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# The impact of coronavirus on reproduction: contraceptive access, pregnancy rates, pregnancy delay, and the role of vaccination

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It is important to closely examine trends in reproduction during a pandemic because it provides not only the foundation for an improved future response but also crucial insights regarding the disparate impact across different races and socioeconomic classes. The coronavirus disease 2019 pandemic is a prime example of the impact a pandemic can have on a nation's reproductive health. Contraception and abortion access became more difficult with more barriers to access, likely contributing to increasing unintended pregnancy rates. Underrepresented minorities and vulnerable populations were disproportionately affected by the virus on their reproductive health as well as by the virus itself. As the first ever messenger ribonucleic acid vaccine in conjunction with the lack of inclusion of pregnant and peripartum women in initial studies and conflicting and misinformation on social media, the initial role of the coronavirus disease 2019 vaccine in women of reproductive age was unclear. Further research inclusive of this group of women has led to the consensus by major medical societies to recommend vaccination of women regardless of pregnancy or lactating status.

Examining these topics in depth will lead to the development of strategies that can be employed to mitigate the negative effects on reproductive health during the current pandemic and can also be applied to future strategic plans to prevent similar negative outcomes. (Fertil Steril Rev® 2022;3:190–200. ©2022 by American Society for Reproductive Medicine.)

**Key Words:** Racial disparities, COVID-19, vaccination, pregnancy, reproduction

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## ESSENTIAL POINTS

- Pandemics, including the most recent coronavirus disease 2019, can wreak havoc on reproductive health with limited access to care, increasing unintended and undesired pregnancy rates, all while disproportionately affecting minorities and lower socioeconomic families.
- The coronavirus 2019 vaccination and booster shot are recommended in pregnant, peripartum, and breastfeeding women owing to the increased risk of severe illness.
- We propose 4 strategies to improve the response to the pandemic, which include increase access and reimbursements for telehealth visits and medical abortions with no-touch policy programs, encouraging vaccinations in pregnant women with updated and clear language while addressing vaccine hesitancy and myths.

**T**he impact of coronavirus disease 2019 (COVID-19) on reproduction is complex and multifaceted. It is important to closely examine trends in reproduction during

a pandemic because it provides not only the foundation for an improved future response but also crucial insights regarding the disparate impact across different races and socioeconomic clas-

ses. Pandemics can worsen economic conditions, ultimately reducing birth rates on a population level (1). However, women of color and women in more vulnerable groups are more likely to experience adverse effects during times of economic instability (1). Our goal was to examine the effects of the pandemic on reproductive health, specifically in regard to access to contraception, impact on pregnancy rates, trends in delaying pregnancy,

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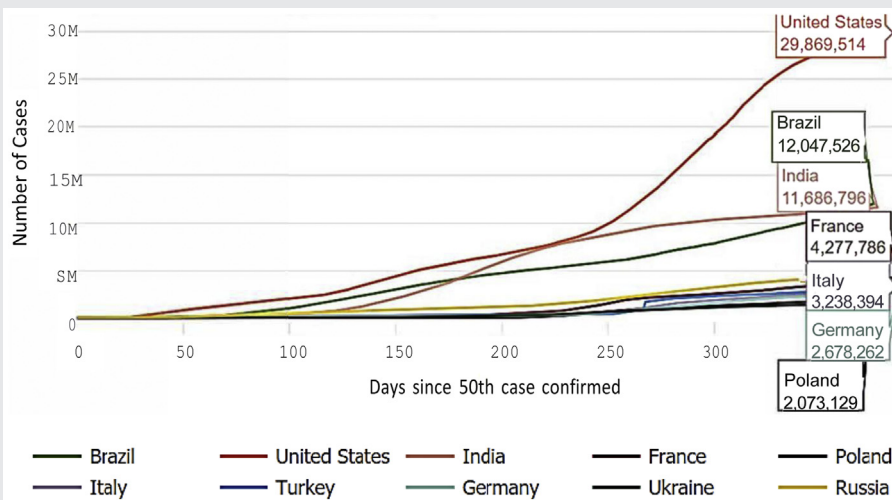
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FIGURE 1



Cumulative cases by days since the 50th confirmed case. For the 20 countries with the highest absolute daily number of deaths, the lines show the cumulative number of cases or deaths reported in that country at each date in time. (From Sully et al. [69]. Reprinted by permission of the publisher.)

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and the role of vaccination. Examining these topics will lead to the development of strategies that can be employed to mitigate the negative effects on reproductive health during the current pandemic and can also be applied to future strategic plans to prevent similar negative outcomes. The secondary aim was to identify the causes of disparities and impact among vulnerable populations to provide a more targeted and effective approach specific to these populations.

To understand the impact of COVID-19 on reproductive health, it is important to first understand the impact of the virus on the overall health of a population. Unfortunately, the virus has had a drastic and disproportionate effect on the US population compared with that on other countries. In March 2021, a year after the World Health Organization declared COVID-19 a pandemic, the United States reached 29,869,514 cases (Fig. 1) and 542,949 deaths (2, 3). As of September 2021, the United States has soared to 39,894,239 cases with 647,361 deaths (4). The United States is comprised of 5% of the world population but continues to account for 18%–20% of the COVID-19 cases worldwide. Control of the virus was initially hindered by a limited centralized response followed by earlier and preemptive reopening of the economy before full virus containment (4, 5). This is a tragic illustration of the crippling effect politicizing public health policies can have on a country, ultimately resulting in an increase in preventable illness and death. Unfortunately, this has culminated in the United States carrying the largest burden of COVID-19-related morbidity and mortality in the world. However, the true extent of damage is not only reflected by the current death toll but will also continue to be palpable in the ensuing months as the state-specific responses to the pandemic continues to limit a single, unified national pandemic response through vaccination and other mitigation strategies.

