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Vaccine Hesitancy, Provider Time, and Decision to Vaccinate

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Abstract

Problem: To date, there is a significant gap in the literature involving studies evaluating the time healthcare providers spend educating vaccine-hesitant caregivers about the necessity for their child's immunizations. Due to alarming resurgence rates of vaccine-preventable diseases in children, this project aimed to answer the following question: In vaccine-hesitant caregivers of newborns through six months of age, what is the effect of provider discussion time on vaccine administration (item) at well-child visits during the child's first six months of life?

Methods: Using a descriptive observation design, pre-collected data on provider discussion time and vaccine administration was evaluated retrospectively from June 1, 2022, through December 31, 2022. A convenience sample of all newborns entering a Midwest pediatric primary care clinic was included ($N = 210$).

Results: A total of 64.3% of caregivers said yes to all items at every visit ($n = 135$) and 35.7% said no to at least one item ($n = 75$). 119 individual teaching sessions with a total discussion time of 23.3 hours were provided. The results of a two-tailed Mann-Whitney *U* test assessing for significant differences in the length of discussion time and caregivers saying Yes or No to items at each visit were found to be not statistically significant. However, a strong clinical effect was seen with 50% of caregivers agreeing to a previously refused item after receiving vaccine education, regardless of length.

Implications: While no clear evidence was determined on how provider discussion time may affect a caregiver's decision to vaccinate their children, the strong clinical effect seen in this project further supports the need for continued research into determining the

most effective way to mitigate vaccine hesitancy and improve childhood vaccination rates.

Vaccine Hesitancy, Provider Time, and Decision to Vaccinate

The World Health Organization (WHO) and Centers for Disease Control and Prevention (CDC) consider vaccines to be the single greatest public health achievement of the 20th century (Miller & Carroll, 2022). Despite the estimated two- to three-million deaths prevented each year through routine childhood immunization, vaccine hesitancy (VH) has been steadily rising in the United States (Miller & Carroll, 2022). The CDC and its Advisory Committee on Immunization Practices recommend children be vaccinated against seven treatable diseases by age 12-months (CDC, 2023). However, only 68% of children are fully vaccinated with their seven-vaccine series by age 24-months (CDC, 2022a) and an estimated one-third of children follow an alternative vaccine schedule (Hargreaves et al., 2020). Recent outbreaks in vaccine-preventable diseases (VPD) such as measles and pertussis further highlight the significance of this problem. With 59% of these positive cases being among unvaccinated children and 70% of these children having nonmedical exemptions, the resurgence of VPD due to VH is alarming (Nguyen et al., 2022). VH among caregivers has become a major contributing factor to low pediatric vaccination rates and places children at increased risk for VPD and threatens overall herd immunity (Hargreaves et al., 2020; Rus & Groselj, 2021).

The WHO describes VH as a resistance to acceptance or refusal of vaccines despite the availability of vaccination services and lists it among their top ten threats to global health (WHO, 2015). The causes of VH are complex and often involve many concomitant factors which may influence an individual's decision to vaccinate. The

Strategic Advisory Group of Experts on Immunization has compartmentalized these factors into three categories: contextual influences, individual and group influences, and vaccination-specific issues (WHO, 2015).

Contextual influences on VH involve several different environmental factors, the most common being social media and misinformation available on the internet. The dramatic decrease in VPD due to the success of effective immunization programs has been cited as one of the primary reasons for VH with caregivers noting a lack of perceived need (Nguyen et al., 2022; Tokish & Solanto, 2020). This has been exploited by many anti-vaccination groups who use the internet and social media to post-vaccine misinformation. One such anti-vaccination group, Parents Educating and Advocating for Children's Health, uses false logic, selectivity, conspiracies, and data misrepresentation to target vaccine-hesitant caregivers and propagate fear and uncertainty (Tokish & Solanto, 2020; WHO, 2017). Further, VH is more common among individuals who receive the majority of their health information from the internet with up to 72% also citing trust in the health information obtained from online sources; hence, the influence of online misinformation is a threat to childhood vaccinations (Bianco et al., 2019; Olson et al., 2020).

Other significant contextual influences on VH are rooted in moral, religious, and philosophical objections. Vaccine-hesitant caregivers may often mention how vaccine mandates required for admittance to school morally infringe on their individual liberties and forces them to vaccinate through what they describe as governmental coercion (Tokish & Solanto, 2020; WHO, 2015). This concern over civil liberties has led to heightened mistrust among some caregivers, especially those who agree with anti-

vaccination political leaders (Bianco et al., 2019). Religious and philosophical objections to vaccines are quite common as well and can take many forms from Catholic concerns about cells derived from aborted fetuses, Muslim concerns about the presence of porcine residues, and a belief in divine fate or suggesting the development of disease was the will of God (Kibongani et al, 2022; WHO, 2017). These objections have led to 44 states allowing for religious exemptions to vaccination and 15 states allowing for personal, moral, or philosophical exemptions (NCSL, 2022). In fact, there is currently more anti-vaccination legislation than pro-vaccination legislation circulating through state legislatures aiming to expand these exemptions and repeal school vaccine mandates (Goldstein et al, 2017; Williams et al, 2020).

