Published in final edited form as:
J Womens Health (Larchmt). 2024 September ; 33(9): 1140–1150. doi:10.1089/jwh.2024.0364.

Building Capacity of Community Health Centers to Improve the Provision of Postpartum Care Services Through Data-Driven Health Information Technology and Innovation

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Abstract

Maternal morbidity and mortality remain significant challenges in the United States, with substantial burden during the postpartum period. The Centers for Disease Control and Prevention, in partnership with the National Association of Community Health Centers, began an initiative to build capacity in Federally Qualified Health Centers to (1) improve the infrastructure for perinatal care measures and (2) use perinatal care measures to identify and address gaps in postpartum care. Two partner health center-controlled networks implemented strategies to integrate evidence-based recommendations into the clinic workflow and used data-driven health information technology (HIT) systems to improve data standardization for quality improvement of postpartum care services. Ten measures were created to capture recommended care and services. To support measure capture, a data cleaning algorithm was created to prioritize defining pregnancy episodes and delivery dates and address data inconsistencies. Quality improvement activities targeted postpartum care delivery tailored to patients and care teams. Data limitations, including inconsistencies in electronic health record documentation and data extraction practices, underscored the complexity of integrating HIT solutions into postpartum care workflows. Despite challenges, the project demonstrated continuous quality improvement to support data quality for

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Authors' Contributions
L.R., P.B.C., J.D.M., R.U., J.O., K.C., and J.S. contributed to study design, data collection, analysis and interpretation, and article preparation. J.W.G., T.-Y.Y., M.W., A.O., and S.K. contributed to data collection, analysis, interpretation, and article preparation.

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The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the CDC.

Author Disclosure Statement
No other competing financial interests exist.

perinatal care measures. Future solutions emphasize the need for standardized data elements, collaborative care team engagement, and iterative HIT implementation strategies to enhance perinatal care quality. Our findings highlight the potential of HIT-driven interventions to improve postpartum care within health centers, with a focus on the importance of addressing data interoperability and documentation challenges to optimize and monitor initiatives to improve postpartum health outcomes.

Keywords

postpartum; health centers; EHR data; health information technology

Introduction

Maternal morbidity and mortality are major public health concerns in the United States.[1] There are significant racial and ethnic disparities in pregnancy-related death that persist regardless of age, education level, or geographic location.[2-4] The leading underlying causes of pregnancy-related death varied by race and ethnicity and are cardiac and coronary conditions among non-Hispanic Black persons, mental health conditions (including overdose related to substance use disorders) among Hispanic and non-Hispanic White persons, and hemorrhage among non-Hispanic Asian persons.[5] More than half of pregnancy-related deaths happen in the postpartum period (i.e., 1 week to 1 year after pregnancy), and 84% of pregnancy-related deaths were preventable.[5]

Efforts to identify and address the immediate health care needs for a person during the pregnancy and postpartum periods are critical for long-term health and well-being.[6] These efforts include helping health care providers make informed decisions for the care of the patient, supporting maternal care coordination and care provision, and developing data and clinical care quality improvement initiatives to improve the standardized documentation and follow-up of pregnancy and postpartum care services. Despite the importance of data to successfully identify, treat, and follow up with patients, critical data on pregnancy status and pregnancy outcomes are not standardized across electronic health records (EHRs). Efforts to develop standards in maternal health in the US Core Data for Interoperability (USCDI) and USCDI+ are occurring but not yet being implemented.[7-9]

In 2018, the Centers for Disease Control and Prevention (CDC), in partnership with the National Association of Community Health Centers (NACHC), began a 6-year initiative to build capacity in Federally Qualified Health Centers (FQHCs) to (1) improve the infrastructure for perinatal care management and measurement of perinatal care quality for health center patients to ultimately inform strategies to (2) use perinatal care measures to identify and address gaps in care around provision of clinically recommended postpartum services and transitions of care in community health centers.

Health centers are an important setting for implementing quality improvement[10] and supporting the interoperability of EHRs to improve the care of pregnant persons.[7,11-13] The Health Resources and Services Administration (HRSA) Health Center Program supports nearly 1,400 FQHCs that provide comprehensive primary health care to ~30.5 million patients at more than 15,000 service sites across the United States, including maternity services to more than 500,000 prenatal care patients.[14] Health centers are often located in areas where economic, geographic, or cultural barriers limit access to health care and serve as a critical safety net for certain populations, including those uninsured or insured by Medicaid and Medicare, migrant and agricultural workers, people experiencing homelessness, residents of public housing, and veterans.[15] NACHC, the national association dedicated to the support of community-based health centers and health care access for the medically underserved and uninsured, provides numerous supports to health centers and networks, including improvement of quality of care and using informatics and Health Information Technology (HIT) systems to improve data standardization for structured documentation and electronic measurement of quality improvement.[16,17]

In this project, NACHC worked across three partner Health Center-Controlled Networks (HCCNs) to build health center capacity to integrate evidence-based recommendations into the clinic workflow and use HIT systems to improve standardized documentation and measurement of quality improvement for the provision of postpartum care. In Year 1, activities focused on advancing the adoption of contraception clinical guidelines, developing a systems approach to identify and manage gestational diabetes, and understanding clinic and data workflows to improve pregnancy-related EHR data collection in health centers. Based on these initial experiences, in Years 2 and 3, the activities merged, and focus shifted to standardizing data capture, streamlining data extraction, and maximizing data output on postpartum care for clinical care quality improvement. NACHC developed a public health informatics data dictionary and built a cloud-based data infrastructure using HIT for data aggregation, data quality improvement, and innovation and implemented decision support tools to improve data quality and standardization. Two partner HCCNs, AllianceChicago and OCHIN, implemented strategies to document the pregnancy episode, a record linking encounters during the period of care from when the pregnancy is identified through the pregnancy outcome, and to integrate the delivery data from the delivery hospitalization into the EHRs at the health center. The analysis of extracted data and information was used to evaluate on demand data extraction, high-quality data capture, and use of data by health centers to drive clinical care quality improvement. In Years 4 and 5, the initiative expanded its scope to a broader spectrum of pregnancy-related care services associated with adverse pregnancy and postpartum outcomes and an additional HCCN joined the project. The efforts were focused to identify pregnancy episodes and expand the measurement of a broader range of perinatal care measures based on clinical and public health guidance and recommendations, including an initial postpartum visit, postpartum management of gestational diabetes mellitus (GDM), postpartum contraception counseling, management of hypertensive disorders of pregnancy and related outcomes, and postpartum depression screening and follow-up. In Year 6, the initiative is refining the implementation strategies to improve the quality of postpartum care, standardizing pregnancy-related data elements with EHR vendors, and developing a dissemination plan involving a communication strategy, learning communities, and collaboration with key partners to ensure sustained improvements in postpartum care quality.

