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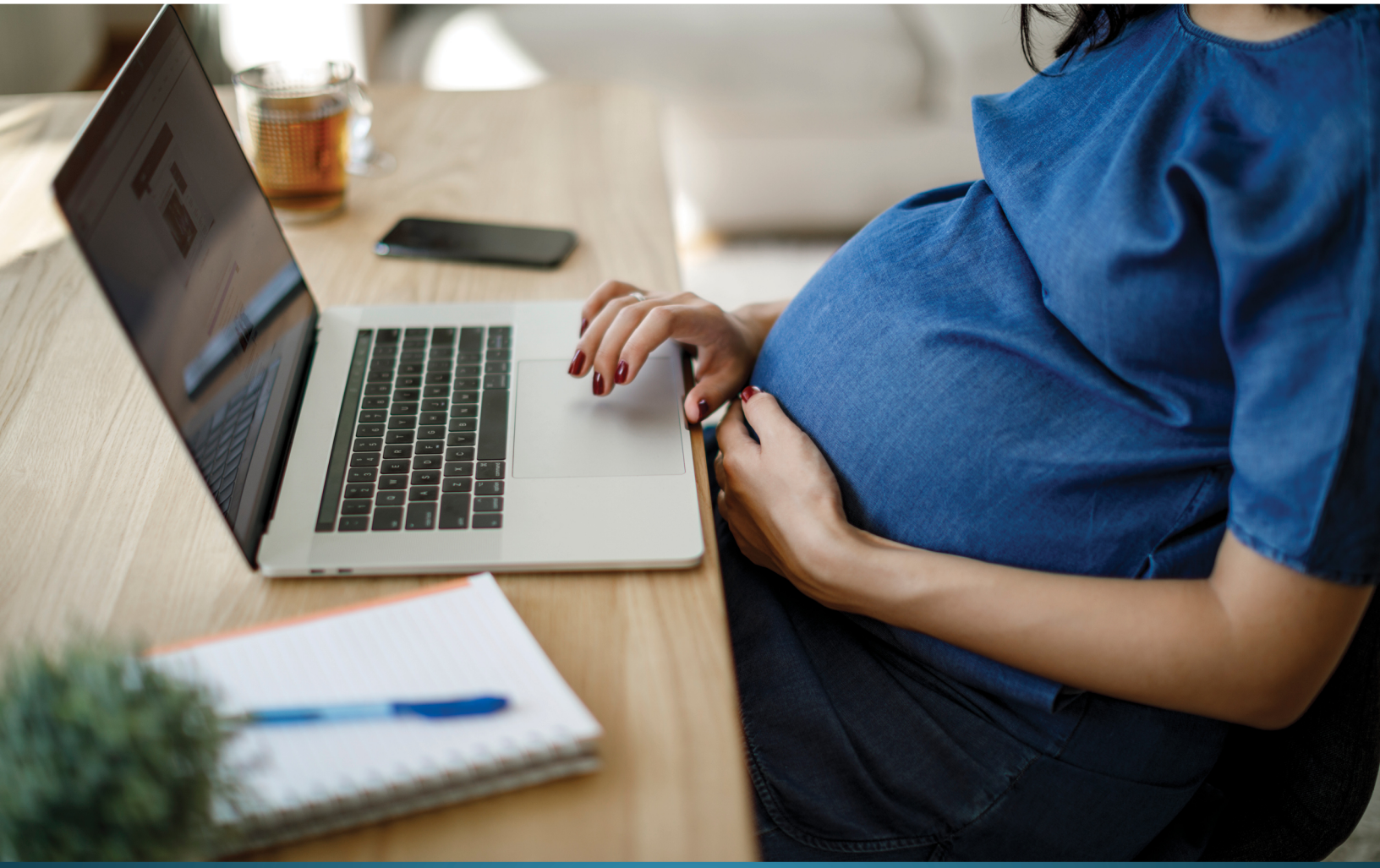
Telehealth Strategies for the Delivery of Maternal Health Care



PCORI Evidence Synthesis: Rapid Review No. 02 July 2022

Telehealth Strategies for the Delivery of Maternal Health Care

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List of Acronyms and Abbreviations

- ACOG, American College of Obstetricians and Gynecologists
- ACTIVE, Authors and Consumers Together Impacting on eVidencE
- ACQ, Asthma Control Questionnaire
- AHRQ, Agency for Healthcare Research and Quality
- App, application
- aRR, adjusted relative risk
- BMI, body mass index
- BP, blood pressure
- CARES Act, Coronavirus Aid, Relief, and Economic Security Act
- CBT, cognitive behavioral therapy
- CI, confidence interval
- CINAHL, Cumulative Index to Nursing and Allied Health Literature
- COVID-19, coronavirus disease
- DASH, Dietary Approaches to Stop Hypertension
- DASS, Depression Anxiety Stress Scales
- ED, emergency department
- EPDS, Edinburgh Postnatal Depression Scale
- EQ-5D-5L, EuroQol Group index of health status
- GAD-7, Generalized Anxiety Disorder 7-item
- GDM, gestational diabetes mellitus
- GWG, gestational weight gain
- HAM-D, Hamilton Depression scale
- HbA1c, hemoglobin A1c
- HTN, hypertension
- IADPSG, International Association of Diabetes and Pregnancy Study Group
- LBW, low birth weight
- LGA, large for gestational age

- MADRS-S, Montgomery-Åsberg Depression Rating Scale
- MD, mean difference
- NICU, neonatal intensive care unit
- NIH, National Institutes of Health
- NR, not reported
- OB, obstetrician
- OR, odds ratio
- PCORI, Patient-Centered Outcomes Research Institute
- PICOTS, population, intervention, comparator, outcomes, time, setting
- PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses
- PROGRESS, place of residence, race, occupation, gender, religion, education, socioeconomic status, social capital
- PROSPERO, International Prospective Register of Systematic Reviews
- PSOC, Parenting Sense of Competence
- RCT, randomized controlled trial
- RM, remote monitoring
- ROB, risk of bias
- RR, relative risk
- SAE, serious adverse event
- SCID-I, Structured Clinical Interview for DSM-IV Axis I Disorders
- SGA, small for gestational age
- SMS, short message service
- STAI, State-Trait Anxiety Inventory
- TEP, Technical Expert Panel

Abstract

Plain Language Summary

Why was this rapid review done?

- To conduct a rapid assessment of the evidence on the effectiveness of telehealth strategies for maternal care for preconception, pregnancy, and postpartum periods. Given the recent increase in the use of telehealth and the uncertainty around its effectiveness, this review aims to evaluate how telehealth compares with usual models of care, including the effects on patient satisfaction and access to care.

What are the findings?

- We identified 42 studies evaluating the use of telehealth for maternal care. The strongest evidence suggests that telehealth interventions during the prenatal and postpartum periods demonstrate similar results compared with Usual in-person care for telehealth interventions that are used to supplement care for mental health conditions and diabetes during pregnancy and to replace in-person general maternity care. Clinical outcomes included maternal health outcomes (eg, depression, hypertension [HTN]), obstetric outcomes (eg, cesarean delivery, premature birth), patient-reported outcomes (eg, satisfaction with care), and utilization of care (eg, appointments attended vs missed). Maternal and obstetric health outcomes were generally similar, with very few instances where telehealth was better or worse than usual care, while patient satisfaction with telehealth was generally better than or similar to that with usual care. Using telehealth as a strategy to implement reduced visit models that replace in-person care for low-risk pregnancies also resulted in similar obstetric and patient-reported outcomes, but higher patient satisfaction, when compared with usual, in-person care.
- For general maternal care, using telehealth for a reduced visit model resulted in improved visit attendance in some, but not all, studies compared with an in-person ACOG-endorsed usual care schedule. Utilization of telehealth visits generally increased during the COVID-19 pandemic compared with usual, in-person care. Studies did not adequately assess factors related to health equity or harms of telehealth.

What do the new findings imply?

- Replacing or supplementing in-person maternal care with telehealth strategies generally results in similar, and sometimes better, clinical outcomes and patient satisfaction compared with those of in-person care. Evidence is lacking for other clinical conditions and outcomes related to access, health equity, and harms.

Background: Telehealth is a promising model for delivering maternity care and may be a strategy for increasing efficacy and patient satisfaction and reducing health disparities. Recent research has explored using telehealth in maternity care for low-risk pregnancies, but it is not clear whether telehealth increases access to care or results in outcomes that are as good as or better than in-person care. Usual maternity care includes frequent in-person visits, but some appointments could occur remotely, with appropriate technology, to facilitate services such as blood pressure or fetal heart monitoring. The coronavirus (COVID-19) pandemic catalyzed the rapid adoption of telehealth to provide care while reducing exposure risk, offering a unique opportunity to reorganize health care delivery, particularly for underserved populations. However, technological issues such as limited internet or broadband access and digital literacy, in addition to equity considerations such as language barriers, may widen existing disparities. In response to the ongoing pandemic and expansion in telehealth utilization, this rapid evaluation of the current evidence aims to inform the uncertainty about the ongoing implementation of telehealth for maternity care.

Objectives: To conduct a rapid review to systematically assess the recent evidence of the effectiveness and harms of maternal care telehealth strategies and produce an evidence map to summarize the evidence and highlight knowledge gaps.

Methods: We followed guidance from the Cochrane Rapid Reviews Methods Group and international Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) reporting guidelines. To identify relevant literature, we systematically searched MEDLINE, the Cochrane Library, CINAHL, and Scopus for relevant English-language studies from January 2015 to April 2022. Included studies evaluated maternal telehealth interventions with bidirectional contact between patients and clinicians to supplement or replace usual maternal care compared with usual care. Eligible study designs were randomized controlled trials (RCTs), cohort studies from before the COVID-19 pandemic began (March 2020), and any comparative design for studies conducted during the pandemic. Maternal care was defined to include pregnancy planning (preconception) and pregnancy (prenatal, intrapartum, and postpartum stages). Telehealth interventions were categorized by mode as phone, virtual (eg, video), messaging, mobile or web apps, or multimodal. We assessed risk of bias (ROB) for all included studies, created an evidence map, and narratively synthesized the evidence.

Results: We identified 3413 unique records through literature searches, from which 28 RCTs and 14 observational studies (in 45 publications) were included. One RCT and 8 observational studies were conducted during the COVID pandemic. ROB was low or moderate in 25 RCTs and 9 observational studies; ROB was high in 3 RCTs and 5 observational studies. The purpose of telehealth interventions was primarily to supplement usual, in-person care (26 studies); 16 studies used telehealth to replace in-person care. The most frequently featured mode of interventions combined more than one type of technology, or were multimodal (17 studies), followed by phone (9 studies), mobile or web apps (10 studies), and virtual (6 studies). Studies addressed several clinical areas including mental health, general maternal care, diabetes care, gestational hypertension (HTN), breastfeeding, smoking cessation, gestational weight gain (GWG), and asthma. Maternal telehealth interventions supplemented in-person care for most studies of mental health and diabetes during pregnancy, primarily resulting in similar, and sometimes better, clinical and patient-reported outcomes compared with usual care. Supplementing in-person mental health care with telephone calls, web-based platforms, or mobile apps resulted in similar or better mental health outcomes compared with in-person care. A reduced-visit prenatal care schedule using telehealth to replace in-person general maternity care for low-risk pregnancies resulted in similar clinical outcomes and higher patient satisfaction compared with usual care. Overall, telehealth strategies were heterogeneous and demonstrated similar obstetric and patient satisfaction outcomes. Utilization (eg, visits attended vs missed) was similar—or, in some cases, better—for telehealth interventions compared with usual care in studies, including those conducted during the COVID pandemic. Evidence was insufficient for other clinical areas and for outcomes related to access, health equity, and harms.

Conclusions: Findings from this rapid review suggest that that replacing or supplementing usual maternal care with telehealth-delivered care is generally associated with similar, and sometimes better, clinical outcomes and patient satisfaction compared with those of in-person care. The impact of telehealth on access to care, health equity, health care utilization, and harms is unclear. Future research should focus on larger studies with broader inclusion criteria; examine effects of telehealth interventions in rural populations; and evaluate outcomes based on population characteristics to inform the impact of telehealth on health disparities, health equity, and potential harms of telehealth interventions.

Introduction

Background and Rationale

The coronavirus (COVID-19) pandemic accelerated the rapid adoption of telehealth in all clinical spaces to provide care while reducing exposure risk[1-3] without time to initially evaluate its effectiveness. Although studies have explored using telehealth in maternity care,[4,5] they have provided only limited data for low-risk pregnancies and have not addressed whether telehealth increases access to care or results in outcomes that are equivalent to or better than those of in-person care. Consequently, calls for new efforts to evaluate the evidence on the effectiveness of maternal telehealth emerged to adopt new strategies in real time. As a result of the pandemic, telemedicine visits have had unprecedented and widespread adoption in the US. New calls for research aim to evaluate the evidence on a compressed timeline to inform future clinical research on telehealth strategies for maternal health care and identify evidence gaps.

Access to high-quality maternal health care is associated with reduced maternal and perinatal morbidity and mortality because it can identify conditions that increase the risk for poor outcomes and facilitate appropriate and timely interventions for prevention or treatment.[6] Despite the cost of pregnancy care in the US far exceeding that of most other developed countries, maternal morbidity and mortality are unacceptably high and significant health disparities exist.[7] For example, women who identify as Black, low-income or live in rural areas are more likely to die during pregnancy.[8,9] In 2015, the US had the highest rate of maternal mortality among industrialized countries—26.4 deaths per 100 000 live births—and rates are increasing.[7] Maternal mortality rates among Black women are nearly 4 times higher than those among White women, regardless of education, income, or socioeconomic characteristics.[10] Health system factors such as access to care and provider shortages and factors driven by social determinants of health such as transportation barriers, food insecurity, interpersonal violence, history of trauma, and structural racism[9,11] also contribute to these disparities.

Given these issues, questions remain about how best to improve maternal health, address health equity, and streamline health care delivery for populations with unacceptable outcomes.[12,13] Maternity care, including prenatal screening, is covered without cost sharing under the Affordable Care Act.[14] Evaluating approaches to care that are inclusive and accessible is

important for ongoing efforts to optimize maternity care and reduce disparities in a rapidly changing health care landscape. Shared decision-making[15] and patient preferences[16] are central considerations for newer maternity care approaches that appeal to women. Alternative models[17,18] for care delivery may present opportunities to enhance efficacy and patient satisfaction and help close the health disparities gap.[19] Telehealth is one promising strategy: Technology can be used to extend health care to remote areas, increase the frequency of patient–clinician interactions, and provide an alternative to in-person care. However, coverage, reimbursement, and regulation of telehealth services, including those provided during pregnancy, have been slow to evolve.[2,20]

Moving toward the delivery of maternal health services via telehealth may offer a unique opportunity to support a paradigm shift toward reorganizing care to reach populations who are underserved or facing access barriers.[21,22] However, these populations are also at risk for widening disparities[23] due to technological challenges (eg, limited internet/broadband access, challenges with digital literacy) and equity considerations (e.g., disability, language barriers).[24, 25] Efforts to address these challenges include federal funding from the Coronavirus Aid, Relief, and Economic Security "CARES" Act (2020)[26] to increase telehealth access and infrastructure for services such as virtual doula care, home blood pressure monitoring, and remote pregnancy monitoring, including fetal Doppler monitors. The American College of Obstetricians and Gynecologists (ACOG) established a telehealth task force to explore the use of technology in routine obstetric care[27] to "enhance, not replace, the current standard of care."[28] Currently, there are no formal practice standards or guidelines for the use of telehealth, but guidance on best practices exists.[28-30]

An evaluation of telehealth modalities to support the delivery of high-quality care is long overdue.[31] The usual approach to maternity care includes frequent in-person visits, but only some of those visits actually require in-person care (eg, physical examination, routine laboratory testing during defined intervals, ultrasound, vaccinations). Other visits that could occur remotely with appropriate technology include patient counseling, fetal heart monitoring, and clinical measurements.[17,32,33] Yet questions remain about whether some services can and should continue to occur remotely and about patient perceptions of virtual vs in-person care.

Objectives and Key Questions

This rapid review aims to systematically evaluate and qualitatively synthesize evidence of the effectiveness and harms associated with telehealth strategies for maternal care; it also seeks to produce an evidence map to provide a high-level overview of the current evidence, important research outcomes, and knowledge gaps. Studies published since a prior systematic review with searches ending in 2015[5] were evaluated using rapid review methodology.[34-36] The following Key Questions informed this rapid review of the literature:

Key Questions

1. Do maternal telehealth strategies intended to supplement or replace in-person care yield equivalent or better patient-centered and maternal health outcomes?
2. Do maternal telehealth strategies intended to supplement or replace in-person care yield equivalent, increased, or decreased access to care, and/or health disparities?
3. What gaps exist in current research? For which pregnancy periods, telehealth modality, or populations are additional primary research studies needed?
4. What are the harms of telehealth strategies for maternal health?

Methods

The methods for this rapid review followed the Evidence-based Practice Center Methods Guide and Cochrane methods guide for rapid reviews[34-39] in accordance with international Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[40] The protocol was registered in PROSPERO on September 3, 2021 (CRD 42021276347). The following section presents an overview of the methods employed for this rapid review. A detailed description of these methods can be found in **Appendices A-F**.

Rapid Review Approach

We engaged a 6-person TEP throughout the rapid review process, using the ACTIVE framework,[41] to seek input on the scope of the review, Key Questions, included studies, minimal data set for abstracting, key elements in risk of bias (ROB) assessments, and elements for the evidence gap map (see Acknowledgments).

Our rapid review approach included the following adjustments to complete the review on an abbreviated 6-month timeline.

Rapid Review Approach

- Defined a narrow scope, focusing on RCTs and observational studies published since 2015; reviewed observational studies conducted prior to the COVID-19 pandemic (before March 2020) to fill gaps or evaluate consistency in the RCT evidence.
- Modified the citation dual-review process. A single investigator reviewed abstracts with a dual review of a random sample of 10% of excluded references as part of a quality assurance strategy.
- Used DistillerSR® software to automate management of literature search results.
- One reviewer conducted focused data extraction on a limited set of predefined outcomes, with dual review of 50% of abstractions for accuracy.
- Conducted ROB assessment on RCTs and modified ROB assessments on observational studies.
- Meta-analysis and grading of the certainty of evidence were not conducted due to heterogeneity of study interventions and outcomes.

Literature Search

We searched MEDLINE, the Cochrane Library, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Embase for relevant English-language studies, from January 2015 (when searches for a prior systematic review[5] on this topic ended) through April 2022, and hand searched bibliographies of included studies. We used the Scopus database to identify relevant publications that cited included studies and supplemented searches with a review of relevant articles' reference lists.

Inclusion and Exclusion Criteria

We developed all study inclusion and exclusion criteria (**Table 1** and **Appendix B**) in collaboration with PCORI and the TEP. To identify research to answer key questions, eligibility criteria were organized by the population, intervention, comparator, outcomes, time, setting, and study design (PICOTS) framework. Telehealth interventions were organized by clinical area and categorized based on the **purpose** of the telehealth intervention (supplementing or replacing usual care), **function** of telehealth (treatment, education, monitoring, prevention, and "routine maternal care" for those that cross these categories), and **mode** of telehealth (phone, virtual visits, messaging by text or email, mobile/web apps, or combination multimodal). We used the term *virtual visits* to describe any study in which the intention of the intervention was video visits but allowed phone as backup. *Telephone only* described visits that were designed and conducted only by phone. Using a priori criteria, we used a "best evidence" approach to capture otherwise eligible observational studies conducted during the COVID-19 pandemic (pre-post and cross-sectional designs after March 2020) or those conducted prior to the pandemic (cohort studies and other rigorous observational designs with a comparator group). See **Appendix D** for a full description of this approach.

Table 1. Summary of Inclusion and Exclusion Criteria

Criteria	Include	Exclude
Population	Adults and adolescents planning pregnancy (preconception), pregnant (prenatal period), in labor and delivery (intrapartum period), or postpartum (1st year after delivery)	Patients seeking contraception (including postpartum), abortion, or undergoing treatment for infertility with a specialist
Intervention	2-way synchronous or asynchronous telehealth between patients and providers	1-way or peer-led interventions, provider consults
Comparator	Usual care (eg, ACOG guidelines) Telehealth plus in-person care vs usual care alone	No comparator, studies not clearly describing both intervention and comparator
Outcomes	• Maternal clinical health (eg, preeclampsia, HTN, GDM) • Obstetric (eg, cesarean delivery, preterm birth) • Mental health (eg, anxiety, depression) • Patient-reported (eg, satisfaction) • Measures of health equity[a] (eg, access, utilization) • Harms (eg, missed diagnosis, treatment delay)	Intermediate outcomes (eg, weight change, diet and activity, patient knowledge), subscale items, cost outcomes, feasibility, barriers, ease of use, patient knowledge
Timing	Published 2015 to present	Published before 2015
Setting	Countries with services and practices similar to those of the US	Countries with UN HDI lower “than “very high”
Study design	• RCTs and cohort studies • Pre-post and comparative surveys for before and after start of COVID-19 pandemic (March 2020)	Case reports or series, single-group prospective studies (eg, single-group surveys)

Abbreviations: ACOG, American College of Obstetrics and Gynecology; COVID-19, Coronavirus disease 2019; GDM, gestational diabetes mellitus; HTN, hypertension; RCT, randomized controlled trial; UN HDI, United Nations Human Development Index; US, United States.

[a] Population characteristics to identify outcomes related to health equity based on the PROGRESS-Plus Framework,[42] including place of residence, race/ethnicity/culture/language, occupation, gender/sex, religion, socioeconomic status, and social capital, as well as other characteristics that may indicate a disadvantage, such as age and disability.

Study Selection

We used DistillerSR online systematic review software to improve efficiency in study selection. One reviewer screened abstracts, with a review of a random sample of 10% of excluded references for quality assurance by a second reviewer. Two investigators reviewed each full-text paper for inclusion, with disagreements resolved through consensus. See **Appendix C** for a list excluded studies with reasons for exclusion.

Data Abstraction

With input from the TEP we selected a limited set of data for abstraction, including the stage of maternal care; PICOTS elements; and results for included outcomes, as described previously. One team member abstracted data, and 50% of abstractions were reviewed by a second investigator for accuracy.

Risk of Bias (ROB) Assessment

To assess ROB of RCTs and observational studies, we used limited sets of criteria from the EPC Methods Guide[36] to evaluate study design aspects most likely to introduce or minimize critical biases, based on prior experience with telehealth studies.[43-47] For RCTs, criteria included randomization, allocation concealment, intention-to-treat analysis, and attrition (**Appendix F**). Cohort studies conducted prepandemic were considered supplemental to RCT evidence and thus evaluated separately using modified criteria from the EPC Methods Guide[36] (**Appendix F**). For pre-post and interrupted time-series studies, criteria derived from an NIH checklist[48] included sample selection, outcome measure ascertainment, and control for temporal trends (**Appendix F**). For surveys, we evaluated the sampling strategy; response rates, sample characteristics, question development, and control for confounders, as outlined in a prior Health Information Exchange systematic review[49] (**Appendix F**). ROB assessments were dual reviewed for each study; and disagreements were resolved through consensus.

Data Synthesis and Analysis

We narratively summarized and qualitatively synthesized data, based on the direction of the effect and statistical significance, and grouped data by clinical area (eg, GDM, mental health), maternal stage (eg, prenatal, postpartum), and intervention details. Evidence tables

identify study characteristics, results of interest, and ROB ratings for all included studies, and summary tables highlight the main findings. We reviewed and highlighted studies using a hierarchy-of-evidence approach, where the best evidence was the focus of the synthesis for each Key Question. Because the Key Questions varied in nature and scope, the approach to synthesis also differed.

We did not conduct meta-analyses (quantitative analyses) due to heterogeneity of studies or insufficient data. Using a best evidence approach, we used pre-COVID-19 observational studies to fill gaps in the evidence from RCTs or evaluate consistency of results, comparing such studies with RCTs with similar patients and interventions. We prioritized RCTs and gave studies with lower ROB ratings more weight in the synthesis for each clinical indication and outcome. We considered cross-sectional studies conducted during the COVID pandemic primarily to inform data on utilization, maternal clinical outcomes, and patient satisfaction outcomes. Trials or observational studies evaluating the effectiveness of telehealth and conducted during the pandemic were considered and organized by clinical condition based on eligibility criteria.

Tables offered summaries of qualitative data. We provided descriptive analysis and interpretation of the results based on the direction and magnitude of effect. Using qualitative synthesis, we created categories of results based mainly on the direction of the effect, with less emphasis on the magnitude of the effect (eg, large difference in benefits, no difference in harms), reporting findings according to ROB ratings and summarizing results across studies grouped by clinical condition and/or telehealth modality. Data on health equity and harms were very limited.

Evidence Map

The evidence map in **Figure 2** represents all the studies to address Key Question 3. The map evaluates gaps in current research, organized by clinical conditions, health outcome (eg, maternal, obstetric, patient reported, utilization, harms), purpose (eg, supplement or replace), and telehealth modality (eg, phone, video, web or mobile apps, multimodal). The evidence map aims to highlight existing evidence and knowledge gaps related to telehealth for maternal health care and to display the extent to which the available evidence supports the use of telehealth.

All included RCTs and observational studies are represented in the map; however, cross-sectional surveys were not included. Key elements selected to display were clinical category, outcome category, overall effect of telehealth, ROB of studies, and mode of intervention. To

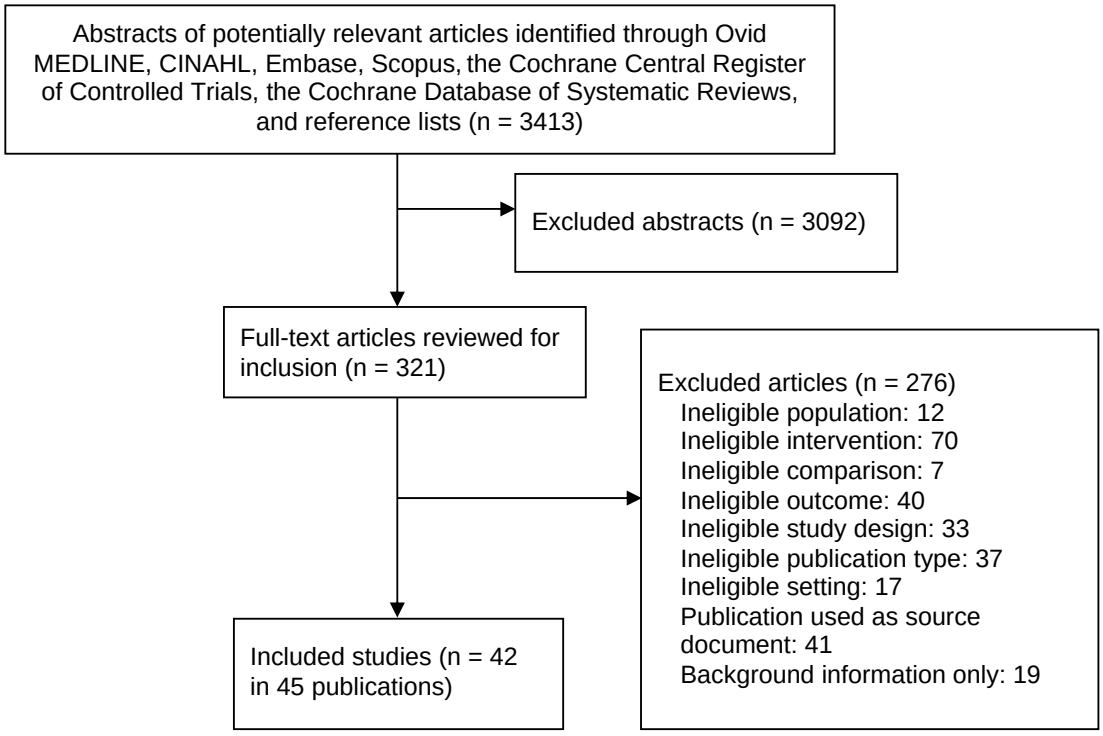
distinguish studies that included more diverse populations, we noted when more than 25% of the enrolled study population identified as Black, Asian, Pacific Islander, South Asian, Native American, mixed race,[50-63] or Hispanic. Using a symbol, we distinguished whether studies aimed to supplement or replace in-person care. For each study, we categorized and color-coded the overall effect for each outcome category (eg, maternal clinical outcomes) based on the effectiveness of telehealth compared with usual care (eg, better than, worse than, or no difference); we characterized some outcomes as having mixed effects in a single study if there was no difference between some outcomes, and others were better or worse than usual care. Importantly, all but one of the mixed studies[64] in the map combined findings that either favored telehealth or found no difference in outcomes between telehealth and usual care groups. We assessed the overall effect for each outcome category based on the direction of the estimate and the statistical significance. **Appendix D** contains additional details.

Results

Literature Search Yields and Study Selection

The primary search identified 3413 unique references. After review of titles and abstracts, we selected 321 papers for full-text review and excluded 276 articles. We identified 42 studies in 45 publications (**Figure 1**) that met our inclusion criteria. Results include a description of included evidence, an evidence map, and a narrative synthesis of the evidence organized by key question. **Appendix C** provides a list of excluded studies and reasons for exclusion.

Figure 1. Literature Flow Diagram



Abbreviation: CINAHL, Cumulative Index to Nursing and Allied Health Literature.

Description of Included Evidence

Of the 42 studies meeting inclusion criteria, 28 were RCTs[50-53,55,56,61-82] and 14 were observational studies (**Appendix E**).[54,57-60,83-93] We rated risk of bias (ROB) as low in 5 RCTs,[53,62,73,74,78,80] moderate in 20 RCTS,[50-52,56,61,63,64,66-72,75-77,79,81,82,94] and high in 3 RCTs[55,65,76] (**Appendix F**). Reasons for downgrading RCTs included unclear randomization and allocation concealment processes, lack of intention-to-treat analyses, and high attrition. Of the 6 prepandemic observational studies, we rated 2 moderate ROB[83,92] and 4 high ROB (**Appendix F**).[59,60,88,93] Of the 8 studies conducted during the pandemic, 3 were rated low ROB,[54,58,91] 4 moderate,[57,84,85,90] and 1 high (**Appendix F**).[86] Reasons for downgrading observational studies included unclear or unreported sampling strategies, inadequate measurement periods, and failure to address confounding. No included studies used a noninferiority study design.

More than half of studies (22 of 42 studies)[53-55,57,58,62,66,69-72,76,77,82-86,88,90,91,93] were conducted during the prenatal period, including all studies of diabetes care (7 studies),[70-72,76,77,83,93] gestational weight gain (GWG) (2),[53,62] and asthma (1),[82] and most studies of general maternal care (9 of 11 studies).[54,57,58,66,84-86,90,91] Of the 13 studies conducted postpartum, most evaluated telehealth interventions for mental health (10 of 12 studies)[60,61,63-65,68,73-75,80,81] and hypertension (HTN) (2 of 3 studies).[56,67] Smoking cessation studies (2)[50,51] and half of breastfeeding studies (2 of 4)[52,79] were conducted during both prenatal and postpartum periods.

