JACC: ADVANCES VOL. 2, NO. 1, 2023

EDITORIAL COMMENT

Bridging the Gap in Maternal Cardiovascular Risk

Identifying Patients at Elevated Risk*

Nandita S. Scott, MD,[a,b] Amy A. Sarma, MD,[a,b] Eunjung Choi, MD[c]

Cardiovascular disease (CVD) is the leading cause of maternal mortality in the United States.[1] While there are screening tools to risk stratify patients with pre-existing CVD, identifying those at higher risk for developing or manifesting de novo disease during pregnancy remains a challenge. In particular, the modified World Health Organization, CARPREG II (Cardiovascular Disease in Pregnancy Study), and ZAHARA[2] risk stratification models are designed for patients for whom CVD has already been identified and were derived largely from cohorts of patients with congenital heart disease. However, an increasing population of patients are entering pregnancy with risk factors for CVD including advanced maternal age, chronic hypertension, pre-existing diabetes,[3] obesity, substance use, and a history of cardiotoxic chemotherapy and/or chest radiation. In such patients, the hormonal and/or hemodynamic stresses of pregnancy may unmask or accelerate clinical CV events. Additionally, there are geographic and racial disparities seen in maternal mortality rates in the United States with Black individuals and those living in rural regions at the highest risk for adverse CV outcomes during pregnancy.[4]

Identification of those at high risk for *de novo* disease is critical for several reasons. First, there is significant overlap between the signs and symptoms of normal pregnancy and those of CVD, which increases the complexity of identifying those experiencing early CV decompensation.[5] As most pregnant patients are cared for by non-cardiologists, easily accessible and reliable CVD risk stratification methods would be of great practical benefit. Second, management of CVD during pregnancy is more complicated than in the nonpregnant state, owing in part to more aggressive disease trajectories in the context of shifting hemodynamics, as well as the need to balance fetal wellbeing. As such, pregnant patients are often best served with cardio-obstetric teams, which may not be accessible to those living in resource-limited settings. Third, an increasing proportion of CVD occurs in patients without preexisting disease. It is important to have a screening/diagnostic tool that is primarily based on current symptoms and exam findings and not only on patient's known CVD history. Lastly, CV maternal morbidity and mortality is largely preventable and tools to detect disease are therefore important to expedite assessment and treatment.[6]

To bridge this critical gap in maternal care, in this issue of the *JACC: Advances*, Hameed et al[7] report on the feasibility of clinically implementing a CVD risk assessment tool for patients without preexisting CVD by adding the California Maternal Quality Care Collaborative (CMQCC) algorithm to electronic health record (EHR) systems. The study was conducted in 3 large hospital networks involving 23 clinic sites, over 250 clinicians and 14,968 patients using 18 parameters including patient's history, self-reported symptoms, vital signs, and physical exam findings to screen for those at high risk for CVD. For those who screened positive, the EHR prompted clinicians to review an order set for further testing and

*Editorials published in *JACC: Advances* reflect the views of the authors and do not necessarily represent the views of *JACC: Advances* or the American College of Cardiology.

From the [a]Division of Cardiology, Massachusetts General Hospital, Boston, Massachusetts, USA; [b]Harvard Medical School, Boston, Massachusetts, USA; and the [c]Division of Cardiology, John Hopkins University School of Medicine, Baltimore, Maryland, USA.

The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

ISSN 2772-963X https://doi.org/10.1016/j.jacadv.2022.100177

FIGURE 1 Practical Application of the CMQCC CVD Risk Assessment Tool, ≥1 Symptom + ≥1 Abnormal Vital Signs + ≥1 Risk Factor OR Any Combination Adding to ≥4 Prompts Further Evaluation

23-year-old G1P0
37 weeks gestation

- ☑ dyspnea
- ☑ HR 110 beats/min
- ☑ BMI 35 kg/m²

45-year-old G4P3
20 weeks gestation

- ☑ diabetic
- ☑ hypertension
- ☑ chest pain
- ☑ BP 145/95 mm Hg

38-year-old G2P1
14 weeks gestation

- ☑ dyspnea
- ☑ palpitations
- ☑ HR 120 beats/min
- ☑ bibasilar crackles

1. If Abnormal exam consult MFM and Primary Care/Cardiology
2. If ≥ 1 symptom+ ≥ 1 abnormal vital signs + ≥ 1 risk factor OR any combination adding to ≥ 4 prompts further evaluation with ECG and BNP, echocardiogram +/- CXR if heart failure or valve disease suspected or if BNP elevated, Holter monitor if arrhythmia suspected, referral to cardiologist for ischemic testing if suspected or results abnormal

Positive Screen with workup revealing:

Elevated BNP > echo
LV EF 35%
New diagnosis PPCM

Abnormal ECG > cardiology consult
> Elevated hs TN > coronary angiogram
> PCI right coronary artery

ECG – sinus tachycardia > Echo moderate rheumatic mitral stenosis > Cardio-Obstetric team consult to manage pregnancy, labor and delivery with goal of optimizing maternal and fetal outcomes

BNP = B-type natriuretic peptide; CMQCC = California Maternal Quality Care Collaborative; CVD = cardiovascular disease; ECG = electrocardiogram; EF = ejection fraction; HR = heart rate; hs TN = high sensitivity troponin; LV = left ventricular; MFM = maternal fetal medicine; PCI = percutaneous coronary intervention; PPCM = peripartum cardiomyopathy.

consultation with a cardiologist when appropriate (Figure 1). Study measures included completion of the algorithm (measure 1) and, if positive, completion of follow-up testing (measure 2).

