OBJECTIVE: To evaluate and summarize reports to the Vaccine Adverse Event Reporting System (VAERS), a national spontaneous reporting system, in pregnant people who received a booster dose of mRNA coronavirus disease 2019 (COVID-19) vaccine.

METHODS: We searched VAERS for U.S. reports of adverse events in pregnant people who received a booster dose of an mRNA COVID-19 vaccine from September 22, 2021, to March 24, 2022. Clinicians reviewed reports and available medical records.

RESULTS: The Vaccine Adverse Event Reporting System received 323 reports of adverse events in pregnant people who received a booster dose of COVID-19 vaccine; 178 (55.1%) after BNT162b2 from Pfizer–BioNTech and 145 (44.9%) after mRNA-1273 from Moderna. Seventy-two (22.3%) reports were coded as serious. One neonatal death was reported, but no maternal deaths occurred. Pregnancy-specific outcomes included 56 (17.3%) spontaneous abortions (before 20 weeks of gestation), eight (2.5%) episodes of vaginal bleeding, five (1.5%) stillbirths (at or after 20 weeks of gestation), four (1.2%) episodes of preeclampsia, and two (0.6%) preterm deliveries. Reporting rates for stillbirth and preterm delivery were below background rates. Ten instances of adverse events in neonates were reported, which included two reports of birth defects. Non–pregnancy-specific adverse events (n=207; 64.1%) were mostly systemic (eg, headache, fatigue) and local reactions and occurred in proportions comparable with those seen in pregnant people who received the primary COVID-19 vaccination series and reported to VAERS during the same period.

CONCLUSION: Review of reports after a booster dose of mRNA COVID-19 vaccine in pregnant people in VAERS found their safety profile was comparable with that of published reports after primary COVID-19 vaccination in pregnant people.

(Vaccination against coronavirus disease 2019 (COVID-19) is safe and effective at preventing illness, including hospitalization and death due to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection, and booster and additional primary dose COVID-19 vaccinations increase protection to known and studied variants. From August to November 2021, a series of Emergency Use Authorizations and recommendations, including those for an additional primary series dose for immunocompromised people and a booster dose for people aged 12 years and older, were approved because of reduced immunogenicity in immunocompromised people and...)

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Each author has confirmed compliance with the journal’s requirements for authorship.

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Pregnant people and recently pregnant people with COVID-19 have an increased risk of severe illness that can result in intensive care unit admission, mechanical ventilation, and death compared with nonpregnant people of reproductive age.\textsuperscript{4,5} Pregnant people with COVID-19 are at increased risk of preterm birth and stillbirth and may be at increased risk of other adverse pregnancy complications compared with pregnant people without COVID-19.\textsuperscript{6,7} Vaccination against COVID-19 is recommended for all people who are pregnant, attempting conception, or who might become pregnant in the future.\textsuperscript{8} People who are pregnant and eligible for a COVID-19 vaccine booster dose should receive it as recommended.\textsuperscript{8} There is growing evidence indicating mRNA COVID-19 vaccines are safe when administered to pregnant people as part of a primary series. A 2021 study found no safety concerns for mRNA COVID-19 vaccines in pregnant people during the first 2 months of the U.S. vaccination program.\textsuperscript{9} This preliminary analysis\textsuperscript{9} included data from three systems: 1) V-safe After Vaccination Health Checker\textsuperscript{10} 2) the V-safe COVID-19 Vaccine Pregnancy Registry,\textsuperscript{11} and 3) the Vaccine Adverse Event Reporting System (VAERS).\textsuperscript{12} Additional studies of COVID-19 vaccination throughout pregnancy have not found an increased risk of spontaneous abortion,\textsuperscript{13,14} preterm birth, or small-for-gestational-age neonates\textsuperscript{15,16} among people who received mRNA COVID-19 vaccines during pregnancy.

There are limited data on the safety of a booster dose of a COVID-19 vaccine in pregnant people. We reviewed reports of adverse events submitted to VAERS from September 22, 2021, through March 24, 2022, where a booster dose of a mRNA COVID-19 vaccine was administered to a pregnant person to assess vaccine safety.

