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Integrating mHealth in a virtual prenatal class to promote behavior modification in pregnant women.

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Integrating mHealth in a Virtual Prenatal Class to Promote Behavior Modification in Pregnant Women

by

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Dedication

This manuscript is dedicated to the amazing family and friends who have supported me throughout my doctoral journey. I want to thank my loving husband, Quinones Corniel, Jr. You have sacrificed so much to allow me to pursue my dreams. I am grateful for your commitment to me during this process. You gave me constant reassurance and continued to encourage me every day. To my parents Randolph and Diane Brown, thank you for your love and guidance throughout my life. The wisdom that you all have shared with me over the years is the reason I am who I am today. Lastly, to my sisters, Tiffaney and Jessica Brown, thank you for always believing in me. After many days of hard work, you two always provided me a place of comfort, peace, and joy.

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Abstract

Background: Occurrences of pre-term births are disparagingly higher among women from vulnerable populations. Prenatal classes provide healthcare professionals an opportunity to educate pregnant women about mitigating their risk factors for perinatal complications.

Purpose: To introduce the use of pregnancy mobile applications in a prenatal class to assist women in obtaining optimal maternal health for fetal development.

Methods: A pre/post-test design was used to explore the relationship between increased mobile health (mHealth) use and achievement of health behavior goals. The project intervention included a 15-minute PowerPoint presentation about optimal use and effectiveness of mobile apps in pregnancy, pregnancy health behaviors, and quality pregnancy apps on the market. Participant follow-up occurred four weeks after the prenatal class to evaluate changes in mHealth use and health behavior modification.

Results: Nine of the 10 participants were using pregnancy apps before the intervention. Ten participants completed the pre-test. Five participants completed the post-test at the 4-week follow-up evaluation. Descriptive statistics were used to analyze demographic and outcome data. The daily usage of a pregnancy app remained the same for one participant, increased for two participants, and decreased for two participants. The daily achievement of the selected health behavior goal remained the same for one participant and increased for four participants.

Discussion: Although there is not enough evidence to conclude that mobile health applications were responsible for the increased achievement of health behavior goals in pregnancy, the results did reveal that women are currently using pregnancy applications, warranting the need for

educational content to be integrated into prenatal classes to teach women about optimal use and selection of quality mobile applications.

Key words: pregnancy apps, prenatal class, virtual education, mHealth, behavior modification, pre-term birth, risk factors.

Contents

Introduction

Background

Problem Data

National Evidence. The Healthy People 2030 goal for women receiving prenatal care in the first trimester is 80.5% (Healthy People 2030, 2021). White women have surpassed this national goal while women from vulnerable populations continue to remain below the target goal. In 2018, 82.5% of white women in the United States received prenatal care in the first trimester while only 72.7% of Hispanic women, 67.1% of black women, 62.5% of American Indian/Alaskan Native (AIAN) women, and 50.9% of Native Hawaiian/Other/Pacific Islander (NHOPI) women sought early prenatal care in the first trimester (Hamilton et al., 2019). The disparity seen in prenatal care utilization is also reflected in perinatal birth outcomes when analyzing national data. Women from ethnic minorities have higher rates of cesarean deliveries, preterm births, and low-birth weight infants than white women (Hamilton et al., 2019). Pre-term birth rates specifically continue to rise for ethnic minority women yearly. The pre-term birth rates for white, Hispanic, black, AIAN, and NHOPI women in 2020 were 9.10%, 9.83%, 14.35%, 11.57%, and 11.98%, respectively (Hamilton et al., 2021).

State Evidence. Kentucky's pre-term birth rate was 11.3% in 2020 which was greater than the national rate of 10.09% (Hamilton et al., 2021; March of Dimes, 2021). The March of Dimes assigns a letter grade to each state and territory in the U.S. to represent the states' progress in reducing their pre-term birth rate. Along with 10 other states, Kentucky received a D rating from the March of Dimes in 2020 (March of Dimes, 2021).

There are currently 27 states with state quality collaboratives. State perinatal quality collaboratives are networks of teams that are focused on improving perinatal outcomes and quality of care for mothers and infants. One of the aims of the state quality collaboratives is to reduce pre-term birth (Centers for Disease Control and Prevention [CDC], 2019). The Kentucky State Perinatal Quality Collaborative is in development. Once a quality collaborative is established, birth outcome data will become more accessible for the state of Kentucky.

Local Evidence. In 2020, Jefferson County had a pre-term birth rate of 11% which is an increase from the previous year (March of Dimes, 2021). Pre-term birth is influenced by many factors such as environmental quality, access to care, socioeconomic status, etc. (Arinola et al., 2018; Krieger et al., 2003).

The University of Louisville Hospital's Community Needs Assessment for 2020-2022 revealed important demographic information and key needs for Jefferson County residents. The assessment revealed that Jefferson County has a higher unemployment rate, higher violent crime rate, poorer air quality, a higher poverty rate, and lower rates of residents with high school and post-secondary education when compared to U.S. averages (University of Louisville [ULH], 2019). These social determinants of health greatly impact the health of pregnant women, clearly indicating the need for quality prenatal care. Quality of care was also one of the overarching themes from the assessment (ULH, 2019).

Significance

The last comprehensive assessment of pre-term birth cost in the U.S was in 2005, when the Institute of Medicine reported that the cost of pre-term births reached a staggering deficit of $26.2 billion (Butler & Behrman, 2007; Frey & Klebanoff, 2016, Ovia Health, 2020). The March

of Dimes partnered with the National Perinatal Information Center Quality Analytic Services to conduct a study of specialty care nursey admissions across the U.S. and reported that in 2010, the average hospital charge of an infant admission was $76,000. Charges were on average $280,000 for infants born (<32 weeks). The report indicated pre-term births accounted for the most admissions to the special care nursery (March of Dimes Perinatal Data Center, 2011). The National Quality Forum (NQF) reports that the U.S. spends the largest amount of the healthcare budget on perinatal health than any other health sector yet is only ranked 61st in the world for perinatal health (NQF, 2019a). Low birth weight is one of the leading causes of infant mortality and is considered a condition that is heavily impacted by receiving quality prenatal care (CDC, 2017).

The ABCs of Measurement was developed by the NQF and identifies healthcare cost as a reason to measure patient outcomes (NQF, 2016). Private and public payers use patient outcomes to pay providers for performances and deny reimbursements to institutions that have adverse patient outcomes. Outcome measures reflect quality of care and are synonymously considered patient outcomes (NQF, 2016). Percentage of low birth weight births is considered an outcome measure. Healthcare costs can be reduced significantly if quality, preventative information can be delivered to pregnant women through group prenatal education (Rowley et al., 2015).

Quality, accessible prenatal care is important and is an essential factor in preventing adverse infant outcomes (Lathrop, 2013). Pregnant women who are from vulnerable populations are less likely to attend prenatal care appointments and receive an adequate amount of prenatal education. Pregnant women are more likely to attend prenatal care appointments when they feel satisfied with their care (Hetherington et al., 2018). To improve health disparities in perinatal

outcomes among vulnerable populations, patient satisfaction with prenatal care services must be improved.

