

RMOMS-SD: An Integrated Obstetric Care Model to Improve Maternal Health Outcomes in Rural Populations

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Abstract

Background

Rural America continues to experience a maternal health crisis as obstetric healthcare deserts grow and workforce shortages continue to rise. The RMOMS-SD program was developed to address health disparities along the pregnancy continuum within a rural health system servicing a vast geographic space and patients from varied levels of rurality.

Methods

RMOMS-SD is a multi-year implementation study of an integrated obstetric care model within a rural health system consisting of three components: care coordination, obstetric hub, and remote patient monitoring. Care coordination addresses social needs and coordination of high-risk care during the prenatal period. The obstetric hub addresses workforce support and patient safety during the delivery period. Remote patient monitoring provides telemonitoring of hypertensive disorders of pregnancy during the postpartum period. Collectively, these three arms form a coordinated approach to provide consistent and comprehensive care along the pregnancy continuum for rural pregnant patients.

Discussion

The RMOMS-SD program will be implemented within a rural health care system working to achieve the goals of reducing severe maternal morbidity and mortality, increasing access to obstetric services, and improving the efficiency and overall reach of the obstetric workforce. This protocol offers the framework for an integrated obstetric care model for health care systems seeking to address maternal health disparities within rural communities.

BACKGROUND

Rural populations face unique maternity care challenges as maternal health deserts continue to expand across America. Rural pregnant populations face transportation barriers including increased distance to care and limited access to obstetric or advanced specialty (e.g. maternal fetal medicine) providers, ultimately resulting in inadequate prenatal care and severe maternal morbidity and mortality (SMM).^{1,2} Although SMM is increasing across the entire United States, individuals in rural communities face a disproportionately higher risk compared to their urban counterpart.³

Rural obstetric (OB) units continue to face challenges in providing high quality care to rural obstetric patients. OB units experience higher fixed costs and low volume-based reimbursement resulting in substantial financial strain.⁴ Workforce shortages, financial losses, liability insurance costs, and clinical safety concerns have contributed to the closure of over 120 rural OB units since 2020.^{4,5} Hung et. al

found that critical access hospitals accounted for 83% of obstetric closures, compared to 51% of open units.⁶ Units that closed had a four times lower birth volume and were located in counties with a lower median annual household income (\$4500 or less).⁶ Rural obstetric units provide critical care to the rural OB population, and continued closures will increase risks associated with rural deliveries, likely leading to increased SMM.

The Rural Maternity and Obstetrics Management Strategies (RMOMS) program, funded by the Health Resources and Services Administration (HRSA), aims to improve access to maternal and obstetric care in rural communities. RMOMS is a four-year program that funds awardees to improve maternal health across the pregnancy continuum in rural and underserved populations by implementing innovative services and care pathways.⁷ To address rural disparities, HRSA identified five core goals: (1) implement evidence-based and sustainable care delivery models, (2) enhance and preserve access to maternal care, (3) train providers based in non-specialty settings, (4) collaborate with academic institutions to identify and overcome clinical barriers, and (5) reduce disparities in infant and maternal health outcomes, especially among rural and underserved populations.⁸

The RMOMS–South Dakota (RMOMS-SD) program focuses on reducing maternal and infant mortality across a geographically vast rural area. Barriers to care include long travel distances, harsh and unpredictable winter weather, lack of public transportation, high poverty, and workforce shortages. South Dakota continues to face ongoing maternal and child health challenges including a preterm birth rate of 11.2% (national average, 10.4%) and an infant mortality rate of 7.2 per 1,000 live births (5.6 per 1,000 live births nationally).^{9,10 11} From 2022–2024, the South Dakota maternal mortality rate was 72.2 deaths per 100,000 births.¹⁰ These statistics highlight the urgency and importance of programs like RMOMS-SD to improve health outcomes for rural pregnant individuals and infants. The purpose of this paper is to describe the methodology of RMOMS-SD through its three-arm approach: (1) care coordination (CC) to address social drivers of health (SDoH) early in pregnancy and coordinate clinical specialty care for high-risk patients, (2) obstetric hub (OB Hub) to provide 24/7 clinical support to rural hospitals, and (3) remote patient monitoring (RPM) for hypertension during the postpartum period to reduce SMM rates related to hypertensive disorders of pregnancy (HDP).

