OBSTETRICS

Identification of severe maternal morbidity during delivery hospitalizations, United States, 1991-2003

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OBJECTIVE: This investigation aimed to identify pregnancy complications and risk factors for women who experienced severe maternal morbidity during the delivery hospitalization and to estimate severe maternal morbidity rates.

STUDY DESIGN: We used the National Hospital Discharge Survey for 1991-2003 to identify delivery hospitalizations with maternal diagnoses and procedures that indicated a potentially life-threatening diagnosis or life-saving procedure.

RESULTS: For 1991-2003, the severe maternal morbidity rate in the United States was 5.1 per 1000 deliveries. Most women who were classified as having severe morbidity had an ICD-9-CM code for transfusion, hysterectomy, or eclampsia. Severe morbidity was more common at the extremes of reproductive age and for black women, compared with white women.

CONCLUSION: Severe maternal morbidity is 50 times more common than maternal death. Understanding these experiences of these women potentially could modify the delivery of care in healthcare institutions and influence maternal health policy at the state and national level.

Key words: pregnancy complication, severe maternal morbidity, surveillance

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Maternal morbidity, broadly defined, encompasses physical and psychologic conditions that result from or are aggravated by pregnancy that have an adverse effect on the woman's health. Maternal morbidity includes a broad spectrum of severity and can include complications and conditions that are associated with any pregnancy outcome. Although there is no established way to identify what maternal conditions to consider as morbidity, extending maternal health surveillance to include the identification and review of pregnancy complications and the factors that are associated with them has the potential to improve maternal health by providing information to influence the delivery of health services and health policy.

Some previous frameworks for measuring maternal morbidity in the United States have been constructed with antenatal hospitalizations as a proxy for maternal morbidity[1,2]; others have used all pregnancy-related complications during delivery hospitalizations.[3] Neither of these frameworks for maternal morbidity has taken into account the severity of illness. A scoring system that used a hospital-based clinical database to identify the most severe morbidity (so-called "near miss" morbidity) performed well,[4] but the information that is needed to obtain the score usually is not readily available, unless an institution has a specialized perinatal databases or a state collects healthcare use data beyond that based on International Classification of Disease 9th Revision, Clinical Modification (ICD-9-CM) codes. Recently, investigators in Canada grouped ICD-9-CM discharge diagnosis codes and Canadian Classification of Diagnostic, Therapeutic, and Surgical Procedure codes to identify women who likely experienced severe morbidity during their delivery hospitalization.[5]

Whereas the severity of morbidity is a continuum, several reasons suggest the importance of focusing on the severe end of the spectrum. Severe morbidity has a greater effect on the woman's health and poses greater risks to her immediate and lifelong well-being. Identifying women who experienced severe maternal morbidity provides cases for review of care and offers the opportunity to better understand the continuum of severity and the factors that are associated with preventability. Thus, as we attempt to expand maternal health surveillance beyond death at the institutional, state, and national level, it would be useful to be able to use readily available information to identify women with severe morbidity during pregnancy. Using national data, we have identified a group of routinely collected ICD-9-CM discharge and procedure codes that we believe indicate significant complications of pregnancy.

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MATERIALS AND METHODS

We used information from the National Hospital Discharge Survey (NHDS) for the years 1991-2003 to identify delivery hospitalizations. This time period was chosen because it reflected the most recent design of the survey and encompassed a large number of deliveries, thereby allowing for exploration of trends in relatively rare events. The NHDS is conducted annually by the Centers for Disease Control and Prevention's National Center for Health Statistics, and its design is described in detail elsewhere.[6] In brief, the National Center for Health Statistics collects data on inpatient use from short-stay, noninstitutional, and nonfederal hospitals in the United States. The NHDS uses a 3-stage sampling design: geographic primary sampling units, hospitals within primary sampling units, and discharges within hospitals. The data are weighted to represent national inpatient hospitalizations; each observation is weighted according to its probability of being sampled. From 1991-2003, a mean of 464 hospitals (range, 426-494) provided information on approximately 300,000 discharges per year.[6-12] For each discharge, the NHDS collects basic demographic information and characteristics of hospitalizations such as length of stay, an ICD-9-CM–coded primary diagnosis, up to 6 additional ICD-9-CM diagnoses, and up to 4 ICD-9-CM procedure codes. Approximately 25% of discharges in the NHDS have no information about race. A previous study showed that hospitals that did not report race were likely to have a higher proportion of white discharges than hospitals that reported race.[13] Hospital characteristics that are collected include region and size. The NHDS samples hospital discharges and not persons. However, because a woman can be hospitalized only once for a delivery and our analysis focused on delivery hospitalizations, the woman was the unit of analysis for this project. This study analyzed deidentified unlinked data and was exempt from institutional review board review.