Individual and group influences may affect VH based on a lack of perceived need either due to reduced personal visibility to a disease as a result of successful vaccination programs, believing vaccines destroy natural immunity, or a proclivity to alternative medicine (WHO, 2015). Another often-cited influence on VH is a lack of trust in public health medicine, governmental health authorities, or pharmaceutical companies. This lack of trust may involve extreme ideas suggesting these industries are driven only by financial motivation and carrying out purposeful concealment of low efficacy or high adverse effects (Bianco et al., 2019).

Vaccination-specific issues all fall under a single overarching theme: safety. By far the most frequently cited determinant of VH is fear over vaccine safety and includes concerns such as additives and potential toxicity, short- and long-term adverse reactions, inadequate research and clinical trials, ineffectiveness, and immune system overload due to an accelerated vaccine schedule often with multiple vaccinations given at once

(Geoghegan et al., 2020; Haroune & King, 2020). One of the most prevalent safety concerns suggests vaccines are responsible for developmental abnormalities such as autism; however, the evidence does not support this claim (Geoghegan et al., 2020). In addition, thimerosal, an additive no longer present in current vaccine formulations, continues to be improperly linked to autism (Bonsu et al., 2021, Tokish & Solanto, 2020). Despite the overwhelming clinical evidence to invalidate these concerns, many caregivers continue to hold this belief with the evidence demonstrating how VH is much higher in caregivers of children with autism spectrum disorder (ASD) or who know someone with ASD (Bonsu et al., 2021; Sahni et al., 2020).

VH is also becoming a significant burden for healthcare providers by requiring extended patient visit times for discussion and education, reduced relative value units (RVU), and a lack of reimbursement for overcoming VH (Mohanty et al., 2018). Therefore, the purpose of this project was to evaluate the amount of time a provider spends discussing vaccines with vaccine-hesitant caregivers and its effect on their decision to vaccinate their children. The aim of this project was to assess provider time and vaccination rate in at least 75% of newborns in a Midwest suburban pediatric clinic over seven months. This was accomplished through retrospective data review from an existing database for all newborns entering the clinical practice. The primary outcome measure for this project was discussion time and the secondary outcome measure was vaccine administration. The Iowa Model of Evidence-Based Practice to Promote Quality Care (Iowa Model) served as a framework to guide this project. This project was designed to answer the following study question: In vaccine-hesitant or resistant caregivers of newborns through six months of age, what is the effect of provider

discussion on vaccine administration at well-child visits during the child's first six months of life?

Review of Literature

A review of the current literature was performed using the following databases: Cochrane Library, CINAHL and MEDLINE via EBSCOhost, and PubMed. Key search terms included 'vaccine hesitancy OR refusal', 'vaccine literacy', 'alternative vaccine schedule', 'childhood vaccines', 'vaccine risk perception', 'anti-vaccination OR anti-vaccine', 'vaccine confidence', and 'health communication'. Boolean operators 'AND', 'OR', and 'NOT' were used to link separate keywords. An asterisk (*) truncation symbol was also used to broaden the search of certain keywords. The initial search yielded 9,047 articles between the four databases. Search results were further refined by applying the following inclusion criteria: (1) peer-reviewed articles published after 2017, (2) articles concerning vaccine-hesitant caregivers with newborns through six months of age, and (3) articles written in the English language. Exclusion criteria were (1) articles published before 2017, (2) studies concerned with children over six months old or pregnant mothers, (3) studies with a non-communication-driven intervention (4) studies focused exclusively on influenza or COVID-19 vaccination, and (5) non-primary studies or studies based solely on opinion. After applying both inclusion and exclusion criteria, the total article count was narrowed down to 987. A total of 11 publications were selected for this literature review.

Currently, there is a significant gap in the literature involving studies evaluating the time healthcare providers spend educating vaccine-hesitant caregivers about the necessity for their child's immunizations. Provider communication is foundational to

educating vaccine-hesitant caregivers; therefore, the primary focus of this literature review is on studies with an emphasis on researching effective communication strategies. The studies within this literature review can be compartmentalized into the following categories: needs of the caregiver, communication strategies, and vaccine messaging approaches.

The needs of the caregiver must be addressed first to properly develop an appropriate communication strategy and messaging approach. Building trust is the cornerstone of a healthy patient-provider relationship and may be a challenge for some vaccine-hesitant caregivers (Bussink-Voorend et al., 2022). While 80% of caregivers report their decision to vaccinate was positively influenced by trust in their provider (Bussink-Voorend et al., 2022), this trust is not always easy to achieve. Trust can be promoted by first assessing overall health literacy related to vaccines and then tailoring the content of the discussion to the specific concerns of the caregiver (Olson et al., 2020). Vaccine-hesitant caregivers do not want to simply receive written material on the benefits of vaccines. Instead, there is a preference to be engaged in discussion through face-to-face communication using an open-dialog format (Kaufman et al., 2018; Olson et al., 2020). Along with this, vaccine-hesitant caregivers typically need extended appointment times to avoid feeling rushed and to have their questions and concerns addressed (Olson et al., 2020).

