the staff do to ensure good care such as proper assessment, administration of medications, and proper execution of procedures (Brosnan, 2017). Outcomes are what happens after the intervention and can range from broad results such as life expectancy of a population, to individual results such as glycemic control (Brosnan, 2017). For this project, the structure was the VAT at the MCHD. Processes were the RNs application of the training

regarding proper administration of the vaccines and the ability to educate patients and their parents about the vaccines. The intended outcome was to have adolescents safely receive all vaccines they were eligible for on each visit and increase adolescent vaccination rates for the MCHD.

Methods

Design

This was a quality improvement initiative with an observational, cross-sectional, descriptive design. A retrospective medical record review was completed for rates of vaccine administration from March 1-April 30, 2018 (cohort 1) and March 1-April 30, 2019 (cohort 2). The VAT was developed and given on March 1, 2019 for clinic A and April 5, 2019 for clinics B and C.

Setting

The MCHD consists of three clinic locations, A, B and C. The service area includes 1,003,362 residents (St. Louis Department of Public Health [DPH], 2016). All three clinics provide walk-in vaccination services providing 40,000-50,000 opportunities for vaccinations each year (personal communication, DPH meeting, September 10, 2018).

Sample

A convenience sample of medical records for adolescent vaccine administrations was reviewed for both cohorts. Inclusion criteria were adolescents aged 11-18 years who visited one of the three MCHD walk-in vaccine clinics. Excluded were children 10 years and younger or adults 19 years and older.

All RNs employed at MCHD were required to go through this training program and were required to complete the pre- and post-tests as a condition of employment and

were included in the survey. Anyone with a title other than RN employed at MCHD was excluded.

Approval process

Approvals were obtained from the MCHD medical director and Internal Research Review Committee, the Doctor of Nursing Practice committee members and institutional review board (IRB) at the University.

Data Collection/Analysis

All medical records were reviewed for age; gender; race/ethnicity; type of vaccine; location of clinic; and eligibility for vaccine. In addition, RN knowledge and confidence with vaccine administration recommendation pre- and post-VAT program was recorded based on responses to a multiple-choice knowledge assessment combined with a Likert scale confidence measure. All personal identifiers were removed. A paired *t*-test was used to analyze the data using SPSS (Statistical Package for the Social Sciences) version 25.

Procedures

Regular meetings with the MCHD medical director and the primary investigator (PI) occurred. The VAT was developed based on CDC vaccine training modules. Topics discussed in the VAT sessions included effective communication techniques, disease processes and prevalence, and ACIP guidelines for safe vaccine administration. Dates were determined for delivery of the VAT to the RN staff.

Results

There was a total of 390 vaccine administration visits between the two cohorts (N = 390). In cohort 1 (March 1-April 30, 2018), there were 196 visits (n = 196) resulting in

274 vaccine administrations. In cohort 2 (March 1-April 30, 2019), there were 194 visits (*n* = 194) resulting in 267 vaccine administrations. The age with the greatest number of visits was 17-years in both cohorts, cohort 1 was 26% (*n* = 50), cohort 2 was 27% (*n* =52). Other ages included those aged 11 years, cohort 1 was 12% (*n* = 23), cohort 2 was 11% (*n* = 21); those aged 12 years, cohort 1 was 9% (*n* = 17), cohort 2 was 6% (*n* = 12); those aged 13 years, cohort 1 was 9% (*n* = 17), cohort 2 was 9% (*n* = 18); those aged 14 years, cohort 1 was 10% (*n* = 19), cohort 2 was 3% (*n* = 6); those aged 15 years, cohort 1 was 12% (*n* = 23), cohort 2 was 9% (*n* = 18); those aged 16 years, cohort 1 was 23% (*n* = 45), cohort 2 was 17% (*n* = 33); those aged 18 years, cohort 1 was 1% (*n* = 2), cohort 2 was 18% (*n* = 34) (Appendix B).

More females than males utilized the clinics in both cohorts, females represented 52% (*n* = 102) in cohort 1, cohort 2 was 55% (*n* = 107). The most common ethnicities to use the clinics were Caucasians in cohort 1 41% (*n* = 80), cohort 2 was 31% (*n* = 60), and African Americans in cohort 2 52% (*n* = 100), cohort 1 was 40% (*n* = 79). Other ethnicities include Hispanic, cohort 1 was 0% (*n* = 0), cohort 2 was 0% (*n* = 0); Asian, cohort 1 was 7% (*n* = 13), cohort 2 was 7% (*n* = 14); Pacific Islander, cohort 1 was 1% (*n* = 1), cohort 2 was 0% (*n* = 0); and Other, cohort 1 was 12% (*n* = 23), cohort 2 was 10% (*n* = 20) (Appendix B).

