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TELEHEALTH USE DURING THE PRENATAL PERIOD: STRENGTHS AND LIMITATIONS

A MASTER'S PROJECT

SUBMITTED TO THE GRADUATE FACULTY

OF THE GRADUATE SCHOOL

BETHEL UNIVERSITY

BY

ADRIAN M. GOBLISCH & TESSA L. HAND

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Telehealth Use During the Prenatal Period: Strengths and Limitations

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May 2021

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Abstract

Background/Purpose: The purpose of this paper is to examine the risks and benefits of telehealth use during the prenatal period. With the increasing use of technology to provide healthcare, especially during the COVID-19 pandemic, it is critical to examine the implications this care modality has on individuals and the community.

Theoretical Framework: Katharine Kolcaba's Comfort Theory was applied to the topic of telehealth use in the prenatal period. This theory explains that there is an immediate experience of strengthening when relief, ease, and transcendence are met and that an individual is more likely to exhibit health-seeking behaviors when comfort in these areas is achieved.

Methods: 21 research articles were critically reviewed in order to determine the risks and benefits of telehealth use during the prenatal period. Search engines used included CINAHL & PubMed. Keywords used in the search process included "telehealth", "pregnancy", "obstetrics", and "midwifery".

Results/Findings: Telehealth use during the prenatal period was found to increase patient satisfaction as well as provide equal or enhanced effectiveness and safety. It was also found that there is a lack of research focusing solely on how telehealth use during the antenatal period may contribute to health disparities. Some common barriers are noted which include access to internet or cell phone and language limitations.

Implications for Research and Practice: While telehealth has many benefits, more evidence is needed to determine whether integration of such technologies into the prenatal care setting contributes to or improves health disparities. The provider should be mindful that some patients

may not have access to certain technologies and that such modalities may not be able to be used by some due to language barriers.

Keywords: telehealth, prenatal, pregnancy, midwifery, obstetrics

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Chapter I: Introduction

Statement of Purpose

Healthcare will forever be changed because of the COVID-19 global pandemic. The pandemic has affected nearly every aspect of people's lives and the entire healthcare industry. It has forced healthcare providers to work differently and placed high importance on ensuring patients' safety by avoiding any potential virus exposures. This has hugely affected society, including pregnant women. The pandemic has made it difficult for some women to seek obstetrical care as they may have infectious viral symptoms, be in isolation, or have other barriers that keep them from being able to seek care (Fryer et al., 2020). These barriers have brought telehealth to the forefront of obstetrical care. Midwives and obstetricians are beginning to transition their care to offer virtual care experiences. Medicaid has expanded its coverage of telehealth services, the need for HIPPA compliant platforms has been waived, and facilities have rushed to implement telehealth services (Fryer et al., 2020). Now, more than ever, it is important to investigate both the benefits and the risks of using telehealth programs to provide prenatal care.

The American College of Nurse-Midwives (ACNM) believes every individual has the right to safe, satisfying health care that accommodates human and cultural variations. They also encourage continuity of care; emphasize safe, evidence-based, competent clinical management; promote health education for women throughout the childbearing cycle; and support women as partners in health care choices. In order to support these beliefs and principles, it is the position of the ACNM that appropriate use of technological intervention is encouraged when the benefits of such technology outweigh the risks, and when the intervention is warranted to improve the health and/or wellbeing of the woman and/or infant (ACNM, 2014). As telehealth is more readily

used, it is important that midwives remember and uphold these values. By understanding both the strengths and limitations of providing prenatal care via telehealth, midwives can ensure that they are providing high quality, culturally competent care without furthering health disparities.

Evidence Demonstrating a Need for Critical Review

Even before the COVID-19 pandemic, the use of telehealth has been increasing in nearly every area of obstetrics and gynecology, including that of prenatal care (American College of Obstetricians and Gynecologists [ACOG], 2020), and it is expected that this mode of care will remain quite popular in the foreseeable future (Ong et al., 2020). Telehealth can be broadly defined as any use of electronic information and telecommunications technologies to support health care (Ong et al., 2020). Examples of how telehealth can be implemented into prenatal care include virtual visits, remote patient monitoring, and mobile health care (ACOG, 2020). However, best practices are not clearly described.

There is no one clear best practice recommendation regarding telehealth as it remains a vast and developing topic. Telehealth services can encompass a full range of different healthcare services beyond just prenatal care. Even within obstetrics, telehealth services may be used in a variety of scopes like prenatal care, postpartum care, birth control access and diabetes management. This large variety of care means there is much research to be done. According to ACOG (2020), “Evidence suggests that telehealth provides comparable health outcomes when compared with traditional methods of health care delivery without compromising the patient–physician relationship, and it also has been shown to enhance patient satisfaction and improve patient engagement”. This initial evidence is supportive of using telehealth to provide prenatal care. A comprehensive study by DeNicola (2020) screened almost 3,926 articles, reviewing 47 of those articles which included over 31,000 participants and concluded that there are many benefits

to using telehealth services in obstetrical care thus continuing the support for providing obstetrical services via telehealth. These benefits are becoming more integrated into OB-GYN health care practices.

Specifically, ACOG reports telehealth is quickly becoming integrated into most aspects of obstetrical care, but it also warns that it should enhance and not replace current standards for care (ACOG, 2020). ACOG encourages providers to ensure that the highest quality of care is being provided while still abiding by any legal requirements, using appropriate billing methods and ensuring that there is appropriate liability insurance to cover any telehealth services (ACOG, 2020). The ACNM does not have as clear of a statement regarding telehealth services but has teamed up with many other organizations to recommend and support legislative efforts to increase access to telehealth services because of the COVID-19 pandemic (ACNM, 2020).

There is much evidence in favor of using telehealth services for obstetrical care but there are no obvious conclusions on the limitations of using these services. This is of particular importance when discussing health disparities. While midwives practice further and more in-depth telehealth services, it is important to evaluate both the strengths and the limitations of providing prenatal care via telehealth.

Significance to Nurse-Midwifery

While one Hallmark of Midwifery highlights the therapeutic value of human presence, another Hallmark recognizes the importance of incorporation of scientific evidence into practice (ACNM, 2020). In order to reach individuals who cannot receive prenatal care, such as those who live in rural areas, those who have limited access to transportation, or those who would prefer to minimize exposure during a pandemic, telehealth may be a good option (Ong et al.,

2020). There is evidence which suggests that current models of prenatal care are outdated, time-consuming, and use many healthcare resources, particularly when women are low risk. It is also shown that integration of telehealth into the prenatal model of care can yield better outcomes without compromising quality of care (Butler et al., 2019).

Midwifery is a profession that is as old as childbearing itself (Connerton, 2012) and it is important that midwifery care continues to improve in order to maintain professional integrity. Application of innovative and modern professional standards, while maintaining balance to incorporate traditional components unique to midwifery care, could be an effective way to factor all Hallmarks of Midwifery (ACNM, 2020) into practice.

Theoretical Framework

The Comfort Theory was developed in the 1990s by an American nurse-scholar named Katharine Kolcaba. This nursing theory describes that, depending upon the situation, comfort can be found as relief, ease, and transcendence. This theory describes that there is an immediate experience of strengthening when relief, ease, and transcendence are met and that an individual is more likely to exhibit health-seeking behaviors when comfort in these areas is achieved. This theory recognizes that comfort is much more than the absence of pain or other physical troubles and explains that comfort must be fulfilled not only physically, but in psychospiritual, sociocultural, and environmental manners as well. It is also mentioned that these comforts can only be achieved when holistic, efficient, and individualized care is provided (Egger-Rainer et al., 2017). Providing women with the option to use telehealth modalities in the prenatal period could increase opportunities for women to feel fulfilled in the areas of relief, ease, and transcendence. However, it should also be considered if telehealth could potentially hinder fulfillment of comfort for some. Further discussion surrounding how prenatal telehealth may

enhance or impede upon comfort will occur in Chapter IV, after a thorough review of the literature has been made.

Chapter II: Methods

This chapter describes the methods and processes used to analyze articles with the goal of finding high-quality data to investigate the strengths and weaknesses of prenatal telehealth. After careful critique, 21 articles were selected and included in this report. In order to explain how these 21 articles were selected, a detailed discussion surrounding search strategies and criteria for inclusion and exclusion will be provided. Additionally, the selected studies will be summarized, and an explanation of evaluation criteria will be given.

Search Strategies

Databases used during the search process included PubMed and The Cumulative Index to Nursing and Allied Health Literature (CINAHL). The search was limited to randomized control trials (RCTs) dated from 2015-2021. An initial search was done using the PubMed database using the terms, “telehealth”, “pregnancy”, “obstetrics”, and “midwifery”, which yielded 24 RCTs. Of these, six were removed after review of duplicates and 17 were removed after review of titles and abstracts, leaving one. Next, a CINAHL database search was conducted using the same terms, which resulted in 37 articles. After review of abstracts and titles and elimination of duplicates, two were left for inclusion. PubMed was again used and the terms “telehealth” and “prenatal” were included. This search yielded 21 RCTs. After duplicates were removed, 19 RCTs were available. After review of titles and abstracts, an additional 12 were removed, leaving seven RCTs for inclusion. An additional PubMed search was made, this time using the terms “telehealth” and “obstetrics”. From this search, 41 articles were populated and 33 were left after removal of duplicates. After review of titles and abstracts, 31 of the 33 were eliminated, leaving two articles for inclusion. A final PubMed search was made using the terms “telehealth” and “pregnancy”. This search yielded 66 RCTs, and 53 were left after removal of duplicates. Of

these 53, 49 were eliminated after review of titles and abstracts, leaving four articles for inclusion. Last, five articles were data-mined from other literature for additional resources.

Criteria for Inclusion and Exclusion

Articles that were included in this report involved interventions that occurred only during the prenatal period and included services being received through various means of telehealth. Excluded articles included any that involved postpartum, intrapartum, primary care, or general gynecological interventions. Several themes were identified during the evaluation of the articles. The themes identified are: telehealth for management of gestational hypertension, interventions for smoking cessation during pregnancy, management of hypertension in pregnancy, encouragement of physical activity while pregnant, weight control or gestational diabetes management in pregnancy, assessment of mental wellbeing in pregnancy, and prenatal care models that use telehealth interventions. Initially, only research completed within the United States was included, however, it was found that the United States did not have a robust number of high-quality articles that met the rest of the inclusion criteria Therefore, high quality research from foreign countries was reviewed and included as well.

Summary of Selected Studies

259 research articles published between 2015 and 2021 were considered for inclusion in this review. After removal of duplicates, the abstracts and titles of 141 RCTs were carefully reviewed and considered according to the inclusion and exclusion criteria. 120 articles were removed after review of abstracts and titles, leaving 21 RCTs for inclusion in this report/paper/study/review. Eight of the included articles came from the United States, two articles came from each China, Australia, and the UK, and one article came from each Canada,

Spain, Sweden, Korea, England, Brazil, and the Netherlands. Next is a description of the evaluation criteria applied in this review.

Evaluation Criteria

The final 21 articles were reviewed and evaluated for quality using the John Hopkins Research Evidence Appraisal Tool (Dearholt & Dang, 2018). This tool allows for categorization of quantitative research articles into levels I-III. A Level I rating describes articles that are RCTs or experimental studies, level II describes articles that are quasi experimental, and level III describes articles that are non experimental. 20 articles in this review were categorized as level I and 1 was categorized as level II. Next, each of the articles were appraised by examining details to determine the quality of the research. Category "A" or "high quality" articles are described as those that have, "Consistent, generalizable results; sufficient sample size for the study design; adequate control; definitive conclusions; and consistent recommendations based on comprehensive literature review that includes thorough reference to scientific evidence." Category "B" or "good quality" articles are described as those that have, "Reasonably consistent results; sufficient sample size for the study design; some control, and fairly definitive conclusions; and reasonably consistent recommendations based on fairly comprehensive literature review that includes some reference to scientific evidence." Category "C" or "low quality" articles are described as those that have, "Little evidence with inconsistent results; insufficient sample size for the study design; and conclusions cannot be drawn" (Dearholt & Dang, 2018, p. 286). Of the articles included in this review, 18 were categorized as "high quality" and 3 were categorized as "good quality". None were categorized as "low quality".

Summary

The majority of articles identified for this review were from the result of performing several searches in the PubMed database. The CINAHL database was used to identify two articles, and five of the articles were data-mined from other literature. The inclusion and exclusion criteria for this review was applied to determine. he final 21 articles examined in this review. kept Last, those 21 articles were appraised using the John Hopkins Research Evidence Appraisal Tool to confirm the type and identify the quality of evidence. Next in Chapter III is a synthesis and analysis of the articles selected for this review.

Chapter III: Literature Review and Analysis

This chapter includes discussion on the articles used for this literature review including a synthesis of the matrix, synthesis of major findings, critique of strengths and weaknesses and a summary. There are five areas of major findings discussed including, patient satisfaction, patient participation, safety, effectiveness and health disparities.

Synthesis of the Matrix

The Literature Review Matrix (Appendix) includes 20 randomized controlled trials and 1 controlled, non-inferiority clinical trial. The level of evidence and quality of each research study was appraised using the Johns Hopkins Research Evidence Appraisal Tool (Dearholt & Dang, 2018). The matrix includes the study design, descriptions of the samples, pertinent findings, implications for practice, strengths and limitations of the study, and the level of evidence and quality assigned to each article. The studies in the matrix are listed in alphabetical order. The purpose, design, pertinent findings, and strengths and limitations of each study are evaluated, and the synthesis of that data is presented in Chapter III.