METHODS

Aim

The RMOMS-SD project aims to address health disparities across the pregnancy continuum in rural populations by enhancing care coordination, improving access to obstetrics care expertise, and implementing remote patient monitoring for hypertension. The overall goal is to develop care pathways that improve the quality of care for pregnant patients and support the delivery of healthy babies to healthy birthing people through a cost-effective and sustainable model. By reducing complications before and during delivery and prioritizing risk-appropriate care, the project aims to reduce SMM and

lower the future risk of chronic disease for both parent and infant. Program outcomes will be achieved through establishment of network partners with ongoing collaboration, CC throughout the project geography, and telehealth interventions using RPM technology in patient homes (postnatal) and specialty surveillance software in rural hospitals (during high-risk or emergency room labor and delivery).

Program Design

RMOMS-SD is a multi-year implementation study of an integrated obstetric care model consisting of three intervention arms. During pregnancy, social stressors can have a profound impact on both maternal and fetal health.¹² Identifying social drivers during this period provides an opportunity to intervene, address barriers to care, and support patients so they can fully engage in their prescribed care. Rural clinics and hospitals commonly do not have specialized CC for obstetric patients, making it difficult for these patients to be referred to and receive appropriate services. To address this, a centralized CC model will be employed with a rural specific care coordinator dedicated to obstetric patients (including those receiving OB services from non-OB providers), providing support where it may otherwise not be provided. CC will be initiated and primarily provided in the prenatal period addressing social needs during the pregnancy. In January 2024, the Centers for Medicare and Medicaid Services (CMS) mandated all patients be screened for SDoH prior to hospital discharge. Therefore, a condensed version of the CMS SDoH screener will additionally be employed at the first prenatal visit (Appendix 1). Patients screening positive for any domain (housing, food, transportation, or interpersonal violence) will be referred to CC, where their individual needs will be addressed. CC will also assist clinically high-risk patients by ensuring enrollment in health monitoring programs and scheduling of appointments for specialty care.

When asked about the state of maternal healthcare in South Dakota, physician stakeholders highlighted several quality and safety concerns, noting delays in situational recognition requiring immediate transport and issues with effectively conveying patient acuity to flight teams. Stakeholders also identified the need to provide greater education and support for labor and deliveries. Eight of the health system's rural hospitals utilize general nurses for obstetric patients, increasing the concern of delays in recognition and response due to inexperience in obstetrics. The OB Hub will consist of experienced OB nurses within the tertiary care transfer center. The OB Hub nurse will act as the initial point of contact for clinicians who initiate a patient transfer. By serving in this role, the OB Hub nurse will facilitate efficient communication and ensure a streamlined transfer process. In addition, the OB Hub nurse will work closely with labor and delivery staff at three pilot sites through perinatal monitoring and telemetry. This collaboration is intended to provide ongoing support to clinical teams, help to address patient needs, and coordinate care consultations during labor and delivery.

HDP is one of the leading causes of SMM in the United States complicating 10–13% of pregnancies.¹³ Complications from the preeclampsia spectrum include pulmonary edema, acute kidney injury, hepatic injury, severe obstetric complications and ICU admissions.¹⁴ HDP complications can continue to impact

a pregnant individual's health over their lifetime including chronic hypertension, renal disease, and cardiovascular disease.¹⁴ HDP are also a common cause of postpartum readmissions. Evidence suggests that postpartum blood pressure (BP) control decreases hospital readmissions, improves adherence to national guidelines, and increases postpartum visit attendance.¹⁵ However, clinician and patient adherence to these evidence-based guidelines remains a challenge in the rural setting. The RPM program will be implemented to monitor postpartum patients with HDP with the goal of addressing high BPs and BP normalization by eight-weeks postpartum.