Delivery hospitalizations were identified by the ICD-9-CM code V27, which designates the outcome of a delivery in the primary diagnosis field. As a conceptual basis for severe maternal morbidity, we considered ways that ICD-9-CM diagnosis and procedure codes could indicate that a woman was likely to have had a significant, potentially life-threatening illness or an event during her delivery hospitalization. Although we did not ignore specific diagnoses, our framework placed less emphasis on obstetric diagnosis codes, which in many instances are nonspecific and do not indicate the severity of the condition, and placed a greater emphasis on diagnosis and procedure codes that reflect that a severe complication occurred during the delivery hospitalization. For example, the diagnosis code for severe preeclampsia (642.5) was not deemed to be sufficient to designate a woman as having severe morbidity. Although this diagnosis includes the term *severe*, there are several ways to meet the definition requirements of severe preeclampsia; therefore, there is a very broad spectrum of severity that is embedded in this diagnosis code.[14] However, regardless of whether a woman had the code for severe preeclampsia, if she had a code that indicated an event that occurred as a likely consequence of severe preeclampsia (such as a cerebrovascular accident, a blood transfusion, or artificial ventilation), she was designated as having had severe morbidity.

We selected ICD-9-CM codes that we believed indicated severe morbidity or were a consequence of severe morbidity. Indicators of severe morbidity based on diagnosis and procedure codes were determined a priori according to a previously published conceptual model,[15] the framework reported for Canada,[5] and a review by 2 medical epidemiologists (W.M.C., C.J.B.) of all codes that are within and outside of the pregnancy chapter of ICD-9-CM. These conditions and procedures and the associated ICD-9-CM codes are shown in the Appendix.

Initially, all women who had at least 1 of the selected ICD-9-CM codes were considered to be potential cases of severe morbidity. Then, in an effort to address potential coding errors, we excluded from further analysis women with a very short length of stay, which we believed was clinically inconsistent with the severe morbidity diagnosis. We restricted the analysis to women with a hospital stay of at least 3 days (2 days being the median length of stay among women who delivered) or who had been transferred to another facility after delivery. Women who had at least 1 of the selected ICD-9-CM codes and a length of stay of at least 3 days or a postpartum transfer were considered to have had severe maternal morbidity for the analysis of detailed morbidities, maternal characteristics, and hospital characteristics.

The severe maternal morbidity rate was defined as the number of women who met our severe morbidity criteria per 1000 deliveries. Severe maternal morbidity rates were tabulated by maternal and hospital characteristics that were available in the NHDS. Imposing a minimum length-of-stay requirement affected the prevalence of severe morbidity. Thus, we calculated severe morbidity rates for a range of minimum length of stays (1-7 days) to explore the effect of this inclusion criterion. We also tested whether the severe morbidity rate had changed over the 14 years of observation with the use of a weighted least-squares test for trend based on a 2-sided z test. To calculate accurate estimates for standard errors and to account for the complex sampling design of the NHDS, all of the analyses were performed with SUDAN (RTI International, Research Triangle Park, NC) statistical software.

RESULTS

From 1991 through 2003, the NHDS contained 423,480 sampled records in which a delivery was indicated by the presence of a V27 code in the primary diagnosis field; the sample represented 50.6 million deliveries when the appropriate weighting was applied. In the same time period, there were 2235 discharge records for delivery hospitalizations with a length of stay of at least 3 days and at least 1 diagnosis or procedure code that met the severe maternal morbidity criteria; these records represent approximately 257,000 women when weighted. The severe morbidity rate for the period