The majority of studies were conducted in populations of younger women (mean ages 26-33.8 years), and no studies enrolled participants younger than 18 years old. Three RCTs enrolled patients with advanced maternal age (≥35 years).[66,79,94] Other studies did not report on the proportion of women with advanced maternal age. Twenty-four[50-63,65-67,71,75,78,82-84,92] of 42 studies reported the race or ethnicity of participants as part of demographic characteristics; the number of studies with more than 25% participants identifying as Black, Asian, Pacific Islander, South Asian, Native American, or mixed race[50-58,60-62] was low (12 of 42 studies), while 2 studies reported only White vs non-White.[59,63] In this report, 25% was the percentage used to approximate studies that enrolled more diverse patient populations, many of which were not conducted in the US. Twelve studies[51-55,57,58,60,62,78,83,84] reported Hispanic ethnicity, with 2 studies[54,84] including more than 25% Hispanic participants; both were in the general maternity care category. **Table 2** describes key characteristics of the studies, including patient demographics.

The most commonly studied clinical areas were mental health and general maternity care, although study designs for these areas differed greatly. The most common purpose of telehealth interventions was to supplement usual care (26 of 42 studies).[50-53,55,56,60-65,68-70,72-80,82,93,94] Sixteen studies[54,57-59,66,67,71,81,83-92] used telehealth as a replacement for usual care. The most common function of telehealth was treatment (15 of 42 studies),[50-52,60,63-65,68,69,73-75,78-81] followed by remote monitoring (RM) (12 studies).[55,56,67,70-72,76,77,82,83,88,93] the remaining 15 studies[53,54,57-59,61,62,66,84-86,90-92,94] provided education, general care and prevention, or multiple functions. Across all clinical areas, the most common mode of telehealth interventions was multimodal (17),[52,55,57,58,62,65-67,69,70,72,75,77,79,83,91,93] followed by phone (9),[50, 51, 53, 60, 68, 73, 74, 80, 84, 85] web/apps (10)[56, 61, 63, 64, 71, 76, 78, 82, 88, 94] and virtual visits (6).[54, 59, 81, 86, 90, 92] There were no studies of interventions using two-way messaging alone. Specifics regarding the purpose, function, and mode of interventions are discussed in more detail in subsequent sections that focus on specific clinical conditions. Comparisons were various forms of usual care, with 8 studies specifically defining *usual care* as care recommended by ACOG; 5 of the 8 were for general maternal care,[59,66,84,85,92] and 1 each for HTN, smoking cessation, and GWG.[50,56,62]

Study designs varied among clinical areas. RCTs and cohort studies were overwhelmingly employed for mental health, GDM, HTN, breastfeeding, and specific clinical areas, whereas many of the data on general maternity care were from cross-sectional studies and only 1 RCT. Due to the variability in study design for certain clinical conditions, the quality (ROB) of studies also varied by condition and is discussed in more detail in condition-specific tables (**Tables 3-8**). Notably, the general maternity care studies were more frequently conducted during the COVID pandemic (8 of 11 studies) and in the US (9 of 11), and they more often assessed interventions intended to replace usual care.

One RCT[63] and 8 observational studies[54,57,58,84-86,90,91] were conducted after the start of the COVID-19 pandemic (starting March 2020); most were conducted in the US.[54,57,58,84,85,90] Seven of the studies conducted during the COVID pandemic were cross-sectional in design and evaluated patient satisfaction, utilization, and limited clinical outcomes to assess the effectiveness of telehealth for delivery of general prenatal care. As such, general care studies, particularly those carried out during the pandemic, were different in intent, quality, and execution than studies of other medical conditions summarized in this report.

Table 2. Characteristics of Included RCTs and Observational Studies

Characteristics	Mental health (K = 12)	General care (K = 11)	GDM (K = 7)	HTN (K = 3)	Breastfeeding (K = 4)	Additional clinical areas[a] (K = 5)
Study design						
RCT ***K*** **(N)**	11 (1777)	1 (300)	5 (498)	2 (297)	4 (1832)	5 (2052)
Cohort ***K*** **(N)**	1 prospective cohort (61)	3 cohorts (13 836)	2 prospective cohorts (221)	1 retrospective cohort (320)	0	0
Other observational designs ***K*** **(N)**	0	7 (23 719)[b]	0	0	0	0
Conducted during COVID ***K*** **(N)**[c]	1 (403)	8 (36 281)	0	0	0	0
Patient characteristics						
US-based ***K*** **(N)**	1 (61)	9 (14 869)	1 (117)	1 (206)	2 (453)	4 (1980)
Studies >25% sample race other than White ***K*** **(N)**	4 (786)	4 (1506)	0	1 (206)	1 (250)	4 (1980)
Studies >25% sample Hispanic ***K*** **(N)**	0	2 (12 711)	0	0	0	0
Intervention and comparators						
Supplement in-person care K (N)	11 (1800)	0	5 (409)	1 (206)	4 (1832)	5 (2052)
Replace in-person care K (N)	1 (38)	11 (37 855)	2 (310)	2 (411)	0	0
ACOG usual-care comparator K (N)	0	5 (14 374)	0	1 (206)	0	2 (409)

Abbreviations: ACOG, American College of Obstetrics and Gynecology; GDM, gestational diabetes mellitus; HTN, hypertension; K, number of studies; N, number of randomized participants; RCT, randomized controlled trial; US, United States.

Note. The total sample in 42 studies (in 45 publications) was 44 894.
[a] Includes smoking cessation, gestational weight gain, and asthma.
[b] Other designs include cross-sectional surveys, pre-post studies, and an interrupted time-series design; three of these studies57,58,85 are discussed in Key Question 2 but not Key Question 1.
[c] Eight observational studies and 1 RCT.

Summary of Findings

Details of study characteristics and findings for each Key Question appear in the following sections. Findings for Key Question 1 are organized by clinical condition and pregnancy stage for all studies (3 studies did not contribute evidence to this question[57,58,85]). Study characteristics and main findings for each clinical area are in **Tables 3 through 8**. Due to limited evidence, findings for Key Questions 2 and 4 are presented for all evidence combined and not stratified by clinical area. Key Question 3 includes the evidence map that incorporates findings from all RCTs and controlled observational studies. **Appendix E** provides additional details for all included studies.

Key Question 1: Do maternal telehealth strategies intended to supplement or replace in-person care yield equivalent or better patient-centered and maternal health outcomes?

We report findings for this question by clinical category. Under each clinical category, outcome data are organized by telehealth intervention purpose, function, and mode. **Tables 3 through 9** present study characteristics and main findings for each clinical category. Evidence tables in **Appendix E** provide additional study details.

Mental Health. The majority of trials, 11 RCTs (in 12 publications) of pregnant or postpartum women and 1 cohort study (n = 61),[60] evaluated the effect of telehealth for addressing perinatal mood disorder prevention or treatment (12 studies; N = 1838; **Table 3 and Appendix E**).[55,61,63-65,68,69,73-75,80,81] We rated ROB as low to moderate in 8 RCTs[61,63,64,68,69,73-75,80] and high in 3 RCTs[55,65,81] due to unclear randomization processes, lack of intention-to-treat analyses, and problems with high or differential attrition (**Appendix F**).[55,65,81] The cohort study had high ROB.[60] Ten studies enrolled postpartum women, with 4 studies[64,68,73,74,80] following women up to 6 to 12 months after birth; 2 RCTS included women followed during the prenatal period only.[55,69] All but 1 study enrolled women who screened positive for perinatal mood disorders using a variety of clinical tools and thresholds.[61] Seven studies excluded participants with active suicidality and/or serious mental health diagnoses (eg, psychosis), and 4 studies excluded those

with less specific mental health risk information (eg, "high levels of distress"). Mean maternal age ranged from 26 to 34 years (1 study did not report age). Six studies did not report race or ethnicity of included populations. Among the 6 studies that did report race, 5 reported the percentage of Black or race other than White participants (range 4%-85%), and one reported that the majority of participants (41.6%) were Chinese and the remaining participants came from other Asian countries.[61]

Among 3 moderate- to low-ROB RCTs, phone-based psychotherapy interventions to supplement usual care resulted in reduced symptoms of anxiety or depression in 2 larger, well-conducted RCTs (N = 638) and resulted in similar rates of depression in a smaller RCT. Anxiety scores improved in 1 well-conducted RCT.

Three RCTs that evaluated interventions using web platforms or mobile apps (web/apps) to supplement care reported improved depression and anxiety scores in 2 of 3 trials, similar depression scores in one trial, and improved patient satisfaction in one trial compared with outcomes in usual care.

Among postpartum or pregnant women with depression, 4 small trials of interventions using web-based CBT with optional support via phone or email to supplement usual care suggested similar depression and anxiety outcomes compared with those of usual care.

The purpose of most telehealth interventions in 10 studies was to supplement usual care; however, 1 study aimed to replace in-person psychotherapy treatment.[81] Nine of the 11 studies used telehealth to deliver treatment; in 1 study the telehealth function was education[61] and in 1 the function was remote monitoring (RM).[55] Telehealth delivery varied by mode (phone, virtual visits, web or app based, and multimodal). Four studies (in 5 publications) evaluated phone-based interventions,[60,68,73,74,80] one evaluated virtual visits,[81] 3 examined interactive web or mobile apps,[61,63,64] and 4 evaluated an intervention that employed more than a single technological component (multimodal).[55,65,69,75] Telehealth interventions were heterogeneous across the trials, with variation in the frequency and content as well as difference in clinical training of persons communicating synchronously or asynchronously. Intervention duration ranged from 1 day to 12 months; follow-up ranged from 4 weeks to 12 months. Comparisons were usual care in all studies, but *usual care* was defined differently in each study and ranged from very minimal contact to in-person psychotherapy. None of the RCTs were conducted in the US; 6 were conducted in Canada. One RCT took place during the COVID-19 pandemic.[63] All the RCTs[55,61,63-65,68,69,73-75,80,81] reported maternal mental health outcomes using validated scales

for mood disorders (**Table 3**). Three RCTs[55,61,73,74] and one observational study[60] contained patient-reported outcomes, including satisfaction with care. A single trial described only patient-reported outcomes.[55]

Mental Health Outcomes

Depression. Nine RCTs[61,63-65,68,73-75,80,81] and one cohort study[60] (in 12 publications) evaluated the effect of telehealth interventions on depressive symptoms in postpartum women.[61,63-65,68,69,73-75,80,81] One RCT[69] enrolled women during pregnancy and evaluated the effect of telehealth on depression during pregnancy (**Table 3**).

Phone interventions. Three RCTs[68,73,74,80] and one observational study[60] evaluated phone interventions to supplement in-person care and reported reduced or similar depressive symptoms among the low- or moderate-ROB RCTs[73,74,80] and mixed findings in the smaller, observational study.[60] One moderate-ROB RCT from Canada (N = 241)[68] reported the proportion of women clinically depressed, based on the Structured Clinical Interview for *DSM-IV* (SCID-I), and demonstrated a statistically significant reduction in clinical depression in the weekly phone-based psychotherapy group (OR 0.22; 95% CI, 0.10-0.46) at 12 weeks postpartum and an improvement in scores on the Edinburgh Postnatal Depression Scale (EPDS) compared with controls (OR 0.26; 95% CI, 0.14-0.48). A low-ROB RCT from China (N = 397) demonstrated a significant improvement in depression scores on the EPDS for major depression (EPDS ≥ 13; D 5.00; 95% CI, 3.12-6.88) at 6 weeks with weekly phone cognitive behavioral therapy (CBT) compared with usual care; however, it found no difference in major depression at 6 months between groups; both groups had improved scores over time.[68,73] These studies reported outcomes differently (eg, diagnostic measures of depression or comparison of specific range of scores) and at different follow-up points (see **Appendix E**). A third, smaller (N = 62)[80] RCT assessed weekly phone-based personal coaching plus online education and evaluated diagnostic status using the SCID-I and the EPDS to measure depressive symptoms. There was no effect of the intervention at 6 months, but more intervention group participants were found to achieve diagnostic remission, based on the SCID-I, at 12 months.[80] A small (N = 61) prospective cohort study[60] of weekly phone-based interpersonal therapy reported significant improvement in depression scores on the Hamilton Depression scale (HAM-D) at 12 weeks postintervention (7.49 vs 12.43; adjusted MD –4.94; 95% CI, –9.36 to –0.52) but similar scores on the EPDS, with reduction in depressive symptoms in both groups.

Virtual interventions. A small (N = 38) pilot RCT, rated high ROB, evaluated the effect of the choice for in-person *or* video conference psychotherapy visits, compared with only in-person psychotherapy visits, to replace in-person care. There was no difference at 3 months between groups in depression or anxiety based on EDPS or 7-item Generalized Anxiety Disorder Questionnaire (GAD-7) scores, respectively.[81]

Web/apps. Three moderate-ROB RCTs[61,63,64] reported mixed results, with web- or app-based interventions to supplement in-person care either improving depression scores[63,64] or resulting in similar scores[61] for intervention and control groups.[61,63,64] A RCT (N = 403) of a 1-day interactive virtual CBT workshop conducted during the COVID-19 pandemic found a statistically significant difference in EPDS scores (11.65 vs 14.04; $p < .001$) and in the proportion of participants with a clinically significant change in EPDS score (>4 points; 64% vs 30%; OR 4.15; 95% CI, 2.66-6.46) at 12 weeks follow-up.[63] A RCT (N = 133)[64] that enrolled women with more moderate depression scores at baseline (mean EPDS 9.15) found mixed results depending on the time point of measurement. At 8 months the intervention group had significantly lower depression scores (EPDS 7.8 vs 8.8; $p < .001$); at 12 months the control group had significantly lower depression scores (EPDS 8.4 vs 7.2; $p < .001$).[64] The third RCT (N = 250)[61] evaluating a messaging intervention in postpartum women without depression did not find differences in EDPS scores between groups at 4 weeks follow-up.[61]

Multimodal. Three small RCTs evaluated the effects of telehealth interventions on depression outcomes and used more than one mode to supplement care for treating women for depression.[65,69,75] Two RCTs that enrolled women with higher baseline depression scores (mean EPDS 15 and 17.4) reported heterogeneous results, depending on the scale (eg, EPDS or Depression Anxiety Stress Scales [DASS]-Depression), at 10 weeks. Both studies[69,75] were small ($N \leq 50$) and results were inconsistent; one study reported no difference in outcomes,[69] and one reported improved depression scores at 10 weeks (**Appendix E**).[75] A small, high-ROB trial that offered phone-based support along with self-guided web-based CBT reported no difference in depression scores.[65]

Anxiety. Six RCTs evaluated the effect of telehealth interventions on anxiety symptoms; results were inconsistent (**Table 3**).[63,65,68,69,75,81] Two trials found that telehealth was associated with significant improvement in anxiety compared with usual care at 12 weeks (in both) and at 36 weeks postintervention in 1 trial.[63,68] Specifically, a moderate-ROB RCT (N = 241)[68] found that

12 weekly, 60-minute, phone-based therapy sessions resulted in significant improvement in anxiety symptoms at 12 weeks (State-Trait Anxiety Inventory [STAI] scale improvement 40.4% vs 65%; OR 0.36; 95% CI, 0.21-0.65) and at 36 weeks (27.7% vs 44.8%; OR 0.47; 95% CI, 0.26-0.85).[68] Another moderate-ROB RCT (N = 403) conducted during the COVID pandemic (described previously) found that a 1-day online workshop using CBT reported a statistically significant improvement in anxiety symptoms at 12 weeks (GAD-7 MD −1.59; 95% CI, −2.62 to −0.61).[63] Two moderate-ROB trials (N = 92) evaluating multimodal interventions did not find a significant impact on anxiety symptoms.[69,75] Two high-ROB RCTs (N = 127) did not find optional virtual visits for psychotherapy[81] or a multimodal intervention[65] to significantly improve anxiety symptoms.

Patient-Reported Outcomes. Three RCTs and one cohort study measured patient-reported outcomes—with mixed results (**Table 3**).[55,61,73,74] One RCT (N = 397), with low ROB,[73] compared a phone intervention with usual care and found higher parental sense of confidence with phone CBT to treat postpartum depression, although the difference in scores was very small (Parenting Sense of Competence [PSOC] scale of 0-100, 6 weeks, 69.4 vs 63.1; $p < .01$; 6 months, 71.8 vs 67.8; $p < .01$). A prospective cohort study (N = 61) of a phone intervention for CBT delivery for depression in postpartum women found no difference in patient acceptance of the intervention compared with usual care (Table 3).[60] A moderate-ROB RCT[61] (N = 250) in postpartum women without depression or anxiety found that parenting efficacy and parenting experience were significantly better with an educational and provider messaging intervention compared with usual care (Parenting Efficacy Scale mean change 11.9% vs –8.5%; $p < .001$).[61] A high-ROB RCT of women (N = 72)[55] with depressive symptoms examined the effect of tracking mood symptoms during prenatal care using a multimodal intervention, which combined a bidirectional mobile app and a patient portal; it found no difference in patient satisfaction for telehealth compared with usual care.[55]

Clinical Effectiveness and Harms Outcomes: All 4 RCTs reported a diabetes-related clinical outcome. Three studies investigating the use of multicomponent VTC interventions versus usual care found similar effects for change in hemoglobin A1c (HbA_{1c}) from baseline to the end of the intervention at 6 to 8 months.[24, 36, 38] One study (N = 338) compared VTC with or without RPM versus in-person care for the management of type 2 diabetes.[24] One study (N = 240) compared VTC plus in-person care and an online portal for uploading patient data with usual care only for the management of type 1 diabetes in children.[38] The third study (N = 165) found that, compared with usual care, a nurse-facilitated VTC intervention with in-person care and an online portal for uploading patient data resulted in a 0.39% reduction in HbA_{1c} from baseline to 8 months, trending toward statistical significance ($p = .055$).[36] The fourth study (N = 75) found similar effects for level of agreement among endocrinologists making prescription decisions for the use of type 2 diabetes medications during consultations that occur via VTC.[50]

Harms: Two studies reported no difference between the VTC and usual care groups for incidence of hypoglycemia at 8 months[36] and 6 months,[38] respectively. Additionally, three studies reported no differences in adverse events between VTC and usual care groups.[24, 36, 38]

Health Care Utilization Patterns: None of the 4 abstracted diabetes studies reported a service utilization outcome.

Patient Satisfaction: One study (N = 240) found that, compared with usual care, VTC plus in-person care and an online portal for uploading patient data for the management of type 1 diabetes in children had similar effects for patient satisfaction at 6 months.[38] Notably, this study reported greater caregiver satisfaction among the VTC group compared with the usual care group at 6 months (adjusted mean difference at 6 months 4.0; 95% CI, 2.1- 5.8; $p < .001$).[38]

Quality of Life: The aforementioned study investigating the use of VTC plus in-person care and an online portal for uploading patient data for the management of type 1 diabetes in children reported similar effects between the VTC and the usual care group for change in participant health-related quality of life at 6 months and similar effects for change in caregiver psychological well-being at 6 months.[38]

Table 3. Studies of Telehealth for Management of Mental Health in Maternal Care

Study and population		Telehealth intervention features			Sample baseline scores	Results
Author (year)	Study design (N); maternal stage; ROB	Purpose; function; mode	Intervention; comparison	Follow-up	Baseline depression or anxiety	
Phone interventions						
Dennis (2020)[68]	RCT (241) Postpartum Moderate	Supplement; Treatment; Phone	Weekly phone session x 12 weeks vs referral to local depression services	12, 24, 36 weeks	EPDS 17.5 STAI 58.3	**Mental health outcomes** ▲ Depression (EPDS ▲12, 24, 36 weeks; SCID ►36 weeks) ▲ Anxiety (STAI 12, 24, 36 weeks)
Ngai (2015)[74] Ngai (2019)[73]	RCT (397) Postpartum Low	Supplement; Treatment; Phone	Weekly phone CBT session x 5 weeks vs 1 follow-up visit	6 weeks, 6 months	EPDS 11.9 Anxiety NR	**Mental health outcomes** ▲ Depression (EPDS 6 weeks, ►6 months) **Patient-reported outcomes** ▲ Satisfaction (PSOC 6 weeks, 6 months)
Posmontier (2016)[60]	Prospective cohort (61) Postpartum[a] High	Supplement; Treatment; Phone	Interpersonal phone psychotherapy x 8 sessions vs referral to mental health professional	12 weeks	EPDS 16.6 Anxiety NR	**Mental health outcomes** ▲/► Depression (▲HAM-D, ►EPDS)
Wozney (2017)[80]	RCT (62) Postpartum Low	Supplement; Treatment; Phone	Printed materials, video, 12 phone CBT sessions vs waitlist control	3, 6, and 12 months	EPDS 16.3 Anxiety NR	**Mental health outcomes** ► Depression (SCID-I 3 and 6 months; EPDS 6 and 12 months) ▲ Depression (SCID-I 12 months)

Virtual interventions						
Yang (2019)81	RCT (38) Postpartum High	Replace; Treatment; Virtual	Virtual visits x 4 weeks vs in-person visits	3 months	EPDS 13.5 GAD-7 9.8	**Mental health outcomes** ► Depression (EPDS) ► Anxiety (GAD-7)
Web/Apps interventions						
Sawyer (2019)64 eMums Plus	RCT (133) Postpartum Moderate	Supplement; Treatment; Web/Apps	Guided group sessions on app (mobile phone) x 12 months vs 1 in-person visit	8 and 12 months	EPDS 9.2 NR	**Mental health outcomes** ▲ Depression (EPDS, 8 months) ▼ Depression (EPDS, 12 months)
Shorey (2017)61	RCT (250) Postpartuma Moderate	Supplement; Education; Web/Apps	Self-guided psychoeducation on app (mobile phone) + asynchronous communication through app x 4 weeks vs usual care	4 weeks	NR NR	**Mental health outcomes** ► Depression (EPDS) Patient-reported outcomes ▲ Satisfaction
Van Lieshout (2021)63	RCT (403) Postpartuma Moderate	Supplement; Treatment; Web/Apps	1-day live interactive online CBT workshop vs waitlist control	12 weeks	EPDS 16.2 GAD-7 12.4	**Mental health outcomes** ▲ Depression (EPDS) ▲ Anxiety (GAD-7)

Multimodal interventions						
Ashford (2018)[65]	RCT (89) Postpartum High	Supplement; Treatment; Multimodal	Self-guided, web-based CBT and optional phone support x 8 weeks vs waitlist control (but no phone support)	8 weeks	DASS-D 8.2 GAD-7 12.3	**Mental health outcomes** ► Depression (DASS-D) ► Anxiety (GAD-7, DASS-A)
Forsell (2017)[69]	RCT (42) Prenatal Moderate	Supplement; Treatment; Multimodal	Guided, web-based self-help CBT x 10 weeks + email feedback vs waitlist control	10 weeks	EPDS 17.4 GAD-7 12.4	**Mental health outcomes** ▲/► Depression Symptoms (▲ MADRS-S; ► EPDS) ▲/► Depression Diagnosis (▲ MADRS-S Response and SCID-I Remission; ►MADRS-S Remission and Deterioration) ► Anxiety (GAD-7)
Hantsoo (2018)[55]	RCT (72) Prenatal[a] High	Supplement; RM; Multimodal	Mood tracking and alert app (mobile phone) + patient portal app (n = 25), mood tracking and alert app + patient portal app + lottery incentive (n = 23) x 8 weeks vs patient portal app with email interaction	8 weeks	NR NR	**Patient-reported outcomes** ► Satisfaction with care
Pugh (2016)[75]	RCT (50) Postpartum Moderate	Supplement; Treatment; Multimodal	Guided, web-based CBT + weekly emails x 7-10 weeks vs waitlist control	10 weeks	EPDS 15.0 DASS-A 11.0	**Mental health outcomes** ▲/► Depression (▲EPDS; ►DASS-D) ► Anxiety (DASS-A)

Direction of effect: ▲= improved outcome with telehealth; ►= similar outcome with telehealth; ▼= worse outcome with telehealth; ▲/► = mixed effects: some outcome measures better and others similar with telehealth.
Note: Refer to Methods section and Full Methods Appendix for descriptions of modes.
Abbreviations: Apps, applications; COVID, Coronavirus disease; DASS, Depression, Anxiety, and Stress Scale (-A, anxiety; -D, depression); EPDS, Edinburgh Postnatal Depression Scale; GAD-7, Generalized Anxiety Disorder 7-item; HAM-D, Hamilton Depression Scale; MADRS-S, Montgomery-Åsberg Depression Rating Scale-Self Report; N, number of randomized participants; NR, not reported; PSOC, Parenting Sense of Competence Scale; RCT, randomized controlled trial; RM, remote monitoring; ROB, risk of bias; SCID-I, Structured Clinical Interview for *DSM-IV* Axis I Disorders; STAI, State-Trait Anxiety Inventory.
[a] Reported >25% of sample was Black, Asian, Pacific Islander, South Asian, or race other than White; one[63] reported only White vs non-White.

General Maternity Care. One RCT[66] of 300 women and 2 observational studies[59,92] (N = 1229) evaluated the effect of telehealth interventions to replace in-person, routine prenatal care (**Table 4** and **Appendix E**). The RCT[66] and one observational study[92] met criteria for moderate ROB, while one quality improvement study[59] was rated high ROB (**Appendix F**). Populations ranged from 171 to 1058 participants. Mean ages ranged from 29.2 to 31.3 years; a small sample of women in the RCT[66] had advanced maternal age (≥35 years, 8.3%). In one study 25% of participants were identified as White vs non-White;[59] no study reported percentage of participants identifying as Hispanic. Telehealth replaced usual care by implementing a reduced-visit model in all 3 studies that employed RM. Alternative schedules of prenatal care via video[59,92] or a combination[66] of telehealth modes were compared with usual ACOG-recommended timing of in-person prenatal care. In the observational studies, the intervention took place primarily in the prenatal stage; one visit was conducted postpartum. Studies reported maternal clinical, obstetric, patient-reported, and utilization outcomes. No studies took place in rural settings, and all were conducted in the US. **Appendix E** presents detailed study characteristics and results.

Findings from 1 RCT and 2 cohort studies suggest similar obstetric and patient-reported outcomes, higher patient satisfaction, and mixed maternal clinical outcomes with the use of virtual telehealth to replace in-person care, compared with usual, in-person prenatal care in low-risk pregnancies. Findings from 5 observational studies conducted during the COVID-19 pandemic and that used telehealth to replace in-person prenatal care support these results, and they report rates of patient satisfaction similar to those of usual care.

Three cross-sectional,[54,86,90] one interrupted time-series,[91] and one cohort study[84] assessed the impact of the COVID-19 pandemic (after March 2020) on effectiveness of telehealth for general maternal care during prenatal and postpartum periods (**Table 4** and **Appendix E**). ROB was low in 3 studies, moderate in one study, and high in another (**Appendix F**). Populations ranged from 47 to 22 323. Mean ages ranged from 27.8 to 31.3 years, with one study[90] reporting 2% of the sample as advanced maternal age (≥40 years); one study[86] did not report population characteristics. More than 25% of participants identified as Hispanic in 2 studies.[84] The purpose of telehealth interventions was to replace usual care; the function was general prenatal care. Mode was phone,[84] virtual,[54,86,90] or a combination of modalities[91] to implement alternative

schedules of telehealth for routine prenatal and postpartum care. Comparisons included usual in-person maternal care in 4 studies,[54,86,90,91] with ACOG-recommended timing of visits as the specific comparison in one study.[84] Studies reported maternal clinical, obstetric, patient-reported, and utilization outcomes. No studies specifically reported being conducted in a rural setting; 3 studies were conducted in the US,[54,84,90] one study in Australia,[91] and one in Poland.[86] **Appendix E** presents detailed study characteristics and results.

Maternal Clinical Outcomes. One moderate-ROB RCT (N = 300)[66] evaluated the effectiveness of a multimodal alternative care model intervention for low-risk pregnancies compared with usual ACOG timing of prenatal care. The reduced-visit schedule included 8 in-person visits interspersed with 6 video or phone calls; the control group received 12 in-person visits. The intervention group also had access to a study-specific online prenatal care community as well as fetal Doppler and sphygmomanometer home-monitoring devices. Primary outcomes included acceptability (patient satisfaction) and effectiveness of care (discussed later). The study was not powered to detect differences in clinical outcomes but reported a higher number of women in the intervention group diagnosed with GDM compared with controls (6 [4.5%] vs 0 [0.0%]; $p < .01$)—a prevalence "consistent with what would be expected in a low-risk obstetric cohort" (**Table 4 and Appendix E**). Limitations included unclear randomization methods and unclear use of intention-to-treat analyses.

One quality improvement cohort study (N = 1058),[59] rated high ROB, assessed effectiveness of a virtual alternative care model compared with the ACOG-endorsed prenatal care schedule. Participants were women with low-risk pregnancies who had enrolled in either virtual visit or usual care programs. The visit schedule included 6 video visits (one at 2 weeks postpartum) and 9 in-person visits; patients were given a fetal Doppler and BP cuff for home measurements. The ACOG-endorsed usual care group had 15 in-person visits, including one visit at 2 weeks postpartum. There was a statistically significant difference between the intervention and control groups for diagnosis of preeclampsia (3.4% vs 8.5%; OR 2.70; 95% CI, 1.21-6.02). Rates of GDM did not differ between study groups. Limitations included inadequate randomization, groups that were not comparable at baseline, and lack of blinding for outcome assessors.

Three studies[84,86,91] conducted during the COVID-19 pandemic reported similar rates of GDM and preeclampsia and lower rates of gestational HTN when using telehealth. One US

cohort study (N = 12 607),[84] rated moderate ROB, compared the use of a phone alternative care model that included 3 phone visits and 10 in-person visits with the ACOG-endorsed prenatal care schedule. Women in the intervention group delivered between May and October 2020, after the adoption of the phone telehealth model, while women in the control group delivered at the public hospital between May and October 2019. There was a statistically significant difference between rates of gestational HTN (19.0% vs 20.1%; aRR 0.93; 95% CI, 0.86-0.99) for intervention vs controls, although the absolute difference was small. Rates of preeclampsia did not differ between groups. Limitations included unclear enrollment of all eligible participants and the use of a historical control group.

One interrupted time-series study (N = 22 323),[91] rated low ROB, compared the effects of a multimodal alternative care model in women during the pandemic (April-July 2020) with usual care in women prior to the pandemic (January 2018-March 2020) in Australia. Women received either hybrid care (5 or 6 video or telephone calls based on patient preference, 3 to 5 in-person visits, and self-monitoring of BP and fetal growth measurements) or usual care (10 or more in-person visits). There were no differences reported between groups in rates of GDM or preeclampsia.

One cross-sectional survey (N = 618),[86] rated high ROB, compared women's experience with virtual telehealth with in-person visits for prenatal care during the pandemic in Poland. There was no difference between groups in rates of GDM diagnosis. Limitations included low participation rates in a convenience sample, limited reporting of sample characteristics, and no consideration of confounders.

Obstetric Outcomes. One RCT[66] and one quality improvement cohort[59] conducted before the pandemic (described previously) reported no differences between telehealth alternative care models and ACOG-endorsed usual care in outcomes of cesarean delivery,[59,66] preterm birth,[59,66] or low birth weight (LBW).[66]

Two studies conducted during COVID-19, one a cohort[84] assessing a telephone hybrid model of care and the other an interrupted time series[91] using a multimodal hybrid care intervention (both described previously), reported no differences between groups in rates of preterm birth. The cohort[84] also reported no difference between groups in outcomes of cesarean delivery, postpartum hemorrhage, or a composite outcome, although the study may have been underpowered to detect the composite outcome end point.