A network partnership governing board will be created with health system, state, tribal, and community leaders. A collective impact model will be utilized to develop the governing board with five conditions for collective impact that each network organization must share. They all must have (1) a common agenda, (2) shared measurement, (3) mutually reinforcing activities, (4) continuous communication, and (5) a backbone organization. Combining organizations with diverse backgrounds provides a deep perspective that is shared collectively to achieve a mutually agreed-upon goal. The primary goal of the governing board is to identify risk areas and develop a more coordinated, sustainable model for improving both maternal and postpartum outcomes in rural areas to improve the quality of care for pregnant patients. This will create formalized referral networks among rural clinics, critical access hospitals, tertiary centers, and tribal health systems. The RMOMS-SD integrated obstetric care model allows for appropriate services to be provided across the entire pregnancy continuum (Fig. 1). The RMOMS-SD protocol was submitted to the Avera Health Institutional Review Board and approved as a quality improvement initiative (protocol number 2023.06_NotHSR_QI), not human subjects research, and as such no consent for participation was needed.

Setting and Participants

The health system is responsible for providing obstetric care services across a wide geographic region (72,000 square miles, Fig. 2), supporting approximately 6,500 births annually, 70% of which are rural. This highly integrated network consists of 13 dedicated maternity centers, collectively ensuring access to care for expectant patients throughout the system. Of these 13 facilities, 12 are situated in rural communities and are designated as level 1 or level 2 maternal care centers.¹⁶ Although some facilities handle fewer than 50 births each year, they remain crucial for providing essential obstetric services to people living in remote areas. The target population includes rural pregnant individuals and surrounding tribal communities with significant barriers to obstetric services and access to care at local healthcare facilities. RMOMS-SD programs will be implemented across the entire health system regardless of patient's rurality.

Intervention Components

Care Coordination

Care coordination has been described as, “the deliberate organization of patient care activities between two or more individuals (including the patient), involved in a patient’s care to facilitate the appropriate delivery of health care services.”¹⁷ RMOMS-SD care coordinators work to ensure rural patients, especially high-risk patients, are referred to the appropriate services within the health system. Centralized CC models provide a single hub with a dedicated team helping coordinate patient access to resources and navigating health system appointments. The CC team will work under the main tertiary hospital utilizing existing CC infrastructure for urban OB patients, with the addition of a care coordinator focused on serving rural OB patients.

The goals of CC are:

1. To provide support for patients’ social needs, especially rural patients.
2. To identify patients with high-risk maternal and fetal conditions, establish an individualized care plan, and connect patients with ancillary health care programming.
3. To ensure patient and care team adherence to an established care plan.

In addition to addressing SDoH factors, care coordinators will assist with medical care plans. High-risk maternal conditions often require additional prenatal appointments, ultrasounds, and specialty consultations. For rural patients, specialty services may only be available at an urban, tertiary care center, adding time, travel, and financial burden. The CC team will work with specialists and the primary OB team to create an individualized care plan, such as referrals to services when appropriate (i.e. RPM for HDP, telemedicine cardiology consultation, and coordination of delivery at a risk-appropriate maternity center). Care planning informed by individual patient needs and medical pregnancy risk factors will be an important implementation strategy to decrease care fragmentation and establish a shared care model among the health care team.

CC data will be extracted from the electronic health record (EHR). A CC documentation note will be created in the EHR containing information regarding the needs of the patient, plans to address these needs, programs the patient is referred to, and programs the patient is actively receiving services from. A partnership and data sharing agreement will be formed with the South Dakota Department of Health to capture state services the patient receives.