This CDC report describes the initiative’s efforts to standardize perinatal care measures and to use the measures to identify and address gaps in postpartum care. We describe data quality improvement efforts to extract data from the EHR, establish baseline data, and identify and address interoperability challenges within health centers. We also highlight health centers' clinical care quality improvement efforts to identify gaps and improve postpartum care. Lessons learned are reported, emphasizing the potential for adaptation and scale-up of HIT tools in other health center networks. This initiative aligns with public health efforts for a comprehensive postpartum quality care approach in outpatient settings and activities to improve the care for hypertension in pregnant and postpartum persons.[18,19] Ensuring quality care for all pregnant and postpartum persons is a strategy for addressing pregnancy-related deaths and related disparities.[20,21]

Methods

Project partners

Partners included three HCCNs spanning multiple states and serving millions of patients in diverse geographic regions and populations. The two original partner HCCNs, AllianceChicago and OCHIN, with complete datasets between 2020 and 2022, are included in this report. Each partner managed and protected their respective health center EHR data. Partners were asked to extract and submit data in alignment with the project Data Dictionary (Supplementary Appendix S1) and standard Data Request (Supplementary Appendix S2) format from real patient data in their EHR systems. Partners were funded by NACHC to participate and to support FQHCs participating in the intervention.

Alongside the data submissions, partner health centers implemented evidence-based clinical interventions informed by the perinatal care measure data from the EHR to drive improvements in clinical workflows and closure of care gaps. One key component to support care teams was modifying the EHR front end to co-locate the documentation and view of pregnancy-related data and care activities.

Data extraction

Partners extracted data either directly from their EHR or from a connected data warehouse following business requirement rules established by the NACHC project team. Partners received two documents to guide their data extraction processes: (1) a Data Dictionary compiling value sets relevant to the project measures (Supplementary Appendix S1) and (2) a Data Request outlining the desired data structure and specifications (e.g., patient age, encounter types, dates of service) (Supplementary Appendix S2). The data dictionary consisted of EHR-structured values, codes, and names. Examples include the International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Clinical Modification for clinical diagnoses and conditions[22]; Logical Observation Identifiers Names and Codes for laboratory tests and specified screening instruments[23]; RxNorm codes, a standardized nomenclature for clinical drugs[24]; and National Drug Code product identifiers for medications.[25] Because this work focused on health centers, the formal data request aligned with the HRSA Uniform Data System framework,[26] used by health centers for their annual data reporting submission to HRSA and the USCDI regulatory requirements for certified EHRs, as the basis for demographic and social data.[8] Although the data dictionary and data request documents served as guides, partners were encouraged to submit relevant data that used additional codes or structured data fields within the EHR, and in other formats, when necessary.

Data governance

The exchange of data between HCCNs and NACHC adhered to Health Insurance Portability and Accountability Act guidelines through a Data Use Agreement (DUA) for a limited dataset, ensuring secure exchange, handling, and processing of data.[27] Dates of service and clinical activities were included, but all direct patient identifiers were encrypted or removed before transmission. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[28] NACHC's Data Governance Council reviewed and approved this activity.

Data processing and analytics

Project partners submitted EHR data securely to NACHC. The data were stored in a secure cloud-based server with Amazon Web Services and cleaned, validated, and streamlined into relational tables that resemble the structure of the EHR (e.g., patient table, medication table). The refined data were transferred to a database management tool for value standardization, analysis, and reporting.

Metrics for the project were calculated across unique pregnancies that ended in live birth. The pregnancy episode was defined by a documented delivery date or estimated delivery date when actual delivery date was not available. The initial dataset comprised 243,635 estimated or documented delivery dates for 141,929 patients. The dataset was cleaned using a two-phase, stepwise process that prioritized documented delivery dates over estimated dates, excluded pregnancies with a defined early pregnancy loss or stillbirth outcome, excluded records documented on an encounter date during the first trimester or more than 12 weeks after the delivery date, and de-duplicated records to adjust the defined delivery date if another record documented a delivery date within 45 days after for the same patient and excluded records indicating incomplete pregnancies, with a delivery date 45–200 days after another record for the same patient (Fig. 1). For this report, the data were filtered to only deliveries with an estimated or recorded delivery date in 2020–2022 and patients between the ages of 15 and 44 years at the time of delivery (96,919). Some patients had multiple deliveries within the project time period; the total number of unique patients in the final dataset is 90,876.

Additional data elements included diagnoses, procedure codes, lab tests, and medications (Supplementary Appendix S1). Records submitted without standard terminologies were semantically linked and mapped to the nearest applicable standard term and code for quality measure analysis.

Measure definitions

Measures were defined based on clinical and public health guidance on components of postpartum care,[6,29-40] priorities identified by health centers, and addressing conditions associated with maternal morbidity and mortality. We explored the feasibility of building and implementing nine digital perinatal care measures using the extracted EHR data from project partners, including two prenatal measures as process predecessors of postpartum care quality (Table 1). The measures included a postpartum visit within 8 weeks after delivery, contraceptive counseling and provision within 6 weeks after delivery, postpartum depression screening, postpartum depression treatment, screening for gestational hypertension, high-risk hypertensive disorder outcomes, high-risk hypertensive disorder postpartum follow-up, aspirin therapy for hypertensive high-risk pregnancies, and diabetes screening in the postpartum period for women with GDM-affected pregnancies. All measurements were calculated using structured data included in the data dictionary and extracted from the EHR. Where appropriate, NACHC selected the measures from existing national quality measure programs (e.g., Healthcare Effectiveness Data and Information Set performance measure) and evidence-based clinical guidelines or recommendations (e.g., American College of Obstetricians and Gynecologists). Using a Human-Centered Design Framework,[41] feedback from project partners on the challenges of implementing the postpartum strategies and capturing the necessary elements for the care measures within EHR systems were used to refine and finalize the quality measures.