Timing and frequency of vaccine education can also be important as the evidence suggests after anti-vaccination ideas begin, they can become much more difficult to dissuade as time goes on (Albers et al., 2022, Kempe et al., 2020). Therefore, starting pro-vaccination education as early as possible may be more successful at reducing VH

(Olson et al., 2020). A stepwise delivery of vaccine information at each well-child visit has also been demonstrated to reinforce positive beliefs and enhance parental intent to vaccinate (Olson et al., 2020).

Developing an approach to communicating with a vaccine-hesitant caregiver can be challenging due to individualized reasons for their VH often involving a complex grouping of varying emotional, cultural, social, cognitive, and political factors (Olson et al., 2020). Therefore, choosing the appropriate messaging approach is paramount. In a systematic literature review evaluating effective strategies to address parental VH, Olson et al. (2020) found the overall ineffectiveness of those clinical interventions where participants were educated using a knowledge-deficit approach and assuming participant VH was simply caused by a lack of sufficient knowledge. In fact, this approach can lead to the presence of unintended cognitive phenomena such as moral outrage and an overkill backfire effect which has been shown to increase VH rates (Mical et al., 2021). While the most effective vaccine messaging approach has not yet been established, encouraging results have been found among studies using either a presumptive language model, motivational interviewing, or message framing (Kaufman et al., 2018).

The use of a presumptive language model has yielded a significant decrease in VH rates in the current literature. This matter-of-fact approach begins a patient-provider conversation by emphasizing vaccination as the social norm and uses language such as ‘John is due for his 1-month vaccines today’ (Opel et al., 2018). In a systematic literature review, Bussink-Voorend et al. (2022) found strong clinical evidence to support the effectiveness of using presumptive language when discussing VH, including one randomized controlled trial yielding a 73% vaccine compliance rate in those participants

who received this messaging approach from their provider compared to 22% compliance who did not. However, some studies have shown a presumptive language approach may also negatively impact the parental visit experience. In their meta-analysis of barriers to and facilitators of early childhood immunizations, Albers et al. (2022) found the improvement in intent to vaccinate when using a presumptive approach was often offset by participants reporting less satisfaction with their visit experience. On the other hand, providers who used a participatory format to begin the conversation (e.g., 'Do you want to vaccinate today?') allowed for improved visit experiences in exchange for decreases in vaccine acceptance (Albers et al., 2022). Therefore, providers must carefully decide on the use of these two approaches and understand the effect subtle word changes may have on mitigating VH (Hofstetter et al., 2017).

Another effective messaging approach is the use of motivational interviewing (MI). This approach uses a collaborative communication method of open-ended questioning and active listening to help identify underlying health concerns and beliefs through partnership, acceptance, compassion, and evocation to enable caregivers to gradually develop their decision to vaccinate (Cole et al., 2022). In a quasi-experimental study to determine the effectiveness of using MI and education-based dialogue to better identify and correct individual determinants of VH, a significant postintervention decrease in VH was seen among 81.8% of the participants using pre- and post- Parent Attitudes about Childhood Vaccine (PACV) surveys (Mical et al., 2021). Further clinical evidence is noted in an observational cohort study by Cole et al. (2022) where providers used a Motivational Interviewing to Improve Vaccine Acceptance tool, MI framework, and a presumptive language approach in their communication with vaccine-hesitant

caregivers. With an available 'routing' system to help providers best proceed with each unique conversation, the results of the intervention yielded a decrease in documented refusals of all vaccines by 44% in children compared to standard care (Cole et al., 2022). Given the effectiveness and utility of both a presumptive language and an MI messaging approach, developing a template to assist providers with these techniques could prove to be beneficial.

Finally, message framing has been shown to also yield some positive effects on reducing VH, though the quality of evidence remains limited. There have been modest improvements in vaccine uptake when using gain-framed messages, or presenting the positive outcomes of performing a behavior (Penţa et al., 2018). For example, "just as a car seat protects a child from injury in a motor vehicle crash, vaccines are a child's car seat for protection against infectious diseases" reflects how gain-framed messaging may be used in clinical practice. Gain-framed messages have been associated with more risk-averse behaviors in patients compared to a more risk-seeking effect seen with loss-framing messaging such as "the polio vaccine is the only protection against paralysis occurring from a polio infection" (Penţa et al., 2018). Combining science-based evidence including references to scientific studies and statistical information, and pairing pro-vaccine messaging with other healthy behaviors such as healthy eating and breastfeeding have also been effective gain-framed messaging techniques (Olson et al., 2020). The additional use of personal narratives, emotive anecdotes and imagery, and gamified messaging by providers has been demonstrated to have a greater impact on reducing VH than fear-based messaging, which has been cited as counterproductive (Olson et al., 2020). Interestingly enough, the integration of humor, satire, and enthusiasm into vaccine

messaging compared to a more serious tone is often received more positively among vaccine-hesitant caregivers (Olson et al., 2020). While more research is necessary, message framing is an effective strategy to integrate into an overall vaccine messaging approach (Penţa et al., 2018).

Regardless of the approach used, provider persistence is crucial as VH is not always overcome in one visit. A longitudinal, prospective quasi-experimental study by Opel et al. (2018) revealed how the persistent use of these messaging techniques at 2-, 4-, and 6-month well-child visits were associated with a 35% decrease in VH as measured by 'days under immunized'. Additionally, providers who respond with persistence over acquiescence when faced with vaccine-hesitant caregivers led to a higher rate of vaccine uptake over time (Opel et al., 2018).