Patient-Reported Outcomes. One RCT[66] (described previously) and one retrospective cohort conducted before the pandemic suggest high levels of patient satisfaction when using telehealth. The RCT reported a statistically significant difference in satisfaction with care, favoring telehealth over usual care as measured by a validated and modified satisfaction subscale survey (0-100, with 100 indicating greater satisfaction; 93.9 vs 78.9; MD 15.01; 95% CI, 13.38-16.64). There was no difference between groups in perceived quality of care for categories of communication with the provider or patient decision-making.

The retrospective cohort (N = 171),[92] rated moderate ROB, compared patients' satisfaction with a virtual alternative prenatal care model for low-risk pregnancies with ACOG usual care in the US. The alternative schedule included 5 video visits, 7 to 9 in-person visits, and a fetal Doppler and BP cuff, compared with 12 to 14 in-person visits. There was a statistically significant difference in overall satisfaction, with patients favoring telehealth compared with usual care as measured by a study-specific satisfaction questionnaire (1-5, with 5 indicating greater satisfaction; 4.69 vs 4.46; $p = .006$). Limitations included a difference in parity in groups at baseline and unclear masking of outcome assessors.

Two cross-sectional surveys[54,90] conducted during the COVID-19 pandemic reported similar levels of overall satisfaction and quality of care when using virtual telehealth strategies for prenatal care. One survey (N = 104),[54] rated low ROB, assessed associations with patient satisfaction in women attending at least one virtual telehealth and one in-person visit in a US safety-net clinic. There was a significant difference in overall satisfaction for telehealth-delivered compared with in-person prenatal care (20 vs 25; $p = .008$), measured by the validated Short Assessment of Patient Satisfaction survey, although both scores were in the satisfied range. A subanalysis of patient satisfaction by demographic groups demonstrated a statistically significant difference in levels of satisfaction, with patients who identified their race as other (23 vs 22; $p = .033$) favoring telehealth over in-person visits. *Statistically* significant differences were also found for English speakers (22 vs 25; $p = .042$), low-risk pregnancies (23 vs 24; $p = .009$), and women identifying as non-Hispanic (22 vs 25.5; $p = .019$) favoring in-person visits, although there was no *clinically* significant difference because all scores were in the satisfied range. Notably, there was no difference in satisfaction with telehealth among patients who identified as Black or White, Hispanic, Spanish language speakers, or high-risk pregnancies.

One survey[90] (N = 47), rated moderate ROB, described perceived quality of care among US women who were offered a video consult with a specialist compared with an in-person consult. Spanish was spoken in 17% of the video consults. There was no difference in perceived quality of prenatal care between telehealth or in-person visits, as measured by a study-specific survey, including in a subanalysis of English- vs Spanish-speaking patients. Limitations included a moderate response rate, lack of a validated survey, and no consideration of confounders.

Table 4. Studies of Telehealth for Management of General Maternal Care

Study and population		Telehealth intervention features			Results
Author (year)	Study design (N); maternal stage; ROB	Purpose; function; mode	Intervention; comparison	Follow-up	
Prepandemic studies					
Virtual interventions					
Pflugeisen (2016)59	Quality Improvement Cohort (1058) Prenatal + postpartuma High	Replacement; General care/RM; Virtual	Hybrid care of video visits x 5 + self-monitoring + in-person visits x 9 vs ACOG usual care	2 weeks postpartum	Maternal clinical outcomes ► GDM ▲ Preeclampsia Obstetric outcomes ► Preterm birth ► Cesarean delivery
Pflugeisen (2017)[92]	Retrospective cohort (171) Prenatal + postpartum Moderate	Replacement; General care/RM; Virtual	Hybrid care of video visits x 5 + self-monitoring + in-person visits x 7-9 vs ACOG usual care	6-12 weeks postpartum	**Patient-reported outcomes** ▲ Satisfaction
Multimodal interventions					
Butler (2019)[66]	RCT (300) Prenatal Moderate	Replacement; General care/RM; Multimodal	Hybrid care of virtual visits (video or phone) x 6 + in-person visits x 8 + online community vs in-person visits (ACOG usual care)	36 weeks' gestation	**Maternal clinical outcomes** ▼ GDM **Obstetric outcomes** ► Cesarean delivery ► Preterm birth ► LBW **Patient-reported outcomes** ▲ Satisfaction ► Quality of care

COVID-19 studies					
Phone interventions					
Duryea (2021)[84] COVID	Cohort (historical control; 12 607) Prenatal[b] Moderate	Replacement; General care; Phone	Hybrid care of phone visits x 3 and in-person visits x 10 vs in-person visits (ACOG usual care)	37 weeks' gestation	**Maternal clinical outcomes** ▲ Gestational HTN ► Preeclampsia **Obstetric outcomes** ► Composite outcome (placental abruption, stillbirth, NICU admission, umbilical cord pH < 7.0) ► Cesarean delivery ► Preterm birth ► Postpartum hemorrhage
Virtual interventions					
Futterman (2020)[54] COVID	Cross-sectional survey (104) Prenatal[a, b] Low	Replacement; General care; Virtual[c]	Hybrid care of at least 1 telehealth visit and 1 in-person visit; compared satisfaction with care for same patients using different visit types	NR	**Patient-reported outcomes** ▼ Overall satisfaction ▲ Satisfaction, "other" race ► Satisfaction, Black, White, Hispanic, Spanish or other language speakers, high-risk pregnancy ▼ Satisfaction, English-language speakers, non-Hispanic, low-risk pregnancy
Jakubowski (2021)[86] COVID	Cross-sectional survey (618) Prenatal High	Replacement General care; Virtual[d]	Hybrid care of at least 1 telehealth visit and 1 in-person visit vs only in-person visits	NR	**Maternal clinical outcomes** ► GDM
Lapadula (2021)[90] COVID	Cross-sectional survey (47) Prenatal Moderate	Replacement; General care; Virtual	One-time video visit at hospital vs in-person visit	NR	**Patient-reported outcomes** ► Quality of care

Multimodal interventions					
Palmer (2021)[91] COVID	Interrupted time-series cohort (22 323) Prenatal Low	Replacement; General care/RM; Multimodal	Hybrid care of virtual visits (video or phone, based on preference) x 5-6 + self-monitoring + in person visits x 3-5 April 20-July 26, 2020, vs in-person visits	NR	**Maternal clinical outcomes** ► GDM ► Preeclampsia **Obstetric outcomes** ► Preterm birth

Direction of effect: ▲= improved outcome with telehealth; ►= similar outcome with telehealth; ▼= worse outcome with telehealth.
Note: Refer to Methods section and Full Methods Appendix for descriptions of modes.
Abbreviations: ACOG, American College of Obstetrics and Gynecology; COVID, coronavirus disease; GDM, gestational diabetes mellitus; HTN, hypertension; LBW, low birth weight; N, number of randomized participants; NICU, neonatal intensive care unit; NR, not reported; RCT, randomized controlled trial; RM, remote monitoring; ROB, risk of bias.
[a] Reported >25% of sample was Black, not specified, or race other than White; one[59] reported only White vs non-White.
[b] Reported >25% of sample was Hispanic.
[c] Study did not specifically define mode, using terms *telehealth* and *virtual* interchangeably, but phone was used to conduct the survey "at the end of an encounter."
[d] Study did not specifically define mode, using terms *telehealth* and *virtual* interchangeably. A website was used to conduct the survey.

Gestational Diabetes. Seven studies evaluated the effect of telehealth interventions for maternal diabetes care. Five moderate-ROB RCTs assessed the effect of telehealth for managing or monitoring GDM in the prenatal period (**Table 5 and Appendices E-F**).[70-72,76,77] Two observational studies also evaluated the effect of telehealth for diabetes management—one in patients with GDM,[83] rated moderate ROB, and the other study in pregnant women already diagnosed with diabetes who required insulin treatment, rated high ROB (**Table 5**).[93] The mean age of enrolled participants ranged from 32 to 34 years. The proportion of patients reported as South or East Asian, African/Caribbean, North African, or race other than White was 22.3% in 1 RCT[71] and 3.8% in 1 observational study.[83] The other studies did not report race, and none reported ethnicity. Four studies reported mean body mass index (BMI) ranging from 25 to 33 kg/m,[2,70-72,77] and 3 reported a history of GDM ranging from 14% to 25% of the study populations.[71,72,83] The purpose of telehealth interventions was to supplement usual care in five studies[70,72,76,77,93] and replace care in two studies;[71,83] function was RM in all studies. The mode used was web/apps in 2 studies[71,76] and multimodal in 5 studies[70,72,77,83,93] that combined bidirectional clinical care with use of an interactive website and/or monitoring devices that facilitated clinical feedback.[77]

RM for GDM reduced the need for insulin and improved intermediate measures of glucose control based on 1 moderate-ROB RCT and 2 cohort studies with moderate or high ROB.

There were unclear effects on cesarean delivery and hypertensive diseases of pregnancy, due to similar but low event rates in 3 studies of patients receiving RM for GDM vs controls.

RM for maternal diabetes care had unclear effects on gestational HTN, preeclampsia, excessive fetal growth (ie, macrosomia, LGA), and preterm delivery, based on equivocal outcomes compared with usual care.

Comparison groups in all studies received usual care consistent with ACOG recommendations for diabetes care during pregnancy (glucose monitoring 4 times a day: once after fasting and again after each meal).[95] Diagnosis of GDM was based on the International Association of Diabetes and Pregnancy Study Group (IADPSG criteria[71] in one trial, 1- or 2-hour oral glucose tolerance testing at 24 to 28 weeks[70,72,76,77] in 4 trials, and unclear criteria in an observational study.[83] The duration of follow-up in the studies ranged from time of delivery to 12 weeks postpartum. Outcomes reported included maternal,[70-72,77,83,93] obstetric,[70-72,76,77,83,93] and patient-reported outcomes.[71] No RCTs took place in the US; 1 cohort study was conducted in the

US.[93] No studies specifically reported being conducted in rural settings; 5 studies took place in urban health centers.[70-72,76,77] There were no studies evaluating telehealth for maternal diabetes care during the COVID-19 pandemic.

Maternal Clinical Outcomes. Four RCTs and 2 observational studies reported maternal outcomes[70-72,77,83,93] in women receiving care for diabetes using telehealth interventions (**Table 5**).

Metabolic outcomes. Two RCTs and 2 observational studies evaluated the effect of RM for diabetes using multimodal interventions to monitor blood glucose.[71,72,77,83] One moderate-ROB RCT (N = 126)[72] and a moderate-ROB observational study (N = 104)[83] found improved measures of diabetes control with RM of blood glucose compared with usual care. The RCT found a lower incidence of women requiring insulin treatment (13.3% vs 30%; $p = .04$) and fewer patients not achieving targets for fasting blood glucose (4.7% vs 8.4%; $p < .001$).[72] The observational study also reported fewer women in the intervention group requiring insulin treatment during pregnancy (15.0% vs 32.8%; $p = .023$) vs controls.[83] A small prospective cohort study (N = 117), rated high ROB, evaluated an electronic RM system and reported lower HbA_{1c} at delivery with telehealth compared with usual care (5.8 vs 6.3; $p = .03$).[93] A small (N = 21) moderate-ROB RCT did not find a difference in the incidence of postpartum diabetes compared with usual care.[77]

Hypertensive diseases of pregnancy. Three studies evaluating the effect of telehealth interventions for diabetes care during pregnancy reported similar rates of gestational HTN and preeclampsia for women in intervention and control groups (**Table 5**).[71,72,83] Studies were not powered to detect these secondary outcomes, and event rates were extremely low.

Obstetric Outcomes. Five RCTs[70-72,76,77] reported obstetric outcomes for telehealth interventions for GDM (**Table 5**). Two studies of electronic RM reported obstetric outcomes—with inconsistent results.[70,93] A small RCT (N = 50),[70] rated moderate ROB, and an observational study (N = 117),[93] rated high ROB, did not find statistical differences in rates of cesarean deliveries.

Rates of cesarean delivery, preterm birth, and large for gestational age (LGA) or macrocosmic infants were not statistically different between mobile or web-based apps to monitor diabetes control and usual care in 2 moderate-ROB RCTs and 1 moderate-ROB observational study.[72,76,83] A third RCT (N = 206)[71] found a statistically significant reduction in

cesarean deliveries in the telehealth intervention group compared with usual care (26.7% vs 46.1%; OR 0.43; 95% CI, 0.24-0.77) and no difference in rates of preterm birth (5.0% vs 12.7%; RR 0.36; 95% CI, 0.12-1.01).

A small (N = 21) moderate-ROB RCT of a multimodal app (an app for monitoring, and messaging with a clinician) did not find a difference in the incidence of cesarean delivery, LGA, or small for gestational age (SGA) infants compared with usual care.[77]

Patient-Reported Outcomes. One trial reported patient-reported outcomes using the Oxford Maternity Diabetes Treatment Satisfaction Questionnaire (**Table 5**).[71] Patient satisfaction was high and similar for both groups (N = 206, scale 0-54, median 43 vs 44.5; $p = .05$).

Table 5. Studies of Telehealth for Management of Gestational Diabetes in Maternal Care

Study and population		Telehealth intervention features			Results
Author (year)	Study design (N); maternal stage; ROB	Purpose; function; mode	Intervention; comparison	Follow-up	
Web/Apps interventions					
Mackillop (2018)[71]	RCT (206) Prenatal Moderate	Replacement; RM; Web/Apps	App (mobile phone) + wifi-enabled monitoring devices with in-person follow-up x 4-8 weeks + SMS messaging feedback through app vs handwritten self-monitoring and in-person follow-up x 2-4 weeks	Unclear	**Maternal clinical outcomes** ► Pregnancy-induced HTN or preeclampsia **Obstetric outcomes** ▲ Cesarean delivery ► Preterm delivery **Patient-reported outcomes** ► Satisfaction with care (OMDTSQ)
Rasekaba (2018)[76] TeleGDM	RCT (95) Prenatal Moderate	Supplement; RM; Web/Apps	Web-based portal + self-monitoring + SMS messaging feedback through portal vs handwritten self-monitoring	4 weeks	**Obstetric outcomes** ► Cesarean delivery ► Macrosomia
Multimodal interventions					
Carral (2015)[83]	Prospective cohort (104) Prenatal Moderate	Replacement; RM; Multimodal	Interactive website + self-monitoring x 2 weeks + phone or email feedback vs usual care	Delivery and 6-12 weeks postpartum	**Maternal clinical outcomes** ▲ Need for insulin ► Gestational HTN **Obstetric outcomes** ► Preterm birth ► Cesarean delivery ► LGA

Given (2015)[70] TELE-MUM	RCT (50) Prenatal Moderate	Supplement; RM; Multimodal	Interactive website + wifi-enabled monitoring devices + phone feedback as needed vs usual care self-monitoring	Unclear	**Maternal clinical outcomes** ► Preeclampsia/pregnancy-induced HTN (timing NR) **Obstetric outcomes** ► Cesarean delivery ► Macrosomia ► Preterm birth
Miremberg (2018)[72]	RCT (126) Prenatal Moderate	Supplement; RM; Multimodal	App (smartphone) + self-monitoring + email feedback vs biweekly usual care	Unclear	**Maternal clinical outcomes** ▲ Target blood glucose (timing unclear) ► Gestational HTN ► Preeclampsia ▲ Insulin treatment **Obstetric outcomes** ► Cesarean delivery ► Emergent cesarean delivery ► LGA
Sung (2019)[77]	RCT (21) Prenatal Moderate	Supplement; RM; Multimodal	App (mobile phone) + self- and wifi-enabled monitoring + messaging feedback via the app vs usual care	4-12 weeks postpartum	**Maternal clinical outcomes** ► Postpartum diabetes **Obstetric outcomes** ► SGA ► LGA ► Cesarean delivery
Wernimont (2020)[93]	Prospective cohort (117) Prenatal High	Supplement; RM; Multimodal	Web-based portal + wifi-enabled monitoring devices + feedback weekly vs handwritten self-monitoring	Delivery	**Maternal clinical outcomes** ▲ Delivery HbA_{1c} **Obstetric outcomes** ► Cesarean delivery ► LGA

Direction of effect: ▲= improved outcome with telehealth; ►= similar outcome with telehealth.
Abbreviations: Apps, applications; HbA_{1c}, hemoglobin A_{1c}; HTN, hypertension; LGA, large for gestational age; N, number of randomized participants; NR, not reported; OMDTSQ, Oxford Maternity Diabetes Treatment Satisfaction Questionnaire; RCT, randomized controlled trial; RM, remote monitoring; ROB, risk of bias; SGA, small for gestational age.

Gestational Hypertension. Three studies evaluated the effect of telehealth interventions to replace or supplement in-person care compared with usual care in patients with gestational HTN (**Table 6 and Appendix E**). Across the 3 studies, participants' mean age was 30 years. In one trial, 74% of participants were Black, Asian, or race other than White; in another trial, 8% were Black or Asian.[56,67] The third was a cohort study that did not report race.[87-89] The 2 RCTs were moderate ROB (N = 297) and assessed the use of bidirectional web- or app-based messaging or a multimodal intervention for RM and management of postpartum HTN—one to supplement and one to replace usual care.[56,67] The retrospective cohort study (N = 320, in 3 publications) was rated high ROB[87-89] and evaluated the use of a web/app intervention for RM and management of prenatal HTN that had been diagnosed after 10 weeks of gestation.

Findings from 2 moderate-ROB RCTs and one observational study with high ROB offer limited evidence of effectiveness of RM for gestational or postpartum HTN vs controls on BP outcomes.

Maternal Clinical Outcomes. A moderate-ROB RCT (N = 91)[67] employed a multimodal intervention using a mobile phone or web/app for messaging to replace in-person care. The study used RM to manage HTN in the postpartum period and reported the proportion of women with BP inside a target range (100-140/60-90) at multiple points (**Table 6**). At 4 weeks' follow-up, there was not a statistically significant difference in BP control for RM compared with usual care (88% vs 74%; adjusted OR 2.5; 95% CI, 0.8-8.3), but at 6 weeks there was a statistically significant difference in BP control, with improved outcomes for the RM group (88% vs 60%; adjusted OR 5.4; 95% CI, 1.7-17.6). There were no differences in BP control at 12 and 26 weeks. Another RCT[56] (N = 206) of a web-based messaging platform with remote BP monitoring to supplement usual care did not find differences in the use of antihypertensive medication at discharge for women in the telehealth group compared with controls. Outcomes for this study were largely utilization outcomes, which are discussed in Key Question 2. Statistically significant differences in rates of preeclampsia were reported in the cohort study (N = 320)[87-89] for patients using remote BP monitoring compared with those receiving usual care (19.8% vs 44.2%; $p < .01$) (**Table 6**). However, this study had several limitations, including imbalances between the groups at baseline in BMI (26.79 vs 28.38 kg/m^2), immunological disorders (2.32% vs 0.93%), and smoking (2.32% vs 10.70%), which limits the validity of the findings.

Obstetric Outcomes. The observational study of RM and management of prenatal HTN to replace in-person care, described previously, found similar rates of cesarean section between groups.[87-89]

Patient-Reported Outcomes. The same observational study of RM and management of prenatal HTN, described previously, found similar quality-of-life scores (based on the EuroQol Group index of health status [EQ-5D-5L] scale) for telehealth compared with usual care at the 6-week and 6-month follow-ups.[87-89] The EQ-5D-5L showed a potential imbalance between groups at baseline, with better scores for telehealth patients, but the difference was not statistically significant.

Table 6. Studies of Telehealth for Management of HTN in Maternal Care

Study and population		Telehealth intervention features			Results
Author (year)	Study design (N); maternal stage; ROB	Purpose; function; mode	Intervention; comparison	Follow-up	
Web/App Interventions					
Hirshberg (2018)[56] [a]	RCT (206) Postpartum[b] Moderate	Supplement; RM; Web/App	Web-based platform + text messaging via the platform vs ACOG usual care	2-3 weeks postpartum	**Maternal clinical outcomes** ► Use of antihypertensive medication at discharge
Lanssens (2018)[88] (companion to Lanssens 2017[87] and Lanssens 2018[89])	Retrospective cohort (320) Prenatal High	Replacement; RM; Web/App	Monitoring via wifi-enabled devices + online dashboard + provider feedback vs usual care	Until delivery or hospital admission	**Maternal clinical outcomes** ▲ Preeclampsia **Obstetric outcomes** ► Cesarean delivery
Multimodal Interventions					
Cairns (2018)[67] SNAP-HT	RCT (91) Postpartum Moderate	Replacement; RM; Multimodal	Self-monitoring using text message or app (smart phone) + website vs usual care	26 weeks	**Maternal clinical outcomes** ▲ BP in target range (100-140/60-90 at 6 weeks; ► at 4, 12, 26 weeks) **Patient-reported outcomes** ► Quality of life (EQ-5D-5L at 6 and 26 weeks)

Direction of effect: ▲= improved outcome with telehealth; ►= similar outcome with telehealth.
Abbreviations: BP, blood pressure; EQ-5D-5L, EuroQol 5-dimension 5-level quality of life instrument; RCT, randomized controlled trial; ROB, risk of bias
[a] Discussed further in Key Question 2.
[b] Reported >25% of sample was Black, Asian, or race other than White.

Breastfeeding. Four RCTs evaluated telehealth interventions designed to improve breastfeeding outcomes (**Table 7 and Appendices E-F**). Two (N = 1405) were moderate ROB and initiated during the prenatal period and continued postpartum,[52,79] while 2 were initiated postpartum: 1 (N = 203)[78] study of rural women, rated low ROB, and the other moderate ROB (N = 224).[94] Three studies reported the mean age of participants (29 years); the fourth[79] did not. One US study[52] reported that 27% of women identified as Black, Asian/Indian, race other than White, or mixed race and 4% as Hispanic; 1 US study[78] of rural women reported that 3.7% identified as race other than White and 1.6% as Hispanic. The remaining 2 studies, conducted in Australia[79] and Israel,[94] did not report race or ethnicity. In all 4 trials, the telehealth purpose was to supplement usual care; the function was treatment in 3 trials[52,78,79] and education in 1 trial.[94] The telehealth intervention was multimodal in the 2 studies conducted across prenatal and postpartum periods, while the mode was email communication or an on-demand video visit accessed via a mobile app in the postpartum studies. Comparisons varied across the 4 trials, with 2 trials comparing only to usual care[78,94] and another comparing to an attention control where mothers received 1-way text messages about a variety of topics (including breastfeeding).[52] The third trial was a 3-arm study of either an informational booklet with telephone support (30- to 60-minute calls with a nurse), the same booklet with support via 2-way SMS text messaging, or usual care.[79] None of these studies were conducted during the COVID-19 pandemic.

Evidence from 2 RCTs suggests telehealth interventions to supplement usual care resulted in similar—or, in 1 trial, better—breastfeeding outcomes compared with those of usual care. One RCT, based on low or moderate ROB, reported better patient satisfaction.

Maternal Clinical Outcomes. Overall, telehealth interventions resulted in similar breastfeeding outcomes compared with usual care (**Table 7**). One postpartum RCT[94] using a mobile app showed improved breastfeeding rates at 6 weeks and 3 months postpartum for intervention compared with controls; however, it found no difference between groups at 6 months. In the 3-arm RCT comparing phone or SMS text breastfeeding support with usual care,[79] there were no statistically significant differences in the proportion of women breastfeeding at 6 or 12 months for either group compared with usual care.

Patient-Reported Outcomes. One study reported patient satisfaction, which was better for telehealth interventions compared with controls (**Table 7**). The study compared an interactive messaging intervention to supplement in-person care that focused on breastfeeding, including optional communication with a lactation consultant via messaging or phone, with a non-interactive messaging control providing general information on infant care (including breastfeeding). Patient satisfaction was higher with telehealth: 84% of patients found the interactive program helpful, compared with 21% finding the control intervention helpful ($p < .001$).[52]

Table 7. Studies of Telehealth to Support Breastfeeding in Maternal Care

Study and population		Telehealth intervention features			Results
Author (year)	Study design (N); maternal stage; ROB	Purpose; function; mode	Intervention; comparison	Follow-up	
Web/Apps interventions					
Miremberg, 2022[94]	RCT (224) Postpartum Moderate	Supplement; Education; Web/Apps	Email communication through app (smartphone), lactation support and education vs usual care	2, 6 weeks and 3, 6 months postpartum	**Maternal clinical outcomes** ▲ Breastfeeding at 6 weeks and 3 months; ► at 2 weeks and 6 months
Uscher-Pines, 2020 Tele-MLC[78]	RCT (203) Postpartum Low	Supplement; Treatment; Web/Apps	App (smartphone or tablet) + video calls through app vs usual care	2, 4, and 12 weeks postpartum	**Maternal clinical outcomes** ► Breastfeeding (at 12 weeks postpartum)
Multimodal interventions					
Demirci, 2020 MLK[52]	RCT (250) Prenatal + postpartum[a] Moderate	Supplement; Treatment; Multimodal	SMS text message support + communication via text, email, or phone vs attention control with general perinatal support	8 weeks postpartum	**Patient-reported outcomes** ▲ Satisfaction
Wen, 2020[79]	RCT (1155) Prenatal + postpartum Moderate	Supplement; Treatment; Multimodal	Intervention booklet + phone sessions or intervention booklet + SMS text messages vs usual care	6 and 12 months	**Maternal clinical outcomes** ► Breastfeeding (6 and 12 months postpartum)

Direction of effect: ▲= improved outcome with telehealth; ►= similar outcome with telehealth.
Abbreviations: RCT, randomized controlled trial; ROB, risk of bias; SMS, short message service.
[a] Reported >25% of sample was Black, Asian/Indian, race other than White, or mixed race.

Additional Clinical Areas. Reported in 5 studies were additional clinical areas including smoking cessation,[50,51] asthma,[82] and GWG,[53,62] with outcomes reported by clinical area. All studies used telehealth to supplement in-person care.

Findings from a large, moderate-ROB RCT demonstrated improved smoking cessation prior to delivery and up to 6 months postpartum with telephone counseling to supplement usual care compared with usual care alone. There were no differences in postpartum tobacco use in a small study of a phone intervention.

Telephone counseling or a multimodal intervention to supplement usual care to encourage healthy weight in pregnancy resulted in similar maternal or obstetric clinical outcomes compared with those of usual care. Compared with usual care, the multimodal intervention reported a significantly higher rate of cesarean delivery, though no similar trend was identified in the phone-based intervention.

A single moderate-ROB RCT of a RM intervention for asthma, using a mobile app to supplement usual care, demonstrated improved asthma outcomes compared with those of usual care, while other maternal and obstetric outcomes had low event rates and were similar for both groups.

Smoking Cessation. Two RCTs evaluated the effect of telehealth interventions to supplement usual care for smoking cessation in the prenatal and postpartum periods in pregnant smokers (N = 1301). Both trials started during pregnancy and continued through 6 months postpartum, with one predelivery assessment and 2 postpartum (**Table 8 and Appendix E**).[50,51] ROB was moderate in both studies, mainly due to high attrition (**Appendix F**). One of the trials reported that 47% of enrolled women were between 18 and 24 years old, and 53% were age 25 years or older.[51] In one study of low-income women, 80% identified as Black or a race other than White.[50] In the other study, 42% identified as Asian, Native American, or a race other than White and 13% as Hispanic.[51] In the smaller study (N = 128), 69% of study participants were current smokers and 31% had recently quit[50]; 98% of the study population in the larger study (N = 1173) identified as a current smoker.[51] The interventions' purpose was to supplement usual care, the function was treatment, and the mode was phone. Both RCTs compared telehealth (9 or 10 telephone calls with a counselor/health coach) with usual care (general smoking cessation materials or access to a quit-line). Reported outcomes were rates of smoking cessation. Both studies took place in the US and neither reported specifically on whether enrolled women were from urban or rural settings. One study enrolled low-income women at a single academic

obstetrics clinic,[50] and the other enrolled women who had called a statewide quit-line.[51] Neither study was conducted during the COVID-19 pandemic.

Measures of smoking cessation (ie, abstinence) differed in the 2 trials, but both reported higher proportions of abstinence in the telehealth group for the end of pregnancy measurement and at 2 and 3 months postpartum compared with controls. The larger study (N = 1173)[51] used more stringent criteria for abstinence and reported a statistically significant difference in abstinence at the end of pregnancy (29.6% vs 20.1%; RR 1.5; 95% CI, 1.2-1.8), 2 months postpartum (22.1% vs 14.5%; RR 1.5; 95% CI, 1.2-2.0) and 6 months postpartum (14.2% vs 8.2%; RR 1.7; 95% CI, 1.2-2.4; **Table 8**). The smaller study (N = 128) found no difference between groups at 6 months postpartum.[50]

Gestational Weight Gain. Two low-ROB RCTs used telehealth interventions to supplement usual care, to promote healthy weight gain during pregnancy (N = 679) in women with overweight or obese pre-pregnancy BMI (**Table 8 and Appendices E-F**).[53,62] The mean age was 33 years in both trials. In one study[53] 67% of women identified as black, Asian, or mixed race and 20% as Hispanic. In the other trial,[62] the total proportion of women identifying as Black or a race other than White was 19%, but there was an imbalance in race/ethnicity between the intervention and usual care groups (24.3% vs 14.2%); 21% of enrolled women identified as Hispanic. Women were enrolled at 8 to 16 weeks' gestation. The mean BMI of participants at baseline in both trials was 29.4 to 31 kg/m^2. The aim of telehealth interventions was supplementation of usual care; function was prevention. The mode was phone-only in one (11 sessions plus 2 in-person sessions)[53] and a combination of 3 individual phone and 6 group webinar sessions (supplemented by a mobile app for self-monitoring of diet and activity and 1-way SMS text or email messages) in the other.[62] One trial focused on behavioral strategies to improve weight, diet, physical activity, and stress management;[53] the other used dietitians to provide dietary counseling. Usual care consisted of health education newsletters and general materials with guidelines on healthy eating and physical activity in pregnancy. Outcomes included excess average weekly gestational weight gain (GWG), based on World Health Organization criteria, measured up to gestational week 35 to 38, but intermediate weight outcomes were not included as part of this rapid review. Maternal clinical and obstetric outcomes were reported as secondary outcomes. Both trials, not specified as rural or urban, took place in the US.

In 2 RCTs, the telehealth intervention resulted in maternal clinical outcomes (GDM, gestational HTN, preeclampsia) and obstetric outcomes (cesarean, preterm birth, LGA, macrosomia, SGA, LBW) similar to those of usual care (**Table 8**).[53,62] Cesarean delivery occurred more frequently in the telehealth group in one trial (N = 398, 39.6% vs 27.0%; adjusted $p = .01$),[62] and studies demonstrated some benefit in weight-related outcomes.[53,62]

Asthma. One moderate-ROB RCT (N = 72) from Australia compared a mobile app to supplement usual care, versus usual care, to improve asthma care during pregnancy (**Table 8 and Appendices E-F**).[82] In it, 17% of enrolled women identified as Asian or a race other than White, and ethnicity was not reported. Baseline duration of asthma was 26 years; 58% had moderate to severe asthma, and 4% were smokers. The study enrolled women at 2 large maternity hospitals in Melbourne but did not report specifically on whether enrolled women lived in urban or rural areas. The telehealth intervention purpose was to supplement usual care; function was RM. The mode was mobile app (web/app). The intervention began at 20 weeks' gestation or later, ended at delivery, and consisted of peak-flow home monitoring and a mobile app to record asthma symptoms and medication use. This app provided weekly feedback on the patients' asthma status and implement an interactive asthma action plan. Usual care consisted of a brochure on asthma care during pregnancy and standard obstetric follow-up. Maternal clinical and obstetric outcomes were assessed at 3 and 6 months.

