A comorbidity-based screening tool to predict severe maternal morbidity at the time of delivery

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BACKGROUND: The obstetric comorbidity index summarizes the burden of maternal comorbidities into a single number and holds promise as a maternal risk-assessment tool.

OBJECTIVE: The aim of this study was to assess the clinical performance of this comorbidity-based screening tool to accurately identify women on labor and delivery who are at risk of severe maternal morbidity on labor and delivery in real time.

STUDY DESIGN: All patients with pregnancies ≥23 weeks gestation presenting to labor and delivery at a single tertiary-care center from February through July 2018 were included in the study. The patient's primary labor and delivery nurse assessed patient comorbidities and calculated the patient's obstetric comorbidity index. The score was recalculated at each 12-hour shift change. A multidisciplinary panel of clinicians determined whether patients experienced severe maternal morbidity based on the American College of Obstetrics and Gynecology and Society for Maternal-Fetal Medicine consensus definition, blinded to the patient's obstetric comorbidity index score. We analyzed the association between the obstetric comorbidity index score and the occurrence of severe maternal morbidity.

RESULTS: The study included 2828 women, of whom 1.73% experience severe maternal morbidity (n=49). The obstetric comorbidity index ranged from 0–15 for women in the study cohort, with a median obstetric comorbidity index of 1 (interquartile range, 0–3). The median obstetric comorbidity index score for women who experienced the severe maternal morbidity was 5 (interquartile range, 3–7) compared with a median of 1 (interquartile range, 0–3) for those without severe maternal morbidity ($P<.01$). The frequency of severe maternal morbidity increased from 0.41% for those with a score of 0 to 18.75% for those with a score ≥9. For every 1-point increase in the score, patients experienced a 1.55 increase in odds of severe maternal morbidity (95% confidence interval, 1.42–1.70). The c-statistic for the obstetric comorbidity index score was 0.83 (95% confidence interval, 0.76–0.89), which indicated strong discrimination.

CONCLUSION: The obstetric comorbidity index can prospectively identify women at risk of severe maternal morbidity in a clinical setting. A particular strength of the obstetric comorbidity index is its ability to integrate multiple compounding comorbidities and highlight the cumulative risk that is associated with the patients' conditions. Routine clinical use of the obstetric comorbidity index has the potential to identify at-risk women whose condition warrants increased surveillance and targeted care to prevent adverse maternal outcomes.

Key words: hemorrhage, maternal death, risk assessment, screening, severe maternal morbidity

Early and reliable identification of women who are at risk of severe maternal morbidity and death at delivery is an important strategy to improve maternal health.[1–3] Trigger systems, such as the maternal early warning criteria, highlight women with abnormal vital signs who are at risk of adverse outcomes, but their clinical utility is challenged by their timing and specificity.[4] The modest prevalence of severe morbidity in the obstetric patient population coupled with transient physiologic hemodynamic variation limits the positive predictive value of vital sign–based screening tools.[5] Furthermore, identification of an at-risk parturient in labor may be too late to provide timely intervention to prevent severe maternal morbidity. Focusing efforts on mothers whose clinical comorbidities place them at risk of severe maternal morbidity (SMM) is an alternative strategy for risk reduction.[6] Targeting these at-risk women allows for tailored care directed towards high-risk issues at the time of delivery.[7,8]

The obstetric comorbidity index (OB-CMI) is a tool that summarizes the burden of maternal comorbidities with a quantified approach.[9,10] Patients are assigned points for maternal and obstetric comorbidities, and these points are summed to generate a single numeric score. The OB-CMI was designed originally to address confounding bias in obstetric research studies.[6] We hypothesize that this comorbidity-based risk assessment tool could be adapted for clinical use. Quantifying the complexity of maternal comorbidities into a single number calls attention to mothers with multiple compounding risk factors that warrant tailored surveillance and risk-appropriate care who may otherwise be overlooked. The aim of this study was to assess prospectively the performance of a comorbidity-based screening tool to identify accurately women on labor and delivery at risk of SMM.