Quality improvement strategy implementation

The partners used the baseline perinatal care measures to design and implement clinical interventions and systems changes to the EHR (e.g., staff training, data capture, data visualization, clinical decision support, customize EHR interface) to drive improvements in clinical workflows, patient engagement, and the closure of care gaps related to postpartum care. Partners had flexibility to tailor interventions to their local needs and clinic workflows, informed by health center staff.

Results

Between January 2020 and December 2022, 90,876 patients and 96,919 pregnancies were identified and included in the dataset, respectively (Table 2). About one-third of pregnancies (34.4%) occurred in people aged 15–24 years, 28.2% in people 25–29 years, and 37.3% in people 30–44 years. More than half of the pregnancies occurred in people identified as Hispanic/Latino (62.3%), followed by Black/African American (14.7%), White (12.5%), and Asian (4.5%). In total, 42.4% of the pregnancies occurred in people whose preferred language was one other than English. There was significant missingness of financial (23.8%) and insurance data (20.3%); however, at least 52.1% of pregnancies occurred in people who lived at or below 100% of the federal poverty level, and 65.3% were insured by Medicaid.

Project partners convened multidisciplinary teams of clinicians, data analysts, and informaticists to identify local challenges and determine which recommended quality improvement activities could be implemented, focusing on HIT systems improvement efforts to support improving postpartum care (Table 3). Some activities focused on improving data quality for perinatal care measures, such as closing out open pregnancy episodes and development of new registries to support postpartum follow-up. Other clinical care quality improvement activities focused on addressing gaps in postpartum care, such as delivering text messages to patients with reminders to schedule postpartum care appointments and implementing a standard protocol for postpartum depression screening.

In general, the longitudinal capture of perinatal care measures shows overall improvement over time. Data capture and extraction of several measures were incomplete at the start of the project, but over time data missingness was improved for measures through data validation and clinical support interventions (Table 4). Contraceptive counseling and provision and screening for gestational diabetes were the initial measures, and data capture for these measures was higher at the beginning of the measurement period. In contrast, data capture for postpartum depression screening and treatment, gestational hypertension, and aspirin therapy, which were later added as measures, was much lower but increased the most over the duration for the project. The combination of targeted clinical support and data extraction adjustments improved the postpartum depression screening measure from 0% (no data) in 2020 to 22.8% (8,316) in 2022, based on EHR records. Similarly, the postpartum depression treatment measure increased from 7.8% in 2020 to 15.2% in 2022, gestational hypertension screening from 2.3% to 40.0%, and aspirin therapy from 0.1% to 10.5%, according to EHR records. Other measures, such as postpartum visits within 8 weeks after delivery, contraceptive counseling, and the identification of persons with high-risk hypertensive outcomes, were steady across the project period.

Discussion

Because the US maternal health crisis continues to have persisting health disparities and worsening health outcomes, there is renewed focus on supporting patients and care teams in improving health outcomes and reducing disparities.[1,20] Existing efforts to improve quality maternal health care, such as the Perinatal Quality Collaborative program[42] and the Alliance for Innovation on Maternal Health,[43] have focused primarily on health care quality at the delivery hospitalization. It is important to support postpartum care, when more than half of pregnancy-related death occurs, particularly for populations with the greatest disparities.[5,44]

This project assessed opportunities to improve the quality of postpartum care in the outpatient setting of health centers. At the initiation of the project, NACHC and its partners identified several pregnancy-related data elements underreported or absent from the EHR, making it difficult to calculate accurate measures and implement and monitor quality improvement activities in postpartum care. Our project partners reported that the current support available for maternal quality and care coordination is inadequate to provide the care team with an effective clinic workflow and the information to close care gaps. By Year 5, NACHC’s partners demonstrated that collection of perinatal-related data elements into EHR structured fields was feasible, which enabled them to more accurately assess the quality of the selected postpartum areas of concern and implement activities to improve service delivery. However, the absence of requirements for pregnancy data standards in EHRs remains a barrier. Specifically, current EHR systems lack interoperability and standards designed for managing information related to pregnancy, childbirth, and postpartum care. Such deficiency leads to poor data completeness, low standardization, and a lack of functionality to support optimal postpartum care in outpatient obstetric settings. NACHC and health center partners continue to support the advancement of these standards in HIT products.[7-9] However, informatics and data strategies to convert electronic and paper-based records (i.e., nonstructured data) to automatically import relevant information to mapped, structured data fields linked to standard terminology codes within a data warehouse, and the

EHR system could reduce the burden on local teams to reinput and abstract these data and allow for messages and dashboards to alert care teams to inpatient encounters and deliveries through a clinical decision support system.

In addition, there are remaining gaps owing to the intentional absence of nonstructured documentation, which was not collected owing to data privacy risks. The accuracy of some of the metrics cannot be fully accounted for without this nonstructured data. However, data gaps that could be resolved with structured data were addressed by providing feedback to the partners and expanding the requested data elements and value sets. Ongoing work to identify relevant data elements and improve extraction and consolidation may impact the results. NACHC, the HCCN partners, and subject matter experts collaborated to determine extensions of the clinical content of the measures and the addition of new measures.

Using a quality improvement strategy that includes better collection of pregnancy data, the capture of perinatal care measures increased progressively in some areas, demonstrating the value of continuous data quality improvement in reaching better outcomes. It also demonstrates how the implementation of clinical care quality improvement efforts can drive improvements in documentation and data capture. A best practice at the initiation of this activity was to have a multidisciplinary team, with a shared goal of aligning processes and measures and identifying clinic workflow and data challenge points.

Our findings suggest that focusing initially on a subset of target measures, including process measures focused on documentation of actual delivery dates to indicate when postpartum follow-up should occur, can create a foundation to track real improvements in care and close data quality gaps. For example, an estimated rather than actual delivery date would shift the measurement timeframe of the numerator criteria and may mask patients who satisfied the measure otherwise. Additional effort in the documentation and extraction of the clinical data elements and measure refinement would likely increase performance of the selected measures. Identifying an initial clinical quality measure set can be led by the multidisciplinary team and include consideration around local patterns of pregnancy-related comorbidities, challenges identified by care team members, and data on maternal mortality available from state Maternal Mortality Review Commissions.[20,38] Identifying pilot sites helps reduce the initial level of effort and allows improvements to be implemented with less burden on the organization. Creating clinical dashboards to guide care teams in their progress is a best practice which supports other staff who provide care coordination to do additional patient outreach and supports measure validation activities (e.g., chart reviews). Health equity goals, such as reducing disparities or addressing health-related social needs, can be included in the monitoring of stratified measure results to ensure new processes reduce inequity instead of reinforcing it.