**METHODS**

The Vaccine Adverse Event Reporting System is a national passive vaccine safety surveillance system, implemented in 1990 and co-administered by Centers for Disease Control and Prevention (CDC) and the U.S. Food and Drug Administration (FDA), that receives spontaneous reports of adverse events from health care professionals, vaccine recipients, manufacturers, and other reporters after vaccination.\textsuperscript{12} Although anyone can report to VAERS, a report does not indicate that the vaccine caused the adverse event.\textsuperscript{12} Vaccine manufacturers are required, by law, to report adverse events that come to their attention, and health care professionals are required to report adverse events that are considered a contraindication to further doses of vaccine and those specified in the VAERS table of reportable events after vaccination.\textsuperscript{12} Data in VAERS are monitored in real time to detect new, unusual, or rare vaccine adverse events as well as increases in known adverse events.

Signs and symptoms of adverse events reported to VAERS are coded by trained personnel and are entered into a database using MedDRA (Medical Dictionary for Regulatory Activities), a clinically validated, internationally standardized medical terminology.\textsuperscript{17} A VAERS report may be assigned one or more MedDRA preferred terms. A preferred term is a distinct descriptor for a symptom, sign, disease, diagnosis, therapeutic indication, investigation, surgical or medical procedure, and medical, social, or family history characteristic.\textsuperscript{17} Reports are further classified as serious as per the U.S. Code of Federal Regulations if one of the following is reported: death, life-threatening illness, hospitalization or prolongation of hospitalization, permanent disability, or a congenital anomaly.\textsuperscript{18} We identified reports of pregnant people who received a booster dose of a mRNA COVID-19 vaccines (BNT162b2 from Pfizer–BioNTech or mRNA-1273 from Moderna) and who reported an adverse event to VAERS by using a search strategy previously described.\textsuperscript{9} Reports after Ad26.COV2.S (Johnson & Johnson/Janssen) vaccine were excluded due to a very low number of reports. A manual review of all reports was done to assess for the adverse event reported but also to ascertain whether the reports pertained to receipt of a booster dose or an additional dose (eg, to immunocompromised patient). Medical records were requested for all serious reports. All VAERS reports were reviewed by a clinician to distinguish reports in pregnant people from nonpregnant people. Obstetricians reviewed medical records of case-reports containing more specialized pregnancy information. If the report described an adverse event in the pregnant person and a neonate, we treated the adverse events as separate but not as separate reports. Adverse events were classified as pregnancy-specific (eg, spontaneous abortion, stillbirth), non–pregnancy-specific (eg, a local or systemic reaction), neonatal (eg, birth defect), or as certain prespecified conditions or adverse events of special interest, which included SARS-CoV-2 infection after COVID-19 vaccination.

We used national vital statistics data on monthly live births and fetal deaths (ie, stillbirths) to calculate rates. To account for the study period of interest, we applied a proportion of 0.30 and 0.77 to birth and
fetal death counts for September and March, respectively. Monthly live births were determined from 2021 monthly provisional counts for 2021. Monthly fetal deaths were estimated using 2020 National Center for Health Statistics Microdata on fetal deaths occurring at or after 20 weeks of gestation by obstetric estimate among women aged 15–49 years in the United States, excluding foreign residents. We determined the product of the median monthly COVID-19 vaccine coverage during pregnancy and the median monthly COVID-19 booster coverage among fully vaccinated women aged 18–49 years in the United States. This product was applied to the monthly live birth and fetal death totals to determine the number of live births and fetal deaths that occurred where a COVID-19 booster dose may have been received during pregnancy. The rate of stillbirths per 100,000 live births and fetal deaths was calculated. The monthly booster vaccine coverage and denominators used for estimating reporting rates can be seen in the Appendix 1, available online at http://links.lww.com/AOG/C803.

We calculated frequencies of the most common MedDRA coding terms and demographic and selected pregnancy and fetal outcomes using SAS 9.3. The proportion for specific adverse events after booster doses were compared with those after the primary series vaccination in pregnancy. Because VAERS is a routine public health surveillance program that does not meet the definition of research, it is not subject to institutional review board review and informed consent requirements. This activity was reviewed by the CDC and was conducted consistent with applicable federal law and CDC policy (see, eg, 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. §241(d); 5 U.S.C. §552a; 44 U.S.C. §3,501 et seq).

