# Addressing Vaccine Hesitancy in the Prenatal Population

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**Abstract**

False accusations concerning the development of autism and other hazardous side effects have triggered parental vaccine hesitancy, leading to outbreaks of vaccine-preventable diseases. This opposition to vaccination risks the health of both individuals and entire communities. The purpose of this project was to determine the effectiveness of prenatal education on maternal vaccine hesitancy and infant immunization rates. In a pretest posttest design, pregnant mothers greater than or equal to 30 weeks gestation were recruited by The Arizona Partnership for Immunization (TAPI) and virtually educated about infant immunization. A voice-over PowerPoint presentation was delivered to the participants virtually and focused on vaccine knowledge, intention to vaccinate, and vaccine hesitancy. These outcomes were evaluated virtually pre- and post-intervention with the Parent Attitudes about Childhood Vaccines (PACV) survey ($\alpha = 0.84$), and the infants' vaccination records were compared against the recommended immunization schedule at two months of age. Using the Wilcoxon Signed-Ranks test, data analysis revealed vaccine hesitancy was significantly reduced between pre- and post-intervention ($Z = 27.70$, $p = .000$), and 100% of the 2-month-old infants were fully immunized with the recommended vaccines. The effect size ($d = 12.807$) also indicated a strong relationship between pre- and post-intervention vaccine hesitancy. Vaccine hesitancy remains a threat to public health. With prenatal education, pregnant mothers will likely become more knowledgeable of vaccine benefits and better prepared to make informed decisions. Confident vaccination will decrease vaccine hesitancy and improve immunization rates, while promoting individual and societal health.

. *Keywords*: Vaccine hesitancy, pregnant mothers, vaccine education, infant immunization

## Addressing Vaccine Hesitancy in the Prenatal Population

Vaccination of children continues to be a widely debated topic in parenting culture. Uncorroborated claims of dangerous side effects and links to autism have led to *vaccine hesitancy.* As vaccine apprehension grows, it threatens children's wellbeing and the societal benefit of *herd immunity*. Although concern of a potential link between autism and vaccines has generated hesitancy, education can expose the falsity of these claims. When educated parents confidently vaccinate their children, both individual and societal health will be achieved.

## Background/Significance

With the controversial nature of vaccination in today's parenting culture, a hesitancy to vaccinate children has been observed. Salmon et al. (2015) define *vaccine hesitancy* as the reluctance or refusal to vaccinate based on the understanding of alleged risks versus benefits. Because vaccines have successfully prevented infectious diseases for several decades, young parents are often unfamiliar with once-common childhood illnesses. Vaccine hesitancy not only endangers individual health, but societal health as well by affecting *herd immunity.* Herd immunity refers to a high proportion of vaccinated individuals, enabling protection for both vaccinated and unvaccinated individuals (Logan et al., 2018). Additionally, outbreaks of vaccine-preventable diseases warrant an increased need for healthcare and its subsequent costs. Thus, patients, providers, communities, and entire healthcare systems are negatively impacted.

With vaccination rates decreasing and outbreaks of vaccine-preventable diseases increasing, it is crucial that parental hesitancy be addressed to achieve vaccine benefits. Recent literary sources have demonstrated the relevance of vaccine hesitancy, and the need for vaccine education (Opel et al., 2016). With prenatal education, pregnant mothers become knowledgeable of vaccine benefits and are consequently able to make informed decisions. Confident vaccination

will decrease vaccine hesitancy and occurrence of vaccine-preventable diseases, while increasing individual and societal health. This paper will serve to establish significance of vaccine education in the prenatal period, synthesize current evidence, describe theoretical and implementation frameworks, and describe methods and results.

In review of recent literature, parental vaccine hesitancy remains prevalent and problematic for worldwide health. Unfortunately, vaccines have become victims of their own success, as many parents are unfamiliar with vaccine-preventable diseases. As a national health initiative, the Centers for Disease Control and Prevention (CDC) (2019) have declared the fight against vaccine preventable diseases as a *winnable battle*. To increase vaccination coverage, several studies have examined the etiology of vaccine hesitancy and its contributing factors; however, substandard immunization rates and outbreaks of vaccine-preventable diseases persist (Logan et al., 2018; Opel et al., 2016; Salmon et al., 2015).

Education remains a popular and consistent response to vaccine hesitancy. However, recent studies revealed that pregnant women are often seeking vaccine information late in the gestational period and/or 0-2 weeks following the child's birth. This is problematic as the standard of care typically involves childhood immunization education provided by the pediatrician at well-child visits (Corben & Leask, 2018; Danchin et al., 2018; O'Leary et al., 2018). Consequently, recent literature examined the effect of prenatal vaccine education on decreasing vaccine hesitancy and improving infant immunization.

An immunization-focused nonprofit organization in the southwest noticed the local increase in outbreaks of vaccine-preventable diseases correlating with decreasing childhood immunization rates and increasing nonmedical vaccine exemptions. Objective data reveals that 80-84% of North Scottsdale Arizona Kindergarten students are immunized against the measles;

ninety-five to 100% is the target rate to establish herd immunity. Furthermore, Arizona experienced 7,129 confirmed cases of vaccine-preventable diseases in 2019 (Arizona Department of Health Services, 2020). Nationally, 70.4% of children ages 19-35 months are receiving the seven recommended vaccination series (CDC, 2017).

Concerned for individual and public safety, the organization contemplated an educational intervention that had not yet been attempted. With the belief that pregnant women form their position on infant immunization by late gestation, the organization focused on pregnant women as a target population. A preliminary interest of this topic has led to the clinically relevant PICOT question: In pregnant women (P), how does prenatal vaccine education (I) compared to standard of care (C) influence vaccine hesitancy or predict infant immunization rates (O)?

## Evidence Synthesis

To best answer the PICOT question, an exhaustive search and review of current literature was performed. Three literature databases were thoroughly searched—PubMed, Cumulative Index of Nursing and Allied Health Literature (CINAHL), and Cochrane Library. These three databases were selected for medical credibility, peer review, and quantity and relevance of information available related to pregnant women, vaccine hesitancy, and infant immunization. Additionally, grey literature from the ASU DNP Final Projects Collection was reviewed. Within the digital repository, there are four projects related to vaccination and vaccine hesitancy but none target pregnant women. Consequently, none of these studies were included for evaluation.

Database search keywords included: *pregnant*, *vaccine education*, *vaccine hesitancy*, and *infant immunization*. Inclusion criteria included primary research published in English, peer-reviewed articles or systematic reviews, and publication date within the past five years. Additionally, MeSH and Boolean terms were utilized to expand the search results. Exclusion

criteria included secondary research and the focus of pregnant women to vaccine themselves, opposed to infant vaccination.

An initial PubMed search yielded 17 results. Thus, MeSH terms were utilized to broaden the search and the following search yielded 11,801 results. Additional terms to specify keywords, such as *infant immunization*, were added to the narrow search. However, utilizing the term *vaccine hesitancy* severely limited results, so *vaccine education* OR *vaccine compliance* were used as alternatives. First or second authors of high-quality articles were also searched for other relevant studies. Studies from various countries were also considered. The final search yielded 142 results. Utilizing rapid critical appraisal (RCA), seven studies were included in the final work.

Similar to the PubMed search, the initial CINAHL search with Boolean phrases included *pregnant women* OR *expectant mothers*, *vaccine education*, and *vaccine hesitancy* within the past five years, which yielded one result. Adding Boolean phrases, such as *infant vaccination* yielded 478 results. Including the term *vaccine education* severely limited search results, so only *education* was searched instead. The final search yielded 13 results, and through RCA, two new studies were included.

The Cochrane Library was the final database searched. First, trials were searched and the initial search included keywords, such as: *pregnant*, *education*, *vaccine hesitancy*, and *immunization*, which resulted in 6,340 trials. In this database, utilizing the term *vaccine education* rather than *education* limited the final yield to 18 results. Nine studies were appropriate for inclusion but had been previously discovered through PubMed and CINAHL. The Cochrane systematic reviews (SR) were also searched with the same key terms and yielded one result, which was included. In summary, 10 total studies were included for final review and

evaluation, which included: four RCTs, one SR, two correlational studies, two cross-sectional surveys, and one observational cohort study.