Materials and Methods

The study population included a convenience sample of all women who delivered pregnancies at ≥23 weeks gestation at a single tertiary-care, academic institution from February–July 2018. We excluded women who were transferred to, but did not deliver at, our hospital. The patient's primary admitting obstetrics nurse assessed patient comorbidities and used the clinically modified version of the OB-CMI to calculate the patient's OB-CMI (Appendix 1). The OB-CMI score was then recorded on the data collection

Cite this article as: Easter SR, Bateman BT, Sweeney VH, et al. A comorbidity-based screening tool to predict severe maternal morbidity at the time of delivery. Am J Obstet Gynecol 2019;221:271.e1-10.

0002-9378/$36.00

https://doi.org/10.1016/j.ajog.2019.06.025

AJOG at a Glance

Why was this study conducted?

To assess the clinical performance of a comorbidity-based screening tool to accurately identify women at risk of severe maternal morbidity on labor and delivery.

Key findings

The frequency of severe maternal morbidity increased from 0.41% for those with a score of 0 to 18.75% for those with a score 9. For every 1-point increase in the score, patients experienced a 1.55 increase in the odds of severe maternal morbidity (95% confidence interval, 1.42-1.70).

What does this add to what is known?

The obstetric comorbidity index summarizes the burden of maternal comorbidities into a single number can prospectively identify women at risk of severe maternal morbidity in a clinical setting.

sheet and in the patient's clinical assessment. To account for evolution in diagnoses after admission, the score was then reassessed by the patient's primary nurse with each 12-hour shift change until the patient delivered and was transferred to the postpartum unit or was deemed stable for transfer to the antepartum unit and left labor and delivery. The risk assessment process was repeated on admission for patients who required readmission to labor and delivery.

Our institution has a long-standing practice of holding twice daily multidisciplinary patient rounds in which a brief synopsis of each patient is presented to members of the obstetric care team that includes obstetric care providers, nurses, anesthesiologists, and neonatal staff. Each patient's OB-CMI was presented by the patient's primary nurse as a part of these rounds to standardize the communication of maternal risk for each patient to members of the multidisciplinary care team. The nurse notified the patient's primary obstetric care provider of patients with an OB-CMI at $\geq$6 to facilitate timely communication and awareness between team members regarding these high-risk patients. A score of 6 was chosen, based on the increase in the prevalence of maternal end-organ damage or intensive care unit (ICU) admission in the original database-derived study.[9] This notification was performed at the time of calculation of the score either on admission to labor and delivery or, if the score changed during its recalculation throughout the hospital course, to draw attention to patients with evolving clinical scenarios.

The original OB-CMI was derived from 854,823 pregnancies in the Medicaid Analytic eXtract with the use of the International Classification of Diseases, 9th Revision, Clinical Modification, diagnosis codes that target a primary outcome of maternal end-organ injury or death (Appendix 2).[9] Bateman et al[9] assigned weights to the conditions of interest based on the strength of the association between the comorbidity and the primary outcome using logistic regression. The tool was subsequently validated in an external population in Alberta, Canada.[10] To make a comprehensive clinical risk assessment tool, we modified the claims-derived OB-CMI to include maternal comorbidities, such as placenta accreta and obesity, that are not reliably captured in claims data. We performed a 1-month training and pilot period in which we asked for feedback on relevant missing comorbidities from members of the clinical care team. During this pilot period, the admission history and physical was reviewed by 1 member of the study team (S.R.E.) to capture additional comorbidities that warrant consideration. We lacked sufficient power to model these additional comorbidities clinically. Therefore, the inclusion and weighting of the comorbidities of the final version of the clinically modified OB-CMI tool were determined by 2 members of the study team (B.T.B. and J.N.R.) based on the expected strength of the association between these comorbidities and the outcome of SMM.