Compared with those in usual care, women in the intervention group saw statistically significant differences in asthma control (Asthma Control Questionnaire [ACQ] <1.5 at 6 months; 82% vs 58%; $p = .03$; **Table 8**), but no significant differences in rates of clinically significant improvement in ACQ or the mini-Asthma Quality of Life Questionnaire scores. No significant differences were reported for other maternal clinical (GDM, gestational HTN) or obstetric outcomes (emergent cesarean, premature birth, postpartum hemorrhage, SGA, macrosomia), but event rates were low in both groups.

Table 8. Studies of Telehealth for Management of Other Clinical Areas in Maternal Care—RCTs

Study and population		Telehealth intervention features			Results
Author (year)	Study design (N); maternal stage; ROB	Purpose; function; mode	Intervention; comparison	Follow-up	
Smoking cessation interventions					
Coleman-Cowger (2018)[50]	RCT (128) Prenatal + postpartum[a] Moderate	Supplement; Treatment; Phone	Biweekly motivational interviewing phone calls x 10 + access to 24/7 quit-line vs referral to 24/7 quit-line (ACOG usual care)	6 weeks, 3 and 6 months postpartum	**Maternal clinical outcomes** ► Smoking cessation (6 weeks, 3 and 6 months postpartum)
Cummins (2016)[51]	RCT (1173) Prenatal + postpartum[a] Moderate	Supplement; Treatment; Phone	Motivational and CBT phone calls x 9 + access to a 24/7 quit-line vs self-help material	36 weeks' gestation, 2 and 6 months postpartum	**Maternal clinical outcomes** ▲ Smoking cessation (36 weeks' gestation, 2 and 6 months postpartum)
Gestational weight gain interventions					
Ferrara (2020)[53] GLOW	RCT (398) Prenatal[a] Low	Supplement; Prevention; Phone	Motivational interviewing phone sessions x 11 and in-person sessions x 2 vs usual care	38 weeks' gestation, after delivery (obstetrics)	**Maternal clinical outcomes** ► GDM ► Gestational HTN ► Preeclampsia **Obstetric outcomes** ► Cesarean ► Preterm birth ► LGA ► Macrosomia ► SGA ► LBW

Van Horn (2018)[62] MOMFIT	RCT (281) Prenatal[a] Low	Supplement; Prevention Multimodal	Coaching phone calls + app (smartphone) + self-monitoring + email/text/phone call messaging + group sessions x 6 + individual sessions x 3 e-handouts + website vs usual care + website	Delivery	**Maternal clinical outcomes** ► GDM **Obstetric outcomes** ▼ Cesarean ► Preterm birth ► LGA ► SGA
Asthma interventions					
Zairina (2016)[82] MASTERY	RCT (72) Prenatal Moderate	Supplement; RM; Web/App	App (smartphone) + self-monitoring + messaging feedback via app vs usual care	3 and 6 months	**Maternal clinical outcomes** ▲ Asthma outcomes (6 months) ► GDM (3 and 6 months) ► Gestational HTN (3 and 6 months) **Obstetric outcomes** ► Cesarean delivery ► Macrosomia ► Premature birth ► SGA ► Postpartum hemorrhage

Direction of effect: ▲= improved outcome with telehealth; ►= similar outcome with telehealth; ▼= worse outcome with telehealth
Abbreviations: App, application; GDM, gestational diabetes mellitus; HTN, hypertension; LBW, low birth weight; LGA, large for gestational age; N, number of randomized participants; RCT, randomized controlled trial; RM, remote monitoring; ROB, risk of bias; SGA, small for gestational age
[a] Reported >25% of sample was Black, Asian, Native American, race other than White, or mixed race.

Key Question 2: Do the results vary by subgroup? How do sociodemographic characteristics affect the use, acceptance, and effectiveness of real-time video visits? Do these findings vary by disease type or for patients with co-occurring conditions?

None of the included studies specifically evaluated access to care or impact on health disparities. Most studies did not report factors related to health disparities. Heterogeneity in study design, clinical area addressed, interventions, and outcomes reported prevented comparisons across studies. Six of the studies[54,57,58,85,86,90] conducted during the COVID pandemic were cross sectional in design and evaluated patient satisfaction, utilization, and limited clinical outcomes to assess the effectiveness of telehealth for delivery of general prenatal care, with limited evidence to assess access to care.

No studies specifically evaluated access to care or health disparities, or reported outcomes, according to demographic groups.

Few studies reported on the geographic location of participants; none of the studies evaluated outcomes based on geographic location.

Utilization of care was higher for telehealth interventions compared with in-person care for studies conducted during the COVID pandemic

Race, Ethnicity, and Health Care Coverage

Twenty-six studies (16 RCTs) reported patient demographics (race/ethnicity, health care coverage) of enrolled populations, but none of the studies reported outcomes according to race/ethnicity.[50-63,65-67,71,75,78,82-84,90,92,93] Twenty-four studies reported race of participants; and, as noted in **Table 2**, the proportion of studies that enrolled more than 25% Black, Asian, Pacific Islander, South Asian, Native American, or mixed-race participants ranged from none in the studies of GDM to 80.5% in the studies of smoking cessation and GWG. Although 5 of these studies reported only on the proportion of participants identified as being White[59,63,66,78,92] (and 2 reporting 25% as White vs non-White)[59,63] and 4 reported that none of the participants were Black,[61,65,75,82] the remaining 15 reported that 2% to 85% were Black, African American, Caribbean, or African.[50-58,60,62,67,71,83,84] In 3 studies, more than 25% of participants were Black.[55,56,60] Only one study[54] was designed to detect differences in patient satisfaction according to race or ethnicity or reflect differences in patient satisfaction outcomes based on patient

demographic characteristics (Key Question 1; **Table 4**). Only 6 RCTs[51-53,55,62,78] reported on Hispanic ethnicity, ranging from 1.6% to 21.3%; 6 observational studies[54,57,58,60,83,84] also noted Hispanic ethnicity (1.9%-76.4%) in the study populations.

Three RCTs reported on participants' type of health care coverage but did not report results based on coverage. These studies reported 53.4% to 74% were Medicaid recipients, and one reported 15.4% of the enrolled population had no insurance.[51,55,56] Four observational studies described health coverage of participants and reported those with no insurance or self-pay from 0.8% to 8%.[57,58,84,93]

Geographic Location of Participants: Urban versus Rural

Few studies reported on participants' geographic location, and none of the studies evaluated outcomes based on geographic location. One RCT specifically enrolled rural participants,[78] and 3 RCTs expressly indicated they covered both urban and rural areas.[67,68,80] Many other studies (including observational studies) described urban-based clinics, but participants' geographic origin was either unclear or not specified.

Utilization of Care

Two RCTs[56,70] (N = 256) and 10 observational studies[57-60,83-89,91] (N = 37 699) reported on utilization of care, primarily comparing visits attended in telehealth with those of control groups (**Tables 3-8**). Of the 2 moderate-ROB RCTs, one[60] assessed a multimodal intervention to monitor and manage GDM (**Table 5**), and one[56] evaluated web-based messaging to monitor gestational hypertensive disorders (**Table 6**). Of the 10 observational studies (6 conducted during COVID-19[57,58,84-86,91] and 4 prepandemic[59,60,83,87-89]), one[60] cohort described phone psychotherapy to treat depression (**Table 3**); 7 studies[57-59,84-86,91] of mixed designs (6 conducted during COVID-19) evaluated reduced-visit models for general maternal care (**Table 4** and **Table 9**); and 2 cohort studies described multimodal interventions to monitor and manage GDM (**Table 5**)[83] or gestational HTN (**Table 6**).[87-89]

One[70] of the 2 RCTs found a benefit with telehealth on visit attendance compared with control groups, while the other[56] reported mixed results of favorable or similar outcomes (**Table 9**). In the mixed-results[56] RCT, women in the telehealth group were more likely to have a BP measurement within 10 days of enrollment and less likely to be readmitted for postpartum HTN,

while rates of ED or office visits for HTN were similar between telehealth and control groups (**Table 9**).

Six[57,58,60,84,85,87-89] of the 10 observational studies (4 conducted during COVID-19) reported a benefit for telehealth groups on visit attendance and perception of access to care in mental health, general maternal care, and gestational HTN areas (**Table 9**). One observational study[86] conducted during the pandemic found mixed results for telehealth in general maternal care; rates of access to medical care and standard tests favored telehealth or were similar between telehealth and control groups (**Table 9**). Two studies, one[59] for telehealth in general maternal care and one[83] for gestational diabetes, reported no difference between groups in routine or emergency visits (**Table 9**). Only one observational study[91] (conducted during COVID-19) found results favoring the control group and reported that women in the telehealth group compared with those in the control groups were less likely to attend visits for general maternal care (**Table 9**).

Table 9. Studies of Telehealth for Management of Maternal Care—Utilization

Study and population		Telehealth intervention features			Results
Author (year)	Study design (N); maternal stage; ROB	Purpose; function; mode	Intervention; comparison	Follow-up	
Studies described exclusively in KQ2					
General maternal care					
Holcomb (2020)[85] COVID	Cross-sectional survey (pre-post element) (283) Prenatal Moderate	Replacement; General care; Phone	Hybrid care of phone visits x 3-4 and in-person visits x 9-10 between March 17-May 31, 2020 (ACOG usual care)	NR	**Utilization outcomes** ▲ Completed visits
Jeganathan (2020)[57] COVID	Cross-sectional survey (pre-post element) (91) Prenatal[a] Moderate	Replacement; General care; Multimodal	Hybrid care with video or audio sessions x 1-3 weeks + self-monitoring + in-person visits March 1-May 30, 2020, vs usual care March 1-May 30, 2019	Unclear	**Utilization outcomes** ▲ Fewer no-show appointments and cancellations
Peahl (2021)[58] COVID	Cross-sectional survey (pre-post element) (253) Prenatal[a] Low	Replacement; General care/RM; Multimodal	Hybrid care of video or phone visits x 4 and in-person visits x 5 + self-monitoring between March 23-June 22, 2020, vs usual care prior to March 2020	NR	**Utilization outcomes** ▲ Total prenatal care visits per week, pre- vs post: 1051 vs 719 (31.6% decrease)

Studies described in KQ1					
Mental health					
Posmontier (2016)[60]	Prospective cohort (61) Postpartum[a] High	Supplement; Treatment; Phone	Interpersonal phone psychotherapy x 8 sessions vs referral to mental health professional	12 weeks	**Utilization outcomes** ▲ Sessions attended
General maternal care					
Duryea (2021)[84] COVID	Cohort (historical control) (12 607) Prenatal[a,b] Moderate	Replacement; General care; Phone	Hybrid care of phone visits x 3 and in-person visits x 10 vs in-person visits (ACOG usual care)	37 weeks' gestation	**Utilization outcomes** ▲ Prenatal encounters
Jakubowski (2021)[86] COVID	Cross-sectional survey (618) Prenatal High	Replacement General care; Virtual[d]	Hybrid care of at least one telehealth visit and one in-person visit vs only in-person visits	NR	**Utilization outcomes** ▲/► Access to medical care and standard tests
Palmer (2021)[91] COVID	Interrupted time-series cohort (22 323) Prenatal Low	Replacement; General care/RM; Multimodal	Hybrid care of virtual visits (video or phone, based on preference) x 5-6 + self-monitoring + in-person visits x 3-5, April 20-July 26, 2020, vs in-person visits January 1, 2018-March 22, 2020	NR	**Utilization outcomes** ▼ Visits not attended
Pflugeisen (2016)[59]	Quality Improvement Cohort (1058) Prenatal + postpartum[a] High	Replacement; General care/RM; Virtual	Hybrid care of video visits x 5 + self-monitoring + in-person visits x 9 vs ACOG usual care	2 weeks postpartum	**Utilization outcomes** ► Routine visits ► Urgent care or ED visits ► Hospital visits ≥2

Gestational diabetes					
Carral (2015)[83]	Prospective cohort (104) Prenatal Moderate	Replacement; RM; Multimodal	Interactive website + self-monitoring + phone or email feedback vs usual care	Delivery and 6-12 weeks postpartum	**Utilization outcomes** ► Visits ► Hospital emergency visits
Given (2015)[70] TELE-MUM	RCT (50) Prenatal Moderate	Supplement; RM; Multimodal	Interactive website + wifi-enabled monitoring devices + phone feedback as needed vs usual care	Unclear	**Utilization outcomes** ▲ Appointments attended (timing NR)
Gestational HTN					
Hirshberg (2018)[56]	RCT (206) Postpartum[a] Moderate	Supplement; RM; Web/App	Web-based platform + text messaging via the platform vs ACOG usual care	2-3 weeks postpartum	**Utilization outcomes** ▲/► (▲ BP readings within 10 days, admission for HTN) ► ED or office visit for HTN
Lanssens (2018)[88] (companion to Lanssens 2017[87])	Retrospective cohort (301) Prenatal High	Supplement + Replacement; RM; Multimodal	Monitoring via wifi-enabled devices + online dashboard + provider feedback vs usual care	Until delivery or hospital admission	**Utilization outcomes** ▲ Visits and prenatal admissions

Direction of effect: ▲= improved outcome with telehealth; ►= similar outcome with telehealth; ▼= worse outcome with telehealth; ▲/► = mixed effects: some outcome measures better and others similar with telehealth.
Abbreviations: ACOG, American College of Gynecology and Obstetrics; BP, blood pressure; COVID, coronavirus disease; ED, emergency department; HTN, hypertension; KQ, Key Question; N, number of randomized participants; NR, not reported; ROB, risk of bias.
[a] Reported >25% of sample was Black, Asian, Pacific Islander, South Asian, Native American, or mixed race; one[59] reported only White vs non-White
[b] Reported >25% of sample was Hispanic.

Key Question 3: What gaps exist in current research? For which pregnancy periods, telehealth modality, or populations are additional primary research studies needed?

Summary of Findings From the Evidence Map

We created an evidence map to summarize key features of included trials and observational studies, organized by outcome category and clinical condition, to highlight current evidence and underscore knowledge gaps related to telehealth for maternal health care. Cross-sectional studies are excluded from the map. The map (**Figure 2**) displays the number and ROB of studies, categorized by outcome (eg, maternal, obstetric, patient satisfaction, utilization, harms) and organized by clinical condition. Each study's telehealth modality (eg, phone, video, web/mobile apps, multimodal) and ROB appear. Studies in which race and ethnicity were reported and more than 25% of the study population was identified as Black, Asian, Pacific Islander, South Asian, Native American, or mixed race are noted to serve as an approximation of more diverse study populations. Notably, none of the included studies reported outcomes based on population characteristics. The map highlights where evidence exists and calls attention to knowledge gaps related to telehealth for maternal health care. The objective is to visually display the extent to which the available evidence supports specific use of telehealth in maternal health care.

Appendix D contains a more detailed description of the map methodology. A legend below the map describes the meaning of the colors (direction of effect), shading (ROB), and letters (telehealth modalities). The map distinguishes whether the studies' purpose was to supplement or replace usual care. An overview of the findings and key characteristics of the included studies are represented in the evidence map (**Figure 2**).

Figure 2. Evidence Map

Clinical condition	Author, Year†	Purpose‡	Outcomes*				
			Maternal	Obstetric	Satisfaction	Utilization	Adverse events
Mental health	Ngai, 2015; Ngai, 2019	+	P		P		
	Dennis, 2020	+	P				
	Van Lieshout, 2021†	+	A				
	Shorey, 2017	+	A		A		
	Forsell, 2017	+	M				
	Pugh, 2016	+	M				
	Wozney, 2017	+	P				
	Yang, 2019	⇌	V				
	Posmontier, 2016†	+	P		P	P	
	Hantsoo, 2018	+			M	M	
	Ashford, 2018	+	M				
	Sawyer, 2019	+	A§				
General maternal care	Duryea, 2021	⇌	P	P		P	
	Butler, 2019	⇌	M	M	M	P	
	Pflugeisen, 2017	⇌			V		
	Pflugeisen, 2016†	⇌	V	V			
Gestational diabetes	Mackillop, 2018†	⇌	A	A	A	A	
	Given, 2015	+	M	M		M	
	Wernimont, 2020	+		M			
	Miremberg 2018	+	M	M			
	Carral, 2015	⇌	M	M		M	
	Sung, 2019	+	M	M			
	Rasekaba, 2018	+		A		A	
Gestational hypertension	Lanssens, 2018	⇌	A	A		A	
	Cairns, 2018	⇌	M		M		M
	Hirshberg, 2018†	+				A	
Breastfeeding	Demirci, 2020†	+	M				
	Uscher-Pines, 2020	+	A		A		
	Wen, 2020	+	M				
Smoking cessation	Cummins, 2016†	+	P				
	Colemna-Cowger, 2018†	+	P				
Gestational weight gain	Ferrara, 2020†	+	P	P			
	Van Horn, 2018†	+	M	M			
Asthma	Zairina, 2016	+	A	A			

Legend and Footnotes

	Direction of effect		
	Favors telehealth	No difference/ mixed effect	Favors comparison
Risk of Bias: Low/Moderate			
High			
	No Studies Assessing Included Outcomes		
Mode of telehealth	P=Phone, V=Virtual, A=Web/App, M=Multimodal		

* Outcomes categories: maternal (eg, depression, anxiety, preeclampsia, hypertension), obstetric (eg, cesarean delivery, preterm birth), patient-reported satisfaction, utilization, and adverse events (eg, any harms such as missed diagnosis, treatment delay). A study may report more than one outcome.
† Studies with ≥25% participants identifying as Black, Asian, Pacific Islander, South Asian, Native American, mixed race or Hispanic; two[59,63] report only White vs non-White.
‡ Telehealth intervention aimed to supplement (+) or replace (⇌) care. Supplement indicates a telehealth intervention was provided in addition to usual, in-person care; replace indicates a telehealth intervention was used in place of in-person care.
§ Mixed results favor telehealth and comparison.
Note. Only RCT and observational (cohort) studies were included in the map. Cross-sectional studies were not included. Ref = reference number.

This evidence map demonstrates that most findings were categorized as "no difference," or mixed results combining no difference and favoring telehealth across multiple outcomes in a single study (47 of 66 findings). The map demonstrates that 26% of findings (17 of 66) favored the telehealth intervention. In the studies that had mixed results, only 1 study[64] had findings in opposite directions (favors telehealth and favors control); the remainder were a mix of findings favoring telehealth and reporting similar outcomes for telehealth vs controls. These data support the overall findings that, for most clinical conditions, telehealth, compared with usual or in-person care, usually results in similar—and, less frequently, better—outcomes.

The most robust evidence is for telehealth interventions for maternal mental health, where telehealth was used to supplement usual care and resulted in mostly similar or improved maternal clinical outcomes vs those of comparisons. Of all telehealth modalities evaluated for mental health, supplementary telephone visits resulted in more favorable outcomes compared with those of usual care, although some of the phone-based interventions had similar outcomes. Other clinical areas have less evidence, such as telehealth for general maternal care, where there are few studies that reported maternal (3), obstetric (3), or patient-reported (3) outcomes. Studies of diabetes care demonstrate that various modalities of telehealth interventions mostly result in maternal (6) and obstetric (7) outcomes similar to those of usual care. Studies reporting utilization as an outcome largely found that both telehealth and total appropriate visits increased, and access was improved, with telehealth compared with in-person care. The map excludes cross-sectional studies, which include studies evaluating utilization that were conducted during the COVID pandemic, when telehealth utilization increased because in-person options were not available.

Studies demonstrating favorable outcomes for telehealth interventions compared with usual care used various modalities for telehealth delivery. Although the majority of studies combined multiple technologies, referred to as *multimodal*, single modes demonstrate effectiveness in certain clinical areas. For example, for mental health care, supplemental phone counseling compared with usual care demonstrated favorable outcomes in a few studies. It is unclear whether one specific telehealth mode is more effective than any other given mode for most clinical conditions.

This map reveals patterns and fosters consideration of overarching trends in the body of evidence. Because it is reductive, the map cannot represent all details of the included studies.

Understanding study details (provided in the Results sections for Key Questions 1, 2, and 4) and the evidence tables (**Appendix E and F)** is necessary for interpreting the nuances of the research and provides context for evaluating the available evidence and how to inform future research.

Evidence Gaps in the Evidence Map

Gray-shaded cells represent evidence gaps. These areas indicate an absence of evidence or suggest a serious gap in the quality of available evidence.

Clinical areas with few studies assessing the impact of telehealth interventions include gestational HTN, breastfeeding, smoking cessation, GWG, and asthma. Clinical areas lacking evidence include obstetric outcomes for prenatal mental health interventions, gestational HTN, smoking cessation, and GWG. Additional clinical areas lacking data include obstetric and utilization outcomes for breastfeeding, most outcomes for smoking cessation, and adverse effects of most telehealth interventions—in addition to patient satisfaction for smoking cessation, GWG, and asthma. Stakeholders can use these evidence gaps to inform priorities for future research. Studies did not evaluate health disparities, and few harms were reported.

Key Question 4: What are the harms of telehealth strategies for maternal health?

Telehealth strategies' harms (eg, missed or incorrect diagnosis, delay in treatment) were infrequently or inconsistently reported. In the few studies reporting them, they were poorly defined for both intervention and control groups. No studies reported harms as primary or secondary outcomes of the interventions. One RCT[67] of gestational HTN reported on the proportion of postpartum women with SAEs (11 of 91) experienced during the trial period, but there was no serious morbidity or mortality and no statistically significant differences between groups. Most studies were underpowered to detect differences in harms when they were reported as potential adverse events of interventions.

Five studies (3 RCTs and 2 observational; N = 723)[58,69,70,76,85] described barriers to the use of telehealth interventions (**Appendix Table G**) using patient-reported narratives. Examples of reported barriers included lack of physical examinations, feelings that something could be missed, and challenges with data transmission. Although these barriers are not harms, they may inform why apprehension about the use of telehealth includes concerns about missed or delayed diagnoses.[58]

Discussion

Summary and Interpretation of Findings

This rapid review synthesizes the available evidence for key clinical areas on maternal telehealth interventions designed to supplement or replace care compared with usual, in-person care models. Studies included for this rapid review (28 randomized controlled trials [RCTs] and 14 observational studies) included 44 894 women and addressed maternal clinical, obstetric, mental health, and patient-reported outcomes as well as utilization. Most RCTs (26 of 28) and observational studies (9 of 14) were rated low or moderate risk of bias (ROB); 2 RCTs and 5 observational studies were rated high ROB. Overall, maternal telehealth had 2 purposes, with 26 studies supplementing and 16 replacing usual care. They employed a range of functions and modes, resulting in mostly similar—or, less often, better—maternal clinical, obstetric, mental health, or patient-reported outcomes (eg, satisfaction with care) compared with those of usual care. Here we highlight the key findings outlined in the Results section and address limitations to this rapid review. Based on the available evidence, we also identify research funding priorities.

Telehealth may have a role as a supplement to usual care for postpartum depression. Phone interventions or web or mobile apps for treating postpartum depression were more likely to improve mood symptoms, at least in the short term, although effects may not be sustained. It is important to note that the interventions delivered via telephone were either psychotherapy or cognitive behavioral therapy (CBT), which, alone, compared with usual or no care, have demonstrated effectiveness for reducing depression symptoms.[96] Whether improved outcomes resulted from delivery of therapy or the populations enrolled, rather than mode of delivery, is unclear. Studies evaluating the effectiveness of telephone encounters alone are needed for mental health services in pregnant and postpartum populations (ie, CBT via telephone vs in-person CBT) to help distinguish these effects. Similarly, additional studies of mental health interventions that replace in-person care may also be informative. Variability in telehealth interventions limits the ability to combine results or develop high-quality evidence.

Studies of diabetes during pregnancy were mostly moderate-ROB RCTs evaluating prenatal remote monitoring (RM) to replace or supplement usual care. Although some studies reported improved intermediate measures of glycemic control, obstetric outcomes such as

cesarean delivery and hypertensive diseases of pregnancy were similar between telehealth and control groups. Telehealth strategies for RM may be effective for targeted clinical conditions based on studies of pregnant women with diabetes or gestational diabetes mellitus (GDM), where telehealth interventions resulted in improved glucose control or need for insulin. Reasons for increased effectiveness are unclear, but studies from general adult populations[97,98] also suggest effectiveness of telehealth for remote diabetes monitoring. Less consistent evidence exists on the effectiveness of virtual interventions targeting GDM, given the mixed direction of results, but studies of interventions that used more than one mode (multimodal) reported outcomes similar to those of usual care.

Most studies of general maternity care were observational and conducted during the COVID-19 pandemic, and they replaced in-person care using virtual telehealth for reduced-visit prenatal care models for low-risk pregnancies. Reduced-visit models were associated with better utilization or satisfaction outcomes based on studies with lower ROB. Studies reporting maternal or obstetric outcomes, such as GDM rates, had higher ROB and the impact of telehealth strategies for these outcomes is less clear. Many recent studies of telehealth implemented during the COVID-19 pandemic report high patient satisfaction and utilization, suggesting telehealth is an acceptable alternative to in-person care. Future considerations for telehealth implementation may be informed by studies that demonstrate comparable outcomes for telehealth vs in-person care; however, evaluating potential adverse effects of telehealth remains a priority.

There is a paucity of evidence to address issues of access to care in underserved populations and a lack of data on harms of telehealth interventions for maternity care. It is important to note that studies were not designed to address these issues, and the available evidence was inadequate to meaningfully evaluate the impact of telehealth on access, health equity, and potential harms. Clinical areas with inadequate evidence to draw conclusions about the effect of telehealth, due to too few studies or participants, included hypertension (HTN) management (2 RCTs), asthma (1 RCT), gestational weight gain (GWG) (2 RCTs), smoking cessation (2 RCTs), and breastfeeding (4 RCTs).

Findings in Context of Prior Knowledge

This rapid review builds on a prior systematic review[5] with an overlapping scope; however, much of the inclusion criteria for key patient, intervention, comparator, outcomes,

setting, and study (PICOTS) elements differed. For example, the prior review compared with usual care telehealth in low- and high-risk obstetric settings, family planning, and gynecology. Although the scope of our review did not include family planning or general gynecology, we included a broader set of outcome measures (eg, patient-reported outcomes and utilization). The prior review also included many studies of telehealth interventions that were one-way or did not connect to a clinician or link to clinical care and would therefore be ineligible for this review. The prior review included 19 studies of low-risk obstetrics and concluded that telehealth interventions improved obstetric outcomes in studies of smoking cessation and breastfeeding. Because of this overlap, 5 studies from the prior review were eligible for inclusion in this rapid review.[56,71,72,82,87] Clinical areas with overlap included 2 trials of smoking cessation and 3 on breastfeeding, none of which reported obstetric outcomes. The prior review included 13 studies of high-risk obstetric patients and concluded that telehealth interventions "decreased the need for high-risk obstetric monitoring office visits while maintaining maternal and fetal outcomes."[5] We included one observational study that identified patients as high-risk obstetric patients.[57] Patients received a synchronous audio or video visit and compared this experience with in-person visits; the telehealth visit resulted in fewer missed or cancelled appointments and high patient satisfaction. Like the findings of the prior review, this study found utilization of care (fewer missed visits) was better with telehealth.

Limitations of Rapid Review Methodology

To facilitate a rapid review of the literature, we narrowed the scope of clinical services related to maternal health and excluded studies on contraceptive care, abortion, and infertility treatment. This more focused approach to maternal health (prenatal or postpartum care) may have limited the applicability of our findings to other populations who seek pregnancy-related care. Using rapid review methodology, we used a "best evidence" approach, prioritizing evidence from RCTs, and used observational studies to provide additional data where there were gaps in RCT evidence. Observational data may have presented additional insights, particularly in the context of telehealth use during the COVID pandemic, when outcomes such as patient satisfaction and utilization were largely concentrated. Meta-analysis was not feasible due to heterogeneity in study designs, interventions, and outcomes. Given the rapid review timeline, we used modified criteria to assess the certainty (strength) of the evidence based on methodological

limitations such as study design, directness, consistency, and precision, to make decisions about the overall effect of telehealth for a given clinical area and intervention.

Because of the rapid expansion of telehealth strategies during the COVID-19 pandemic, we made the a priori decision to include studies conducted during the pandemic using *any* comparative design—and to assess their ROB. These studies' designs (eg, cross-sectional surveys, pre-post studies) have an inherently higher ROB than do other observational designs or RCTs, and there is less agreement on how to assess such studies, which may result in variability and less certainty in ROB ratings. Given the rapid review timeline, we used a modified ROB approach for observational studies. There were no clinical areas where a prepandemic observational study was the only study offering evidence for a given clinical area or telehealth intervention.

Limitations and Strengths of the Evidence Base

Limitations include restriction to English-language articles, although this criterion may increase applicability for maternal care in the US. Limitations of the evidence base varied across the population and specific outcomes being studied, with some having extremely limited evidence (eg, asthma) and others having more robust data, more studies, or studies with lower ROB (eg, mental health). Including observational studies to help fill gaps in the RCT evidence was important in the case of general maternal care during the prenatal period, because only 1 RCT and 10 observational studies mainly focused on evaluating reduced-visit models of care. The evidence was extremely limited for studies addressing health equity and access to care. Not all studies reported population characteristics, and all but one study did not report outcomes according to different populations. There was no evidence to inform how outcomes differed in populations adversely affected by disparities, such as racial and ethnic minorities, socioeconomically disadvantaged populations, underserved rural populations, or sexual and gender minority populations. Evidence was lacking on the potential harms of telehealth interventions. **Table 11** presents other limitations, using the PICOTS framework.

Strengths of this review include that several areas of maternal health signaled equivalent or better outcomes compared with those of usual care. Areas of maternal telehealth with comparable outcomes to standard care, including mental health, diabetes care, and general maternal care using reduced visit models, highlight the opportunity to further explore how

telehealth might be an appropriate innovation to better reach key prenatal care goals, including access to care and/or improving health equity.[99,100] Several recent studies of telehealth implemented as a result of the COVID-19 pandemic demonstrate high patient satisfaction and utilization and indicate that telehealth is an acceptable alternative to in-person care. Although these studies used less rigorous designs, they confirm that telehealth may be a feasible alternative to in-person care going forward.

Table 10. Limitations of the Evidence

Domain	Limitations of the evidence
Populations	• Few older women, no adolescents, limited studies for women with asthma and high-risk pregnancies, lack of reporting on or analyses of social determinants of health, such as race/ethnicity, insurance coverage
Interventions	• Some lack of clarity on details of the interventions (how they worked, how often patients actually interacted with providers), especially mobile apps
Comparisons	• Wide variability in defining the term usual care; some compared with altered usual care, some usual care from other countries that may not be the same as US but difficult to determine differences or impacts
Outcomes	• For some, lack of clear definitions or variably defined (eg, thresholds for mental illness diagnosis, diagnosis of gestational diabetes) • Lack of prespecified telehealth harms outcomes • Longer-term follow-up required for some outcomes (eg, outcomes associated with breastfeeding, GWG) • Access and health equity outcomes not reported; simple reporting of utilization does not address access
Timing	• Cohort observational studies were not clear on the duration of follow-up
Setting	• Lack of specificity on location of the patient (urban vs rural), reporting is limited to the location of the clinician
Study design	• Small numbers of RCTs for some clinical areas (breastfeeding, HTN, general maternal care, smoking cessation, asthma and GWG) • Inadequate RCT sample size (11 of 28, 39% <100 participants), • ROB (attrition bias issues) • Studies often not designed to test equivalence; noninferiority designs not used • Studies conducted during pandemic used observational study designs that are inherently higher ROB (pre-post or cross-sectional)

Abbreviations: GWG, gestational weight gain; HTN, hypertension; RCT, randomized controlled trial; ROB, risk of bias; US, United States.