Coronavirus disease 2019 has disproportionately affected underrepresented minorities and vulnerable populations;

therefore, the effects of the virus on reproductive health are expected to be exacerbated in these communities. The COVID-19 infection rates, hospitalizations, and death are disproportionately higher among Black, Hispanic, American Indian, Alaskan Natives, and Pacific Islanders (5). Individuals in high-risk populations are more likely to work in “essential” high-risk jobs that put them at increased risk of contracting the virus (6). These groups are less likely to have access to personal protective equipment, such as masks, gloves, and hand sanitizers. They are more likely to reside in multigenerational households, therefore limiting their ability to safely quarantine at home without infecting multiple household members (6). In addition, they often have decreased access to testing and essential health services. Experience from past pandemics has proven that the lack of access to essential health services has resulted in more deaths than the epidemic/pandemic disease itself (7). Therefore, decreased access to essential health care further compounds the already heightened risk in these populations.

## CONTRACEPTION ACCESS

Limiting contraception access results in devastating maternal and neonatal morbidity and mortality by increasing the incidence of undesired pregnancy (8–11). Undesired pregnancy is associated with an increase in unsafe abortions, miscarriages, pregnancy complications, transmission of human immunodeficiency virus and other sexually transmitted infections, as well as increased incidence of posttraumatic stress disorder, depression, suicide, and intimate partner violence (8, 11–12). Historically, disruption in contraception access has disproportionately affected developing countries and marginalized groups in the United States, further broadening national and international gaps in health care. Data from the Ebola virus outbreak in Western Africa show

**TABLE 1**

**Potential annual impacts of a 10%<sup>a</sup> proportional decline in the use of sexual and reproductive healthcare services resulting from COVID-19-related disruptions in 132 low- and middle- income countries. (From Sully et al. [69]. Reprinted by permission of the publisher.)**

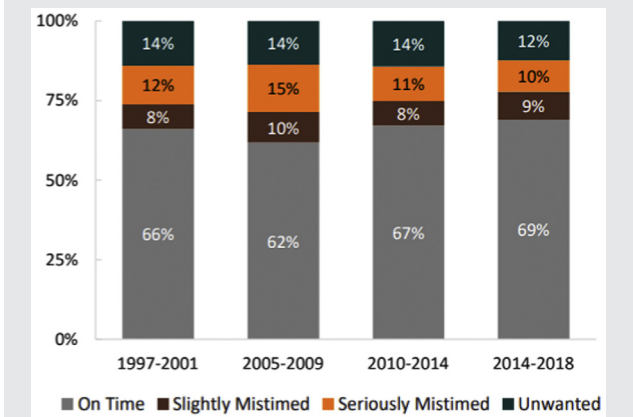
Disruption in essential sexual and reproductive healthcare	Impact
10% decline in the use of short- and long-acting reversible contraceptives	48,558,000 additional women with an unmet need for modern contraceptives 15,401,000 additional unintended pregnancies
10% decline in service coverage of essential pregnancy-related and newborn care <sup>a</sup>	1,745,000 additional women experiencing major obstetric complications without care 28,000 additional maternal deaths 2,591,000 additional newborns experiencing major complications without care 168,000 additional newborn deaths
10% shift in abortions from safe to unsafe <sup>b</sup>	3,325,000 additional unsafe abortions 1,000 additional maternal deaths

Note: Service changes are presumed to be the average change over a year, and impacts are on an annual basis.  
<sup>a</sup> The 10% reduction in service coverage encompasses changes in access for some interventions (e.g., delivery in a facility) and changes in the content or quality of care for others (e.g., provision of magnesium sulfate for eclampsia treatment).  
<sup>b</sup> Unsafe abortions are those performed by persons lacking the necessary skills or in an environment that does not conform to minimal medical standards or both.  
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service disruption in maternal and newborn care contributed to an estimated 3,600 maternal deaths, neonatal deaths, and stillbirths. This is nearly equal to the number of deaths caused by the Ebola virus itself (11). Research conducted by the United Nations projects that more than 47 million women may lose access to contraception, leading to 7 million unintended pregnancies because of COVID-19 (12).

Barriers to obtaining contraceptives during the COVID-19 pandemic include quarantine and travel restrictions, supply chain shortages of condoms and progesterone-containing contraceptives, fewer appointments because of reduced provider and staff availability, and closures of abortion clinics across the country. A survey study examining access during the pandemic (n = 554) found that 17% of respondents reported that access to contraceptives had become more difficult during the pandemic (13). Of the 17%, 9% reported that it was more difficult to get to a pharmacy, 4% reported that it was more difficult to afford contraceptives, 3% reported that it was more difficult to get a prescription, 2% reported that it was more difficult to have long-acting reversible contraceptives (LARCs) placed, and 1% reported that it was more difficult to have LARCs removed (13). On closer examination, those that reported difficulty obtaining contraception were more likely to have decreased income resulting in the inability to afford food, transportation, and/or housing. This underscores the disproportionate impact of decreased contraceptive access in

**FIGURE 2**



Trends in birth intendedness, 1997–2018. Source: 1997–2001, 2005–2009, 2010–2014, National Survey of Family Growth (NSFG) (Guzzo, 2017); 2014–2018, National Center for Family & Marriage Research analyses of pregnancy data files from NSFG cycles 2015–2017 and 2017–2019.  
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lower socioeconomic groups. Although this study showed that 17% of respondents reported limited access, a modeling study by the Guttmacher Institute predicted that even a 10% proportional deterioration in consumption of several short-acting contraceptives and LARCs by women would result in 48,558,000 more women developing an unmet need for modern contraceptives. This translates to an additional 15,401,000 unintended pregnancies, 3,325,000 unsafe abortions, and 1,000 maternal deaths in 1 year (Table 1) (2, 14, 15).