Our primary outcome of interest was the presence of SMM or death as outlined by the Obstetric Care Consensus document authored by the American College of Obstetrician Gynecologists (AJOG) and Society for Maternal-Fetal Medicine (SMFM).[11] These guidelines define SMM as unintended outcomes of the process of labor and delivery that result in significant short-term or long-term consequences to a woman's health. The consensus statement specifically avoids providing a comprehensive list of outcomes to define SMM but propose potential scenarios that constitute this outcome and classify SMM into 9 different causes: hemorrhage, hypertension/neurologic, renal, sepsis, pulmonary, cardiac, ICU/invasive monitoring, surgical/bladder/bowel complications, and anesthesia complications. These guidelines prioritize developing processes to identify SMM that are distinct from diagnosis code–based definitions proposed by the Centers for Disease Control and Prevention because of the low predictive value of these algorithms and the challenge of identifying cases in a timely manner.[11,12]

The ACOG and SMFM consensus statement recommends reviewing any cases of transfusion of $\geq$4 units of blood or admitted to the ICU to determine whether SMM occurred. Many critically ill patients at our institution are treated in labor and delivery by critical care–trained obstetrics nurses as opposed to being admitted to the ICU. This institutional practice may limit the sensitivity of the nationally recommended screening criteria for the identification of cases of SMM. We therefore developed an institution-specific protocol to identify patients who are at risk for SMM warranting discussion at a monthly multidisciplinary meeting.[13] Specifically, we reviewed cases of women who were admitted to the ICU, who received any blood or blood component transfusion,

who delivered with general anesthesia, and who were admitted to or consulted on by the maternal-fetal medicine inpatient team who were flagged by the admitting obstetrics resident as potentially experiencing SMM.

We held monthly multidisciplinary meetings that included obstetric, maternal-fetal medicine, obstetric anesthesia, and nursing providers to review cases meeting the aforementioned screening criteria and to determine whether SMM occurred. After presentation of the case by 1 clinician (S.R.E.), the presence of SMM was deemed by consensus of the panel based on the criteria specified by ACOG and SMFM and blinded to the specific comorbidities and OB-CMI of the patient. For those patients who were deemed to have SMM, the preventability of each cases of SMM was determined as "likely preventable," "possibly preventable," or "likely not preventable" based on the opinion of the multidisciplinary panel. On request from the multidisciplinary panel to inform the discussion of preventability and quality improvement review, additional details about maternal comorbidities were provided after a patient was deemed to have SMM. Those cases deemed as either likely or possibly preventable were reviewed within the context of quality assurance to examine outcomes for potential process improvement as outlined by the recommendations set forth in the ACOG and SMFM guidelines.

We extracted sociodemographic and obstetric covariates and delivery and neonatal outcomes using hospital birth records. Paper copies of the OB-CMI tool were transcribed into an electronic format by trained research personnel using REDCap electronic data capture tools hosted at Harvard University.[14] We determined the frequency of SMM for women with a given score and examined the association between the OB-CMI score and our primary outcome using the Wilcoxon Rank Sum test. We then used logistic regression to examine the association between the OB-CMI score and SMM and calculated a c-statistic to determine the discrimination of the score. For patients with multiple admissions or prolonged courses in labor and delivery, the highest score before delivery was used for all analyses. All analyses were performed with the use of Statistical Analysis software (version 9.4; SAS Institute Inc, Cary, NC). This study was approved by the Partners Human Research Committee (protocol 2017P002514) who deemed it exempt from informed consent.

TABLE 1
Maternal and obstetric characteristics of hospital and clinical validation cohort

Characteristic	Patients (n=2828)
Maternal age, y[a]	33.1 (29.8–36.0)
Race/ethnicity, n (%)	
White	1664 (58.8)
Black	363 (12.8)
Hispanic	165 (5.8)
Asian	277 (9.8)
Other	290 (10.3)
Missing	69 (2.4)
Gestational age, wk[a]	39.1 (38.1–40.6)
Preterm birth <37 wk, n (%)	352 (12.5)
Nulliparous, n (%)	1352 (47.8)
Vaginal delivery, n (%)	1891 (66.9)
Neuraxial analgesia, n (%)	2427 (85.8)

[a] Data presented as median (interquartile range).
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Results

The study included 2828 women who delivered at ≥23 weeks gestation during the study period. The characteristics of the women in the cohort are presented in Table 1. The majority of women in the cohort were white with a median gestational age of 39.1 weeks. Forty-seven percent of women were nulliparous; the rate of vaginal birth was 66.9%.

