EXPLORING FACTORS INFLUENCING CHILDHOOD IMMUNIZATION RATES

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Communicable diseases are dangerous to public health, especially to the pediatric population. Children are more vulnerable to these diseases as a result of their biologic status, developmental stage and environmental factors. Children have an underdeveloped immune system and they are less consistent with proper hand washing techniques. In addition, they are exposed to hundreds of other children in congregate settings such as schools, daycare centers and summer camps.

Childhood immunizations have been the solution to the prevention of transmission of many diseases. As many as twenty-one diseases can be prevented with vaccinations (U.S. Department of Health and Human Services, 2014). The American Nurses Association (ANA) strongly supports immunizations for the wellbeing of the general public (American Nurses Association, 2015, p. 11).

Substandard vaccination rates have led to outbreaks of highly contagious diseases, such as the 2015 measles outbreak noted in Anaheim, California at Disneyland (Majumder, Cohn, Mekaru, Huston, & Brownstein, 2015). Since measles is a highly contagious disease, a high vaccination rate of 96% to 99% is needed to attain herd immunity and keep the population safe; but measles vaccination rates usually do not reach that parameter (Majumder, Cohn, Mekaru, Huston, & Brownstein, 2015). Even though vaccinations are important to public health, numerous children do not have them completed in a timely manner due to a variety of different circumstances. The purpose of this project is to explore barriers and facilitators to childhood immunizations by conducting a program evaluation of a school-based health center's immunization program and rates.

BACKGROUND AND SIGNIFICANCE

In 2012, 22 million children were not completely vaccinated, even though vaccinations have helped to eradicate diseases such as smallpox worldwide (Kaufman et al., 2013). With proper administration, vaccinations can prevent approximately 322 million illnesses, 21 million deaths, and 732,000 deaths for children born between the years 1994 and 2013 (Hill, Elam-Evans, Yankey, Singleton, & Kolasa, 2015). In 2014, coverage for multiple vaccines fell below the *Healthy People 2020* target for coverage. Vaccine coverage indicates how many individuals received the full series, and percentages from 2014 for DTAP (83.1%), *Haemophilus influenzae* type B vaccine (Hib) (82%), and hepatitis B (74.2%) indicate that many children were underimmunized (Hill, Elam-Evans, Yankey, Singleton, & Kolasa, 2014). Still, children who received no vaccinations whatsoever remained below 1% (Hill, Elam-Evans, Yankey, Singleton, & Kolasa, 2015). In addition to receiving incomplete coverage, many children are not receiving immunizations on time. In 2013, one out of every twelve children in the United States did not get the first measles, mumps and rubella (MMR) vaccination on time (Hill, Elam-Evans, Yankey, Singleton, & Kolasa, 2015).

These incomplete vaccination rates put the United States child population at risk for transmission of harmful communicable diseases. Not only are the effects of the disease crippling, but the costs to treat and manage the disease are extensive. For example, if a child contracts pertussis, costs would range anywhere from $278 to $4,331 for immediate medical treatment, not including the lifetime costs if the child was permanently affected (Moser, Reiss, & Schwartz, 2015). On the contrary, vaccinations have been estimated to save approximately $14.7 billion in direct costs and $75 billion in societal costs over the lifetime of a single cohort in relation to the costs spent treating and managing the disease (Moser, Reiss, & Schwartz, 2015).

REVIEW OF LITERATURE

A review of literature was conducted to evaluate current evidence on childhood immunization services and programs especially related to barriers and facilitators. The electronic databases utilized in this literature review were CINHAL, PubMed, PsychInfo and Ovid. Search terms used were “childhood immunizations”, “barriers”, “measles outbreak”, and “childhood vaccination rates”. Articles were selected from the years 2010 to 2015 and were related to research conducted about childhood vaccinations. Studies reviewed included secondary analyses and cross-sectional, interventional, qualitative, and retrospective cohort studies. Thirty articles were evaluated, with twenty articles pertaining specifically to the topic and included in this review of literature. Articles from this review were organized into four overarching categories of vaccination opposition; parental education and income; healthcare systems and policies; and source of information.

Vaccination Opposition

Even though vaccinations are considered to be one of the most “cost-effective health investments in history”, vaccination opposition has existed throughout history (Steffanelli & Rezza, 2013, p. 6). In the U.S. population today, over one-third of parents are apprehensive about vaccination schedules for their children and distrust health care providers who recommend these schedules (Steffanelli & Rezza, 2013). Parental opposition includes conflicting religious beliefs and concerns about vaccine side effects (Steffanelli & Rezza, 2013). Misconceived notions gathered from the Internet also serve as a common reason for vaccination opposition. One largely disseminated myth is the notion that childhood vaccinations cause autism (Wolff & Madlon-Kay, 2014). Other anti-vaccination arguments fall under the following categories:

concern about safety and effectiveness, a shift towards alternative medicines, individual freedom to make a choice, conspiracy theories, and religious ideations (Steffanelli & Rezza, 2013).