Furthermore, initial and ongoing training is pivotal for the effective use of pregnancy and postpartum modules in the EHR, facilitating ongoing feedback and allowing adjustments to clinic workflows. Some care gaps require the addition of patient outreach and support. Efforts such as targeted text messaging using EHR data elements can enhance patient outreach, whereas prenatal and postpartum navigators can play a vital role in educating patients, filling data gaps, and facilitating comprehensive care, including social needs coordination. As new measures are onboarded, clinical efforts to support care coordination and train and equip care teams with tools can be implemented in phases until goals are met and sustained. Quality improvement frameworks can also be used to support the delivery of high-quality patient care and improved patient outcomes.[45]

Ongoing monitoring of these measures is key to identifying new gaps in the data or care process that may occur after the initial monitoring period. In our data, despite the general trend of improvement over time, there were measures and periods of time where the capture of performance measures decreased. Our findings reinforce the importance of supporting ongoing monitoring of measures longitudinally, including reviewing patient volume by site, performing chart reviews, and following-up with training and care coordination activities.[46]

The findings in this report are subject to several limitations related to the completeness and accuracy of reported perinatal measures. First, interoperability challenges impact data capture in the pregnancy and postpartum period. Hospital-level information from the delivery encounter is seldom electronically transmitted to the health center's system in structured data. This results in the care team redocumenting paperwork data or manually verifying the delivery by contacting the patient or hospital. EHR systems also lacked effective tools for documenting and linking multiple encounters within a single pregnancy episode. These data challenges and existing clinical workflows led to inconsistencies in critical pregnancy data, causing patients to have multiple estimated delivery dates close to each other. NACHC addressed this by developing an algorithm to prioritize reported delivery dates, selecting the most recent estimated date if unavailable, and excluding additional dates within months of the final accepted date. In addition, health centers reported building workflows to assist care team members in documenting and closing pregnancy episodes to address this gap. Second, significant missing data may arise from unstructured information (e.g., progress notes), as extracting structured data from such sources is not a routine practice in electronic health care documentation. Third, metrics for the project focused on postpartum care delivery and were calculated across unique pregnancies that ended with a live birth; women experiencing a stillbirth or pregnancy loss may still need postpartum care services. Finally, this analysis is limited to data that were available to NACHC and may not reflect the full extent of data available to the partners directly.

Conclusion

Our findings highlight the challenges to measure and improve postpartum care in outpatient health center settings. However, health centers are key partners for implementing quality improvement activities that align with evidence-based clinical guidance and recommendations. HIT is an integral part of these activities, with priority on documenting the pregnancy episode in the EHR and supporting users providing postpartum care with EHR systems tailored for dedicated clinical decision support. Documentation of pregnancy episodes and outside data from inpatient delivery sites that automatically populate delivery dates and delivery outcomes can support the outpatient care team to close the pregnancy episode and initiate follow-up to patients who should receive postpartum care services. Incomplete pregnancy-related data in outpatient settings continues to limit care and coordination. Health organizations who choose to make incremental, longitudinal actions to monitor these data can see improvements over time in their quality measure performance and care team effectiveness.[47] The infrastructure and strategies used in this project may translate to other areas of health care and provide value for organizations moving toward value-based care.[48] The multidisciplinary approach to data and clinical care quality improvement yields the opportunity to align organizational goals and improve the delivery of postpartum care in settings that serve communities disproportionately impacted by poor outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

The authors would like to acknowledge the following individuals and organizations who contributed to various aspects of this initiative: Kathy McNamara, Ron Yee, John Gresh, Crystal Nwachuku, Noah Pierce, and Andrea Price (National Association for Community Health Centers); AllianceChicago; OCHIN; Aliados Health; California Maternal Quality Care Collaborative, Monterey County; Southern Jersey Family Medical Centers Inc.; TrueCare; Clinica Romero; and LifeLong Medical Care.

Funding Information

This project was funded by the CDC (CDC-RFA-OT18–1802).

Data Availability Statement

As per the DUA, the data underlying this article cannot be shared publicly owing to ownership by individual health centers serving medically underserved or uninsured, minority, and marginalized communities across the United States. These health centers have different policies, and agreements around data sharing to protect these communities, and have agreed to participate in this project with the condition that their data be shared only in aggregate to further protect the communities they serve.

References

1. The White House. White House Blueprint for Addressing the Maternal Health Crisis. 2022. Available from: Maternal-Health-Blueprint.pdf (whitehouse.gov) [Last accessed: March 8, 2024].
2. Petersen EE, Davis NL, Goodman D, et al. Racial/ethnic disparities in pregnancy-related deaths—United States, 2007–2016. MMWR Morb Mortal Wkly Rep 2019;68(35):762–765; doi: 10.15585/mmwr.mm6835a3 [PubMed: 31487273]
3. Centers for Disease Control and Prevention. Pregnancy Mortality Surveillance System 2024. Available from: https://www.cdc.gov/reproductivehealth/maternal-mortality/pregnancy-mortality-surveillance-system.htm [Last accessed: March 8, 2024].
4. Merkt PT, Kramer MR, Goodman DA, et al. Urban-rural differences in pregnancy-related deaths, United States, 2011–2016. Am J Obstet Gynecol 2021;225(2):183.e1–e16; doi: 10.1016/j.ajog.2021.02.028
5. Trost S, Beauregard J, Chandra G, et al. Pregnancy-related deaths: Data from maternal mortality review committees in 36 US states, 2017–2019. Available from: Pregnancy-Related Deaths: Data from Maternal Mortality Review Committees in 36 US States, 2017–2019 (reviewtoaction.org). [November 6, 2023].
6. McKinney J, Keyser L, Clinton S, et al. ACOG committee opinion No. 736: Optimizing postpartum care. Obstet Gynecol 2018;132(3):784–785; doi: 10.1097/AOG.0000000000002633