The frequency of each maternal comorbidity and the weight of that comorbidity in the clinically modified OB-CMI is shown in Table 2. Comorbidities with a weight of 1 in the OB-CMI, which included asthma, previous cesarean delivery, or myomectomy, and maternal age from 35–39 years were the most common with rates of 15.24%, 16.62%, and 25.57%, respectively. Four percent of women had preeclampsia with severe features weighted at 5 points; 11.92% of women had preeclampsia, gestational hypertension, or chronic hypertension without severe features weighted at 2 points. The OB-CMI ranged from 0–15 for women in the study cohort, with a median OB-CMI score of 1 (interquartile range, 0–3). The distribution of OB-CMI scores for patients in the cohort is presented in Figure 1.

One hundred women met the screening criteria that warranted presentation in our monthly SMM review. The indications for review included transfusion (n=37), concern for SMM from admitting resident (n=25), general anesthesia at delivery (n=19), and ICU admission (n=1). Eighteen patients had multiple indications for review for possible SMM. Forty-nine women (1.7%) experienced the primary outcome of SMM or death based on the adjudication of the review committee. Figure 2 presents the observed risk of the primary outcome of interest according to OB-CMI score. The risk increased from 0.41% for women with a score of 0–18.8% for women with a score of ≥9. The median OB-CMI for women with SMM was 5 (interquartile range, 3–7)

TABLE 2
Weight of individual maternal conditions in the clinical modification of the obstetric comorbidity index score and the prevalence of these conditions in the study population

Comorbidity	Points	Total (N=2828), n (%)
Preeclampsia with severe features or eclampsia	5	115 (4.07)
Preeclampsia/gestational/chronic hypertension	2	337 (11.92)
Congestive heart failure	5	2 (0.07)
Pulmonary hypertension	4	0 (0)
Ischemic heart disease/cardiac arrhythmia	3	39 (1.38)
Congenital heart and/or valvular disease	4	33 (1.17)
Multiple gestation	2	82 (2.90)
Fetal death	2	19 (0.67)
Placenta previa/suspected accreta/abruption	4	73 (2.58)
Previous cesarean delivery/myomectomy	1	470 (16.62)
Autoimmune disease/lupus	2	91 (3.22)
HIV/AIDS	2	1 (0.04)
Sickle cell disease/bleeding disorder/coagulopathy/anticoagulation	3	103 (3.64)
Epilepsy/cerebrovascular accident/neuromuscular disorder	2	50 (1.77)
Chronic renal disease	1	24 (0.85)
Asthma	1	431 (15.24)
Diabetes mellitus with insulin therapy	1	134 (4.74)
Maternal age, y		
>44	3	20 (0.71)
40–44	2	179 (6.33)
35–39	1	723 (25.57)
Substance use disorder	2	29 (1.03)
Alcohol abuse	1	13 (0.46)
Body mass index, kg/m^2		
>50	3	24 (0.85)
>40	2	159 (5.62)

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compared with a median of 1 (interquartile range, 0–3; $P<.001$) for those without. In a logistic regression model that predicted the primary outcome of SMM and modeled the OB-CMI score as a continuous independent variable, every 1-point increase in the score increased the odds of SMM by 1.55 (95% confidence interval, 1.42–1.70). The c-statistic for the OB-CMI in this model was 0.83 (95% confidence interval, 0.76–0.89).

The distribution of the primary outcome of interest according to organ system along with the adjudication of preventability is presented in Table 3. Hemorrhage was the most common cause of SMM. Four women experienced multiple causes of SMM. No cases of SMM secondary to anesthetic complications or for the sole indication of ICU or invasive monitoring occurred. The frequency of cases of SMM deemed either likely or possibly preventable according to OB-CMI score are presented in Figure 3. Risk of likely or possibly preventable SMM increased with an increasing OB-CMI score. The risk of preventable SMM ranged from 0.10% for those with an OB-CMI score of 0–9% for those with an OB-CMI score of ≥9.