Access to abortion during the COVID-19 pandemic has been specifically tumultuous in the United States. Despite statements in support of continued abortion care by the American College of Obstetricians and Gynecologists (ACOG) and American Medical Association, 13 states halted abortion services by deeming abortions as “nonessential” or “elective” procedures during the COVID-19 crisis (15). With fewer providers available, patients, especially those seeking later abortions, are required to travel further for care, which is a limiting or deterring factor for several women. The disparity in effect is evidenced by data showing that pregnant women who are unable to undergo a desired abortion are 4 times more likely to live below the federal poverty level and 3 times more likely to be unemployed (16). Although Google data from searched content during the pandemic showed a modest decrease in abortion searches in the early weeks of the lockdown, this was promptly followed by a return to average search levels thereafter and, ultimately, a slightly higher than usual level by the 13th week of the lockdown (17). Unfortunately, the rebound in abortion necessity was met with a limit in abortion access, likely resulting in a net increase in unintended pregnancy.

The effects of these limitations in contraception access were partially balanced by the introduction of telemedicine and virtual visits. Before the COVID-19 pandemic, telemedicine was rarely employed in the scope of reproductive health services. The pandemic resulted in the opportunity to

streamline digital solutions, ultimately providing a multitude of reproductive services, including prenatal care, medical abortion, and contraceptive renewal. In a survey study of 172 US physicians practicing family planning, 78% of providers reported being new to telemedicine. On average, telemedicine physicians only required that the patient be seen for an in-person visit in 24% of cases, with the most common reason for in-person referral being LARC insertion. Most providers strongly agreed that telemedicine visits are an effective way to provide contraceptive counseling (80%) and that this service should be expanded after the pandemic (84%) (18).

## UNINTENDED PREGNANCY RATES DURING THE PANDEMIC

Reducing unintended childbearing is a public health concern in the United States because of its links to poorer outcomes for mothers, children, and families (19). By the age of 45 years, more than half of US women have had at least 1 unintended pregnancy (20). Unintended pregnancy is highest among low-income women, women aged 18–24 years, cohabitating women, and women of color (21). Higher-income women, married women, White women, and college graduates had the lowest rates of unintended pregnancy. Women without high school degrees had the highest unintended pregnancy rates among those of any education level (21). In 2011, the unintended pregnancy rates for African-Americans, Hispanics, and White women in the United States were 33%, 31%, and 17%, respectively (22). Minority women and those with lower socioeconomic status are both disproportionately affected by COVID-19 and are at increased risk of unintended pregnancy. Before the pandemic, there was incremental progress toward decreasing unintended pregnancies with the first decline since 1997 occurring between 2014 and 2018 (Fig. 2).

Limiting contraception and abortion access in the setting of the pandemic threatens to reverse this positive momentum gained by the introduction of LARCs and will likely result in a net increase in unintended pregnancies. A survey study ( $n = 184$ ) conducted in Italy during the pandemic showed that all married women who were living with their spouse continued to use their contraceptive, whereas 50.5% of single women self-discontinued their short-acting contraceptive. Of the women who discontinued contraception, 46.5% continued sexual activity, resulting in 32% of women in the study having unintended pregnancy, for which 15% sought termination (23). Although we do not have similar data for the United States, the outcomes are likely similar. This illustrates the grave effects of limited/discontinued contraception on unintended pregnancies. A report produced by the Guttmacher Institute of 2009 cisgender women indicated that during the COVID-19 pandemic, although 36% of women wanted to delay childbearing and 27% of women wanted to have fewer children than previously planned, 39% reported that they had to delay or cancel sexual and reproductive healthcare visits, to include contraceptive care, because of the pandemic itself, which will likely manifest as a significant increase in unintended pregnancies (24).

## HISTORIC TRENDS IN BIRTH RATES DURING DISASTERS

Historic disasters have always been correlated with declines in birth rate. Emergencies and crisis lead to increased caution, anxiety, depression, isolation, and worsening of preexisting health conditions that decreases desires for childbearing. In the 1918 Spanish flu pandemic, increases in mortality were matched with declines in birth. Each spike in mortality led to a fall of 21 births per 1,000 and an overall 12.5% decline. However, after disease recovery, the birth rate returned to baseline levels and did not overshoot to the prespike levels, implying that there were fewer births overall (25). The Great Recession of 2007–2009 led to a large decline in birth rates. In 2007, there were 69.1 births per 1,000 women. This was followed by a 9% drop, equivalent to 400,000 fewer births by 2012.