After an exhaustive literature search, 10 studies were selected for rapid critical appraisal. Half of the studies are high-level, including four RCTs and one SR. The remaining five studies consist of nonexperimental cross-sectional surveys or correlational studies. The literature review included international sampling, with only one study conducted in the U.S. All studies are recent (2017-2019), and the majority utilized the Health Belief Model (HBM) as theoretical framework. Eight out of 10 studies disclosed funding sources and limited bias was evident throughout. Significant homogeneity was apparent in demographics, with all participants consisting of pregnant women. The average age amongst studies was approximately 30 years. Only one study also included expectant fathers (Otsuka-Ono et al., 2019). Slightly more than half of the participants were multiparous, and the majority were educated (high school or college graduates). Heterogeneity existed in number of participants amongst studies, ranging from 175 to 6182 (see Appendix A, Table 1).

The majority of experimental studies utilized face-to-face vaccine education (FTFVE) as an intervention with commonalities among variables of interest, including: intention to vaccinate (ITV), infant immunization rates, vaccine knowledge and decision making, and vaccine hesitancy. Heterogeneity existed among study setting, with approximately half of the studies conducted in a hospital setting and half in an obstetrician office clinic, with three studies performed in both settings (see Appendix A, Table 2). Only one study conducted virtual FTFVE (Veerasingam et al., 2017). Significant heterogeneity was also observed among measurement tools, with several studies comparing immunization rates to the national immunization requirements and/or utilizing Likert scales (self-developed by authors; validity and reliability not

discussed). This finding suggests a gap in current literature. Measuring parental vaccine hesitancy and efficacy of FTFVE is not yet well-researched or supported, and a valid, reliable tool would greatly benefit current and future practice. Homogeneity was observed among primary outcomes, with the majority of studies focusing on identification of vaccine hesitancy, increased maternal vaccine knowledge, and increased infant immunization rates and intention to vaccinate. Lastly, common themes were also evident among studies, including: prevalence of vaccine hesitancy among pregnant women, FTFVE and decreased vaccine hesitancy, and FTFVE and increased ITV and infant immunization rates. All study results were communicated in confidence intervals, odds ratios, means, standard deviations, and/or level of evidence (see Appendix A, Table 1).

Current literature confirms the significance of vaccine hesitancy in pregnant women and suggests FTFVE delivered in the antenatal period can significantly improve maternal vaccine knowledge, ITV and decision making, and infant immunization rates (see Appendix A, Table 2). Additionally, primiparous mothers are significantly more vaccine hesitant than multiparous mothers. The literature review also demonstrates the indirect relationship between vaccine hesitancy and trust in healthcare providers. Lastly, pregnant mothers willing to receive influenza or pertussis vaccinations during pregnancy for themselves were significantly less vaccine hesitant toward infant immunization. Establishing a trusting provider-patient relationship during pregnancy, especially with first-time mothers, and providing FTFVE during the antenatal period can positively impact infant health and societal wellbeing by supporting herd immunity. Addressing vaccine hesitancy prior to final decision-making of infants' immunization status can significantly decrease the occurrence of VPD, thus decreasing disease-related treatment costs and positively impacting medical providers and entire healthcare systems.

## Theoretical Framework and Implementation Framework

Theory is essential in development of evidence-based practice, as it provides an organized view of complex phenomena. In short, theory helps to explain what is known and inspires what is yet to be learned (Moran et al. 2020). For this project, the Health Belief Model (HBM) was chosen for the theoretical framework due to its prevalence in relevant studies and its ease of application. Originally developed in the 1950s by Dr. Hochman and social scientist colleagues, HBM was utilized to explain health-related behaviors (as cited in Larsen, 2019). HBM was updated in the 1980s and currently consists of four foundational components: 1) perceived benefits versus perceived barriers, 2) perceived threat (based on perceived seriousness and susceptibility), 3) self-efficacy, and 4) cues to action (see Appendix B, Figure 1). These components determine the likelihood of engagement in the health behavior. HBM continues to be utilized today and is particularly helpful in exploration of attitudes and beliefs related to adherence behaviors (Larsen, 2019).

When applied to pregnant mothers and vaccine hesitancy related to infants, HBM suggests that pregnant mothers will not decide to vaccinate unless they believe the infant is at risk and understand how severe that risk may be. Benefits and barriers to infant immunization must also be assessed. Lastly, HBM suggests that pregnant mothers may want to make a change but are unable to follow through. Thus, self-efficacy and cues to action are imperative. Cues to action may include external or internal events that motivate an individual to change. In this particular project, it may include positive infant vaccination marketing (i.e. health fair, billboard, social media) and/or personal or relative experience with vaccine-preventable illnesses. Lastly, empowering pregnant mothers to confidently vaccinate their children will contribute to self-efficacy. This may be most successful when applied to the foundation of a trusting patient-

provider relationship. Improving patients' self-efficacy may include setting attainable goals, reframing perceived obstacles, and visualizing the long-term, "big picture" benefits.

In addition to HBM, Rosswurm and Larabee's (1999) model for evidence-based practice was selected to guide the implementation process. This framework was chosen not only for its applicable stepwise process, but also for the incorporation of planned change during the implementation phase. Utilizing data from a variety of sources is also an advantageous component of this framework. Rosswurm and Larabee's (1999) model includes six necessary steps to generate evidence-based change: 1) assess need for change in practice, 2) link problem intervention and outcomes, 3) synthesize best evidence, 4) design practice change, 5) implement and evaluate change in practice, and 6) integrate and maintain change in practice (see Appendix B, Figure 2). Additionally, utilizing HBM as theoretical underpinning fits well within the Rosswurm and Larabee model.

Specifically, Rosswurm and Larrabee's model is appropriate for use in this project, evident by the feasible completion of the models' initial steps. A need for change was identified with the increasing occurrence of VPDs, decreasing infant/childhood immunization rates, and increasing prevalence of parental vaccine hesitancy. Comparing the internal and external data lead to the identification of a problem. Using standardized classification systems, potential interventions, such as education, and desired outcomes, such as increased infant immunization rates and decreased occurrence of VPDs, were identified. Through RCA, high-quality evidence was synthesized for common themes (i.e. effectiveness of prenatal FTFVE) and assessed for feasibility (see Appendix A, Tables 1 and 2). The next step involves designing a practice change, including the proposed change of educating pregnant women on infant immunization as the standard of care. Necessary resources, such as access to/willingness of pregnant women and

agreeable setting accommodations, would be identified. Measurement outcomes would also be defined. The following steps include implementation of the design, evaluation, integration into standard of care, and maintenance with continuous monitoring for process improvement.

## Methods

Arizona State University's Institutional Review Board (IRB) approved the study September 22nd, 2020. Participants were recruited by Women, Infant, and Children (WIC) Maricopa Clinics and The Arizona Partnership for Immunization (TAPI). Inclusion criteria included: pregnant women greater than or equal to 30 weeks of gestation, at least 18 years of age, proficient in English, and planning to parent the infant after birth. Due to the pandemic and social distancing recommendations, vaccine education was delivered virtually via PowerPoint presentation. The educational presentation is approximately ten minutes in length with voice recording and was emailed directly to the consenting participants. Ethical considerations were contemplated, participants' confidentiality was maintained throughout, and consent was obtained from all participants.

The project's online educational intervention focused on vaccine knowledge, intention to vaccinate, and vaccine hesitancy. Through prenatal vaccine education, a decrease in vaccine hesitancy and an increase in infant immunization was anticipated. If accomplished, prenatal vaccine education has the potential to create a multi-tier impact: improvement in individual health, fulfillment of herd immunity, and lessened costs and demands on healthcare providers and healthcare organizations. The eligibility survey, which included the consent and inclusion criteria, was distributed to potential participants in November and December 2020. Once participants were identified through the eligibility survey, they were immediately sent the pretest. Once the pretest survey was completed, the voice-over PowerPoint educational tool was

distributed to project participants. When the participants finished viewing the PowerPoint, they were directed to complete the post-intervention survey immediately afterward. The majority of participants completed the viewing of the PowerPoint and post-intervention survey in December 2020, with a few participants completing the education and survey in January 2021. Lastly, the participants completed a final, 2-month post-intervention survey and sent a picture of their infant's immunization record following the 2-month well-child visit. Two-month surveys and infant immunization records were collected in March and April 2021.