Parents who oppose vaccinations may be reluctant to the advice of a health care provider regarding recommended immunization. One author suggests, "the most effective way to increase vaccine coverage is to improve immunization rates among children whose parents either are open to vaccination but encounter barriers to obtaining vaccines or hesitant because of fears and concerns about safety" (Diekema, 2012, p. 392).

Parental Education and Income

Numerous studies have shown that parental education and income are two of the most pivotal demographic factors related to childhood immunization completion rates (Pearce, Marshall, Bedford, & Lynch, 2015; Crouch & Dickes, 2015; Bbaale, 2013; Pearce, Marshall, Bedford, & Lynch, 2015; Vikram, Vanneman, & Desai, 2012; Schreiber, Juul, Dehlendorff, & Kjaer, 2015; Chen et al., 2011; Roberts et al., 2011). Children whose parents have a lower level of education and income are less likely to be completely immunized (Pearce, Marshall, Bedford, & Lynch, 2015). Out of a survey of more than 17,000 people, Crouch and Dickes (2015) found that education and income were statistically significant in predicting the vaccination status of a preschool child in the United States.

The education and income phenomenon remained consistent across both developed and developing nations. In Uganda, Bbaale (2013) found higher levels of maternal education and partner education resulted in more complete immunization coverage. This trend was apparent in multiple countries including Australia, India, Denmark, Taiwan, and the United Kingdom (Pearce, Marshall, Bedford, & Lynch, 2015; Vikram, Vanneman, & Desai, 2012; Schreiber, Juul, Dehlendorff, & Kjaer, 2015; Chen et al., 2011; Roberts et al., 2011). This global trend shows

how parental education and income can affect the rate of complete childhood immunizations across cultures.

Health Care Systems and Policies

Health care systems have been identified as a way of both facilitating and hindering access to childhood immunization programs and services. Many studies have shown how flaws in health care systems can negatively impact childhood vaccination rates (Luthy, Beckstrand, & Callister, 2012; Bhat-Schelbert et al., 2012; Nguyen, Klusaritz, & Cronholm, 2014). Out of 801 parents recruited from county health departments in the state of Utah, 26.1% of parents asked the school district for an exemption for their child due to frustration with the health care system (Luthy, Beckstrand, & Callister, 2012). Frustrations stemmed from an inability to locate a child's vaccination record promptly to file it with the school system, a believed medical exemption without proper documentation, or a time delay between health insurance coverage and a pediatric visit (Luthy, Beckstrand, & Callister, 2012). In addition, Bhat-Schelbert et al (2012) found that a mismatch between vaccine demand and vaccine availability makes it difficult for those who want vaccinations to acquire them. A Pennsylvania family practice site found that vaccination rates were affected by patients who had failed to show up for their appointment, opportunities that were missed to immunize during non-preventive visits, and staff who were giving doses at incorrect intervals (Nguyen, Klusaritz, & Cronholm, 2014).

Health care systems can also serve as facilitators to childhood vaccination coverage. Bhat-Schelbert et al (2012) found that parents preferred more convenient vaccination options. By providing services at school or after normal clinic hours, parents could get their children vaccinated without the burden of taking time off from work. In addition, phone and email reminders helped parents to keep up with vaccination schedules (Bhat-Schelbert et al., 2012). By

utilizing clinician reminders and more convenient scheduling options, health care providers could increase childhood vaccination coverage (Elam-Evans, Yankey, Singleton, & Kolasa, 2014).

In an effort to safeguard public health and wellness, government policies have been implemented to mandate certain vaccinations before a child may enter the public school system (Luthy, Beckstrand, & Callister, 2012). For example, in North Carolina, the mandatory vaccinations before entering kindergarten are DTaP (5), polio (4), MMR (2), Hib, Hep B (3), and varicella (NC Department of Health and Human Services, 2015). To be considered up-to-date on vaccinations in middle school, a child must have the DTaP, polio, MMR, Hib, Hep B, chickenpox, Tdap, and meningococcal conjugate vaccinations by 7th grade (NC Department of Health and Human Services, 2015). Yet, policy changes in states such as Arkansas have allowed for more parents to request philosophic and religious exemptions for mandatory vaccinations, contributing to the rise in exemptions by about 23.1% each year in this state (Safi et al., 2012).