Optimizing communication between a provider and a vaccine-hesitant caregiver also involves transparently providing the risks and benefits of vaccinations by first providing facts and then dispelling common myths (Dubé et al., 2020). Combining this with the reassurance of a national widespread vaccine safety system involving thorough testing and a robust Vaccine Adverse Events Reporting System can help alleviate concerns over safety and build confidence in vaccinations (CDC, 2022b). A systematic literature review by Kaufman et al. (2018) also found that perceived confidence in the provider results in higher vaccination rates. Conversely, hesitation and poor provider communication can result in some caregivers feeling confused and mistrusting and therefore, exacerbate the problem (Kaufman et al., 2018).

Regardless of the communication techniques used, the evidence demonstrates face-to-face communication between a provider and a caregiver is the most effective at

reducing VH (Kaufman et al., 2018). Face-to-face communication using the aforementioned techniques can improve child vaccination rates, parental health literacy, and intention to vaccinate through interactivity and adaptability to allow for better identification of individual determinants of VH (Kaufman et al., 2018).

The literature shows how the use of certain vaccine messaging and communication strategies such as a trusting relationship; the timing of the conversation; face-to-face communication; the use of presumptive language; the use of a participatory format; MI and an education-based dialogue; and message framing may be effective at reducing VH. In contrast, written information only; short visit times; a knowledge-deficit approach; choice of words when discussing vaccines; and loss-framed messages may perpetuate VH in some caregivers. Regardless, there remains a gap in the literature involving studies measuring the total time healthcare providers spend educating vaccine-hesitant caregivers about the necessity for their child's immunizations.

The Iowa Model served as a framework to guide this project. Through the use of this model, VH was identified as a problem-focused trigger and was regarded as a priority to the clinic. A team of key stakeholders determined there was not sufficient evidence to pilot a clinical change and therefore, this project focused on the evaluation of current practice to help the providers better understand the problem of VH (Iowa Model Collaborative et al., 2017). An additional goal for this project was to provide the practice with baseline data on the frequency and total time its providers are spending educating vaccine-hesitant caregivers about the importance of childhood vaccines.

Methods

Design

This data evaluation project used a descriptive observational design. Pre-collected data was evaluated retrospectively for the time period from June 1, 2022, through December 31, 2022, with discussion time as the primary outcome measure and vaccine administration as the secondary outcome measure.

Setting

This project took place at a suburban Midwest pediatric primary care clinic serving over 5000 patients. The practice is staffed by two physicians, one pediatric nurse practitioner, one registered nurse, three medical assistants, and one medical receptionist. The clinic is the only pediatric practice within a large medical organization and one of the few pediatric clinics in its surrounding metropolitan area willing to accept caregivers who are vaccine-hesitant or resistant.

Sample

A convenience sample of all newborns entering the practice through six months of age being seen for a well-child visit was included ($N = 210$). Children older than six months or seeking acute medical care were excluded. The desired sample size for this study was 75% of newborns to the practice.

Approval Process

Approval for practice evaluation of provider time and vaccination rates was granted by the pediatric primary care practice. Approvals from the University of Missouri – St. Louis (UMSL) nursing doctoral committee, the medical organization institutional review board (IRB), and UMSL IRB were also obtained. No ethical concerns were identified for this project as this was a retrospective review of previously collected data and did not involve human subjects research.

Procedure

A team of key stakeholders, including the medical providers of the practice and the primary investigator (PI) agreed to evaluate the data previously collected on all newborns to the practice. All newborns between June 01, 2022, and December 31, 2022, were seen as scheduled by their provider(s) for all recommended well-child visits for their first six months of life. This included the birth visit, 1st office visit after birth, typically taking place within the first 10 days of life, as well as the 1-month, 2-month, 4-month, and 6-month visits. A total of three healthcare providers were involved in this project; two physicians and one pediatric nurse practitioner. This project tracked the administration of Ilotycin, Vitamin K (VitK), and vaccines (item), as the practice has noticed a rise in the declination of these important treatments. At the conclusion of each visit, the provider documented the total discussion time (in minutes), if any, and the administration of any items. Colored highlights were then applied to patient data rows 1) when a caregiver refused at least one item due, 2) when a caregiver agreed to at least one item previously refused (conversion), and 3) when a caregiver agreed to at least two items previously refused (conversion). Vaccine administration was evaluated including hepatitis b (HepB), rotavirus (RV), and pneumococcal conjugate (PCV13). Combination vaccinations measured included diphtheria, tetanus, acellular pertussis, inactivated poliovirus (DTaP), and *haemophilus influenzae* type b (Pentacel) and DTaP, *haemophilus influenzae* type b, inactivated poliovirus, and HepB (Vaxelis). The providers ultimately selected the de-identified data to be shared with and evaluated by the primary investigator (PI).