Pregnant women prefer face-face, small group education sessions where they can talk to each other and the educator (Kovala, Cramp, & Xia, 2016). In 2018, The American College of Obstetricians and Gynecologists (ACOG) issued a committee opinion on the group prenatal care delivery model with recommendations for the future. ACOG states that this alternative delivery model may improve perinatal outcomes, patient knowledge, satisfaction, and social support in pregnant women from select populations (American College of Obstetricians and Gynecologists [ACOG], 2018). Quality, group prenatal education programs are a solution to increasing patient satisfaction and compliance among vulnerable pregnant women (Ickovics et al., 2007).

Pre-term birth, which is defined as a birth occurrence less than 37 weeks gestation, is considered a direct cause of low-birth weight, which is a birth weight less than 2500 grams and can cause adverse outcomes for the infant (World Health Organization [WHO], 2019). The NQF developed guidelines for choosing measures for research and quality improvement initiatives. The NQF developed the Perinatal and Reproductive Health Project in 2015 to identify measures for quality improvement in the perinatal and reproductive health sector (National Quality Forum [NQF], 2019b). The NQF identified 24 quality measures to improve reproductive and perinatal outcomes in women. The percentage of low birthweight births is an endorsed quality measure by the NQF (NQF, 2019a). Reduction of low birth weight births and pre-term births are also Healthy People 2030 objectives for improving Maternal, Child, and Infant health (Healthy People 2030, 2021). The Health Resources and Services Administration (HRSA) has identified outcome measures commonly used by Medicare and Medicaid to assess for quality in an institution, including low birth weight (HRSA, 2018).

Esposito et al. (2015) report that women need proper prenatal education to improve pregnancy knowledge and subsequently reduce the effects of maternal risk factors. Modifiable lifestyle factors such as smoking and alcohol use have been attributed to low birth weight, pre-term delivery, pre-eclampsia, and mortality while maternal obesity, gestational diabetes, and lack of folic acid have been attributed to neurological, cardiac, and orofacial defects in the infant. There is a need for community-based interventions that enhance prenatal education programs to improve perinatal outcomes (Woods & Chesser, 2015). Nurses play a critical role in educating patients about their health and knowing how patients learn is essential in developing strategies to educate patients (Inott & Kennedy, 2011). An educational program for patients should consider several types of learning styles and teaching techniques (Beagley, 2011).

Target population

Pregnant women seeking to deliver at ULH were the target population for this project. All patients delivering at ULH were invited to attend a virtual group prenatal class. Patients who received their prenatal care from other community health centers and prenatal clinics were also welcomed to attend the class. Patients were encouraged to invite their support partners as well. The purpose of providing a free, community-based class was to reduce a barrier to attendance for patients from vulnerable populations. Vulnerable populations include patients who are a part of racial or ethnic minorities, come from socioeconomically disadvantaged areas, are underinsured, and/or have certain medical conditions (Waisel, 2013). Any pregnant woman could participate, as there were no exclusions.

Rationale

Needs Assessment

An informal needs assessment was conducted with the prenatal education coordinator at ULH. The education coordinator is responsible for organizing the free, community-based group prenatal class that is offered to families delivering at ULH. Several themes emerged from the interview including the need for: an updated curriculum, interventions to improve patient engagement in class, information on healthy lifestyle behaviors, and a facilitator guide for registered nurses that lead the class. The education coordinator reported that class evaluation forms are given to participants after each class. Qualitative data from the evaluation forms showed a lack of satisfaction with the materials presented during the class. A unit-based council made of labor and delivery, postpartum, and neonatal intensive care unit (NICU) nurses at ULH provided feedback about their experiences facilitating the group prenatal class. The council agreed that there is a need for an updated curriculum and believed a change in the class structure could improve patient engagement. The council also expressed the desire to have a facilitator guide to help organize the class in a way that can be replicated consistently by different class leaders. The manager of the labor and delivery unit echoed the concerns from the education coordinator and unit-based council.

The first needs assessment was conducted in September of 2019. Several changes were made to the class to reflect the deficits outlined from the initial needs assessment. The class was delivered in a physical face to face format, however, due to social distancing restrictions enforced by the CDC after the COVID-19 pandemic outbreak in March of 2020, the class was then offered in a virtual format. Participants were emailed a link to join the prenatal class and engage with each other as well as the class facilitators. The curriculum was updated, and a

facilitator PowerPoint was created to guide facilitators. Several games were integrated into the class to improve engagement. The DNP project intervention content was delivered via PowerPoint, allowing feasible integration in the existing virtual class format.

Purpose

Health disparities in maternal-fetal outcomes among vulnerable populations can be mitigated by increased access to health information (Chedid & Phillips, 2019). The purpose of this quality improvement project was to introduce the use of pregnancy mHealth (mobile health) applications in a prenatal class to assist in obtaining optimal maternal health for fetal development. With the use of mobile health applications, pregnant women have access to reliable health information and education, which may facilitate informed decision-making during the pregnancy.

Aims

Aim I

To educate patients about the usability and effectiveness of mobile health applications in assisting with behavior modification during pregnancy.

Aim II

To evaluate the effectiveness of pregnancy mobile health application use in assisting patients with achieving health behavior goals.

Agency Goals

The mission and vision of ULH is to improve the quality of life for patients through innovation, collaboration, and evidence-based practices (University of Louisville Hospital

[ULH], 2020). The guiding principles of ULH are based on research, community-centered care, and education (ULH, 2020). ULH strives to cultivate a culture of constant quality improvement and program evaluation to achieve positive change. This quality improvement project aligns with the mission, vision, and guiding principles of this institution by promoting healthy behaviors and educating patients about an evidence-based tool to help facilitate behavior change.

Environment

The University of Louisville Hospital is a federally funded academic research facility centered in downtown Louisville, Kentucky. ULH offers a free, virtual prenatal class to all pregnant patients. The prenatal class is offered six times a year and is approximately 4-6 hours in duration. A variety of topics are discussed such as expectations for labor, childbirth, postpartum care, newborn care, and lactation. The class is facilitated by two obstetric nurses and a certified lactation consultant. The organization stakeholders of this DNP project were receptive to the intervention and encouraged its' integration in the existing prenatal class, a strong facilitator of implementation. A barrier to implementation of this project was the need to use technology to virtually educate the patients.

Ethics and Permission

IRB Approval

This DNP project protocol was approved by the University of Louisville Institutional Review Board (IRB) as a quality improvement project. This protocol received approval from the Center for Women and Infants' clinical nurse manager, quality improvement coordinator, and director of nursing. This protocol was also submitted to the University of Louisville Hospital Interdisciplinary Research Oversight Council (IROC) for approval. An IROC coordinator

reviewed the protocol and deemed it was not necessary to be approved by the council, as it was not a research study.

Conceptual Framework

The PRECEDE PROCEED model is a quality improvement framework for designing, implementing, and evaluating health promotion programs (Rural Health Information Hub [RHI Hub], 2011). The model is used to assess a community of its needs then to design effective interventions to meet those needs. PRECEDE [Predisposing, Reinforcing, and Enabling Constructs in Educational Diagnosis and Evaluation] refers to the community assessment, which is the first phase of the model (RHI Hub, 2011). A needs assessment was performed with the prenatal education coordinator at the University of Louisville Hospital. Social, ecological, and epidemiological factors that influence behavior change among prenatal patients were identified, as outlined by the model. Administrative and policy barriers were also discussed during the needs assessment. A summary of the needs assessment was shared with the quality improvement coordinator, nurse manager, and unit-based council. Effective interventions were developed based on an evidence-based literature review.