Other states, such as California, Mississippi, and West Virginia, have done the opposite by repealing or limiting philosophic and religious exemptions (Yang, Barraza, & Weidenaar, 2015).

Sources of Information

The provision of vaccine information is a federal government requirement to the public prior to administration of any vaccine. This information, called a Vaccine Information Statement (VIS) is a document created by the Centers for Disease Control and Prevention (CDC) under the U.S. Department of Health and Human Services (DHHS) that provides information about the risks and benefits of the vaccine (DHHS, 2014). The VIS is written in English at a 10th grade reading level, but has also been translated into approximately 40 other languages (DHHS, 2014).

Health care providers play a legal role in providing VIS to parents and the general public (Diekema, 2012).

A wide variety of informal sources of vaccine information exist and greatly affect people's perceptions of vaccinations, and in turn affect the completion rates for childhood immunizations. In a research study conducted by Weiner, Fisher, Nowak, Basket, and Gellin (2015), 200 first-time U.S. mothers were surveyed. These mothers were unsure of their vaccination plans and stated that they relied primarily on socially available sources of information to make their decision (Weiner, Fisher, Nowak, Basket, & Gellin, 2015). Another study using focus groups determined that a main reason for refusal was a concern regarding vaccine safety (Barbacariu, 2014). This concern regarding vaccine safety was raised from different sources; some information was from traditional sources, such as healthcare providers, while other information was from nontraditional sources, such as online parent forums or blogs (Barbacariu, 2014). Bhat-Schelbert et al (2012) found that participants reported the media as a common source of misinformation, inciting fear or mixed messages. Parents can find both reliable and inaccurate information on the Internet (Ruiz & Bell, 2014). The Internet has allowed for anti-vaccination arguments to be widely shared, resulting in one vaccine opposition article out of every five articles that comes up in a standard Google search (Steffanelli & Rezza, 2013). In Oregon, a retrospective cohort study found that parents who had knowledge of someone with a child who was injured by a vaccination were more likely to exempt their child based on this personal story (Gaudino & Robison, 2012). This finding suggests a community influence on parent decisions regarding immunizations, which can explain why certain geographic areas may experience very low or very high complete immunization rates (Gaudino & Robison, 2012).

SUMMARY

The main factors that determine or preclude successful childhood immunization rates include vaccination opposition, parental education and income, healthcare systems and policies, and sources of information. Vaccination opposition has been noted to include mistrust of health care providers, safety concerns, conflicting religious beliefs, and lack of or inaccurate knowledge. Knowledge regarding immunizations, usually obtained from a healthcare provider, can play a factor in reducing opposition (Kaufman et al., 2013). Low parental education and low income are associated with lower immunization rates (Pearce, Marshall, Bedford, & Lynch, 2015). Facilitators and barriers exist within healthcare systems that can affect childhood vaccination rates (Luthy, Beckstrand, & Callister, 2012; Bhat-Schelbert et al., 2012; Elam-Evans, Yankey, Singleton, & Kolasa, 2014). Lastly, sources of information, formal or informal, can deter or strengthen a parent's inclination to have their child vaccinated (Weiner, Fisher, Nowak, Basket, and Gellin, 2015).

The purpose of this senior honors project was to conduct a program evaluation in a public school in rural North Carolina to determine the barriers and facilitators to immunization coverage and to make program recommendations based on the evaluation.

PROGRAM EVALUATION QUESTIONS

The questions for this program evaluation were: What are the barriers and facilitators for completion of childhood vaccinations? What current educational tools exist in Eastern North Carolina for childhood vaccinations? How does a current immunization program minimize barriers and strengthen facilitators to improve childhood immunization rates? What is the reading level of the Vaccine Information Statement (VIS)?

METHODOLOGY

Design

Childhood immunizations are required by law for school-age children and are one of the health indicators in the North Carolina Prevention Action Plan. I conducted a program evaluation to explore the barriers and facilitators for completion of childhood immunizations. This was done in collaboration with a RN school nurse preceptor in a middle school. I focused on the age-appropriate immunizations needed for this school-age population, which are DTaP, polio, MMR, Hib, Hep B, chickenpox, Tdap, and meningococcal conjugate vaccinations (K-12 School Requirements, 2015). In North Carolina, rates for these vaccinations are: DTaP (87.5%), polio (95.9%), MMR (96%), Hib (87%), hepatitis B (94.3%), chickenpox (94.6%), Tdap (89.4%) and meningococcal conjugate vaccinations (72.4%) (NC Immunization Rates, 2015). Nationally, rates for the same immunizations are: DTaP (84.2%), polio (93.3%), MMR (91.5%), Hib (93.3%), hepatitis B (91.6%), chickenpox (91%), Tdap (86%) and meningococcal conjugate vaccinations (72.4%) (Hill, Elam-Evans, Yankey, Singleton & Kolasa, 2015).