Comment

Principal findings

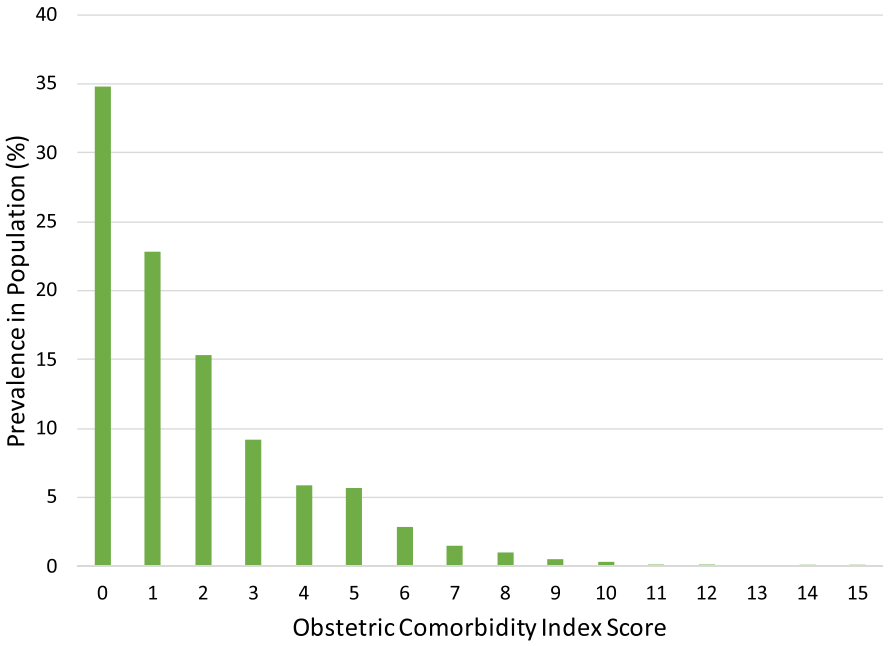
We evaluated the ability of the OB-CMI to quantify the risk of SMM in clinical practice among a prospective cohort of women who delivered at a United States academic tertiary care center. The c-statistic was 0.83, which indicated that the score had good discrimination with the risk of severe morbidity increasing from less than one-half of 1% for those with a score of 0 to nearly 20% in those with a score of ≥9.

Results in context

The OB-CMI was developed as a research tool but holds particular promise in the clinical arena in our contemporary obstetric environment that is characterized by an increasing contribution of maternal medical disease to maternal death.[1,2,9,10] A particular strength of the OB-CMI is its ability to integrate multiple compounding comorbidities and highlight the cumulative risk that is associated with the patients' conditions. A clinician may easily identify that women with high-risk conditions, such as cardiac disease or preeclampsia with severe features, are at risk of SMM. A 40-year-old obese parturient with chronic hypertension and a previous cesarean delivery may have a similar objective risk of SMM that could be overlooked easily when her comorbidities are considered in isolation.

The ability of the OB-CMI to capture women who are at risk for multiple disease processes is 1 of many strengths over existing intrapartum early warning systems that often are geared towards the early identification of hypertension or sepsis.[4,15–17] As opposed to many of the physiology-based warning systems based solely on expert opinion or derived from nonobstetric populations, the OB-CMI was derived from a nationally representative sample of obstetric patients and

FIGURE 1
Prevalence of each obstetric comorbidity index score within cohort



The obstetric comorbidity index ranged from 0–15 for women in the study cohort with a median obstetric comorbidity index of 1 (interquartile range, 0–3).