Obstetric Hub

The OB Hub model will employ a safety-II proactive approach with adaptive solutions, rather than a safety-I reactive approach with rigid, linear solutions.¹⁸ Resource availability, knowledge, and experience vary widely in rural healthcare. Taking a safety-II approach considers the complex, dynamic nature of rural healthcare and provides key facilitators to positive outcomes versus improving workflows when adverse outcomes occur. The OB Hub will have experienced OB nurses providing centralized OB support to rural hospitals. OB Hub nurses will use the AI-based software PeriGEN to review fetal heart rate tracings for all laboring patients. They will also monitor adherence to maternal vital sign protocols (hypertension, hypotension, and fever). OB Hub nurses will assist with all maternal transfers to the

tertiary care center and initiate any needed maternal fetal medicine consultations during labor. This bidirectional communication model will enable rural nursing staff to consult OB experts as needed, while allowing the OB Hub nurses to proactively notify rural sites of safety or care quality concerns.

The goals of the OB Hub are:

1. 1. To improve the maternal transfer process.
2. 2. To provide rural obstetric nurses with real-time coaching and education.
3. 3. To improve recognition and response to evolving maternal and fetal conditions.
4. 4. To improve protocol adherence to high-risk medications like magnesium sulfate, oxytocin, insulin and blood product.

Effective surveillance of multiple maternal-fetal dyads (across the health system) requires technologies that support seamless communication, timely alerting of abnormal conditions, and real-time visibility into labor and delivery capacity. The following integrated technologies were selected to fulfill these needs:

- Electronic Health Record: The EHR is a digital system that stores and organizes patient health information, providing a centralized source for clinical data and supporting coordination among the OB Hub and rural care teams.
- PeriGEN Vigilance HUB Surveillance Software: This platform aggregates data from all laboring patients into a single dashboard. It employs rules-based alerts and artificial intelligence algorithms to identify and escalate abnormal maternal or fetal findings to a central monitoring board. The OB Hub nurse can then “drill down” (review detailed patient information within the chart) to evaluate specific clinical concerns, allowing for targeted assessment without requiring continuous direct monitoring of every patient.
- VOALTE Secure Mobile Communication Platform: This tool enables secure, real-time nurse-to-nurse communication and supports multi-participant phone conversations, ensuring that care teams can quickly collaborate and respond to evolving patient needs.
- TeleTracking Technologies Patient Flow and Capacity Management System: This system provides an up-to-date overview of labor and delivery capacity across the health system, helping determine which facilities can accept patient transfers and optimizing resource allocation.

Integrating these technologies will allow the OB Hub nurse to efficiently monitor multiple maternal-fetal dyads across the health system footprint, rapidly identify and escalate abnormal conditions, and coordinate patient care and transfers. This comprehensive approach seeks to enhance maternal and fetal safety and support the rural OB workforce. To guide implementation, an OB Hub steering committee (OBHSC) and site physician and nurse leads have been identified.

Phase 1 of the OB Hub will be limited to supporting maternal transfers only. Recognizing the importance of consistent processes across the health system, the OBHSC determined that maternal transport

support should be extended to all facilities immediately. This decision aimed to prevent the development of separate procedures for facilities, ensuring a unified approach to maternal transfers throughout the network.

Phase 2 of the OB Hub will include escalating persistent category two fetal heart tones where minimal or no intervention was documented, persistent abnormal maternal vital signs including hypotension, severe hypertension, fever and persistent concerning tachycardia at three chosen pilot sites. OB Hub nurse communication pathways and escalation of care protocols were developed. Gradual roll out of additional services (beyond transfer and consultation coordination) will be provided to all interested facilities as OB Hub capacity allows.

The OB Hub nurses will have access to the EHR where they will see all pertinent patient information. Additionally, the OB Hub nurse will be monitoring the PeriGEN software tracings for both the patient and fetus. In tandem with the above resources, the research team will collect a survey from the OB Hub nurse once a call or interaction is complete (Appendix 2).