To evaluate the outcomes of the vaccine education provided to pregnant mothers, two different measurements were utilized. First, the Parent Attitudes about Childhood Vaccines (PACV) survey was repeated pre-, immediate post-, and 2-months post-intervention to assess changes in vaccine knowledge, intention to vaccinate, and vaccine hesitancy. The PACV's three subsections (safety and efficacy, general attitudes, and behavior) indicate good reliability with Cronbach's α of 0.74, 0.84, and 0.74, respectively (Opel et al., 2011). Lastly, the PACV is an appropriate measurement tool for the project due to its strong alignment with the evaluation questions. Secondly, infant immunization status (including adherence and timeliness) was assessed when the infant reached two months of age. The immunization status of the following vaccines was evaluated: Hib, PCV13, polio, DTaP, rotavirus, and completion of the hepatitis B series. This information was accessed from the infant's mother (project participant), who sent a picture of the infant's state immunization record booklet.

All data was collected and stored within the REDCap application. This application was also utilized for survey creation and distribution. Data analysis included description statistics (mean, standard deviation, percentages) to describe all variables. The Wilcoxon Signed-Ranks test was conducted to compare the difference between pre-and post-intervention surveys. Finally,

the effect size was calculated to estimate clinical significance and establish the presence of relationship(s). Lastly, there was no outside funding available for this project, and the only cost was the monetary reward disbursed to participants for completing all required surveys (see Appendix B, Figure 3). This cost was covered by the survey's author.

## Results

Results were analyzed using the SPSS statistic software. Demographic results indicated the mean age range of project participants was 25-34 years, the mean gestational age was 38-40 weeks, the majority were multiparous and had completed timely vaccination for their previous children. All participants were Caucasian and married, and the majority had completed a bachelor's degree and were currently employed. The Wilcoxon Signed-Ranks test revealed a mean PACV score of 34.2 (SD = 1.398) for pre-intervention and 6.5 (SD = 1.780) for post-intervention and indicated that vaccine hesitancy was significantly reduced between the pre- and post-intervention ($Z = 27.70$, $p = .000$). The effect size ($d = 12.807$) exceeded Cohen's convention for a large effect ($d = .80$), which indicates a strong relationship between pre- and post-intervention vaccine hesitancy. Lastly, 100 percent of the infants were fully immunized based on the CDC recommended 2-month vaccines.

The results indicate a statistically significant reduction in vaccine hesitancy after the educational intervention and demonstrate a strong relationship between vaccine hesitancy and vaccine education. The impact of this project allows for promotion of individual health through routine vaccination and reduction in outbreaks of VPDs and promotion of community health through herd immunity. Consequently, healthcare providers and systems are positively impacted by reduction in time and costs associated with treatment of vaccine-preventable diseases. Based on the results of this project, policymakers should strongly consider legislation that requires

prenatal vaccine education as standard of care. Lastly, the project has a high likelihood of sustainability due to the ease of application with various healthcare providers and low cost of implementation.

## Discussion

Virtual vaccine education was delivered to pregnant women to assess the influence of education on infant immunization rates and maternal vaccine hesitancy. As evidenced by pre- and post-intervention surveys and assessment of 2-month infant immunization status, prenatal vaccine education significantly reduced maternal vaccine hesitancy and increased infant immunization rates. Thus, prenatal vaccine education has the potential to reduce outbreaks of VPDs and decrease VPD-associated treatment and cost, which will positively impact entire healthcare systems. Due to the pandemic, the project's intervention was conducted virtually and may have been more effective if the education had been delivered in person. The project is limited by its single setting and small sample size ($N = 10$). Additionally, the maternal self-report of infant immunization status may reveal potential bias. Overall, the project's findings are consistent with the literature supporting FTFVE as an effective way to reduce vaccine hesitancy and increase immunization rates (Hu et al., 2017; Kaufman et al., 2018; Otsuka-Ono et al., 2019; Saitoh et al., 2017). Future recommendations include conduction of a similar project or study with a larger sample size, diverse demographics, and various settings.

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# Appendix A

## Evaluation and Synthesis Tables

### Table A1

*Evaluation Table Quantitative Studies*

| Citation | Theory/ Conceptual Framework | Design/ Method | Sample/ Setting | Major Variables & Definitions | Measurement/ Instrumentation | Data Analysis | Findings/ Results | Level/Quality of Evidence; Decision for practice/ application to practice |
|---|---|---|---|---|---|---|---|---|
| Bechini et al., (2019). Impact assessment of an education course on vaccinations in a population of pregnant women: A pilot study.<br><br>**Funding**: None explicitly disclosed; no grants received<br>**Bias**: None listed | HBM - inferred | **Design**: Correlational pilot study<br><br>**Purpose**: Evaluate PG women's VK and attitudes towards vaccination, ITV, and impact of educational interventio | **N**: 201<br><br>**Demographics**: Gender (%): 100% PG females<br>Race (%): 94% Italian<br>Age (mean): 34 yr<br>Education (%): 45% graduates<br><br>**Setting**: OB Department of University of Florence, Italy<br><br>**Inclusion criteria**:<br>1) PG women | **IV**: FTFVE<br><br>**DV1**: ITV<br>**DV2**: VK, ATV<br><br>**Definition**: ITV in this study included both intent to vaccine themselves during pregnancy and their infants | 3-point Likert scale (self-developed by authors; validity and reliability not discussed) | Stata 12, paired-sample t-Test | **DV1**: 42.57<br>95%CI: 41.31-43.82<br>t = 7.36<br>$p < 0.00$<br>**DV2**: 22.47<br>95%CI: 21.63-23.32<br>t = 10.61<br>$p < 0.001$ | **LOE**: IIIa<br><br>**Strengths**: Small attrition, significant results, feasible and cost-efficient intervention<br><br>**Weaknesses**: Small N, no funding disclosed, low hierarchy of evidence, Likert scales lacked reliability and validity due to authors' self-development<br><br>**Conclusions**: FTFVE significantly increased ITV, VK, and ATV. FTFVE also increased ITV for both mother and infant—imperative to |

Key: **ACIR**-Australian Childhood Immuisation Register; **ATV**-attitudes toward vaccination; **BCG**-bacillus calmette-guerin live attenuated vaccine; **CG**-control group; **CI**-confidence interval; **DM**-decision-making; **DTaP-IPV**-inactivated polio virus, diphtheria, tetanus, pertussis; **DTP**-diphtheria-tetanus combined vaccine; **DS**-databases searched; **DV**-dependent variable; **ELM**-Elaboration Likelihood Model; **FT**-full-time; **FTFVE**-face-to-face vaccine education; **FTM**-first time mothers; **Gest**.-gestational; **GP**-general practitioner; **HBM**-Health Belief Model; **HBV**-hepatitis B virus; **HCP**-health care providers; **Hib**-*haemophilus influenzae* type b; **IBM**-Integrated Behavioral Model; **IG**-intervention group; **ITT**-intention to treat; **ITV**-intention to vaccine; **IV**- independent variable; **JEV**-Japanese encephalitis live attenuated vaccine; **MANOVA**-multivariate analysis of variance; **MP**-multiparous; **MR**-measles-rubella combined live attenuated vaccine; **mo**-month; **N**-number of studies (if SR) or participants in study; **n**- number of participants (if SR) or number of participants in subset;; **NIP**-National Immunization Program; **NIR**-National Immunization Register; **NR**-not reported; **NZ**-New Zealand; **OB**-obstetrician; **OCS**-observational cohort study; **OPV**-oral polio live attenuated virus; **OR**-odds ratio; **PACV**-Parental Attitudes About Childhood Vaccines; **PCV13**-conjugated 13-valent pneumococcal; **PG**-pregnant/pregnancy; **PMP**-primiparous; **PP**-postpartum; **PVE**-prenatal vaccine education; **PVL**-Preventative Vaccination Law; **QoE**-quality of evidence; **RCT**-randomized control trial; **RoR**-review of records; **RV**-rotavirus; **r/t**-related to; **SES**-socioeconomic status; **SMD**-standard mean difference; **tri**-trimester; **TV**-television; **VarV**-varicella vaccine; **VH**-vaccine hesitant/hesitancy; **VK**-vaccine knowledge; **wk**-week; **yr**-year; #-number of