Planned Project Outcomes

The primary objectives were:

1. Complete an audit of 50 immunization records of adolescents at a public middle school.
2. Interview key informants (KIs) regarding their perception of immunization coverage.
3. Evaluate the reading level of the Vaccine Information Statement (VIS) of the required NC vaccinations using the SMOG evaluator.

Setting and Sample

This program evaluation was conducted in a public middle school in a rural county in Eastern North Carolina. A windshield survey, one component of a community assessment which

records observational data on environmental conditions and individual interactions with the environment, was conducted on a weekday in the early afternoon in January 2016. From these brief observations, it was concluded that this county has a large minority population, especially Hispanic and African Americans. Some individuals in the community were observed to be overweight and smoking. In the rural area, there were many older single-family homes and trailer parks. The economy of this community was heavily agricultural, including poultry and pork factories.

This population of approximately 125,000 was 64% Caucasian, 32% African American and 11% Hispanic (United States Census Bureau, 2014). Within this community, 82% of the population has a high school degree or higher, but only 17.2% of the population has received a bachelor's degree or higher (United States Census Bureau, 2014). In this county, 23.3% of the population lives in poverty and 7% are foreign-born. 24% of the population are below the age of 18 years (United States Census Bureau, 2014). Health services available for children and adolescents in this area include: school nurse, pediatric offices, local health department, rural health centers, and a community hospital. A department of social services is connected to the local health department for easy access to safety net programs, such as Medicaid and the Supplemental Nutrition Assistance Program (SNAP). In addition, 66.3% of students are enrolled in free or reduced lunch (Kids Count Data Center, 2016). Public transportation services available in this county are primarily in the city, but residents of outlying towns can make transportation appointments with this service for appointments. In addition, the public school system has a large network of buses to transport children to and from their schools. There is a Family YMCA and surrounding towns have small, mostly well-lit parks.

This program evaluation was done during a 7-week community health clinical rotation at a public school with a school school-based health center (SBHC). The SBHC is a primary care clinic that offers nursing services, primary care, mental health counseling, and health education. This SBHC nurse maintains an oversight role on childhood immunizations to make sure all children who attend the public school are up-to-date on their needed vaccinations.

The middle school, serving students from 5th to 7th grades, has a population of 509 students, 37.9% African American, 44.6% Hispanic, and 13.9% White. The minority population in this school are higher than the county. This program evaluation is tailored to this population because it takes into consideration many different factors specific to this population, such as racial and ethnic group, age, socioeconomic status, required childhood immunizations and insurance status.

A sub-sample of students was chosen for this program evaluation in collaboration with a SBHC nurse preceptor. We audited 52 records of children in 5th through 8th grade, males and females between ages 10 to 15 years, who were enrolled in the school-based health center. The SBHC nurse preceptor was the primary partner in this project to determine the sample records and provide expertise on immunization policies at the state and local level. The clinic office manager helped track the appropriate student records.

Data Collection

Data was collected in three separate steps: 1) record audit, 2) key informant interviews, and 3) VIS readability determination.

Record Audit

The first group of records was chosen if the child had a recent (within the past 6 months) physical examination. A total of 18 records between August 25, 2015 and September 22, 2015

were selected using this method. Following a process evaluation, a second sampling strategy was initiated to possibly yield other findings. A total of 33 records of current SBHC users (February 2 and February 9, 2016) was audited, regardless of their reason for visiting the health center. Immunization records were double-checked using the online North Carolina Immunization Registry. An audit tool was designed to collect relevant information (see sample below):

Student	Ethnicity/Race	Gender	Insurance	Grade	Immunizations Received	Other
#1						
#2						
#3						

Key Informant Interviews

Key informants were chosen in relation to their contact with middle school students, their background knowledge of the SBHC and school policies, and suggestions from the preceptor and nursing faculty. Interviews were conducted in-person and hand-recorded. Interview questions were: What is your role in relation to childhood immunizations? What do you believe are reasons for which a child may not be completely immunized? And What practices do you think promote childhood immunizations?