Data Collection/Analysis

A retrospective data review of deidentified patient data regarding information related to vaccine declination or administration during each well-child visit was performed. The primary data collected included total discussion time (in minutes) and items administered during each well-child visit (i.e., birth, 1st visit, 1-month, 2-month, 4-month, and 6-month). While item administration was tracked at birth (i.e., when providers first saw patients in the hospital nursery), this project did not track discussion time or conversion for this visit. Additional data collected included race and assigned gender of each patient. A master copy of the practice database was stored on the providers' organizational hard drive in a password-protected file and de-identified information was shared with the PI after IRB approval to evaluate the data.

Results

As shown in Appendix A, a sample of 100% of newborns to the practice included 210 patients ($N = 210$) with 52.4% female ($n = 110$) and 47.6% male ($n = 100$). The most frequently observed race was Caucasian ($n = 102$) followed by African American ($n = 74$), Asian ($n = 19$), Hispanic ($n = 8$), and Other ($n = 7$) (see Appendix B). A total of 64.3% of caregivers ($n = 135$) said yes to all items at every visit while 35.7 % ($n = 75$) said no to at least one item (see Appendix C). There was also a total of 11.4% ($n = 24$) of patients who left the practice early for various reasons and did not return during the data collection period.

A total of 119 individual teaching sessions were provided to 60 caregivers who said no to at least one item due**,** with some caregivers receiving vaccine education across all five well-child visits. There were 15 occasions when a caregiver said no to an item and our dataset reflected no discussion time. One of two events occurred for these

instances: 1) the caregiver made it abundantly clear to the provider that they were not interested in receiving vaccine education of any kind and would not be vaccinating their child, or 2) the provider failed to update the database with their total provided discussion time for the visit. Across all three providers, there was a total discussion time of 1400 minutes or 23.3 hours. As shown in Appendix D, the individual discussion time ranged from a minimum of five minutes to a maximum of 40 minutes, with an average time spent of 11 minutes (M = 11.024). The greatest number of time spent teaching took place during the 1st visit (M = 13.48) and the 2-month visit (M =12.02) (see Appendix D). The majority of visits had a low skewness and were more normally distributed around their individual means. However, the data for the 1st visit was more greatly skewed to the positive, likely due to larger outliers in discussion time during this visit (see Appendix D). It should also be noted that even though discussion time at birth was not tracked, there were several teaching sessions and subsequent conversions that took place during this visit.

Of the 60 caregivers who received vaccine education on at least one visit, 50% (n =30) were converted on at least one item, and 6.5% (n = 4) were converted on at least two items (see Appendix E). No caregivers were converted on any items who did not receive any vaccine education. When comparing the frequency of administered items from birth through 1-month visits, VitK was the most commonly accepted item and HepB was the most commonly refused item. There was a total of 14 VitK conversions (n = 14) by the 1st visit and only three HepB conversions (n = 3) by the 1-month visit (see Appendix F). When comparing items administered over the 2-month, 4-month, and 6-month visits, RV and PCV13 were consistently the most commonly accepted items.

While PCV13 shared a high acceptance with RV across these three visits, it was also the most commonly rejected item, likely because Pentacel and Vaxelis split their total rejections between each other (see Appendix G). During these three well-child visits, seven *haemophilus influenzae* type b, three HepB, three DTaP, and one inactivated poliovirus were given as one-off items in cases where caregivers rejected the combination vaccine to which these items are a part of (i.e., Pentacel, Vaxelis), but agreed to receive a single item. Additionally, during the six-month visit 26 seasonal influenza vaccines were given (n = 26) with 77% of these given in cases where caregivers said yes to all other items.

A non-parametric two-tailed Mann-Whitney *U* test was performed to assess for any significant differences in the length of discussion time and caregivers saying no (Group N) and yes (Group Y) to individual items at each visit. The Mann-Whitney *U* test is used when the assumption of normality for the Independent Samples *t*-Test has been violated due to the dependent variable data being ordinal, or not normally distributed. A Shapiro-Wilk test was used to confirm data non-normality of the dependent variable. The other required assumption for the Mann-Whitney *U* test, having a dichotomous independent variable, was met.

The results of the two-tailed Mann-Whitney *U* test were not significant across the majority of visits using an alpha value of 0.05 (see Appendix H). This suggests there was not a statistically significant difference in the mean rank and median discussion time among Group N and Group Y across the majority of well-child visits. This also suggests discussion time length doesn't necessarily affect a caregiver's decision to vaccinate. It should be noted that seven items across three visits were unable to be analyzed due to a

lack of a dichotomous independent variable (i.e., caregivers only said no). Lastly, Pentacel during the 2-month visit was the only item that did suggest a significant difference between Group N (mean rank = 10.59) and Group Y (mean rank = 3.90) using an alpha value of 0.05, $U = 4.5$, $z = -2.72$, $p = 0.006$. However, the low sample size of this specific test provides reduced statistical power (see Appendix H).

Discussion

In a retrospective evaluation of 100% of newborns entering the practice over seven months, no statistical significance was found between the length of discussion time a provider spends discussing vaccines with vaccine-hesitant caregivers and their decision to vaccinate their children. Results of the Mann-Whitney *U* test confirm this by suggesting a lack of any significant difference in the mean rank and median discussion time of Group N and Group Y when comparing item administration across the majority of well-child visits (see Appendix H). However, when we omit discussion time and focus on the likelihood of conversion for a caregiver who receives vaccine education, 50% were converted on at least one item, and 6.5% were converted on at least two items (see Appendix E). Considering over seven months this clinic documented a 35.7% refusal rate to at least one item among all caregivers, these results indicate the importance of provider-led vaccine education in improving vaccination rates among vaccine-hesitant caregivers. These results are also further substantiated in the literature with many studies noting improvements in VH when provider-led vaccine education was provided, regardless of the messaging approach used (Mical et al., 2021; Opel et al., 2018; Penţa et al., 2018).