Synthesis of the Major Findings

Each of the 21 articles evaluated in this review focus on telehealth interventions used in the antenatal period. Interventions discussed in the 21 selected articles include seven articles about gestational diabetes management programs, five articles about physical activity and weight gain in pregnancy, three articles about prenatal care and screening models, three articles about antenatal mental health, two articles about smoking cessation in pregnancy and one article about gestational hypertension management. Several themes emerged from the review of the articles

that are synthesized next in this literature review. These themes include patient satisfaction, patient participation, safety, effectiveness, and health disparities.

Patient Satisfaction

Patient satisfaction is a key component that drives how Medicaid and Medicare reimburse providers. Evaluating the impact that telehealth has on patient satisfaction is an important consideration. Although there is no generalized research to support increased patient satisfaction when using telehealth services for antenatal care, most articles cite either equal or greater satisfaction with telehealth when compared to usual care. Several of the sturdies reviewed show examples.

The first example is an RCT that evaluated OB Nest. OB Nest is a reduced frequency prenatal care program that consists of eight onsite appointments combined with 6 virtual visits. When comparing patients in a control group of traditional prenatal care (UC) participants to participants randomized to OB Nest (OBN), the OBN group had higher satisfaction with care (OBN = 93.90 vs UC = 78.89; mean group difference [MD] 15.01, 95% confidence interval [CI], 13.38–16.64) (Butler Tobah et al., 2019). Not only did women who participated in the OB Nest model report higher satisfaction rates, but they also reported lower pregnancy-related stress at 14 weeks of gestation (OBN = 0.32 vs UC = 0.41; MD = -0.09, 95% CI, -0.14 to -0.04) and at 36 weeks of gestation (OBN = 0.34 vs UC = 0.40; MD = -0.06, 95% CI, -0.11 to -0.01) (Butler Tobah et al., 2019).

The next example is A randomized controlled trial that evaluated the feasibility of a web-based mental health e-screenings of 636 pregnant women (intervention [n=305], control [n=331]) shows that women reported the features of the e-screenings as much more favorable

than the control groups (58.9%), citing that they were more confidential, less impersonal, and less time-consuming (Kingston, 2017).

Another randomized controlled trial evaluated 90 patients with gestational diabetes and tested a clinical decision support system called *Sinedie* that managed the treatment of these patients' gestational diabetes. This study found that patients reported higher satisfaction with the web-based telemedicine platform when compared to traditional management systems. In addition, researchers found patients considered telehealth not only useful but also considered it to be trustworthy (Caballero-Ruiz, 2017). Another example of an RCT that evaluated patient satisfaction is next.

A randomized controlled trial by Mackillop et al. (2018) studied 203 women with abnormal oral glucose tolerance tests and evaluated the effectiveness of phone-based blood glucose management (n=98) compared to standard care (n=85). They found both groups reported high levels of satisfaction with the care they received (intervention: median 43, IQR 39-46; control: median 44.5, IQR 41-46; Kruskal-Wallis χ^2_1=3.9, *P*=.049). In the intervention group, 57 of 60 women who used the app said they would use it again and 51 of 60 in the control group stated they would consider using a mobile phone app. Overall, women using the intervention had higher satisfaction with care (P=.049).

Last, Leeuw et al. (2019) aimed to evaluate face-to-face information provision in patient counseling for prenatal screening compared with two forms of digital information provision, noninteractive instructional video or interactive video. The control group (n=67) received usual care, meaning a single consultation of face-to-face information provision and counseling. The intervention group was randomized between information provision of an instructional (n=36) or interactive video (n=38) before they continued to face-to-face, personal counselling. Regarding

patient satisfaction, it was found that the intervention group was noninferior compared with the control group (control: 3.91 (CI, 3.38-4.42), intervention: 3.93 (CI, 3.53-4.33), *P* = .88).

Patient Participation

Promotion of patient participation an international priority identified by the World Health Organization. It is also considered an important aspect of person-centered care by various national bodies around the world (Oxelmark et al., 2017). In the antenatal period, patient participation is crucial in order to achieve high-quality care and optimal outcomes. Upon review of the literature, it was identified that several studies defined, measured patient participation, with most of the findings showing an increase in participation levels. Examples of patient participation measures in RCT studies is next.

First, Guo et al. (2019) studied 124 patients with gestational diabetes mellitus (GDM) and randomly divided patients into two groups (control: n=60, intervention: n=64). Those in the control group received standard outpatient treatment, while the remaining patients received a nurse's online guidance both through a mobile medical app installed on their phone and through regular offline clinical treatment in the mHealth group. The authors found that the mobile medical app resulted in higher levels of compliance in blood glucose management amongst women with gestational diabetes (intervention: 83.3 ± 12.5% vs. control: 70.4 ± 10.1%, t = -6.293, df = 122, $p < 0.001$). Increased levels of compliance and participation subsequently resulted in lower frequency of outpatient service (intervention: 8.1 ± 1.3 vs. control: 11.2 ± 1.1, t = 14.285, df = 122, $p < 0.001$), lower hemoglobin A1C before delivery (intervention: 4.7 ± 0.2 vs. control: 5.3 ± 0.3, t = 13.216, df = 122, $p < 0.001$), and decreased rates of off-target measurements of both fasting (intervention: 4.6 ± 0.4% vs. control: 8.3 ± 0.6%, t = 40.659, df = 122, $p < 0.001$) and 2-hour postprandial readings (intervention: 7.9 ± 0.7% vs. control: 14.7 ±

0.8%, t = 50.746, df = 122, p < 0.001). Additionally, participants in the mHealth group were better able to manage weight gain when compared to the control group (intervention: 3.2 ± 0.8 vs. control: 4.8 ± 0.7, t = 11.851, df = 122 p < 0.001). Further promising results in the area of patient participation were discovered in the next article by Oliveria-Ciabati.

Oliveira-Ciabati et al. (2017) studied a bi-directional, mobile phone based, short text message service called PRENACEL and its ability to increase the coverage of recommended antenatal care practices. Pregnant women aged 18 or above with a gestational age of 20 weeks or less were enrolled in this study (n=1210). Women who registered in PRENACEL (n=770) received a weekly set of short text messages with health education and health promotion content related to pregnancy and childbirth and were also able to clarify antenatal care queries through text messages. It was found that women who received and read the PRENACEL messages had higher mean antenatal care scores (intervention: 48.5 [±4.2] vs control: 45.2 [±8.7], p < 0.01), there was a higher proportion of women with ≥6 ANC visits (intervention: 96.9% vs. control: 84.8%, p = 0.01), and there were higher rates of syphilis testing (intervention: 40.5% vs. control: 24.8%, p = 0.03) as well as HIV testing (intervention: 46.6% vs. control: 25.7%, p < 0.01), thus increasing patient participation in antenatal care.

Last, Pealing et al. (2019) studied 158 women (control: n=54, intervention: n=104) to assess the feasibility of a blood pressure self-monitoring intervention for managing pregnancy hypertension. Self-monitoring involved daily home blood pressure measurements with recording via study diary or tele monitoring. There was high persistence with the self-monitoring intervention with 86% (43/50 of those supplying home data) of women with chronic and 76% (38/49) of women with gestational hypertension providing home BP readings for 80% or more of their time from enrolment until delivery. This suggests that patient participation was high and

thus at home blood pressure monitoring may be a good option, when combined with clinic monitoring.

Safety

The World Health Organization (2017) states that patient safety is a fundamental principle of health care., Several high-income countries have published studies showing that significant numbers of patients are harmed while obtaining health care, either resulting in permanent injury, increased length of stay in health care facilities, or even death (The World Health Organization [WHO], 2017). One trend noted upon review of the selected articles regarding telehealth during the prenatal period is that patient safety was at least maintained, and there is some suggestion of improved patient safety outcomes. Next are examples of the Safety theme found in the syntheses of the studies in this literature review.

One example is from Mackillop et al. (2018) aimed to determine whether the use of a mobile phone-based real-time blood glucose management system to manage women with GDM remotely was as effective in controlling blood glucose as standard care through clinic attendance. It was found that preterm birth was less common in the intervention group (intervention: 5/101, 5.0% vs control: 13/102, 12.7%: OR 0.36, 95% CI 0.12-1.01). There were fewer cesarean deliveries compared with vaginal deliveries in the intervention group (intervention: 27/101, 26.7% vs control: 47/102, 46.1%, P=.005), there were significantly more blood glucose readings in the intervention group (intervention: mean 3.80 [SD 1.80] and control: mean 2.63 [SD 1.71] readings per day; P<.001), and there were no unexpected adverse outcomes. In summary, these authors found that the system appears safe with comparable glycemic control and comparable maternal and newborn outcomes between allocated groups. Of note, there was also superior data capture in the intervention group, which may further reflect patient safety.

Another example of safety is a study that measured the effects of telemedicine supported gestational diabetic care on a range of health service utilization and maternal and fetal outcomes. It was found that there were no differences between the groups (control: n=34, intervention: n=61) in a number of face-to-face appointments (median [IQR] intervention = 8[7], control = 8[6], p = 0.843), rates of caesareans, macrosomia, large for gestational age newborns, special care nursery admission or newborn birth weight. Participants receiving the intervention reached optimal glycemic control more quickly (intervention: mean [SD] 4.3[4.2] weeks vs. control: 7.6[4.5] weeks, p = 0.0001) and telemedicine was a significant predictor of better glycemic control (HR = 1.71[95%] CI: 1.11, 2.65, p = 0.015). The conclusion was drawn that the use of telemedicine produced similar clinical outcomes as usual care and posed no added risk to clinical quality of care. The intervention may also be associated with fewer insulin dose titrations, which further enhances patient safety (Rasekaba et al., 2018). Effectiveness is the next theme described in this synthesis of this literature review.

Effectiveness

When examining telehealth in the prenatal period, one major trend researchers sought to examine was the effectiveness of the intervention. This is likely because effectiveness is a key component in determining if an intervention is worthwhile. In articles that examined effectiveness, much of the research found that the interventions were just as effective or enhanced the effectiveness of traditional care methods already in place. Example of effectiveness measures in many of the studies in this review are next.

To begin these examples, Butler Tobah et al. (2019) evaluated the acceptability and effectiveness of OB Nest (OBN), a reduced frequency prenatal care model that uses remote home monitoring devices and nursing support. This model consists of eight onsite appointments

with an OB provider, 6 virtual visits on the phone or online with a nurse, supplemental fetal Doppler and blood pressure monitoring at home, and access to an online community of pregnant women. Effectiveness was evaluated by proxy measures including adherence to the American College of Obstetricians and Gynecologists' (ACOG)-recommended routine prenatal laboratory services, ultrasound imaging, immunization, and patient education. Findings revealed that there was no significant difference in the provision of ACOG recommended ancillary prenatal services (influenza vaccine [OBN=105 (80.2%) vs UC=109 (83.8%), *P* = .44], a Tdap booster [OBN=119 (90.8%) vs UC=117 (90.0%), *P* = .82], mid-pregnancy education [OBN=127 (96.6%) vs UC=123 (94.6%), *P* = .35], screening for group B *Streptococcus* [OBN=128 (97.7%) vs UC=129 (99.2%), *P* = .32], and depression screening [OBN=130 (99.2%) vs UC=129 (99.2%), *P* = 1.0]). It was also found that participants randomized to OB Nest group had higher satisfaction with care (OBN=93.90 vs UC=78.89; mean group difference [MD] 15.01, 95% confidence interval [CI], 13.38–16.64) and decreased rates of pregnancy-related stress at 14 weeks (intervention=0.32 vs control=0.41, P < .01) and at 36 weeks of gestation (intervention=0.34 vs control= 0.40, P < .03). Last, quality of care was not significantly different across the two groups. After considering these outcomes, the authors conclude OB Nest is effective and offers an alternative approach that yields better outcomes without affecting quality of care. The OB nest prenatal care model is just one way that telehealth services can promote antepartum care. The next study discussed reviews how telehealth services can be utilized to manage the treatment of gestational diabetes.

Caballero-Ruiz et al. (2017) also investigated the effectiveness of *Sinedie*, a clinical decision support system designed to manage the treatment of patients with gestational diabetes. This randomized controlled trial evaluated 90 participants and found that *Sinedie* detected all

situations that required a therapy adjustment, and all the generated recommendations were safe. There was no monitoring loss, and on average, patients measured their blood glucose 3.890 times per day. It was concluded that *Sinedie* generates safe advice about therapy adjustments, reduces the clinicians' workload, and helps physicians to identify which patients need a more urgent or more exhaustive examination and those who present good metabolic control. *Sinedie* saves patients unnecessary displacements which contributes to medical centers' waiting list reduction as well. To summarize, it was determined that the telehealth mechanism in this scenario was highly effective in blood glucose management, clinician workload reduction, and medical center wait list reduction. This study showed promising results, as did the next study discussed which reviewed physical activity in pregnant women.

A study by Choi et al. (2016) aimed to investigate the efficacy of a 12-week mobile health (mHealth) physical activity intervention in pregnant women. Intervention participants had a 1096 ± 1898 step increase in daily steps compared to an increase of 259 ± 1604 steps in control participants at 12 weeks. The intervention group also reported lower perceived barriers to being active and with a lower lack of energy than the control group at the 12-week visit ($p = 0.02$). However, this was a relatively small study, only examining 30 participants, thus this small pilot study was unable to show statistically significant effects on physical activity between the intervention and control groups and a larger study on this intervention is recommended. Telehealth services can not only be effective in managing physical activity, but also weight management in pregnancy, which is discussed in the next article.