7. Office of the National Coordinator for Health Information Technology. Interoperability of Maternity Health Care Records: Best Practices Informational Resource. 2024. Available from: https://www.healthit.gov/sites/default/files/page/2024-03/FY23%20ONC%20Maternity%20Care%20Info%20Resource%20Guide_508%20%281%29.pdf
8. Office of the National Coordinator for Health Information Technology. United States Core Data for Interoperability (USCDI). 2024. Available from: https://www.healthit.gov/isa/united-states-core-data-interoperability-uscdi [Last accessed: March 18, 2024].
9. Office of the National Coordinator for Health Information Technology. United States Core Data for Interoperability (USCDI)+. 2024. Available from: https://uscdiplus.healthit.gov/uscdi.
10. Health Resources and Services Administration. Clinical Quality Improvement. 2023. Available from: https://bphc.hrsa.gov/technical-assistance/clinical-quality-improvement [Last accessed: March 18, 2024].
11. Centers for Disease Control and Prevention. Sampling Procedures for the Collection of Electronic Health Record Data From Federally Qualified Health Centers, 2021–2022 National Ambulatory Medical Care Survey. 2023. Available from: https://www.cdc.gov/nchs/data/series/sr_02/sr02-203.pdf [Last accessed: March 19, 2024].
12. Office of the Assistance Secretary for Planning and Evaluation. Enhancing Surveillance of Maternal Health Clinical Practices and Outcomes with Federally Qualified Health Centers' (FQHCs) Electronic Health Records Visit Data. 2024. Available from: https://aspe.hhs.gov/enhancing-surveillance-maternal-health-clinical-practices-outcomes-federally-qualified-health [Last accessed: March 18, 2024].
13. Office of the Assistance Secretary for Planning and Evaluation. Linking Federally Qualified Health Center EHR and TMSIS Implementing. 2024. Available from: https://aspe.hhs.gov/linking-federally-qualified-health-center-ehr-medicaid-data [Last accessed: March 18, 2024].
14. Health Resources and Services Administration. 2022 Uniform Data System Trends Data Brief. 2023. Available from: https://bphc.hrsa.gov/sites/default/files/bphc/data-reporting/2022-uds-trends-data-brief.pdf [Last accessed: March 5, 2024].
15. Health Resources and Services Administration. HRSA Health Center Program: Impact and Growth. 2020. Available from: https://bphc.hrsa.gov/sites/default/files/bphc/about/healthcenterfactsheet.pdf [Last accessed: March 5, 2025].
16. National Association of Community Health Centers. Health Information Technology: Clinical Informatics. 2023. Available from: https://www.nachc.org/resource/informatics-strengths-explainer/ [Last accessed: March 20, 2024].
17. Romero L, Carneiro PB, Riley C, et al. Building capacity of community health centers to overcome data challenges with the development of an agile COVID-19 public health registry: A multistate quality improvement effort. J Am Med Inform Assoc 2021;29(1):80–88; doi: 10.1093/jamia/ocab233 [PubMed: 34648005]
18. National Institutes of Health. Pathways to Prevention (P2P) Program: Identifying Risks and Interventions to Optimize Postpartum Health. 2023. Available from: https://prevention.nih.gov/research-priorities/research-needs-and-gaps/pathways-prevention/identifying-risks-and-interventions-optimize-postpartum-health [Last accessed: March 20, 2024].
19. Centers for Disease Control and Prevention. Million Hearts: Focusing on Health Equity. 2023. Available from: https://millionhearts.hhs.gov/about-million-hearts/health-equity/index.html [Last accessed: March 20, 2024].
20. Centers for Disease Control and Prevention. State Strategies for Preventing Pregnancy-Related Deaths: A Guide for Moving Maternal Mortality Review Committee Data to Action. 2022. Available from: https://www.cdc.gov/reproductivehealth/maternal-mortality/preventing-pregnancy-related-deaths/state-strategies.html [Last accessed: March 8, 2024].
21. Centers for Medicare & Medicaid Services. Maternity Care Action Plan. 2023. Available from: https://www.cms.gov/files/document/cms-maternity-care-action-plan.pdf [Last accessed: March 11, 2024].
22. Centers for Disease Control and Prevention. International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM). 2023. Available from: https://www.cdc.gov/nchs/icd/icd-10-cm.htm [Last accessed: February 23, 2024].