PROCEED [Policy, Regulatory, and Organizational Constructs in Educational and Environmental Development] refers to the implementation and evaluation phases of the evidence-based intervention (RHI Hub, 2011). Once the participants committed to a health behavior change, they were advised to use a mobile health application to aid them in their behavior modification. The evaluation of intervention effectiveness occurred through process, impact, and outcome evaluations according to the PROCEED phase of the model (RHI Hub, 2011). Mobile health app use was evaluated using a 5-point Likert scale. Patients were also asked how frequently they achieved their health behavior goal using a 5-point Likert scale.

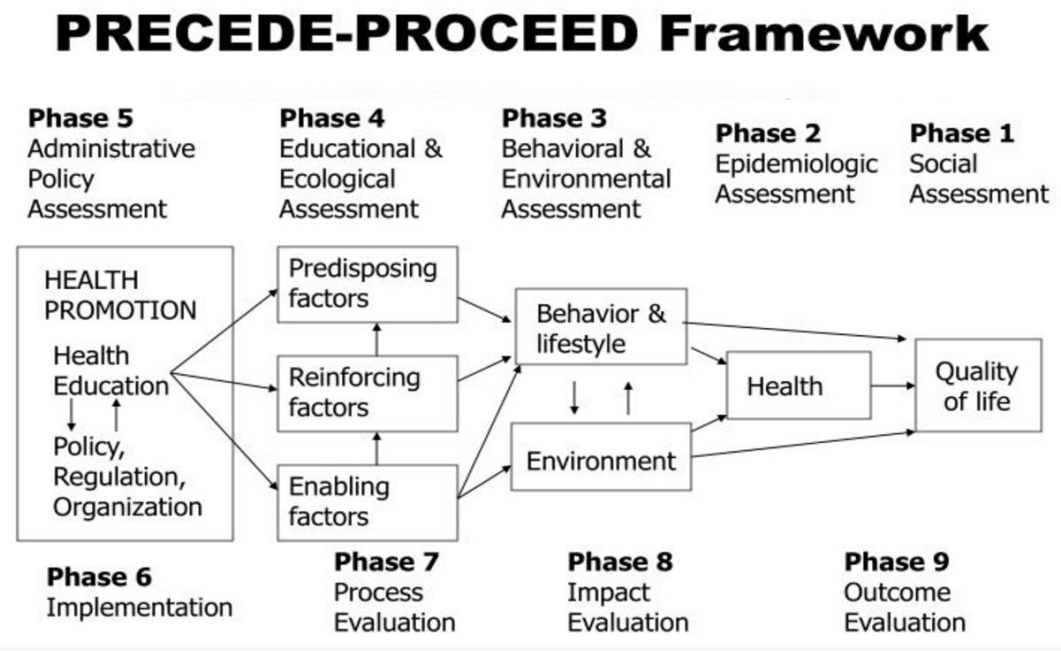

Figure 1. Conceptual Framework

Intervention

Description

The quality improvement project intervention included a PowerPoint presentation integrated into an existing virtual prenatal class including the definition of health behaviors, a list of healthy pregnancy behaviors endorsed by the American College of Obstetricians and Gynecologists (ACOG), the usability and effectiveness of mobile health applications in changing health behaviors in pregnancy, and a list of five, pre-screened pregnancy mobile health applications. Once the presentation concluded, the participants identified at least one health behavior goal to achieve daily for 4 weeks. Participants were advised to use a safe, evidenced-based mHealth application to aid in their behavior modification. A list of prescreened evidence-based mHealth applications was listed during the presentation. Participants reported their health behavior goal and chosen pregnancy mobile app to the DNP student. Participants were educated

on how to optimally use a pregnancy mobile application to achieve health behavior goals. Participants received follow-up via phone call four weeks after the prenatal class.

Literature Review

All articles included in this review were published between 2014 and 2020, published in English, peer-reviewed, considered a level III or higher based on the John Hopkins Model for Evidence-Based Practice, and were appraised using the Equator Network Guidelines to evaluate rigor and quality.

Innovative, virtual strategies to educate pregnant patients became increasingly relevant during the COVID-19 pandemic. Fear of crowded in-person prenatal classes and becoming sick may deter women from seeking prenatal services (Zangmo et al., 2020). In a prospective controlled trial, Marko et al. (2019) found that in-person prenatal visits can be decreased without decreasing patient satisfaction. Adult patients need to feel self-directed in their learning to promote engagement in an education program (Russell, 2006).

Patient activation is having the knowledge, self-efficacy, and/or skills to manage one's health and has been shown to increase with the use of mobile phone applications in pregnancy, which subsequently improves outcomes (Greene & Hibbard, 2012; Ledford et al., 2016). High levels of patient activation positively correlated with the utilization of mobile health care services (McCabe et al., 2018). Childbearing-age women are interested in electronic health interventions, particularly when educated about lifestyle modifications (Van Den Heuvel et al., 2018). Lifestyle modifications that pregnant women may be educated on are diet, exercise, and stress management. Women who use mobile health applications (apps) have improved behavior changes such as fruit and vegetable consumption and increased use of stress management

strategies (Mauriello et al, 2016). Many expecting women choose to journal to keep track of their experiences during pregnancy including management of health habits. Mobile health apps are used more than traditional pregnancy journals to document behavioral changes (Ledford et al., 2016).

Chan et al. (2019) conducted a meta-analysis assessing the effect of mHmealth and social media in prenatal care and analyzed 15 randomized control trials. The total effect size, standard error, and *p*-value of the analysis were 0.75, 0.16, and $p < .001$, respectively. The mHealth interventions evaluated had moderate to large effect sizes for maternal health, mental health, and pregnancy knowledge. The analysis revealed that mHealth positively affects pregnancy-related stress and depression. The meta-analysis revealed a moderate effect in gestational weight management by promoting lifestyle modification and self-monitoring using mHealth apps and social media. Mobile health apps were also useful for pregnant women with gestational diabetes with a small to moderate effect size. Xu and Long (2020) found in a meta-analysis that in pregnant patients with hypertension, smartphone use was positively correlated with decreased blood pressure.

In a systematic review evaluating the usability and effectiveness of mHealth in pregnancy, 24 out of 29 studies showed positive results for the acceptability and/or feasibility of implementing mHealth in a prenatal education program (Overdijink et al., 2018). The review also revealed that mHealth apps are used to reduce gestational weight gain, increase the intake of vegetables and fruits, improve smoking cessation, and support health care for the prevention of infections during pregnancy. Nineteen of the 29 apps assessed usability and effectiveness for lifestyle modifications. Ten of the 29 apps assessed usability and effectiveness for medical care support in pregnancy like asthma, diabetes, and the use of vaccinations.