Ferrara et al. (2020) aimed to discover if a primarily telehealth lifestyle intervention reduced excess gestational weight gain (GWG) among women with overweight or obesity. The core lifestyle intervention consisted of 2 in person and 11 telephone sessions on behavioral

strategies to improve weight, diet, physical activity, and stress management to help women meet a trial goal of gaining at the lower limit of the Institute of Medicine (IOM) guidelines range for total GWG. The authors found that, compared with usual care, women in the lifestyle intervention had reduced weekly rates of GWG (intervention: mean 0.26 kg per week [SD 0.15] vs control: mean 0.32 kg per week [0.13]; mean between-group difference -0.07 kg per week, 95% CI -0.09 to -0.04), concluding that this telehealth intervention is effective.

A study by Forsell et al. (2017) tested the efficacy of a pregnancy adapted version of an existing 10-week internet cognitive behavioral therapy (ICBT)-program for depression. It was determined that the ICBT group (n=22) had significantly lower levels of depressive symptoms post treatment ($p < 0.001$, Hedges g =1.21), and the authors concluded pregnancy adapted ICBT for antenatal depression is feasible, acceptable, and efficacious. However, they recommend that these results need to be replicated in larger sample size (sample size for this study, n=42) to validate these promising findings.

Guo et al. (2019) explored the effects of a mobile health (mHealth) intervention on pregnancy weight management, blood glucose control, and pregnancy outcomes. In this study, 60 patients were placed in the control group and received standard outpatient treatment, while the remaining 64 patients received a nurse's online guidance both through a mobile medical app installed on their phone and through regular offline clinical treatment. The mHealth intervention was effective in increasing levels of compliance (intervention: 83.3 ± 12.5% vs control: 70.4 ± 10.1%, $t = - 6.293$, $df = 122$, $p < 0.001$), lowering frequency of outpatient service (intervention: 8.1 ± 1.3 vs control: 11.2 ± 1.1, $t = 14.285$, $df = 122$, $p < 0.001$), decreasing hemoglobin A1C before delivery (intervention: 4.7 ± 0.2 vs control: 5.3 ± 0.3, $t = 13.216$, $df = 122$, $p < 0.001$), reducing excess weight gain (intervention: 3.2 ± 0.8 vs control: 4.8 ± 0.7, $t = 11.851$, $df = 122$ p

< 0.001), as well as lowering rates of off-target measurements in both fasting (intervention: 4.6 ± 0.4% vs control: 8.3 ± 0.6%, t = 40.659, df = 122, p < 0.001) and 2 hour postprandial glucose (intervention: 7.9 ± 0.7% vs control: 14.7 ± 0.8%, t = 50.746, df = 122, p < 0.001).

A study by Hantsoo et al. (2017) tested whether a mood tracking and alert (MTA) mobile application (app) improved mental health care delivery in a high-risk obstetric population. Participants were randomly assigned to one of three conditions: A mobile app allowing access to a "patient portal" (PP), a standard of care available to all patients at the health center, that enabled email-like communication with providers; PP with the addition of a mood tracking and alert (MTA) app that alerted providers when participant mood symptoms worsened, prompting the provider to contact the participant; The PP app and MTA app with a lottery incentive to encourage MTA app use. It was discovered that MTA users had significantly more contacts with mental health professionals including telephone encounters (F=6.0, df=1 and 55, p=.02) and referrals to a mental health provider (t=−2.3, df=15, p=.03). They also rated their ability to manage their own health significantly better than controls (F=4.03, df=4 and 49, p=.007). Among MTA users, PHQ-9, GAD-7, and self-reported daily mood scores significantly improved over eight weeks. Measures of depressive (F=7.87, df=2.5 and 47.3, p=.001) and anxiety (F=6.32, df=2.2 and 42.1, p=.003) symptoms and self-reported daily mood (F=2.62, df=4.2 and 139.9, p=.03) also improved over eight weeks among MTA app users. However, patients with depressive symptoms tend to improve over time, therefore, the researchers are unable to make causal claims that symptom improvement was due to app use.

Herring et al. (2016) aimed to evaluate whether a technology-based behavioral intervention could decrease the proportion of African American women with overweight or obesity who exceeded Institute of Medicine (IOM) guidelines for gestational weight gain.

Participants were randomized to usual care or a behavioral intervention that promoted weight control in pregnancy. The intervention included empirically supported behavior changes goals, interactive self- monitoring text messages, biweekly health coach calls, and skills training and support through Facebook. This study found that the intervention resulted in lower prevalence of excessive gestational weight gain (intervention: 8.7 vs control: 12.3 kg, adjusted mean difference: 23.1 kg, 95% CI: 26.2 to 20.1), concluding that telehealth in this scenario was effective.

Leeuw et al. (2019) studied face-to-face information provision in patient counseling for prenatal screening compared with two forms of digital information provision including non-interactive instructional video and interactive video. The control group received usual care, meaning a single consultation of face-to-face information provision and counseling, while the intervention group was randomized between information provision by through an instructional or an interactive video before they continued to face-to-face, personal counseling. Each participant in the intervention group watched or interacted with the video in a private waiting room immediately before the counseling, and each counselors timed the duration of their total consultation. Results revealed that the knowledge grade difference was higher after using the intervention (knowledge grade difference pre/posttest control: +0.91 vs intervention: +2.07), and the duration was significantly longer in the face-to-face group at 23 minutes versus 16 minutes in the intervention group. This means that including an instructional video in patient counseling was effective in improving patient's knowledge and shortening time consumption of the counselor.

A study by Mackillop et al. (2018) aimed to determine whether the use of a mobile phone-based real-time blood glucose management system to manage women with GDM

remotely was as effective in controlling blood glucose as standard care through clinic attendance alone. Participants in the intervention group were loaned a mobile phone with the preinstalled GDm-health app and taught how to record, tag, and review blood glucose readings by a research midwife. Every 4 to 8 weeks these participants attended the outpatient clinic, which was half as many clinic visits as the standard clinic care group. Results showed that there was no significant difference in rate of change of blood glucose (intervention: –0.16 mmol/L vs control: –0.14 mmol/L per 28 days, P=.78), meaning that the telehealth intervention in this case was equally as effective as standard care.

Naughton et al. (2017) studied the effectiveness of pregnancy smoking cessation support delivered by short message service (SMS) text message. 407 participants were randomized to the intervention (n = 203) or usual care (n = 204). Eligible women were < 25 weeks' gestation, smoked at least one daily cigarette (> 5 pre-pregnancy), could receive and understand English SMS texts and were not already using text-based cessation support. All participants received a smoking cessation leaflet; intervention participants also received a 12-week program of individually tailored, automated, interactive, self-help smoking cessation text messages (MiQuit). Using the validated, continuous abstinence outcome, 5.4% (11 of 203) of MiQuit participants were abstinent versus 2.0% (four of 204) of usual care participants [odds ratio (OR) = 2.7, 95% confidence interval (CI) = 0.93–9.35]. This study provides some evidence that a text-messaging program may increase cessation rates in pregnant smokers when provided alongside routine cessation care.

Oliveira-Ciabati et al. (2017) aimed to determine whether PRENACEL (a bi-directional, mobile phone based short text message service (SMS)) can increase the coverage of recommended antenatal care (ANC) practices. This study included 1210 pregnant women aged

18 or above with a gestational age of 20 weeks or less: 770 women in the intervention group and 440 in the control group. All women received routine antenatal care. Those who registered in PRENACEL additionally received a weekly set of short text messages with health education and health promotion content related to pregnancy and childbirth and could also clarify antenatal queries through SMS. Researchers found that women who received and read the PRENACEL massages had higher mean antenatal care scores (intervention: 48.5 [±4.2] vs control: 45.2 [±8.7], $p < 0.01$), were more likely to have an increased number of antenatal visits (>6 visits; intervention: 96.9% vs control: 84.8%, $p = 0.01$), and increased coverage of recommended antenatal practices including syphilis (intervention: 40.5% vs control: 24.8%, $p=0.03$) and HIV (intervention: 46.6% vs control: 25.7%, $p < 0.0$) testing, therefore confirming effectiveness of this telehealth system.

In order to explore the effects of telemedicine supported gestational diabetes care on a range of maternal and fetal outcomes, Rasekaba et al. (2018) performed an exploratory randomized controlled trial of adjunct telemedicine support in the management of insulin treated GDM (intervention) and compared it to usual care (control). The study included 95 participants: 61 in the intervention group and 34 in the control group. Participants who were randomized to the intervention were briefed on how to enter their self-monitoring GDM data -self-monitoring blood glucose, insulin dosing, dietary information and symptoms- on a proprietary web-based patient-controlled health record, Online Health Portfolio (www.onlinehealthportfolio.com). They were also instructed on how to share the data with their health professionals via this site. Regarding effectiveness, the authors found that participants receiving the intervention reached optimal glycemic control quicker (mean [SD]; intervention: 4.3 [4.2] weeks vs. control: 7.6 [4.5]

weeks, p = 0.0001). Additionally, telemedicine increased the rate of obtaining optimal glycemic control by 71% (HR = 1.71) (95% CI: 1.11, 2.65, p = 0.015).

Sung et al. (2019) performed a single center randomized controlled trial on 21 patients who were diagnosed with GDM during 24-28 weeks of gestation in order to develop and evaluate a model for the management of GDM with the use of mobile health care. Women were randomly assigned to the conventional management (CM) group or the mobile management (MM) group at a ratio of 1:1. Those who were allocated to the CM group received standard antenatal care from obstetricians and endocrinologists and those who were allocated to the MM group received standard antenatal care and tailored mobile health care services. The tailored mobile health care services were provided by a health care provider team by the mobile phone application specifically designed for the study; each team included an endocrinologist, nurses, and nutritionists. Participants in the MM group were given monitoring system devices, including a glucometer with Bluetooth connectivity and an accelerometer to detect physical activity level. A mobile phone application specifically designed for this study was installed at enrollment for the MM group to collect clinical data and messages from the patients. Patients allocated to the MM group recorded their blood glucose concentration and diet by the mobile phone application, and health care providers regularly scanned clinical data. The health care providers then analyzed the transmitted records and sent messages to participants twice a week. Participants also received regular messages once a week by mobile application about recommendations for adequate diet and exercise. Findings revealed that the MM group (n=11) had no significant difference in glycemic index compared with the CM group (n=10) and no statistically significant differences were found in rates between the 2 groups for large for gestational age newborns and cesarean

section at the time of delivery. This suggests that these mobile health care services could be an effective and efficient way to manage gestational diabetes.

Tian et al. (2020) randomized 309 women to receive routine clinical prenatal care or additional online management (WeChat) in order to explore the effectiveness of telehealth in blood glucose control rates and self-monitoring blood glucose (SMBG) compliance of women with gestational diabetes mellitus. All women who received standard clinical prenatal care (control group) (n=162) were asked to attend maternity schools organized by prenatal care institutions, which were established according to the Beijing Municipal Health Commission. Participants were taught the basic knowledge about gestational diabetes and how to perform self-management including how to conduct blood glucose monitoring, what the blood glucose values were supposed to be, and the form of lifestyle diaries. Patients in the intervention group (n=147) received additional WeChat group management when standard clinical prenatal care was conducted. In the WeChat group chat, researchers issued a briefing to encourage patients to take an active part in gestational diabetes control and a task card to pinpoint the basic requirements, including dietary advice, demonstration of meals from counterparts, rules of exercise, and other parameters. Patients conducted self-management according to the basic criteria given in combination with their actual situation and shared photos of their meals and extra meals, daily exercise routine and experience regarding blood glucose control. It was shown that both the intervention group and the control group had an increasing blood glucose control rate and decreasing SMBG during the whole follow-up period. The authors explain that the reasoning for the decreasing SMBG in the intervention group was due to effective education and management online, which ensured a well-controlled blood glucose, therefore it was not necessary to monitor as frequently. Of additional note, the intervention group with online management increased their

control rate faster than that of the traditional medical group. These findings suggest that standard prenatal care is effective for gestational diabetic management, but the addition of online management can increase the blood glucose control rate more quickly and stabilize it at a higher level. Therefore, mobile medical management is likely effective in enabling pregnant women to improve their awareness of blood glucose management as soon as possible, quickly develop the habit of self-management, and achieve blood glucose control earlier, faster, and more effectively than standard care.

Last, Wilcox et al. (2017) aimed to determine the effectiveness of an mHealth intervention that promoted healthy diet, physical activity, and gestational weight gain in pregnant women. Women (n=91) were recruited at their first antenatal clinic visit and randomized into either an intervention group (n=50, with 5 people withdrawing) or a control group (n=50, with 4 people withdrawing). The intervention consisted of a variety of strategies delivered (from first antenatal visit until 36 weeks' gestation) via multiple modalities available on mobile devices. It was found that most women engaged regularly by replying to program-initiated texts (43/45: 96%), with the majority (n=91:97.6%) reporting that the intervention was helpful. Secondary outcomes demonstrated a significantly lower gestational weight gain in the intervention group (7.8 kg ± 4.7 versus 9.7 kg ± 3.9; P=0.041) compared with the control group at intervention completion. This evidence further supports the use of telehealth in the prenatal period by demonstrating effectiveness in reducing gestational weight gain. Next, the fifth and final theme of Health Disparities is synthesized in this literature review.

Health Disparities

It is important to note that in of all the literature included in this study, only one article specifically focused on an underserved population (Herring et al., 2016). No articles were found

that focused specifically on the potential affect telehealth service use in the prenatal period may have on health disparities. A review of the research article focused specifically on an underserved population (Herring et al., 2016) is next followed by an in-depth discussion surrounding some coincidental findings on health disparities in other studies, and the potential implications that these findings may have.