23. LOINC. The international standard for identifying health measurements, observations, and documents. 2024. Available from: https://loinc.org/ [Last accessed: February 23, 2024].
24. RxNorm. Product, Program, and Project Descriptions. 2021. Available from: https://www.nlm.nih.gov/research/umls/rxnorm/index.html [Last accessed: February 23, 2024].
25. US Food and Drug Administration. National Drug Code Directory. 2022. Available from: https://www.fda.gov/drugs/drug-approvals-and-databases/national-drug-code-directory [Last accessed: February 23, 2024].
26. Health Resources and Services Administration. Uniform Data System (UDS) Resources. 2021. Available from: https://bphc.hrsa.gov/datareporting/reporting/index.html [Last accessed: March 5, 2024].
27. US Department of Health and Human Services. Health Information Privacy. 2017. Available from: https://www.hhs.gov/hipaa/for-professionals/special-topics/research/index.html [Last accessed: March 20, 2024].
28. US Department of Health and Human Services. 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. §3501 et seq. Available from: Regulations | HHS.gov [Last accessed: February 6, 2024].
29. National Committee for Quality Assurance. Prenatal and Postpartum Care (PPC). 2024. Available from: https://www.ncqa.org/hedis/measures/prenatal-and-postpartum-care-ppc/ [Last accessed: March 8, 2024].
30. American College of Obstetricians and Gynecologists. ACOG Practice Bulletin No. 201: Pregestational diabetes mellitus. Obstetrics & Gynecology 2018;132(6):e228–e48; doi: 10.1097/AOG.0000000000002960 [PubMed: 30461693]
31. National Committee for Quality Assurance. Postpartum Depression Screening and Follow-up (PDS-E). 2024. Available from: https://www.ncqa.org/hedis/measures/postpartum-depression-screening-and-follow-up/ [Last accessed: March 11, 2024].
32. American College of Obstetricians and Gynecologists. ACOG Practice Bulletin No. 202: Gestational hypertension and preeclampsia. Obstet Gynecol 2019;133(1):1; doi: 10.1097/AOG.0000000000003018
33. American College of Obstetricians and Gynecologists. ACOG Practice Bulletin No. 203: Chronic hypertension in pregnancy. Obstet Gynecol 2019;133(1):e26–e50; doi: 10.1097/AOG.0000000000003020 [PubMed: 30575676]
34. American College of Obstetricians and Gynecologists. ACOG Practice Bulletin, Number 222: Gestational hypertension and preeclampsia. Obstet Gynecol 2020;135(6):e237–e60; doi: 10.1097/AOG.0000000000003891 [PubMed: 32443079]
35. American College of Obstetricians and Gynecologists. ACOG Practice Bulletin, Number 231: Multifetal gestations: Twin, triplet, and higher-order multifetal pregnancies. Obstet Gynecol 2021;137(6):e145–e62; doi: 10.1097/AOG.0000000000004397 [PubMed: 34011891]
36. American College of Obstetricians and Gynecologists. ACOG Committee Opinion No. 743: Low-dose aspirin use during pregnancy. Obstet Gynecol 2018;132(1):e44–e52; doi: 10.1097/AOG.0000000000002708 [PubMed: 29939940]
37. Davidson KW, Barry MJ, Mangione CM, et al. Aspirin use to prevent preeclampsia and related morbidity and mortality: US. Jama2021;326(12):1186–1191; doi: 10.1001/jama.2021.14781 [PubMed: 34581729]
38. California Maternal Quality Care Collaborative. Hypertensive disorders of pregnancy toolkit. 2021. Available from: https://www.cmqcc.org/resources-tool-kits/toolkits/HDP [Last accessed: March 11, 2024].
39. Gibson KS, Combs CA, Bauer S, et al. Society for maternal-fetal medicine special statement: Quality metric for timely postpartum follow-up after severe hypertension. Am J Obstet Gynecol 2022;227(3):B2–b8; doi: 10.1016/j.ajog.2022.05.045
40. American College of Obstetricians and Gynecologists. ACOG Practice Bulletin No. 190: Gestational diabetes mellitus. Obstet Gynecol 2018;131(2):e49–e64; doi: 10.1097/AOG.0000000000002501 [PubMed: 29370047]
41. Righi C, James J. User-centered design stories: real-world UCD case studies. Elsevier; 2010.

42. Centers for Disease Control and Prevention. Perinatal Quality Collaboratives. 2023. Available from: https://www.cdc.gov/reproductivehealth/maternalinfanthealth/pqc.htm [Last accessed: February 6, 2024].

43. Alliance for Innovation on Maternal Health. AIM Patient safety Bundles. 2024. Available from: https://saferbirth.org/ [Last accessed: February 6, 2024].

44. Callahan T, Zaharatos J, St Pierre A, et al. Enhancing reviews and surveillance to eliminate maternal mortality. J Womens Health (Larchmt) 2021;30(8):1068–1073; doi: 10.1089/jwh.2021.0357 [PubMed: 34410869]

45. Reed JE, Davey N, Woodcock T. The foundations of quality improvement science. Future Hosp J 2016;3(3):199–202; doi: 10.7861/futurehosp.3-3-199 [PubMed: 31098226]

46. Kearney LK, Wray LO, Dollar KM, et al. Establishing measurement-based care in integrated primary care: Monitoring clinical outcomes over time. J Clin Psychol Med Settings 2015;22(4):213–227; doi: 10.1007/s10880-015-9443-6 [PubMed: 26645091]

47. D'Amore JD, McCrary LK, Denson J, et al. Clinical data sharing improves quality measurement and patient safety. J Am Med Inform Assoc 2021;28(7):1534–1542; doi: 10.1093/jamia/ocab039 [PubMed: 33712850]

48. Teisberg E, Wallace S, O'Hara S. Defining and implementing value-based health care: A strategic framework. Acad Med 2020;95(5):682–685; doi: 10.1097/ACM.0000000000003122 [PubMed: 31833857]

