

FELLOWS-IN-TRAINING & EARLY CAREER SECTION

Cardio-Obstetrics



Developing a Niche in Maternal Cardiovascular Health

Garima Sharma, MD,^a Kathryn Lindley, MD,^b Anna Grodzinsky, MD^c

Over the last 2 decades, the U.S. maternal mortality ratio has increased, as has the contribution of cardiovascular disease (CVD) to pregnancy-related mortality (1). In the United States, CVD is now the leading cause of death in pregnancy and the postpartum period, accounting for 26.5% of the pregnancy-related deaths (2). Although the identification of pregnancy-related deaths may be improving, the increasing contribution of chronic diseases to pregnancy-related mortality suggests a change in risk profile of U.S. mothers. Adverse pregnancy outcomes (APOs) such as preterm birth (birth before 37 weeks of pregnancy), intrauterine growth restriction (fetal weight that is below 10th percentile of gestational age), gestational diabetes and hypertensive disorders of pregnancy including gestational hypertension (new onset hypertension after 20 weeks of gestation), and preeclampsia (new onset hypertension after 20 weeks of pregnancy with proteinuria or end organ damage) were originally considered pure obstetrical issues but are now recognized as risks for development of CVD at younger ages than are those patients who do not have an APO (3). Recently, the American College of Obstetricians and Gynecologists released several practice bulletins addressing the challenges posed by these CVD risk enhancers in women and developed recommendations for appropriate perinatal risk assessment, antenatal care, and postpartum follow-up (2,4-6).

Cardio-obstetrics is an expanding subspecialty within cardiology that focuses on the prevention, early detection, and appropriate management of CVD in pregnancy. We describe a stepwise approach for training programs to consider this rapidly expanding subspecialty with a focus on fellows-in-training (FITs) and early career professionals (ECPs). We highlight the evolving spectrum of CVD in pregnancy, the need for multidisciplinary care and registry data, and the growing need of developing core competencies in cardio-obstetrics (Table 1).

UNDERSTANDING THE CURRENT AND EVOLVING SPECTRUM OF CARDIO-OBSTETRICS

The incidence of pregnancy in women with congenital heart disease is rising, with an increase in maternal congenital heart disease (6.4 to 9.0 per 10,000 delivery hospitalizations) from 2000 to 2010 (7). Historically, cardio-obstetrics focused on women with congenital heart disease, but now, acquired CVD and CVD risk factors, including hypertension, diabetes, and age, account for the highest proportion of maternal mortality and morbidity (8,9). Today, more common presentations of acquired maternal heart disease during pregnancy and postpartum periods are heart failure including peripartum cardiomyopathy (PPCM), myocardial infarction, arrhythmias, and aortic dissection (2).

The number of delivery hospitalizations with hypertensive disorders of pregnancy is increasing, and these hospitalizations are associated with a substantial burden of severe obstetric morbidity (8). In addition, the prevalence of pre-existing diabetes mellitus and gestational diabetes is increasing (9). The Centers for Disease Control and Prevention published a report from 9 maternal mortality review committees recognizing the majority of the pregnancy CVD-related deaths to be preventable (10).

From the ^aCiccarone Center for Prevention of Cardiovascular Disease, Johns Hopkins University School of Medicine, Baltimore, Maryland; ^bDivision of Cardiology, Department of Medicine, Washington University School of Medicine in St. Louis, St Louis, Missouri; and the ^cDivision of Cardiology, Saint Luke's Mid America Heart Institute, Kansas City, Missouri. The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