First, Herring et al. (2016) studied 66 socioeconomically disadvantaged, overweight or obese African American pregnant women in a randomized clinical trial to evaluate whether a technology based behavioral intervention would decrease the amount of gestational weight gain in this population. Although the article was only rated as having good quality evidence, the decision was made to include it in the research because it was the only article that specifically examines African American women. In the study, the intervention group received help with behavior change goals, interactive text messages to self-monitor, biweekly health coach calls and different skill training through a platform on Facebook. The control group only had access to usual prenatal care. Herring et al. (2016) concluded that the intervention reduced the proportion of women who exceeded the Institute of Medicine's guidelines (total weight gain >11.5 kg as excessive in overweight women and >9 kg as excessive in obese women) compared to usual care (37% vs. 66%, P50.033). It was also concluded that intervention participants gained less weight during pregnancy (intervention: 8.7 vs control: 12.3 kg, adjusted mean difference: 23.1 kg, 95% CI: 26.2 to 20.1).

Next, A study on eHealth interventions to reduce the risk of excessive gestational weight gain looked at 1335 relatively diverse and healthy pregnant women who were randomized into an intervention group (n=898) and a control group (n=437). Both groups had access to a resource-rich website. However, the intervention group had additional access to a weight tracker

and a diet/physical activity goal setting tool. The study had some very interesting findings regarding health disparities. Graham et al. (2017) found that the usage patterns for both groups varied by demographic characteristics and that higher-income older, white, married women in both groups were more likely to use the website. In the intervention arm, which included participants with lower income and normal range BMI (n=179), the relative risk of excessive GWG was 1.92 times higher for an almost consistent or inconsistent tracker compared with the nonuser. Inconsistent trackers in this same group gained 2.48 kg more than a nonuser. Itervention arm participants with normal range BMI who had higher incomes (n=319) and were consistent or "super-user" trackers had reduced relative risk of excessive GWG amount (relative risk =0.64) and weekly rate (relative risk =0.72). This group also gained 1.49 kg less in total GWG. Among overweight and obese higher-income participants (n=228), consistent or "super-user" trackers also saw a reduced relative risk of excessive GWG amount (relative risk =0.87) and gained 2.17 kg less. Lower income women (n=351) had no detectable difference in their gestational weight gain based on usage. Graham et al. (2017) also found that consistent weight tracking and website usage was lower in the low-income participants (n=351) with only 25% of them consistently tracking.

Another examples is a 2017 study about the effectiveness of a text messaging smoking cessation program for pregnant women. Observed limitations include the need to own a cell phone with unlimited text messaging and having the ability to understand the English language (Abroms et al., 2017). Another study looked at physical activity interventions delivered via mobile health and cited similar limitations (Choi et al., 2016). Non-English-speaking women were excluded in the research by Kingston et al. (2017), Mackillop et al. (2018), and Naughton et al. (2017) as well. Naughton et al. (2017) cited the preexisting ability to receive SMS messages

as an inclusion criterion for their research, and the research by Oliveira-Ciabati et al. (2017) required access to a cellphone with SMS messaging as well. Hantsoo et al. (2017), Sung et al. (2019), and Guo et al. (2019) also performed studies where lack of access to a cell phone was a limitation. Other exclusion criteria in the research by Sung et al. (2019) was the inability to understand Korean and being and unfamiliar with mobile phones. Tian et al. (2020) had similar exclusion criteria. Forsell et al. (2017) excluded women who did not have internet access from their study. Leeuw et al. (2019) revealed promising findings regarding telehealth use during the prenatal period, however, participants of a low-educational status were not included; therefore, it is unknown if the same effect would occur within this demographic Next is an evaluation of the strengths and weaknesses of the literature reviewed in this study.

Critique of Strengths and Weaknesses

There are several different strengths and weaknesses of this literature review. One strength is that this collection of literature includes almost entirely randomized controlled trials that were rated Level I and high quality according to the Johns Hopkins Research Evidence Appraisal Tool. All studies are limited to the last five years, with articles as recent as 2020. Some studies did report small sample sizes but were still included as they allowed further exploration of identified common themes and had appropriate sizes for the circumstances.

One weakness of this literature review is that it explores many different areas of telehealth applications in the prenatal period, making it difficult to provide major generalizable findings. In other words, there is not a substantial amount of literature on any one specific telehealth model, and it is important to consider this when applying telehealth in the clinical setting. Another common weakness with the studies included in this literature review are major language and resource barriers as described earlier. For example, the findings from Abroms et al.

(2017) are not applicable to those who do not have access to a cell phone with unlimited text messaging and who do not speak English. Choi et al. (2017) was also limited because their education was only provided in English, which excluded non-English-speaking participants. A requirement of many studies was that the individual needed access to technical services, such as the internet and/or a cell phone, which excludes application of the findings to women without access to such resources.

Summary

In summary, 21 articles were critically reviewed with the intent of discussing the strengths and limitations of utilizing telehealth programs to deliver prenatal care. Common themes were evaluated in the research and expanded on. These themes included patient satisfaction, patient participation, safety, effectiveness, and health disparities. Next, Chapter IV provides a synthesis of the reviewed literature, the implications for Midwifery practice, recommendations for future research, and applies the Comfort Theory (Kolcaba, 1994) framework to telehealth use during the prenatal period.

Chapter IV: Discussion, Implications, and Conclusions

21 randomized controlled trials were analyzed using the John Hopkins Research Evidence Appraisal Tool. While analyzing the literature the themes of patient satisfaction, patient participation, safety, effectiveness, and health disparities were explored further. Since the articles encompassed many different areas of prenatal care, these themes were used to find commonalities between articles. These commonalities allow for discussion on trends and gaps in the literature, implications for midwifery practice, recommendations for future research, and integration of the Comfort Theory (Kolcaba, 1994).

Literature Synthesis

The fundamental question that drove the research for this literature review was to evaluate the strengths versus the limitations of utilizing telehealth services to provide prenatal care. The selected literature was synthesized into five common themes: patient satisfaction, patient participation, safety, effectiveness, and health disparities. When discussing patient satisfaction, four of the studies cited statistically significant increases in patient satisfaction in the groups that used the telehealth intervention (Butler Tobah et al., 2019) (Kingston, 2017)(Caballero-Ruiz, 2017)(Mackillop et al., 2018) and one study found telehealth to be noninferior compared to usual care (Leeuw et al., 2019). Regarding patient participation in care and patient safety, three studies found statistically significant increases with telehealth modalities compared to usual care (Guo et al., 2019)(Oliveira-Ciabati et al., 2017)(Pealing et al., 2019) and two studies found that patient safety was maintained, with some suggestion that patient safety improved with the use of telehealth (Mackillop et al., 2018)(Rasekaba et al., 2018). Effectiveness of telehealth was found to be most supported by the evidence with 16 articles suggesting that telehealth was at least as effective as usual care, and in some cases, more effective (Butler Tobah

et al., 2019)(Caballero-Ruiz et al., 2017)(Choi et al., 2016)(Ferrara et al., 2020)(Forsell et al., 2017)(Guo et al., 2019)(Hantsoo et al., 2017)(Herring et al., 2016)(Leeuw et al., 2019)(Mackillop et al., 2018)(Naughton et al., 2017)(Oliveira-Ciabati et al., 2017)(Rasekaba et al., 2018)(Sung et al., 2019)(Tian et al., 2020)(Wilcox et al., 2017). These studies all highlight the many strengths of telehealth but looking at the limitations is of utmost importance.

There were no studies found that focused specifically on how telehealth affects health disparities. However, it was noticed that many of the studies listed limitations with use of telehealth that could likely further contribute to health disparities. Specifically, 12 studies excluded disadvantaged individuals such as those who do not own a smartphone or cellphone with SMS messaging (Abroms et al., 2017)(Choi et al., 2016)(Guo et al., 2019)(Hantsoo et al., 2017)(Naughton et al., 2017)(Oliveira-Ciabati et al., 2017)(Sung et al., 2019)(Tian et al., 2020), women with language barriers (Abroms et al., 2017)(Choi et al., 2016)(Kingston et al., 2017)(Leeuw et al. 2019)(Mackillop et al., 2018)(Naughton et al., 2017)(Sung et al., 2019)(Tian et al., 2020), and women without access to the internet (Forsell et al, 2017). Women who were of low-educational status were minimal in one study (Leeuw et al., 2019) and those who were unfamiliar with mobile phones were excluded in other studies (Sung et al., 2019)(Tian et al., 2020). All of these are barriers to telehealth services that may affect those who are already underserved.

In summary, this literature review revealed that strengths of telehealth use in the prenatal period include patient satisfaction, patient participation, safety, and effectiveness. However, many of these findings cannot apply to those who are disadvantaged in the areas of access to internet and/or telehealth modalities such as a smartphone, as well as those who may have

language or technological knowledge barriers; this is the main limitation of telehealth that was discovered.

Trends and Gaps in the Literature

Much of the noted evidence regarding telehealth use in the prenatal period involves management of gestational diabetes and gestational hypertension. Other areas of research included use of telehealth to compliment prenatal care models, smoking cessation, weight management, and mood management. Despite these trends, there still appears to be several gaps in the literature. The most alarming and overwhelming gap in the literature surrounds investigation on how telehealth may contribute to health disparities. Additionally, only one article was found that focused exclusively on women of color (Herring et al., 2016). This finding supports that further research in the area of telehealth is needed. Recommendations for further research are discussed next.

Recommendations for Future Research

Based upon these gaps, it can be concluded that there is much room for increased research of telehealth, particularly surrounding racial diversity and the use of telehealth in cases of language barriers, lack of technological knowledge, and lack of required technologic equipment. Further studies should be conducted on use of these services with an interpreter or automated translator to help minimize language barriers. Regarding technological knowledge, studies should be conducted that investigate the ease of use in those who are not technologically savvy and/or those who have a low-educational status. Last, examination of methods to increase accessibility of technological equipment and services such as a smartphone, internet access, unlimited messaging, a tablet, etc., should occur as well. Research is desperately needed in these

areas before it can be concluded that telehealth interventions do not contribute to health disparities.

Implications for Midwifery Practice

As the COVID-19 pandemic continues to push providers towards telehealth services, it is important that midwives understand the implications of participating in such interventions. Telehealth interventions can completely revolutionize how midwives care for their patients. That being said, an important Hallmark of Midwifery is honoring and acknowledging the therapeutic value of human presence (ACNM, 2020). As telehealth gains momentum, midwives need to reflect upon whether this modality aligns with the care that the midwife profession desires to associate with. In order to help with this decision making and honor the woman and her wishes for care delivery, the Hallmark of Midwifery that reflects upon the importance of advocating for informed choice, shared decision making, and the right to self-determination should be in the forefront of a midwife's mind (ACNM, 2020).

Integration of the Comfort Theory

After examining the literature, integration of Katharine Kolcaba's Comfort Theory is useful in considering how telehealth care modalities in the prenatal period can affect women, their families, and the community on a deeper level. Next is an analysis application of this theory's principles to prenatal telehealth that demonstrates how the areas of relief, ease, and transcendence can be enhanced or hindered when telehealth is used to provide prenatal care.

Relief

Relief occurs when a specific need is met (Egger-Rainer et al., 2017). Major barriers to getting prenatal care include problems with childcare and transportation (Heaman et al., 2015).

Integrating telehealth into prenatal care has the potential to eliminate the need for childcare and transportation as the care can be provided from the comfort of one's home. The client would no longer have to worry about gathering other children and keeping them preoccupied while at a visit. The client would also no longer have to worry about making sure they have a ride to the clinic or have gas in their car to make it to the visit which could serve as a financial relief.

Use of telehealth in the prenatal period may afflict relief. A common theme that in the literature was that women who did not have access to telehealth equipment, such as a smartphone with unlimited messaging, were excluded in the research. It is likely that not having access to these resources in an already technologically dependent society creates an immense burden on some individuals. Adding telehealth options to prenatal care could cause further stress and deepen one's need for such technological equipment, preventing achievement of relief. Next is an analysis of the application of ease in the Comfort Theory framework.

Ease

Kolcaba explains that ease is met when a state of calm and contentment is experienced (Egger-Rainer et al., 2017). In cases where patients have anxiety surrounding the clinical setting, telehealth would be especially beneficial in bringing them calm and contentment by eliminating the need to place themselves in an anxiety-provoking situation. There is also much anxiety today surrounding exposure to COVID-19. It has been documented that women have been less likely to seek prenatal care since the start of the pandemic due to social distancing recommendations and fear of falling ill (Masjoudi et al., 2020). Allowing for social distancing will help break the chain of infection, and reduce the risk of infection in women, their family members, friends, and the rest of the community. Getting the necessary care without potentially being exposed to a highly contagious and dangerous virus would likely bring calm and contentment to many.

While telehealth may enhance ease for some, it could create complications for others. This was likely present in cases with language barriers or lack of technological knowledge. Articles that studied the use of telehealth in a variety of languages or with the use of an interpreter were not found. There were no studies regarding the use of telehealth in cases of low technologic knowledge. Presumably, use of technology to get health care could create stress and discontent in these cases, as opposed to calm and contentment. Next is an analysis of the application of transcendence which is the third element of the Comfort Theory framework.