RESULTS

From September 22, 2021, through March 24, 2022, VAERS received a total of 53,525 reports after receipt of a booster mRNA COVID-19 vaccine; 323 (0.6%) of these reports involved pregnant people. Among the 323 reports, 178 were after BNT162b2, and 145 after mRNA-1273. Characteristics of pregnancy reports in VAERS can be seen in Table 1 and were similar for both brands of COVID-19 vaccine. Seventy-two (22.3%) reports were coded as serious. Most COVID-19 boosters were reported as administered during the first (n=75; 37.9%) or second trimester of pregnancy (n=123; 38.1%). Adverse events for both COVID-19 brands were comparable. The most frequent pregnancy-specific adverse events reported after administration of a booster dose of an mRNA COVID-19 vaccine (Table 2) were spontaneous abortion (n=56, 17.3%), vaginal bleeding (n=8, 2.5%), and stillbirth (n=5, 1.5%). In 124 (38.4%) spontaneous

Table 1. Characteristics of Reports Received After Booster Doses of mRNA Coronavirus Disease 2019 (COVID-19) Vaccines in Pregnant People, Vaccine Adverse Event Reporting System, United States, September 22, 2021–March 24, 2022

| Characteristic                              | All   | BNT162b2 vaccine | mRNA-1273 vaccine |
|--------------------------------------------|-------|-----------------|------------------|
| Total reports                              | N=323 | N=178           | N=145            |
| Maternal age (y)                           | 32 (15–53) | 32 (17–47)    | 33 (15–53)       |
| Maternal age 35 y or older                 | 124 (38.4) | 66 (37.1)      | 57 (39.6)        |
| Gestational age at time of vaccination (wk)* | 14 (2–39) | 21 (1–38)      | 11 (2–39)        |
| Reports of serious adverse events†         | 72 (22.3) | 40 (22.4)      | 32 (22.1)        |
| Type of reporter                           |       |                 |                  |
| Patient or parent                          | 176 (54.5) | 93 (52.2)      | 83 (57.2)        |
| Health care professional                   | 90 (27.9)  | 52 (29.2)      | 38 (26.2)        |
| Other                                      | 21 (6.5)   | 12 (6.7)       | 9 (6.2)          |
| Manufacturer                               | 36 (11.1)  | 21 (11.8)      | 15 (10.3)        |
| Trimester of pregnancy at time of vaccination | n=198   | n=108           | n=94             |
| 1st (0–13 wk)                              | 75 (37.9)  | 44 (40.7)      | 33 (35.1)        |
| 2nd (14–27 wk)                             | 67 (33.8)  | 35 (32.4)      | 32 (34.0)        |
| 3rd (28 wk or more)                        | 56 (28.3)  | 29 (26.9)      | 29 (30.9)        |

Data are n, median (range), or n (%).
* Gestational age or trimester of vaccination unknown for 125 reports.
† A report is defined as serious when one of the following is reported: death, life-threatening illness, hospitalization or prolongation of hospitalization, permanent disability, birth defect.18
abortion reports, maternal age was 35 years or older. Of the 42 spontaneous abortion reports with gestational age included, gestational age was 9 weeks or less in 37 (88.1%), 10–14 weeks in four (10%), and 17 weeks in one (2%). Ten reports of adverse events in neonates were received, which included one neonatal death in a patient who presented with premature rupture of membranes at 32 weeks of gestation and who underwent cesarean delivery due to arrest of descent with acute blood loss anemia. Two reports of birth defects included spina bifida in a pregnant person exposed to vaccine at 3 weeks of gestation and an unspecified condition. No maternal deaths were reported. Non–pregnancy-specific adverse events (n = 207; 64.1%) were mostly systemic or local reactions and were comparable with the proportion of such reports received after doses from the primary series among pregnant people who reported to VAERS (Table 3). Twenty-four reports describing normal deliveries were reported.

Among prespecified conditions of interest, 20 reports (6.2%) of SARS-CoV-2 infection after a booster dose of COVID-19 vaccine were reported. The median onset time from administration of the booster to diagnosis of SARS-CoV-2 infection was 53 days (range 0–125 days) in 19 reports with this information available. Twenty-seven vaccination errors (8.4%) were reported, with extra dose of vaccine, expired vaccine administered, and inappropriate schedule of product administration being the most common, and none involving an adverse health event.

