



Telemedicine and Digital Health Solutions in Intrapartum and Postpartum Care

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Abstract

Purpose of Review Telemedicine and digital health platforms are now integral to the way patients and clinicians interact with the health system. Application of these technologies in the antepartum context is well studied and accepted. The purpose of this review is to outline the state of telemedicine and digital health solutions in the intrapartum and postpartum period, understanding applications for labor and the months following delivery.

Recent Findings Telemedicine can be used in the intrapartum period to assist with staffing shortages, remote assessment of intrapartum fetal heart tracings, and doula support. Application in the postpartum period includes but is not limited to remote blood pressure monitoring, lactation support, mental health screening and treatment, and substance use disorder.

Summary Both telemedicine and digital health solutions aim to augment, not replace, care relationship during pregnancy, delivery, and postpartum. Whether these tools advance intrapartum and postpartum care remains subject to the same contingencies present in other specialties and care contexts. Ongoing investment into the application and evaluation of telemedicine and digital health solutions throughout pregnancy should be prioritized.

Keywords Telemedicine · Telehealth · Digital health · Mobile apps · Innovation

Introduction

Once novel technologies in the care delivery space, telemedicine and digital health platforms are now integral to the way patients and clinicians interact with the health system. The COVID-19 pandemic spawned—out of necessity—a rapid and widespread adoption of these technologies across specialties and care contexts. In one assessment comparing ambulatory encounters in a large commercially insured cohort, telehealth visits went from accounting for less than 0.5% of billable interactions in 2019 to 24% in 2020 [1]. That trend persisted, even as the pandemic waned: 87% of physicians reported using telemedicine to deliver

care in 2021, compared with less than 20% in 2019 [2•]. Compared with the traditional in-person care model, there are many theoretical advantages to delivering pregnancy care remotely for patients and clinicians alike in the way of expanded care access, increased patient satisfaction, lower care costs, and enhanced personal health data collection [3••]. Still, these advantages are only virtuous insofar as care quality and health equity are upheld or bolstered in the process [4••].

There is a significant literature to date examining the application of these technologies to the care of pregnant patients, with an emphasis on the antepartum context [5, 6, 7•, 8•]. This focus on the prenatal period is sensible for clinicians, researchers, and commercial stakeholders, both because it encompasses the longest portion of the pregnancy episode and contains the most individual care interactions with the patient. This should not, however, undermine the importance of applying and evaluating telemedicine and digital health platforms for labor and delivery, and for maternal health in the months that follow. Here, we review the state of telemedicine and digital health solutions applied to the intrapartum and postpartum period.

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Intrapartum Care

While contemporary applications of telemedicine often occur in the outpatient space, it is important to recall that several specialties tested and adopted *inpatient* telemedicine long before the recent wave of pandemic-spurred digital health technology. Telemedicine for acute stroke management—referred to more commonly as “tele-stroke”—emerged a quarter century ago, with remote neurologists evaluating patients experiencing acute strokes and guiding time-sensitive management decisions, such as whether to administer thrombolytic therapy. Implementation of these programs has been associated with improvements in several care quality and outcome indicators [9]. Likewise, intensive care units (ICUs) have long adopted telemedicine models to ease intensivist staffing constraints. Though research prior to the pandemic on the value of these models produced mixed results [10], teleICU became instrumental in supporting hospitals with a limited intensivist presence during the COVID 19 pandemic [11].

To date, the literature is sparse when it comes to implementation of telemedicine programs for inpatient obstetrics, and as a result little is known about the potential for telemedicine to impact maternal morbidity and mortality in units with limited in-person staffing for routine obstetric care (to say nothing of maternal-fetal medicine and critical care obstetrics). This is of particular concern against the backdrop of widespread obstetric service closures and rural staffing challenges, giving rise to maternity care deserts [12•]. While more than half of births in the US take place at high-volume obstetric hospitals (i.e., those with 2,000 deliveries or more per year), more than a third of all units are classified as low volume (i.e., those with 10–500 births per year). Among low volume units, only a quarter are within 30 miles of a high-volume obstetric hospital [13], a practical barrier to the timely transfer of acute patients requiring a higher level of care. Recently, the Mayo Clinic published a report on the provision of telemedicine obstetric hospitalist services to 17 low-resource hospitals across two states. The “TeleOB” program is staffed by obstetric hospitalists physically located in a tertiary medical center and uses on-demand high-definition audio and video to support clinicians at the remote site. 25 site activations have been completed to date: 17 deliveries, two postpartum consultations, and four antepartum consultations. 80% of these activations occurred at sites without maternity services and in most of the deliveries, tele-neonatology was jointly activated to guide resuscitation efforts [14••]. Recently, others in the literature have reported on the use of a digital platform for the remote assessment of intrapartum fetal heart tracings across multiple labor units, though a formal, published assessment of outcomes

is still forthcoming [15]. In England, one small qualitative study of home inductions of labor suggests remote intrapartum fetal monitoring is acceptable and may be preferable for those laboring, though again, assessment of outcomes remains limited [16]. Significant strides are being made in the application of remote fetal monitoring [17••, 18•] and patient-operated ultrasound [19•, 20] to antepartum surveillance; these technologies may extend to intrapartum care in the future, but at least for now falls outside the scope of this review. The need for more implementation and health services research into this underexplored area of intrapartum care cannot be overstated.

