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Major article

Patient volumes and pre- and postdischarge postpartum infection: A retrospective cohort study

Andrea M. Parriott PhD [a,*], Onyebuchi A. Arah MD, DSc, PhD [b,c,d]

[a] Department of Health Policy and Management, UCLA Fielding School of Public Health, Los Angeles, CA
[b] Department of Epidemiology, UCLA Fielding School of Public Health, Los Angeles, CA
[c] UCLA Center for Health Policy Research, Los Angeles, CA
[d] California Center for Population Research, UCLA, Los Angeles, CA

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Background: To examine the association between hospital and clinician obstetric volume and postpartum infection risk in the pre- and postdischarge periods.

Methods: We used data from the 2011 New York State Inpatient and Emergency Department Databases to fit generalized estimating equation models to examine the effect of hospital and clinician obstetric volume on infection before discharge and in the 30 days after discharge after delivery.

Results: Higher clinician volume was associated with lower predischarge infection risk (odds ratio [OR] for first vs third quartile was 0.84; 95% confidence interval [CI], 0.77-0.98). There was an uncertain trend toward higher predischarge infection risk in higher volume hospitals (OR for first vs third quartile was 1.36; 95% CI, 0.79-2.34). We found no associations between patient volumes and postdischarge infections; however, power was insufficient to rule out small associations. The joint association of hospital and clinician volumes with postdischarge infection appeared submultiplicative (product term OR = 0.95; 95% CI, 0.92-0.98).

Conclusion: This study adds to the evidence that hospital obstetric volume is positively associated with predischarge postpartum infections, whereas clinician volume may be negatively associated with those predischarge infections. The associations between hospital obstetric volume and postdischarge infection appear to differ. These results underscore the importance of including postdischarge follow-up in hospital-based studies of postpartum infection.

A large body of literature has found relationships between patient volumes (at both facility and clinician levels) and patient outcomes. A number of studies have examined the relationship between patient volumes and perinatal outcomes. Several studies have found better neonatal outcomes with higher volume providers.[1-3] However, the relationship between volume and maternal outcomes is not as well documented. Quality research on the effect of patient volumes on maternal outcomes is crucial to determining the ideal patient volumes for both hospitals and clinicians.

Postpartum infection is a common complication of childbirth.[4] There is evidence to suggest that higher volume facilities and departments may predispose patients to certain types of infections.[5,6] There are also reasons to hypothesize that clinician volume may affect infection risk. A handful of studies have found lower risk of infection when surgical procedures are performed by surgeons with higher patient volumes.[7-9]

We found 3 previous U.S. studies that sought to examine the association between obstetric volume and a broad set of postpartum infectious outcomes. Janakiraman et al found an increased risk of infection in higher volume facilities (although this association was not adjusted for patient mix).[10] Goff et al[11] also found an increasing risk of infection with increasing hospital obstetric volume, while noting that it explained a relatively small proportion of hospital differences in infection rates, and Kyser et al[12] found a nonmonotonic relationship, where patients in hospitals with very low and very high volumes were at greater risk than patients at midvolume hospitals. Janakiraman et al[10] also found that patients attended by low volume clinicians had

* Address correspondence to Andrea M. Parriott, PhD, 650 Charles E Young Dr S, 31-269 CHS, Los Angeles, CA 90095-1772.
E-mail address: aparriott@ucla.edu (A.M. Parriott).
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Table 1
(Maternal) Outcomes and associated ICD-9-CM codes

Condition	ICD-9-CM codes
Urinary tract infections	032.84, 590.0, 590.01, 590.10, 590.11, 590.2, 590.3, 590.80, 590.81, 590.9, 595.0, 595.1, 595.2, 595.3, 595.4, 595.81, 595.82, 595.89, 595.9, 597.0, 597.80, 597.81, 597.89, 598.00, 598.01, 599.0
Sepsis and bloodstream infections	670.20, 670.22, 670.24, 670.30, 670.32, 670.34, 038.0, 038.10, 038.11, 038.12, 038.19, 038.2, 038.3, 038.4, 038.41, 038.42, 038.43, 038.44, 038.49, 038.8, 038.9, 785.52, 790.7, 995.90, 995.91, 995.92, 998.02
Genital tract infections	670.10, 670.12, 670.14
Surgical wound complications	674.12, 674.14, 674.32, 674.34
Other postsurgical infections	998.5, 998.59, 998.51
Other major puerperal infections	670.00, 670.02, 670.04, 670.80, 670.82, 670.84
Device-associated infection	996.60, 996.62

higher risk of infection. All 3 studies considered only infections occurring during the index hospitalization (ie, hospitalization for delivery).