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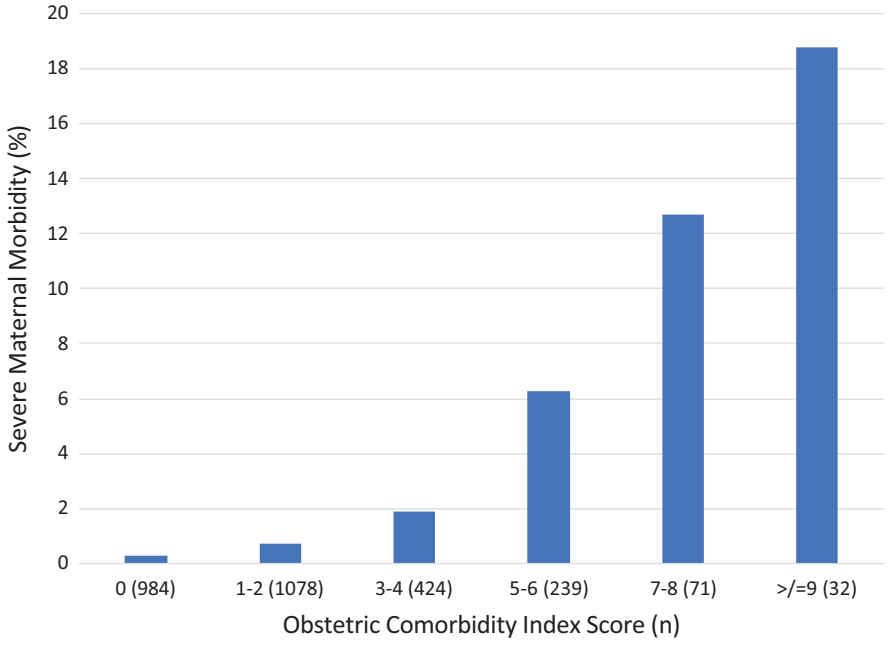
FIGURE 2
Rate of severe maternal morbidity according to obstetric comorbidity index score



The frequency of severe maternal morbidity increased from 0.41% for those with a score of 0–18.75% for those with a score ≥9.

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subsequently was validated in external populations.[4,18,19] Finally, the OB-CMI is a risk assessment tool that relies primarily on information that is known before or on arrival to labor and delivery, which potentially offers more lead time than existing intrapartum screening tools.[20] This scoring system is an easy-to-implement tool that holds potential for the identification of those women who warrant intervention in advance of delivery who may benefit from risk-appropriate maternal care.[21,22]

Strengths and limitations

The predictive ability of the OB-CMI has been demonstrated in the aforementioned research settings, but our study is the first report of this scoring system in the clinical arena and offers strengths over previous work.[9,10,20] The clinical OB-CMI score includes covariates, such as placenta accreta and obesity, that are known to impact maternal outcomes but have not been used in other retrospective risk analyses.[9,23,24] The primary outcome of SMM relies on a comprehensive contemporary obstetric definition that was determined by a multidisciplinary panel of clinicians. This ACOG/SMFM definition of SMM is designed specifically to differentiate clinically significant severe morbidity from unanticipated events of minimal short- or long-term consequence.[3,11,12,25–27] The strength of this model, coupled with its ease of use, demonstrates its potential as a standardized risk assessment tool in the clinical setting.[6]

Despite these strengths, our study is not without limitations. Although we attempted to blind reviewers to patient comorbidities, it is possible that the clinicians inferred patient comorbidities based on the outcome presented or when making a determination of preventability after receiving additional information about the case. The weight of the individual condition reflects the population effect of that comorbidity on a maternal outcome. Recognizing that many disease processes exist on a spectrum, the clinically modified OB-CMI groups together overlapping disease processes of similar weight to aid in its ease of use. As a result, a patient with severe aortic stenosis

TABLE 3
Distribution of severe maternal morbidity and death and preventability by primary cause

Severe maternal morbidity	Primary outcome, n	Likely preventable, n (%)	Possibly preventable, n (%)	Likely not preventable, n (%)
Total	49	6 (12)	18 (37)	25 (51)
Maternal death	1	0 (0)	0 (0)	1 (100)
Hemorrhage	24	2 (8)	9 (38)	13 (54)
Hypertension/neurologic	3	0 (0)	2 (67)	1 (33)
Renal	1	0 (0)	0 (0)	1 (100)
Sepsis	3	1 (33)	1 (33)	1 (33)
Pulmonary	5	0 (0)	2 (40)	3 (60)
Cardiac	5	1 (20)	1 (20)	3 (60)
Intensive care unit/invasive monitoring	0	NA	NA	NA
Surgical, bladder, and bowel complications	3	0 (0)	3 (100)	0 (0)
Anesthesia complications	0	NA	NA	NA
Multiple causes	4	2 (50)	0 (0)	2 (50)

NA, not applicable.