Kim et al. (2019) conducted a prospective cohort study in which a mobile health app was used to provide supplemental pre-term birth risk factor information to pregnant patients and their partners. At the conclusion of the 4-week study, patients reported increased pre-term birth risk awareness (93%), discussions of pregnancy and premature risk factors among women and their partners (86%), and the number of questions asked at prenatal appointments (43%). Participants also reported receiving more prenatal information from the mobile app than from the healthcare provider. The average amount of time used in the app was eight hours during the 4-week study (Kim et al., 2019). Mobile health applications also improve prenatal visit attendance and decrease the incidence of low-birth weight infants (Bush et al., 2017). Although mobile health apps have been shown to improve outcomes, there is still a lack of regulatory agencies to properly vet the apps for accuracy (Brown et al., 2019; Hughson et al, 2018; Larson et al., 2019). Health care providers can integrate mHealth in prenatal practices to promote behavior modification and improve perinatal outcomes if the apps are screened for quality.

Through an extensive systematic review (71 studies) of electronic health usage in pregnancy, several common uses were identified such as improving gestational diabetes management, mental health, virtual surveillance (fetal heart rate and uterine monitoring), smoking cessation, gestational weight gain, telemonitoring, and teleconsulting (Van Den Heuvel et al., 2018). Web-based learning is a cost-effective, accessible strategy to deliver prenatal education and improve patient engagement when combined with standard prenatal care (Van Den Heuvel et al., 2018). Abuidhail et al. (2019) found that pregnant women are more likely to view interactive videos and images about breastfeeding education than viewing standard reading material in a randomized control trial. Women of childbearing age rely heavily on the internet for gaining knowledge and the use of web-based modules in a prenatal setting can improve

engagement among women (Abuidhail et al., 2019). In an unblinded quasi-experimental study of low-risk pregnant women who received web-based prenatal care, levels of patient satisfaction, self-efficacy, and stress improved significantly when compared to a group of pregnant women who received only standard prenatal care ($p < .001$) (Tsai et al. 2019).

Ninety percent of pregnant patients reported that they learned something new after viewing an interactive video and game in a quasi-experimental study focusing on Latina women. After using the kiosk that housed the video and game, 57% of participants reported they would prefer this method of knowledge acquisition over receiving information from a pamphlet. ($p < .01$) (Rosas et al., 2014). With web-based learning, patients can learn in a comfortable environment without restrictions in time and associated fees with attending a class (Van Den Heuvel et al., 2018). The evidence from these studies implicates that pregnant women prefer a combination of both traditional prenatal education and web-based options. Incorporating web-based options in a prenatal practice can increase access to care, allow social distancing, and provide the opportunity for women to repeatedly reference the material.

Methods

Project Design

This evidence-based DNP project used a pre/post-test design in a virtual group prenatal class to evaluate health behavior change in participants. Participants were recruited from the ULH prenatal class. During the education session, the term health behavior was defined. The session included a list of healthy pregnancy behaviors (nutrition, physical activity, hydration, and substance use) from the American College of Obstetricians and Gynecologists (ACOG). Once the education session was completed, participants were asked to identify one health behavior goal and complete a pre-intervention survey assessing how frequently they are currently using a

mobile health application and how frequently they are currently achieving their respective pregnancy health behavior goals. Four weeks after the intervention, participants were called and asked to complete a post-intervention survey assessing how frequently a mobile health application was used and how frequently the health behavior was achieved weekly.

Procedure

Intervention Team

The DNP project student co-taught the virtual prenatal class with the Center for Women and Infants quality improvement coordinator/prenatal class educator and a certified lactation consultant. The DNP student educated the implementation team about the intervention via PowerPoint.

Stakeholders

Project stakeholders included the Center for Women and Infants' clinical nurse manager, clinical nurse educator, quality improvement coordinator, and director of nursing. All stakeholders received the DNP project protocol, the PowerPoint presentation and the script that was used to educate patients via email.

Participants

Marketing materials for the virtual prenatal class were available on the University of Louisville Hospital's general website and a University of Louisville Hospital affiliated Facebook page. Pamphlets with general information about the class were available at the University of Louisville Hospital prenatal clinic and on the Center for Women and Infants labor and delivery unit. Participants were identified from the list of registered attendants for the February 2021

prenatal class. At the beginning of the class, participants were informed of the DNP project and received a preamble.

Implementation

Preamble

Participants received an electronic preamble via email. The project purpose and description were included. Participants were informed of all potential risks for partaking in the intervention. There was a potential risk for participants to consume contradictory educational messages from unregulated mobile health applications and thus make decisions that were not endorsed by the prenatal class facilitators.

Data Collection

Participants were given an electronic survey that included questions about demographic data and received an identification number (ID). Each participant identified at least one pregnancy health behavior goal. The participants' goal statements, the name of their selected pregnancy app and answers to the two pre-intervention questions were compiled in an excel spreadsheet that corresponded with their ID number and demographic information. Four weeks after the initial intervention, the participants received a post-intervention evaluation via phone call. The answers to the evaluation were recorded in the data excel spreadsheet.

Data Maintenance and Security

All data collection and entry occurred using a password protected laptop. All email correspondence with participants was encrypted. All participants received an identification number and sensitive information was de-identified. The excel spreadsheet used for data entry

was saved on a secure flash drive. The hard drive will be stored in the office of the DNP project committee chair at the UL School of Nursing.

Budget

Table 1. Budget

Item/Activity	Cost
Time: Brittney Corniel, Prenatal Educator	2 classes x 3 hours x hourly wage ($32)
Time: Co-Prenatal Educator	2 classes x 3 hours x hourly wage ($32)
Time: Lactation Consultant	2 classes x 3 hours x hourly wage ($40)
Laptop/Webcam/Microphone	$0, provided by class facillitators
Virtual Prenatal Curriculum	$0, provided by ULH
mHealth Intervention PowerPoint	$0, provided by DNP student
Electronic Promotional Flyer	$0, provided by ULH marketing team
Electronic Registration	1 hour x 2 weeks x hourly wage ($32)
Electronic Consent Forms	1 hour x 2 weeks x hourly wage ($32)
Electronic Follow-Up Surveys	1 hour x 2 weeks x hourly wage ($32)
Web Conferencing Platform	$0, provided by class facillitators
Total Cost	$816

Measurements

Process Measures

Instrument

The 23-item MARS tool evaluates mobile health applications using five subscales: engagement, functionality, aesthetics, information quality, and a subjective quality scale. The MARS tool has a high level of internal consistency (alpha = .90) and interrater reliability intraclass correlation coefficient (ICC = .79). Permission for use was requested by the corresponding author via email. The Mobile App Rating Scale (MARS) was used to screen a list of pre-selected applications. The top five rated pregnancy applications from the Google Play Store were evaluated with the MARS tool. This tool can be used to measure app quality using

four domains: engagement, functionality, aesthetics, and accuracy of information (Stoyanov et al., 2015).

A search in the Google Play Store was conducted using the term “pregnancy apps”. The following five mobile health applications had the highest ratings out of five possible points: Amila: Pregnancy Week by Week (4.9 rating/1 million+ downloads), Baby Center: Pregnancy Tracker + Countdown to Baby Due Date (4.8 rating/10 million+ downloads), Phillips Consumer Lifestyle B.V: Pregnancy + tracker (4.8 rating/10 million + downloads), What to Expect: Pregnancy & Baby Tracker (4.8 rating/ 1 million+ downloads), XO group: The Bump-Pregnancy & Baby tracker (4.8 rating/1 million+ downloads). The scores for each application were given to participants during the prenatal class. Participants either chose an application from the list provided during the educational session or one of their personal choice. Each participants’ choice was recorded for data collection.