In states that were most affected by the recession, there were higher unemployment rates and greater declines in birth rates. During the Spanish flu, although the birth rate declined, the economy was supported by the ongoing war effort, resulting in economic stability. In the case of the Spanish flu, economic stability counteracted the pandemic-driven decline in birth rates (26). In contrast, with the COVID-19 pandemic, economic instability is likely to decrease pregnancy and birth rates and persist for longer time periods. The monthly unemployment rates spiked from 3.5% in March 2020 (prepandemic) to 14.8% in April 2020, the highest rate seen in over a decade. Since its peak, the unemployment rate has continued to decrease but has not yet returned to prepandemic rates with the most recent rate at 4.6% in October 2021 (27). In addition to increasing unemployment, a study suggests that 42% of layoffs during the pandemic will be permanent, which will negatively impact lifetime earnings, even if new employment is obtained (28). On the basis of historic crises, it can be projected that in 2021, there will be a 5.5%-point reduction in births or 206,000 fewer births from unemployment projections alone (29). This does not account for the added reduction in birth rate that will occur because of the health crisis. Studies show that in June to August 2020, before COVID-19-related effects were reflected in the data, the birth rate was already declining. The already declining pre-COVID-19 birth rate, in addition to the expected declines in birth rate induced by the health crises, sustained unemployment, and the post-COVID financial turmoil indicate that COVID-19 could be a part of a larger and longer decline in birth rates than was seen in previous epidemics.

## PREGNANCY DELAY

Historically, economic recessions have been associated with a pregnancy delay. The projected recession because of COVID-19 and its persistent economic turmoil will likely decrease lifetime income. A decrease in lifetime income will not only result in a delay in birth rates but may also result in a sustained decrease in birth rates over time. Delayed fertility will also lower total fertility because some women will inadvertently age out of the reproductive-age group. A survey by the Guttmacher Institute reported that 34% of American women have delayed their plans to have a child



or reduce the number of children they expect to have overall, as a result of the COVID-19 pandemic (24). A study conducted by Luppi et al. (30) showed similar results in European women who are also planning to postpone giving birth or have fewer children altogether. Sexual activity has decreased during the pandemic, as Trojan condoms sales have dropped with double digit losses since the onset of the pandemic. In a recent survey, almost half of respondents reported a decline in their sex lives (31). Those with young children and those with school-aged children report the largest declines in intercourse. Ongoing school closures likely contribute to increased strain and reduce desire to have more children. Restrictions on socializing likely contribute to fewer new couplings. Interestingly, Google trends also support the prediction of reduced fertility. Pregnancy-related topic searches such as prenatal vitamins and morning sickness have also decreased in the middle and the last half of 2020. Pregnancy-related terms such as “ClearBlue,” “ultrasound,” and “morning sickness” have decreased since the pandemic began with a predicted association of a 15% decrease or more in birth rates (32).

## REPRODUCTIVE SERVICES

Infertility in the United States is a significant health issue with the latest National Survey of Family Growth showing 12.0% or 7.3 million women of reproductive age having received infertility services in their lifetime (33). With the height of the COVID-19 pandemic, infertility treatments were abruptly stopped with recommendations from the American Society for Reproductive Medicine (ASRM) (34). Despite the global pandemic, the stress of infertility was the most frequently cited top stressor and is a comparable stressor to the pandemic itself (35). A survey sent to 2,202 nonpregnant female patients (34% response rate) at a large university-affiliated infertility practice in New England reported that before the pandemic (January 2020), the percentage of patients who cited infertility to be their top stressor was 81%, whereas in early March 2020 at the start of the pandemic and September 2020 in the midst of the pandemic, it dropped to 69.3% and 66.4%, respectively. Despite the decrease, infertility was still the most frequently reported top stressor during all time periods (35). Even in the midst of the COVID-19 pandemic, only 6% of women believed that infertility treatment, including in vitro fertilization, should not be offered during the COVID-19 pandemic, whereas two thirds of the respondents were awaiting infertility treatment at the time of the survey. This highlights the psychological impact of the global pandemic on infertility patient.

Congruent with delaying pregnancy, more women in the United States have been seeking oocyte cryopreservation. Fifty-four fertility clinics across the United States reported a higher number of patients freezing oocytes in 2020 than those in 2019 (36), some reporting up to a 52% increase in oocyte retrievals (37). With travel restrictions in place, more women have been able to consider cryopreservation. Working from home also allows for flexibility and availability during the work day to attend frequent office visits for blood work and ultrasounds that are required during the fertility preservation

cycle. In addition, those who have insurance coverage for fertility preservation are more apt to undergo cryopreservation to capitalize on coverage while they have job security, disproportionately benefiting women who are privileged with access and coverage to these fertility preservation procedures. With reproductive services slowly resuming to prepandemic levels, there may be a higher rate of oocyte preservation in this group further widening the gap. As of April 2020, the ASRM Patient Management and Clinical Recommendations during the COVID-19 pandemic recommended gradual and judicious resumption of reproductive care with return of most if not all reproductive services at this time.

## RISKS OF COVID-19 INFECTION DURING PREGNANCY

The risks of deferring a COVID-19 vaccine in pregnancy are twofold. The primary concern is an increased morbidity and mortality in pregnant mothers who are infected with the COVID-19 virus. Several studies have shown that pregnant women with COVID-19 infection are at risk of more severe disease and at increased risk of intensive care unit admission, mechanical ventilation, and death than nonpregnant women (38, 39). These findings are supported by biologic plausibility, as the immune response in pregnancy is diminished to protect the fetal allograft from immune attack. Although protective for the fetus, compromised immunity in pregnancy results in more severe disease progression. Data from prior pandemics involving severe acute respiratory syndrome and Middle East respiratory syndrome are supportive of this theory, as they both resulted in an increased maternal mortality and spontaneous abortion rate during pregnancy. Women with independent risk factors, including but not limited to diabetes, obesity, cardiac disease, chronic lung disease, and chronic hypertension, having a high risk of exposure, and being part of an underserved or minority population are even more at risk of developing severe disease from a COVID-19 infection in addition to this already increased risk of severe disease with pregnancy alone.