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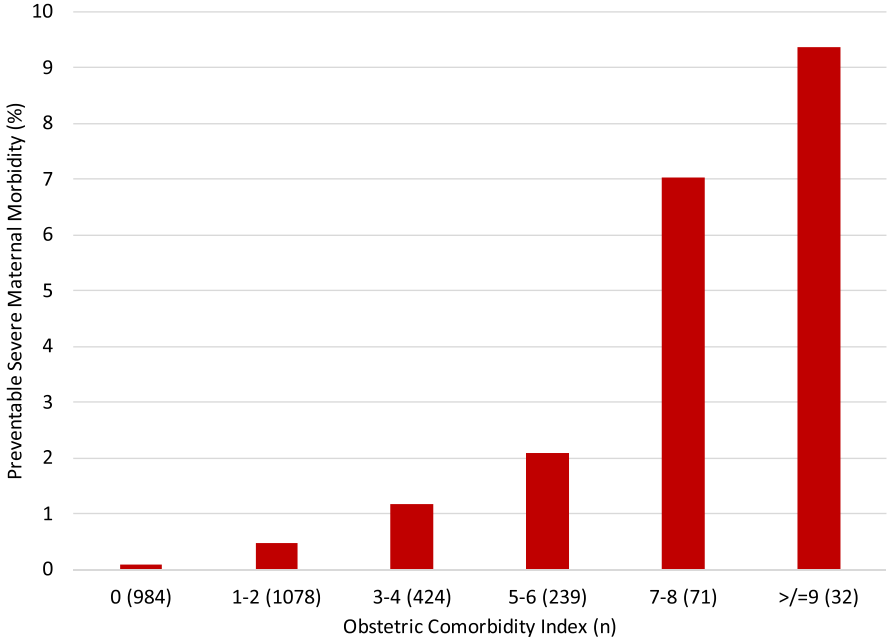
FIGURE 3
Preventability of cases of severe maternal morbidity according to obstetric comorbidity index score



Risk of likely or possibly preventable severe maternal morbidity increased with an increasing obstetric comorbidity index score. The risk of preventable severe maternal morbidity ranged from 0.10% for those with an obstetric comorbidity index score of 0—9% for those with an obstetric comorbidity index score ≥9.

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could be assigned similar weight as a patient with mild mitral regurgitation.[28] Quantification of maternal disease burden offers many advantages in terms of risk stratification and communication but cannot supplant the role of clinical judgment in anticipating adverse maternal outcomes. The OB-CMI can be used to simplify communication of maternal risk status among members of a multidisciplinary care team, which is analogous to the Apgar score for pediatricians. The rarity of our primary outcome of interest, however, limits our ability to consider the impact of the use of the score on maternal outcomes.[29] The single-center setting of our study and the aforementioned institution-specific protocol for the identification of SMM highlights a role for verification in other clinical environments to demonstrate the generalizability of the tool.

Clinical and research implications

The use of risk stratification is an important component of all safety bundles that target SMM prevention.[30—33] Potential applications for the OB-CMI include its use in routine prenatal care

and integration with existing screening tools. Although we assigned scores to women on admission to labor and delivery, the majority of the conditions in the OB-CMI can be diagnosed early on in pregnancy, which makes the tool of potential value as a part of prenatal care. The OB-CMI could serve as an objective triaging system either to establish prenatal care with or to seek consultation from maternal-fetal medicine and other specialists at the initial prenatal visit. Repeating this risk assessment in the third trimester to capture the development of obstetric comorbidities, such as hypertensive disorder of pregnancy or abnormalities of placentation, may also be a useful approach to ensure that women with evolving risk states are not missed. Routine use of the tool in the antenatal setting to identify women at highest risk for SMM gives the clinician an opportunity to intervene earlier with involvement of specialists and delivery planning that would include seeking the most appropriate maternal level of care for delivery.[6–8]

Intrapartum use of the OB-CMI could complement physiologic-based screening tools with which the highest-risk mothers could be targeted for focused use of the maternal early warning system criteria to improve the specificity of the maternal early warning system.[4] The integration of existing diagnosis-specific bundles that target common diseases, such as hemorrhage, cardiovascular disease, sepsis, or hypertension, based on the comorbidities highlighted by the OB-CMI may help integrate clinical risk assessment with a timely and appropriate response.[5,30–33] Future research that will explore an ideal cutoff and proposed intervention for high-risk mothers is warranted. Considering the diversity of conditions that are captured in the score and range of birthing facilities in our country, an ideal cutoff and response may differ according to the resources available in a given clinical setting.