We are unaware of any published studies of the relationship between hospitals' or clinicians' obstetric volume and postpartum infections in the period after discharge from the hospital. This is a substantial gap in the literature because most postpartum infections are diagnosed postdischarge.[4,13] We sought to examine the associations of obstetric volumes at the hospital and clinician levels with a variety of postpartum infections, including infections diagnosed both during the index hospitalization and in readmissions and emergency room visits after discharge.

MATERIALS AND METHODS

Data source

The study data came from the 2011 New York State Inpatient Database and the New York State Emergency Department Database, products of the Health Care Cost and Utilization Project, the Agency for Healthcare Research and Quality, and the New York State Department of Health. These databases are derived from administrative data and contain the universe of non-Federal hospital and emergency department discharges for New York State in 2011. Each individual patient in the New York State Inpatient Database and New York State Emergency Department Database is given a unique identification number (based on first and last names and date of birth) which allows tracking across admissions, facilities, and settings (inpatient vs emergency department), without compromising the privacy of the patient. Each record is also assigned a masked date variable which allows calculation of the number of days between admissions.

Because the data source was publicly available and deidentified, this study was exempt from review by the UCLA Institutional Review Board.

Study group

The study group consists of women who delivered an infant in a New York State hospital in 2011 and were assigned a unique identification number. Deliveries are identified using the method developed by Kuklina et al.[14] We excluded women if they were transferred from another hospital before delivery or had unknown transfer status because they were exposed to multiple hospitals and clinicians, and we were unclear if it would be more appropriate to use the volumes of the pre- or post-transfer hospital and clinician. Because including multiple deliveries per patient would dictate that we treated individual deliveries as repeated measures within patients, we excluded a small number (<300) of second deliveries to women who had multiple deliveries in 2011. For predischarge infections, we considered only those conditions which were recorded as not present on admission. For postdischarge infections, we excluded women who developed an infection during the index hospitalization.

We sought to limit our study to hospitals and clinicians that were intended to be providers of labor and delivery services and excluded those providers that occasionally performed deliveries as emergency providers. To this end, we excluded deliveries in hospitals with <25 deliveries and clinicians with <10 deliveries in 2011.

Outcomes

The outcomes of interest were postpartum infections presenting during hospitalization for delivery of an infant or in a readmission or emergency department visit within 30 days after discharge following delivery. We coded this as a dichotomous variable equal to 1 for ≥ 1 infection and 0 for no infection. Because all data were from 2011, women who delivered after December 1 had <30 days of follow-up. Table 1 lists types of infections and associated ICD-9-CM codes. We chose to include ICD-9-CM codes 674.12 and 674.14 (disruption of cesarean wound) and 674.32 and 674.34 (other complications of obstetrical surgical wounds) because cesarean wound infections comprise a large proportion of postpartum infections, there are no specific ICD-9-CM codes for cesarean wound infections, and we expect a large proportion of surgical wound complications to be infections based on prior research.[4,15,16]

Obstetric volume measures

The predictor variables of interest were obstetric volumes at the hospital and clinician (physician or midwife) levels. These were measured as the number of deliveries at each hospital and by each clinician in 2011.

Covariates

Patient-level covariates were selected to provide as complete of a case-mix adjustment as possible and included age, race, expected payer (private, Medicaid, or other), and a set of obstetric and nonobstetric comorbidities. Obstetric comorbidities are listed in Table 2. Because we did not wish to adjust for potential intermediates between obstetric volume and infections, we focused on conditions that typically present before labor and therefore before hospital admission.

To adjust for nonobstetric comorbidities we used a modified version of the method developed by Elixhauser et al.[17] The Elixhauser index is a widely used method to adjust for hospital case mix and, in particular, to account for the fact that certain hospitals have a disproportionate number of patients at high risk for adverse events. Although it was not developed specifically to adjust for risk of infection, it is frequently used to risk adjust patient populations