Analysis also revealed a greater amount of discussion time was spent during earlier well-child visits, specifically the 1st, 1-month, and 2-month visits. This suggests a longer initial discussion time may be required for providers to introduce vaccine education and begin to combat existing VH using a stepwise delivery of vaccine education at each well-child visit (Olson et al., 2020). However, further research is required to confirm this. While the data does not suggest any clear pattern of acceptance or denial for items across all six months of well-child visits, HepB and PCV13 remain the most frequently rejected vaccines. With 28% of the individual teaching sessions occurring during the 1st visit resulting in zero HepB conversions, this vaccine presents a challenge for providers. Further research is required to determine what unique characteristics these two vaccines possess which makes vaccine-hesitant caregivers particularly averse to them. Lastly, the increase in one-off vaccines in cases where caregivers rejected 5-item and 6-item combination vaccines (i.e., Pentacel, Vaxelis) warrants further investigation into whether offering non-combination vaccine administration options may be better accepted.

Several limitations exist for this study and warrant mentioning. First, despite the relatively large and diverse sample, the results may not fully reflect the unique characteristics of other clinic patient populations and therefore, lack generalization. Additionally, this project did not track caregiver demographics such as assigned gender and race which may have provided additional helpful baseline data for the clinic. Second, only 21.5% of patients (n = 45) had complete data reported through all six months of well-child visits since some patients were born later into the designated data period. This limited amount of 4-month and 6-month visit data presents a problem in accurately

analyzing for statistical correlations among these visits. Future studies may be able to reconcile this as the clinic continues to add data for new and existing patients and is currently up to newborns from March 2023. Third, while item administration was tracked at birth, adding discussion time and whether any conversion occurred at this visit would have provided more valuable data to the overall analysis and should be included in any future studies. Fourth, while absolute caregiver refusal to vaccine education accounted for the majority of the 15 instances where discussion time was omitted from the database for a vaccine-hesitant visit, a tighter control for data entry would have helped minimize this missing data.

In addition to the aforementioned recommendations, continued research is necessary to evaluate the extended time providers are spending educating vaccine-hesitant caregivers. Future studies could expand on the framework of this project by including a randomized controlled trial intervention component investigating which commonly used communication strategies found in the literature are most effective, both in improving vaccination rates and reducing total discussion time. The inclusion of pre- and post-intervention PACV surveys with a qualitative component asking caregivers to expand on their individual reasons for VH may also add valuable information to this growing body of knowledge.

Conclusion

VH among caregivers continues to be a major contributing factor to low vaccination rates among children and continues to cause rates of VPD to rise (Hargreaves et al., 2020; Rus & Groselj, 2021). Additionally, improving pediatric vaccination rates continues to be a complex issue requiring a multifaceted approach. This project takes an

important first step in filling the gap in the literature regarding studies evaluating the time healthcare providers spend educating vaccine-hesitant caregivers about the necessity for their child's immunizations. While no clear statistical evidence was determined on how provider discussion time may affect a caregiver's decision to vaccinate their children, a strong clinical effect was seen on item conversion for those caregivers who received vaccine education, regardless of its length. These results further support the need for providers to continue educating vaccine-hesitant caregivers while ensuring the healthcare system provides them with appropriate appointment times and proper reimbursement to accomplish these important objectives. Continued research is required to determine the most effective timing, frequency, and messaging approach (i.e., presumptive language model, MI, or message framing) required to improve the conversion of vaccine-hesitant caregivers.

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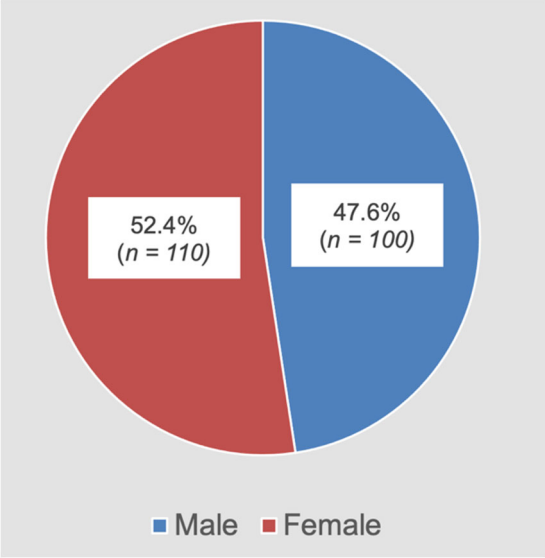
Appendix A