The second concern of deferring the COVID-19 vaccine in pregnancy is vertical transmission to the neonate in the setting of a mother with active COVID-19. Data regarding vertical transmission are more limited but suggest a low (2%–3%) risk of vertical transmission (40). Coronavirus disease 2019 has not been routinely detected in the amniotic fluid, cord blood, or neonatal nasopharyngeal samples of pregnant women who are known to be affected by COVID-19 (41–47); however, further studies are ongoing. Given the risk of severe disease in pregnant women, the consensus from the Centers for Disease Control and Prevention (CDC), Society for Maternal-Fetal Medicine (SMFM), and ACOG is to vaccinate all women of childbearing age regardless of pregnancy or lactating status. Antipyretics can be used to limit the messenger ribonucleic acid (mRNA) reactogenicity that a proportion of patients may experience, resulting in fever, fatigue, headache, chills, and muscle and joint pain, before vaccination in pregnant women.

## VACCINATION IN PREGNANT WOMEN

As women in the reproductive-age group comprise a large part of the population, vaccination in this group will help to curtail household transmissions and viral spread, which will mitigate the negative impact of the virus on a national scale. Women traversing through varied parts of the reproductive process, including conception, pregnancy, or breastfeeding, were initially faced with the difficult decision of being vaccinated with novelty of the vaccine being a primary concern. Vaccination was complicated by the limitations of inclusionary scientific evidence because initial vaccine safety and efficacy trials mostly did not include pregnant and/or breastfeeding women in their cohorts. Further amplifying the confusion was the plethora of myths and misinformation released on social media.

Regarding the general safety of mRNA vaccines (Pfizer and Moderna), the mechanisms of vaccination are novel and first to be available in the United States. Mechanistically, there is no reason to believe that an mRNA vaccine would be pathogenic (48–50). In fact, mRNA vaccines are theoretically safer than older-generation vaccines because they do not require injection of the antigen itself. Most previously approved vaccines introduce an antigen, which usually consists of an inactivated or purified protein from the infectious agent. The result is an immune response and targeted antibody formation. In contrast, the COVID-19 mRNA vaccines developed by Pfizer and Moderna work by carrying only the genetic information necessary to manufacture a spike protein of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) viral coat. Once the vaccine is injected, the mRNA is used to manufacture the spike protein. The mRNA never enters the nucleus and, thus, cannot be integrated into deoxyribonucleic acid, subsequently degrading in the cell cytoplasm within minutes to hours of injection (51). The AstraZeneca and Janssen vaccines use adenovirus vectors that have been modified to prevent replication. The Janssen vaccine adenovirus (human adenovirus 26) was successfully used against the Ebola vaccine (52).

With initial vaccination trials excluding pregnant participants, studies of the approved COVID-19 vaccines continue to be tested for safety, immunogenicity, reactogenicity, or efficacy in pregnant women and for their effects on fetal programming (53). Pfizer reported that there were 23 pregnant persons inadvertently enrolled in their clinical trial, including 12 in the vaccine group, whereas Moderna reported 13 pregnancies in their clinical trial, including 6 in the vaccine group. When the CDC's Advisory Committee on Immunization Practices released interim guidance recommending that health care personnel be included in the initial phase of vaccination because of their high risk of exposure, this opened the door to include even more reproductive women (54). The CDC and US Food and Drug Administration (FDA) continue to actively monitor women who were unknowingly pregnant at the time of vaccination and have not reported any red flags. Regarding the Moderna vaccine (48), a combined developmental and perinatal and postnatal study was conducted in rats and showed no adverse effects on female reproduction, fetal or embryonic development, or postnatal development. No red

flags have been observed in the 30,000 women, of whom many are healthcare workers, who have received the vaccine (53).

Since the inception of these vaccines, the safety profile in pregnant and breastfeeding women has been determined to be beneficial and is now recommended for all individuals aged  $\geq 12$  years, including individuals who are pregnant or breastfeeding. The initial data reported by Gray et al. (54) have shown that pregnant and lactating women elicited comparable vaccine-induced humoral immune responses to nonpregnant controls and generated higher antibody titers than those observed after SARS-CoV-2 infection in pregnancy. Animal studies and preliminary information regarding ongoing pregnancies in vaccinated women have also not reported any adverse effects.

## VACCINATION IN BREASTFEEDING WOMEN

The Academy of Breastfeeding Medicine and ACOG agree that vaccination poses minimal to no potential risk to the newborn, given that vaccine-related mRNA has not been detected in early breast milk studies and no plausible mechanism of neonatal harm has been identified. In fact, studies have shown a neonatal benefit with vaccine-generated antibodies present in the umbilical cord and breast milk after vaccination (54). This vaccine-stimulated maternal immunoglobulin passes through breast milk and is theoretically able to provide early protection against SARS-CoV-2 infection. Neonatal protection resulting from maternal antibodies is theoretical because it is unknown how long after immunization antibodies are present in maternal serum and the competency of these antibodies is also undetermined. Nevertheless, the vaccine should be considered safe for lactating women because there is no plausible reason to suspect that receipt of the vaccine would lead to any adverse neonatal effects and should be recommended to lactating women.

## COVID-19 VARIANTS

In the time required to transition to include pregnant and breastfeeding women in routine recommendation for COVID-19 vaccination, multiple variants of the COVID-19 virus have emerged. The World Health Organization defines a variant of concern as one that is more infectious, likely to cause breakthrough or reinfections in vaccinated and previously infected individuals, cause severe disease, evade diagnostic tests, or resist antiviral treatment. In the United States, the variant of concern is the delta variant, and the alpha, beta, and gamma variants also fall in this category (55, 56). Research suggests that the vaccines still appear to provide protection against severe COVID-19 caused by variant strains. Studies from the United Kingdom suggest that full vaccination of the Pfizer vaccine is 88% effective at preventing symptomatic disease and 96% at preventing severe disease in a delta variant infection (57). A Canadian study suggests that a single dose of Moderna vaccine is 72% effective at preventing symptomatic disease and 96% effective at preventing severe disease caused by the delta variant. With pregnant women experiencing more severe

forms of the disease overall, the vaccination should be recommended for any woman trying to conceive or who is currently pregnant or is breastfeeding.