Research Recommendation

Maternity care is one aspect of health care that is particularly ripe for innovation because "usual" prenatal care is largely based on tradition and not grounded in strong evidence.[101,102] There are limited data to support the current standardized approach to prenatal care that relies on multiple in-person visits. Considering the mostly comparable outcomes between telehealth and usual care when used to supplement mental health care, replace in-person general maternity care with reduced-visit models, and supplement or replace prenatal diabetes care, this rapid review suggests telehealth strategies could help reach prenatal care goals. These findings also highlight an ongoing need to incorporate methods to evaluate and improve health equity—an important element lacking in these telehealth studies.[99,100] For example, for those who cannot access care due to issues related to transportation, childcare, or work, prenatal care via telehealth could offer flexibility and improve access to care. Furthermore, for rural populations where distance to care is a barrier, telehealth could offer an alternative approach, although the effectiveness of telehealth has not been well evaluated in such settings. To inform the impact of telehealth on health disparities, health equity, and potential harms of telehealth interventions, future research should focus on larger studies with broader inclusion criteria, examine effects of telehealth interventions in rural populations, and evaluate outcomes based on population characteristics. Future studies could evaluate different models of prenatal care and compare their delivery using both in-person and telehealth models to further inform the field and assess when telehealth supplementation adds value.

The evidence map (**Figure 2**) reveals patterns and displays limitations of the evidence to identify gaps. The figure illustrates the heterogeneity of the evidence addressing the use of telehealth for maternal health care, including variation in outcomes assessed and telehealth modalities evaluated. This heterogeneity limits the ability to make global, conclusive statements about the impact of telehealth for maternal health care. We can make more specific observations by focusing on specific sections of the map. For example, few studies of telehealth for smoking cessation exclusively used phone interventions and reported no difference or mixed findings in maternal outcomes, suggesting the need for studies of different telehealth approaches. Overall, the map shows that, for most clinical conditions, there is no difference between telehealth interventions and in-person care—and sometimes there are more favorable outcomes for the

telehealth. For most clinical conditions no one specific telehealth modality is more effective than another.

Further interpretation requires framing questions according to stakeholder priorities. The following boxes list key areas where future research is needed to inform policy decisions on telehealth in maternal care in the US.

Primary Research Priorities

- RCTs conducted in the US, with noninferiority designs, larger sample sizes, conducted in multiple sites that report **clinical health outcomes** related to the use of telehealth for maternity care compared with in-person care.
- Studies evaluating the effectiveness of telehealth for maternal care in **diverse groups of patients,** including women with advanced maternal age, adolescents, and underserved or vulnerable populations affected by health disparities.
- Studies evaluating the effectiveness of **remote patient monitoring** to supplement in-person care for different clinical conditions in pregnant patients from diverse backgrounds and geographic areas.
- Enrollment and reporting of participants from key geographic areas including **rural populations.**
- Studies that address issues of **health disparities** and consider **social determinants of health** to analyze outcomes by population characteristics (eg, age, race/ethnicity, gender identity, income, geographic location).
- Studies to analyze care **access and acceptability** for studies of telehealth replacing in-person care, particularly among underserved populations.
- Studies that evaluate **harms** of telehealth.

Other Research Recommendations

- Studies of clinical areas not well represented in the current evidence, such as hypertensive diseases of pregnancy, asthma, smoking cessation, and breastfeeding.
- Use of standardized clinical outcome measures that assess clinically important health outcomes (not intermediate outcomes).
- Once efficacy is established, focus on study designs that assess effectiveness, feasibility, and implementation.

Conclusions

Findings from this rapid review suggest that replacing or supplementing usual maternal care with telehealth is generally associated with clinical outcomes and patient satisfaction that are similar to and sometimes better than those of in-person care. The impacts of telehealth on access to care, health equity, health care utilization, and harms are unclear. Future research should focus on larger studies with broader inclusion criteria; examine effects of telehealth interventions in rural populations; and evaluate outcomes based on population characteristics to inform the impact of telehealth on health disparities, health equity, and potential harms of telehealth interventions.

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Appendices

Appendix A: Literature Search Methods

Database: Ovid MEDLINE(R) ALL Search Strategy:

1 telemedicine/ or telemedicine.ti,ab. or (interactive adj3 consult$).ti,ab. or (interactive adj3 diagnos$).ti,ab. or (health adj3 mobile).ti,ab. or (mobile adj3 health).ti,ab. or telehealth.ti,ab. or (ehealth or e-health).ti,ab. or (mhealth or m-health).ti,ab. or (telecommunications/ and remote.ti,ab.) or remote consultation/ or (remote adj3 consult$).ti,ab. or (remote adj3 telecommunication$).ti,ab. or (video adj3 visit$).ti,ab. or (remote adj3 visit$).ti,ab. or (remote adj3 monitor$).ti,ab. or (mobile adj3 app$).ti,ab. or (mobile adj3 media).ti,ab. or (digital adj3 health).ti,ab. or ((smartphone$ or smart phone$) adj3 app$).ti,ab. or smartphone/ or mobile applications/ or (secure adj3 message$).ti,ab. or wearable$.ti,ab. or (wearable$ adj3 device$).ti,ab. or (patient adj3 generate$ adj3 data).ti,ab. or (distance adj3 health).ti,ab. or (connect$ adj3 health).ti,ab. or (remote.ti,ab. and videoconferencing/) or (remote adj3 videoconferenc$).ti,ab. or telepharmacy.ti,ab. or (telemedicine/ and (pharmacy service, hospital/ or community pharmacy services/)) or teleradiology/ or teleradiology.ti,ab. or ((radiology information systems/ or technology, radiologic/) and telemedicine/) or telepathology/ or telepathology.ti,ab. or (pathology/ and telemedicine/) or in-home.ti,ab. or (wireless adj4 monitor$).ti,ab. or teleultraso$.ti,ab. or tele-ultraso$.ti,ab. or tele-radiology.ti,ab. or tele-pathology.ti,ab. or tele-pharmacy.ti,ab. or tele-medicine.ti,ab. or tele-health.ti,ab. or (virtual adj3 care).ti,ab. or (remote adj3 care).ti,ab. or (digital adj3 technolog$).ti,ab. or (portable adj3 device$).ti,ab. or ((phone or smartphone or smart phone) adj3 based).ti,ab. or (text adj3 messag$).ti,ab. or ((sms adj3 messag$) or short message service$).ti,ab. or (tablet adj3 app$).ti,ab. or (computers, handheld/ and mobile applications/) or (patient adj3 engage$ adj3 app$).ti,ab. or (virtual adj3 consult$).ti,ab. or (virtual adj3 visit$).ti,ab. or (virtual adj3 health$).ti,ab.

2 pregnancy complications/ or exp pregnancy outcome/ or exp labor, obstetric/ or exp labor presentation/ or exp parturition/ or exp pregnancy, high risk/ or prenatal care/ or postpartum period/ or perinatal care/ or antenat$.ti. or prenat$.ti. or antepart$.ti. or intrapart$.ti. or peripart$.ti. or postpart$.ti. or puerperium/ or puerper$.ti. or obstetrics/ or obstetric$.ti.

3 exp Delivery, Obstetric/

4 (pregnant or pregnancy).ti.

5 2 or 3 or 4

6 1 and 5

7 limit 6 to yr="2015 -Current"

8 limit 7 to english language

Database: EBM Reviews – Cochrane Central Register of Controlled Trials

1 telemedicine/ or telemedicine.ti,ab. or (interactive adj3 consult$).ti,ab. or (interactive adj3 diagnos$).ti,ab. or (health adj3 mobile).ti,ab. or (mobile adj3 health).ti,ab. or telehealth.ti,ab. or (ehealth or e-health).ti,ab. or (mhealth or m-health).ti,ab. or (telecommunications/ and remote.ti,ab.) or remote consultation/ or (remote adj3 consult$).ti,ab. or (remote adj3 telecommunication$).ti,ab. or (video adj3 visit$).ti,ab. or (remote adj3 visit$).ti,ab. or (remote adj3 monitor$).ti,ab. or (mobile adj3 app$).ti,ab. or (mobile adj3 media).ti,ab. or (digital adj3 health).ti,ab. or ((smartphone$ or smart phone$) adj3 app$).ti,ab. or smartphone/ or mobile applications/ or (secure adj3 message$).ti,ab. or wearable$.ti,ab. or (wearable$ adj3 device$).ti,ab. or (patient adj3 generate$ adj3 data).ti,ab. or (distance adj3 health).ti,ab. or (connect$ adj3 health).ti,ab. or (remote.ti,ab. and videoconferencing/) or (remote adj3 videoconferenc$).ti,ab. or telepharmacy.ti,ab. or (telemedicine/ and (pharmacy service, hospital/ or community pharmacy services/)) or teleradiology/ or teleradiology.ti,ab. or ((radiology information systems/ or technology, radiologic/) and telemedicine/) or telepathology/ or telepathology.ti,ab. or (pathology/ and telemedicine/) or in-home.ti,ab. or (wireless adj4 monitor$).ti,ab. or teleultraso$.ti,ab. or tele-ultraso$.ti,ab. or tele-radiology.ti,ab. or tele-pathology.ti,ab. or tele-pharmacy.ti,ab. or tele-medicine.ti,ab. or tele-health.ti,ab. or (virtual adj3 care).ti,ab. or (remote adj3 care).ti,ab. or (digital adj3 technolog$).ti,ab. or (portable adj3 device$).ti,ab. or ((phone or smartphone or smart phone) adj3 based).ti,ab. or (text adj3 messag$).ti,ab. or ((sms adj3 messag$) or short message service$).ti,ab. or (tablet adj3 app$).ti,ab. or (computers, handheld/ and mobile applications/) or (patient adj3 engage$ adj3 app$).ti,ab. or (virtual adj3 consult$).ti,ab. or (virtual adj3 visit$).ti,ab. or (virtual adj3 health$).ti,ab.

2 pregnancy complications/ or exp pregnancy outcome/ or exp labor, obstetric/ or exp labor presentation/ or exp parturition/ or exp pregnancy, high risk/ or prenatal care/ or postpartum period/ or perinatal care/ or antenat$.ti. or prenat$.ti. or antepart$.ti. or intrapart$.ti. or peripart$.ti. or postpart$.ti. or puerperium/ or puerper$.ti. or obstetrics/ or obstetric$.ti.

3 exp Delivery, Obstetric/

4 (pregnant or pregnancy).ti.

5 2 or 3 or 4

6 1 and 5

7 conference abstract.pt.

8 "journal: conference abstract".pt.

9 "journal: conference review".pt.

10 "http://.www.who.int/trialsearch*".so.

11 "https://clinicaltrials.gov*".so.

12 or/7-11

13 6 not 12

14 limit 13 to yr="2015 -Current"

15 limit 14 to english language

Database: EBM Reviews – Cochrane Database of Systematic Reviews

1 (telemedicine or telehealth).ti,ab.

2 (pregnancy or pregnant or maternal or perinatal or prenatal or antenatal).ti,ab.

3 1 and 2

Database: EBSCOhost CINAHL Plus

S1 (MH "Telehealth") OR (MH "Telemedicine+")

S2 (MH "Mobile Applications")

S3 TI telemedicine OR telehealth OR mobile OR virtual OR remote

S4 S1 OR S2 OR S3

S5 (MH "Pregnancy+")

S6 TI pregnant OR pregnancy OR prenatal OR perinatal OR antenatal OR peripartum OR postpartum OR obstetric

S7 S5 OR S6

S8 S4 AND S7 Limiters - Published Date: 20150101-20211231; Peer Reviewed; Publication Type: Randomized Controlled Trial

Database: Elsevier Scopus

(TITLE-ABS-KEY (telemedicine OR "interactive consul*" OR "interactive diagnos*" OR "mobile health" OR telehealth OR ehealth OR "e-health" OR mhealth OR "m-health" OR virtual OR "remote health") AND TITLE ((pregnant OR pregnancy OR prenatal OR perinatal OR antenatal OR peripartum OR postpartum OR obstetric))) AND (LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015)) AND (LIMIT-TO (SRCTYPE , "j")) AND (LIMIT-TO (SUBJAREA , "MEDI") OR LIMIT-TO (SUBJAREA , "NURS") OR LIMIT-TO (SUBJAREA , "HEAL")) AND (LIMIT-TO (LANGUAGE , "English"))

Appendix B: Inclusion and Exclusion Criteria

PICOTS	Include	Exclude
Populations	• Adults and adolescents who are planning for pregnancy (preconception period), pregnant (prenatal period; planned or unplanned pregnancy), in labor and delivery (intrapartum period), or in the 1st year after delivery (postpartum period)	• Patients seeking contraception (including postpartum), abortion, or undergoing treatment for infertility with a specialist
Interventions	• Any 2-way telehealth strategy intended to supplement or replace usual (in-person) care (eg, virtual visits, remote pregnancy monitoring, mobile apps, at-home use of medical devices, use of a facilitator) • Must include direct contact between a clinician or another provider (including lactation consultants) and a patient or group of patients • Telehealth can be synchronous or asynchronous • Interventions may be a single telehealth strategy or may be delivered as telehealth packages, composed of multiple telehealth strategies	• Telehealth provider-to-provider consults • 1-way interventions (eg, 1-way email/phone/text or app messages) • Peer-led interventions (no provider involvement)
Comparators	• Usual or in-person care or local maternal care models (eg, ACOG guidelines) • Telehealth alone vs in-person care alone, OR • Telehealth + in-person care vs in-person care alone	• No comparison • Studies not clearly describing both intervention and comparator
Outcomes	• Maternal health and clinical outcomes: Maternal morbidity and mortality; outcomes related to maternal complications (eg, preeclampsia, HTN, diabetes); obstetric outcomes (eg, preterm birth, LBW, LGA, cesarean delivery); mental health outcomes (eg, maternal anxiety, postpartum depression); other clinical health outcomes (eg, initiation and/or continuation of breastfeeding, infections, smoking cessation) • Patient-reported outcomes: patient empowerment, engagement, and satisfaction • Measures of health equity, health care access and utilization, and health disparitiesa • Harms (eg, missed diagnosis, incorrect diagnosis, delay in treatment, increases in redundant testing or in low-value care)	• Outcomes not relevant to the Key Questions • Intermediate outcomes—eg, BP and blood glucose, weight change (lbs/kgs), diet and activity, patient knowledge • Subscale items (eg, SF-36 subscale items on depression) • Cost outcomes, feasibility or ease of use of technology (provider/system perspective), patient knowledge
Timing	• Studies published from 2015 to the present	• Published before 2015

PICOTS	Include	Exclude
Clinical setting	• Patient and provider must be in different locations • Home, outpatient, inpatient • Urban and rural	• None
Country setting	• Research conducted in the US or in populations similar to those of US, with services and interventions applicable to US practice (ie, countries with a UN HDI[1] of "very high")	• Not "very high" on UN HDI
Study designs	• RCTs • A best evidence approach will be used for considering inclusion of observational studies (non-RCT with some type of comparison): ○ Studies that specifically note they were conducted during the COVID-19 pandemic (eg, either specify they are assessing effects of COVID, or they compare practices before and after March 2020) will be included. Studies with data that overlap this period will be considered only if results are stratified by pre-post pandemic. • Other observational studies will be collated, with limited reporting of study characteristics and direction of effect for the primary outcome. Individual observational studies that may fill an important gap in the RCT literature will be considered for comprehensive review and synthesis.	• Case reports, case series
Language	• English language	• Not English language

Abbreviations: ACOG, American College of Obstetrics and Gynecology; BP, blood pressure; COVID-19, coronavirus disease 2019; HTN, hypertension; LBW, low birth weight; LGA, large for gestational age; RCT, randomized controlled trial; SF-36, short form 36; UN HDI, United Nations Human Development Index; US, United States

[a] Population characteristics to identify outcomes related to health equity based on the PROGRESS-Plus Framework,2 including place of residence, race/ethnicity/culture/ language, occupation, gender/sex, religion, socioeconomic status, and social capital, as well as other characteristics that may indicate a disadvantage, such as age and disability

Search Methods for Identification of Studies.

References

1. United Nations. *Human Development Report 2020 – The Next Frontier: Human Development and the Anthropocene*. The United Nations Development Programme; 2020.
2. O'Neill J, Tabish H, Welch V, et al. Applying an equity lens to interventions: using PROGRESS ensures consideration of socially stratifying factors to illuminate inequities in health. *J Clin Epidemiol*. 2014;67(1):56-64. doi:10.1016/j.jclinepi.2013.08.005.

Appendix C: Excluded Studies

1. Impact of mobile health interventions during the perinatal period on maternal psychosocial outcomes. *Nurs Health Sci*. 2022;24(1):341-344. doi:10.1111/nhs.12889. **Exclusion reason:** Used as source document
2. Abbaspoor Z, Amani A, Afshari P, et al. The effect of education through mobile phone short message service on promoting self-care in pre-diabetic pregnant women: a randomized controlled trial. *J Telemed Telecare*. 2020;26(4):200-206. doi:10.1177/1357633X18791419. PMID: 30193565. **Exclusion reason:** Ineligible outcome
3. Abbate M, Srinivas SK, Triebwasser JE. 911 Readmission for hypertension among women in a postpartum remote blood pressure monitoring program. *Am J Obstet Gynecol*. 2021;224(2):S566. doi:10.1016/j.ajog.2020.12.936. **Exclusion reason:** Ineligible publication type
4. Abroms LC, Johnson PR, Heminger CL, et al. Quit4baby: results from a pilot test of a mobile smoking cessation program for pregnant women. *JMIR Mhealth Uhealth*. 2015;3(1):e10. doi:10.2196/mhealth.3846. PMID: 25650765. **Exclusion reason:** Ineligible intervention
5. Abroms LC, Johnson PR, Leavitt LE, et al. A randomized trial of text messaging for smoking cessation in pregnant women. *Am J Prev Med*. 2017;53(6):781-790. doi:10.1016/j.amepre.2017.08.002. PMID: 28982527. **Exclusion reason:** Ineligible intervention
6. Adib-Hajbaghery M, Hashemi-Demneh T. Effect of telephone follow-up on postdelivery breastfeeding and maternal attachment. *J Nurs Midwifery Sci*. 2017;4(4):117-124. doi:10.4103/JNMS.JNMS_6_18. **Exclusion reason:** Ineligible population
7. Ahmed AH, Roumani AM, Szucs K, et al. The effect of interactive web-based monitoring on breastfeeding exclusivity, intensity, and duration in healthy, term infants after hospital discharge. *J Obstet Gynecol Neonatal Nurs*. 2016;45(2):143-154. doi:10.1016/j.jogn.2015.12.001. PMID: 26779838. **Exclusion reason:** Ineligible intervention
8. Aksoy Derya Y, Altiparmak S, AkÇA E, et al. Corrigendum to "Pregnancy and birth planning during COVID-19: the effects of tele-education offered to pregnant women on prenatal distress and pregnancy-related anxiety" [Midwifery 92 (2021) /102877]. *Midwifery*. 2021;95:102932. doi:10.1016/j.midw.2021.102932. PMID: 33516563. **Exclusion reason:** Ineligible publication type
9. Aksoy Derya Y, Altiparmak S, AkCa E, et al. Pregnancy and birth planning during COVID-19: the effects of tele-education offered to pregnant women on prenatal distress and pregnancy-related anxiety. *Midwifery*. 2021;92:102877. doi:10.1016/j.midw.2020.102877. PMID: 33157497. **Exclusion reason:** Ineligible intervention
10. Al-ofi EA, Mosli HH, Ghamri KA, et al. Management of postprandial hyperglycaemia and weight gain in women with gestational diabetes mellitus using a novel telemonitoring system. *J Int Med Res*. 2019;47(2):754-764. doi:10.1177/0300060518809872. PMID: 30442052. **Exclusion reason:** Ineligible outcome
11. Almuslim H, AlDossary S. Models of incorporating telehealth into obstetric care during the COVID-19 pandemic, its benefits and barriers: a scoping review. *Telemed J E Health*. Epub 2021 Apr 05 doi:10.1089/tmj.2020.0553. PMID: 33819434. **Exclusion reason:** Used as source document

12. Altazan AD, Redman LM, Burton JH, et al. Mood and quality of life changes in pregnancy and postpartum and the effect of a behavioral intervention targeting excess gestational weight gain in women with overweight and obesity: a parallel-arm randomized controlled pilot trial. *BMC Pregnancy Childbirth*. 2019;19(1):50. doi:10.1186/s12884-019-2196-8. PMID: 30696408. **Exclusion reason:** Ineligible intervention

13. Alves DS, Times VC, da Silva EMA, et al. Advances in obstetric telemonitoring: a systematic review. *Int J Med Inform*. 2020;134:104004. doi:10.1016/j.ijmedinf.2019.104004. PMID: 31816495. **Exclusion reason:** Used as source document

14. Aquino M, Munce S, Griffith J, et al. Exploring the use of telemonitoring for patients at high risk for hypertensive disorders of pregnancy in the antepartum and postpartum periods: scoping review. *JMIR Mhealth Uhealth*. 2020;8(4):e15095. doi:10.2196/15095. PMID: 32301744. **Exclusion reason:** Used as source document

15. Asklund I, Nyström E, Sjöström M, et al. Mobile app for treatment of stress urinary incontinence: A randomized controlled trial. *Neurourol Urodyn*. 2017;36(5):1369-1376. doi:10.1002/nau.23116. PMID: 27611958. **Exclusion reason:** Ineligible population

16. Atzmon Y, Ishay EB, Hallak M, et al. Continuous maternal hemodynamics monitoring at delivery using a novel, noninvasive, wireless, PPG-based sensor. *J Clin Med*. 2021;10(1):8. doi:10.3390/jcm10010008. PMID: 33375211. **Exclusion reason:** Ineligible setting

17. Aziz A, Zork N, Aubey JJ, et al. Telehealth for high-risk pregnancies in the setting of the COVID-19 pandemic. *Am J Perinatol*. 2020;37(8):800-808. doi:10.1055/s-0040-1712121. PMID: 32396948. **Exclusion reason:** Ineligible intervention

18. Baker TB, Fraser DL, Kobinsky K, et al. A randomized controlled trial of financial incentives to low income pregnant women to engage in smoking cessation treatment: effects on post-birth abstinence. J Consult Clin Pychol. 2018;86(5):464-73. doi: 10.1037/ccp0000278. PMID: 29389142. **Exclusion reason:** Ineligible intervention

19. Balaji B, Halperin I, Mukerji G, et al. Ehealth technologies for gestational diabetes mellitus: summary of features and effectiveness: scoping review. *Diabetes*. 2020;69(suppl 1):1350-P. doi:10.2337/db20-1350-P. **Exclusion reason:** Ineligible publication type

20. Barbour KD, Nelson R, Esplin MS, et al. A randomized trial of prenatal care using telemedicine for low-risk pregnancies: patient-related cost and time savings. *Am J Obstet Gynecol*. 2017;216(1):S499. doi:10.1016/j.ajog.2016.11.782. **Exclusion reason:** Ineligible publication type

21. Baron AM, Ridgeway JL, Stirn SL, et al. Increasing the connectivity and autonomy of RNs with low-risk obstetric patients. *Am J Nurs*. 2018;118(1):48-55. doi:10.1097/01.NAJ.0000529715.93343.b0. PMID: 29280806. **Exclusion reason:** Ineligible outcome

22. Baroni NF, Baldoni NR, Alves GCS, et al. Do lifestyle interventions in pregnant women with overweight or obesity have an effect on neonatal adiposity? A systematic review with meta-analysis. *Nutrients*. 2021;13(6):1903. doi: 10.3390/nu13061903. **Exclusion reason:** Used as source document

23. Barrera CM, Powell AR, Biermann CR, et al. A review of prenatal care delivery to Inform the Michigan plan for appropriate tailored health care in pregnancy panel. *Obstet Gynecol*. 2021;138(4):603-615. doi:10.1097/aog.0000000000004535. PMID: 34352841. **Exclusion reason:** Background

24. Battle JD, Farrow L, Tibaijuka J, et al. mHealth for safer deliveries: A mixed methods evaluation of the effect of an integrated mobile health intervention on maternal care utilization. *Healthc (Amst)*. 2015;3(4):180-184. doi:10.1016/j.hjdsi.2015.10.011. PMID: 26699340. **Exclusion reason:** Ineligible setting

25. Bayrampour H, Trieu J, Tharmaratnam T. Effectiveness of eHealth interventions to reduce perinatal anxiety: a systematic review and meta-analysis. *J Clin Psychiatry*. 2019;80(1):18r12386. doi:10.4088/JCP.18r12386. PMID: 30688418. **Exclusion reason:** Used as source document

26. Bhat A, Mao J, Unutzer J, et al. Text messaging to support a perinatal collaborative care model for depression: a multi-methods inquiry. *Gen Hosp Psychiatry*. 2018;52:14-20. doi:10.1016/j.genhosppsych.2018.01.005. PMID: 29494854. **Exclusion reason:** Ineligible intervention

27. Bickmore T, Zhang Z, Reichert M, et al. Promotion of preconception care among adolescents and young adults by conversational agent. *J Adolesc Health*. 2020;67(suppl 2):S45-S51. doi: 10.1016/j.jadohealth.2019.09.006. PMID: 32718515. **Exclusion reason:** Ineligible intervention

28. Binstock A, Lemon L, Hauspurg A, et al. 129: The effect of a remote blood pressure monitoring program on postpartum healthcare utilization. *Am J Obstet Gynecol*. 2020;222(1):S98-S99. doi: 10.1016/j.ajog.2019.11.145. **Exclusion reason:** Ineligible publication type

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222. Rochelson B, Nimaroff M, Combs A, et al. The care of pregnant women during the COVID-19 pandemic - response of a large health system in metropolitan New York. *J Perinat Med*. 2020;48(5):453-461. doi:10.1515/jpm-2020-0175. PMID: 32432568. **Exclusion reason:** Ineligible study design

223. Rolfs S, Makkar A, Lapadula MC, et al. Evaluating satisfaction with telemedicine use for neonatology prenatal consultations during the COVID-19 pandemic. *J Investig Med*. 2021;69(2):650. **Exclusion reason:** Ineligible study design

224. Rollo ME, Baldwin JN, Hutchesson M, et al. The feasibility and preliminary efficacy of an ehealth lifestyle program in women with recent gestational diabetes mellitus: a pilot study. *Int J Environ Res Public Health*. 2020;17(19):7115. doi:10.3390/ijerph17197115. PMID: 32998401. **Exclusion reason:** Ineligible intervention

225. Rohan AJ, Krowchuck HF, Lake E, et al. Toward Evidence-Based Practice. *MCN Am J Matern Child Nurs*. 2020;45(5):312. doi: 10.1097/NMC.0000000000000650. **Exclusion reason:** Ineligible publication type

226. Sakamoto JL, Carandang RR, Kharel M, et al. Effects of mHealth on the psychosocial health of pregnant women and mothers: a systematic review. *BMJ Open*. 2022;12(2): e056807 doi:10.1136/bmjopen-2021-056807. **Exclusion reason:** Used as source document

227. Sandborg J, Henriksson P, Larsen E, et al. Participants' engagement and satisfaction with a smartphone app intended to support healthy weight gain, diet, and physical activity during pregnancy: qualitative study within the HealthyMoms trial. *JMIR Mhealth Uhealth*. 2021;9(3):e26159. doi:10.2196/26159. PMID: 33666554. **Exclusion reason:** Ineligible study design

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235. Silva-Jose C, Sánchez-Polán M, Diaz-Blanco Á, et al. Effectiveness of a virtual exercise program during COVID-19 confinement on blood pressure control in healthy pregnant women. *Front Physiol*. 2021;12:645136. doi:10.3389/fphys.2021.645136. PMID: 33776798. **Exclusion reason:** Ineligible intervention

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237. Stanhope KK, Piper K, Goedken P, et al. Quality and satisfaction with care following changes to the structure of obstetric care during the COVID-19 pandemic in a safety-net hospital in Georgia: results from a mixed-methods study. *J Natl Med Assoc*. 2022;114(1):94-103. doi:10.1016/j.jnma.2021.12.017. **Exclusion reason:** Ineligible study design

238. Sun W, Yu L, Liu S, et al. Comparison of maternal and neonatal outcomes for patients with placenta accreta spectrum between online-to-offline management model with standard care model. *Eur J Obstet Gynecol Reprod Biol*. 2018;222:161-165. doi:10.1016/j.ejogrb.2018.01.035. PMID: 29408749. **Exclusion reason:** Ineligible setting

239. Sung YS, Zhang D, Eswaran H, et al. Evaluation of a telemedicine program managing high-risk pregnant women with pre-existing diabetes in Arkansas's Medicaid program. *Semin Perinatol*. 2021;45(5):151421. doi:10.1016/j.semperi.2021.151421. **Exclusion reason:** E4

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241. Sushko K, Menezes HT, Strachan P, et al. Self-management education among women with pre-existing diabetes in pregnancy: a scoping review. *Int J Nurs Stud*. 2021;117:103883. doi:10.1016/j.ijnurstu.2021.103883. PMID: 33548591. **Exclusion reason:** Ineligible intervention

242. Swanson JO, Plotner D, Franklin HL, et al. Web-based quality assurance process drives improvements in obstetric ultrasound in 5 low- and middle-income countries. *Glob Health Sci Pract*. 2016;4(4):675-683. doi:10.9745/GHSP-D-16-00156. PMID: 28031304. **Exclusion reason:** Ineligible population

243. Tapia-Conyer R, Lyford S, Saucedo R, et al. Improving perinatal care in the rural regions worldwide by wireless enabled antepartum fetal monitoring: a demonstration project. *Int J Telemed Appl*. 2015;2015:794180. doi:10.1155/2015/794180. PMID: 25691900. **Exclusion reason:** Ineligible population

244. Theiler RN, Butler-Tobah Y, Hathcock MA, et al. OB Nest randomized controlled trial: a cost comparison of reduced visit compared to traditional prenatal care. *BMC Pregnancy Childbirth*. 2021;21(1):71. doi:10.1186/s12884-021-03557-3. PMID: 33478433. **Exclusion reason:** Ineligible outcome

245. Tian Y, Zhang S, Huang F, et al. Comparing the efficacies of telemedicine and standard prenatal care on blood glucose control in women With gestational diabetes mellitus: randomized controlled trial. *JMIR Mhealth Uhealth*. 2021;9(5):e22881. doi:10.2196/22881. PMID: 33783365. **Exclusion reason:** Ineligible setting

246. Tinius R, Duchette C, Beasley S, et al. Obstetric patients and healthcare providers perspectives to inform mobile app design for physical activity and weight control during pregnancy and postpartum in a rural setting. *Int J Womens Health*. 2021;13:405-432. doi:10.2147/IJWH.S296310. PMID: 33953614. **Exclusion reason:** Ineligible study design

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249. Tsai Z, Kiss A, Nadeem S, et al. Evaluating the effectiveness and quality of mobile applications for perinatal depression and anxiety: a systematic review and meta-analysis. *J Affect Disord*. 2022;296:443-453. doi:10.1016/j.jad.2021.09.106. **Exclusion reason:** Used as source document

250. Ukoha EP, Davis K, Yinger M, et al. Ensuring equitable implementation of telemedicine in perinatal care. *Obstet Gynecol*. 2021;137(3):487-492. doi:10.1097/AOG.0000000000004276. PMID: 33543895. **Exclusion reason:** Background