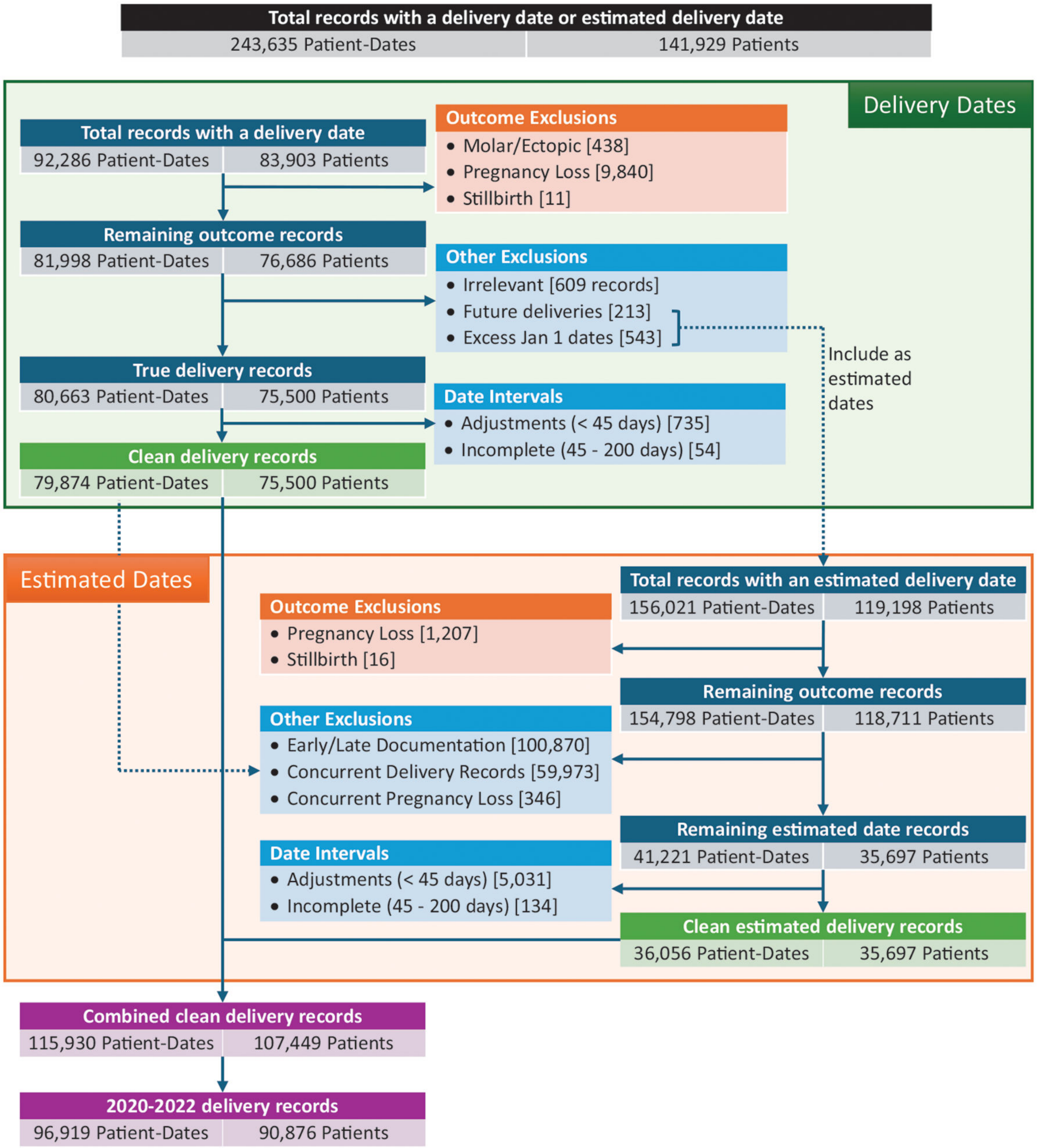

FIG. 1.

Delivery date data cleaning and processing flowchart.

Table 1.

Perinatal Care Measures: Definitions

Measure domain, name, description	**Denominator, exclusions**	**Numerator**
Postpartum Visit		
Postpartum visit within 8 and 12 weeks after delivery	All patients, regardless of age, who gave birth during a 12-month period.	Patients in the denominator seen for postpartum care visit within 8 and 12 weeks of delivery.
Percent of patients who had a postpartum care visit within 8 weeks after delivery.	Exclusions: None	
Source: American College of Obstetricians and Gynecologists (ACOG). Committee Opinion 736. Optimizing Postpartum Care[6]; National Committee for Quality Assurance. Postpartum visit at 12 weeks (Healthcare Effectiveness Data and Information Set [HEIDIS]).[29]		
Postpartum Contraception		
Contraceptive counseling and provisions within 6 weeks after delivery Percent of patients who were provided family planning and contraceptive counseling and education within 6 weeks postpartum.	All patients, regardless of age, who gave birth during a 12-month period. Exclusions: None	Patients in the denominator who were provided family planning and contraceptive counseling and education (including provision of contraception, if necessary) before or at 6 weeks postpartum.
Source: ACOG Committee Opinion 736. Optimizing Postpartum Care.[6]		
Diabetes Screening		
Diabetes screening for women with gestational diabetes mellitus (GDM)-affected pregnancies Percent of patients who were diagnosed with gestational diabetes during pregnancy who had a glucose screen within 12 weeks after delivery or any diabetes screen within 6 months.	All patients, regardless of age, who gave birth during a 12-month period and had a gestational diabetes diagnosis during pregnancy. Exclusions: Patients with preexisting diabetes mellitus before pregnancy	Patients in the denominator who were screened with a glucose screen before or at 12 weeks postpartum. Patients in the denominator who were screened with any diabetes screen before or at 6 months postpartum.
Source: ACOG Practice Bulletin No. 190: Gestational Diabetes Mellitus.[40]		
Postpartum Depression and Screening and Follow-up		
Postpartum depression screening Percent of patients who were screened for postpartum depression before or at 8 weeks postpartum.	All patients, regardless of age, who gave birth during a 12-month period. Exclusions: Patients with preexisting mental illness	Patients in the denominator who were screened for postpartum depression before or at 8 weeks postpartum.
Source: Postpartum Depression Screening and follow-up (HEDIS).[31]		
Postpartum depression treatment Percent of patients with a postpartum depression diagnosis who are prescribed an anti-depressant medication or seen by or referred to behavioral health.	Patients with a postpartum depression diagnosis within 8 weeks after delivery. Exclusions: Patients with preexisting mental illness	Patients prescribed selective serotonin reuptake inhibitor (SSRI)/serotonin and norepinephrine reuptake inhibitor (SNRI)/ bupropion or referred for follow-up mental health appointments within 30 days of screening and diagnosis.
Source: Postpartum Depression Screening and follow-up (HEDIS).[31]		
Hypertension Screening and Care		
Screening for gestational hypertension Percent of patients with pregnancy after 20 weeks with a blood pressure (BP) measurement screening for gestational hypertension.	All patients, regardless of age, with pregnancy at or past 20 weeks of gestation up until delivery. Exclusions: None	Patients in the denominator who had BP screening.

Measure domain, name, description	Denominator, exclusions	Numerator
Source: ACOG Practice Bulletin No. 201: Pregestational Diabetes Mellitus[30]; ACOG Practice Bulletin 202: Gestational Hypertension and Preeclampsia[32]; ACOG Practice Bulletin 203: Chronic Hypertension in Pregnancy[33]; ACOG Practice		
Bulletin 222: Gestational Hypertension and Preeclampsia[34]; ACOG Practice Bulletin, Number 231: Multifetal Gestations: Twin, Triplet, and Higher-Order Multifetal Pregnancies[35]; ACOG Committee Opinion No. 743: Low-Dose Aspirin Use During Pregnancy.[36]		
Hypertension Screening and Care		
Aspirin therapy for hypertensive high-risk pregnancies Percent of patients who are diagnosed with pregnancy-related or previously diagnosed hypertension (HTN) or previous preeclampsia/eclampsia who are prescribed aspirin 81 mg orally daily.	Pregnant patients with chronic HTN, gestational HTN, or history of preeclampsia or eclampsia. Exclusions: None	Patients in the denominator with documentation of low-dose aspirin (81 mg) prescribed or on medication list.
Source: Davidson KW, Barry MJ, Mangione CM, et al. Aspirin Use to Prevent Preeclampsia and Related Morbidity and Mortality: US Preventive Services Task Force Recommendation Statement. JAMA.[37] Sep 28;326 (12):1186–1191; ACOG Practice Bulletins: 202, 203, 222, 231, and Committee Opinion: 743.[32-36]		
High-risk hypertensive disorder outcomes Percent of hypertensive pregnant patients who have a higher risk factor for developing moderate-to-severe hypertensive morbidity/sequela.	Pregnant patients with chronic hypertension, gestational hypertension, preeclampsia, and eclampsia. Exclusions: None	Patients in the denominator with BP >160/110 or diagnosis of preeclampsia, eclampsia or Hemolysis, Elevated Liver enzymes and Low Platelets (HELLP) syndrome.
Source: ACOG Practice Bulletins: 202, 203, 222, 231, and Committee Opinion: 743.[32-36]; California Maternal Quality Care Collaborative (CMQCC).[38]		
High-risk hypertensive disorder postpartum follow-up Percent of hypertensive pregnant patients who had a documented follow up with appropriate screenings in a 7-day time frame.	Pregnant patients with chronic hypertension, gestational hypertension, preeclampsia, and eclampsia. Exclusions: None	Patients in the denominator with 7 day follow-up after delivery (BP check and symptom check).
Source: ACOG Committee Opinion No. 736: optimizing postpartum care. Obstet Gyneco[6];131:e140–50; Society for Maternal-Fetal Medicine (SMFM); Gibson KS, Combs CA, Bauer S, et al; SMFM Patient Safety and Quality Committee. Quality metric for timely postpartum follow-up after severe hypertension. Am J Obstet Gynecol.[39] Sep;227 (3):B2–B8.		