Figure 1

Assigned Gender of Patient

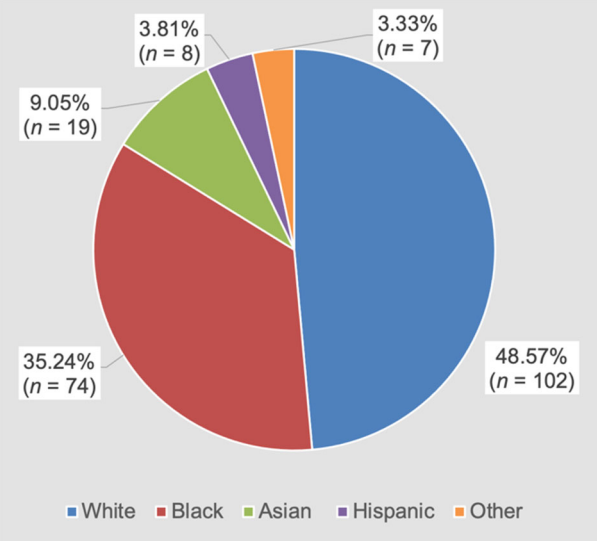


Note. Figure illustrates breakdown of assigned gender of patients (*N*=210).

Appendix B

Figure 2

Race of Patient

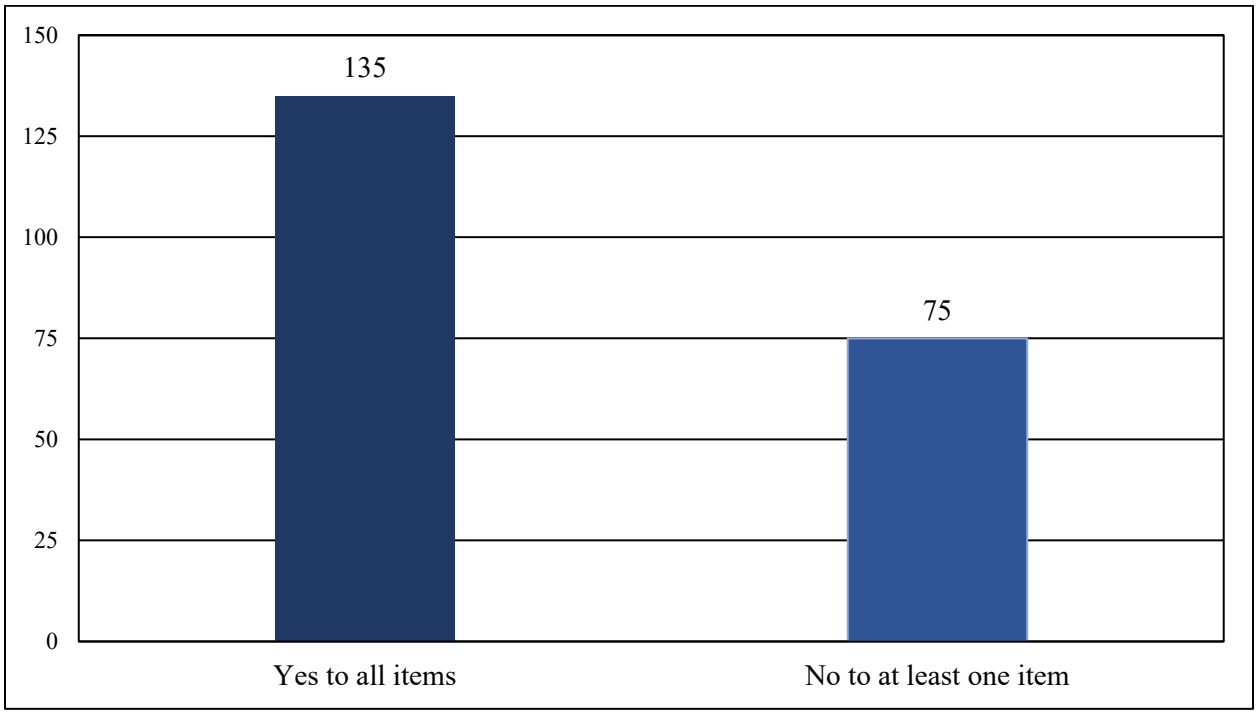


Note. Figure illustrates breakdown of race of patients (*N*=210*)*.

Appendix C

Figure 3

Item Acceptance and Refusal



Note. Figure illustrates total number caregivers who said yes to all items (n = 135) and total number caregivers said no to at least one item (n = 75).