Table 2

Results from MARS evaluation tool

App Name	Engagement	Functionality	Aesthetics	Information	Overall score
Pregnancy +	5	4.75	4.6	4.8	4.7875
Baby Center	4.2	4.75	4.6	4.8	4.5875
What to Expect	4.2	4.5	4	4.8	4.375
The Bump	3.8	4.5	3.6	4.4	4.075
Week by Week	3.6	4.75	3.6	4.2	4.0375

Outcome Measures

Four weeks after the prenatal class, each participant received a post-intervention evaluation via phone call. The evaluation consisted of a 2-item questionnaire.

Question 1

On average, how many times a week have you used the mobile health application of your choice?

The answers were recorded using a 5-point Likert scale. The Likert scale was coded as follows: 0 = Never, 1 = Once a week, 2 = Twice a week, 3 = Three times a week, 4 = Four times a week, 5 = Five times a week or more.

Question 2

On average, how many times a week have you achieved your health behavior goal?

The answers were recorded using a 5-point Likert scale. The Likert scale was coded as follows: 0 = Never, 1 = Once a week, 2 = Twice a week, 3 = Three times a week, 4 = Four times a week, 5 = Five times a week or more.

Demographic Data

The demographic data obtained from each participant included the following items: age, gravida, and race.

The participant data excel spreadsheet included the following items in row 1: participant ID number, age, gravida, race, the participant's selected mHealth app, the participant's health goal, the answer to question 1 of the pre- and post-intervention follow up questionnaire, the answer to question 2 of the pre- and post-intervention follow up questionnaire. All quantitative data in the excel spreadsheet was reviewed by the DNP student for errors, extra spaces, and duplicates and compared to the initial electronic surveys twice.

Data Analysis

Due to a 50% attrition rate, the data points lacked normality in distribution. The results of this DNP project did not meet the statistical assumptions to complete a paired *t*-test for analysis as intended. Descriptive statistics were used to analyze demographic and outcome data. Frequency distributions of race/ethnicity and selected mobile app were calculated to evaluate the racial diversity of the class and the usage of mobile apps. Measures of central tendency and dispersion (mean, standard deviation, minimum, maximum and range) were computed for the age, gravida, and the two pre- and post-intervention responses. All result findings were manually computed by the DNP student.

Results

Quantitative Data

The total sample size was 10 pregnant women; all 10 women completed the pre-intervention survey, resulting in a 100% response rate initially. Demographic data collected included age, race/ethnicity, and gravida, or the number of total pregnancies. Seventy percent of the participants were white, and the average participant age was 32 years old. The most frequently used mobile application was *"What to Expect"*. Sixty percent of participants chose exercise as their health behavior goal. Five participants did not complete the 4-week follow-up survey. At the post-intervention evaluation, the daily usage of the selected mobile application remained the same for one participant, increased for two participants, and decreased for two participants. The daily achievement of the selected health behavior goal remained the same for one participant and increased for four participants. The overall mean average for days of

mHealth used from pre- to post- intervention decreased, but the mean average for days a health behavior goal was achieved increased.

Qualitative Data

No qualitative questions were included in the pre- or post- intervention surveys; however, two participants provided qualitative data at the 4-week follow-up evaluation.

Participant #2: "I stopped using the app once I got closer to my due date."

Participant #7: "I was using the app about twice a week, but I just deleted it. I think it's a lot easier to look stuff up on google."

Table 3

Frequency Distribution of Race/Ethnicity (*N* = 10)

Race/ethnicity	*Frequency*	*Percent*	*Valid Percent*	*Cumulative Percent*
White or Caucasian	7	70	70	70
Black or African American	0	0	0	70
Hispanic or Latino	2	20	20	90
American Indian or Alaskan Native	0	0	0	90
Hawaiian or Pacific Islander	0	0	0	90
Other	1	10	10	100
Missing	0	0	0	100
Total	10	100	100	100

Table 4

Descriptive Statistics for Age and Gravida

Variable	N	Mean	Standard Deviation	Minimum	Maximum	Range

Age	10	31.7	4.7	24	40	16
Gravida	10	1.3	0.7	1	3	2

Table 5

Frequency Distribution of Chosen Mobile Application ($N = 10$)

Mobile Application	*Frequency*	*Percent*	*Valid Percent*	*Cumulative Percent*
What to Expect	2	20	20	20
What to Expect and Glow	1	10	10	30
What to expect and The Bump	1	10	10	40
Baby Center	3	30	30	70
The Bump	1	10	10	80
Flo	1	10	10	90
Pregnancy Plus	1	10	10	100
Missing	0	0	0	100
Total	10	100	100	100