Remote Patient Monitoring

40% of patients do not attend their postpartum follow-ups, which is when complications due to HDP most commonly occur.^{19,20} The RPM program was created to address concerns related to timely and appropriate treatment of elevated postpartum BPs. RPM will monitor postpartum BPs for patients with a HDP to escalate care when necessary. RPM for HDP will be integrated into the health system's existing remote monitoring department.

The goal of the RPM program is to increase rural care delivery of three evidence-based practices:

1. Postpartum blood pressure evaluation 3–10 days postpartum.²⁰
2. Same-day evaluation and treatment for severe-range blood pressures.²¹
3. Blood pressure monitoring through eight-weeks postpartum.¹⁹

Health Recovery Solutions (HRS) is a web-based patient monitoring program that will be used which integrates into EHRs through usual HL7 interfaces. HRS clinical dashboards alerting parameters will be adjusted to meet the needs of the postpartum population. The HRS patient-facing app allows connection of a Bluetooth BP cuff, patient reminders, symptom monitoring by survey, text-to-text communication, and auto-upload of vital sign metrics (BP, pulse). App pushes will be sent twice daily for BP readings and symptom evaluation. Program satisfaction questions will also be pushed through the app at designated intervals. RPM nurses will monitor vital sign and symptom responses daily. The HDP RPM care pathway was created for nurse response based on BP readings and symptom responses (Appendix 3).

A staggered roll out will be used, with the tertiary care location as the initial pilot site for a larger postpartum patient referral base and its co-location with the RPM monitoring team. To be enrolled in

RPM the patient will need a HDP diagnosis or persistent high BP readings during the labor and delivery hospital admission. Physician referrals will be sent through the EHR system to the RPM nursing team. Once the patient is discharged, the RPM team will contact the patient about initial enrollment and education. Once enrolled, the patient will be sent the required equipment (Appendix 4). Throughout the eight-week period, if the patient stays engaged, the RPM nurses will monitor vital signs and symptoms and escalate care if necessary. Contact pathways were created if patients disengage in the program (Appendix 5).

Vital sign measurements, symptom survey responses, program activity, and program satisfaction survey responses will be collected within the HRS database and will be accessible to the RPM nursing team. Additionally, a PDF report will be created for each biometric measurement and sent to the patient's EHR for provider accessibility. Data regarding postpartum hospital readmissions and HDP complications will be extracted from the health system EHR.

Data Collection and Evaluation

A comprehensive logic model was created and will be utilized for program management and evaluation (Appendix 6). Data across the continuum will be captured throughout the project timeline, enabling the research team to connect the maternal health outcome data of each respective pregnant patient, with their infant's health outcome data. Securing and syncing data across the continuum of care will provide a novel approach for analyzing the program's impact. This data will be used to evaluate RMOMS-SD in achieving its objectives of reducing SMM, increasing access to obstetric services, and improving the efficiency and overall reach of the workforce through process and outcome measures.

Throughout the performance period, the project's progress will be tested for its operational efficacy and overall alignment with the RMOMS-SD focus areas using both process and outcome measures. Process measure evaluation will include: (1) the establishment of a sustainable and collaborative health care network focused on improving access, workforce, and reimbursement for obstetrics services throughout the health system; (2) gathering information from and sharing with stakeholders the services available and proposed care model components; (3) development of a feasible and replicable rural obstetrics care model. Outcome measure evaluation will include: (1) improved access to resources and CC for pregnant patients and (2) creating a rural obstetrics care model that could be replicated in health care organizations throughout other rural regions.

Primary data will be extracted from the EHR with supplementary data obtained from the HRS database and RedCap for RPM and OB Hub respectively. The data will be managed and analyzed within the health system's research institute which includes a data management, analysis, and evaluation core that houses data analysts, epidemiologists, and biostatisticians well versed in data acquisition, data cleaning, and evaluation. Data collection will follow HRSA reporting guidelines to include variables such as demographic information, early diagnosis of pregnancy, appropriate prenatal care, chronic factors

affecting pregnancy, SMM, delivery mode (vaginal, c-section), preterm birth, ICU and NICU admissions, attendance to postpartum visits, SDoH, postpartum depression screenings, and more.