### REGISTRIES CURRENTLY ENROLLING AND/OR REPORTING ON VACCINATED WOMEN IN PREGNANCY

In addition to following women who were unknowingly pregnant and included in vaccine trials, the CDC has also established a registry termed the V-Safe Vaccine Pregnancy Registry, which uses a phone application to collect health information from volunteers who received COVID-19 vaccination in the periconception period (within 30 days before the last menstrual period) or during pregnancy. Multiple pharmaceutical companies have initiated trials in pregnant women. Pfizer enrolled approximately 4,000 pregnant women between 24 and 34 weeks of gestation in their trials, including participants in the United States as well as Argentina, Brazil, Canada, Chile, Mozambique, South Africa, Spain, and the United Kingdom. The Pfizer vaccine is now FDA approved for vaccination in all women of childbearing age regardless of pregnancy status. The Johnson & Johnson subsidiary, Janssen vaccines, enrolled 824 pregnant participants in a phase 2 placebo-controlled trial of its COVID-19 vaccine. Moderna has also created a registry to monitor pregnancy outcomes.

### RECOMMENDATIONS BY PROFESSIONAL SOCIETIES

Medical societies, such as the ACOG, SMFM, and ASRM, have made significant efforts to provide guidance to clinicians who care for women. In December of 2020, 12 obstetrics and gynecology societies released a joint statement supporting public health measures to combat COVID-19. The group concluded that the benefits of COVID-19 vaccination in pregnancy far outweighed the risks. At that time, they endorsed vaccination for all eligible health care workers, patients, and society at large, including populations who are disproportionately affected by COVID-19 (58, 59). As of September 2021, professional societies, including but not limited to the SMFM, ACOG, ASRM, Society for Assisted Reproductive Technology, as well as CDC, have transitioned from *not withholding* the COVID-19 vaccine from pregnant or lactating women to *recommending* vaccination in all individuals aged  $\geq 12$  years, including women who are pregnant, breastfeeding, or currently trying to get pregnant or may become pregnant in the near future.

### DISCUSSION

Before the pandemic, the United States saw a decline in undesired pregnancy for the first time since 1997. Pandemic-related barriers to obtaining contraceptives include quarantine and travel restrictions, supply chain shortages of condoms and progesterone-containing contraceptives, and limited access to clinics and pharmacy. Access to abortion clinics has been specifically challenging in the United States, given state closures of abortion clinics.

Although there was a modest decrease in abortions in the early weeks of the lockdown, this was promptly followed by a return to average search levels thereafter and, ultimately, a slightly higher than usual level by the 13th week after a lockdown. Unfortunately, the rebound in abortion necessity was met with a limit in abortion access, likely resulting in a net increase in unintended pregnancy.

Limiting access to contraception and abortion services because of COVID-19 jeopardizes this crucial progress in lowering undesired pregnancy rates. These negative effects were somewhat mitigated by initiating telemedicine visits and programs such as “no-touch” medical abortions. This is also likely somewhat mitigated by decreased pregnancy rates during the pandemic, as some studies report up to 34% of women have planned to delay fertility. However, this also reflects the heightened vulnerability of those in the lower socioeconomic classes, as studies show that women who desire to delay fertility but are unable to are more likely to be in the lower socioeconomic classes because access to contraceptive- and abortion-related resources disproportionately affected minorities and those in the lower socioeconomic class.

As for women who plan to delay pregnancy because of the pandemic, oocyte cryopreservation is a viable option that has increased substantially during this time. Women who previously were considering undergoing this procedure may now have the time and flexibility to undergo fertility procedures given the increase in teleworking. Unfortunately, this again disproportionately benefits women who are privileged to have access and/or coverage for fertility preservation procedures.

Despite the recommendations from multiple major professional societies, false messaging and misinformation have led to a new pandemic of unvaccinated. As of August 2021, only 50.9% of the US population is fully vaccinated despite vaccine availability (60). For women of reproductive age, this is especially concerning because the prevalence and severity of the disease can be worsened in pregnancy. With respect to vaccination itself, although there were initially limited data on safety in pregnant and breastfeeding women, the vaccine is now FDA approved and recommended in all individuals aged  $\geq 12$  years regardless of pregnancy or breastfeeding status.

### CONCLUSION

It is evident that the COVID-19 pandemic has affected reproductive health in the United States through multiple mechanisms. As the United States continues to have a disproportionately high number of COVID-19 cases and deaths, the duration of these negative effects will likely be protracted for the foreseeable future. Unfortunately, women of color and women in more vulnerable groups are disproportionately affected in each of the subsections of reproductive health examined in this review. In summary, the effects of COVID-19 on reproductive health are profound. With the understanding of COVID-19-related factors that have affected reproductive health negatively and those populations who are most vulnerable to the negative effects, strategies to



mitigate the negative effects can be suggested, including vaccination of all reproductive-age women.