| Citation | Theory/ Conceptual Framework | Design/ Method | Sample/ Setting | Major Variables & Definitions | Measurement/ Instrumentation | Data Analysis | Findings/ Results | Level/Quality of Evidence; Decision for practice/ application to practice |
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| **Country**: Italy | | n on vaccination | 2) Referred to OB Department at University of Florence<br><br>**Exclusion criteria**: None explicitly listed<br><br>**Attrition**: 4% (lost to follow-up/incompletion of post survey) | | | | | deliver FTFVE in antenatal period.<br><br>**Applicability**: Likely applicable, but may not be generalizable—immunization policies and practices differ between countries.<br><br>**Utility to PICO**: Applies to PICO—consistent with all elements. Recommended for use in practice due to the effectiveness of interventions. |
| Corben, & Leask, (2018). Vaccination hesitancy in the antenatal period: A cross-sectional survey<br><br>**Funding**: University of Sydney and Mid North | HBM - inferred | **Design**: Cross-sectional survey<br><br>**Purpose**: Assess ITV, DM, social influences, and concerns toward vaccines | N: 221<br><br>**Demographics**: Gender (%): 100% PG female<br>Age (%): 33% 30-34yr<br># PG (%): 64.9% multipara<br>Trimester (%): 61% 3rd trimester<br>Education (highest year of | **IV1:** PMP women<br>**IV2**: PG women support for infant vaccination<br>**IV3**: PG women trust in HCP<br>**IV4**: PG women vaccinating themselves | 42-question survey, based on Decisional Conflict Scale, ($\alpha$=0.87) and PACV ($\alpha$=0.84) | Fisher's exact test, Chi-squared, Wilcoxon rank-sum | **DV1**:<br>IV1: more likely to be VH<br>OR = 3.40<br>95%CI: 1.34-8.60<br>IV2: less likely to be VH<br>$p < 0.005$<br>IV3: Decreased trust = increased VH<br>$p < 0.0001$ | **LOE**: IIIb<br><br>**Strengths**: Significant results r/t vaccine DM, adequate N for survey, measurement tools thoroughly discussed and based on valid/reliable scales<br><br>**Weaknesses**: Lower level of evidence, large attrition (r/t lack of consent to access immunization records), possible selection bias (pro-vaccination mothers may have |

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| Coast Local Health District<br>**Bias**: Possible selection bias<br>**Country**: Australia | | and infant immunization rates among pregnant mothers | schooling, %): 73.1% Year 12<br><br>**Setting**: Antenatal clinics across six hospitals on the NSW north coast<br><br>**Inclusion criteria**:<br>1) PG<br>2) At least 18 yr<br><br>**Exclusion criteria**:<br>None explicitly listed<br><br>**Attrition**: 56% (did not consent to access infant immunization records)<br>0% for post survey completion | **DV1**: VH<br>**DV2**: Perceived vaccine risks<br>**DV3**: Decision-making<br>**DV4**: Infant immunization*<br><br>*Based on accordance with Australian Immunization Register (AIR) at 8 mo | Comparison to the AIR | | **DV2**:<br>IV1: Less sure of balance of vaccine risks<br>OR = 4.84<br>95%CI: 1.44-16.29<br>**DV3**:<br>IV1: less likely to have decided about vaccination by end of 2nd tri<br>$p = 0.0015$<br>and higher decisional conflict<br>$p = 0.0033$<br>**DV4**:<br>IV1:<br>$p = 0.242$<br>IV4:<br>OR = 1.78<br>95%CI: 0.63-4.99 | been more inclined to complete survey)<br><br>**Conclusions**: PMP women = more VH and undecided about infant immunization. Results indicate a strong justification to screen for hesitancy in the antenatal period and offer assistance in this decision-making.<br><br>**Applicability**: FTFVE may benefit mothers in the antenatal period, but mothers' attitudes/beliefs may also differ between countries/cultures.<br><br>**Utility to PICO**: Applies to PICO—consistent with all elements. Recommend antenatal screening for vaccine hesitancy—ideal timing in antenatal period remains unknown. |

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| Cunningham et al., (2018). Prevalence of vaccine hesitancy among expectant mothers in Houston, Texas.<br><br>**Funding**: None disclosed<br>**Bias**: None disclosed<br>**Country**: U.S. (Houston, TX) | HBM - inferred | **Design**: Cross-sectional survey<br><br>**Purpose**: Assess the prevalence of vaccine hesitancy among pregnant mothers in Houston, TX | **N**: 648<br><br>**Demographics**:<br>Gender (%): 100% PG female<br># PG (%): 51% FTM<br>Maternal age (%): 66% > 30yr<br>Marital status (%): 89% married<br>Education (%): 43% more than 4-yr college degree<br>Household income (%): 75% >$50K/yr<br># of children in household (%): 46% 0 children<br>Race (%): 54% White<br>High-risk PG (%): 78% not high-risk<br><br>**Setting**: Baylor College of Medicine | **IV1**: PG women<br><br>**IV2**: PG women receipt of annual influenza vaccine<br><br>**IV3**: PG women education level<br><br>**DV**: VH | PACV ($\alpha$=0.84) | Fisher's exact, multivariable logistic regression, Bland-Altman plots | **DV**:<br>IV1: 8.2% VH<br>95%CI: 6.1-10.7<br>IV2: Decreased VH<br>$p < 0.001$<br>Maternal decline of annual influenza vaccine = 7.4x more likely VH<br>95%CI: 3.9-14.0<br>IV3:<br>Higher education = decreased VH<br>$p = 0.003$ | **LOE**: IIIb<br><br>**Strengths**: Large N, very small attrition, detailed description of data collection and analysis, valid/reliable measurement<br><br>**Weaknesses**: Lower level of evidence, no funding disclosed, single variable measured, single setting, majority participants = Caucasian, high income, higher level education<br><br>**Conclusions**: VH is prevalent among PG mothers, especially those with lower education. Screening for VH in PG is feasible and may be beneficial in improving parental vaccine education and infant immunizations.<br><br>**Applicability**: Identify VH prior to infant birth. Educating |

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| | | | OBGYN practice at Texas Children's Pavilion for Women, Houston, TX<br><br>**Inclusion criteria**:<br>1) English-speaking<br>2) At least 18 yr<br>3) PG, 12-31 wks gestation (fathers could also be included)<br>4) No prior participation in previous vaccine study at study institution<br><br>**Exclusion criteria**:<br>None explicitly listed | | | | | PG mothers may positively influence vaccine DM.<br><br>**Utility to PICO**: Applies to PICO—consistent with all elements. |

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| | | | **Attrition**: 1.5% (unable to link father to PG mother) | | | | | |
| Danchin et al., (2018). Vaccine decision-making begins in pregnancy: Correlation between vaccine concerns, intentions and maternal vaccination with subsequent childhood vaccine uptake<br><br>**Funding**: Grants from Murdoch Childrens Research Institute and | HBM | **Design**: Correlational study<br><br>**Purpose**: To determine correlation between 1) intentions and concerns regarding childhood vaccination, 2) concerns about pregnancy vaccination, 3) SES, and 4) update of influenza | **N**: 975<br><br>**Demographics**: Gender (%): 100% PG female Gest. (mean): 31wk Education (%): 60% University degree Birth country (%): 62% Australia # children (%): 49% 0 (first child)<br><br>**Setting**: 4 public hospitals across Australia<br><br>**Inclusion criteria**: 1) PG female 2) English proficiency | **IV1:** PMP mothers **DV1**: Vaccine DM **DV2**: VH r/t vaccine safety<br><br>**IV2:** PMP + MP PG women **DV3**: Vaccine information sources **DV4**: VK provided in PG **DV5**: Vaccine receipt in PG **DV6**: HCP recommendation for vaccines during PG<br><br>**IV3**: VH PG women | Paternal Immunisation Needs and Attitudes-Antenatal survey (validity/reliability not discussed)<br><br>Maternal self-report<br><br>ACIR records compared to survey | Chi-square tests, binary regression, logistic regression | **DV1**: More undecided than MP; 15% difference in proportion 95%CI: 10-21% $p < 0.001$ **DV2**: More VH than MP mothers $p = 0.002$ **DV3**: 56% discussed vaccines during PG; Midwives (66%) and GP (58%) = most popular sources **DV4**: 66% felt they received adequate VK during PG 95% CI: 60-72; | **LOE**: IIIb<br><br>**Strengths**: Large N, solid theoretical framework, significant results<br><br>**Weaknesses**: Very high attrition, lower level of evidence, non-English proficient women were excluded from study, funding by grant from a vaccine organization (possible bias), validity/reliability of measurement scale not discussed<br><br>**Conclusions**: Maternal DM r/t infant/childhood immunization begins in prenatal period. PMP are significantly more hesitant than MP. All PG mothers should be provided VK by HCP and advised to receive |