DISCUSSION

There are five main strengths to RMOMS-SD program implementation. First, the program spans the entire perinatal continuum, providing services in the prenatal, delivery, and postpartum periods. This allows for early detection and assistance when needed. The second strength is that the program addresses multiple factors affecting maternal and child health outcomes. SDoH are known to be associated with adverse pregnancy outcomes. To ensure proper social support CC refers pregnant patients to needed services. The OB Hub bolsters rural workforce support ensuring patient safety and quality care during rural hospital deliveries. Postpartum RPM for HDP allows for daily monitoring of maternal vital signs through eight-weeks postpartum when most maternal complications from pregnancy occur. The third strength is the strong integration with the main tertiary hospital. All three arms of the program are centralized under the main hospital allowing easier access to tertiary hospital resources for the program and its patients. The fourth strength is that all three arms of the program will be implemented using evidence-based guidelines ensuring appropriate care pathways and bundles. The final strength of the program is that all three programs have individual evaluation plans allowing for continuous improvement in each specific program area.

A challenge for this program is implementation across a large healthcare system that spans five states, 72,000 square miles, one tertiary care hospital, 12 rural maternity centers, and 200 + clinics. Although the health system adheres to standardized protocols and procedures, individual hospitals and regions have their own cultures and operational practices. Program implementation will need to be tailored to fit the internal operations of the various hospitals and clinics. Another challenge is that the three programmatic arms are housed within three different departments, and each arm interacts with multiple other departments. Consistent communication with rural sites will be crucial to ensuring proper program rollout across the system. Site champions will be utilized as a point of contact to ensure successful integration at rural locations.

Addressing rural maternal health disparities requires coordinated, system-level solutions rather than isolated interventions. RMOMS-SD brings together care coordination, obstetric clinical workforce support, and remote monitoring into a unified model designed to improve outcomes across the pregnancy continuum. This program offers a framework for health systems seeking to address similar challenges in geographically dispersed and resource-limited settings. Insights gained from implementation and evaluation will be critical to refining the model and identifying key facilitators to improving health outcomes and program sustainability.

Abbreviations

SMM

Severe maternal morbidity and mortality
OB
Obstetric
RMOMS
The Rural Maternity and Obstetrics Management Strategies
HRSA
Health Resources and Services Administration
RMOMS-SD
The Rural Maternity and Obstetric Management Strategies South Dakota
CC
Care coordination
SDoH
Social drivers of health
OB Hub
Obstetric hub
RPM
Remote patient monitoring
HDP
Hypertensive disorders of pregnancy
CMS
The Centers for Medicare and Medicaid Services
BP
Blood Pressure
EHR
Electronic health record
OBHSC
Obstetric hub steering committee
HRS
Health Recovery Solutions

Declarations

Ethics approval and consent to participate:

The RMOMS-SD protocol was submitted to the Avera Health Institutional Review Board and approved as a quality improvement initiative (protocol number 2023.06_NotHSR_QI), not human subjects research, and as such no consent for participation was needed.

Consent for Publication:

Not applicable

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Author Contribution

Authors' contributions: MP and KM were major contributors to the writing of the manuscript. HV contributed to writing and literature search. LM, CH, and TB were significant contributors to the editing process. All authors read and approved the final manuscript.

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Availability of data and materials:

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study. However, materials and workflows are available upon reasonable request to the corresponding author.