During the study period, approximately 36,247 live births occurred among women who received a booster COVID-19 vaccine during pregnancy. We observed a stillbirth rate of 13.7 per 100,000 live births and fetal deaths, and a preterm delivery rate of 5.5 per 100,000 live births (Table 4).

DISCUSSION

During September 22, 2021, through March 24, 2022, approximately 91,109,196 people received a booster or an additional dose of an mRNA COVID-19 vaccine. During this same period, VAERS received 51,763 reports of adverse events after a booster dose of mRNA COVID-19 vaccine, and 323 of these were reports of pregnant people. During the first few months after mRNA vaccine roll-out, an initial assessment of VAERS reports after receipt of the booster dose revealed no increased risks of adverse events.

### Table 2. Reported Adverse Events in Pregnant People After Receiving a Booster Dose of an mRNA Coronavirus Disease 2019 (COVID-19) Vaccine, Vaccine Adverse Event Reporting System, September 22, 2021–March 24, 2022

| Adverse Event* | All (N=323) | BNT162b2 vaccine (n=178) | mRNA-1273 vaccine (n=145) |
|----------------|-------------|--------------------------|---------------------------|
| Pregnancy-specific outcomes† | 84 (26.0) | 52 (29.2) | 32 (22.1) |
| Spontaneous abortion (before 20 wk) | 56 (17.3) | 36 (20.2) | 20 (13.8) |
| Vaginal bleeding | 8 (2.5) | 5 (2.8) | 3 (2.1) |
| Stillbirth (at or after 20 wk) | 5 (1.5) | 3 (1.7) | 2 (1.4) |
| Preeclampsia | 4 (1.2) | 3 (1.7) | 1 (0.7) |
| Preterm delivery | 2 (0.6) | 1 (0.6) | 1 (0.7) |
| Other‡ | 7 (2.2) | 4 (2.2) | 3 (2.1) |
| Neonatal outcomes | 10 (3.1) | 7 (3.9) | 3 (2.1) |
| Neonatal death | 1 (0.3) | 1 (0.6) | 0 |
| Birth defects | 2 (0.6) | 1 (0.6) | 1 (0.7) |
| NICU admission§ | 3 (0.9) | 2 (1.1) | 1 (0.7) |
| Other¶ | 4 (1.2) | 3 (1.7) | 1 (0.7) |
| Deliveries | 24 (7.4) | 15 (8.4) | 9 (6.2) |
| Non–pregnancy-specific conditions | 207 (64.1) | 106 (59.6) | 101 (69.7) |

NICU, neonatal intensive care unit. Data are n (%).
* Adverse events are not mutually exclusive; percentages of adverse events do not constitute reporting rates.
† Percentages for all conditions calculated using total pregnancy reports.
‡ Included one report each of premature rupture of membranes, rupture of membranes and delivery of a healthy neonate, ectopic pregnancy, mass in ovary (a possible ectopic pregnancy), oligohydramnios, velamentous cord insertion, and decreased levels of human chorionic gonadotropin.
§ Neonatal intensive care unit hospitalization for one neonate with prematurely closed ductus arteriosus, a pale neonate who required resuscitation, and observation of a healthy neonate.
¶ Neonatal conditions included two reports of fetal tachycardia and one report each of a heart defect and small for gestational age.
primary mRNA series received by those who were pregnant did not identify unexpected or unusual increased reporting of any adverse event. In the months since this initial report, we have continued to closely monitor VAERS reports after COVID-19 vaccination during pregnancy for any unexpected increase in adverse events, particularly pregnancy-specific conditions for participants who received the primary vaccine series. We noted a small predominance of BNT162b2 booster reports, which may be explained by this brand being approved and used as a booster first before mRNA-1273.