Of the vaccines recommended to be given during adolescence the percentage of vaccines given in the timeframe of March 1-April 30 for each cohort to utilize the MCHD walk-in clinic was as follows: Tdap for cohort 1 was 10% (*n* = 27) and cohort 2 was 11% (*n* = 30); HPV for cohort 1 was 7% (*n* = 20), cohort 2 was 8% (*n* = 21); MenACWY for cohort 1 was 15% (*n* = 41), cohort 2 was 22% (*n* = 59); MenB for cohort 1 was 2% (*n* =

6), cohort 2 was 1% (*n* = 4) (Appendix C). When comparing adolescent vaccine administration rates for April 2018 with April 2019, clinic A had an increase in administrations to qualifying adolescents who received Tdap from 18% (*n*=5) to 20% (*n*=6); MenACWY increased from 29% (*n*=10) to 44% (*n*=14); there was no change in adherence for HPV 11% (*n*=4) for both 2018 and 2019 or MenB 0% (*n*=0) for 2018 and 2019. Clinic B had an increase in Tdap rates from 0% (*n*=0) to 25% (*n*=2); HPV rates did not change with 0% (*n*=0) vaccines given in 2018 or 2019; MenACWY decreased from 50% (*n*=4) to 25% (*n*=2); MenB increased from 0% (n=0) to 17% (*n*=1). Clinic C had increases in adherence to the most vaccines of the three clinics in April 2018 to April 2019. Tdap increased from 12% (*n*=4) to 20% (*n*=8); HPV increased from 2% (*n*=1) to 12% (*n*=5); MenACWY increased from 25% (*n*=6) to 40% (*n*=16); and MenB remained constant with 0% (*n*=0) in both 2018 and 2019 (Appendix D).

Twenty-four RNs (*N* = 24) participated in the VAT and completed pre- and post VAT vaccine administration knowledge and vaccine administration confidence measures. There was an increase in RN knowledge from pre-VAT scores (M = 73.83, SD = 17.54) to post-VAT score (M = 79.38, SD = 14.63); *t* (23) = -2.34, p = 0.029. There was no difference in RN vaccine administration confidence from pre-VAT (M = 4.13, SD = 1.42) to post-VAT (M = 4.46, SD = 1.1) confidence scores; *t* (23) = -2.00, p = 0.057.

Discussion

Comprehensive training has been documented as an important part of safely and effectively administering vaccinations (NCSBN, 2005; ANA, 2014). Literature supported vaccine training to increase vaccine rates among patient populations (Uskun et al., 2008; Strohfus et al., 2016).

In the pre-VAT survey, RN participants were asked what they thought the main reason for vaccine non-compliance among adolescents was in their population. Among the three clinics, 23 opinions were expressed. The most common answer was "lack of patient education" (n = 9). Other frequently occurring answers were "parental concern regarding HPV vaccine; not wanting to have the sex talk" (n = 4) and "rumors/misinformation" (n = 3). These answers confirmed the need for patient and family education. The answers had an underlying theme of inadequate knowledge of vaccines, their safety, and efficacy in the MCHD community. Increases in administration rates for specific vaccines at each clinic suggested the VAT was successful in increasing RN communication skills regarding educating patients about the benefits of vaccination.

This was a short-term project; the long-term effects of the training are not yet known. The training was only done at 3 clinics in one healthcare system; therefore, it is not known if results would differ among the cultures of other clinics or patient populations. There was a paucity of documentation on whether RNs recommended and educated patients about all vaccines due verses simply administering and educating on only those vaccines requested. Due to the nature of the walk-in clinics, patients came in requesting specific immunizations that they wanted to receive. It is unknown if conducting a similar study on primary care clinics would have different results.

Healthcare providers had a short timeframe to give comprehensive education to their patients. In order to increase vaccination rates, more education is necessary for the public regarding the value of vaccines and implications of not being vaccinated. Sledge, Jensen, Cibulka, & Hoffman (2019) found adolescent males were eager to learn about HPV and the HPV vaccine, were receptive to face-to-face education, and open to

receiving the vaccine after learning about it. This could possibly apply to Tdap and meningococcal vaccines as well. A community education program to increase knowledge and understanding of the benefits of vaccinations is recommended.

MenACWY, the only adolescent vaccine required for school, had the highest administration rates for both cohort 1 and 2 at each of the three clinics. A systematic review of pre and post mandates on childhood vaccine rates found vaccine rates improved in both the short-term and long-term after mandates were implemented (Lee & Robinson, 2016). Consideration should be given to requiring adolescents to receive Tdap, HPV, and MenB vaccines to increase compliance and reduce instances of vaccine preventable disease.

Conclusion

The VAT program implemented in this study resulted in greater RN knowledge and an increase in some adolescent vaccinations at each MCHD clinic, specifically Tdap and MenACWY. More interventions are necessary to encourage adolescents to receive all recommended vaccines. Vaccine education for patients and their families will make a measurable impact on influencing populations to choose to become vaccinated. Requiring additional vaccines for school will increase vaccine administrations among those who might not otherwise be motivated to receive all recommended vaccines.