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Figures

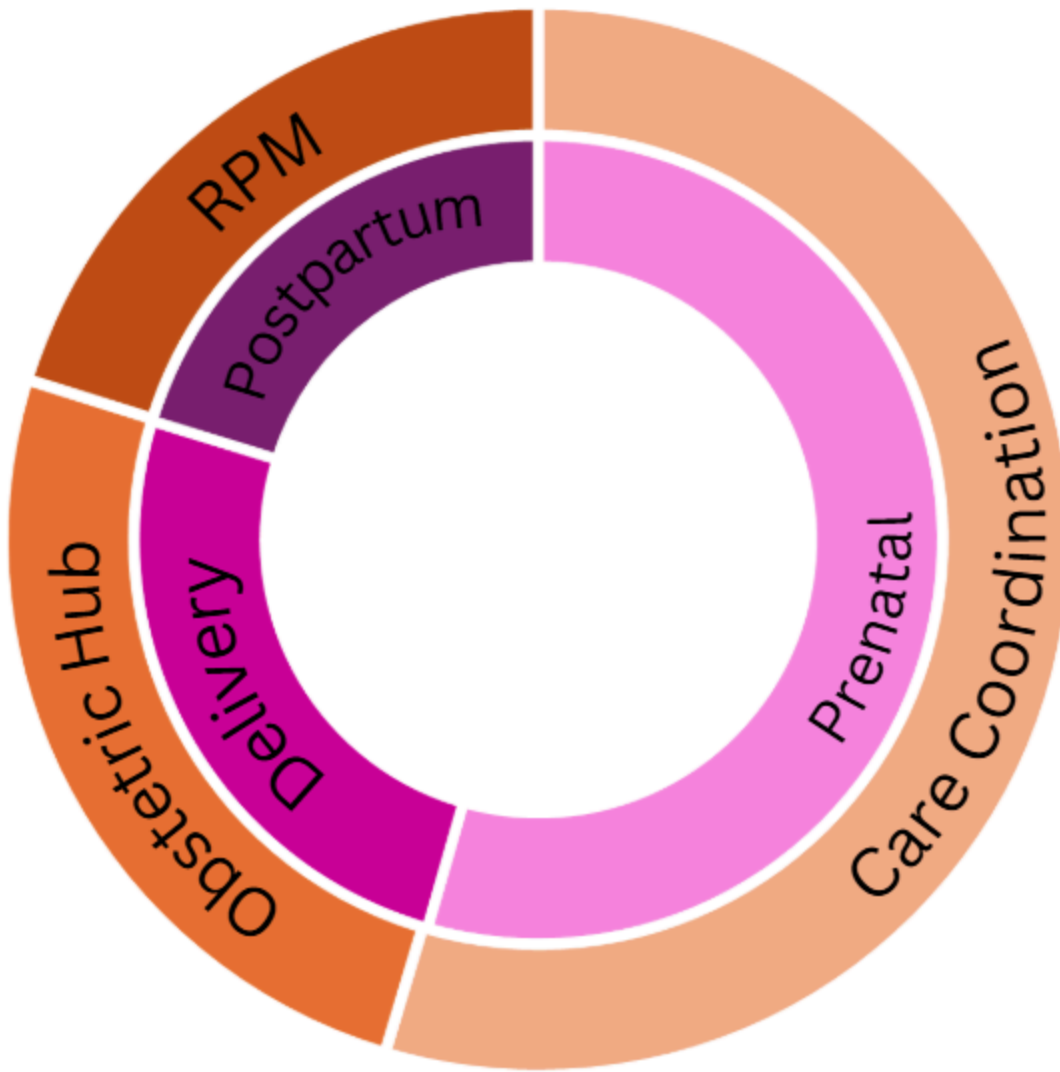


Figure 1

RMOMS-SD Interventions Along the Perinatal Continuum.

Care Coordination provides care primarily in the prenatal period, the obstetric hub provides care during labor and delivery, and remote patient monitoring provides care during the postpartum period.



Figure 2

Health System Catchment Area.

The Health System service area includes counties from South Dakota, Iowa, Minnesota, Nebraska, and North Dakota.

Supplementary Files

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