Transcendence

Last, transcendence is achieved when people can rise above their challenges. When one can move past an issue, the result is increased individual strength (March & McCormack, 2009). This has potential to be exemplified in cases where prenatal telehealth is used because having the ability to get proper care for themselves and their unborn child may prove to be empowering. Being unable to get the care because of barriers such as childcare or transportation may leave the woman feeling defeated, whereas providing her with increased options to make getting care more achievable likely will be uplifting, motivating, and inspiring.

Yet, it is important to acknowledge that the use of telehealth could create more challenges for some. Again, in cases of language barriers, lack of technologic knowledge, and lack of technological resources, one may feel more defeated than empowered by the use of telehealth. In these cases, it will be important to consider how to help women overcome such barriers in order to facilitate transcendence.

Conclusion

Lack of prenatal care, regardless of the reason, can be very harmful to both mother and fetus (Masjoudi et al., 2020). In many cases, telehealth has potential to lead to promotion of health-seeking behaviors and subsequently improved obstetrical outcomes by increasing accessibility. Research has shown that women are generally satisfied with integrating telehealth into their prenatal care. It has also been demonstrated that the use of telehealth can increase patient participation, meet or exceed safety standards, and that it is equal to or more effective than usual care modalities. Nonetheless, there are many ways that integrating telehealth into prenatal care could further health disparities, in particular by leaving those who do not have access to smart phones out of research studies. Further research to expand on and evaluate how telehealth impacts those already underserved is needed. All of the strengths and limitations of utilizing telehealth services should be carefully considered when implementing a telehealth program. However, providing these services as an option, not as a requirement, to get prenatal care when appropriate can be a means to providing holistic, efficient, and individualized care while honoring the Hallmarks of Midwifery (ACNM, 2020).

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Appendix 1 – Literature Review Matrix

<table>
<tr><td colspan="4">Source: Abroms, L. C., Chiang, S., Macherelli, L., Leavitt, L., & Montgomery, M. (2017). Assessing the National Cancer Institute's SmokefreeMOM text-messaging program for pregnant smokers: Pilot randomized trial. Journal of Medical Internet Research, 19(10), e333. https://doi.org/10.2196/jmir.8411</td></tr>
<tr><td>Purpose/Sample</td><td>Design (Method/Instrument)</td><td>Results</td><td>Strengths/Limitations</td></tr>
<tr><td>Purpose:
-To test the acceptability and feasibility of SmokefreeMOM, a national smoking cessation text-messaging program for pregnant smokers.
Sample/Setting:
-99 women in Washington, DC, metropolitan area
Level of evidence:
-Level 1
Quality of evidence:
-A: High quality</td><td>-Women were randomized to receive SmokefreeMOM (n=55), an automated smoking cessation text-messaging program, or a control text message quit line referral (n=44).
-Control group participants were texted a single text message after enrollment and were mailed self-help printed materials from the Centers for Disease Control and Prevention (CDC) on quitting smoking while pregnant.</td><td>-The SmokefreeMOM program was highly rated overall and rated more favorably than the control condition in its helpfulness at 3-month follow-up (P<.01) and in its frequency of messaging at both 1-month and 3-month follow-ups (P<.001, P<.01, respectively).
Conclusion:
-A text-messaging program that makes use of interactive text messages timed around the quit date and a baby's due date is acceptable to pregnant smokers.</td><td>Strengths:
-Main strength: this study is the first evaluation of a program that is nationally available for pregnant smokers—a group that is high-risk, -underserved, and in need of new treatments.
-Other strengths: use of a control group, biochemical verification of self-reported smoking status, and overall good follow-up rates.
Limitations:
-Recruitment was a challenge for this study.
-While the intervention was aimed at pregnancy cessation, by 3-month follow-up some women gave birth during the study period (n=20: 7 in intervention and 13 control). As birth of a baby is a significant risk factor for smoking relapse, it remains unclear what the impact of the birth was on study outcomes.
-SmokefreeMOM program experienced technical problems during the study period, which may have minimized the effect of the intervention.
-Study results may not be generalizable to all pregnant smokers as participants had the following characteristics: they had disclosed their smoking status to their medical provider, were from a mid-Atlantic metropolitan area, and on average were 21.42 weeks pregnant.</td></tr>
<tr><td colspan="4">Author Recommendations: SmokefreeMOM be further refined, and a future study be designed to evaluate whether this free and readily available resource can promote cessation in pregnant smokers.</td></tr>
<tr><td colspan="4">Summary for current clinical practice question:
<u>Strengths of telehealth:</u> Use was highly rated in acceptability and feasibility by participants, some evidence to suggest that this telehealth intervention may be helpful in smoking cessation amongst pregnant women.
<u>Limitations of telehealth:</u> Technical issues, results not applicable to those who do not have access to a cell phone with unlimited text messaging and who do not speak English.</td></tr>
</table>

<table>
<tr><td colspan="4">Source: Butler Tobah, Y., LeBlanc, A., Branda, M., Inselman, J., Morris, M., Ridgeway, J., Finnie, D., Theiler, R., Torbenson, V., Brodrick, E., Meylor de Mooij, M., Gostout, B., & Famuyide, A. (2019). Randomized comparison of a reduced-visit prenatal care model enhanced with remote monitoring. American Journal of Obstetrics and Gynecology, 221(6), 638.e1–638.e8. https://doi.org/10.1016/j.ajog.2019.06.034</td></tr>
<tr><td>Purpose/Sample</td><td>Design (Method/Instrument)</td><td>Results</td><td>Strengths/Limitations</td></tr>
<tr><td>Purpose:
-Evaluate the acceptability and effectiveness of OB Nest, a reduced frequency prenatal care model with remote home monitoring devices and nursing support.
Sample/Setting:
-300 pregnant women from the Outpatient Obstetrics Division at the Mayo Clinic in Rochester, Minnesota.
Level of evidence:
-Level I
Quality of evidence:
-A: High Quality</td><td>-Randomized controlled trial.
-Women were randomized to OB Nest or usual care.
-OB Nest care consists of 8 onsite appointments with an OB provider, 6 virtual visits on the phone or online with a nurse, supplemental fetal doppler and blood pressure monitoring at home and access to an online community of pregnant women.</td><td>-Acceptability: OBN had higher satisfaction with care (OBN=93.90 vs UC=78.89; mean group difference [MD] 15.01, 95% confidence interval [CI], 13.38–16.64).
-Effectiveness: There was no significant difference in the provision of ACOG recommended ancillary prenatal services.
Conclusion:
-OB Nest offers an alternative approach that yields better outcomes without impacting quality of care.</td><td>Strengths:
-Rigorous randomized trial design and high survey completion rates.
-Adequately powered to detect statistical differences in patient-reported outcomes.
Limitations:
-Women participating in the study were all receiving care at the same tertiary academic center.
-Most participants were college-educated white women of high socioeconomic status.
-Study nurses, clinicians, and pregnant women were aware of the assigned arm, which may have affected questionnaire responses.
-Underpowered to detect differences in adverse maternal and fetal safety outcomes.</td></tr>
<tr><td colspan="4">Author Recommendations: Additional research is needed to investigate the impact of telehealth on maternal and fetal safety outcomes, the scalability in differing health systems, the unexpected finding of longer duration of connected nursing care appointments and the impact this could have on cost of care, and to determine if this model of care is as effective in a more sociodemographically diverse population.</td></tr>
<tr><td colspan="4">Summary for current clinical practice question:
<u>Strengths of telehealth:</u> Greater patient satisfaction and lower maternal stress. Great option for low-risk patients.
<u>Limitations of telehealth:</u> Longer duration of coordinating care (due to novelty of OB Nest) and significantly longer duration of connected nursing care appointments.</td></tr>
</table>

Source: Caballero-Ruiz, E., García-Sáez, G., Rigla, M., Villaplana, M., Pons, B., & Hernando, M. E. (2017). A web-based clinical decision support system for gestational diabetes: Automatic diet prescription and detection of insulin needs. *International Journal of Medical Informatics (Shannon, Ireland)*, *102*, 35–49. https://doi.org/10.1016/j.ijmedinf.2017.02.014

Purpose/Sample	**Design (Method/Instrument)**	**Results**	**Strengths/Limitations**
Purpose: -Evaluate *Sinedie*, a clinical decision support system designed to manage gestational diabetes, regarding effectiveness, safety, impact on professionals' workload, number of office-to-face visits, frequency and duration of telematics reviews, patient compliance to self-monitoring, and patient satisfaction. **Sample/Setting:** -90 patients with GDM -Parc Tauli University Hospital in Spain **Level of evidence:** Level I **Quality of evidence:** A: High Quality	-Randomized controlled clinical trial. -A web-based telemedicine platform (*Sinedie)* was designed to remotely evaluate patients allowing them to upload their glycemia data at home directly from their glucose meter, as well as report other monitoring variables like ketonuria and compliance to dietary treatment. -Diet recommendations are automatically prescribed and notified to the patients, insulin recommendations are notified also to the physicians, who will decide if insulin needs to be prescribed.	-*Sinedie* detected all situations that required a therapy adjustment, and all the generated recommendations were safe. -The time devoted by clinicians to patients' evaluation was reduced by 27.389% and face-to-face visits per patient were reduced by 88.556%. -Patients reported to be highly satisfied with the system. **Conclusion:** -*Sinedie* is safe, effective, and decreases workload.	**Strengths:** -Only one patient dropped out of the study. -Patients were compliant with the self-monitoring protocol prescribed. -The results regarding detection of insulin needs are satisfactory since no patient that needed insulin was overlooked by the system. **Limitations:** -Most insulin proposals generated by the system were rejected or postponed because providers reported that they needed more time to see how the patient's glycemic control evolved.

Author Recommendations: Further refinement of the knowledge base specification could enhance the definition of insulin proposals and allow the generation of diet recommendations driven by these parameters.

Summary for current clinical practice question:
Strengths of telehealth: Patients reported to be highly satisfied with the system. Effective system. Safe system.
Limitations of telehealth: Can contribute to an already large provider workload by allowing more pts to be seen.

<table>
<tr><td colspan="4">Source: Choi, J., Lee, J., Vittinghoff, E., & Fukuoka, Y. (2016). mHealth physical activity intervention: A randomized pilot study in physically inactive pregnant women. Maternal & Child Health Journal, 20(5), 1091–1101. https://pubmed.ncbi.nlm.nih.gov/26649879/</td></tr>
<tr><td>Purpose/Sample</td><td>Design (Method/Instrument)</td><td>Results</td><td>Strengths/Limitations</td></tr>
<tr><td>Purpose:
-Test a 12-week mobile health (mHealth) physical activity intervention for feasibility and potential efficacy in pregnant women.
Sample/Setting:
-30 pregnant women between 10 and 20 weeks of gestation from the San Francisco Bay area.
Level of evidence:
-Level I
Quality of evidence:
-A: Good Quality</td><td>-Randomized controlled trial.
-Randomization was computer-generated and stratified by body mass index category based on self-reported pre-pregnancy weight and height: normal and overweight/obese.</td><td>-Intervention participants had a 1096 ± 1898 step increase in daily steps compared to an increase of 259 ± 1604 steps in control participants at 12 weeks.
-The intervention group reported lower perceived barriers to being active and lower lack of energy than the control group at the 12-week visit ($p = 0.02$).
Conclusion:
-The intervention appeared to be feasible and acceptable.</td><td>Strengths:
-The retention rate was about 97% indicating that women find interventions like this acceptable, once they have decided to increase their physical activity levels.
Limitations:
-Study findings should be interpreted with caution given the small sample size and the program’s focus on short-term behavior change.
-Findings may not be generalizable to non-English speakers or women who are not motivated to use those technologies.</td></tr>
<tr><td colspan="4">Author Recommendations: It was hard to recruit inactive women who wanted to increase physical activity level during pregnancy, but pregnant women who were motivated to increase physical activity found using mobile technologies promoting PA acceptable. Public awareness of safety and benefits of physical activity during pregnancy should be promoted and the role of prenatal care professionals in this effort is greatly needed.</td></tr>
<tr><td colspan="4">Summary for current clinical practice question:
<u>Strengths of telehealth:</u> It appears that programs like this may be feasible, but more research is needed as to whether they are beneficial.
<u>Limitations of telehealth:</u> This type of education was only provided in English making non-English participants excluded.</td></tr>
</table>