Table 2.

Demographics and Social Characteristics Extracted from the Electronic Health Record of All Pregnancies Identified from January 2020 to December 2022[a]

	n	%
Pregnancies	96,919	
Age		
15–19	9,212	9.5
20–24	24,167	24.9
25–29	27,300	28.2
30–34	21,599	22.2
35–39	11,755	12.1
40–44	2,926	3.0
Race/Ethnicity		
Hispanic/Latino	60,359	62.3
Black/African American	14,260	14.7
White	12,147	12.5
Asian	4,317	4.5
Native Hawaiian or Pacific Islander	793	0.8
American Indian/Alaskan Native	467	0.5
Another race or multiracial	1,137	1.2
Unreported/Chose not to disclose	3,439	3.5
Sexual Orientation		
Heterosexual (or straight)	69,514	71.7
Bisexual	1,155	1.2
Lesbian or gay	216	0.2
Other	204	0.2
Unreported or unknown	25,830	26.7
Federal Poverty Level		
100% and below	50,473	52.1
101–150%	10,875	11.2
151–200%	5,142	5.3
Over 200%	7,316	7.5
Unreported or unknown	23,113	23.8
Insurance Type		
Medicaid	63,278	65.3
Medicare	278	0.3
Other public insurance	2,328	2.4
Private insurance	9,145	9.4
None/Uninsured	2,169	2.2
Unreported or unknown	19,721	20.3
Preferred Language		
English	55,716	57.5

	n	%
Non-English	41,074	42.4
Unreported	129	0.1

[a] Total number of unique patients is 90,876.

Table 3.

Quality Improvement Activities Implemented by Health Centers to Improve Postpartum Care

Quality improvement activity	Type of quality improvement
Built a dedicated section of the electronic health record (EHR) (a “Postpartum Express Lane” and a “Postpartum Navigator”) to bring together postpartum data for users (i.e., physician, nurse) to see critical pregnancy-related data, and document or act on recommended postpartum care activities	Data quality improvement (e.g., improvement in measures, data quality)
Required users to close open pregnancy episodes by documenting missing delivery data	Data quality improvement
Deployed a text messaging intervention to remind patients to schedule a postpartum visit, one that includes mental health screening	Clinical care quality improvement (e.g., postpartum care services)
Implemented a standard protocol for postpartum depression screening, the Edinburgh Postnatal Depression Scale (EPDS), for women’s health providers to use with an electronic referral for all patients diagnosed with depression	Clinical care quality improvement
Added support staff for clinical areas that had originally been outside of project scope (e.g., anemia and lactation services	Clinical care quality improvement
Reconfigured the health center-controlled network’s (HCCN) population health tool to include data elements for birth, delivery date, and postpartum services, which lead the HCCN to develop a list of patients to be called to remind them to come back to the clinic for postpartum care	Clinical care quality improvement
Developed, refined, and implemented definitions for high-risk hypertension disorder outcomes in multiple domains to enable early follow-up care and active management of risk during and after pregnancy	Data quality improvement

Table 4.

Capture of Perinatal Care Measures in Electronic Health Records in Two Participating Health Center Controlled Networks from 2020 to 2022[a]

Year	2020		2021		2022	
Total deliveries	30,827		29,606		36486	
Measure Name						
Postpartum visit within 8 weeks after delivery	14,597	47.4%	19,567	66.1%	15665	42.9%
Contraceptive counseling and provisions within 6 weeks after delivery	4,079	13.2%	4,971	16.8%	5388	14.8%
Postpartum depression screening[b]	0	0.0%	3,890	13.1%	8316	22.8%
Postpartum depression treatment[b,c]	8 (103)	7.8%	63 (384)	16.4%	129 (847)	15.2%
Screening for gestational hypertension[b]	712	2.3%	2,532	8.6%	14596	40.0%
Aspirin therapy for hypertensive high-risk pregnancies[b,c]	1 (851)	0.1%	41 (910)	4.5%	135 (1286)	10.5%
High-risk hypertensive disorder outcomes[c]	134 (1,277)	10.5%	193 (1,599)	12.1%	205 (1963)	10.4%
High-risk hypertensive disorder postpartum follow-up[c]	235 (712)	33.0%	331 (716)	46.2%	300 (1069)	28.1%
Diabetes screening by 12 weeks postpartum[c]	170 (1,319)	12.9%	273 (1,687)	16.2%	149 (1234)	12.1%
Diabetes screening by 6 months postpartum[c]	418 (1,319)	31.7%	611 (1,687)	36.2%	351 (1234)	28.4%

[a] Data extracted using the electronic health record (EHR).

[b] Low numerators and percentages in the early years are primarily attributed to documentation and data availability.

[c] Percentage values for these measures are not among total population but among subgroups (denominators in parentheses) to which the measure applies. All other measures use the total deliveries count as the denominator. Measure definitions can be found in Table 1.