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| Wesfarmers Centre of Vaccines and Infectious Diseases, Telethon Kids Institute<br>**Bias**: None disclosed<br>**Country**: Australia | | and pertussis vaccines during pregnancy and routine childhood vaccines | **Exclusion criteria**: None explicitly listed<br><br>**Attrition**: 58% (lost to follow-up survey) | **DV7**: Timely infant immunization<br><br>**IV4**: Perceived vaccine safety<br>**DV8**: Vaccine uptake | | | **DV5**: 46% received influenza vaccine; 82% received pertussis vaccine<br>**DV6**: HCP recommendation = more likely to receive<br>Pertussis:<br>OR 3.5<br>95%CI: 1.9-5.0<br>$p = 0.002$<br>Influenza:<br>OR 3.1<br>95%CI: 1.9-5.0<br>$p = 0.000$<br>**DV7**: VH mothers = less likely to have their infants up-to-date on vaccines<br>95% CI: 1-41%<br>$p = 0.035$ | pertussis and influenza vaccines during PG.<br><br>**Applicability**: Although Australia's NIP differs from the U.S., the results are likely still applicable. Providing vaccine education in the prenatal period is also feasible.<br><br>**Utility to PICO**: Applies to PICO—consistent with all elements, especially that the antenatal period is crucial to address vaccine hesitancy. This article also contained extra information about the correlation between maternal vaccine uptake and its effect on infant immunization. |

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| | | | | | | | **DV8**: Increased acceptance of vaccine safety = increased vaccine uptake 95% CI: 14-79 $p = 0.005$ | |
| Hu et al., (2017). Prenatal vaccination education intervention improves both the mothers' knowledge and children's vaccination coverage: Evidence from randomized controlled trial from eastern China **Funding**: Funded by the general medical | HBM - inferred | **Design**: RCT<br><br>**Purpose**: Examine and verify effectiveness of PVE, specifically on the improvements of mother's vaccine knowledge and improvement of completeness and | **N**: 1252<br>**n**: 626 (IG)<br>**n**: 626 (CG)<br><br>**Demographics**: Gender: 100% PG female<br>Age (range): 20-30 yr<br>Gest. wk (range): 29-36 wks<br>Educational level (mean): college or above<br>Occupation (mean): farmer, worker, or businessman<br>SES: similarly divided among high, middle, and | **IV**: FTFVE<br><br>**DV1**: VK<br>**DV2**: Vaccination coverage*<br>**DV3**: Completeness and timeliness of vaccine doses*<br><br>**Definition**: FTFVE included one-on-one 15-minute interactive FTFVE sessions | Pre- and post-test (self-developed by authors; validity and reliability not discussed)<br><br>Comparison with China's NIP requirements and China's public immunizat | Chi-square analysis, Wilcoxon rank-sum test, logistic regression, MANOVA | **DV1**: Knowledge of required vaccines: IG: 16.7% $p < 0.001$ Knowledge of vaccination policy: IG: 84.2% $p < 0.001$ OR: 5.2 95%CI: 2.6-8.8<br>**DV2**: IG: 90.0% $p < 0.01$ OR: 3.4 95%CI: 2.1-4.8<br>**DV3**: IG: 51.9% $p < 0.01$ | **LOE**: II<br><br>**Strengths**: RCT design, large N, significant results, SES diverse participants, homogeneity between IG and CG, no apparent author bias<br><br>**Weaknesses**: Large attrition, validity and reliability not measured, no exclusion criteria specifically listed, 3-mo interval between intervention may allow participants to receive vaccine information from other sources (TV, Internet)<br><br>**Conclusions:** Prenatal FTFVE can significantly improve VK and timely and complete |

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| research program of Zhejiang province **Bias**: None recognized or reported **Country**: China | | timeliness of infant immunization based on the China NIP guidelines | low for both IG and CG.<br><br>**Setting**: 6 districts within the Zhejiang province (Yinzhou, Dinghai, Dongyang, Changxing, Liandu, and Kecheng); 4 obstetric hospitals with >500 deliveries annually were chosen from each district = 24 hospitals total. Intervention took place in educational classrooms.<br><br>**Inclusion criteria**: Female, PG, residing | *Vaccination coverage and timeliness was based on China's NIP schedule for a child at 12 mo, including: BCG, $HBV_3$, $OPV_3$, $DTP_3$, MR, and JEV. "Fully immunized" indicates 1 dose of BCG, 3 doses of HBV, 3 doses of OPV, 3 doses of DTP, 1 dose of MR, and 1 dose of JEV. | ion records. | | OR: 2.3<br>95%CI: 1.6-3.5 | vaccination. HCPs involved in prenatal care should develop partnership with NIPs.<br><br>**Applicability**: China's NIP differs from US immunization requirements. Unsure whether results will be applicable in a country or region with differing immunization requirements--questionable generalizability.<br><br>**Utility to PICO**: Greatly beneficial—consistent with all PICO elements. |

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| | | | within Zhejiang province<br><br>**Exclusion criteria**: None explicitly listed<br><br>**Attrition**: 32% (lost to drop out) | | | | | |
| Hu et al., (2018). Evaluation of two health education interventions to improve the varicella vaccination: A randomized controlled trial from a province in the east China.<br><br>**Funding**: General medical | ELM | **Design**: RCT<br><br>**Purpose**: Evaluate the effect of two health education interventions on VarV coverage and timeliness and knowledge and attitude | **N**: 204<br>**n**: 68 (IV1)<br>**n**: 68 (IV1)<br>**n**: 68 (CG)<br><br>**Demographics**: Gender (%): 100% PG female<br>Age (mean): 25.8<br>Education (%): 59% vocational or college graduated<br>Job status (%): 75.5% employed<br>Immigration status (%): 61.5% resident | **IV1**: Video VarV education<br>**IV2**: Booklet VarV education<br><br>**DV1**: VarV coverage*<br>**DV2**: VarV timeliness*<br>**DV3**: VarV ITV<br><br>**Definition**: Coverage measured at 24 mo of age, timeliness measured based | Comparison to Zhejiang provincial immunization information system<br><br>5-point Likert scale (self-developed by authors; validity | Chi-squared tests, u-tests, STATA | **DV1**:<br>IV1: 86.4%<br>*RR*: 4.8<br>95%CI: 2.1-11.3<br>IV2: 76.1%<br>*RR*: 2.4<br>95%CI: 1.2-5.1<br>**DV2**:<br>IV1: 70.1%<br>IV2: 61.2%<br>**DV3**:<br>IV1: 93.9%<br>IV2: 82.1%<br>$p < 0.05$ | **LOE**: II<br><br>**Strengths**: High-quality RCT design, small attrition, good theoretical framework<br><br>**Weaknesses**: Small N, no blinding, limited to East China province (possibly not generalizable), validity and reliability not measured, control group could have intentionally read/watched VarV educational material<br><br>**Conclusions**: Vaccine education through video or booklet methods may improve |

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| research program of Zhejiang province<br>**Bias**: None disclosed<br>**Country**: China | | toward VarV vaccination | # children (mean): 0<br>Gest. wk at enrollment (mean): 16.8wk<br><br>**Setting**: 4 OB hospitals within the Zhejiang Province<br><br>**Inclusion criteria**:<br>1) PG women<br>2) At least 12wk gest.<br>3) Living within Zhejiang Province<br><br>**Exclusion criteria**: Not explicitly discussed<br><br>**Attrition**: 1.9% (lost to follow-up) | on Zhejiang recommendations | and reliability not discussed) | | | infant vaccination. Video education > booklet education.<br><br>**Applicability**: Recommended for use in practice due to the significance of the interventions. However, may not be generalizable due to its homogenous population in the study.<br><br>**Utility to PICO**: Valuable—only one vaccine examined but consistent with all PICO elements. |