Figure 2

Participant Health Behavior Goals

Figure 3

Results of Baseline and Follow-up responses: Question #1

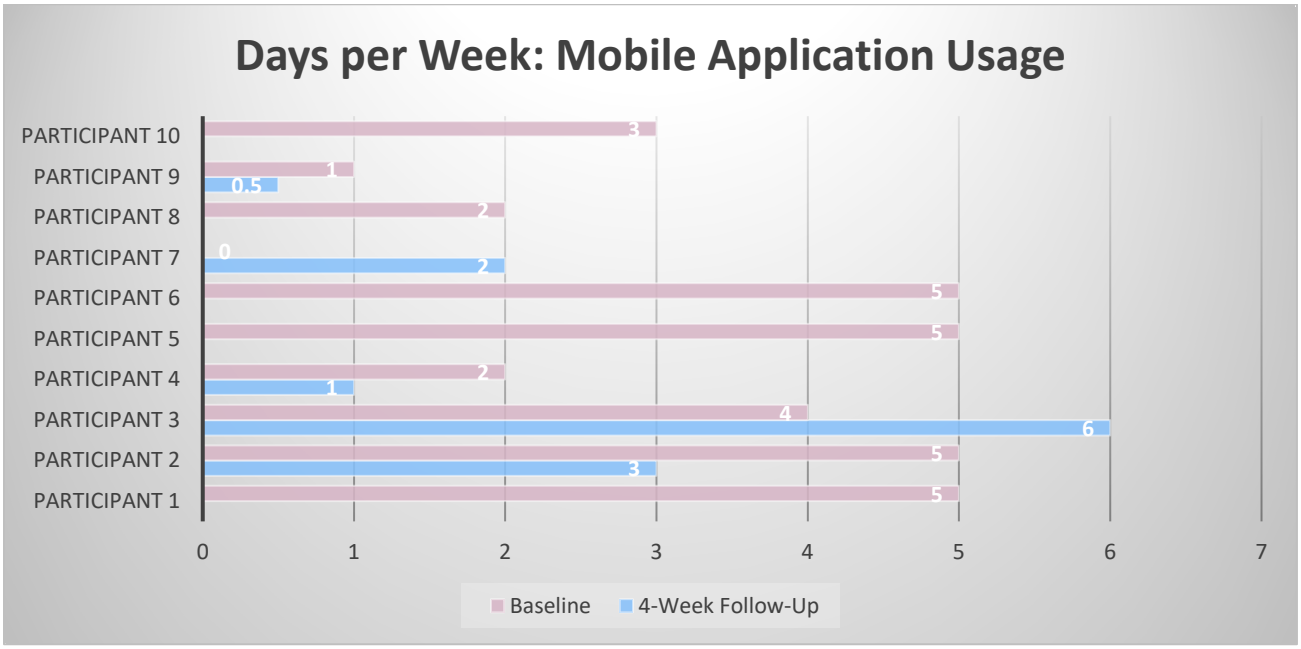

Figure 4

Results of Baseline and Follow-up responses: Question #2

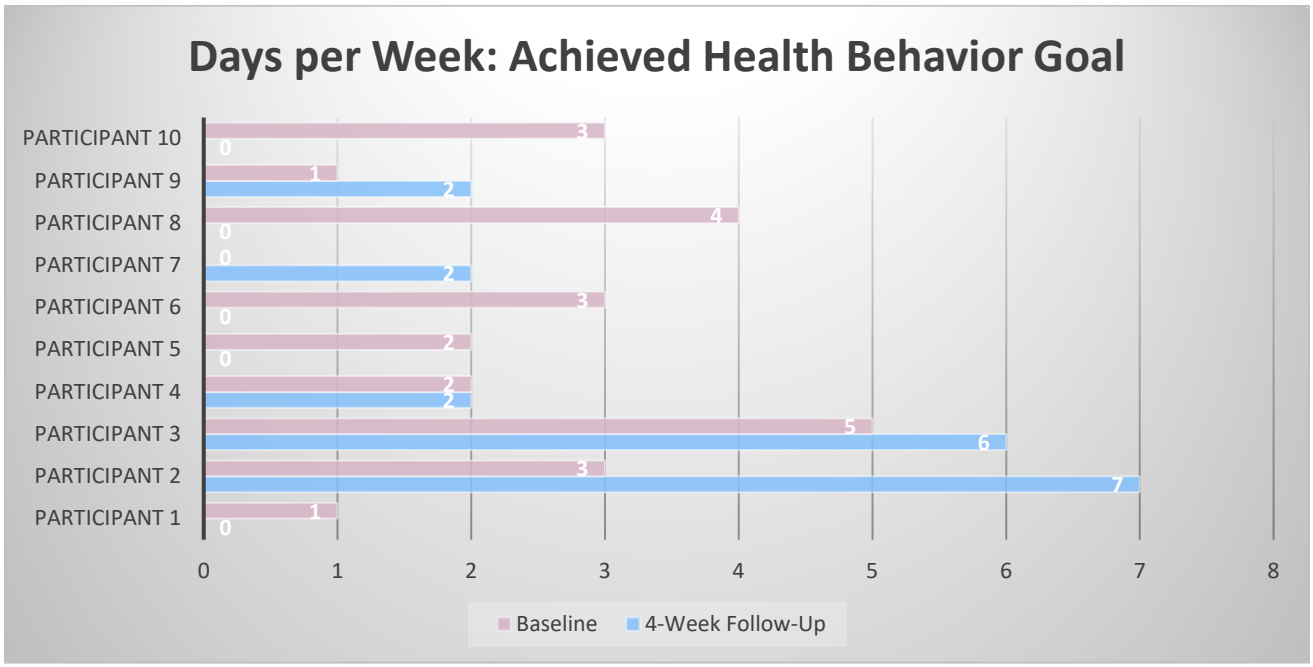

Table 6

Descriptive Statistics for Mobile App Usage

Variable	N	Mean	Standard Deviation	Minimum	Maximum	Range
Day per week app use (Baseline)	10	3.2	1.9	0	5	5
Day per week app use (4-week follow-up)	5	2.6	2.1	1	6	5

Table 7

Descriptive Statistics for Health Behavior Goal Achievement

Variable	N	Mean	Standard Deviation	Minimum	Maximum	Range
Day per week goal achievement (Baseline)	10	2.4	1.5	0	5	5
Day per week goal achievement (4-week follow-up)	5	3.8	2.5	0	7	7

Discussion

Summary

Pre-term birth rates among African American women are consistently higher than any other ethnic group. Health agencies such as the CDC and March of Dimes recommend the utilization of prenatal classes for women to reduce their risk factors for perinatal complications, particularly pre-term birth. Current evidence suggests that the use of mobile health applications in pregnancy provides added benefits to traditional prenatal classes in mitigating pre-term birth risk factors. The overarching aim of this quality improvement project was to educate patients

about the usability and effectiveness of mobile health applications in assisting with behavior modification during pregnancy and to then evaluate the effectiveness of a pregnancy mobile health application use in assisting patients with achieving health behavior goals.

Much of the sample were white women in their thirties who were experiencing their first pregnancy. There were no African American women in the prenatal class, thus there can be no conclusions made about whether mobile applications can assist black women in modifying their health behaviors to reduce pre-term risk factors. Nine of the 10 participants were using a mobile application before the interventional education content was delivered. By the end of the intervention, all participants had pregnancy applications downloaded on their cellular devices. The participant who was not currently using an application was the oldest participant of the sample (40 years old) and had two prior pregnancies, suggesting that women who have more anecdotal pregnancy knowledge may not be using pregnancy apps at the same rate as new mothers. Six of the 10 participants selected exercise as a health behavior goal, demonstrating a desire to have a healthy pregnancy. One of the 10 participants saw an increase in weekly goal achievement with increase mobile app usage. However, decreases in mobile application use did not affect the participants' ability to achieve their weekly health behavior goal, as no decreases were noted in weekly achievement.

Interpretation

There is not enough evidence to conclude that mobile health applications were responsible for the increased achievement of health behavior goals in pregnancy. The results did reveal that many women are currently using pregnancy applications, warranting the need for educational content to be integrated into prenatal classes to teach women about optimal use and selection of quality mobile applications.

The qualitative data collected provided unexpected insight into barriers of mobile application use. Participant #2 stated that using Google to find health information was easier to navigate illustrates a gap in education about mobile application usability and functionality. This commentary also reveals the possibility of women consuming unsubstantiated health information from unreliable internet sources and the importance of providing mobile applications with credible and accurate health information. The mobile app rating scale provided a structured, consistent method to vet mobile applications for quality and can be used in the future to evaluate mobile app quality. Participant #7 stated that she stopped using the application as she got closer to her due date implies that perhaps mobile application use may be more relevant in the early gestational period.

There was a low level of participation in the prenatal class. This could possibly be the result of the class being virtual. Although a virtual class does increase access for certain groups, it ais a barrier for participants with limited resources to technology. There was also a lack of diversity. The lack of racial diversity in the sample shows a need to explore barriers for African American women to attend prenatal classes.

Limitations

The small sample size and 50% attrition rate limited the generalizability and significance of the result findings. Participants received a follow-up phone call and voicemails were left for participants who did not answer. Perhaps in a future project, a different evaluation method should be explored to increase the response rate. Implementing a virtual education format did not allow women to participate who did not have computers, cellular devices and/or internet access. The intervention was delivered in February 2021. A majority of participants identified an

increase in exercise as their health behavior goal. Achievement of this goal may have been limited due to the winter season.