<table>
<tr><td colspan="4">Source: Ferrara, A., Hedderson, M. M., Brown, S. D., Ehrlich, S. F., Tsai, A., Feng, J., Galarce, M., Marcovina, S., Catalano, P., & Quesenberry, C. P. (2020). A telehealth lifestyle intervention to reduce excess gestational weight gain in pregnant women with overweight or obesity (GLOW): A randomised, parallel-group, controlled trial. The Lancet: Diabetes & Endocrinology, 8(6), 490–500. https://doi.org/10.1016/S2213-8587(20)30107-8</td></tr>
<tr><td>Purpose/Sample</td><td>Design (Method/Instrument)</td><td>Results</td><td>Strengths/Limitations</td></tr>
<tr><td>Purpose:
-Investigate whether a primarily telehealth lifestyle intervention reduced excess gestational weight gain (GWG) among women with overweight or obesity.
Sample/Setting:
-398 women from five antenatal clinics in CA, USA.
Level of evidence:
-Level I
Quality of evidence:
-A: High quality</td><td>-Two-arm, parallel-group, randomized controlled trial.
-The core lifestyle intervention consisted of 2 in person and 11 telephone sessions on behavioral strategies to improve weight, diet, physical activity, and stress management to help women meet a trial goal of gaining at the lower limit of the Institute of Medicine (IOM) guidelines range for total GWG: 7 kg for women with overweight and 5 kg for women with obesity.</td><td>-96 (48%) women in the lifestyle intervention group and 134 (69%) women in the usual care group exceeded Institute of Medicine guidelines for rate of GWG per week.
Conclusion:
-The intervention was effective in decreasing excess GWG, improving pregnancy diet, sedentary behavior, markers of insulin resistance, leptin concentrations, and cord blood concentrations of C-peptide and leptin.</td><td>Strengths:
-Large sample size, ability to recruit a racially and ethnically diverse population, including Asian women (a group underrepresented in previous trials), and the identification and enrolment of potential participants very early in gestation.
Limitations:
-Participants were not masked to study group, which could have biased responses to self-reported measures of diet and physical activity.
-Women in the usual care group did not receive any extra contacts with research study intervention staff, while women in the intervention group did; therefore, it is not possible to assess whether the observed between-group differences in GWG were attributable to increased contact time or to the intervention content itself.</td></tr>
<tr><td colspan="4">Author Recommendations:
Larger trials with longer follow-up periods are needed to assess the effect of reduced GWG on perinatal and long-term outcomes, and obesity prevention efforts in women of reproductive age are urgently needed to reduce complications associated with obesity.</td></tr>
<tr><td colspan="4">Summary for current clinical practice question:
<u>Strengths of telehealth:</u> Effective in decreasing GWG, improving pregnancy diet, sedentary behavior, markers of insulin resistance, leptin concentrations, and cord blood concentrations of C-peptide and leptin.
<u>Limitations of telehealth:</u> No major implications.</td></tr>
</table>

Source: Forsell, E., Bendix, M., Holländare, F., von Schultz, B. S., Nasiell, J., & Blomdahl-Wetterholm, M., Eriksson, C., Kvarned, S., van der Linden, J. L., Söderberg, E., Jokinen, J., Wide, K., & Kaldo, V. (2017). Internet delivered cognitive behavior therapy for antenatal depression: A randomised controlled trial. *Journal of Affective Disorders*, *221*, 56–64. https://doi.org/10.1016/j.jad.2017.06.013

Purpose/Sample	**Design (Method/Instrument)**	**Results**	**Strengths/Limitations**
Purpose: -Test the efficacy, acceptability, and adherence of a pregnancy adapted version of an existing 10-week internet cognitive behavioral therapy (ICBT)-program for depression. **Sample/Setting:** -42 pregnant women currently suffering from major depressive disorder in Stockholm. **Level of evidence:** -Level I **Quality of evidence:** -B: Good Quality	-Randomized controlled trial -42 pregnant women, 12-28 weeks' gestation, with major depression were randomized to either treatment as usual (TAU) provided at their antenatal clinic or to ICBT (Internet based cognitive behavioral therapy) as an add-on to usual care.	-The ICBT group had significantly lower levels of depressive symptoms post treatment ($p < 0.001$, Hedges g =1.21) and were more likely to be responders (i.e., achieve a statistically reliable improvement) (RR = 0.36; p = 0.004). -Credibility, satisfaction, utilization, and adherence were comparable to implemented ICBT for depression. **Conclusion:** -Pregnancy adapted ICBT for antenatal depression is feasible, acceptable, and efficacious.	**Strengths:** -Low level of attrition post-treatment leads to more confidence in main findings. **Limitations:** -Small sample size with no long-term evaluation.

Author Recommendations:
These results need to be replicated in larger trials to validate these promising findings.

Summary for current clinical practice question:
Strengths of telehealth: Digital means for therapy during pregnancy can be effective and efficient even if the therapist is not specialized in prenatal depression.
Limitations of telehealth: Women without access to the internet were excluded.

<table>
<tr><td colspan="4">Source: Graham, M. L., Strawderman, M. S., Demment, M., & Olson, C. M. (2017). Does usage of an eHealth intervention reduce the risk of excessive gestational weight gain? Secondary analysis from a randomized controlled trial. Journal of Medical Internet Research, 19(1), e6. https://doi.org/10.2196/jmir.6644</td></tr>
<tr><td>Purpose/Sample</td><td>Design (Method/Instrument)</td><td>Results</td><td>Strengths/Limitations</td></tr>
<tr><td>Purpose:
-Examine if an internet-based intervention is associated with a reduced risk of excessive gestational weight gain.

Sample/Setting:
-1335 (898 intervention and 437 control) relatively diverse and healthy pregnant women from a midsize city in northeastern United States.
Level of evidence:
-Level I
Quality of evidence:
-A: High Quality</td><td>-Randomized controlled trial
-A website was created with content including blogs, local resources, articles, FAQs and was available to both groups of women. The intervention arm had additional access to a weight gain tracker and diet and physical activity goal-setting tools. Usage patterns were examined in both groups and regression analysis was used to estimate the association between usage patterns and three GWG outcomes: excessive total GWG, excessive GWG rate and GWG.</td><td>-Usage patterns for both intervention and control arm participants varied by demographic characteristics. Higher-income, older, white, and married women in both arms were more likely to be higher users of the website.
Conclusion:
-In the intervention arm some usage patterns were associated with GWG outcomes. The implications for this particular intervention to prevent excessive GWG vary by socioeconomic status of the women.</td><td>Strengths:
-The intervention’s measures of usage are objectively measured by the website; no study staff reporting bias
-Large, randomized trial with an economically and racially diverse sample
Limitations:
-Consistent weight tracking and logging in to the website was low and was particularly low among lower-income participants; this affects the ability to detect statistically significant differences in the GWG outcomes between groups defined by usage.</td></tr>
<tr><td colspan="4">Author Recommendations: Future self-directed Internet-based interventions should consider best approaches for consistently engaging lower-income women when the success of interventions is anticipated to depend on consistent use.</td></tr>
<tr><td colspan="4">Summary for current clinical practice question:
Strengths of telehealth: Usage rates may depend on the patient’s personality and demographics.
Limitations of telehealth: For higher-income women there was a reduction in GWG, but not necessarily a significant reduction in rate or excessive GWG for overweight or obese higher-income women. For lower income women there were no detectable effects of usage on GWG.</td></tr>
</table>

Source: Guo, H., Zhang, Y., Li, P., Zhou, P., Chen, L.-M., & Li, S.-Y. (2019). Evaluating the effects of mobile health intervention on weight management, glycemic control and pregnancy outcomes in patients with gestational diabetes mellitus. *Journal of Endocrinological Investigation*, *42*(6), 709–714.

Purpose/Sample	**Design (Method/Instrument)**	**Results**	**Strengths/Limitations**
Purpose: -Explore the effects of mobile health (mHealth) intervention on pregnancy weight management, blood glucose control, and pregnancy outcomes. **Sample/Setting:** -124 with gestational diabetes mellitus (GDM) at the Metabolic Disease Hospital of Tianjin Medical University. **Level of evidence:** -Level I **Quality of evidence:** -A: High Quality	-Randomized controlled trial. -60 patients in the control group received standard outpatient treatment, while the remaining 64 patients received a nurse's online guidance both through a mobile medical app installed on their phone and through regular offline clinical treatment in the mHealth group.	-mHealth group demonstrated higher levels of compliance, lower frequency of outpatient service, lower hemoglobin A1C before delivery, as well lower weight gain and rates of off-target measurements both fasting and 2 h post-prandial. **Conclusion:** -The intervention improves patients' compliance and blood glucose control and reduces weight gain, thereby reducing the rates of complications in both pregnant women and fetus.	**Strengths:** -Clear improvement in the control of blood glucose and body weight among GDM patients. **Limitations:** -No statistically significant difference between these two groups in terms of pregnancy outcomes. -Only patients with smartphones and proficiency in the use of mobile Apps were included, the majority of whom already have a high level of cultural literacy, indicating that the included participants may not be representative of expectant mothers in high-risk and low socioeconomic groups. -This study currently lacks long-term follow-up, and the research on the impact of Mobile Health intervention on postpartum progression to type 2 diabetes in patients with gestational diabetes is insufficient.

Author Recommendations: Further research on the impact of Mobile Health intervention on postpartum progression to type 2 diabetes in patients with gestational diabetes is recommended.

Summary for current clinical practice question:
Strengths of telehealth: Effective in management of gestational diabetes mellitus and subsequent reduction in in pregnancy and delivery complications. Increased patient compliance. Effective in minimizing excess weight gain during pregnancy.
Limitations of telehealth: Access to a smartphone is necessary, therefore this method may not be effective for mothers in high-risk and low socioeconomic status groups.

Source: Hantsoo, L., Criniti, S., Khan, A., Moseley, M., Kincler, N., Faherty, L. J., Epperson, C. N., Bennett, I. M. (2017). Mobile application for monitoring and management of depressed mood in a vulnerable pregnant population. *Psychiatric Services*, *69*(1), 104–107. https://doi.org/10.1176/appi.ps.201600582			
Purpose/Sample	**Design (Method/Instrument)**	**Results**	**Strengths/Limitations**
Purpose: -Investigate whether a mood tracking and alert (MTA) mobile application (app) improved mental health care delivery in a high-risk obstetric population. **Sample/Setting:** -72 pregnant women from an urban ambulatory prenatal clinic within an academic medical center in the U.S. **Level of evidence:** -Level I **Quality of evidence:** -A: High Quality	-Participants were randomly assigned to one of three conditions: 1. Mobile app allowing access to a "patient portal" (PP) 2. PP with the addition of a mood tracking and alert (MTA) app (Ginger.iO; San Francisco, California) 3. The PP app and MTA app with a lottery incentive to encourage MTA app use. -As an exploratory outcome, depressive and anxiety symptoms were assessed after eight weeks within the MTA group.	-MTA users had significantly more contacts addressing mental health, rated ability to manage their own health significantly better, and were more likely to receive a mental health specialist referral. -Among MTA users, PHQ-9 (F= 7.87, df=2.5, 47.3, p=.001), GAD-7 (F= 6.32, df=2.2, 42.1, p=.003), and self-reported daily mood scores (F= 2.62, df = 4.2, 139.9, p=.03) significantly improved over eight weeks. **Conclusion:** -A mobile MTA app improved service delivery and patient engagement.	**Strengths:** -Randomization to the MTA app or a control app -Extended (eight week) period of app use **Limitations:** -Restricting participation to smartphone users actively seeking prenatal care -Un-blind status of the research staff. -Underpowered to adjust the assessment of statistical significance for multiple comparisons. -Focused on care delivery rather than clinical outcomes.
Author Recommendations: Future studies should assess depressive and anxiety symptoms in both app and control groups to assess the role of these apps in improving clinical outcomes.			
Summary for current clinical practice question: Strengths of telehealth: Improved service delivery and patient engagement Limitations of telehealth: Requires access to a smartphone.			

Source: Herring, S., Cruice, J., Bennett, G., Rose, M., Davey, A., & Foster, G. (2016). Preventing excessive gestational weight gain among African American women: A randomized clinical trial. *Obesity (Silver Spring, Md.)*, *24*(1), 30–36. https://doi.org/10.1002/oby.21240			
Purpose/Sample	**Design (Method/Instrument)**	**Results**	**Strengths/Limitations**
Purpose: -Evaluate whether a technology-based behavioral intervention could decrease the proportion of African American women with overweight or obesity. **Sample/Setting:** -66 socioeconomically disadvantaged African American pregnant women (12.5 6 3.7 weeks' gestation; 36% overweight, 64% obesity) recruited from two outpatient obstetric practices at Temple University. **Level of evidence:** -Level I **Quality of evidence:** -B: Good Quality	-A two-arm pilot randomized clinical trial. -Randomized to usual care (n533) or a behavioral intervention (n533) that promoted weight control in pregnancy. -The intervention included: 1) empirically supported behavior changes goals. 2) interactive self-monitoring text messages 3) biweekly health coach calls 4) skills training and support through Facebook.	-Intervention reduced the proportion of women who exceeded IOM guidelines compared to usual care (37% vs. 66%, P50.033), gained less weight during pregnancy (8.7 vs. 12.3 kg, adjusted mean difference: 23.1 kg, 95% CI: 26.2 to 20.1), and no group differences in neonatal or obstetric outcomes were found. **Conclusion:** -Intervention resulted in lower prevalence of excessive gestational weight gain.	**Strengths:** -Clinic staff were blind to randomization assignment, so any measurement bias would likely be non-differential across treatment groups. **Limitations:** -Study had a pilot nature and small sample size. -It used clinic measured weights to calculate the primary outcome, and thus, it cannot be certain these weights were collected with the same degree of quality (e.g., calibrated scales, no shoes) as weights collected by research staff. -Study did not allow for isolation of the independent contribution of discrete intervention components, and thus, was unable to determine which component attributed to the high degree of efficacy observed.
Author Recommendations: Whether minimizing excessive weight gain in pregnancy can successfully reduce disparities in obesity and improve child health among this high-risk population is still unknown but remains of great interest for further investigation.			
Summary for current clinical practice question: Strengths of telehealth: Study shows efficacy of a technology-based behavioral intervention for controlling gestational weight gain in African American women with overweight or obesity. One of the only studies to really look at telemedicine from the lens of health disparities. Limitations of telehealth: Not the highest quality of evidence, but important because it specifically looks at African American women.			