Appendix D

Table 1

Summary Statistics Table for Discussion Time

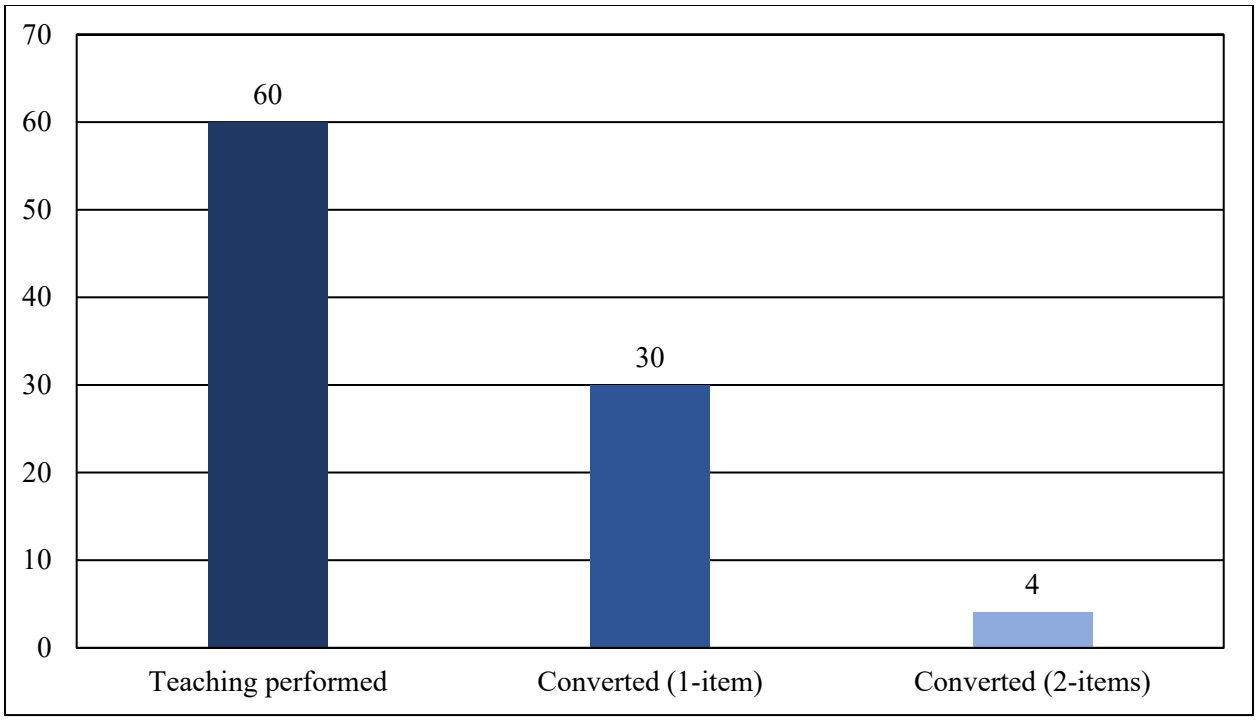
Discussion Time	*M*	*SD*	*n*	SE_M	Min	Max	Skewness
Discussion Time 1st visit	13.48	9.88	33	1.72	5.00	40.00	1.59
Discussion Time 1-month	11.62	3.67	26	0.72	5.00	20.00	0.02
Discussion Time 2-month	12.02	4.57	41	0.71	5.00	25.00	0.49
Discussion Time 4-month	8.00	2.54	15	0.65	5.00	10.00	-0.41
Discussion Time 6-month	10.00	4.08	4	2.04	5.00	15.00	0.00

Note. Total discussion time across all well-child visits = 1400 minutes (23.3 hours).

Appendix E

Figure 4

Item Conversion



Note. Figure illustrates total number caregivers who received vaccine education and total caregivers converted on item administration.

Appendix F

Table 2

Frequency Table for Items (Birth through 1-month)

Item	Birth	1st visit	1-month
Ilotycin			
Yes	177	-	-
No	33	-	-
Vitamin K			
Yes	194	14	-
No	16	4	-
Hepatitis B			
Yes	145	0	3
No	65	32	23

Note. Table depicts the total number of items administered and rejected over the birth visit, 1st office visit after birth, and 1-month well-child visit.

Appendix G

Table 3

Frequency Table for Items (2-month, 4-month, 6-month)

Item	2-month	4-month	6-month
Pneumococcal			
Yes	123	83	38
No	28	14	13
Rotavirus			
Yes	123	84	44
No	27	14	7
Vaxelis			
Yes	111	8	38
No	25	3	8
Pentacel			
Yes	13	74	5
No	13	16	1

Note. Table depicts the total number of items administered and rejected over 2-month, 4-month, and 6-month well-child visits.

Appendix H

Table 4

Two-Tailed Mann-Whitney Test

	Y		N				
Discussion Time per item	Mean Rank	*n*	Mean Rank	*n*	*U*	*z*	*p*
Discussion Time 1st visit (VitK)	12.33	3	8.29	14	31.00	-1.33	.183
Discussion Time 1-month (HepB)	13.52	23	13.33	3	35.00	-0.04	.965
Discussion Time 2-month (Pentacel)	3.90	5	10.59	11	4.50	-2.72	.006
Discussion Time 2-month (PCV13)	17.90	15	22.79	26	148.50	-1.32	.186
Discussion Time 2-month (RV)	20.56	17	21.31	24	196.50	-0.21	.835
Discussion Time 2-month (Vaxelis)	16.54	12	19.48	24	120.50	-0.83	.407
Discussion Time 4-month (PCV13)	7.00	2	7.58	12	11.00	-0.21	.832
Discussion Time 4-month (RV)	6.00	3	8.50	12	12.00	-1.02	.309

Note. Two-tailed Mann-Whitney *U* test was not statistically significant across the majority of well-child visits (α=0.05). The following items were unable to be analyzed due to a lack of a required a dichotomous independent variable: Discussion Time 1st visit (HepB), Discussion Time 4-month (Pentacel), Discussion Time 4-month (Vaxelis), Discussion Time 6-month (Pentacel), Discussion Time 6-month (PCV13), Discussion Time 6-month (RV), Discussion Time 6-month (Vaxelis).