TABLE 1 A Stepwise Approach to Developing a Niche in Cardio-Obstetrics

Area of Intervention	Focused Intervention for FITs/ECPs, Institutions and Professional Science Organizations, and Competency Management Committees
Understanding the disease spectrum	<ul style="list-style-type: none"> Understanding the social determinants of health and poor pregnancy outcomes Improving knowledge on APOs and long-term CV risks Incorporating detailed pregnancy history in routine encounters Understanding physiology of pregnancy and its effects on CV system Learning pharmacotherapeutics in pregnancy
Developing a pregnancy heart team	<ul style="list-style-type: none"> Need for short- and long-term follow-up of women with APOs Developing multidisciplinary team-based care for high-risk women Preconception CV risk assessment and pregnancy planning Implement quality improvement projects and hospital protocols Volunteering on hospital and state maternal mortality review committees
Improving research and registry data	<ul style="list-style-type: none"> Studying subclinical and overt CV dysfunction in APOs and acquired heart disease in pregnancy Pregnancy outcomes in women with congenital heart disease and peripartum cardiomyopathy Large, multicenter phenomic and proteomic investigations of APOs Understanding the role of placental ischemia and antiangiogenic proteins in the etiology of APOs Population data research associations of APOs and long-term CV risks Outcomes research on healthy lifestyle interventions in women with CVD risk enhancers
Improving training and education	<ul style="list-style-type: none"> Designing and implementing curricula in fellowship Increasing collaborative sessions on CVD in pregnancy at national societal meetings Developing multidisciplinary grand rounds Revising COCATS to incorporate modules on CVD in pregnancy

APO = adverse pregnancy outcome; COCATS = Core Cardiovascular Training Statement; CV = cardiovascular; CVD = cardiovascular disease; ECP = early career professional; FIT = fellow-in-training.

There has also been a strong focus on reduction of APOs.

APOs are believed to be caused by defective placentation, shallow trophoblastic invasion, and an imbalance in uteroplacental blood flow leading to placental malperfusion, inflammation, and ischemia and development of antiangiogenic proteins that are associated with long-term maternal CVD (3). APOs play an important physiologic role in the pathogenesis of CVD by enhancing placental vascular abnormalities and promoting the development of abnormal cardiac mechanics, coronary endothelial dysfunction, and loss of arterial compliance (3). Although APOs are important CVD risk enhancers in women, conditions such as ischemic heart disease, cardiomyopathy, pulmonary hypertension, congenital heart disease, aortopathies, and valvular disease also contribute to management challenges of the pregnant patient.

Pregnancy-associated factors such as preeclampsia and gestational hypertension are associated with 75% and 67% higher risk of CVD-related mortality, respectively, in women with prior history as compared with those with no history (11). Odds of subsequent CVD in women with gestational diabetes is 68% higher as compared with women with no history (11). The prevalence of PPCM has also increased over the last 30 years, and PPCM with concomitant preeclampsia is associated with increased morbidity and mortality (12). Race is an important risk factor for maternal mortality and morbidity in the United States. Non-Hispanic blacks have 3.4 times higher risk

of dying from CVD-related pregnancy complications compared with white women (2). Understanding social determinants of health, implicit and explicit bias in patient care, health system barriers, and genetic, environmental, and lifestyle-related risk factors is integral to optimizing care of our patients. Recognition of these risk factors and temporal trends in pregnancy-associated CVD is just the first step toward improving outcomes of moms with cardiac conditions and their babies. Integrating this knowledge within a multidisciplinary network is the next key step to optimizing care.

UNDERSTANDING THE ROLE OF MULTIDISCIPLINARY CARE THROUGH THE PREGNANCY HEART TEAM

Developing a cardio-obstetrics service line relies heavily on multidisciplinary care and is recommended for the pregnant patient with moderate to high-risk cardiac disease (modified World Health Organization categories III and IV) to optimize maternal and fetal outcomes (2). At a minimum, the pregnancy heart team should include a cardiologist, an obstetrician or maternal-fetal medicine specialist, and an obstetric anesthesiologist with expertise in the management of CVD in pregnancy (Table 2) (2). Such an approach may aid in pregnancy-associated risk mitigation.

Multidisciplinary risk counseling should include risk of maternal morbidity and mortality, risk of fetal

congenital heart disease, and risk of obstetric or neonatal complications. Clinical rotations with the cardio-obstetrics team will allow FITs to better manage such patients, and create learning opportunities for those desiring to develop a clinical niche. As multidisciplinary care is more challenging in smaller hospitals, collaboration with tertiary care centers with women’s cardiovascular specialties may provide avenues for both improved patient care and training for FITs and ECPs. Multidisciplinary grand rounds or case-based didactics can improve understanding of CVD in pregnancy.

For ECPs, developing specific quality improvement initiatives, streamlining appropriate follow-up after pregnancy, implementing new delivery protocols, participating in hospital and state maternal mortality review committees, and disseminating educational materials through workshops and lectures will fortify their niche and engage the medical community in cardio-obstetrics.