Similar to VAERS reports after receipt of the primary series doses, the most common pregnancy-specific adverse event reported after a booster dose was spontaneous abortion, which accounted for one fifth of all reports submitted. Spontaneous abortions are relatively common during pregnancy, and their rates increase with increasing maternal age, with rates as high as 80% at 45 years of age. In the reports of spontaneous abortion reported to VAERS after a booster dose of mRNA COVID-19 vaccine almost half had advanced maternal age (35 years or older). Other pregnancy-specific conditions, such as vaginal bleeding or stillbirths, were reported infrequently. We noted that reporting rates for stillbirth and preterm delivery were well below background rates for these conditions. Systemic and local reactions were commonly reported, and the frequency of reporting was similar to that of pregnant people who received the primary vaccination series. The frequency of these reactions has also been described in other systems, such as V-safe, used to

| Adverse Event | Primary Series COVID-19 Vaccination Reports in Pregnant People (N=1,995) | Booster Doses in Pregnant People | All Vaccine Brands (n=207) | Pfizer–BioNTech Vaccine (n=106) | Moderna Vaccine (n=101) |
|---------------|------------------------------------------------|-------------------------------|-------------------------|---------------------------|----------------------|
| Headache      | 392 (19.7)                                   | 42 (20.3)                     | 26 (24.5)               | 16 (15.8)                 |
| Fatigue       | 377 (18.9)                                   | 32 (15.5)                     | 20 (18.9)               | 12 (11.9)                 |
| Pyrexia       | 321 (16.1)                                   | 33 (15.9)                     | 18 (17.0)               | 15 (14.9)                 |
| Pain          | 317 (15.9)                                   | 25 (12.1)                     | 15 (14.2)               | 10 (9.9)                  |
| Chills        | 311 (15.6)                                   | 26 (12.6)                     | 16 (15.1)               | 10 (9.9)                  |
| Nausea        | 277 (13.9)                                   | 24 (11.6)                     | 14 (13.2)               | 10 (9.9)                  |
| Pain in extremity | 262 (13.1)                             | 19 (9.2)                      | 13 (12.3)               | 6 (5.9)                   |
| Dizziness     | 224 (11.2)                                   | 17 (8.2)                      | 11 (10.4)               | 6 (5.9)                   |
| Injection site pain | 173 (8.7)                      | 17 (8.2)                      | 9 (8.5)                 | 8 (7.9)                   |
| Vomiting      | 164 (8.2)                                    | 16 (7.7)                      | 6 (5.7)                 | 10 (9.9)                  |

COVID-19, coronavirus disease 2019.
Data are n (%).
* Adverse events are not mutually exclusive; percentages of adverse events do not constitute reporting rates.
† Reports after primary series of COVID-19 vaccination (Pfizer–BioNTech and Moderna combined) in pregnant people who reported to the Vaccine Adverse Event Reporting System, September 22, 2021–March 9, 2022.
monitor the safety of a booster dose of COVID-19 vaccines.²⁵

During the postauthorization monitoring of adverse events reported after receipt of COVID-19 vaccines, VAERS has identified a few rare serious adverse events associated with COVID-19 vaccination such as myopericarditis after the mRNA COVID-19 vaccines²⁶, thrombosis with thrombocytopenia syndrome, and Guillain Barré Syndrome both after Ad26.COV2.S.²⁷,²⁸ Passive surveillance systems such as VAERS have a number of important limitations and their data cannot be compared directly with findings from randomized or observational studies; findings, therefore, need to be interpreted in this context. The Vaccine Adverse Event Reporting System may be prone to biased reporting (overreporting or underreporting) and inconsistency in the quality and completeness of reports. The Vaccine Adverse Event Reporting System also generally cannot determine whether a vaccine caused an adverse event.¹² Stimulated reporting can occur after publicity around a potential adverse event, and adverse events occurring closer to vaccination or those more serious in nature may be reported more frequently.¹²

Our preliminary review of maternal safety for a booster dose of the mRNA COVID-19 vaccines from VAERS did not identify any new or unexpected adverse events and fills an important gap in COVID-19 vaccine safety information in pregnant people. The proportion of VAERS reports after a booster dose of the mRNA COVID-19 vaccines reporting specific adverse events was similar or less than published reports of pregnant people who received the primary series, and reporting rates for selected conditions were below background rates. Reported systemic and local reactions were frequent and similar to primary series dose given to pregnant people who also reported to VAERS. The CDC and the FDA will continue to closely monitor the safety of COVID-19 vaccines in pregnant people in VAERS, complementing the safety data from other vaccine safety active surveillance systems.¹¹,²⁹ Timely results from enhanced safety monitoring after COVID-19 vaccination continues to inform federal agencies, health care professionals, domestic immunization partners, and the public on the safety of these new vaccines in pregnant people.