Birthing patients have benefited from other digital technologies aimed at empowerment in the intrapartum period. Doula care, until recently an in-person-only service, is now offered in many parts of the country as a virtual service across pregnancy, including the intrapartum period [21••]. One study examining the impact of virtual doula services demonstrated lower rates of cesarean section and higher rates of personal satisfaction with the labor process among patients using a virtual doula platform. In a sub-analysis of users who identify as Black, platform use was associated with a significantly higher rate of vaginal birth after cesarean (VBAC) [22••]. Beyond direct care delivery, several studies have evaluated the impact of smartphone app-enabled educational tools on patient-centered and clinical outcomes [23•, 24]. Cai and colleagues recently published a randomized controlled trial evaluating the impact of a labor-focused podcast series on pregnant patients in the third trimester. Those randomized to the podcast intervention were more likely to report higher levels of personal satisfaction following labor; among the subgroup of patients who underwent induction of labor, labor agency scores were significantly higher in the podcast group [23•]. Though not yet the subject of peer-reviewed research, digital patient review platforms for birthing units and clinicians are becoming important tools for patient empowerment. Irth, for example, is a review and rating platform for patients who identify as Black or brown to publish their care experiences. The platform aims to support birthing people and new parents in care selection and to provide health systems with candid feedback to promote anti-racist care practices.

Postpartum Care

Historically, postpartum health has received an unacceptable lack of attention from society, including the medical community. To quote Dr. Kristin Tully and Dr. Allison Stuebe, “It is as though the baby is the candy, and the mother is the wrapper. After the candy is out, the wrapper is cast aside” [25•]. This is no less evident in the focus of smartphone application

developers, at least in the published literature prior to the pandemic. In a systematic review of mobile health applications for postnatal care published at the start of 2019, researchers counted 48 postnatal applications available for download on the iOS and Android repositories. As might be suggested by the word “postnatal”, the authors analyses show that while all 48 apps contained content on care for the neonate, most overlooked content on care for the parent [26]. Since that time, maternal health in the postpartum period has garnered increasing attention from researchers, policy makers [27], and commercial interests, particularly as epidemiologic data have demonstrated that most maternal mortality occurs long after delivery [28•]. Telemedicine and digital health platforms are necessary components in a multifaceted approach to stem avoidable maternal harm and eliminate racial disparities therein. If implemented thoughtfully, they have the capacity to expand care access to those that are, concomitantly, the most in need of care and the most at risk for adverse outcomes in the postpartum period [4••].

The shift to telemedicine through the pandemic produced a natural experiment in care access across specialties. Postpartum visits—erstwhile singular, poorly attended, in-person-only office visits six weeks after delivery—were suddenly occurring through telemedicine or video chat platforms. The postpartum period, more so than its prenatal counterpart, introduces barriers to accessing legacy in-person care for reasons that are self-evident; one might hypothesize, then, enhanced access to care following the shift to postpartum telemedicine. In one retrospective study conducted during the pandemic, researchers found that the availability of a telemedicine option was associated with higher rates of postpartum visit attendance and postpartum depression screening [29•]. This same period, however, was also associated with lower rates of uptake for long-acting reversible contraception (LARC) and permanent sterilization—more likely a consequence of the pandemic rather than the advent of telemedicine. Furthermore, Kumar and colleagues demonstrated a significant decrease in racial disparities in postpartum visit attendance following telehealth implementation, as well as in postpartum depression screening [30•]. While far from conclusive, this suggests a role for telemedicine as a lever to increase postpartum care access, particularly for those likely to face outside barriers to care from the start.

The surveillance and treatment of postpartum hypertension is perhaps the best studied example of condition-specific telemedicine implementation in the postpartum period. Post-delivery remote blood pressure monitoring programs use a smartphone application or text message-based platform to prompt patients to obtain and submit blood pressures at defined intervals during the postpartum period. When a blood pressure reading is flagged as abnormal, the program routes it to a clinician for review

and further management. The value of these programs in patients with postpartum hypertension includes increased ascertainment of blood pressure readings compared to controls and a significantly lower risk of adverse maternal outcomes in the first six months following delivery among those enrolled [31, 32, 33••]. Likewise, remote blood pressure monitoring programs enable large scale data collection, with enough heft to support instrumental analyses of blood pressures trajectories following delivery and to identify racial disparities in hypertension management across the postpartum period [34•, 35]. Similarly, blood glucose monitoring in patients with gestational or pregestational diabetes has long been the subject of research on digital health interventions to improve maternal and perinatal outcomes. Most of the recent literature focuses on *antepartum* glucose management with continuous glucose monitoring (CGM) devices [36•, 37, 38]. This falls outside the scope of the current manuscript and, we argue, deserves a dedicated review of its own.