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| Kaufman et al., (2018). Face-to-face interventions for informing or educating parents about early childhood vaccination<br><br>**Funding**: La Trobe University grant, NHMRC, Sydney's Children Hospital Network<br>**Bias**: None reported<br>**Country**: 10 RCTs conducted in various countries: Australia, | HBM, TRA, TPB, IBM, TTM, and Social Cognitive Theory | **Design**: SR of RCTs and cluster-RCTs<br><br>**Purpose**: To assess the effects of face-to-face interventions for educating parents about early childhood vaccination on vaccination status and parental knowledge, attitudes, and ITV | **N**: 10<br>**n**: 4527<br><br>**DS**: Cochrane Library, Medline, Embase Ovid, CINAHL, PsycINFO<br><br>**Inclusion criteria**:<br>1) RCT or cluster-RCT<br>2) FTFVE intervention<br>3) Intervention targeted toward parents and relevant to childhood immunization<br><br>**Exclusion criteria**:<br>1) Intervention was based on maternal outreach or support | **IV**: FTFVE<br><br>**DV1**: Vaccination status (at final time point)<br>**DV2**: VK<br>**DV3**: ATV<br>**DV4**: ITV<br>**DV5**: Adverse effects (anxiety r/t intervention)<br><br>**Definition**: Final time point varied between studies (3mo-15mo) | RoR and/or parental survey<br>Pre- and post-tests<br><br>Likert scale (based on HBM, IBM) and questionnaire based on Beliefs about Flu Vaccination Questionnaire ($\alpha$=0.82)<br><br>1-wk post- and 3-mo post surveys | PRISMA, GRADE | **DV1:** Low QoE<br>$Z = 2.53$<br>$p = 0.01$<br>$RR = 1.2$<br>95%CI: 1.04-1.37<br>**DV2**: Moderate QoE<br>$Z = 1.99$<br>$p = 0.05$<br>SMD = 0.19<br>95%CI: 0-0.38<br>**DV3**: Low QoE<br>$Z = 0.28$<br>$p = 0.78$<br>SMD = 0.03<br>95%CI: -0.2-0.27<br>**DV4**: Low QoE<br>$Z = 3.5$<br>$p = 0$<br>SMD = 0.55<br>95%CI: 0.24-0.85<br>**DV5**: Low QoE<br>$Z = 0.71$<br>$p = 0.48$<br>SMD = -1.93 | **LOE**: I<br><br>**Strengths**: High-quality RCTs, use of standardized GRADE tool for evaluation, reputable theoretical frameworks discussed<br><br>**Weaknesses**: Small sample size with 10 articles, majority (8/10) of articles > 5 yr old, high levels of statistical heterogeneity leading to downgraded certainty of evidence<br><br>**Conclusions**: FTFVE may improve vaccination status, VK, ATV, and slightly increase ITV. Some populations may be more receptive to FTFVE than others—important to address specific barriers.<br><br>**Applicability**: Recommended for use in practice, although results are not moderate to |

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| Canada, China, England, Japan, Nepal, Pakistan | | | intervention—immunization content not specified<br>2) FTFVE could not be isolated (i.e. mass media campaign) | | | | 95%CI: -7.27-3.41 | high. Several countries evaluated in the SR—may not be generalizable. Address populations for specific barriers and modify FTFVE appropriately.<br><br>**Utility to PICO**: Valuable—consistent with all PICO elements. |
| Otsuka-Ono et al., (2019). A childhood immunization education program for parents delivered during late pregnancy and one-month postpartum: A randomized controlled trial.<br><br>**Funding**: Pfizer Health | HBM, IBM | **Design**: RCT<br><br>**Purpose**: To assess the effect of individual education sessions including both mother and father in late pregnancy and PP on | **N**: 175<br>**n**: 88 (IG)<br>**n**: 87 (CG)<br><br>**Demographics**: Age, mother (mean): IG: 32.8, CG: 33.0<br>Age, father (mean): IG: 34.8, CG: 35.1<br>Race (mother): 100% Japanese (both IG & CG)<br># of preg (%): IG: 53% FTM | **IV**: FTFVE<br><br>**DV1**: Immunization status*<br>**DV2**: ITV<br>**DV3**: Vaccine DM<br><br>**Definition**: FTFVE involved mothers and fathers delivered in late PG and early PP | Parental self-reports<br><br>5-point Likert scale (based on HBM, IBM) ($\alpha$=0.80) | Fisher's exact test, Mann-Whitney *U* test, Spearman's rank correlation coefficient | **DV1**:<br>HBV: 76%<br>$p < 0.001$<br>RV: 84%<br>$p = 0.019$<br>Hib: 95%<br>$p > 0.999$<br>PCV13: 97%<br>$p = 0.491$<br>Number of completed vaccinations (0-4): 3.5 (0.9%)<br>$p < 0.001$<br>Completed all four vaccinations: 72% | **LOE**: II<br><br>**Strengths**: High-quality RCT design, small attrition, homogeneity between IG and CG, detailed discussion of intervention development and contents utilized<br><br>**Weaknesses**: Small N, Pfizer funding, intervention setting had previously tried to improve immunization rates, educator and researcher had the same role—possible conflict of interest |

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|---|---|---|---|---|---|---|---|---|
| Research Foundation<br>**Bias**: Possible self-reporting bias; no bias disclosed from authors<br>**Country**: Japan | | immunization rates, ITV, and vaccine DM | CG: 55% FTM<br>Marital status (%): 99% married (both IG & CG)<br>Education level (%):<br>IG: 40% university<br>CG: 36% university<br>Mothers' job status (%): IG: 44% unemployed<br>CG: 46% unemployed<br>Fathers' job status (%):<br>IG: 97% FT employment<br>CG: 96% FT employment<br>Annual income (thousands of yen):<br>IG: 42% 4000-5999<br>CG: 37% 4000-5999 | *Immunization status based on HBV, RV, Hib, and PCV13 vaccines, recommended by Japan's PVL | | | $p < 0.001$<br>**DV2**: Intention to receive most vaccines: 77%<br>$p = 0.001$<br>**DV3**: DM regarding vaccinations: Father and mother: 68%, mother only: 32%<br>$p = 0.043$ | **Conclusions**: Prenatal and PP FTFVE = significant increase in infant immunization rates and parental ITV. Involving fathers in the FTFVE sessions may have contributed to the findings.<br><br>**Applicability**: May be applicable, but cost-effectiveness was not evaluated. May not be generalizable—immunization policies and practices differ between countries.<br><br>**Utility to PICO**: Valuable—consistent with all PICO elements. |

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| Citation | Theory/ Conceptual Framework | Design/ Method | Sample/ Setting | Major Variables & Definitions | Measurement/ Instrumentation | Data Analysis | Findings/ Results | Level/Quality of Evidence; Decision for practice/ application to practice |
|---|---|---|---|---|---|---|---|---|
| | | | **Setting**: Private Tokyo hospital<br><br>**Inclusion criteria**:<br>1) PG, gestational wk: 29-33<br>2) At least 18 yr<br><br>**Exclusion criteria**:<br>None explicitly listed<br><br>**Attrition**: 2% (lost to follow-up) | | | | | |
| Saitoh et al., (2017). Effect of stepwise perinatal immunization education: A cluster-randomized controlled trial. | HBM | **Design**: Cluster-RCT<br><br>**Purpose**: To evaluate the impact of stepwise FTFVE interventio | **N**: 188<br>**n**: 100 (IG)<br>**n**: 88 (CG)<br><br>**Demographics**:<br>Mean age (IG): 31.9<br>Mean age (CG): 31.5 | **IV**: FTFVE in three separate occasions<br><br>**DV1**: Completion of recommended vaccines* | Parental self-reports<br><br>5-point Likert scale (self-developed by | Fisher's exact test, Mann-Whitney *U* test | **DV1***: All 5 vaccines-<br>43.0%<br>95% CI: 0.5-1.6<br>$p = 0.77$<br>Hib-<br>85.0%<br>95% CI: 0.7-3.3<br>$p = 0.26$<br>PCV13- | **LOE**: II<br><br>**Strengths**: RCT design, explicit details of stepwise education intervention, small attrition, homogeneity between IG and CG<br><br>**Weaknesses**: Small N, lack of confirmation of accuracy on |