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252. Valencia S, Callinan L, Shic F, et al. Evaluation of the MoMba live long remote smoking detection system during and after pregnancy: development and usability study. *JMIR Mhealth Uhealth*. Nov 24;8(11):e18809. doi:10.2196/18809. PMID: 33231550. **Exclusion reason:** Ineligible outcome

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255. Van Dijk MR, Huijgen NA, Willemsen SP, et al. Impact of an mHealth platform for pregnancy on nutrition and lifestyle of the reproductive population: a survey. JMIR Mhealth Uhealth. 2016 May 27;4(2):e53. doi: 10.2196/mhealth.5197. PMID: 27234926. **Exclusion reason:** Ineligible intervention

256. van Dijk MR, Koster MPH, Oostingh EC, et al. A mobile app lifestyle intervention to improve healthy nutrition in women before and during early pregnancy: single-center randomized controlled trial. *J Med Internet Res*. 2020;22(5):e15773. doi:10.2196/15773. PMID: 32412417. **Exclusion reason:** Ineligible outcome

257. van Dijk MR, Oostingh EC, Koster MP, et al. The use of the mHealth program Smarter Pregnancy in preconception care: rationale, study design and data collection of a randomized controlled trial. *BMC Pregnancy Childbirth*. 2017;17(1):46. doi:10.1186/s12884-017-1228-5. PMID: 28125970. **Exclusion reason:** Ineligible publication type

258. Varnfield M, Redd C, Stoney RM, et al. M♡THer, an mHealth system to support women with gestational diabetes mellitus: feasibility and acceptability study. *Diabetes Technol Ther*. 2021;23(5):358-366. doi:10.1089/dia.2020.0509. PMID: 33210954. **Exclusion reason:** Ineligible outcome

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261. Wang X, Xu X, Luo J, et al. Effect of app-based audio guidance pelvic floor muscle training on treatment of stress urinary incontinence in primiparas: a randomized controlled trial. *Int J Nurs Stud*. 2020;104:103527. doi:10.1016/j.ijnurstu.2020.103527. PMID: 32058140. **Exclusion reason:** Ineligible intervention

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263. Whittington JR, Hughes DS, Rabie NZ, et al. Detection of fetal anomalies by remotely directed and interpreted ultrasound (teleultrasound): a randomized noninferiority trial. *Am J Perinatol*. 2022;39(2):113-119. doi:10.1055/s-0041-1739352. PMID: 154589915. Language: English. Entry Date: 20220131. Revision Date: 20220202. Publication Type: Article. **Exclusion reason:** Ineligible comparator

264. Wilkinson TA, Berardi MR, Crocker EA, et al. Feasibility of using text message reminders to increase fulfilment of emergency contraception prescriptions by adolescents. *J Fam Plann Reprod Health Care*. 2017;43(1):79-80. doi:10.1136/jfprhc-2016-101647. PMID: 27888182. **Exclusion reason:** Ineligible population

265. Willcox JC, Wilkinson SA, Lappas M, et al. 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*. 2017;124(11):1718-1728. doi:10.1111/1471-0528.14552. PMID: 28220604. **Exclusion reason:** Ineligible intervention

266. Wu JJY, Ahmad N, Samuel M, et al. The influence of web-based tools on maternal and neonatal outcomes in pregnant adolescents or adolescent mothers: mixed methods systematic review. *J Med Internet Res*. 2021;23(8):e26786. doi:10.2196/26786. **Exclusion reason:** Used as source document

267. Wu KK, Lopez C, Nichols M. Virtual visits in prenatal care: an integrative review. *J Midwifery Womens Health*. 2022;67(1):39-52. doi:10.1111/jmwh.13284. **Exclusion reason:** Used as source document

268. Xie W, Dai P, Qin Y, et al. Effectiveness of telemedicine for pregnant women with gestational diabetes mellitus: an updated meta-analysis of 32 randomized controlled trials with trial sequential analysis. *BMC Pregnancy Childbirth*. 2020;20(1):198. doi:10.1186/s12884-020-02892-1. PMID: 32252676. **Exclusion reason:** Used as source document

269. Yang P, Lo W, He ZL, et al. Medical nutrition treatment of women with gestational diabetes mellitus by a telemedicine system based on smartphones. *J Obstet Gynaecol Res*. 2018;44(7):1228-1234. doi:10.1111/jog.13669. PMID: 29797375. **Exclusion reason:** Ineligible setting

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272. Zahmatkeshan M, Zakerabasali S, Farjam M, et al. The use of mobile health interventions for gestational diabetes mellitus: a descriptive literature review. *J Med Life*. 2021;14(2):131-141. doi:10.25122/jml-2020-0163. **Exclusion reason:** Used as source document

273. Zairina E, Abramson M, Stewart K, et al. Management of asthma with supportive telehealth of respiratory function in pregnancy (the mastery©trial). *Respirology*. 2015;20(suppl 2):135-139. doi:10.1111/resp.12495_16. **Exclusion reason:** Ineligible publication type

274. Zhang Y, Wang L, Yang W, et al. Effectiveness of low glycemic index diet consultations through a diet glycemic assessment app tool on maternal and neonatal insulin resistance: a randomized controlled trial. *JMIR Mhealth Uhealth*. 2019;7(4):e12081. doi:10.2196/12081. PMID: 30998227. **Exclusion reason:** Ineligible intervention

275. Zhao L, Chen J, Lan L, et al. Effectiveness of telehealth interventions for women with postpartum depression: Systematic review and meta-analysis. *JMIR Mhealth Uhealth*. 2021;9(10):e32544. doi:10.2196/32544. **Exclusion reason:** Used as source document

276. Zhou C, Hu H, Wang C, et al. The effectiveness of mHealth interventions on postpartum depression: a systematic review and meta-analysis. *J Telemed Telecare*. 2022;28(2):83-95. doi:10.1177/1357633X20917816. PMID: 32306847. **Exclusion reason:** Used as source document

Appendix D: Methodology

By definition, a rapid review requires methods that differ from a comprehensive systematic review (SR). Conducting a rapid review requires choices and trade-offs to optimize efficiency while still providing rigorous review of the evidence.[1] Our approach to conducting the rapid review was based on the EPC Methods Guide[2-6] and the Cochrane Rapid Reviews Methods Group's guidance on conducting rapid reviews.[7] We completed core review tasks using the PICOTS framework (population, interventions, comparators, outcomes, timing, and settings), managed conflicts of interest, interacted with stakeholders, and produced a draft and final report that integrated stakeholder input.

In general, the approaches to rapid review include narrowing the scope of the questions and restricting the searches to capture the most relevant publications, or abbreviating SR processes that require significant time. We selected specific rapid review methods including prioritization of the best evidence (RCTs and larger cohort studies), efficiency in study selection (number of reviewers and use of automation), and succinctness in presentation of findings (focused abstraction of study data, evidence maps), while maintaining full-review methods for assessing study-level ROB.

The utility of a rapid review depends on harmonizing these methodologic choices to the end users' priorities, and it requires transparency in communicating these choices to the reader. For this reason, engaging with stakeholders to ensure our methods corresponded to end-user needs was essential.

Rapid Review Approach

We engaged a 6-person TEP throughout the rapid review process using the ACTIVE framework,[8] developed specifically for systematic reviews. We sought input on our list of included studies, the minimal data set for abstracting, key elements in risk of bias (ROB) assessments, and elements for the evidence gap map (see Acknowledgments).

To conduct this rapid review, we employed an abbreviated systematic review method to complete the product on a 6-month timeline. Our rapid review approach included the following adjustments:

Rapid Review Approach

- Defined a narrow scope, focusing on randomized controlled trials (RCTs) and observational studies published since 2015. We reviewed observational studies conducted prior to the COVID-19 pandemic (before March 2020) to fill gaps or evaluate consistency in the RCT evidence.
- Modified the citation dual-review process. A single investigator reviewed the abstracts, with a dual review of a random sample of 10% of excluded references as part of a quality assurance strategy.
- Automated management of literature search results using DistillerSR® software.
- Focused data extraction conducted on a limited set of predefined outcomes by one reviewer, with dual review of 50% of abstractions for accuracy.
- Conducted ROB assessment on RCTs and modified ROB assessments on observational studies.
- Did not conduct meta-analysis and grading of the certainty of evidence due to heterogeneity of study interventions and outcomes.

Literature Search

The EPC research librarian developed search strategies for Ovid® MEDLINE®, Embase®, CINAHL®, the Cochrane Central Register of Controlled Trials, and the Cochrane Database of Systematic Reviews **(Appendix A)**. We updated searches with TEP input, and final searches in April 2021 were limited by design (RCTs, and observational studies with concurrent controls), date (2015 to present) and language (English). In the updated search conducted in April 2022, we identified one new study[9] for inclusion from CINAHL or Embase databases; we reviewed references lists in eligible articles and the Scopus database to ensure all eligible studies had been identified. The TEP reviewed our list of included studies and recommended additional studies for consideration.

Inclusion and Exclusion Criteria

We developed study inclusion and exclusion criteria in collaboration with PCORI and the technical expert panel (TEP); we followed the Agency for Healthcare Research and Quality (AHRQ) PICOTS framework (population, intervention, comparator, outcomes, timing, setting).

For this review we included telehealth interventions that use technology to facilitate bidirectional interactions between specific patients and health care providers. Interactions could occur over time (asynchronous) as well as over distance. Using this definition, *telehealth* included using video or mobile devices to provide care or to offer counseling (synchronous), and remote patient monitoring using technology to measure and transmit physiologic data to providers, who may use this information to adjust patient care (asynchronous).
We considered phone conversations, email, and SMS texts to be telehealth if they allowed interaction between patient and provider and could replace or supplement an in-person interaction. In some cases, visits may have been converted to phone if there were technical difficulties on a video call. Virtual visits were used to describe any study where the intention of the intervention was video visits but allowed phone as backup. *Phone only* described visits that were designed and conducted only by telephone. These interventions were not included if they occurred only in one direction or if they were not personalized (eg, phone, email, or SMS notifications, generic messages sent to a group of patients). Studies were eligible if they were published in or after 2015 to ensure clinical relevance of data (published within the prior 5 years) based on a prior systematic review,[10] as outlined in the PCORI request for proposal (PCORI RFP, Appendix B, page 22).

We employed a "best evidence" approach for selecting observational studies. This approach adapts a full systematic review literature search to meet the timelines of a rapid review, with priority given to RCTs. Using this hierarchy-of-evidence approach, RCTs are followed by studies traditionally assessed as lower internal or external validity and quality, such as observational studies, when gaps in the evidence exist. We modified a priori criteria established for RCTs regarding study design to capture otherwise eligible studies conducted during the COVID-19 pandemic (pre-post and cross-sectional surveys with a comparator group conducted after March 2020, or pre-post studies explicitly stating overlap in the pre- and post-March 2020 time period) or those conducted prior to the pandemic (cohort studies and other rigorous observational designs with a comparator group). We considered for comprehensive review and synthesis limited reporting of study characteristics and direction of effect for the primary outcomes to fill an important gap in the RCT literature.

Appendix B shows full eligibility criteria to identify studies that addressed the Key Questions.

Study Selection

We used DistillerSR® online systematic review software to aid in the literature screening process. To meet the rapid review timeline, a single reviewer with extensive review experience screened citations and abstracts. We began with an initial pilot set of 50 abstracts distributed to 4 team members for practice, and we discussed any variation in initial decisions at a team meeting. We employed a decision-rule of "if in doubt, retrieve it" and augmented this policy with a review of a random sample of 10% of excluded references as part of a quality assurance strategy. After potentially relevant citations had been selected, 2 researchers reviewed full-text papers; consensus resolved any differences. We discussed any inconsistencies among pairs of reviewers at regular team meetings. We used DistillerSR software's DAISY ranking to sort more relevant references at the top of abstract and full-text review lists. No additional automated tools were used in the screening process, as full automation requires 2000 to 3000 citations to learn from before being accurate enough to use.

Data Extraction

Our data abstraction into Microsoft Excel® was abbreviated, focusing on the most relevant information on the population, including the period of maternal care being studied (eg, prenatal, postpartum); demographics of the study population (eg, age, race, ethnicity, urban, rural) to capture the inclusion of populations at risk for disparities, including insurance characteristics (Medicaid coverage, duration of coverage, uninsured); interventions including the modality and function of the telehealth intervention (eg, videoconference, phone, mobile app); comparisons; prioritized outcomes; timing (eg, before and/or during the COVID pandemic); setting (clinical, rural vs urban, and country); and study designs (RCT, observational, cross-sectional). We determined the minimal set of data to abstract based on input from the TEP and presented information in tables. As part of the rapid review methods, one reviewer abstracted data; a second reviewer reviewed for accuracy half of the abstractions. We contacted authors for clarification on a telehealth intervention to evaluate study eligibility or in those cases where reported data appeared erroneous. In one instance, the upper limit of a 95% CI appeared to be in error; we contacted the authors for the correct number and updated the data.[11] In another situation, we contacted authors about the role of the providers in app-based interventions and ultimately excluded the study based on their response.[12]

Risk of Bias (ROB) Assessment

We assessed ROB of individual studies using tools specific to RCTs and consistent with AHRQ guidance on systematic review methods.[13-17] Given the rapid nature of this review, and our experience with prior reviews of telehealth interventions, we focused on a small number of criteria that assess study design aspects most likely to introduce or minimize critical biases. The criteria selected for RCTs in this review addressed randomization, allocation concealment, analysis according to randomized groups (intention-to-treat analysis), and overall and differential attrition. For pre-post and interrupted time series assessing effects during the COVID-19 pandemic, we derived our criteria from an NIH checklist[18] and focused on enrollment of all eligible participants; prespecified, valid outcome measures clearly defined and assessed at multiple times; blinding of outcome assessors; and consideration and controlling for temporal trends. For surveys, we derived our criteria from a set of questions developed by members of this review team for a Health Information Exchange systematic review.[19] We focused on appropriate and clear sampling strategy and selection; reported response rates, sample characteristics, and survey questions; and made appropriate consideration of confounders and analyses. We included cohort studies to fill gaps in evidence and assessed them for ROB using modified criteria.[6] We also used modified criteria for studies conducted during the pandemic. We conducted dual review of the ROB assessments, focusing primarily on the overall assessment (low, moderate, or high ROB). As described in the AHRQ guidance on review methods,[13-17] low ROB indicates no major or minor sources of bias, implying that any bias present is unlikely to influence results, and readers may have confidence in the validity of the study results. Moderate ROB suggests the study may be susceptible to some bias but has no major or fatal flaws; readers may have some confidence in the validity of the results, but potential missing information may constrain readers' ability to assess limitations. High ROB suggests the study has major or fatal flaws that increase the potential for bias and invalid results; there is low confidence that the data represent the true effects. Consensus resolved any disagreements.

Data Synthesis and Analysis

As described in rapid review methodology guidance, meta-analyses are conducted only if appropriate, when there are a sufficient number of similar studies and appropriate data to pool. For this review, we did not conduct meta-analyses because the eligible evidence base did not meet these criteria due to heterogeneity of studies or insufficient data. Our approach to

qualitative synthesis focused on creating categories of results based primarily on the direction of the effect and whether there was statistical significance, with less emphasis on the magnitude of the effect (eg, large difference in benefits, no difference in harms), reporting findings according to ROB ratings, and summarizing results across studies grouped by maternal stage and telehealth purpose, function, and modality (mode). For Key Question 1, we assessed clinical outcomes individually and grouped them into maternal, obstetric, and patient-reported outcomes. Utilization outcomes were reported separately in Key Question 2. For the study protocol, we did not initially include intermediate outcomes when scoping this rapid review; however, when intermediate outcomes were relevant to the intervention, they were considered for the body of evidence but given lower priority, given the limited clinical implications of intermediate measures that do not meet diagnostic criteria (eg, individual blood glucose levels vs diagnostic glucose tolerance testing, or BP changes over time vs diagnosis of clinical HTN). Grouping outcomes allowed us to draw conclusions about the general direction of results and consider the magnitude of effects.

For Key Question 1 and Key Question 3 (the Evidence Map, FIgure 2), we synthesized data across studies grouped by clinical condition (eg, gestational diabetes, mental health) and maternal stage (eg, prenatal, postpartum). We categorized the telehealth interventions according to the **purpose** (supplementing or replacing usual care), **function** (treatment, education, monitoring, prevention, and "routine maternal care"), and **mode**. Mode could include phone (synchronous, audio-only, real-time conversations); virtual visits (intended to be all or mostly synchronous video visits; telephone is an option as backup only); asynchronous SMS text messaging or email; web- or mobile-based apps (purpose-built software for any hardware, such as smartphone, tablet, computer, that facilitates asynchronous transfer of information; may also include educational information that is general or tailored to the patient); and combination of modes, or multimodal (with definitions in table footnotes). *Virtual visits* were used to describe any study where the intention of the intervention was video visits but allowed phone as backup. *Phone-only* described visits that were designed and conducted only by telephone. If a mobile app's function is only to facilitate a video visit or messaging phone call, it was coded as such.

For Key Question 2 (health equity, access, utilization, and disparities), we intended to use the PROGRESS-Plus Framework.[13] However, due to limited reporting of or analysis according to patient-level characteristics, we could not employ it. Data for harms (Key Question 4) was

extremely limited. Given the review's rapid timeline and the anticipation that evidence would not be robust, we did not assess the overall strength or certainty of the evidence.

Evidence Map

Evidence maps offer a visual presentation of key characteristics of the identified relevant research and help identify or highlight patterns, including gaps in the evidence. Evidence maps may focus on the quantity of research across topics (eg, the number of studies), key characteristics of studies (eg, number of subjects included or ROB ratings), or trends in the study findings (eg, whether findings across studies support the intervention of interest).[20,21]

Although data visualizations generally—and evidence maps more specifically—are increasingly common[22,23] as either standalone products or adjuncts to various types of evidence reports for a range of topics,[24-28] there are no universally accepted or endorsed standards or methodology for their creation.[29-31] Therefore, decisions about the selection of variables to include and how the map (**Figure 2**) appears in the Results section of this report were informed by input from the TEP and PCORI based on what would be most useful to end users.

For Key Question 3, we produced a summary figure as the evidence-gap map. The map underscores the available evidence and the lack of evidence ("gaps") for telehealth interventions for maternal health care. An accompanying descriptive summary of the evidence, including characterizing the extent to which the available evidence supports the use of different modes of telehealth for different clinical conditions for maternal care, follows the map. Classification of evidence and a guide to the coding of the map, representing the evidence in Figure 2, is described below.

We selected a limited number of key elements to display in the map. Elements selected were clinical condition, outcome category, overall effect of telehealth interventions, ROB rating of the study, and mode of the telehealth intervention. We noted whether more than 25% of the enrolled subjects identified as Black, Asian, Pacific Islander, South Asian, Native American, mixed race, or Hispanic when race was reported. Although studies did not report results according to population characteristics, this notation served as a method to denote studies that enrolled more diverse study populations. We abstracted data for map elements from the evidence tables into a Microsoft Excel spreadsheet and then converted them into categories to serve as the data for the map. Each cell in the map represents a summary of the findings for an outcome type

in a single study. For example, if a study included maternal and obstetric outcomes, it would be represented in the map by 2 cells: 1 that summarizes the finding for the maternal outcomes and 1 that summarizes the finding for the obstetric outcomes. For this reason, 42 studies translate into 66 data points, or cells, in the map.

Three categories indicate the direction of effect, represented by different colors. Studies that had mixed results with a combination of outcomes that either favored telehealth (green) or showed no difference between telehealth and usual care were color coded in the same category (blue) as studies where telehealth interventions had outcomes similar to those of usual care (ie, difference not found). Only one study[32] had mixed results with outcomes favoring the comparison and outcomes favoring telehealth; we color coded it the same as the other single study favoring the comparison[33] (red). ROB is represented by binary shading, with low- or moderate-ROB studies shaded dark and high- risk of bias studies with light shading. Clinical conditions or outcomes with no eligible studies are shaded gray to represent gaps in the evidence. Cross-sectional studies are not included in the map given their many limitations.

In the map, the cells are arranged by clinical condition (row) and outcome category (column). The number of colored cells at the intersection of each clinical condition and outcomes category provides information about the volume of evidence. Areas with no evidence are represented by a gray shade meant to convey gaps in the evidence.

The legend below the map explains the conventions used to define the key elements described above. Specifically, the row and column placement, color and shade, and letter in each cell are used to convey key variables or characteristics:

- The **placement in the row** corresponds to the clinical condition.
- The **placement in the column** corresponds to the outcome category.
- The **color** of the cell summarizes the findings. For each study, the overall effect of telehealth for each outcome category (eg, maternal clinical outcomes) was categorized as better than, worse than, or similar to the comparison. All but one of the studies reporting mixed results favored telehealth and comparison, so these were coded as "no difference/mixed effect." The coding of the effect was based on the direction of the estimate and whether any difference was statistically significant. **Green** indicates that study findings favored telehealth; **blue** if outcomes are similar for telehealth and the

comparison group (no difference) or if there is a combination of studies that favor telehealth or are similar; and **red** if the results favored the comparison group or are a combination of studies that favor the comparison or are similar. It is important to note that all but one[32,34] of the mixed studies combine findings that either favored telehealth or had similar outcomes between telehealth and usual care groups.

- The **shade** of the color is binary and conveys the ROB rating for the study. For studies that were assessed as low or moderate ROB, the color is dark; the color is light for high-ROB studies.
- The **letter** in each cell represents the mode of the telehealth intervention as follows:

P = Phone, defined as audio-only, real-time conversations.

V = Virtual visits were real-time video visits as the primary intervention. Phone may have been an option or backup.

A = Apps (mobile or web-based) using purpose-built software or portals for any hardware (phone, pad, computer, etc) with an interface that facilitates transfer of information. This information can be self-entered patient data (eg, blood glucose readings) as a part of monitoring and management. For this review, apps may include educational information that is tailored to patient. Apps that served only to facilitate a video visit, messaging, or phone call were not counted as apps but as the mode that they facilitated (eg, virtual).

M = Multimodal, where the intervention involved more than one mode.

The purpose of the map is to summarize the characteristics of the available evidence and to reveal patterns, including gaps in the evidence; however, the map is descriptive and reductionist by design. The availability of research on a topic does not guarantee that the evidence can support practice or policy decisions, as the evidence may not be of sufficient quality or quantity, or findings may not be consistent across studies. Also, the availability of evidence does not guarantee that the results are replicable, as the map does not explicitly evaluate applicability.

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Appendix E: Evidence Tables

Randomized Controlled Trials

Author (year) Trial name	Study characteristics	N of participants, interventions, and duration	Study population including main Appendix B and exclusion criteria	Baseline population characteristics	Main results
Mental health					
Ashford (2018)[1]	N = 89 (29) Setting: Online and phone, England Funding: NR ROB: High	Treatment (G1) N = 46 (8) Self-guided web-based treatment based on cognitive behavioral and mindfulness principles, with optional telephone support Usual care (G2) N = 43 (21) Waitlist control, with access after 8 weeks to web-based treatment but not to telephone support Treatment duration: 8 weeks Follow-up: 8 weeks after randomization	Inclusion: English women >18 years old and ≤12 months postpartum with anxiety (score ≥5 on GAD-7) and internet access. Exclusion: Current psychological treatment, self-harm, or suicidal ideation.	Age, mean: 32 years White: 94% Asian: 4% Mixed or multiple race/ethnicity: 1% Ethnicity: NR GAD-7 score: 12.26 DASS-Anxiety score: 6.52 DASS-Depression score: 8.16	G1 vs G2 Mean score (SD); *P* value **Mental health outcomes** GAD-7: 6.6 (5.3) vs 8.3 (4.2); $p \geq .05$ DASS-Anxiety: 3.4 (1.9) vs 4.1 (4.7); $p \geq .05$ DASS-Depression: 2.8 (3.3) vs 5.0 (3.9); $p = .17$*
Dennis (2020)[2]	N = 241 (197) Setting: Urban and rural public health departments, Canada	Treatment (G1) N = 120 (101) Weekly telephone interpersonal	Inclusion: Women >18 years; EPDS >12; depression per SCID-I; 2-24 weeks postpartum; discharged home from hospital with infant.	Age: <25 years: 17.8% 26-34 years: 55.6% >35 years: 26.6% Race/ethnicity: NR	G1 vs G2 Mean scores (SD); *P* value **Mental health outcomes** 12 weeks EPDS: 7.27 (5.14) vs 12.40 (4.36); **$p < .001$**

Author (year) Trial name	Study characteristics	N of participants, interventions, and duration	Study population including main Appendix B and exclusion criteria	Baseline population characteristics	Main results
	Funding: Government ROB: Moderate	psychotherapy (60 min) Usual care (G2) N = 121 (96) Usual care (local postpartum depression services) Treatment duration: 12 weeks Follow-up: 12, 24, 36 weeks	Exclusion: Current antidepressant or antipsychotic; receiving psychotherapy; active suicidal ideation or intent; infanticidal thoughts; psychosis; chronic depression >2 years.	EPDS score: 17.52 STAI score: 58.25	STAI: 40.77 (14.47) vs 50.10 (13.36); **p < 0.001** 24 weeks EPDS: 6.54 (4.89) vs 11.79 (4.74); ***p* < .001** STAI: 36.91 (14.48) vs 49.33 (15.76); ***p* < .001** 36 weeks EPDS: 6.79 (5.40) vs 9.77 (4.69); ***p* < .001** STAI: 38.18 (15.70) vs 43.96 (15.09); ***p* = .009** % meeting anxiety (STAI) or depression (SCID) criteria Proportion; OR (95% CI) 12 weeks STAI: 40.4% vs 65%; 0.36 (**0.21-0.65**) SCID: 10.5% vs 35%; 0.22 (**0.10-0.47**) 24 weeks STAI: 22.8% vs 59.4%; 0.20 (**0.11-0.37**) SCID: 10.9% vs 33.7%; 0.24 (**0.11-0.51**) 36 weeks STAI: 27.7% vs 44.8%; 0.47 (**0.26-0.85**) SCID: 10.9% vs 14.9%; 0.66 (0.29-1.54)
Forsell (2017)[3]	N = 42 (39) Setting: Online, Sweden Funding: Government; local nonprofit ROB: Moderate	Treatment (G1) N = 22 (21) Internet-delivered, guided and self-help CBT with email feedback Usual care (G2) N = 20 (18)	Inclusion: Pregnant women gestational week 10 to 28; aged ≥18 years; access to smartphone and internet; SCID-I depression; MADRS-S score 15-35; score ≤4 on MADRS-S item 9 Exclusion: Score 5 or 6 on MADRS-S item 9; ongoing psychological treatments or	Age, mean: 31 years Race/ethnicity: NR Prior depression: 91% (note: baseline different 96% vs 85%) Prior antenatal depression: 34% (note: 27% vs 40%)	G1 vs G2 Mean score (SD); Hedges g (95% CI); *P* value **Mental health outcomes** MADRS-S: 14.3 (4.6) vs 21.1 (6.4); 1.21 (0.50-2.92), ***p* < .001** EPDS: 12.4 (4.9) vs 15.0 (4.9); 0.52 (–1.08 to 2.12), *p* = .31

Author (year) Trial name	Study characteristics	N of participants, interventions, and duration	Study population including main Appendix B and exclusion criteria	Baseline population characteristics	Main results
		Waitlist control, continuation of current maternity care Treatment duration: 10 weeks Follow-up: 10 weeks	psychiatric or medical conditions adversely affecting participation.	Prior postnatal depression: 31% (note: 27% vs 35%) GAD: 31% Prior psychological treatment: 17% Ongoing psychological treatment: 36% Current antidepressant: 5% MADRS-S score: 24.3 EPDS score: 17.4 GAD-7 score: 12.4	GAD-7: 7.2 (4.1) vs 10.1 (5.3); 0.63 (–0.84 to 2.10), *p* = .10 Percent meeting criteria; RR (95% CI) Remission (MADRS-S post-score <13): 33% vs 11%; RR 3.00 (0.71-12.66)* Response (MADRS-S decrease by 8 points): 71% vs 22%; 0.36 (**0.1-0.82**) Deterioration (MADRS-S increase 4 points): 5% vs 17%; RR 0.29 (0.033-2.51)* Remission (SCID-I depression, no longer met diagnostic criteria): 63% vs 12%; 0.42 (**0.23-0.77**)
Hantsoo (2018)[4]	N = 72 (72) Setting: Urban prenatal academic center-affiliated clinic, Canada Funding: Government; nonprofit ROB: High	Treatment (G1) N = 48 (48) Mood tracking and alert app (n = 25), + lottery incentive (n = 23) Usual care (G2) N = 24 (24) Patient portal app with provider email or phone interaction Treatment duration: 8 weeks Follow-up: 8 weeks	Inclusion: Pregnant women ≤32 weeks' gestation; aged ≥18 years; depressive symptoms (score ≥5 on PHQ-9); owned smartphone. Exclusion: NR	Age, mean: 26.4 years % Black: 85% % Hispanic: 8% Medicaid: 74% PHQ-9 score: 11.4 Psychiatric diagnosis: 53% Current psychiatric medication: 4%	G1 vs G2 Mean scores (SD); *P* value **Patient-reported outcomes** Likert 1-7, 7 high Feel confident managing own health: 6.1 (1.0) vs 6.1 (0.8), *p* = .07 Care team understands needs: 6.1 (1.2) vs 6.2 (1.4); *p* = .71 Feel connected to care team: 5.8 (1.4) vs 5.5 (1.5); *p* = .39 Satisfied with prenatal care: 6.1 (1.0) vs 5.8 (1.3); *p* = .71 Likert 1-6, 6 high Ability to reach provider by phone: 3.9 (1.4) vs 4.1 (1.3); *p* = .69 Likert 1-6, 6 never

Author (year) Trial name	Study characteristics	N of participants, interventions, and duration	Study population including main Appendix B and exclusion criteria	Baseline population characteristics	Main results
					How often leave appointment with unanswered questions: 5.7 (0.7) vs 5.6 (0.7); *p* = .77
Ngai (2015)[5] Ngai (2019)[6]	N = 397 (397) Setting: Urban regional public hospitals, Hong Kong Funding: Government ROB: Low	Treatment (G1) N = 197 (197, although 174 completed post-tests) Weekly telephone CBT (20-30 min) Usual care (G2) N = 200 (200, although 197 completed post-tests) Usual care (6-week postpartum follow-up visit) Treatment duration: 5 weeks (weeks 1-5 postpartum) Follow-up: 6 weeks, 6 months	Inclusion: Women aged ≥18 years; 2nd or 3rd day postpartum with healthy full-term singleton; EPDS score ≥10 Exclusion: Delivery complications; regular psychiatric follow-up; current antidepressant or antipsychotic.	Age, mean: 30.75 years Race/ethnicity: NR EPDS mean score: 11.9 EPDS score 10-12: 10.84 EPDS score ≥13: 14.65 PSOC score: 66.15	G1 vs G2 Mean score (SE); absolute difference (95% CI) **Mental health outcomes** 6 weeks EPDS, percent scoring ≥10: 31.9% vs 55.3%; 23.3% (**13.7-33.0**) EPDS, score 10-12: 8.10 (0.43) vs 10.00 (0.42); 1.90 (**0.72-3.08**); Cohen's d = 0.36 EPDS, score ≥13: 7.86 (0.68) vs 12.86 (0.68); 5.00 (**3.12-6.88**); Cohen's d = 0.95 6 months EPDS, percent scoring ≥10: 26.9% vs 38.3%; 11.4% (**1.9-20.8**) EPDS, score 10-12: 6.94 (0.41) vs 8.15 (0.39); 1.20 (**0.09-2.32**); Cohen's d = 0.25 EPDS, score ≥13: 8.33 (0.66) vs 10.02 (0.63); 1.69 (-0.10 to 3.47) **Patient-reported outcomes** PSOC mean score; *P* value 6 weeks 69.4 vs 63.1; ***p* < .01** 6 months 71.8 vs 67.8; ***p* < .01**
Pugh (2016)[7]	N = 50 (41) Setting: Online, Canada	Treatment (G1) N = 25 (19 at 7-10 weeks, 15 at 11-14 weeks)	Inclusion: Women living in Saskatchewan aged ≥18 years with infant aged ≤12 months; access to computer and internet; EPDS score ≥10; no	Age, mean: NR White: 96% Other: 4% Ethnicity: NR	G1 vs G2 Mean scores (SD); *P* value **Mental health outcomes** EPDS: 8.68 (3.8) vs 12.71 (3.7); ***p* = .02**