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Appendix A

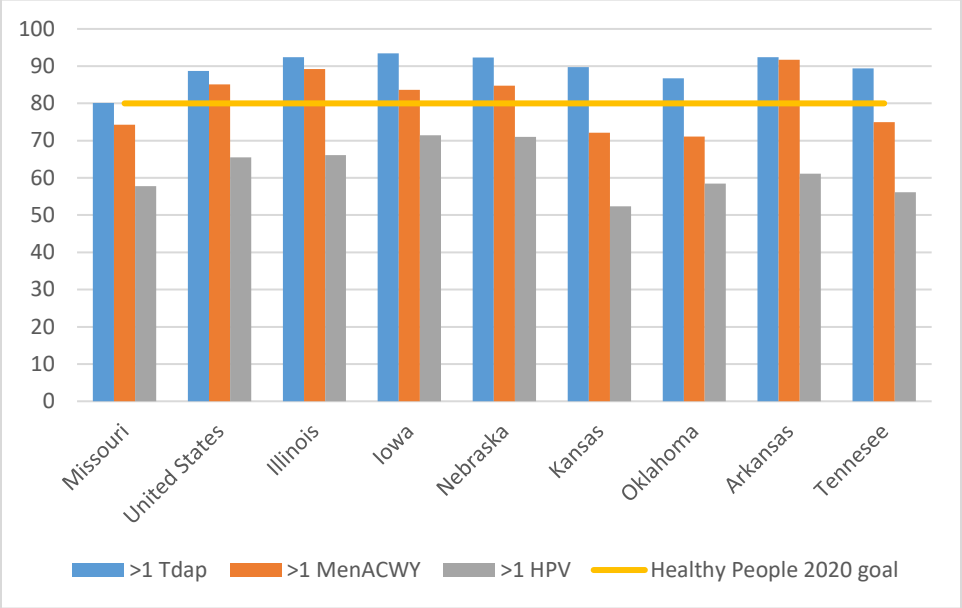

Figure 1. Missouri's Adolescent vaccination percentage rates by vaccine as compared to the rates of the nation and surrounding states (Office of Disease Prevention and Health Promotion, 2019; Walker et al., 2018)

Appendix B

Table B2

Demographic characteristics of St. Louis DPH walk-in vaccine clinic users

Sex	**Cohort 1 (*n*) =*196***	**Cohort 2 (*n*) = 194**
Male	94	87
Female	102	107
Age		
11	23	21
12	17	12
13	17	18
14	19	6
15	23	18
16	45	33
17	50	52
18	2	34
Ethnicity		
African American	79	100
Caucasian	80	60
Hispanic	0	0
Asian	13	14
Pacific Islander	1	0
Other	23	20

Appendix C

Table C3

Vaccine frequencies received by adolescents who visited the DPH walk in vaccine clinic in Cohort 1 as compared to Cohort 2

Vaccine	**Cohort 1 (*n*)**	**Cohort 2 (*n*)**
Adolescent Vaccines		
Tdap	27	30
HPV	20	21
MenACWY	41	59
MenB	6	4
Other vaccines		
Hepatitis A	68	71
Hepatitis B	22	6
Polio	24	10
Td	12	3
Varicella	17	13
Typhoid	12	27
Yellow fever	2	10
MMR	19	10
Flu	4	3
Total	274	267

Appendix D

Table D4

Percent of vaccines given to qualifying adolescents

Clinic	Visits (*n*)		%Tdap		%HPV		%MenACWY		%MenB	
	March	April	March	April	March	April	March	April	March	April
A 2018	42	38	33 *n*=33	18 *n*=28	32 *n*=41	11 *n*=37	33 *n*=35	29 *n*=34	23 *n*=13	0 *n*=16
A 2019	41	35	21 *n*=29	20 *n*=31	22 *n*=41	11 *n*=35	50 *n*=34	44 *n*=32	0 *n*=22	0 *n*=22
B 2018	15	9	10 *n*=10	0 *n*=6	0 *n*=15	0 *n*=9	29 *n*=14	50 *n*=8	0 *n*=11	0 *n*=8
B 2019	11	9	17 *n*=6	25 *n*=8	0 *n*=10	0 *n*=8	43 *n*=7	25 *n*=8	0 *n*=9	17 *n*=6
C 2018	50	40	21 *n*=29	12 *n*=32	8 *n*=48	2 *n*=40	28 *n*=33	25 *n*=32	0 *n*=27	0 *n*=21
C 2019	51	43	24 *n*=37	20 *n*=40	10 *n*=49	12 *n*=43	40 *n*=42	40 *n*=40	9 *n*=35	0 *n*=26

*Clinics B and C had training in April, 2019, therefore rates for March 2018 vs March 2019 are irrelevant