Conclusions

Several themes emerged from the result findings including the popularity of pregnancy application use among childbearing age women, the lack of racial diversity in prenatal class attendance, and the need to educate women on finding credible sources for pregnancy-related information. Prior to DNP project implementation, there was no content delivered about criteria for a healthy pregnancy, pre-term birth risk factors, and using mHealth in pregnancy. This project demonstrated the feasibility of integrating education about and suggestions on using mobile apps in pregnancy to assist with behavior modification and risk reduction. This project can be sustained, as the educational materials including the intervention PowerPoint and script were provided to the prenatal class coordinator, nurse manager, and director of nursing. Now that the prenatal class is delivered virtually, it can be further disseminated to increase its accessibility to the community. Before the COVID-19 pandemic, transportation, coordinating childcare, and work schedules were barriers for patients attending the in-person class. With emerging innovations in technology such as mHealth and telemedicine, these barriers are becoming obsolete. The new barrier that was identified in this project is access to technology. This barrier can be mitigated by large hospital organizations partnering with community organizations to provide internet access (computers, tablets, wi-fi connection) to its residents using virtual cafes, satellite prenatal classes, and social media.

Although the results of this quality improvement project could not demonstrate a direct relationship between mHealth use and behavior modification, it did show the need for education on proper and optimal use of pregnancy apps. A curriculum update for prenatal classes including

education about mHealth in pregnancy should be considered when appropriate. Applications are being used; however, without existing regulations on apps on the market, the need for an evidence-based tool to evaluate app quality is evident. The MARS tool is a reliable and valid instrument and can be used by professional prenatal educators when recommending pregnancy apps to patients. Further research is needed to determine if mHealth can influence behavior modification among black pregnant women. Longitudinal studies evaluating the effectiveness of mHealth use in reducing pre-term birth risk factors should also be considered. Capturing women in pregnancy to improve lifestyle choices will produce a lifetime of health and wellness for mothers and their infants.

References

Abuidhail, J., Mrayan, L., & Jaradat, D. (2019). Evaluating effects of prenatal web-based breastfeeding education for pregnant mothers in their third trimester of pregnancy: Prospective randomized control trial. *Midwifery*, *69*, 143-149.

American College of Obstetricians and Gynecologists. (2018). *Group prenatal care: ACOG committee opinion.* https://www.acog.org/Clinical-Guidance-and-Publications/Committee-Opinions/Committee-on-Obstetric-Practice/Group-Prenatal-Care?IsMobileSet=false

Arinola, G., Dutta, A., Oluwole, O., & Olopade, C. (2018). Household air pollution, levels of micronutrients and heavy metals in cord and maternal blood, and pregnancy outcomes. *International Journal of Environmental Research and Public Health*, *15*(12), 2891.

Beagley, L. (2011). Educating patients: Understanding barriers, learning styles, and teaching techniques. *Journal of PeriAnesthesia Nursing*, *26*(5), 331-337.

Brown, H. M., Bucher, T., Collins, C. E., & Rollo, M. E. (2019). A review of pregnancy apps freely available in the Google Play Store. *Health Promotion Journal of Australian Health Promotion Professionals, 31*(3), 340-342.

Bush, J., Barlow, D. E., Echols, J., Wilkerson, J., & Bellevin, K. (2017). Impact of a mobile health application on user engagement and pregnancy outcomes among Wyoming Medicaid members. *Telemedicine and e-Health*, *23*(11), 891-898.

Butler, A. S., & Behrman, R. E. (Eds.). (2007). *Preterm birth: Causes, consequences, and prevention.* National Academies Press.

Centers for Disease Control and Prevention. (2017). *Pregnancy and prenatal care*.

https://www.cdc.gov/healthcommunication/toolstemplates /entertainmented/tips/PregnancyPrenatalCare.html

Centers for Disease Control and Prevention. (2018). *Community health assessments and health improvement plans.* https://www.cdc.gov /public health gateway/cha/plan.html

Centers for Disease Control and Prevention. (2019). *State perinatal quality collaboratives.* https://www.cdc.gov/reproductivehealth/maternal infanthealth/pqc-states.html

Chan, K. L., & Chen, M. (2019). Effects of social media and mobile health apps on pregnancy care: Meta-analysis. *JMIR mHealth and Health*, *7*(1), e11836.

Chedid, R. A., & Phillips, K. P. (2019). Best practices for the design, implementation, and evaluation of prenatal health programs. *Maternal and Child Health Journal*, *23*(1), 109-119.

Esposito, G., Ambrosio, R., Napolitano, F., & Di Giuseppe, G. (2015). Women's knowledge, attitudes, and behavior about maternal risk factors in pregnancy. *PLoS ONE*, *10*(12), e0145873.

Frey, H. A., & Klebanoff, M. A. (2016, April). The epidemiology, etiology, and costs of preterm birth. In *Seminars in Fetal and Neonatal Medicine* (Vol. 21, No. 2, pp. 68-73). WB Saunders.

Gielen, A. C., McDonald, E. M., Gary, T. L., & Bone, L. R. (2008). Using the PRECEDE-PROCEED model to apply health behavior theories. *Health behavior and Health Education: Theory, Research, and Practice*, *4*, 407-29.

Green, L. W. (1974). Toward cost-benefit evaluations of health education: Some concepts, methods, and examples. *Health Education Monographs*, *2*(1_suppl), 34-64.

Greene, J., & Hibbard, J. H. (2012). Why does patient activation matter? An examination of the

relationships between patient activation and health-related outcomes. *Journal of General Internal Medicine*, *27*(5), 520-526.

Hamilton, B. E., Martin, J. A., Osterman, M. J., & Rossen, L. M. (2019). *Births: Provisional data for 2018.* https://stacks.cdc.gov/view/cdc/78430

Hamilton, B. E., Martin, J. A., Osterman, M. J., & Rossen, L. M. (2020). *Births: Provisional data for 2019*. https://www.birthbythenumbers.org/wp-content/uploads /2020/05/VSRR-2019.pdf

Hamilton, B. E., Martin, J. A., Osterman, M. J., & Rossen, L. M. (2021). *Births: Provisional data for 2020.* https://www.cdc.gov/nchs/data/vsrr/vsrr012-508.pdf

Health Resources and Services Administration. (2018). *Health center program: Health outcomes and disparities.* https://bphc.hrsa.gov/ qualityimprovement/performancemeasures/healthoutcomes.html

Healthy People 2030. (2021). *Maternal, infant and child health: Objectives.* https://health.gov/healthypeople/objectives-and-data/browse-objectives/pregnancy-and-childbirth

Hetherington, E., Tough, S., McNeil, D., Bayrampour, H., & Metcalfe, A. (2018). Vulnerable women's perceptions of individual versus group prenatal care: Results of a cross-sectional survey. *Maternal and Child Health Journal*, *22*(11), 1632-1638.

Hughson, J. A. P., Daly, J. O., Woodward- Kron, R., Hajek, J., & Story, D. (2018). The rise of pregnancy apps and the implications for culturally and linguistically diverse women: Narrative review. *JMIR mHealth and uHealth*, *6*(11), e189.