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| Citation | Theory/ Conceptual Framework | Design/ Method | Sample/ Setting | Major Variables & Definitions | Measurement/ Instrumentation | Data Analysis | Findings/ Results | Level/Quality of Evidence; Decision for practice/ application to practice |
|---|---|---|---|---|---|---|---|---|
| **Funding**: St. Luke's Life Science Institute<br>**Bias**: None reported<br>**Country**: Japan | | n on infant immunization status and maternal knowledge | Education (mean): Junior college<br># PG (%): FTM (48%, 40%)<br>Job status (%): Unemployed (73%, 60%).<br>Household income (%): 3000-4999 (thousands of yen) (38%, 32%)<br><br>**Setting**: Five hospitals and four private OB clinics<br><br>**Inclusion criteria**:<br>1) PG, gestational wk: 24-30<br>2) At least 18 yr<br>3) Able to communicate in Japanese<br><br>**Exclusion criteria**: | **DV2**: Vaccine schedule adherence*<br>**DV3**: VK<br><br>**Definition**: FTFVE provided in prenatal period (34-36 wk), postnatal period (3-6 days post-delivery), and 1-mo PP at well baby check-up<br><br>*Completion and adherence based on the 5 vaccine doses required at 6mo (Hib, PCV13, DTaP-IPV, HBV, and RV) | authors; validity and reliability not discussed) | | 85.0%<br>95% CI: 0.7-3.5<br>$p = 0.19$<br>DTaP-IPV-<br>85.0%<br>95% CI: 1.0-4.3<br>$p = 0.04$<br>HBV-<br>54.0%<br>95% CI: 0.5-1.8<br>$p = 1.00$<br>RV-<br>66.0%<br>95% CI: 0.1-2.3<br>$p = 0.45$<br>**DV2**: $Hib_3$-Mean+/-SD: 129.3+/-14.8<br>$p = 0.003$<br>$PCV13_3$-Mean+/-SD: 129.5+/-15.9<br>$p = 0.006$<br>$DTaP\text{-}IPV_3$-Mean+/-SD: 160.1+/-14.9<br>$p = 0.03$<br>$HBV_2$- | parental self-reporting, Likert scale utilized lacked reliability and validity, potential for exposure to other sources for vaccine information (TV, Internet)<br><br>**Conclusions**: FTFVE = improvement in immunization rates and maternal VK. Repeating study in different country and/or with larger N may yield significant results. Overall, may help with development of standardized prenatal FTFVE programs.<br><br>**Applicability**: May not be generalizable—immunization policies and practices differ between countries. Applicability is also uncertain—cost-effectiveness was not evaluated. |

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| Citation | Theory/ Conceptual Framework | Design/ Method | Sample/ Setting | Major Variables & Definitions | Measurement/ Instrumentation | Data Analysis | Findings/ Results | Level/Quality of Evidence; Decision for practice/ application to practice |
|---|---|---|---|---|---|---|---|---|
| | | | None explicitly listed<br><br>**Attrition**: 9.6% (lost to follow-up) | | | | Mean+/-SD: 112.2+/-35.2 $p = 0.60$ $RV_3$- Mean+/-SD: 130.9+/-15.9 $p = 0.34$ **DV3****: Mean+/-SD: 10.7+/-1.6 $p = 0.70$<br><br>*****Based on ITT analysis<br>******Knowledge at 6-mo follow-up | **Utility to PICO**: Consistent with all PICO elements—may be a valuable reference |
| Veerasingam et al., (2017). Vaccine education during pregnancy and timeliness of infant immunization. | HBM - inferred | **Design**: Observational cohort study<br><br>**Purpose**: Describe the source of encouragin | **N**: 6182<br><br>**Demographics**: Gender (%): 100% PG female Ethnicity (%): 54% European Age group (%): 52% 30-39yr | **IV1**: PG women **DV1**: Characteristics of VK **DV2**: Sources of VK | Survey (self-developed by authors; validity and reliability not discussed) | Multivariable logistic regression | **DV1**: IV1: 30%-only encouraging 10%-both encouraging and discouraging 4%-only discouraging | **LOE**: IIIb<br><br>**Strengths**: large N, nationally generalizable, no bias, very low attrition rate<br><br>**Weaknesses**: Lower level of evidence, no details on the type of media used for VK, self-developed survey |

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| Citation | Theory/ Conceptual Framework | Design/ Method | Sample/ Setting | Major Variables & Definitions | Measurement/ Instrumentation | Data Analysis | Findings/ Results | Level/Quality of Evidence; Decision for practice/ application to practice |
|---|---|---|---|---|---|---|---|---|
| **Funding**: New Zealand Ministries of Social Development, Health, Education, Justice, and Pacific Island Affairs and other various government departments and ministries<br>**Bias**: None disclosed<br>**Country**: New Zealand | | g and discouraging immunization information received by PG women and its association with timeliness of infant immunization | Parity (%): 58% subsequent child<br>Planned PG (%): 60% planned<br>Education (%): 69% tertiary<br><br>**Setting**: Computer-assisted face-to-face interview, no additional details provided<br><br>**Inclusion criteria**:<br>1) PG women<br>2) EDD between 4/25/2009-3/25/2010<br>3) Residents of defined region of NZ (chosen for its population diversity)<br><br>**Exclusion criteria**: None | **IV2**: Characteristics of VK<br>**DV3**: Infant vaccination timeliness<br><br>**Definition**: Timeliness based on NZ's NIR and the NZ Immunization Schedule | Comparison to NIR | | 56%-no information<br>**DV2**:<br>14%-from family/friends<br>35%-from HCP<br>14%-from media<br>**DV3**:<br>IV2: Discouraging info only, taking all immunizations:<br>OR = 0.49<br>95%CI: 0.38-0.64<br>Timeliness:<br>OR = 2.61<br>95%CI: 1.87-3.59<br>Both encouraging and discouraging, taking all immunizations:<br>OR: 0.51 | **Conclusions**: PG women who received discouraging VK = increased VH, regardless of receipt of encouraging VK. Large amount of PG women did not receive any VK during PG—it is imperative that HCP discuss vaccines in antenatal period.<br><br>**Applicability**: Providing truthful, encouraging VK to PG mothers is recommended in practice due to potential benefits. May not be generalizable due to differing immunization policies and practices between countries.<br><br>**Utility to PICO**: Consistent with all PICO elements—valuable to also know the sources of VK |

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|---|---|---|---|---|---|---|---|---|
| | | | **Attrition**: 1% (lost to incompletion of interview) | | | | 95%CI: 0.42-0.63<br>Timeliness:<br>OR: 2.70<br>95%CI: 2.08-3.50<br>No information, taking all immunizations:<br>OR = 1.00<br>Timeliness:<br>OR = 1.00 | |

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**Table A2**

*Synthesis Table*

| Author | Bechini et al. | Corben & Leask | Cunningham et al. | Danchin et al. | Hu et al. | Hu et al. | Kaufman et al. | Otsuka-Ono et al. | Saitoh et al. | Veerasingam et al. |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | 2019 | 2018 | 2018 | 2018 | 2017 | 2018 | 2018 | 2019 | 2017 | 2017 |
| Study Design (LOE) | CRS (IIIa) | CSS (IIIb) | CSS (IIIb) | CRS (IIIb) | RCT (II) | RCT (II) | SR (I) | RCT (II) | RCT (II) | OCS (IIIb) |
| Theoretical Framework | HBM (inferred) | HBM (inferred) | HBM (inferred) | HBM | HBM (inferred) | ELM | HBM | HBM, IBM | HBM | HBM (inferred) |
| Demographics | | | | | | | | | | |
| Age (% or mean) | 34yr | 33% 30-34yr | 66% > 30yr | NR | 20-30yr | 25.8 | | 32.8yr (M) 34.8yr (F) | 31.9yr | 52% 30-39yr |
| %Females | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% (expectant fathers also included) | 100% | 100% |
| ED level (% or mean) | 45% college graduates | 73.1% high school graduates | 43% more than 4-yr college degree | 60% university degree | College or above | 59% vocational or college graduation | | 40% university graduates | Junior college | 69% tertiary |
| % # PG | NR | 64.9% multiparous | 46% primiparous | 49% primiparous | NR | NR | | 53% primiparous | 48% primiparous | 58% multiparous |
| Setting | | | | | | | | | | |
| Hospital | | X | | X | X | X | X | X | X | |
| OB clinic | X | X | X | | | | X | | X | |
| Virtual | | | | | | | | | | X |

Key: **CRS**-correlational study; **CSS**-cross-sectional survey; **DM**-decision making; **ED**-education; **ELM**-Elaboration Likelihood Model; **FTFVE**-face-to-face vaccine education; **HBM**-Health Belief Model; **IBM**-Integrated Behavioral Model; **II**-infant immunization; **LOE**-level of evidence; **NR**-not reported; **OB**-obstetrician; **OCS**-observational cohort study; **PG**-pregnant/pregnancy; **SR**-systematic review; **RCT**-randomized control trial; **VH**-vaccine hesitancy; **VK**-vaccine knowledge; **U.S.**-United States; **yr**-years; **#** -number of; *-statistically significant with $p < 0.05$; ~ - low/moderate evidence in SR; + - strong evidence in SR; ↑ - increase

