ABSTRACT

Objectives: (1) To identify the most appropriate models for use in predicting maternal mortality in pregnant and postpartum women; (2) to establish temporal and geographic trends in maternal morbidity, mortality and admission to intensive care in Canada; (3) to identify factors associated with maternal morbidity and death in Canada; and (4) to explore variation in admission to intensive care among Canadian hospitals for pregnant and postpartum women.

Methods: For the first objective, we performed a systematic review and meta-analysis of risk prediction models. Objectives two through four were addressed within a series of nationwide population-based observational studies using the hospital-based Discharge Abstract Database from the Canadian Institute for Health Information. Estimated annual percent change of maternal morbidity, mortality and admission to intensive care were computed with negative-binomial regression models. Multi-level logistic regression models were employed to investigate factors associated with the outcomes. Median odds ratios and the variance partitioning coefficient were used to describe variation in admission to intensive care.

Results: The systematic review identified 38 studies that developed and/or validated 12 models for predicting mortality among hospitalized pregnant and postpartum women. The Collaborative Integrated Pregnancy High-dependency Estimate of Risk (CIPHER) model for hospitalized critically ill obstetric populations, and the Maternal Severity Index for hospitalized general obstetric populations had very good discrimination, calibration, a low risk of bias and were internally validated for critically ill pregnant and postpartum women. Prediction models developed from non-obstetric patients and from general ICU patient populations had very good discrimination but were at risk of over- or under-estimation of true mortality.
The national population-based study identified a stable maternal mortality rate of 6.2 per 100,000 deliveries, but increasing rates of severe maternal morbidity and admission to intensive care with estimated annual percent changes, 1.32% (95% Confidence Interval (CI) 0.60 – 2.04) and 1.83% (95% CI 0.68 – 2.98), respectively. Severe maternal morbidity varied across Canadian regions but was highest in the northern Territories at 22.8 per 1000 deliveries. Province of residence, maternal comorbidity, income level, and extremes of maternal age - especially those aged 45 years and older, in comparison to those 20 to 24 years - were associated with severe maternal morbidity and mortality. For two pregnant women with similar characteristics at different hospitals, the median odds of being admitted to ICU was 1.92 in one hospital compared to another, indicating substantial variability in admission patterns to intensive care for pregnant and postpartum women in Canadian hospitals. The variability in ICU admission among hospitals was 18.6%. Hospitals admitting the fewest number of pregnant patients, more likely to be in rural areas, and had a higher proportion of patients in lower income quintiles, had the highest incidence of severe maternal morbidity and mortality.

Conclusions: In Canada, while maternal mortality appears stable, maternal age is increasing over time and is independently associated with severe maternal morbidity. There is substantial regional variation in maternal morbidity and mortality. Finally, there is wide variability in maternal admission to intensive care among hospitals and among provinces in Canada. Increased recognition of risk factors at both the patient and health system level, and a lower threshold for intensive care may be one strategy to mitigate the risks associated with older maternal age, and a mechanism to improve the health outcomes for both mothers and babies in Canada.