Ickovics, J. R., Kershaw, T. S., Westdahl, C., Magriples, U., Massey, Z., Reynolds, H., & Rising,

S. S. (2007). Group prenatal care and perinatal outcomes: A randomized controlled trial. *Obstetrics and Gynecology*, *110*(2 Pt 1), 330.

Inott, T., & Kennedy, B. B. (2011). Assessing learning styles: Practical tips for patient education. *Nursing Clinics of North America*, *46*(3), 313-320.

Kim, U. O., Barnekow, K., Ahamed, S. I., Dreier, S., Jones, C., Taylor, M., ... & Basir, M. A. (2019). Smartphone-based prenatal education for parents with preterm birth risk factors. *Patient Education and Counseling*, *102*(4), 701-708.

Kovala, S., Cramp, A. G., & Xia, L. (2016). Prenatal education: Program content and preferred delivery method from the perspective of the expectant parents. *The Journal of Perinatal Education*, *25*(4), 232-241.

Krieger, N., Chen, J. T., Waterman, P. D., Soobader, M. J., Subramanian, S. V., & Carson, R. (2003). Choosing area based socioeconomic measures to monitor social inequalities in low birth weight and childhood lead poisoning: The Public Health Disparities Geocoding Project (US). *Journal of Epidemiology & Community Health*, *57*(3), 186-199.

Larson, R. S. (2018). A path to better-quality mHealth apps. *JMIR mHealth and uHealth*, *6*(7), e10414.

Lathrop, B. (2013). A systematic review comparing group prenatal care to traditional prenatal care. *Nursing for Women's Health*, *17*(2), 118-130.

Ledford, C. J., Canzona, M. R., Cafferty, L. A., & Hodge, J. A. (2016). Mobile application as a prenatal education and engagement tool: A randomized controlled pilot. *Patient Education and Counseling*, *99*(4), 578-582.

March of Dimes Perinatal Data Center. (2011). *Special Care Nursery Admissions*. https://www.marchofdimes.org/peristats/ pdfdocs/nicu_summary_final.pdf

March of Dimes. (2021). 2020 premature birth report card: United States. https://www.marchofdimes.org/peristats/tools/reportcard.aspx?frmodrc=1&reg=21

March of Dimes. (2019). *Prenatal education and outreach*. https://www.marchofdimes.org/mission/prenatal-education-and-outreach.aspx

Marko, K. I., Ganju, N., Krapf, J. M., Gaba, N. D., Brown, J. A., Benham, J. J., ... & Meltzer, A. C. (2019). A mobile prenatal care app to reduce in-person visits: Prospective controlled trial. *JMIR mHealth and uHealth*, *7*(5), e10520.

Mauriello, L. M., Van Marter, D. F., Umanzor, C. D., Castle, P. H., & de Aguiar, E. L. (2016). Using mHealth to deliver behavior change interventions within prenatal care at community health centers. *American Journal of Health Promotion*, *30*(7), 554-562.

McCabe, P. J., Stuart-Mullen, L. G., McLeod, C. J., Byrne, T. O., Schmidt, M. M., Branda, M. E., & Griffin, J. M. (2018). Patient activation for self-management is associated with health status in patients with atrial fibrillation. *Patient Preference and Adherence*, *12*, 1907.

National Quality Forum. (2016). *The ABCs of Measurement* http://hitconsultant.net/2012/07/18/74-of-physicians-report-ehr-adoption-enhanced-patient-care/

National Quality Forum. (2019a). *Perinatal and Reproductive Health Project 2015-2016: Descriptions.* www.qualityforum.org /Project Description.aspx?projectID =80680

National Quality Forum. (2019b). *Perinatal and Reproductive Health Project 2015-2016: Measures*. http://www.qualityforum.org /Project Measures.aspx?projectID=80680

Overdijkink, S. B., Velu, A. V., Rosman, A. N., Van Beukering, M. D., Kok, M., & Steegers-Theunissen, R. P. (2018). The usability and effectiveness of mobile health technology–

based lifestyle and medical intervention apps supporting health care during pregnancy: Systematic review. *JMIR mHealth and uHealth*, *6*(4), e109.

Ovia Health. (2020). *The real cost of preterm birth – how to save lives and save millions.* https://www.oviahealth.com/blog/the-real-cost-of-preterm-birth-how-to-save-lives-and-save millions/#:~:text=According%20to%20the%20March%20of,U.S% 20healthcare%20costs%20each%20year.

Rising, S. S. (1998). Centering pregnancy: An interdisciplinary model of empowerment. *Journal of Nurse-Midwifery*, *43*(1), 46-54.

Rosas, L. G., Trujillo, C., Camacho, J., Madrigal, D., Bradman, A., & Eskenazi, B. (2014). Acceptability of health information technology aimed at environmental health education in a prenatal clinic. *Patient Education and Counseling*, *97*(2), 244-247.

Rural Health Information Hub. (2011). *Program models: Precede-proceed*. https://www.ruralhealthinfo.org/toolkits/ health-promotion/2/program-models/precede-proceed

Russell, S. S. (2006). An overview of adult - learning processes. *Urologic Nursing*, *26*(5), 349-352.

Stoyanov, S. R., Hides, L., Kavanagh, D. J., Zelenko, O., Tjondronegoro, D., & Mani, M. (2015). Mobile app rating scale: A new tool for assessing the quality of health mobile apps. *JMIR mHealth and uHealth*, *3*(1), e27.

Tsai, Y. J., Hsu, Y. Y., Hou, T. W., & Chang, C. H. (2018). Effects of a web-based antenatal care system on maternal stress and self-efficacy during pregnancy: A study in Taiwan. *Journal of Midwifery & Women's Health*, *63*(2), 205-213.

University of Louisville Hospital. (2020). *About us: Our mission, vision and values*.

https://uoflhospital.org/our-mission-vision-and-values

University of Louisville Hospital. (2019). *Community Health Needs Assessment 2020-2022.* https://uoflhospital.org/sites/default/files/2019-09/FY20-22%20ULH%20CHNA%20FINAL.pdf

Van Den Heuvel, J. F., Groenhof, T. K., Veerbeek, J. H., Van Solinge, W. W., Lely, A. T., Franx, A., & Bekker, M. N. (2018). eHealth as the next-generation perinatal care: An overview of the literature. *Journal of Medical Internet Research*, *20*(6), e202.

Woods, N. K., & Chesser, A. (2015). Becoming a mom: Improving birth outcomes through a community collaborative prenatal education model. *Journal of Family Medicine and Disease Prevention*, *1*(002), 1-4.

World Health Organization. (2019). *Care of the pre-term and low-birth weight newborn.* https://www.who.int/maternal_child_ adolescent/newborns/prematurity

Xu, H., & Long, H. (2020). The effect of smartphone app – based interventions for patients with hypertension: Systematic review and meta-analysis. *JMIR mHealth and uHealth*, *8*(10), e21759.

Zangmo, R., Kumari, A., Garg, D., & Sharma, K. A. (2020). Redesigning routine antenatal care in low resource setting during COVID-19 pandemic. *Journal of Family Medicine and Primary Care*, *9*(9), 4547.