The study tool automatically pulled in the existing data from the EHR and required <1 minute to complete. It was designed to be user friendly and be implemented by busy clinicians and those without CVD expertise. Within the 3 hospital networks, the tool was utilized at a rate of 57.1%, 71.5%, and 98.7% (study measure 1), with higher utilization among sites whose EHR created a hard stop that required assessment completion. Among those with a positive screen, patients were referred for recommended follow-up at a rate of 65.8%, 72.5%, and 55.9% (study measure 2). Seventy-five percent of clinicians felt that orientation and training on the tool further assisted with successful utilization. Notably, nurse practitioners and physician extenders were early adopters of the tool as compared to more experienced physicians, underscoring the importance of multidisciplinary care teams in advancing maternal health initiatives. Overall, 89% of clinicians felt that the tool was valuable for pregnant and postpartum assessment.

As maternal mortality continues to rise in the United States among those with readily identifiable risk factors for CVD, practical and readily implementable tools for busy clinicians are urgently needed. Hameed et al should be congratulated on elegantly tackling this critical gap in maternal care with a tool designed for non-cardiologists that can be easily completed and widely disseminated through the existing infrastructure of the EHR. This tool has received support from the American College of Obstetricians and Gynecologists and pending further research, support for inclusion into the Cardiac Conditions in Obstetrical Care bundle by the Alliance for Innovation for Maternal Health. Next steps include larger scale studies that can help refine the tool to optimize identification of those at highest risk for adverse CV events, as there are limited data in the current feasibility analysis regarding disease prevalence among those identified at high risk, as well as those who experienced CVD in the absence of screen positivity. Larger studies should also investigate methods to help facilitate utilization of this tool in busy clinical practices with highly complex patients and limited resources where such screening is potentially of highest yield. Despite requiring less

than a minute to complete, cited barriers to implementation in this study included busy clinical settings, competing priorities, complexity of medical conditions, and lack of access to stethoscopes for input of physical exam findings. With such investigation, this tool holds important promise to: 1) identify patients with readily identifiable risk factors for CVD who are currently missed by the available risk stratification tools for pregnant patients; 2) reduce morbidity and mortality through early referral to appropriate care; 3) raise provider and patient awareness of CVD risk in this population; and 4) provide an important opportunity for education and risk factor modification. Hameed et al should be commended on moving the needle in the tackling of the United States maternal health crisis.

FUNDING SUPPORT AND AUTHOR DISCLOSURES

Dr Sarma was given the CRICO patient safety award; and has received the MGH Department of Medicine Innovation grant. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

ADDRESS FOR CORRESPONDENCE: Dr Nandita S. Scott, Massachusetts General Hospital, 55 Fruit Street, Yawkey 5B, Boston, Massachusetts 02114, USA. E-mail: nsscott@mgh.harvard.edu.

REFERENCES

1. Trost SL, Beauregard J, Njie F, et al. *Pregnancy-Related Deaths: Data from Maternal Mortality Review Committees in 36 US States, 2017-2019*. Centers for Disease Control and Prevention, US Department of Health and Human Services; 2022.

2. Denayer N, Troost E, Santens B, et al. Comparison of risk stratification models for pregnancy in congenital heart disease. *Int J Cardiol*. 2021;323:54–60.

3. Al-Shaikh GK, Ibrahim GH, Fayed AA, Al-Mandeel H. Grand multiparity and the possible risk of adverse maternal and neonatal outcomes: a dilemma to be deciphered. *BMC Pregnancy Childbirth*. 2017;17(1):310.

4. Merkt PT, Kramer MR, Goodman DA, et al. PetersenUrban-rural differences in pregnancy-related deaths, United States, 2011–2016. *Am J Obstet Gynecol*. 2021;225(2):183.e1–183.e16.

5. Mehta LS, Warnes CA, Bradley E, et al. Cardiovascular considerations in caring for pregnant patients: a scientific statement from the American Heart Association. *Circulation*. 2020;141(23):e884–e903.

6. Pfaller B, Sathananthan G, Grewal J, et al. Preventing complications in pregnant women with cardiac disease. *J Am Coll Cardiol*. 2020;75(12):1443–1452. https://doi.org/10.1016/j.jacc.2020.01.039

7. Hameed AB, Tarsa M, Graves C, et al. Cardiovascular risk assessment as a quality measure in pregnancy and postpartum period. *JACC Adv*. 2023;2(1):100176.

KEY WORDS cardiovascular disease, maternal mortality, pregnancy