<table>
<tr><td colspan="4">Source: Kingston, D., Austin, M., van Zanten, S. V., Harvalik, P., Giallo, R., McDonald, S. D., MacQueen, G., Vermeyden, L., Lasiuk, G., Sword, W., & Biringer, A. (2017). Pregnant women's views on the feasibility and acceptability of web-based mental health e-screening versus paper-based screening: A randomized controlled trial. Journal of Medical Internet Research, 19(4), e88. https://doi.org/10.2196/jmir.6866</td></tr>
<tr><td>Purpose/Sample</td><td>Design (Method/Instrument)</td><td>Results</td><td>Strengths/Limitations</td></tr>
<tr><td>Purpose:
-Evaluate the feasibility and acceptability of Web-based mental health e-screening compared with paper-based screening among pregnant women.
Sample/Setting:
-636 pregnant women were recruited from 2 community-based family physician–led maternity clinics, a high-risk antenatal unit in a tertiary care center, and 2 community hospital-based prenatal classes in Canada.
Level of evidence:
-Level I
Quality of evidence:
-A: High Quality</td><td>-Parallel group randomized controlled superiority trial.
-Intervention group (n=305); Control group (n=331)
-Intervention group completed the Antenatal Psychosocial Health Assessment and the Edinburgh Postnatal Depression Scale on a tablet computer, while controls completed them on paper.</td><td>-More women in the e-screening group strongly or somewhat agreed that they would like to use a tablet for answering questions on emotional health (57.9%, 175/302 vs 37.2%, 121/325) and would prefer using a tablet to paper (46.0%, 139/302 vs 29.2%, 95/325), compared with women in the paper-based screening group.
Conclusion:
-Feasibility and acceptability of e-screening among pregnant women is supported.</td><td>Strengths:
-Randomized controlled trial.
-Large group
Limitations:
-Only evaluation of the e-screening and paper-based versions of the ALPHA and the EPDS screening tools were included. Although these 2 tools are widely used in perinatal clinical settings, evaluation of other tools is warranted.
-Overall, women in the study tended to be well-educated, partnered, and affluent, which may limit the generalizability of the findings.
-Women who did not speak English were excluded as the first step to trial e-screening.</td></tr>
<tr><td colspan="4">Author Recommendations: One of the most important applications of e-screening may be the feature of having immigrant women answer questions in their preferred language and devising a computer-based algorithm to assess the scale score and interpret it automatically for the English-speaking provider. Future studies should evaluate this application of e-screening.</td></tr>
<tr><td colspan="4">Summary for current clinical practice question:
<u>Strengths of telehealth:</u> This mode of telehealth was feasible, acceptable, and preferred by women. It did not alter disclosure rates and was perceived as more private or confidential, less impersonal, and less time-consuming.
<u>Limitations of telehealth:</u> Only applicable to affluent, partnered, well educated women who speak English.</td></tr>
</table>

Source: Leeuw, R. A., van der Horst, S. F. B., de Soet, A. M., van Hensbergen, J. P., Bakker, P. A., Westerman, M., de Groot, C. J. M., & Scheele, F. (2019). Digital vs face-to-face information provision in patient counselling for prenatal screening: A noninferiority randomized controlled trial. *Prenatal Diagnosis*, *39*(6), 456–463. https://doi.org/10.1002/pd.5463

Purpose/Sample	**Design (Method/Instrument)**	**Results**	**Strengths/Limitations**
Purpose: -Evaluate face-to-face information provision in patient counselling for prenatal screening compared with two forms of digital information provision, namely, noninteractive instructional video or interactive video. **Sample/Setting:** -141 women in the first trimester of their pregnancy at an outpatient clinic of the Amsterdam University Medical Centers, VUmc University, Amsterdam. **Level of evidence:** -Level I **Quality of evidence:** -A: High Quality	-Prospective, noninferiority, cluster-randomized controlled trial comparing face-to-face (control group) with digital (intervention group) information provision before counselling for prenatal screening. -The intervention group was randomized between information provision by means of an instructional or interactive video before they continued to face-to-face, personal counselling.	-Intervention group was noninferior compared with the control group regarding the level of satisfaction. -Knowledge grade difference was higher after using intervention, and the duration was significantly longer in the face-to-face group at 23 minutes versus 16 minutes. **Conclusion:** -Adding an instructional video to patient counselling is of added value to improve patient's knowledge and shorten time consumption of the counsellor.	**Strengths:** -When evaluating an instructional instrument, it is crucial to have a control group and, if possible, to evaluate an educational variation as well. This study did both. -The study reached the necessary sample size to evaluate the primary outcome: participant satisfaction. -Randomization was ensured, given the comparable baseline characteristics. **Limitations:** -Unable to randomize by participant; however, days between the control group and the intervention were randomized. This could cause a selection bias, although the administration and participants were blinded, and it did not affect the baseline characteristics. -The baseline characteristics did show that the study population is very homogenous and overall, very well educated. This will influence the generalizability of the results. -The secondary outcome, knowledge, was not corrected for a possible test-retest bias, which could have caused an increase in knowledge but should be expected to be equal in both groups.

Author Recommendations: Counselling will always need a face-to-face element, because of legislation and ethical considerations, but optimizing the patient's prior knowledge, understanding, and attitude can improve counselling. Finding the right format to do this will be the challenge. Whether this will be interactive information aids, virtual reality question-and-answer environments or any other variant of digital information provision should be further evaluated.

Summary for current clinical practice question:
Strengths of telehealth: Patient satisfaction equal to the nonintervention group, increased knowledge, decreased counseling time.
Limitations of telehealth: Participants of a low-educational status and those who did not speak Dutch were excluded.

<table>
<tr><td colspan="4">Source: Lemelin, A., Paré, P., Bernard, S., & Godbout, A. (2020). Demonstrated cost-effectiveness of a telehomecare program for gestational diabetes mellitus management. Diabetes Technology & Therapeutics, 22(3). https://doi.org/10.1089/dia.2019.0259</td></tr>
<tr><td>Purpose/Sample</td><td>Design (Method/Instrument)</td><td>Results</td><td>Strengths/Limitations</td></tr>
<tr><td>Purpose:
-Evaluate the cost-effectiveness of telehomecare (THCa) by assessing the direct costs, including the related reduction in medical visits, and the impact of THCa on diabetes control, GDM-related complications, and patient satisfaction.
Sample/Setting:
-161 Women, singleton pregnancies with a diagnosis of GDM in a Canadian hospital.
Level of evidence:
Level II
Quality of evidence:
High Quality</td><td>-Prospective noninferiority and controlled clinical trial. A total of 161 women were assigned to either an intervention group provided with a THCa system for transmission and online analysis of capillary glucose data (n = 80) or a control group receiving usual care in the clinic (n = 81).</td><td>-A decrease in medical visits by 56% (P < 0.001) in the THCa group.
-No difference in diabetes control or maternal and fetal complications.
-Satisfaction with care was high.
-Cost savings of 16% in patients followed by THCa.
Conclusion:
Intervention decreased medical visits and costs in GDM women without compromising pregnancy outcomes, quality of care, or patient satisfaction.</td><td>Strengths:
-Large number of patients were included in each arm.
-Analysis of patient satisfaction demonstrated that THCa is convenient, well accepted, and easy for patients to use. This suggests that THCa can play a role in improving quality of life and facilitating better acceptance of the GDM condition during pregnancy.
Limitations:
-Absence of formal randomization and blinding, blinding was not possible.</td></tr>
<tr><td colspan="4">Author Recommendations: Further analyses by formal multicentric randomized and controlled trials are needed to better characterize the impact of a THCa system on direct and indirect costs in women with GDM.</td></tr>
<tr><td colspan="4">Summary for current clinical practice question:
<u>Strengths of telehealth:</u> THCa monitoring significantly decreased medical visits and direct costs without compromising outcomes, quality of care, or satisfaction.
<u>Limitations of telehealth:</u> This program was a huge burden for nurses and to be effective required an entire nurse just to manage the program.</td></tr>
</table>

Source: Mackillop, L., Hirst, J. E., Bartlett, K. J., Birks, J. S., Clifton, L., Farmer, A. J., Gibson, O., Kenworthy, Y., Levy, J. C., Loerup, L., Rivero-Arias, O., Ming, W. K., Velardo, C., & Tarassenko, L. (2018). Comparing the efficacy of a mobile phone-based blood glucose management system with standard clinic care in women with gestational diabetes: Randomized controlled trial. *JMIR Mhealth Uhealth*, *6*(3), e71. https://doi.org/10.2196/mhealth.9512

Purpose/Sample	**Design (Method/Instrument)**	**Results**	**Strengths/Limitations**
Purpose: -Determine whether the use of a mobile phone-based real-time blood glucose management system to manage women with GDM remotely was as effective in controlling blood glucose as standard care through clinic attendance. **Sample/Setting:** -203 women with an abnormal oral glucose tolerance test in a large UK tertiary referral hospital. **Level of evidence:** -Level I **Quality of evidence:** -A: High Quality	-Randomized to a mobile phone-based blood glucose management solution (GDm-health, the intervention) or routine clinic care. -Intervention group loaned a mobile phone with the preinstalled GDm-health app. -Every 4 to 8 weeks they attended the outpatient clinic (i.e., half as many clinic visits as the standard clinic care group). -A diabetes midwife reviewed the blood glucose readings on a secure website at least three times a week.	-No significant difference in rate of blood glucose change (–0.16 mmol/L vs –0.14 mmol/L in 28 days, P=.78). -Higher satisfaction (P=.049) -Less preterm birth (5/101, 5.0% vs 13/102, 12.7%: OR 0.36, 95% CI 0.12-1.01). -Fewer cesarean births (27/101, 26.7% vs 47/102, 46.1%, P=.005). -No unexpected adverse outcomes. **Conclusion:** -Safe, comparable glycemic control, improved satisfaction.	**Strengths:** -Rigorous design and attention to randomization. -Conducted under "real life" conditions in a busy maternity diabetes service. **Limitations:** -Unable to demonstrate a difference in the number of clinic attendances between the groups. -Booking follow-up appointments based on study allocation proved challenging, as routine 2-week, rather than modified 4-week follow-up appointments for participants assigned to receive the GDm-health intervention were often made by clerical staff, most of whom were unaware of the study.

Author Recommendations: Further large, detailed health economic evaluation of these systems at scale is required to understand their potential impact on health care systems.

Summary for current clinical practice question:
Strengths of telehealth: Higher patient satisfaction, reduced clinic visits, safe, superior data capture.
Limitations of telehealth: Need to be able to understand written and spoken English.

Source: Naughton, F., Cooper, S., Foster, K., Emery, J., Leonardi-Bee, J., Sutton, S., Jones, M., Ussher, M., Whitemore, R., Leighton, M., Montgomery, A., Parrott, S., & Coleman, T. (2017). Large multi-centre pilot randomized controlled trial testing a low-cost, tailored, self-help smoking cessation text message intervention for pregnant smokers (MiQuit). *Addiction (Abingdon, England)*, *112*(7), 1238–1249. https://doi.org/10.1111/add.13802

Purpose/Sample	**Design (Method/Instrument)**	**Results**	**Strengths/Limitations**
Purpose: -Estimate the effectiveness of pregnancy smoking cessation support delivered by short message service (SMS) text message. **Sample/Setting:** -407 women at 16 antenatal clinics in England. **Level of evidence:** -Level I **Quality of evidence:** -A: High Quality	-Multi-center, parallel-group, single-blinded, individual randomized controlled trial. -All participants received a smoking cessation leaflet; intervention participants also received a 12-week program of individually tailored, automated, interactive, self-help smoking cessation text messages (MiQuit).	-5.4% (11 of 203) of MiQuit participants were abstinent versus 2.0% (four of 204) of usual care participants [odds ratio (OR) = 2.7, 95% confidence interval (CI) = 0.93–9.35]. **Conclusion:** There was some evidence, although not conclusive, that a text-messaging program may increase cessation rates in pregnant smokers when provided alongside routine NHS cessation care.	**Strengths:** -Largest RCT to investigate the efficacy of text message-based, self-help cessation support which is appropriate for and can be followed safely by pregnant smokers. -Conducted to the highest RCT standards; it employed remote randomization, those enrolling participants were blind to treatment allocations and abstinence was biochemically validated. -Researchers collecting outcome data were, where possible, blind to treatment allocations, so outcome ascertainment bias was minimized. -Intervention fidelity was high. **Limitations:** -RCT did not have a specified primary outcome.

Author Recommendations: If further research is confirmatory, pregnancy-orientated text message systems such as MiQuit could be made available quickly and cheaply alongside other first-line support options to help pregnant smokers to stop.

Summary for current clinical practice question:
Strengths of telehealth: Texting services might be an easy way to help women stop smoking.
Limitations of telehealth: Study required women to be able to understand English and receive SMS texting.