Conclusion

The prevention of SMM is a priority for patient care and at the top of the national public health agenda. Risk stratification to guide early identification and appropriate response is central to existing efforts such as regionalization of maternity care and patient safety bundles. The OB-CMI is a clinically valid tool that is capable of the identification of women at risk of SMM at the time of delivery. Integration of this intuitive comorbidity-based risk assessment tool into routine practice holds promise for clinicians and policymakers alike. ■

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Received March 11, 2019; revised June 9, 2019; accepted June 12, 2019.

Supported, in part, by grants from Eli Lilly and Company and Novartis Pharmaceuticals Corporation to the Brigham and Women's Hospital (J.J.G.).

J.J.G. is a consultant to Aetion, Inc, and Optum, Inc, and B.T.B. is a consultant to the Alosa Foundation and Aetion, Inc. The remaining authors report no conflict of interest.

Presented as an abstract at the Society for Maternal Fetal Medicine Annual Meeting, Las Vegas, NV, February 14, 2019.

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APPENDIX 1
Obstetric comorbidity index score form

Obstetric Comorbidity Index Score

Patient Sticker Here

Maternal Condition	Points	Comments
Preeclampsia with Severe Features* or Eclampsia	5	
Preeclampsia / Gestational / Chronic Hypertension	2	
Congestive Heart Failure	5	
Pulmonary Hypertension	4	
Ischemic Heart Disease / Cardiac Arrhythmia	3	
Congenital Heart and/or Valvular Disease	4	
Multiple Gestation	2	
Intrauterine Fetal Demise	2	
Placenta Previa / Suspected Accreta / Abruption	4	
Previous Cesarean Delivery / Myomectomy	1	
Autoimmune Disease / Lupus	2	
HIV/AIDS	2	
Sickle Cell Disease / Bleeding Disorder / Coagulopathy / Anticoagulation	3	
Epilepsy / Cerebrovascular Accident / Neuromuscular Disorder	2	
Chronic Renal Disease	1	
Asthma	1	
Diabetes on Insulin	1	
Maternal Age > 44	3	
Maternal Age 40-44	2	
Maternal Age 35-39	1	
Substance Use Disorder	2	
Alcohol Abuse	1	
BMI > 50	3	
BMI > 40	2	
*__Severe Features__: Systolic BP ≥ 160, diastolic BP ≥ 110, creatinine > 1.1, oliguria (<30 cc/hr), elevated AST or ALT, platelets < 100,000, persistent epigastric pain, headache, or scotomata, placental abruption.	**Total:**	**MD Notified:**

Instructions for Use:
1) Circle comorbidities present in your patient and tally score at bottom.
2) Does this patient have any other high-risk features you think should be added to the list? _____
3) Notify Responding Clinician for patients with OB-CMI score > 6 or with any other concerns.
4) Document the OB-CMI score in the nursing handoff template.
5) Place completed sheet in locked bin behind desk.

RN _____ Date _____ Time _____

Easter et al. OB-CMI for maternal risk assessment. Am J Obstet Gynecol 2019.

APPENDIX 2

List and weight of comorbidities from the database-derived obstetric comorbidity index[9]

Comorbidity	Weight
Severe preeclampsia or eclampsia	5
Chronic congestive heart failure	5
Congenital heart disease	4
Pulmonary hypertension	4
Chronic ischemic heart disease	3
Sickle cell disease	3
Multiple gestation	2
Cardiac valvular disease	2
Systemic lupus erythematosus	2
HIV	2
Mild or unspecified preeclampsia	2
Drug abuse	2
Placenta previa	2
Chronic renal disease	1
Preexisting hypertension	1
Previous cesarean delivery	1
Gestational hypertension	1
Alcohol abuse	1
Asthma	1
Preexisting diabetes mellitus	1
Maternal age, y	
>44	3
40–44	2
35–39	1

Easter et al. OB-CMI for maternal risk assessment. Am J Obstet Gynecol 2019.