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Independent Variables | | | | | | | | | | |
| FTFVE | X | | | | X | | X | X | X | |
| Video education | | | | | | X | | | | |
| Booklet education | | | | | | X | | | | |
| PG women | | X | X | X | | | | | | X |
| Dependent Variables | | | | | | | | | | |
| VH | | X | X | X | | | | | | |
| II & Timeliness | | X | | X | X | X | | X | X | X |
| ITV | X | | | | | X | X | X | | |
| VK/DM | X | X | | X | X | | X | X | X | X |
| Themes | | | | | | | | | | |
| FTFVE & ITV or II | ↑ * | | | | ↑ * | | ↑ ~ | ↑ * | ↑ * | |
| FTFVE & VK | ↑ * | | | | ↑ * | | ↑ + | ↑ * | ↑ * | |
| PG women & VH prevalence | | ↑ * | ↑ * | ↑ * | | | | | | |

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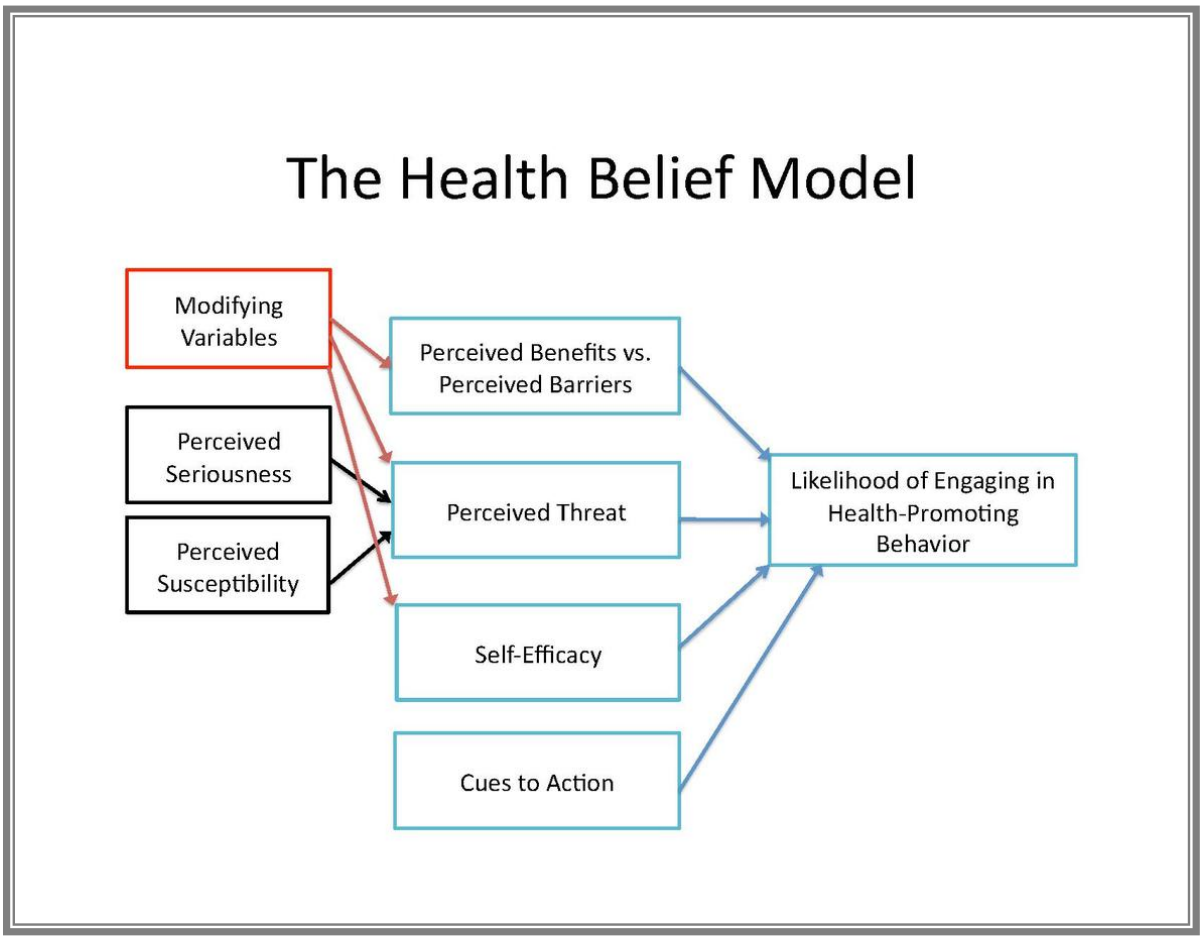
## Appendix B

## Models and Frameworks

**Figure 1**

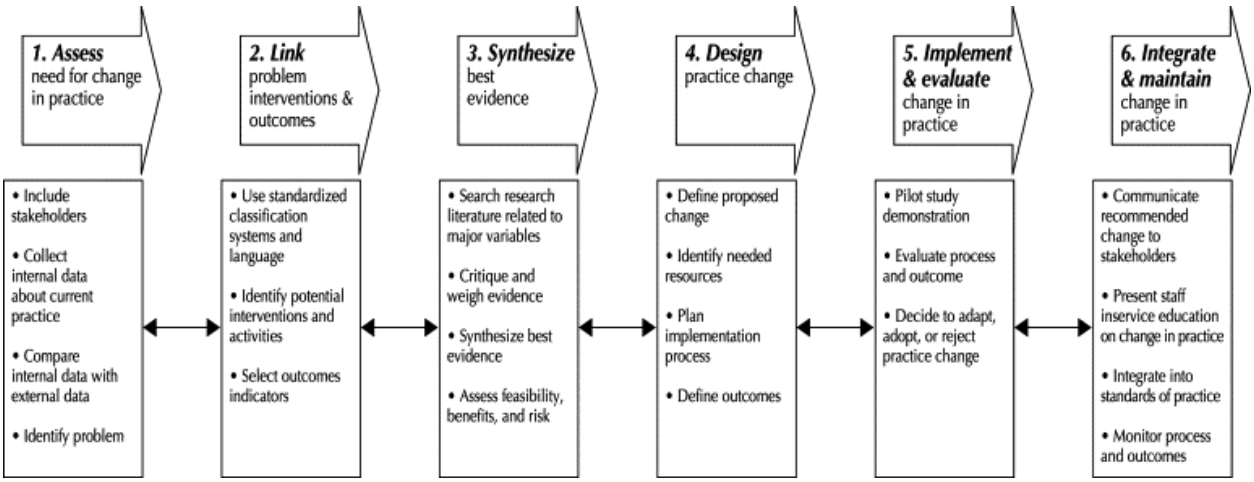
*Health Belief Model*




as cited in Larsen (2019).

**Figure 2**

*Rosswurm & Larrabee Evidence-Based Practice Model*




Rosswurm & Larrabee (1999).

**Figure 3**

*Budget for Addressing Vaccine Hesitancy in the Prenatal Population with Education*

| Phase | Activities | Cost | Subtotal | Total |
|---|---|---|---|---|
| **Direct Costs** | | | | |
| **Preparation** | Design PowerPoint presentation to be used during virtual implementation | $0 | | |
| | Design of pre- and post-survey in virtual format (via REDCap) and emailed to participants | $0 | **$0** | |
| **Delivery** | Voice-over PowerPoint | $0 | **$0** | |
| **Evaluation** | Email remainders to complete post-survey and inform of infant's immunization status | $0 | **$0** | |
| **Indirect Costs** | | | | |
| **Delivery** | Computer and Internet access for virtual delivery | $0 | **$0** | |
| **Evaluation** | Small monetary participant gift ($10/participant x 20) | $200 | **$200** | **$200** |
| **Funding** | | | | |
| | None | | | **$0** |
| **Cost Savings** | | | | |
| Providing vaccine education to pregnant mothers may significantly decrease vaccine hesitancy and increase vaccine knowledge and infant immunization rates. Implementation of vaccine education in the prenatal period can provide parents with confidence to vaccinate their infants, which proactively improves both the infant's health and societal health by contributing to *herd immunity* (Logan et al., 2018; Salmon et al., 2015). Decreased vaccine hesitancy and increased infant immunization rates will also lessen the outbreaks of vaccine-preventable diseases (VPDs). Although the project does not provide direct revenue to TAPI or the WIC clinics, the cost savings have monumental potential. With less treatment of VPDs, healthcare-related costs (time off work for patients/family, hospital stays, | | | | |

medication prescribed, healthcare providers time/pay, etc.) and demands are lessened and entire healthcare systems are positively impacted (Opel et al., 2016).