VIS Readability Determination

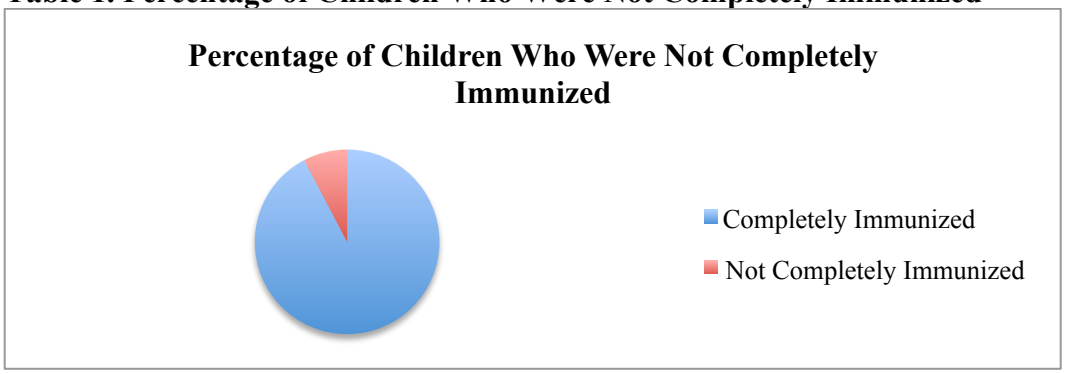
The SMOG formula first begins with counting 10 sentences in a row near the beginning of the VIS, next counting 10 sentences in the middle, and finally counting 10 sentences near the end. Using these 30 sentences, count every word with three or more syllables (including if the same word appears more than once), then add the total number of polysyllabic words counted.

McLaughlin (1969) then guides the evaluator to "estimate the square root of the number of polysyballic words counted…by taking the square root of the nearest perfect square" (p. 639) and add 3 to the approximate square root to determine the grade level.

FINDINGS

A record audit of 52 students revealed an immunization coverage of 92.3% (see Table 1). Out of these 52 students, 4 students were not completely vaccinated; one varicella, one meningococcal, one TDAP, and one was missing both meningococcal and varicella vaccinations. Of the 52 students, 30 were male and 22 were female; 28 were African American, 15 were Hispanic, 8 were White, and 1 other. Regarding health insurance, 44 were covered under Medicaid, 4 under self-pay (uninsured) and 4 under private insurance. Factors associated with incomplete immunization coverage were: insurance provider and race and ethnicity. Of the 4 students with incomplete vaccination coverage, 2 had Medicaid and 2 were self-pay. Of the 4 students, 1 was White, 1 was Hispanic and 2 were African American, representing 12.5% (1/8) White, 7.1% (2/28) African American, and 6.7% (1/15) Hispanic students respectively.

Table 1. Percentage of Children Who Were Not Completely Immunized



These key informants provided qualitative information about their knowledge and experience with childhood immunizations. Key informant interviews revealed 3 common trends regarding barriers and facilitators to childhood immunizations, which were 1) language barriers 2) parental autonomy and 3) misinformation.

Using the SMOG readability formula, it was found that English VIS statements for TDAP and meningococcal vaccinations were at the 11th grade reading level, which is higher than the recommended 5th grade reading level for healthcare information.

Limitations

The limitations of this project were a small number of records were audited during a limited time period, few key informants interviewed, and potential bias of key informants.

DISCUSSION

This program evaluation suggests that the SBHC model is effective for ensuring immunization coverage of required immunizations. Particularly noteworthy is that ethnic and racial minority students had better immunization coverage than White students in this sub-sample. Specific facilitators include clinician reminders and convenience of appointments, both provided by the SBHC. The convenience of the SBHC appeared to be the biggest facilitator to childhood immunizations in this program evaluation. This population of students had a high percentage of students covered by Medicaid or self-pay, unemployed parents of children, immigrants who spoke little English, and ethnic minorities.

In order to increase vaccination rates, school nurses could model some of the activities used in this SBHC, such as post-card reminders and location for easy access. School nurses could enlist public health nurses in an immunization outreach clinic during the first week of the school year. In low-income school districts, we recommend the establishment of SBHCs to extend the convenience of primary care on-site to families across the state that would benefit from such services.

The readability of government VIS forms is a major concern considering parents' health literacy. Therefore, an immunization infographic might offer easy understandability to supplement the VIS forms.

Childhood immunizations are an essential aspect of public health nursing as they provide a primary prevention approach to health promotion. This project provided an evaluation of the barriers and facilitators to childhood immunizations and recommendations for future programs.

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