

# The Clinical and Economic Impact of Nurse to Patient Staffing Ratios in Women Receiving Intrapartum Oxytocin

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## Abstract

**Objective** To examine the relationship between nurse-to-patient staffing ratios and perinatal outcomes in women receiving oxytocin during labor.

**Study Design** A retrospective analysis of perinatal outcomes in women receiving oxytocin for induction or augmentation of labor during 2010. Outcomes examined were fetal distress, birth asphyxia, primary cesarean delivery, chorioamnionitis, endomyometritis, and a composite of adverse events. Frequency of 1:1 nurse-to-patient staffing was determined for each hospital. Outcomes were compared between hospitals categorized into quartiles of staffing ratios.

**Results** In 208,033 women delivering during 2010, there was no relation between frequency of 1:1 nurse-to-patient staffing ratio and improved perinatal outcomes. Adoption of universal 1:1 staffing in the United States would result in the need for an additional 27,000 labor nurses and a cost of \$1.6 billion.

**Conclusion** Available data do not support the imposition of mandatory 1:1 nurse-to-patient staffing ratios for women receiving oxytocin in all U.S. facilities.

## Keywords

- ▶ oxytocin
- ▶ nurse staffing
- ▶ patient safety

Oxytocin is used for labor induction or augmentation in approximately one-half of all deliveries in the United States.<sup>1,2</sup> Because of the potential for uterine tachysystole and its adverse effects on the fetus, careful monitoring of such women by nursing staff is essential.<sup>3,4</sup> Proposed approaches to improve such monitoring have included uniform training of nursing staff in the interpretation of electronic fetal heart rate and uterine contraction monitor tracings, the use of checklists, and the implementation of protocols that standardize the administered oxytocin infusion rate.<sup>1–6</sup> In other areas of medicine, fixed staffing ratios have been investigated and occasionally linked to improved patient outcomes, although most studies have not shown such a relationship.<sup>7–10</sup> Our purpose was to evaluate the effects of 1:1 nursing care for women receiving oxytocin in labor, both from the perspective of patient safety and cost.

## Materials and Methods

This study was performed in Hospital Corporation of America affiliated facilities, which account for the largest number of inpatient obstetric services in the United States, with over 200,000 deliveries annually in 110 affiliated hospitals in 21 states. Approximately 6% of U.S. deliveries occur in these hospitals, and prior publications have suggested that this system is fairly representative of the U.S. population as a whole.<sup>11,12</sup> We analyzed data from January 1, 2010, to December 31, 2010. During this time, there was no single, uniform staffing policy in Hospital Corporation of America (HCA)-affiliated hospitals for women receiving oxytocin during labor. Instead, on-site nursing and medical personnel were encouraged to use their judgment regarding appropriate staffing ratios for all women in labor, with and without

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oxytocin infusion, depending on the level of acuity demonstrated by individual patients.

Our study design included three parts. First, staffing ratios for women receiving oxytocin were surveyed, and facilities divided into four groups based on the frequency (0 to 25%, 26 to 50%, 51 to 75%, or > 75%) with which each facility provided 1:1 staffing for such patients during 2010. These analyses were performed independently by the labor and delivery nursing directors at each facility.

Second, we obtained coding-based data on pertinent perinatal outcomes for all women receiving oxytocin for either induction or augmentation of labor at each facility during 2010 (►Table 1). The category of *multiple complications* includes women with more than one of the listed adverse outcomes. An additional neonatal outcome, birth asphyxia (Diagnosis Related Groups (DRGs) 7685, 7686, 7689), was analyzed from newborn records for the entire population of women delivering at each facility during 2010. The data for each hospital were stratified into the four frequency categories previously described.

Finally, we performed a gap analysis, comparing actual staffing levels with a hypothetical model in which each patient receiving oxytocin during labor also received 1:1 nursing care during oxytocin infusion. We analyzed this model both in terms of additional full-time equivalents needed and the total cost of providing this hypothetical type of care. We utilized previously published data from our system documenting a mean duration of oxytocin infusion of approximately 8.5 hours for women receiving labor induction or augmentation.<sup>3</sup> We then extrapolated our results to a second model in which 1:1 nursing care would be provided to all women receiving oxytocin during labor in the United States (►Table 3).