RECOGNIZING THE NEED FOR COLLABORATIVE RESEARCH AND REGISTRY DATA IN CARDIO-OBSTETRICS

The collaboration between cardiology and obstetrics is progressing in the research realm as well as in the clinical realm. Today, risk estimation using history, physical examination, and previously established risk models (such as the CARPREG [Cardiac Disease in Pregnancy] II or ZAHARA [Zwangerschap bij vrouwen met een Aangeboren HARTafwijking-II] risk models) identifies patients who require further surveillance. However, these models are developed largely from European and Canadian cohorts and may not be generalizable to other cohorts. Significant gaps in knowledge regarding how pregnancy affects cardiovascular conditions, and vice versa, further highlight the need for more data collection and analysis. One example of a multisite, prospective registry exploring outcomes of mothers with CVD and their babies is the HOPE (Heart Outcomes in Pregnancy: Expectations) for Mom and Baby Registry (13). This developing registry seeks to collect clinically important and robust data to help standardize the care of our patients and to support and extend existing guidelines in the United States regarding the care of patients with cardiac disease in pregnancy. Last, scientific organizations, including the American College of Obstetricians and Gynecologists, Heart Failure Society of America, Society for Maternal-Fetal Medicine, American Heart Association, and American College of Cardiology

TABLE 2 Key Team Members Focused on a Multidisciplinary Approach to the Care of the Cardio-Obstetric Patient

Physicians and surgeons	Allied health professionals and cardiovascular team members
Cardiologist (and cardiac subspecialists)	Mental health specialist
Obstetrician/maternal fetal medicine specialist	Nurse specialist/physician assistant
Cardiac anesthesiologist	Pharmacist
Cardiothoracic surgeon	Geneticist
Pediatric cardiologist	
Neonatologist	
Pulmonary hypertension specialist	
Family medicine/internist	

have worked collaboratively to support research dissemination arising from this cardio-obstetric subspecialty by inviting leaders from each field to present at national and international conferences. This support will contribute to furthering understanding of novel approaches in cardio-obstetrics.

IMPROVING EXISTING TRAINING AND DEVELOPING FOCUSED CURRICULA IN CARDIO-OBSTETRICS

Last, and most importantly, even though cardio-obstetrics is an expanding field, most trainees do not receive any formal training in this field (14). There are no specific recommendations on developing competence in cardio-obstetrics beyond mandating outpatient clinic experiences to include patients of varied ages and gender, which presumably would include pregnant women (15). Cardio-obstetrics, unlike other modules such as prevention, valvular heart disease, and arrhythmias, is not a separate category on certification exams. All FITs, and particularly those interested in pursuing a subspecialty in this field, would benefit from specific training in hypertension management in pregnancy, simple and complex congenital and valvular heart disease, pregnancy-associated spontaneous coronary dissection, anticoagulation and medication safety in lactation and pregnancy, physical examination and physiological changes of the cardiovascular system, multimodality imaging in pregnancy, indications of cesarean section, and pre-pregnancy risk assessment. Our Core Cardiovascular Training Statement may need to be modified to incorporate the nuances of CVD management in pregnancy (15). Under the section on training in ambulatory, consultative, and longitudinal cardiovascular care of the Core Cardiovascular Training Statement, a specific mention on improving medical knowledge and specific duration

of training in cardiovascular management in pregnancy would be helpful. For FITs planning to pursue a career with a focus on cardio-obstetrics, we suggest incorporating at least 1 month of elective time dedicated to work within a combined cardio-obstetrics clinic, or with a maternal-fetal medicine provider or cardiologist focused on the care of pregnant patient with CVD. A unique recommendation may focus on requiring that FITs or ECPs attend cardiovascular conferences or grand rounds (or talks at national meetings) at which the topic of cardio-obstetrics is stressed.