## STRATEGIES TO MITIGATE THE NEGATIVE EFFECTS OF COVID-19 ON REPRODUCTION

The pandemic offers a window of opportunity to capitalize and expand on strategies that have been effective in balancing the negative effects thus far and that can be employed in future strategic plans to prevent similar negative outcomes. Four strategies will be briefly discussed: increasing access and reimbursement for contraception visits via telehealth; increasing access to medical abortions with no-touch policy programs, with a specific focus on catering to the underserved populations and lower socioeconomic class; encouraging vaccination in pregnant women by delivering current information via clear and concise messaging; and increasing vaccination in the general population by addressing vaccine hesitancy and debunking myths.

Telemedicine visits are a plausible mechanism by which the negative effects of limiting access to care may be mitigated. There should be a strong momentum toward initiating telemedicine in practices that have not already done so and an even stronger momentum to increase these resources available to those in the lower socioeconomic class who are disproportionately affected. The ACOG is in support of telehealth for a multitude of prevention-, obstetrics-, and gynecology-related areas; however, not all practices have adopted telehealth practices and/or are not equipped to support the shift. The Health Resources and Services Administration estimates that the community health centers have only seen 57% of their typical weekly visits during the COVID-19 crisis. Although 51% of visits were telehealth, these centers need additional support and strategic planning to get back to their pre-COVID volume. Given that community health centers serve a disproportionate share of low-income, racial/ethnic minority, and immigrant populations, providing these centers with support will begin to address disparities. Strategies to help centers adapt include payment parity, such as reimbursing the same amount for a telehealth visit as a face-to-face visit. This requires state mandates; otherwise, private insurers will be able to individually adjust telehealth policies. Currently, 12 states have mandated all-payer parity for telehealth. Additionally, several low-income patients lack health and digital literacy. Virtual telehealth platforms should design applications, which are intuitive and easy to navigate. For patients who do not have a camera, insurers should waive audio-video requirements and consistently reimburse for phone-only visits. Local governments should identify the areas with least access and consider loaning laptops or smartphones and supplying Internet hotspots for these communities to enable access.

The second strategy to mitigate the negative outcomes is to increase access to medical abortions via no-touch/no-test policy programs. The ACOG and National Abortion Federation have issued statements endorsing telehealth and no-test (also called no-touch or no-contact) approaches for abortion care to maintain social distancing (58, 61) and have published a sample protocol for providing no-test

### TABLE 2

#### Summary of COVID-19 vaccine-related myths and facts (original).

Myth	Fact
The vaccines can make you sick.	Symptoms are a normal sign that the body is building protection against the virus.
I have already had COVID-19, so I do not need to be vaccinated.	The vaccines are still necessary because it is unclear how long immunity from natural infections lasts and it may protect you from different strains of the virus.
The vaccine will alter my DNA.	The COVID-19 vaccines do not change or interact with your DNA. The Pfizer and Moderna vaccines are mRNA vaccines which teach our cells how to make a protein that triggers an immune response. The mRNA from the vaccine does not enter the nucleus of the cell, which is where the DNA is stored. Human cells breakdown and get rid of the mRNA soon after they have finished using the message from the vaccine.
The vaccine causes infertility.	There is currently no evidence that COVID-19 vaccination causes issues with pregnancy, including the development of the placenta. In addition, fertility is not known to be a side effect of any vaccine, including COVID-19. This misinformation is believed to originate from Internet posts from a former scientist known to hold antivaccination views.
It is not safe because it was rapidly developed and tested.	Biopharmaceutical companies did not bypass the safety protocols or testing periods. To receive FDA EUA, the manufacturers were required to follow at least half the study participants for 2 months at minimum after completion of the vaccination series. To receive EUA, the vaccine must be proven to be safe and efficacious in the study population.
The vaccine was developed using fetal cells.	Pfizer and Moderna did not use fetal cells in the development of production of their vaccines.

Note: COVID-19 = coronavirus disease 2019; DNA = deoxyribonucleic acid; EUA = Emergency Use Authorization; mRNA = messenger ribonucleic acid.

Aly. Impact of coronavirus on reproduction. Fertil Steril Rev 2022.

medical abortion (62). The no-test approach involves evaluating the patient by video or phone and relying on the reported date of the patient's last menstrual period to assess the duration of pregnancy, with phone follow-up to rule out

**TABLE 3**

**Psychobehavioral profiles for individuals less likely to vaccinate.**

Group	Watchful (20%)	Cost-anxious (14%)	System disrupters (9%)	Conspiracy believers (17%)
Characteristics	<ul style="list-style-type: none"> <li>• Older</li> <li>• Female</li> </ul>	<ul style="list-style-type: none"> <li>• Younger</li> <li>• Rural areas</li> <li>• Essential or frontline workers</li> </ul>	<ul style="list-style-type: none"> <li>• Younger</li> <li>• Lower income</li> <li>• Essential or frontline workers</li> <li>• Minorities</li> </ul>	<ul style="list-style-type: none"> <li>• Republican</li> <li>• Rural areas</li> </ul>
Key barriers	<ul style="list-style-type: none"> <li>• Concerns about short- and long-term side effects</li> </ul>	<ul style="list-style-type: none"> <li>• Cost of vaccine</li> <li>• Physical side effect</li> </ul>	<ul style="list-style-type: none"> <li>• Belief of inadequate testing in minorities</li> <li>• Low trust in the health system</li> </ul>	<ul style="list-style-type: none"> <li>• Belief in COVID-19 conspiracy theories</li> <li>• Entrenched beliefs that the vaccine is unsafe</li> <li>• Low perceived risk of disease</li> </ul>
Strategies	<ul style="list-style-type: none"> <li>• Emphasize norms with visible evidence of vaccinations in the community</li> <li>• Encourage family conversations</li> <li>• Positive vaccine stories</li> </ul>	<ul style="list-style-type: none"> <li>• Promote cost-free vaccine by trusted leaders</li> <li>• Make vaccines available in workplace</li> </ul>	<ul style="list-style-type: none"> <li>• Track and distribute data on racial disparities</li> <li>• Host a session with communities and vaccination clinics</li> </ul>	<ul style="list-style-type: none"> <li>• Deprioritize this group</li> <li>• Counter misinformation online</li> <li>• Identify trusted leaders to serve as influencers</li> </ul>

Note: COVID-19 = coronavirus disease 2019.