Author (year) Trial name	Study characteristics	N of participants, interventions, and duration	Study population including main Appendix B and exclusion criteria	Baseline population characteristics	Main results
	Funding: Government; non-profit ROB: Moderate	Therapist-assisted, internet-delivered CBT for postpartum depression with 7 modules + individual weekly emails Usual care (G2) N = 25 (21) Waitlist control, information pamphlet on postpartum depression and website for provincial mental health support services Treatment duration: Weekly for 7-10 weeks Follow-up: 10 weeks	other psychotherapy; if on medication, stable dose ≥1 month. Exclusion: Past or present diagnosis of psychotic mental illness; suicidal ideation or intent.	Current psychological medication: 29.8% Parity 1: 47% 2: 40% 3: 13% 4: 2% EPDS score: 15.03 DASS-Depression score: 15.3 DASS-Anxiety score: 11.04 (note: baseline differed, 13.04 vs 9.04, *P* value = NR)	DASS-Depression: 5.05 (5.67) vs 11.52 (8.39); $p > .05$ DASS-Anxiety: 6.10 (6.16) vs 7.62 (6.74); $p > .05$
Sawyer (2019)[8] eMums Plus	N = 133 (113) Setting: Urban home visits by CaFHS community clinic nurses, South Australia Funding: Nonprofit; government ROB: Moderate	Treatment (G1) N = 72 (55) CaFHS nurse-led online group using mobile device Usual care (G2) N = 61 (58) Single home visit by CaFHS nurse within 4 weeks of birth; health check, advice, information on community resources	Inclusion: Mothers with infants aged 1-4 weeks with EPDS score ≥7; at least 1 self-reported parenting problem; spoke English; access to smartphone. Exclusion: Identified by nurses as having high levels of distress.	Age, mean: 31.7 years Race/ethnicity: NR EPDS score: 9.15	G1 vs G2 Adjusted mean score (95% CI); *P* value for difference **Mental health outcomes** 8 months EPDS: 7.8 (6.6-9.0) vs 8.8 (7.5-10.1); $\mathbf{p < .001}$ 12 months EPDS: 8.4 (7.2-9.6) vs 7.2 (5.9-8.3); $\mathbf{p < .001}$

Author (year) Trial name	Study characteristics	N of participants, interventions, and duration	Study population including main Appendix B and exclusion criteria	Baseline population characteristics	Main results
		Treatment duration: 12 months Follow-up: 8 and 12 months			
Shorey (2017)[9]	N = 250 (125) Setting: Urban tertiary hospital, Singapore Funding: University ROB: Moderate	Treatment (G1) N = 126 (63) Self-guided mobile psychoeducation health app "Home-but not alone" with asynchronous communication with providers Usual care (G2) N = 124 (62 mothers) Usual care: educational support, scheduled follow-up visit Treatment duration: 4 weeks Follow-up: 4 weeks	Inclusion: Parents ≥21 years; delivered a healthy newborn to discharge at home; English literate; owns at least 1 portable smart gadget; will remain in Singapore for the first 4 weeks postpartum. Exclusion: Physical or mental disorders; delivered a newborn with deformities or complications; infant admitted into NICU.	Note: baseline data for both mothers and fathers Age, mean: 32.7 years Race/ethnicity: Chinese: 41.6% Malay: 16.8% Indian: 18.4% Other: 23.2% No antenatal classes: 78.0%	G1 vs G2 Percent change (SD); adjusted change estimate (95% CI) **Mental health outcomes** EPDS: 8.0% (88.6) vs 8.3% (70.7); –0.69 (–1.66 to 0.29); *p* = .167 **Patient-reported outcomes** What Being the Parent of a New Baby Is Like scale: 4.4% (19.1) vs –34.7% (14.4); 37.10 (28.86-45.35); **p < .001** Parenting Efficacy Scale: 11.9% (22.8) vs –8.5% (20.3); 20.46 (11.59-29.33); **p < .001**
Van Lieshout (2021)[10] COVID	N = 403 (357) Setting: Online, Canada Funding: Nonprofit ROB: Moderate	Treatment (G1) N = 202 (165) Live interactive online 1-day CBT workshop for postpartum depression with 4 modules Usual care (G2) N = 201 (192)	Inclusion: Women living in Ontario aged ≥18 years with infant aged ≤12 months; EPDS score ≥10 Exclusion: NR	Age, mean: 31.8 years White: 74.5% Ethnicity: NR Prior counseling: 41% Current antidepressant: 22% EPDS score: 16.20 GAD-7 score: 12.38	G1 vs G2 Mean scores; *P* value for difference **Mental health outcomes** EPDS: 11.65 vs 14.04; *p* < .001 Clinically significant change (>4 points): 64% vs 30%; OR 4.15 (95% CI, **2.66-6.46**) GAD-7: 7.97 vs 10.76; *p* < .001 Clinically significant change (>4 points): 57% vs 31%; OR 3.09 (95% CI, **1.99-4.81**)

Author (year) Trial name	Study characteristics	N of participants, interventions, and duration	Study population including main Appendix B and exclusion criteria	Baseline population characteristics	Main results
		Waitlist control, treatment as usual (psychotherapy and/or medication) Treatment duration: 1 day (8 hours) Follow-up: 12 weeks			
Wozney (2017)[11]	N = 62 (62) Setting: Urban and rural health authorities, Canada Funding: Government ROB: Low	Treatment (G1) N = 32 (32) 12 weekly sessions with CBT handbook, video, coaching phone calls, booster phone call Usual care (G2) N = 30 (30) Waitlist control (1 year) received weekly newspaper column, brochure, plus any usual care treatment Treatment duration: 12 sessions (mean 18 weeks) Follow-up: 3, 6, 12 months	Inclusion: Women aged 19-45 years; live in Nova Scotia; access to telephone; 1-12 months postpartum; depression by SCID-I; if current psychotropic medication, stable for prior 4 weeks. Exclusion: Active suicidal ideation and/or attempted suicide in the previous 6 months; history of a psychotic disorder; involvement with Child Protection Services; substance dependence; received a similar intervention in past 6 months	Age, mean: 29 years Race/ethnicity: NR Urban: 56% EPDS score: 16.26 BDI-II score: 29.57	G1 vs G2 Remission per SCID-I, ITT analysis (OR; *P* value for difference) **Mental health outcomes** 3 months 1.2; $p = .73$ 6 months 1.8; $p = .40$ 12 months 5.2; $p = .053$ Remission per SCID-I, complete case (OR; *P* value for difference) 3 months 1.5; $p = .742$ 6 months 1.54; $p = .696$ 12 months 12.5; ***p* = .009** Time x treatment interaction; *P* value for difference 6 months EPDS, 6 months: $p = .138$ BDI-II, 6 months: $p = .064$ 12 months

Author (year) Trial name	Study characteristics	N of participants, interventions, and duration	Study population including main Appendix B and exclusion criteria	Baseline population characteristics	Main results
					EPDS, 12 months: *p* = .131 BDI-II, 12 months: *p* = .133
Yang (2019)[12]	N = 38 (38) Setting: Urban mental health referral clinic, Canada Funding: Hospital ROB: High	Treatment (G1) N = 19 (19) Psychotherapy with video-conference replacement of in-person sessions for any session over 4 weeks Usual care (G2) N = 19 (19) Standard in-person therapy (psychotherapy + medication) up to 1 year postpartum Treatment duration: 4 weeks Follow-up: 3 months	Inclusion: Patients in specialized perinatal mental health program age ≥18 years, referred for mood and/or anxiety symptoms, access/ability to use web-enabled personal device or computer with required audiovisual capability, functioning email address; if postpartum, <9 months postpartum Exclusion: Patients with acute mania or psychosis, severe suicidal ideation with planning and intent	Age, mean: 33.8 years Race/ethnicity: NR EPDS score: 13.45 GAD-7 score: 9.75	G1 vs G2 Mean score (95% CI); treatment effect size (95% CI) **Mental health outcomes** EPDS: 11.7 vs 12.1; −0.42 (−4.23 to 3.91) GAD-7: 8.7 vs 9.1; −0.44 (−4.49 to 3.62)
General maternal care					
Butler (2019)[13]	N = 300 (267) Setting: Urban academic center-affiliated obstetric clinics, US Funding: Hospital ROB: Moderate	Treatment (G1) N = 150 (136) 8 in-person clinic visits with OB/CNM, 6 virtual visits (phone or online) with OB Nest RN (home BP, fetal HR evaluation, nursing education), and access to an online community (peers)	Inclusion: 18-36 years, <13 weeks' gestation, no medical or obstetric complication. Exclusion: Chronic medical conditions, high-risk pregnancy	Age, mean: 29.6 years Advanced maternal age (≥35): 8.3% White: 91% Ethnicity: NR	G1 vs G2 Proportion; *P* value for difference **Maternal clinical outcomes** GDM: 4.5% vs 0%; **p < .01** **Obstetric outcomes** Cesarean delivery: 12.7% vs 14.9%; *p* = .57 Preterm birth: 3.0% vs 2.3%; *p* = .71 LBW (<2500 grams): 0.7% vs 1.5%; *p* = .56 **Patient-reported outcomes** Mean score; MD (95% CI)

Author (year) Trial name	Study characteristics	N of participants, interventions, and duration	Study population including main Appendix B and exclusion criteria	Baseline population characteristics	Main results
		Usual care (G2) N = 150 (133) Usual prenatal care; 12 clinic visits with OB/CNM (ACOG) Treatment Duration: 23 weeks (up to 36 weeks' gestation) Follow-up: 36 weeks' gestation			Satisfaction with care (0-100): 93.9 vs 78.9; 15.01 (**13.38-16.64**) Quality of Care, patient assessment (0-100): Communication: 83.56 vs 82.96; 0.6 (–2.37 to 3.57) Decision-making: 80.44 vs 52.93; 3.37 (–0.91 to 8.37)
Diabetes during pregnancy					
Given (2015)[14] TELE-MUM	N = 50 (47) Setting: Urban specialist antenatal clinics, Ireland and Northern Ireland Funding: Government ROB: Moderate	Treatment (G1) N = 24 (21) Interactive website with telephone feedback + wifi-enabled scale, BP monitor, and glucometer Usual care (G2) N = 26 (26) Self-monitoring of BG and regular follow-up visits Treatment duration: Unclear Follow-up: Unclear	Inclusion: Women diagnosed with GDM or impaired glucose tolerance who had the ability to use telemedicine equipment and communication skills Exclusion: Previous diabetes diagnosis and receiving oral steroid therapy (previous GDM diagnosis not excluded)	Age, mean: 32 years Race/ethnicity: NR BMI, mean: 33.1	G1 vs G2 Proportion; RR (95% CI) or *P* value for difference **Maternal clinical outcomes** Preeclampsia/pregnancy-induced HTN: 0.0% vs 3.9%; 0.41 (0.02-9.55)* **Obstetric outcomes** Cesarean delivery: 47.6% vs 38.5%; 1.24 (0.64-2.40)* Macrosomia: 28.6% vs 8.0%; 3.71 (0.83-16.54)* Preterm birth: 0.0% vs 8%; 0.25 (0.01-4.85)* **Utilization outcomes** Appointments attended, mean (SD): 97.8 (SD 6.1) vs 92.6 (SD 18.2); p = .007*
Mackillop (2018)[15]	N = 206 (203) Setting: Urban tertiary referral hospital, England	Treatment (G1) N = 103 (101) mHealth app (mobile phone) + wifi-enabled	Inclusion: Women aged 18-45 with singleton pregnancy <35 weeks and GDM diagnosis Exclusion: NR	Age, mean: 33 years White: 78% South Asian: 11% African/Caribbean: 5%	G1 vs G2 Proportion; OR (95% CI) or *P* value for difference **Maternal outcomes**

Author (year) Trial name	Study characteristics	N of participants, interventions, and duration	Study population including main Appendix B and exclusion criteria	Baseline population characteristics	Main results
	Funding: Government ROB: Moderate	glucometer with in-person follow-up every 4-8 weeks + text message feedback, advice and encouragement Usual care (G2) N = 103 (102) Paper logging of blood glucose values with in-person follow-up every 2-4 weeks; instructed to contact midwife if blood glucose levels were too high Treatment duration: Unclear Follow-up: Unclear		East Asian: 2% Other: 4% Ethnicity: NR Parity 0: 38.4% 1: 36.0% ≥2: 25.6% BMI, mean: 31.4 kg/m^2 Smoking in pregnancy: 3.9% Previous GDM: 13.6% HbA1C, mean: 5.4	Pregnancy-induced HTN or preeclampsia: 1.0% vs 4.9%; 0.20 (0.004-1.79) **Obstetric outcomes** Cesarean delivery: 26.7% vs 46.1%; 0.43 (0.24-0.77)* Preterm delivery: 5.0% vs 12.7%; 0.36 (0.12-1.01) **Patient-reported outcomes** Satisfaction with care (OMDTSQ), median (IQR): 43 (39-36) vs 44.5 (41-46); *p* = .49
Miremberg (2018)[16]	N = 126 (120) Setting: Urban university medical center, Israel Funding: NR ROB: Moderate	Treatment (G1) N = 61 (60) App (smartphone) for daily blood glucose measurements + email feedback Usual care (G2) N = 65 (60) Biweekly visits up to 35 weeks' gestation and weekly thereafter with education on glucose monitoring, nutrition, and physical	Inclusion: English-speaking women 18 to 45 years with no pre-GDM and first diabetes in-person pregnancy visit <34 gestational weeks who owned a smartphone. Exclusion: NR	Age, mean: 32 years Race/ethnicity: NR BMI, mean: 27.1 kg/m^2 Chronic HTN: 5% Previous GDM: 25% Family history of diabetes: 41.7% Smoking: 8.3% Baseline HbA_{1c}: 5.2	G1 vs G2 Proportion; *P* value for difference **Maternal clinical outcomes** % Off-target fasting glucose measurement: 4.7% (SD 0.4) vs 8.4% (0.6); ***p* < .001** Gestational HTN: 0% vs 1.7%; *p* > .99 Preeclampsia: 5.0% vs 3.3%; *p* > .99 Insulin treatment: 13.3% vs 30%; ***p* = .04** **Obstetric outcomes** Cesarean delivery: 20% vs 33.3%; *p* = .15 Emergent cesarean delivery: 6.7% vs 11.6%; *p* = .53

Author (year) Trial name	Study characteristics	N of participants, interventions, and duration	Study population including main Appendix B and exclusion criteria	Baseline population characteristics	Main results
		activity; ongoing monitoring Treatment duration: 12 months Follow-up: Unclear			LGA: 11.6% vs 11.6%; $p > .99$
Rasekaba (2018)[17] TeleGDM	N = 95 (95) Setting: Urban outpatient GDM clinics, Australia Funding: Foundation ROB: Moderate	Treatment (G1) N = 61 (61) Self-monitoring of GDM on web-based, patient-controlled health record shared with provider; review and feedback of data by diabetes nurse with feedback via in-app messaging Usual care (G2) N = 34 (34) Hand-written recording of GDM self-monitoring data, reviewed by diabetes nurse at visits Treatment duration: Unclear Follow-up: 4 weeks	Inclusion: Pregnant women diagnosed with GDM using insulin up to 35 weeks' gestation with access to an internet connected computer or smartphone/tablet. Exclusion: NR	Age, mean: 32 years Race/ethnicity: NR Parity, median: 1 High GDM risk: 60%	G1 vs G2 Proportion; *P* value for difference **Obstetric outcomes** Cesarean delivery: 45.9% vs 32.4%; $p = .20$ Large birthweight (macrosomia): 4.9% vs 2.9%; $p = 1.00$
Sung (2019)[18]	N = 21 (19) Setting: Urban hospital, Republic of Korea Funding: Government ROB: Moderate	Treatment (G1) N = 11 (10) Phone-based mHealth app with glucometer and accelerometer to record data; data reviewed by providers	Inclusion: Singleton pregnant women diagnosed with GDM at 24 to 28 weeks of gestation Exclusion: After 30 weeks of gestation; existing pre-gestational diabetes; unable to understand Korean;	Age, mean: 33 years Race/ethnicity: NR BMI, mean: 25.4 kg/m^2 Family history of diabetes: 43%	G1 vs G2 Proportion; RR (95% CI) **Maternal clinical outcomes** Postpartum diabetes: 28.6% vs 25.0%; 1.14 (0.21-6.11)* **Obstetric outcomes**

Author (year) Trial name	Study characteristics	N of participants, interventions, and duration	Study population including main Appendix B and exclusion criteria	Baseline population characteristics	Main results
		twice weekly; tailored medical and nutritional guidance from providers via app Usual care (G2) N = 10 (9) Standard antenatal care consisting of biweekly visits up to 36 weeks of gestation, followed by weekly visits until delivery and regular monitoring of BP, urinalysis (for proteinuria), and blood glucose concentration Treatment duration: Unclear Follow-up: 4-12 weeks postpartum	unfamiliar with or no access to mobile phones or already receiving similar services		SGA: 30.0% vs 22.2%; 1.35 (0.29-6.34)* LGA: 20.0% vs 0.0%; 4.55 (0.25-83.70)* Cesarean delivery: 60.0% vs 44.4%; 1.35 (0.56-3.28)*
Gestational Hypertension					
Cairns (2018)[19] SNAP-HT	N = 91 (86) Setting: England, rural vs urban NR Sites: 5 NHS hospitals Funding: Government ROB: Moderate	Treatment (G1) N = 45 (41) BP self-monitored, text messages (mobile) or app messages (smartphone) with provider about down-titrating medication	Inclusion: Women ≥18 years, after pregnancy with gestational HTN or preeclampsia requiring antihypertensive treatment Exclusion: Prescription of >3 antihypertensive medications, self-report of HTN diagnosed outside of pregnancy	Age, mean: 31.7 years White: 92% Asian: 6% Black: 2% Ethnicity: NR IMD quintile 1-2: 59% Gestational HTN: 46% Preeclampsia: 54%	G1 vs G2 % with BP inside target range; aOR (95% CI) **Maternal clinical outcomes** 4 weeks 88% vs 74%; 2.5 (0.8-8.3) 6 weeks 88% vs 60%; 5.4 (1.7-17.6)

Author (year) Trial name	Study characteristics	N of participants, interventions, and duration	Study population including main Appendix B and exclusion criteria	Baseline population characteristics	Main results
		according to schedule set by investigator + website Usual care (G2) N = 46 (45) BP monitored by community midwife and antihypertensive medication adjusted by general practitioner Treatment duration: median of 29 vs 41 days (G1 vs G2) Follow-up: 26 weeks			12 weeks 80% vs 76%; 1.3 (0.5-3.9) 26 weeks 75% vs 67%; 1.4 (0.5-3.7) % with SAEs aRR/IRR (95% CI) ≥ SAE: 16% vs 9%; aRR 2.0 (0.6 to 6.2) Total SAE episodes: 16% vs 9%; IRR 1.8 (0.5-6.2) ≥1 BP-related SAE: 11% vs 7%; aRR 1.7 (0.4-6.8) Total BP-related SAE episodes: 11% vs 7%; IRR 1.7 (0.4-7.2) **Patient-reported outcomes** Quality of life EQ-5D-5L VAS, MD (95% CI) Baseline: 76.3 vs 68.8; MD 7.5 (–0.4 to 15.3) 6 weeks: 85.3 vs 85.9; MD –1.0 (–6.3 to 4.3) 6 months: 86.2 vs 89.2; MD –3.3 (–7.5 to 0.9)
Hirshberg (2018)[20]	N = 206 (206) Setting: Urban university hospital, US Funding: Nonprofit ROB: Moderate	Treatment (G1) N = 103 (103) Text-based surveillance with home monitoring of BP via web-based platform; established algorithm used to determine treatment Usual care (G2)	Inclusion: Postpartum women >18 years, with gestational HTN, preeclampsia, chronic HTN with super-imposed preeclampsia, or HELLP syndrome Exclusion: New-onset postpartum HTN	Age, mean: 28 years Black: 68% White: 26% Asian: 3% Other: 3% Ethnicity: NR Medicaid: 58.3% GDM: 6.8%	G1 vs G2 **Maternal outcomes** Use of antihypertensive medication at discharge: 23.3% vs 18.4%; *p* = .39* **Utilization outcomes** BP reading obtained within 10 days: 92.2% vs 43.7%; aOR 58.2 (95% CI, 16.2-208.1), ***p* < .001** Postpartum HTN readmission: 0 vs 3.9%; ***p* = .04**

Author (year) Trial name	Study characteristics	N of participants, interventions, and duration	Study population including main Appendix B and exclusion criteria	Baseline population characteristics	Main results
		N = 103 (103) Standard follow-up with provider 4 to 6 days postpartum (ACOG); used same algorithm as G1 to determine treatment Treatment duration: 2 weeks postpartum Follow-up: 2 to 3 weeks postpartum		Chronic HTN with medications: 5.3% Chronic HTN without medications: 7.8%	ED or office visit for HTN not resulting in readmission: 2.9% vs 1.9%; *p* = .65
Breastfeeding					
Demirci (2020)[21] MILK	N = 250 (186) Setting: Urban prenatal clinics, US Funding: Government ROB: Moderate	Treatment (G1) N = 126 (98) Tailored text messages about breastfeeding + communication via text, email, or phone Usual care (G2) N = 124 (88) Attention control; automated usual text messages about infant care, including breastfeeding (Text4Baby) Treatment duration: 8 weeks postpartum Follow-up: 8 weeks postpartum	Inclusion: Nulliparous singleton pregnant women ≥18 years, 13 to 25 gestational weeks, intended to exclusively or nearly exclusively breastfeed for ≥2 months Exclusion: Any contraindications to breastfeeding and maternal or fetal conditions likely to compromise breastfeeding or milk supply	Age, mean: 28.8 years White: 73% Black: 19% Asian/Indian: 5% Mixed: 2% Other: 1% Hispanic: 4.0% WIC recipient: 24.3% Intended duration any breastfeeding, 6 months or longer: 95.1% Intended duration exclusive breastfeeding, 6 months or longer: 53.4%	G1 vs G2 Proportion; *P* value for difference **Patient-reported outcomes** Participants reported messages were "helpful" or "very helpful" at 8 weeks postpartum: 84% vs 21%; ***p* < .001**

Author (year) Trial name	Study characteristics	N of participants, interventions, and duration	Study population including main Appendix B and exclusion criteria	Baseline population characteristics	Main results
Miremberg, 2022[22]	N = 224 (197) Study Design: RCT Setting: Urban medical center, Israel Purpose: Supplement Funding: Hospital ROB: Moderate	Treatment (G1) N = 112 (97) Tailored, web-based app (smartphone) with lactation information, direct email communication with staff (MFM specialist, postpartum nurses, lactation consultants, clinical psychologist), additional lactation support; optional in-person lactation consult Usual care (G2) N = 112 (100) Standard postpartum care (routine outpatient public health services) + lactation information (at least 1 meeting with nurse pre-discharge) Treatment duration: 6 months postpartum Follow-up: 6 months	Inclusion: Postpartum women aged 18-45 years, singleton term delivery, owned smartphone, intention to breastfeed at least 6 months Exclusion: Known prenatally diagnosed congenital anomalies	Age, mean: 32 years Advanced maternal age (>35): 22.8% Race/ethnicity: NR Nulliparous: 28.9% BMI, mean: 29.1 kg/m^2 Smoking: 7.6% Diabetes mellitus: 11.7% Prior breast surgery: 4.6%	G1 vs G2 *P* value for difference **Other clinical outcomes** Breastfeeding (Lactation rate) 2 weeks: 98.9% vs 97.0%, $p = .62$ 6 weeks: 96.9% vs 82.0%, $\mathbf{p < .001}$ 3 months: 81.4% vs 69.0%, $\mathbf{p = .049}$ 6 months: 59.8% vs 49.0%, $p = .78$
Uscher-Pines (2020)[23] Tele-MILC	N = 203 (187) Setting: Rural critical access hospital, US Funding: Government	Treatment (G1) N = 102 (94) Telelactation App (smartphone or tablet) with on-	Inclusion: Postpartum women aged ≥18 years who had a singleton baby at a gestational age of ≥35 weeks, and had initiated breastfeeding and	Age, mean: 26.5 years White: 96% Hispanic: 1.6% Primiparous: 39.6%	G1 vs G2 Proportion at 12 weeks; *P* value for difference **Patient-reported outcomes**

Author (year) Trial name	Study characteristics	N of participants, interventions, and duration	Study population including main Appendix B and exclusion criteria	Baseline population characteristics	Main results
	ROB: Low	demand video calls with IBCLCs via app Usual care (G2) N = 101 (93) Standard postpartum care (routine, outpatient pediatric health maintenance visits, with access to breastfeeding services for women enrolled in WIC) Treatment duration: 12 weeks Follow-up: 2, 4, and 12 weeks	planned to continue after hospital discharge Exclusion: Planned separation from infant, NICU stay, or a condition where breastfeeding was medically contraindicated	Prior experience with breastfeeding: 56.7% Planned to breastfeed at least 3 months: 77.5% Planned to breastfeed at least 6 months: 72.2% Infant breastfed exclusively during newborn hospital stay: 78.6% (71% vs 86%, *p* = .01)	Participants reported being satisfied with their breastfeeding experience: 73% vs 78%; *p* = .41 **Other clinical outcomes** Exclusively breastfeeding (among those still breastfeeding): 51% vs 46%; *p* = .47 Any breastfeeding: 71% vs 68%; *p* = .73
Wen (2020)[24]	N = 1155 (1155) Setting: Urban antenatal clinics, Australia Funding: Government ROB: Moderate	Treatment (G1) N = 386 (386) Telephone support provided by a child and family nurse (30-60 minutes) Treatment (G2) N = 384 (384) Received SMS messages twice a week for 4 weeks via 2-way system Usual care (G3) N = 385 (385) Usual care in the local health districts, plus home safety	Inclusion: Pregnant women ≥16 years, between weeks 24 and 34 of pregnancy. Exclusion: NR	Age: 16-24 years: 8% 25-29 years: 24% 30-34 years: 38% 35-39 years: 23% 40-49 years: 7% Race/ethnicity: NR First-time mother: 54%	G1 vs G2 vs G3 %; aOR (95% CI) **Other clinical outcomes** Breastfeeding 6 months Exclusive: 7% vs 6% vs 4%; 1.80 (0.83-3.86)**, *p* ≥ 0.05 for G1 vs G3 Current: 70% vs 71% vs 68%; 1.14 (0.80-1.64) for G1 vs G3 G2 vs G3 1.08 (0.91-1.27) 12 months Current: 49% vs 49% vs 44%; 1.25 (0.91-1.72) for G1 vs G3 G2 vs G3 1.11 (0.95-1.30)

Author (year) Trial name	Study characteristics	N of participants, interventions, and duration	Study population including main Appendix B and exclusion criteria	Baseline population characteristics	Main results
		promotion materials and a newsletter on kids' safety Treatment duration: 4 weeks Follow-up: 6 and 12 months			
Smoking Cessation					
Coleman-Cowger (2018)[25]	N = 128 (128) Setting: Urban academic obstetrics clinic, US Funding: Government ROB: Moderate	Treatment (G1) N = 64 (64) Smoking cessation program with 10 phone calls (every 2 weeks) with a health coach using motivational interviewing techniques from gestational week 36 to 6 months postpartum, and access to a 24/7 quit-line Usual care (G2) N = 64 (64) Referral to a 24/7 quit-line postpartum (ACOG) Treatment duration: 7 months Follow-up: 6 weeks, 3 and 6 months	Inclusion: 1st or 2nd trimester, 1st prenatal visit, ≥18 years, tobacco user (within 90 days); clinic primarily sees low-income women Exclusion: NR	Age, mean: 26.0 years Black: 81% White: 16% Other: 4% Ethnicity: NR Prior pregnancy: 0-1: 36.2% 2-4: 41.7% ≥5: 22.0% Current smoker: 68.5% Recently quit: 31.5%	G1 vs G2 Proportion; abstinent past 7 days OR (95% CI) **Other clinical outcomes** 6 weeks PP 39% vs 25%; 1.92 (0.7-5.6) 3 months PP 25% vs 14%; 2.0 (0.6-7.3) 6 months PP 24% vs 24%; 1.04 (0.3-3.3)

Author (year) Trial name	Study characteristics	N of participants, interventions, and duration	Study population including main Appendix B and exclusion criteria	Baseline population characteristics	Main results
Cummins (2016)[26]	N = 1173 (1172) Setting: Statewide, US Funding: Nonprofit; Government ROB: Moderate	Treatment (G1) N = 584 (351) Smoking cessation program with 9 phone calls with a counselor using CBT and motivational interviewing gestational week 36 to 6 months postpartum, and access to a 24/7 quit-line Usual care (G2) N = 589 (409) Received self-help materials Treatment Duration: Variable, from enrollment to 4 weeks postpartum Follow-up: Third trimester, 2, 6 months postpartum	Inclusion: Aged 18-45 years, pregnant <27 weeks' gestation, first-time callers to quit-line, willing to quit within 1 month or recent quitters (within 2 weeks) Exclusion: Active psychiatric disorders, current substance or alcohol abuse, being in recovery for <6 months, requested counseling, or planned to use pharmacotherapy for smoking cessation	Aged 18 to 24: 46.8% Aged ≥25: 53.2% White: 58% Native American: 4% Asian: 3% Other: 2% Hispanic: 12.9% Medicaid: 53.4% First baby: 39.6% No insurance: 15.4% Daily smoker: 97.8% Cigarettes per day: 1-14: 68.9% 15-24: 26.0% ≥25: 5.0%	G1 vs, G2 Proportion; abstinent past 30 days RR (95% CI) **Other clinical outcomes** 3rd trimester % abstinent past 30 days): 29.6% vs 20.1%; 1.5 (**1.2-1.8**) 2 months PP (% abstinent past 90 days) 22.1% vs 14.5%; 1.5 (**1.2-2.1**) 6 months PP (% abstinent past 180 days) 14.2% vs 8.2%; 1.7 (**1.2-2.4**)
Gestational weight gain					
Ferrara (2020)[27] GLOW	N = 398 (394) Setting: 5 large medical centers, US Funding: Government ROB: Low	Treatment (G1) N = 200 (199) Telehealth lifestyle intervention: 2 in-person and 11 telephone sessions using motivational interviewing on behavioral strategies	Inclusion: Pre-pregnancy BMI 25·0 kg/m² to 40·0 kg/m², 18 years or older, singleton pregnancy Exclusion: fertility-assisted pregnancy; bed rest; diabetes diagnosis; current uncontrolled HTN; thyroid disease in last	Age, mean: 32.5 years White: 33% Asian: 21% Multiracial/other: 19% Black: 8% Hispanic: 20% Pre-pregnancy BMI, mean: 29.4 kg/m²	G1 vs G2 Proportion; RR (95% CI) **Maternal clinical outcomes** GDM: 8% vs 8%; 1.04 (0.53-1.94) Gestational HTN: 8% vs 8%; 1.00 (0.51-1.98) Preeclampsia: 5% vs 8%; 0.58 (0.26-1.31) **Obstetric outcomes**