Other emerging telemedicine and smartphone applications target specific aspects of routine postpartum care. Lactation support represents one example, with mixed results in the literature to date. A randomized trial among approximately 200 patients planning to feed by lactation examined the effects of a smartphone-based platform on rates of lactation over time. Users of the platform, which provided daily feedback and counseling from a multidisciplinary lactation team, showed higher rates of lactation at six and twelve weeks compared to controls [39••]. In a separate trial powered to detect differences in breastfeeding initiation, 170 low-income, primiparous patients were randomized to a curated smartphone app containing on-demand education and videos compared to a control application with digital breastfeeding handouts. Neither intervention improved breastfeeding rates above known baseline rates, with no differences between groups [40]. A secondary analysis assessed rates of breastfeeding initiation in each group stratified by app usage; however, increased usage was not associated with higher rates of breastfeeding in either group [41].

The treatment of maternal mental health and substance use disorder (OUD) warrants considerable national attention, particularly considering each condition’s alarming contribution to the preventable pregnancy-related death rate [42, 43•]. Recent data surrounding the detection and management of postpartum depression through telemedicine and digital health solutions offer some encouragement. A 2020 systematic review and meta-analysis included 11 studies focused on a mobile health intervention for the prevention and treatment of postpartum depression. Subgroup analyses were planned for telephone-based and smartphone application-based interventions, as well as for those focused on prevention versus those focused on treatment. Overall, the meta-analysis suggests that telephone and smartphone application-based interventions were each

associated with a statistically significant improvement in the prevention and treatment of postpartum depression, with no significant heterogeneity among studies and no significant difference in the result after sensitivity analyses [44]. More recently, a large randomized controlled trial was conducted in Japan to assess the impact of internet-delivered cognitive behavioral therapy (iCBT) for the prevention of postpartum depression. Over 5,000 pregnant individuals were randomized in the midtrimester to either iCBT or general health information and assessed for major depression at 32 weeks and 3 months postpartum. There was no difference in rates of perinatal or postpartum depression between groups, though rates of depression were lower than predicted (<3%, whereas a 5% rate was predicted) in both groups, which suggests the study may have been underpowered to detect a difference [45•]. This (i.e., study size) reflects one of several ongoing issues in the evaluation of telemedicine and perinatal mental health, in addition to concerns surrounding patient acceptability of remote management and how to account appropriately for comorbid trauma and substance use in patients with perinatal mood disorders [46].

Though the academic community has issued calls for increased access to SUD services through telemedicine platforms [47••], the literature on the subject remains limited. A descriptive report from Patton and colleagues documents their experience in a perinatal medical home model during the pandemic, offering hybrid in person and telemedicine prenatal care and OUD treatment. Appointment attendance rates were noted to be higher under the hybrid model than they were prior to the pandemic and though not quantified, clinicians in the program noted that many patients preferred virtual visits, citing various deterrents associated with in-person appointments [48]. Limited quantitative data are offered through this account, however, and it is difficult to discern the model's impact on the prenatal versus postpartum period. A 2020 trial from Guille and colleagues compared the standard in-person care delivery model for OUD in pregnancy and the postpartum period with a new virtual treatment model integrated into obstetric practices. There was no significant difference in postpartum treatment retention or neonatal abstinence syndrome between groups [49]. These limited data support a virtual option for SUD management in pregnancy and the postpartum period as a safe means of extending access to care without a decrement to care quality. Further research is needed to rigorously assess hybrid and telemedicine models against legacy in-person models of care.

Conclusion

At their core, both telemedicine and digital health solutions aim to augment, not replace, care relationships—between care providers and patients, clinicians and their colleagues,

patients and their peers. Even as research continues to parse interventions that serve patients from those that do not, whether these tools advance intrapartum and postpartum care remains subject to the same contingencies present in other specialties and care contexts. These span from legal and regulatory hurdles to billing and reimbursement policies, from large scale patient health data stewardship to interoperability challenges with legacy systems, and from end-user troubleshooting to ongoing concerns surrounding health disparities [50•]. Overcoming these barriers relies, first and foremost, on the iterative and rigorous process of testing these technologies and their implementation in appropriate populations. Ongoing investment into the application and evaluation of telemedicine and digital health solutions throughout pregnancy should be prioritized.

Author Contributions AH and JS made substantial contributions to the conception or design of the work; drafted the work and revised it critically for important intellectual content, approved the version to be published; and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Data Availability No datasets were generated or analysed during the current study.

Compliance with Ethical Standards

Conflict of Interests The authors have no relevant financial or non-financial interests to disclose.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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