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ectopic pregnancy (62, 63). This practice has been shown to be safe and effective for those who are certain of period date and have no known risk factors for ectopic pregnancy (62). However, efforts to use telehealth for medication abortion have been hindered by 2 factors. First, the FDA requires mifepristone to be dispensed in a clinic, doctor’s office, or hospital rather than allowing for the common dispensing of medication in a pharmacy. The second factor limiting medical abortion is state prohibition. Currently, 18 states have effectively prohibited telemedicine for abortion (64). A survey examining COVID-19–related changes in protocols in 100 abortion clinics across the United States found that only 15% of clinics were omitting the preabortion ultrasound. A total of 20% reported allowing quick pickup of medication abortion pills, and 4% began mailing medications directly to patients after a telehealth consultation. In addition, facilities in the Northeast (73%) were more likely to have started or to have increased telehealth than facilities in the South (23%) (65). Focusing on increasing telehealth support for abortion clinics, specifically in the southern states as well as implementing telehealth in place of the preabortion ultrasounds will result in broadening access to safe abortions and, therefore, decrease maternal and neonatal mortality.

Encouraging vaccination in reproductive-age women and of the population at large will greatly mitigate all negative effects of COVID-19, including the negative effects on reproduction. Collaborating with colleagues in family medicine as well as other providers, such as nurse practitioners, physician assistants, and certified nurse midwives, can have a pivotal role in patient education regarding COVID-19 vaccination. This allows for patients to undergo counseling from multiple providers regarding the recommendation of the COVID-19 vaccine as well as its effects on reproductive health. Further distribution of evidenced-based resources to help women in making these decisions will likely limit the confusion concerning the benefits of vaccination.

Lastly, a strategic plan for addressing vaccine hesitancy in the general population will increase the vaccination rates, thus positively impacting global and reproductive health. The Kaiser Family Foundation Study has identified groups that exhibit the most vaccine hesitancy. These groups were identified by those who answered “probably not” or “definitely not” in response to getting the vaccine if it were safe and available at no cost (66). Republicans were the group most likely to have vaccine hesitancy at 42%, followed by the age group 30–49 years (36%), rural residents (35%), Black adults (35%), and essential workers (33%) (66). Although diverse, these groups shared some common concerns regarding the vaccine. Trust appears to be the dominant reason for vaccine hesitancy in all groups. The Pew Research Group found that vaccine intent is 75 points higher among those with high trust than among those with low trust (67). The number of Republicans who report that the impact of science is positive has recently decreased since 2019 from 70%–57% compared with that of Democrats whose views on the impact of science have remained constant (78% in 2019 vs. 79% currently). This difference may be, in part, a reflection of the lack of trust, which ultimately affects vaccine acceptance. Other influential factors include concerns about community health, side effects, concerns that the vaccine was developed and tested too quickly, a lack of understanding of how the vaccine works, and concerns about previous health care mistakes (67). Many of these factors can be addressed by debunking myths that have been circulating via social media and news outlets. A summary of myths regarding the vaccine and the relevant true facts is presented in Table 2.

Differences across demographic and political groups on COVID-19 vaccines also contribute to vaccine refusal. There is an emphasis on targeting vaccine acceptance among Blacks and Hispanics, yet Republicans are the most vaccine resistant. Black adults have become more accepting of vaccination, whereas there has been little change among Republicans.

Black Americans are more likely to have contracted the virus or know someone who has had the disease. Therefore, nearly half of Black adults consider the disease a major threat to their personal health compared with 26% of White adults. Black Americans are also more concerned about the possibility that they may unknowingly spread the disease to others. This may also explain why vaccine hesitancy has decreased among Black adults. Most Black adults now say that they plan to get or have already received a vaccine (61%). Individuals who are Republican or lean Republican who plan to get or have already received a COVID-19 vaccine decreased from 65%–56% over the same period (67, 68).

The published literature regarding targeted messaging on the basis of specific groups is limited; however, there are emerging data that may help inform messaging strategies. In a survey study of over 2,500 adults, researchers evaluated psychobehavioral factors to identify effective approaches. The investigators identified 5 groups on the basis of vaccine acceptance: the enthusiasts (40%) and those less likely to get vaccinated (60%). In the group that was less likely to get vaccinated, there were 4 subgroups: the watchful (20%), cost-anxious (14%), system distrusters (9%), and conspiracy believers (17%). All of the subgroups, with the exception of the conspiracy believers, were identified as persuadable. Each subgroup had characteristics and concerns that were unique to their group (69). This information was then used to propose strategies to target each subgroup and is summarized in Table 3.

The global pandemic has had a significant negative impact; however, it presents an unparalleled opportunity to optimize and advance current practices to counteract the negative effects on reproductive health. In addition, it underscores the continued need to focus efforts on marginalized groups who are at disproportionately high risk of being affected by the COVID-19 pandemic and the aftermath to follow. We present tools and strategies that can be employed to limit the negative effects on reproductive health and a tailored approach targeting at-risk populations.



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