Hospitals were categorized into quartiles according to frequency of 1:1 nursing (0–25%, 26–50%, 51–75%, > 75% of the time), and outcomes were compared between quartiles using chi-square test for trends. A  $p < 0.05$  was used to denote statistical significance. Because this study used only deidentified aggregate data for quality improvement purposes, institutional review board approval was not necessary.

## Results

During 2010, 208,033 women delivered at an HCA-affiliated facility. Of these women 101,777 (49%) received oxytocin for labor induction or augmentation. ►Table 1 demonstrates perinatal outcomes for each 1:1 nursing frequency quartile. ►Table 2 demonstrates rates of birth asphyxia for each quartile. Primary cesarean delivery rates and rates of overall complications increased significantly as the frequency of 1:1 nurse staffing ratios increased. Lower rates of coded fetal distress were seen with more consistent 1:1 staffing ratios (►Table 1). There was no significant trend between staffing ratio and the rates of birth asphyxia (►Table 2). Cost and staffing calculations for the model of universal 1:1 staffing are detailed in ►Table 3. Compliance with a hypothetical model of universal 1:1 staffing for women undergoing induction or augmentation of labor would necessitate an

**Table 1** Relationship between nurse staffing ratio and intrapartum complications: oxytocin induction/augmentation

1:1	n	Primary cesarean	OR <sup>a</sup> (95% CI)	Fetal distress	OR <sup>a</sup> (95% CI)	Amnionitis	OR (95% CI)	Endometritis	OR (95% CI)	Multiple complications	OR <sup>b</sup> (95% CI)
76–100	14,644	4,530 (30.9%)	1	2,544 (17.4%)	1	434 (3.0%)	1	59 (0.40%)	1	2,086 (14.3%)	1
51–75	24,704	7,382 (29.9%)	0.95 (0.91–0.99)	4,459 (18.1%)	1.05 (0.99–1.11)	587 (2.4%)	0.80 (0.70–0.91)	91 (0.40%)	0.91 (0.65–1.29)	2,446 (9.9%)	0.66 (0.62–0.70)
26–50	13,753	3,928 (28.6%)	0.89 (0.85–0.94)	2,541 (18.4%)	1.08 (1.01–1.15)	268 (2.0%)	0.65 (0.56–0.76)	40 (0.30%)	0.72 (0.47–1.10)	1,763 (12.8%)	0.88 (0.83–0.95)
0–25	48,676	15,649 (32.1%)	1.06 (1.02–1.10)	9,668 (19.9%)	1.18 (1.12–1.24)	1,245 (2.6%)	0.86 (0.77–0.96)	184 (0.38%)	0.94 (0.69–1.27)	5,637 (11.6%)	0.79 (0.75–0.83)
Total	101,777	31,489 (30.9%)		19,212 (18.9%)		2,834 (2.8%)		374 (0.37%)		11,932 (11.7%)	

Abbreviations: CI, confidence interval; OR, odds ratio.

<sup>a</sup> $p < 0.0001$ .

<sup>b</sup> $p = 0.002$ .

**Table 2** Relationship between nurse staffing and birth asphyxia: all deliveries

1:1	n	Birth asphyxia	OR (95% CI)
76–100	28,605	104 (0.36%)	1
51–75	55,365	158 (0.29%)	0.78 (0.61–1.01)
26–50	27,503	105 (0.38%)	1.05 (0.79–1.39)
0–25	96,560	354 (0.37%)	1.01 (0.81–1.26)

Abbreviations: CI, confidence interval; OR, odds ratio.

additional 1,618 full-time labor and delivery nurse equivalents in the system of HCA affiliates, at an additional cost of \$97 million annually, using the assumptions outlined in ►Table 3. Extrapolation of these data to staffing throughout the United State would result in the need for an additional 27,000 labor nurses at an additional cost of approximately \$1.6 billion annually.