REFERENCES
1. Thompson MG, Natarajan K, Irving SA, Rowley EA, Griggs EP, Gaglani M, et al. Effectiveness of a third dose of mRNA vaccines against COVID-19-associated emergency department and urgent care encounters and hospitalizations among adults during periods of delta and omicron variant predominance – VISION network, 10 states, August 2021-January 2022. MMWR Morb Mortal Wkly Rep 2022;71:139–45. doi: 10.15585/mmwr.mm7104e3
2. Mbaeyi S, Oliver SE, Collins JP, Godfrey M, Goswami ND, Hadler SC, et al. The Advisory Committee on Immunization Practices’ interim recommendations for additional primary and booster doses of COVID-19 vaccines—United States, 2021. MMWR Morb Mortal Wkly Rep 2021;70:1545–52. doi: 10.15585/mmwr.mm7044e2 external icon
3. U.S. Food and Drug Administration. COVID-19 vaccines. Accessed May 20, 2022. https://www.fda.gov/emergency-preparedness-and-response/coronavirus-disease-2019-covid-19/covid-19-vaccines
4. Centers for Disease Control and Prevention. Pregnant and recently pregnant people: at increased risk for severe illness from COVID-19. Accessed May 20, 2022. https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/pregnant-people.html
5. Centers for Disease Control and Prevention. Science brief: evidence used to update the list of underlying medical conditions that increase a person’s risk of severe illness from COVID-19. Accessed May 20, 2022. https://www.cdc.gov/coronavirus/2019-ncov/science/science-briefs/underlying-evidence-table.html
6. Allotey J, Stallings E, Bonet M, Yap M, Chatterjee S, Kew T, et al. Clinical manifestations, risk factors, and maternal and perinatal outcomes of coronavirus disease 2019 in pregnancy: living systematic review and meta-analysis BMJ 2020;370:m3320. doi: 10.1136/bmj.m3320
7. DeSisto CL, Wallace B, Simeone RM, Polen K, Ko JY, Meaney-Delman D, et al. Risk for stillbirth among women with and without COVID-19 at delivery hospitalization – United States, March 2020–September 2021. MMWR Morb Mortal Wkly Rep 2021;70:1640–5. doi: 10.15585/mmwr.mm7047e1
8. Centers for Disease Control and Prevention. COVID-19 vaccines while pregnant or breastfeeding. Accessed May 20, 2022. https://www.cdc.gov/coronavirus/2019-ncov/vaccines/recommendations/pregnancy.html
9. Shimabukuro TT, Kim SY, Myers TR, Moro PL, Oduyebo T, Panagiotakopoulos L, et al. Preliminary findings of mRNA Covid-19 vaccine safety in pregnant persons [published erratum appears in N Engl J Med 2021;385:1536]. N Engl J Med 2021;384:2273–82. doi: 10.1056/NEJMoa2104983
10. Centers for Disease Control and Prevention. V-safe After Vaccination Health Checker. Accessed May 20, 2022. https://www.cdc.gov/coronavirus/2019-ncov/vaccines/safety/v-safe.html
11. Centers for Disease Control and Prevention. V-safe COVID-19 Vaccine Pregnancy Registry. Accessed May 20, 2022. https://www.cdc.gov/coronavirus/2019-ncov/vaccines/safety/v-safe-pregnancyregistry.html
12. Shimabukuro TT, Nguyen M, Martin D, DeStefano F. Safety monitoring in the Vaccine Adverse Event Reporting System (VAERS). Vaccine 2015;33:4398–405. doi: 10.1016/j.vaccine.2015.07.035
13. Zache LH, Wallace B, Smoots AN, Olson CK, Oduyebo T, Kim SY, et al. Receipt of mRNA Covid-19 vaccines and risk of spontaneous abortion. N Engl J Med 2021;385:1533–5. doi: 10.1056/NEJMcm2113891
14. Kharbanda EO, Haapala J, DeSilva M, Vazquez-Benitez G, Vesco KK, Naleway AL, et al. Spontaneous abortion. N Engl J Med 2021;385:1533–5. doi: 10.1056/NEJMmc2113891
15. Lipkind HS, Vazquez-Benitez G, DeSilva M, Vesco KK, Ackerman-Banks C, Zhu J, et al. Receipt of COVID-19 vaccine during pregnancy and preterm or small-for-gestational-age at birth—eight integrated health care organizations, United States,