CONCLUSIONS

Given the rising prevalence of cardiac conditions complicating pregnancy, improved recognition of pregnancy-associated factors, and the call from the Centers for Disease Control and Prevention to improve perinatal quality care collaboratives, FITs and ECPs will benefit from dedicated education highlighting this field. We recognize the growing for training competent clinicians who will prevent, detect, and manage the cardiac complications in pregnancy and beyond. Emerging CVD risk enhancers

and their associated future CVD-related mortality and morbidity need to be better understood through research. Cardio-obstetrics presents a unique opportunity for FITs and ECPs to develop a niche in this expanding subspecialty, and the future holds great promise for improved multidisciplinary collaborations between cardiology and obstetrics. Dedicated curricula in cardio-obstetrics, multidisciplinary rounds, clinical rotations in heart centers for women, publishing consensus statements and guidelines, developing quality improvement projects, and large registries will help improve the science behind the care for this population. Ultimately, our training and education, practices, policies, and health systems must reflect our continued commitment toward reducing the CVD burden during pregnancy and beyond.

ADDRESS FOR CORRESPONDENCE: Dr. Garima Sharma, Division of Cardiology, Department of Medicine, Johns Hopkins University School of Medicine, 1800 Orleans Street, Zayed 7125 A, Baltimore, Maryland 21287. E-mail: gsharma8@jhmi.edu. Twitter: [@GarimaVSharmaMD](https://twitter.com/GarimaVSharmaMD).

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RESPONSE: Cardio-Obstetrics

Time to Assess

Mary Norine Walsh, MD

From the Heart Failure and Cardiac Transplantation Section, St. Vincent Heart Center, Indianapolis, Indiana

E-mail: macwalsh@iquest.net

Twitter: [@MinnowWalsh](https://twitter.com/MinnowWalsh)

Specialization in the field of medicine began in the late 1800s and has not stopped since. The continuing explosion and rapid dissemination of knowledge since then has contributed to the movement of physicians into more and more narrowed fields of practice. In cardiovascular medicine, the need for specific technical skills and expertise has led to more subspecialization than in any field of internal medicine. Currently, clinical electrophysiology, interventional cardiology, advanced heart failure and transplantation cardiology, and adult congenital cardiology are the 4 subspecialties that have program requirements stipulated by the Accreditation Council of Graduate Medical Education and opportunity for certification by the American Board of Internal Medicine. Further, there are many cardiologists clamoring to establish other areas of subspecialty in our field. Experts in multimodality cardiac imaging, cardiology, and more recently, preventive cardiology have all been advocating for more formal and extensive training during fellowship as well as additional years of training, and some are bent on establishing certification examinations that quantify the body of knowledge and help a physician better demonstrate expertise.

Dr. Sharma and colleagues bring the field of cardio-obstetrics to this discussion. As they clearly outline, the drivers of the need for a focus on maternal cardiovascular care are many. The growing population of women with congenital heart disease who are achieving pregnancy, rising age at the time of first and subsequent pregnancies, increase in frequency of peripartum cardiomyopathy and preeclampsia, and growing prevalence of cardiac risk factors such as hypertension and diabetes in women of childbearing age all contribute to an ever-increasing patient

population that demands expertise of those who care for these patients. Teams of obstetricians, maternal-fetal medicine physicians, anesthesiologists, and cardiologists have always collaborated in the care of such patients, though many high-risk patients with congenital heart disease have sought care at a few specialty centers across the country. At most institutions, 1 or 2 cardiologists have traditionally been designated to consult on these patients, with on-the-job learning the primary curriculum. But now, the rising numbers of critically ill pregnant women demand a shift in our thinking and a shift in our current paradigms.

Maternal cardiovascular mortality in the United States is a public health emergency and will require an all-hands-on-deck approach to address it. As Sharma and colleagues detail, the solution needs to be multipronged, with a focus on data, science, education, training, and evidence-based solutions and strategies. There is a need to provide adequate training in cardiovascular disease fellowships, such that all cardiologists are familiar with risk assessment, best practices during pregnancy and delivery, and the need for targeted follow-up for women at risk for ongoing cardiovascular disease. We do not know yet whether a formalized multidisciplinary approach will deliver better care to these patients, as outcomes data are still lacking. It will be incumbent on those cardiologists who choose to specialize in the nascent discipline of cardio-obstetrics to ask hard questions, design trials, enroll patients in registries, and publish their investigations. If this newer, more collaborative and encompassing type of practice can impact maternal cardiovascular morbidity and mortality in the United States, we will have invested well in another new cardiology subspecialty.