<table>
<tr><td colspan="4">Source: Oliveira-Ciabati, L., Vieira, C. S., Franzon, A. C. A., Alves, D., Zaratini, F. S., Braga, G. C., Sanchez, J. A. C., Bonifácio, L. P., Andrade M. S., Fernandes, M., Quintana, S. M., Fabio, S. V., Pileggi, V. N., Vierira, E. M., & Souza, J. P. (2017). PRENACEL - A mHealth messaging system to complement antenatal care: A cluster randomized trial. Reproductive Health, 14(1). https://doi.org/10.1186/s12978-017-0407-1</td></tr>
<tr><th>Purpose/Sample</th><th>Design (Method/Instrument)</th><th>Results</th><th>Strengths/Limitations</th></tr>
<tr><td>Purpose:
Determine whether PRENACEL (a bi-directional, mobile phone based short text message service (SMS)) increases the coverage of recommended antenatal care (ANC) practices.
Sample/Setting:
1210 pregnant women in Brazil.
Level of evidence:
Level I
Quality of evidence:
A: High Quality</td><td>-Parallel, cluster-randomized trial.
-20 public primary Health Care Units (PHCUs) were randomly allocated to the intervention (10 PHCUs, 770 women) or control (10 PHCUs, 440 women) group.
-Women who registered in PRENACEL received a weekly set of short text messages with health education and health promotion content related to pregnancy and childbirth and were also able to clarify ANC queries through SMS.
-All women received routine ANC.</td><td>-Women who received and read the PRENACEL messages were more likely to have an increased number of ANC visits and coverage of recommended ANC practices, including syphilis and HIV testing.
Conclusion:
-A bi-directional, mobile phone based, short text message service is potentially useful to improve the coverage of recommended ANC practices, including syphilis and HIV testing.</td><td>Strengths:
-Large sample size
-Randomization
Limitations:
-The main data source used to evaluate the coverage of antenatal care practices was the ANC card, which could have been incomplete or improperly filled out by the health provider, thus failing to report all care received during the pregnancy.
-Under-reporting of testing and visits on the card would occur to a comparable extent in both study groups.
-Despite performing a balanced randomization, there were differences between groups in variables not considered in the balancing process, such as the greater proportion of intervention PHCUs being in “slum” areas.
-The possibility of sampling bias should be considered, as women who voluntarily register in PRENACEL could also be prone to better engage in ANC.</td></tr>
<tr><td colspan="4">Author Recommendations: Further research focusing on how to maximize the reach of similar mobile health programs is recommended.</td></tr>
<tr><td colspan="4">Summary for current clinical practice question:
<u>Strengths of telehealth:</u> Provides women with additional knowledge to support ANC and increase compliance with and distribution of recommendations.
<u>Limitations of telehealth:</u> Must be motivated enough to sign up for the program. Must have access to a cell phone with SMS.</td></tr>
</table>

<table>
<tr><td colspan="4">Source: Pealing, L. M., Tucker, K. L., Mackillop, L. H., Crawford, C., Wilson, H., Nickless, A., Temple, E., Chappell, L. C., & McManus, R. J. (2019). A randomised controlled trial of blood pressure self-monitoring in the management of hypertensive pregnancy. OPTIMUM-BP: A feasibility trial. Pregnancy Hypertension, 18, 141–149. https://doi.org/10.1016/j.preghy.2019.09.018</td></tr>
<tr><td>Purpose/Sample</td><td>Design (Method/Instrument)</td><td>Results</td><td>Strengths/Limitations</td></tr>
<tr><td>Purpose:
-Assess the feasibility of a blood pressure self-monitoring intervention for managing pregnancy hypertension.
Sample/Setting:
-158 women at 4 centers in the United Kingdom.
Level of evidence:
-Level I
Quality of evidence:
-A: High Quality</td><td>-Randomized-controlled trial.
-Compared a self-monitoring of blood pressure (SMBP) intervention versus usual care for the management of pregnancy hypertension.
-Self-monitoring involved daily home blood pressure (BP) measurements, with recording via study diary or telemonitoring.
-Clinicians were invited to use the home readings in clinical and antihypertensive titration decisions.</td><td>-Participants persisted with the intervention for 80% or more of their time from enrolment until delivery in 86% (43/50) and 76% (38/49) of those with chronic and gestational hypertension respectively.
-Recorded clinic and study BPs were similar for both groups.
Conclusion:
-BP self-monitoring for the management of hypertension during pregnancy is feasible and well tolerated by women when combined with clinic monitoring.</td><td>Strengths:
-Large recruiting area with women recruited from a range of ethnicities and socioeconomic and educational backgrounds.
-High adherence and persistence with the self-monitoring intervention is reassuring given the high recruitment proportion of more than 70% of those eligible. The recruitment rate of 2.5 per site per month suggests that this is a feasible intervention to trial on a larger scale.
Limitations:
-Potential for inaccuracy of reporting BP readings by participating women, via text, study app or recorded in diaries.</td></tr>
<tr><td colspan="4">Author Recommendations: A large scale randomized controlled trial powered to explore the effectiveness and cost-effectiveness of self-monitoring for improved BP control in hypertensive pregnancies is warranted.</td></tr>
<tr><td colspan="4">Summary for current clinical practice question:
Strengths of telehealth: At home BP monitoring may be a great option if combined with clinic monitoring. High adherence rate helps improve accessibility.
Limitations of telehealth: More research on cost-effectiveness is needed. There is potential for inaccurate recordings.</td></tr>
</table>

Source: Rasekaba, T. M., Furler, J., Young, D., Liew, D., Gray, K., Blackberry, I., & Lim, W. K. (2018). Using technology to support care in gestational diabetes mellitus: Quantitative outcomes of an exploratory randomised control trial of adjunct telemedicine for gestational diabetes mellitus (TeleGDM). *Diabetes Research and Clinical Practice*, *142*, 276–285. https://doi.org/10.1016/j.diabres.2018.05.049			
Purpose/Sample	**Design (Method/Instrument)**	**Results**	**Strengths/Limitations**
Purpose: -Explore the effects of telemedicine supported GDM care on a range of health service utilization and maternal and fetal outcomes. **Sample/Setting:** -95 women at an Australian clinic **Level of evidence:** -Level I **Quality of evidence:** -A: High Quality	-Exploratory randomized controlled trial. -Groups (intervention n=61, control n=34) were compared on outcomes and Poisson and Cox regression analysis were performed for predictors of health service utilization, glycemic control and costs.	-No differences between the groups in number of face-to-face appointments (median (IQR) intervention = 8(7), control = 8(6), p = 0.843), rates of caesareans, macrosomia, large for gestational age, special care nursery admission or newborn birthweight. -Telemedicine was a significant predictor of better glycemic control (HR = 1.71(95%CI: 1.11, 2.65, p = 0.015). **Conclusion:** -Intervention produced similar GDM clinical outcomes as usual care and posed no added risk.	**Strengths:** -Implemented in a real-world clinical setting. **Limitations:** -Lack of integration with existing EHR systems -Small exploratory study, it was potentially under-powered to detect significant differences in most of the clinical outcomes; this is even more pertinent for outcomes such as macrosomia and LGA, which had very low rates.
Author Recommendations: Telemedicine support in GDM care does not produce adverse outcomes.			
Summary for current clinical practice question: Strengths of telehealth: Produces similar levels of service utilization, as well as clinical and cost outcomes as usual care processes. Does not contribute to adverse outcomes when managing GDM. Limitations of telehealth: Limitation in technology may limit the ability of telehealth to be utilized effectively.			

Source: Sung, J. H., Lee, D. Y., Min, K. P., & Park, C. Y. (2019). Peripartum management of gestational diabetes using a digital health care service: A pilot, randomized controlled study. *Clinical Therapeutics*, *41*(11), 2426–2434. https://doi.org/10.1016/j.clinthera.2019.09.005			
Purpose/Sample	**Design (Method/Instrument)**	**Results**	**Strengths/Limitations**
Purpose: -To develop and evaluate a model for the management of GDM with the use of mobile health care. **Sample/Setting:** -21 patients in Korea who were diagnosed with GDM during 24-28 weeks of gestation. **Level of evidence:** -Level I **Quality of evidence:** -A: High Quality	-Single center randomized controlled trial. -Women allocated to the intervention group received standard antenatal care and tailored mobile health care services which were provided by a health care provider team (endocrinologist, nurses, and nutritionists). -Participants received regular messages once a week by mobile application about recommendation for adequate diet and exercise during the study period.	-No significant difference in glycemic index between groups. -No statistically significant differences were found in rates between the 2 groups for (1) neonate large for gestational age and (2) cesarean section at the time of delivery. **Conclusion:** -This study indicates that mobile health care services could be an efficient GDM management tool.	**Strengths:** -Randomized, controlled trial to compare glycemic control, compliance, and perinatal outcome between a mobile phone intervention group and a standard care group in patients with GDM. **Limitations:** -Small sample size. -Obstetric and neonatal data for analysis were insufficient because many patients delivered at a local hospital.
Author Recommendations: Future studies must focus on the effect of mobile phone-based platforms on pregnancy and neonatal outcomes with a larger sample size and a more advanced platform.			
Summary for current clinical practice question: Strengths of telehealth: Mobile health could be an efficient management tool as there were similar outcomes in both the control and intervention group. Limitations of telehealth: Must be able to speak and read Korean, be familiar with mobile phones, and have access to a mobile phone.			

<table>
<tr><td colspan="4">Source: Tian, Y., Zhang, S., Huang, F., Shi, F., Li, Y., Chen, X., Zhang, C., Zhong, H., Ma, W., Liu, C., Niu, C., Xue, X., & Ma, L. (2020). Glycemic qualification rate and frequency of self-monitoring blood glucose (SMBG) in women with gestational diabetes mellitus (GDM). Diabetes Research and Clinical Practice, 170. https://doi.org/10.1016/j.diabres.2020.108482</td></tr>
<tr><td>Purpose/Sample</td><td>Design (Method/Instrument)</td><td>Results</td><td>Strengths/Limitations</td></tr>
<tr><td>Purpose:
-Explore the relationship between blood glucose (BG) control rate and self-monitoring blood glucose (SMBG) compliance of women with gestational diabetes mellitus (GDM).
Sample/Setting:
-309 women from 9 prenatal clinics in China.
Level of evidence:
-Level I
Quality of evidence:
-A: High quality</td><td>-Randomized controlled trial.
-Women with GDM were randomized to receive routine clinical prenatal care (n=162) or additional online management (WeChat)(n=147).</td><td>-Both groups had increasing BG control and decreasing SMBG compliance.
-The intervention group with online management increased their control rate faster than that of the traditional medical group.
Conclusion:
-The addition of online management can increase the BG control rate more quickly and stabilize it at a higher level.</td><td>Strengths:
-Randomized control design with a relatively large sample size.
-Participant follow-up was from diagnosis to delivery; thus, complete BG data collection allowed for interpretation of the relationship between BG control and SMBG frequency from multiple perspectives and to demonstrate the possible role of mobile medical care.
Limitations:
-The goal of compliance was set by the project team at 15 blood glucose records every two weeks, which was not specified in the guidelines.
-During the follow-up period, with the development of gestation, participants gradually gave birth, resulting in a large decline in the sample number which may affect the interpretation of the trend.
-Evaluations of self-efficacy and health management outcomes for the subjects were lacking, so it is difficult to quantify the impact of mobile medical management; thus, the results were inferred.</td></tr>
<tr><td colspan="4">Author Recommendations: A more complete, large-scale study on evaluation of self-efficacy and health management outcomes should be conducted in order to quantify the impact of mobile medical management.</td></tr>
<tr><td colspan="4">Summary for current clinical practice question:
<u>Strengths of telehealth:</u> Able to provide more in-depth education in a timely and effective manner. Increased the speed at which women were able to control their blood glucose.
<u>Limitations of telehealth:</u> For this method, women had to know Chinese, which creates a language barrier. They also needed access to a smartphone and the skills to be able to operate the smartphone for verbal correspondence.</td></tr>
</table>

Source: Wilcox, J. C., Wilkinson, S. A., Lappas, M., Ball, K., Crawford, D., McCarthy, E. A., Fjeldsoe, B., Whittaker, R., Maddison, R., & Campbell, K. J. (2017). A mobile health intervention promoting healthy gestational weight gain for women entering pregnancy at a high body mass index: The txt4two pilot randomised controlled trial. BJOG: An International Journal of Obstetrics and Gynaecology, 124(11), 1718–1728. https://doi.org/10.1111/1471-0528.14552

Purpose/Sample	**Design (Method/Instrument)**	**Results**	**Strengths/Limitations**
Purpose: -Determine the feasibility and effectiveness of an mHealth intervention promoting healthy diet, physical activity and gestational weight gain in pregnant women. **Sample/Setting:** -91 women at an Australian tertiary obstetric hospital. **Level of evidence:** -Level I **Quality of evidence:** -High Quality	-Randomized controlled trial -The intervention consisted of a variety of strategies delivered (from first antenatal visit until 36 weeks' gestation) via multiple modalities available on mobile devices.	-Most women engaged regularly with the program, with the majority (97.6%) reporting that the intervention was helpful. -Secondary outcomes demonstrated a significantly lower GWG in the intervention group (7.8 kg ± 4.7 versus 9.7 kg ± 3.9; *P*=0.041). **Conclusion:** -Intervention showed significantly smaller reductions in total, light- and moderate-intensity physical activity from baseline to completion of the intervention (*P* = 0.001).	**Strengths:** -The study used a theory-based design with the intervention constructed specifically to target key behavior change mediators from the behavior change taxonomy. -The intervention was developed utilizing an mHealth Development and Evaluation framework which included formative research, concept testing, and a pilot study, -Multiple modalities or technological elements (e.g., combination of texts, website, videos and social media) to appeal to a range of preferences and learning styles were used. **Limitations:** -There is potential for recall bias and socially desirable reporting associated with self- reported pre-pregnancy weight, diet and physical activity. -Lack of detected dietary change; a larger trial would require more valid and reliable measures of diet. -The study was done in large tertiary hospital, which may affect generalizability. -Testing the feasibility of recruiting participants and delivering the initial interview by hospital clinic staff, rather than research staff, will be important in terms of scalability and generalizability in further trials.

Author Recommendations: Sustainable and wide-reaching interventions promoting a healthy lifestyle in the antenatal period are urgently required to address negative maternal and child health outcomes.

Summary for current clinical practice question:
Strengths of telehealth: Effective in promotion of exercise and healthy GWG
Limitations of telehealth: When relying on self-reported values, it is important to note that the patient may not be truthful. Requires cell phone.