Author (year) Trial name	Study characteristics	N of participants, interventions, and duration	Study population including main Appendix B and exclusion criteria	Baseline population characteristics	Main results
		to improve weight, diet, and physical activity, and stress management to help women meet lower limit of IOM guidelines range for total GWG Usual care (G2) N = 198 (195) Standard antenatal care, including mean 8 visits, educational newsletters, study-specific newsletters Treatment duration: 13 weeks Follow-up: 38 weeks' gestation	30 days; history of cardiovascular, cancer, lung or serious gastrointestinal disease; history of eating disorder or bariatric surgery; serious mental illness; recent history of mood or anxiety disorder; drug or alcohol use disorder; more than 13 weeks' gestation; gestational diabetes		Cesarean: 14% vs 15%; 0.91 (0.56-1.47) Preterm birth (25-37 weeks): 6% vs 6%; 1.00 (0.44-2.25) LGA (90th percentile): 12% vs 15%; 0.84 (0.50-1.41) Macrosomia (>4000 g): 12% vs 11%; 1.06 (0.61-1.84) SGA (10th percentile): 13% vs 9%; 1.41 (0.81-2.43) LBW (<2500 g): 5% vs 2%; 2.20 (0.64-7.57)
Van Horn (2018)[28] MOMFIT	N = 281 (275) Setting: Urban university hospital, US Funding: Government ROB: Low	Treatment (G1) N = 140 (139) Coached on healthy diet (MAMA-DASH), increased activity, and increased sleep by RDN; multimodal intervention using electronic educational materials, an app, email, SMS, telephone, and group video meetings Usual care (G2) N = 141 (136)	Inclusion: Women with singleton pregnancy, 18-45 years, gestational age <16 weeks, self-reported pre=pregnancy BMI 25 to 40 Exclusion: Diagnosis of diabetes or HbA_{1c} >6.5%, in vitro fertilization, weight difference of >15 lb relative to self-reported pre-pregnancy weight, substance abuse, smoking, plans to terminate pregnancy, plans to move out of the area	Age, mean: 33.5 years White: 63% Black: 19% Other: 17% Hispanic: 21.3%	G1 vs G2 Proportion; *P* value for difference **Maternal clinical outcomes** Gestational diabetes: 5.3% vs 7.1%; adjusted *p* = .41 **Obstetric outcomes** Cesarean delivery: 39.6% vs 27.0%; **adjusted *p* = .01** Premature birth, <37 weeks: 4.3% vs 8.8%; *p* = .13 Small for gestational age: 18.0% vs 19.9%; adjusted *p* = .61 LGA: 5.8% vs 8.8%; adjusted *p* = .51

Author (year) Trial name	Study characteristics	N of participants, interventions, and duration	Study population including main Appendix B and exclusion criteria	Baseline population characteristics	Main results
		Usual care with access to MOMFIT website and electronic newsletters Treatment duration: 19 weeks Follow-up: Through delivery			
Asthma					
Zairina (2016)[29] MASTERY	N = 72 (69) Setting: Urban antenatal clinics, Australia Funding: Institution; government; Industry ROB: Moderate	Treatment (G1) N = 36 (33) COPD-6 instrument to measure lung function and forced expiratory volume; loaned smartphone with app to record asthma symptoms and medication use with automated feedback messages to providers and participants Usual Care (G2) N = 36 (33) Regular follow-up visits and asthma and pregnancy brochure Treatment duration: 6 months Follow-up: 3 and 6 months	Inclusion: English-speaking, pregnant women 18 years and older, up to 20 weeks' gestation reporting use of any inhaled bronchodilator or anti-inflammatory agent for asthma in previous 12 months Exclusion: Women under specialist care for brittle/difficult asthma; not in possession of a smartphone	Age, mean: 31 years White: 83% Asian: 8% Other: 8% Ethnicity: NR Currently smoking: 4.2% Duration of asthma, median years: 26.0 Moderate to severe asthma: 58.3%	G1 vs G2 Proportion; RR (95% CI) (timing NR) **Maternal clinical outcomes** GDM: 9% vs 17%; 0.55 (0.15-2.01) Hypertensive disorders of pregnancy: 6% vs 6%; 1.09 (0.16-7.31) Proportion of participants with well-controlled asthma (ACQ <1.5) at 6 months: 82% vs 58%; ***p* = .03** **Obstetric outcomes** Premature birth (<37 weeks): 3% vs 6%; 0.55 (0.05-5.74) SGA (<10th percentile): 12% vs 19%; 0.62 (0.20-1.94) Emergency cesarean: 12% vs 17%; 0.72 (0.22-2.35) Macrosomia: 6% vs 14%; 0.44 (0.09-2.10) Postpartum hemorrhage: 3% vs 6%; 0.55 (0.05-5.74)

Abbreviations: aOR, adjusted odds ratio; aRR, adjusted relative risk; BDI-II, Beck Depression Inventory; BG, blood glucose; BMI, body mass index; BP, blood pressure; CaFHS, Child and Family Health Service; CBT, cognitive behavioral therapy; CI, confidence interval; CNM, certified nurse-midwife; COVID, Coronavirus disease 2019; CSQ-8, Client Satisfaction Questionnaire; DASH, Dietary Approach to Stop Hypertension; DASS, Depression, Anxiety, and Stress Scale; ED, emergency department; EPDS, Edinburgh Postnatal Depression Scale; GAD-7, Generalized Anxiety Disorder 7-item; GDM, gestational diabetes; GLOW, GestationaL Weight Gain and Optimal Wellness; GWG, gestational weight gain; HbA_{1c}, hemoglobin A_{1c}; HELLP, hemolysis, elevated liver enzymes, low platelets; HR, heart rate; HTN, hypertension; IBCLCs, International Board Certified Lactation Consultants; IMD, Index of Multiple Deprivation; IOM, Institute of Medicine; IQR, interquartile range; IRR, incidence risk ratio; ITT, intention to treat; LBW, low birth weight; LGA, large for gestational age; MADRS-S: Montgomery-Åsberg Depression Rating Scale-Self Report; MAMA-DASH, Modified-Dietary Approach to Stop Hypertension; MASTERY, Management of Asthma with Supportive Telehealth of Respiratory Function in Pregnancy; MD, mean difference; mHealth, mobile health; MOMFIT, Maternal Offspring Metabolics Family Intervention Trial; NA, not applicable; NHS, National Health Services; NICU, neonatal intensive care unit; NR, not reported; OB, obstetrician; OMDTSQ, Oxford Maternity Diabetes Treatment Satisfaction Questionnaire; OR, odds ratio; PHQ-9, Patient Health Questionnaire-9; PP, postpartum; PSOC, Parenting Sense of Competence Scale; RDN, registered dietician nutritionist; RN, registered nurse; RR, relative risk; SAEs, serious adverse events; SCID-I, Structured Clinical Interview for *DSM-IV* Axis I Disorders; SD, standard deviation; SE, standard error; SGA, small for gestational age; SMS, short message service; SNAP-HT, Self-management of Postnatal Anti-Hypertensive Treatment, STAI, State-Trait Anxiety Inventory; TeleGDM, Telemedicine for Gestational Diabetes Mellitus; Tele-MILC, Telehealth for Mothers to Improve Lactation Confidence; US, United States; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children.
* EPC calculated.
** The upper bound of the 95% CI appeared to be an error, and the authors were contacted for the correct number.

Glossary:

- CSQ-8: Client Satisfaction Questionnaire assesses treatment satisfaction on 8 items rated on a 5-point Likert scale; score ranged from 8 to 32, with higher score indicating higher satisfaction.
- DASS-21: Depression Anxiety Stress Scale-21 includes 21 items rated on a 4-point Likert-scale ranging from 0 to 3. Higher scores indicate more severe symptoms of depression, anxiety, and stress.
- DASS: Depression Anxiety Stress Scale-Short Form assesses mood, fear, arousal, nervousness, and agitation on 21 items using a 4-point Likert scale.
- EPDS: Edinburgh Postnatal Depression Scale is a self-reported depression screening measure on 10 items; scores range from 0 to 30, with scores ≥12 predictive of major depressive disorder. Cutoffs for postpartum depression are generally scores ≥10, with reduction in score of at least 4 points as clinically significant.
- EQ-5D-5L VAS: EuroQol Group index of health status (score 0-100; higher is better).
- GAD-7: Generalized Anxiety Disorder 7-item assesses symptoms of general anxiety on 7 items using 4-point scale from “never” to “nearly every day” plus one perceived impairment rating; score ≥10 highly suggestive of problem with anxiety, so reduction of 5 points suggests clinically meaningful improvement (4 points for postpartum depression).
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- SCID: Structured Clinical Interview for *DSM* provides clinicians with a step-by-step diagnostic process, with questions corresponding to *DSM* criteria. In Dennis 2020, patients were diagnosed as clinically depressed according to SCID for DSM-IV.
- STAI: State-Trait Anxiety Inventory measures anxiety on 40 items using 4-point scale from “almost never/not at all” to “almost always/very much so,” with scores ranging from 20 to 80. Although cutoff values vary depending on population and age, generally moderate anxiety scores range from 38 to 44 and high anxiety scores are ≥45.

Observational Studies

Author (year) Trial name	Study characteristics	Interventions and duration or time period	Study population	Baseline population characteristics	Main results
Mental health					
Posmontier (2016)[30]	N = 61 (61) Study design: Prospective cohort Setting: US Multicenter Funding: Government ROB: High	Treatment (G1) N = 41 (41) Interpersonal psychotherapy administered by certified nurse midwives by phone Usual care (G2) N = 20 (20) Referral to various mental health professionals Treatment duration: ≤8 sessions over ≤12 weeks Follow-up: 12 weeks after enrollment	Inclusion: age ≥16, 6 weeks to 6 months postpartum, EPDS score >9, met criteria for major depression on MINI, telephone access Exclusion: mother with severe cognitive deficits, current alcohol or substance abuse, active suicidality, homicidality, or psychosis, or serious medical illness; infant with major medical complication or birth defect, or given up for adoption	Age, mean: 29.4 years White: 52% Black: 28% Other: 7% Hispanic: 13.1% Annual income: 41.0% <$50 000 Depression during pregnancy: 13.1% Bipolar I disorder: 3.3% Current antidepressants: 29.5% HAM-D: 14.51 EPDS: 16.57	G1 vs G2 **Mental health** Depression at 12 weeks: HAM-D: 7.49 vs 12.43; aMD –4.94 (**–9.36 to –0.52**); Cohen's d 0.79 (medium ES) EPDS: aMD –0.98 (–4.23 to 2.27) **Access** Sessions attended: 6.22 vs 2.85; ***p* <0.001**

Author (year) Trial name	Study characteristics	Interventions and duration or time period	Study population	Baseline population characteristics	Main results
General maternity					
Duryea (2021)[31] COVID	N = 12 607 Study design: Cohort (historical control) Setting: Urban, US Funding: Hospital ROB: Moderate	Treatment (G1) N = 6048 Synchronous phone visits (3) at gestational week 14, 34, and 37 plus in-person visits (10) May 1-October 31, 2020 Usual care (G2) N = 6559 In-person care May 1-October 31, 2019 (ACOG) Follow-up: 37 weeks' gestation	Inclusion: Women delivering infants ≥500 g Exclusion: NR	Age, mean: 27.8 years Black: 17.1% (G1 18%, G2 16.3%, *p* = .04) White: 3% Hispanic: 76.4% GDM: 7.2% Chronic HTN: 4.5% Medicaid or CHIP: 86% Self-pay or free care: 8%	G1 vs G2 %; aRR (95% CI) **Maternal outcomes** Gestational HTN: 19.0% vs 20.1%; 0.93 (**0.86-0.99**) Preeclampsia (severe): 10.7% vs 10.6%; 0.99 (0.89-1.09) **Obstetric outcomes** Proportions; aRR (95% CI) Composite outcome (placental abruption, stillbirth, NICU admission in full-term infant, umbilical cord blood pH < 7.0): 2.9% vs 3.0%; 0.96 (0.78-1.17) Preterm birth (<37 weeks): 9.8% vs 10.2%; 0.96 (0.86-1.06) Cesarean: 31.7% vs 29.9%; 1.03 (0.98-1.09) Cesarean (primary): 13.5% vs 12.0%; 1.10 (**1.01-1.21**) Postpartum hemorrhage (>1000 mL): 9.4% vs 8.8%; 1.04 (0.93-1.16) **Access** Mean (SD) Number of prenatal encounters: 9.8 (3.4) vs 9.4 (3.8); ***p* < .001**

Author (year) Trial name	Study characteristics	Interventions and duration or time period	Study population	Baseline population characteristics	Main results
Futterman (2020)[32] COVID	N = 104 Study design: Cross-sectional survey (phone) Setting: Urban, US Funding: NR ROB: Low	Treatment (G1) N = 104 At least one virtual visit between March 1 and May 1, 2020 Usual care (G2) In-person care between March 1 and May 1, 2020	Inclusion: Patients receiving both virtual and in-person care at safety-net hospital Exclusion: NR	Age, mean: 31.2 years Not specified: 76% Black: 13% White: 9% Hispanic: 74% High risk: 28% GDM: 12.5% Poor obstetric history: 4.8%	G1 vs G2 SAPS scores by variable, telehealth vs in-person visit, median (IQR) z-score, *P* value **Satisfaction outcomes** Overall: 20 (20-25) vs 24 (22-26), ***p* = .008** African American: 22 (21.75-25.25) vs 25 (20.75-27); *p* = .368 White: 21.5 (16.75-25.5) vs 25.5 (21.75-26.25); *p* = .174 Other: 23 (20-25) vs 22 (22-26); ***p* = .033** English language: 22 (20.25-26) vs 25 (22-27); ***p* = .042** Other language (primarily Spanish): 23 (20-25) vs 23 (21.5-25); *p* = .101 Hispanic: 23 (20-25) vs 23 (21.5-25.5); *p* = .082 Non-Hispanic: 22 (21-25) vs 25.5 (22-27); ***p* = .019** High risk: 22 (20-24.5) vs 22 (21-25); *p* = .389 Low risk: 23 (20.25-25) vs 24 (22-27); ***p* = .009** SAPS scores in telehealth visit only by variable; median (IQR); *P* value % non-white vs white: 21.5 (16.75-.5) vs 22 (20-25); *p* = .459 High risk vs low risk: 22 (20-24.5) vs 23 (20.25-25); *p* = .109

Author (year) Trial name	Study characteristics	Interventions and duration or time period	Study population	Baseline population characteristics	Main results
Holcomb (2020)[33] COVID	N = 283 Study design: Cross-sectional survey (phone) with pre-post element Setting: Urban, US Funding: NR ROB: Moderate	Treatment (G1) N = 283 Telephone survey of patients who received phone visits (3-4) and in-person visits (9-10) between March 17 and May 31, 2020 Usual care (G2) ACOG usual care (in-person)	Inclusion: Pregnant women with at least 1 prenatal virtual visit from March 17-May 31, 2020 Exclusion: NR	Age, mean: NR Race/ethnicity: NR	G1 vs G2 %; *P* value for difference **Access** Visits completed as scheduled, telehealth vs in-person: 88% vs 82%; ***p* < .001**
Jakubowski (2021)[34] COVID	N = 618 Study design: Cross-sectional survey (social media) Setting: Online, Poland Funding: University ROB: High	Treatment (G1) N = 293 At least one virtual and one in-person visit Usual care (G2) N = 325 In-person visits	Inclusion: Women aged 18-40 who were pregnant and/or gave birth in Poland during the COVID pandemic; answered all mandatory questions Exclusion: Not meeting inclusion criteria	Age: NR Race/ethnicity: NR Population in state of residence >500 000: 32% 100 000-500 000: 40% <100 000: 28%	G1 vs G2 %; *P* value for difference **Maternal outcomes** Diagnosed GDM: 18.8% vs 13.5%; *p* = .077 **Access** Had difficulties accessing medical care because of pandemic: 83.3% vs 64%; ***p* < .001** Access to double marker test: 64.5% vs 54.8%; ***p* = .028** Ultrasound screening, 28-32 weeks: 73.4% vs 63.1%; ***p* = .006** Completely implemented standard of care (n = 253 vs 297): 49.8% vs 51.2%; *p* = .748

Author (year) Trial name	Study characteristics	Interventions and duration or time period	Study population	Baseline population characteristics	Main results
Jeganathan (2020)[35] COVID	N = 91 Study design: Cross-sectional survey (email); cohort (historical control) Setting: Urban/suburban system, US Funding: Local health system ROB: Moderate	Treatment (G1) N = 5116 visits Video or audio sessions every 1-3 weeks as replacement, plus with in-person visits, BP cuffs March 1, 2020-May 30, 2020 Usual care (G2) N = 5698 visits In-person visits March 1-May 30, 2019	Inclusion: High-risk obstetrical patients with telehealth visit (2-way audio or audiovisual) Exclusion: NR	Aged <24: 2% Aged 25-29: 14% Aged 30-34: 31.9% Aged 35-39: 39% Aged ≥40: 13% White: 45% Asian: 23% Hispanic: 19% Black: 12% Native Hawaiian or Pacific Islander: 1% Other: 4% Medicaid: 22% No insurance: 1%	G1 vs G2 %; *P* value for difference **Utilization** No-show appointments: 4.61% vs 8.49%; ***p* < .001** Patient-cancelled appointments: 4.96% vs 7.06%; ***p* < .001** Patient same-day cancellations: 1.35% vs 2.30%; ***p* < .001**
Lapadula (2021)[36] COVID	N = 47 Study design: Cross-sectional survey (written, at time of visit) Setting: Urban, US Funding: NR ROB: Moderate	Treatment (G1) N = 35 Video consult with neonatologist in private room at hospital May 1-November 15, 2020 Usual care (G2) N = 12 In-person consult with neonatologist May 1-November 15, 2020	Inclusion: Pregnant women diagnosed with fetal anomalies with consults at local hospital Exclusion: NR	Aged <20: 2% Aged 20-39: 89% Aged >40: 2% No answer: 6% Race/ethnicity: NR Spanish language consults: 17%	G1 vs G2 %; *P* value for difference **Satisfaction outcomes** Overall consult quality good or excellent: 100% vs 100%; *p* = NR Composite consult quality score (of 30), mean (SD): 28.71 (2.22) vs 28.92 (1.78); *p* = .75 Overall consult quality score (of 5), mean (SD): 4.83 (0.38) vs 4.83 (0.40); *p* = .97 Easy to speak with doctor: 97% vs 100%; *p* = .55 Doctor was polite and caring: 100% vs 92%; *p* = .09

Author (year) Trial name	Study characteristics	Interventions and duration or time period	Study population	Baseline population characteristics	Main results
Palmer (2021)[37] COVID	N = 22 323 Study design: Interrupted time-series Setting: Urban, Australia Funding: None ROB: Low	Treatment (G1) N = 2292 Video or phone visits (5-6) and in-person visits (3-5), BP cuffs, fetal growth charts April 20-July 26, 2020 Usual care (G2) N = 20 031 In-person visits January 1, 2018, to March 22, 2020	Inclusion: Births ≥20 weeks' gestation or with birthweight ≥400 grams if gestation uncertain in midwifery- or shared (low risk) or obstetric specialist-led (high-risk) care models Exclusion: NR	Age, mean: 31.3 years Race/ethnicity: NR	G1 vs G2 Proportion; *P* value for difference **Maternal outcomes** Preeclampsia, low risk: 3% vs 3%; $p = .70$ Preeclampsia, high risk: 9% vs 7%; $p = .15$ GDM, low risk: 22% vs 22%; $p = .89$ GDM, high risk: 30% vs 26%; $p = .06$ **Obstetric outcomes** Preterm birth, low risk: 6% vs 4%; $p = .10$ Preterm birth, high risk: 27% vs 29%; $p = .34$ **Access** Visits not attended: 8% vs 5%; $\mathbf{p < .001}$
Peahl (2021)[38] COVID	N = 253 Study design: Cross-sectional survey (online; historical control) Setting: Suburban, US Funding: Government; nonprofit ROB: Low	Treatment (G1) N = 253 Three months after March 20, 2020, TH protocol implementation of video or phone visits (4) and in-person visits (5), BP cuffs, fetal Dopplers Usual care (G2) EHR query of in-person visits 3 months before March 20, 2020	Inclusion: Pregnant women >20 weeks' gestation registered for EHR portal with prenatal visits December 16, 2019 to June 28, 2020 Exclusion: NR	Age, mean: 31.2 years White: 71% Black: 6% Asian: 4% American Indian/Alaska Native: 1% 2 or more: 3% Hispanic: 2% Did not respond/say: 14% High-risk: 11.9% Medicaid: 10.7% No insurance: 0.8% Hypertensive disorder of pregnancy: 9.9% GDM: 8.0% Preterm birth: 3.6%	G1 vs G2 **Access** Total prenatal visits in sample week (pre vs post): 1051 vs 719 (31.6% decrease) During this time, virtual visits also increased from 101 to 239 (136.6%)

Author (year) Trial name	Study characteristics	Interventions and duration or time period	Study population	Baseline population characteristics	Main results
Pflugeisen (2016)[39]	N = 1058 (1058) Study design: Quality improvement cohort Setting: US # sites unclear Funding: NR ROB: High	Treatment (G1) N = 117 (117) 5 video visits with obstetric ARNP, using home Doppler and BP cuff, plus 9 in-person physician visits and a 2-week postpartum video visit Usual care (G2) N = 941 (941) ACOG-endorsed 14 in-person physician visits and 1 postpartum visit Follow-up: 2 weeks postpartum	Inclusion: G1 identified from electronic medical records as having enrolled in virtual visit program and given birth within the health system; G2 patients had enrolled in traditional care program Exclusion: NR	Age: 29.2 years White: 74% Ethnicity: NR Not WIC enrolled: 66% GDM: 16.6% Preeclampsia: 4%	G2 vs G1; OR (95% CI) except as indicated **Maternal outcomes** Gestational diabetes: 16.4% vs 17.9%; 0.99 (0.58-1.69) Preeclampsia: 3.4% vs 8.5%; 2.70 **(1.21-6.02)** **Obstetric outcomes** Preterm birth (<37 weeks): 5.8% vs 7.7%; 1.20 (0.55-2.59) Cesarean birth: 30.7% vs 27.4%; 0.71 (0.45-1.12) **Access and utilization** Routine visits (in-person or virtual): 15.6 vs 14.9 visits; *p* = .14 Urgent care or ED visits, ≥1: 10.6% vs 7.7%; 0.75 (0.37-1.55) Hospital visits, ≥2: 24.8% vs 19.7%; 0.86 (0.53-1.41)
Pflugeisen (2017)[40]	N = 171 (NR) Study design: Retrospective cohort Setting: US Single center Funding: Nonprofit ROB: Moderate	Treatment (G1) N = 75 (NR) 5 video visits with obstetric ARNP, using home Doppler and BP cuff, plus 7 to 9 in-person visits with physician or midwife Usual care (G2) N = 96 (NR) ACOG-endorsed 12 to 14 in-person visits with physician or midwife	Inclusion: G1 identified from electronic medical records as having enrolled in virtual visit program and completed ≥1 virtual visit; 2:1 pair-matched G2 patients had enrolled in traditional care program. Surveys mailed and those responding constituted the sample. Exclusion: high-risk pregnancy in both groups	Age: 31.3 years White: 77% Ethnicity: NR Household income: 65.5% ≤$100 000 Distance to obstetric clinic: 22.8% <5 miles	G1 vs G2 **Patient-reported outcomes** Overall satisfaction, from questionnaire developed by authors (score 1-5, higher better): 4.69 vs 4.46; ***p* = .006**

Author (year) Trial name	Study characteristics	Interventions and duration or time period	Study population	Baseline population characteristics	Main results
Gestational diabetes					
Carral (2015)[41]	N = 104 (104) Study design: Prospective cohort Setting: Spain Single center Funding: Other (laboratory) ROB: Moderate	Treatment (G1) N = 40 (40) Glucose control self-monitored and added to interactive website every 2 weeks, feedback via phone or email Usual care (G2) N = 64 (64) Glucose control evaluated in-person every 2-3 weeks Treatment duration: Until delivery Follow-up: Delivery and 6-12 weeks after delivery	Inclusion: age ≥18, GDM diagnosed either before pregnancy or in the current pregnancy, referred to gestational diabetes unit before week 30 of pregnancy Exclusion: NR	Age, mean: 33.8 years White: 96% North African: 2% Hispanic: 1.9% Distance to hospital: 22.9 km GDM: 74% Prior GDM: 19.2% HTN: 4.8%	G1 vs G2 **Maternal clinical outcomes** Need for insulin: 15.0% vs 32.8%; **p = .023** Pregnancy-induced HTN: 5.0% vs 4.7%; *p* = .966 **Obstetric outcomes** Preterm birth (<37 weeks): 7.5% vs 7.8%; *p* = .175 Cesarean delivery: 30.0% vs 40.6%; *p* = .164 LGA: 12.5% vs 9.4%; *p* = .660 **Access and utilization** Visits to assess glycemic control (in-person + online): 10.9 vs 9.0; *p* = .123 Hospital emergency visits: 2.3 vs 2.9; *p* = .184
Wernimont (2020)[42]	N = 117 (117) Study design: Prospective cohort Setting: US Single center Funding: Government ROB: High	Treatment (G1) N = 72 (72) Cellular-enabled glucometer (Telecare) + web-based portal + weekly feedback Usual care (G2) N = 45 (45) Standard glucometers, recording glucose values on log sheets, contacted weekly by diabetes care nurse to report values Treatment duration and follow-up: Until delivery	Inclusion: women <29 6/7 weeks' gestation and requiring insulin Exclusion: spontaneous or therapeutic abortion, lack of HbA_{1c} at delivery	Age, mean: 31.6 years Race/ethnicity: NR Household income: NR Private insurance: 47.7% GDMA2: 14.5% Chronic HTN: 19.8% Preeclampsia: 14.1%	G1 vs G2 **Maternal clinical outcomes** Delivery HbA_{1c}: 5.8 vs 6.3; **p = .03** **Obstetric outcomes** Cesarean delivery: 56% vs 42%; *p* = .182 LGA: 32% vs 25%; *p* = .411

Author (year) Trial name	Study characteristics	Interventions and duration or time period	Study population	Baseline population characteristics	Main results
Gestational Hypertension					
Lanssens (2018)[43] (companion to Lanssens 2017 and 2018)[44,45]	N = 320 (301) Study design: Retrospective cohort Setting: Belgium Single center Funding: Mixed ROB: High	Treatment (G1) N = 86 (86) Remote obstetric surveillance via a wireless BP monitor, weight scale, and activity tracker; remote follow-up performed by midwife Usual care (G2) N = 98 (98) Conventional care (regular in-person visits per local management protocols) Follow-up: Until delivery or hospital admission	Inclusion: G1 identified as women diagnosed with GHD at gestational age ≥10 weeks where an intensive follow-up until delivery was desirable Exclusion: Women at a gestational age < 10 weeks were eligible to receive only conventional care	Age, mean: 30.7 years Race/ethnicity: NR BMI, mean kg/m^2: 27.9 Cardiovascular disorders: 1.7% Smoking: 8.3%	G1 vs G2; *P* value from multivariate analysis **Maternal clinical outcomes** Preeclampsia: 19.8% vs 44.2%; **p < .01** **Obstetric outcomes** Cesarean section: Primary: 17.4% vs 21.4%; *p* = .63 Secondary: 11.6% vs 14.9%; *p* = .76 **Access and utilization** Total prenatal visits: 6.9 vs 7.6; **p < .01** Prenatal admission: 51.2% vs 71.6%; **p < .01**

Statistically significant findings in **bold**
Abbreviations: ACOG, American College of Obstetricians and Gynecologists; aMD, adjusted mean difference; aOR, adjusted odds ratio; ARNP, Advanced Registered Nurse Practitioner; aRR, adjusted relative risk; BMI, body mass index; BP, blood pressure; CaFHS, Child and Family Health Service; CBT, cognitive behavioral therapy; CI, confidence interval; CSQ-8, Client Satisfaction Questionnaire; DASS, Depression, Anxiety, and Stress Scale; ED, emergency department; EPDS, Edinburgh Postnatal Depression Scale; ES, effect size; GAD-7, Generalized Anxiety Disorder 7-item; GDM, gestational diabetes; GDMA2, GDM requiring hypoglycemic agents; GHD, gestational hypertensive disorder; HbA_{1c}, hemoglobin A1C; HTN, hypertension; IBCLCs, International Board Certified Lactation Consultants; IMD, Index of Multiple Deprivation; IRR, incidence risk ratio; km, kilometer; MADRS-S: Montgomery-Åsberg Depression Rating Scale-Self Report; MAMA-DASH, Modified-Dietary Approach to Stop Hypertension; MD, mean difference; MINI, Mini-International Neuropsychiatric Interview; MOMFIT, Maternal Offspring Metabolics Family Intervention Trial; NA, not applicable; NHS, National Health Services; NICU, neonatal intensive care unit; NR, not reported; OMDTSQ, Oxford Maternity Diabetes Treatment Satisfaction Questionnaire; PHQ-9, Patient Health Questionnaire-9; PP, postpartum; PSOC, Parenting Sense of Competence Scale; ROB, risk of bias; RDN, registered dietician nutritionist; SAEs, serious adverse events; SCID, Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders; SD, standard deviation; SMS, short message service; STAI, State-Trait Anxiety Inventory; US, United States; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children.
Population density only abstracted when clearly specified.

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- GAD-7: Generalized Anxiety Disorder 7-item assesses symptoms of general anxiety on 7 items using 4-point scale from "never" to "nearly every day" plus one perceived impairment rating; score ≥10 highly suggestive of problem with anxiety, so reduction of 5 points suggests clinically meaningful improvement (4 points for postpartum depression).
- HAM-D: Hamilton Rating Scale for Depression measures depression symptoms over the past week on 17 items. Severity ranges from no depression or clinical remission (0-7), mild to moderate (8-14), moderate to severe (19-22), and severe (>23).
- MADRS-S: Montgomery-Åsberg Depression Rating Scale-Self Report measures depression on 9 items, with scores ranging from 0 to 54. Severity ranges from mild (13-19 points) and moderate (20-34) to severe (35-54). Remission indicated by post-intervention scores <13; positive response indicated by reduction of 8 points; deterioration indicated by increase of 4 points.
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- STAI: State-Trait Anxiety Inventory measures anxiety on 40 items using 4-point scale from "almost never/not at all" to "almost always/very much so," with scores ranging from 20 to 80. Although cutoff values vary depending on population and age, generally moderate anxiety scores range from 38 to 44 and high anxiety scores are ≥45.
- What Being the Parent of a New Baby is Like: Assesses parenting satisfaction on 11 items, with scores on each item ranging from 0 to 9. Higher scores indicate higher parental satisfaction.

References

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