## Discussion

Careful nursing care is a vital component of modern obstetric management, not only for women receiving oxytocin during labor, but for all women giving birth. Patient safety may, in some cases, be enhanced by decreasing nurse-to-patient staffing ratios. In fact, in a sufficiently large series we would expect to be able to identify some statistical benefit to any cohort of laboring women receiving consistent 1:1 nurse-to-patient staffing, as compared with a lower staffing ratio. Critical to such an analysis, however, is the realization that in an era of limited medical resources and increasing demand for services, medical expenditures of this type must be seen as a “zero sum” in which a dollar spent in any one area of care is a dollar taken from another.<sup>13,14</sup> In a similar manner, the number of nurses in the United States cannot be readily expanded indefinitely.<sup>15,16</sup> Under these circumstances, any new recommendation for care requiring significant additional resources must be evidence-based, with the strength of evidence for benefit directly proportional to the magnitude of proposed additional resource allocation.

In this large series of over 100,000 deliveries across a broad range of facilities in the United States, we could demonstrate no meaningful positive clinical relationship between staffing ratios and perinatal outcomes for women receiving oxytocin during labor. Facilities that provided 1:1 staffing for these women < 25% of the time had similar outcomes to those that provided such staffing > 75% of the time. The extremely large numbers in our series did lead to a few differences that achieved statistical significance in a trend analysis, suggesting a possible *detrimental* effect of higher staffing ratios. Higher staffing ratios were associated with more cesarean deliveries and overall complications, but no difference in rates of birth asphyxia, which along with cesarean rate would be the outcome of primary importance with respect to oxytocin use during labor. Although from a statistical standpoint one might conclude that a 1:1 staffing ratio was actually detrimental, because of differences in patient acuity between facilities, we believe such clinical conclusions are unjustified; it is also possible that those facilities with higher acuity appropriately determined the need for more frequent 1:1 staffing ratios, and with the use of such judgment achieved rates of birth asphyxia equivalent to those seen in facilities with lower mean patient acuity. These data also do not suggest unwise resource utilization for facilities that, because of typical patient acuity or nursing staff experience, have decided to utilize universal 1:1 coverage for any class of patient. Rather, these data support our current policy of allowing staffing decisions to be made for individual patients by on-site clinicians, rather than mandating universal staffing ratios for any broad group of patients.

Our interpretation of these findings involves the heterogeneity of individual patients within the broad category of “received oxytocin during labor.” A woman with a category I fetal heart rate tracing and a normally grown fetus beginning an induction at 41 weeks is in a risk category very different than a woman with known intrauterine growth restriction, oligohydramnios, and variable decelerations receiving augmentation in the active phase of labor. Yet both are receiving oxytocin. Further, a woman in the next room with a bleeding placenta previa at 28 weeks may be in a risk category significantly higher than either of these women. Under

**Table 3** Oxytocin staffing cost analysis

n	% 1:1	Mean	Pts if 1:1	Additional pts if 1:1	h/pt	Excess FTE	\$/h	Excess cost
14,644	76–100	86.5	16,930	2,286	8.5	9.7	30	582,930
24,704	51–75	62.5	39,526	14,822	8.5	63	30	3,779,610
13,753	26–50	37.5	36,674	22,922	8.5	97	30	5,845,110
48,676	0–25	12.5	389,408	340,732	8.5	1,448	30	86,886,660
101,377	Total					1,618		97,094,310

Abbreviations: CI, confidence interval; FTE, full-time equivalent; OR, odds ratio; pt, patient.

Note: Calculation example, first row: These facilities were staffed to provide one-on-one care for 14,644 women an average of 86.5% of the time. The provision of one-on-one care to 14,644 women 100% of the time would be the functional equivalent of caring for 16,930 patients 86.5% of the time, or an additional 2,286 patients. Given a mean duration of oxytocin infusion of 8.5 h in our system, a 40-h work week for a registered nurse full-time equivalent at 50 wk/y, and a mean hourly pay rate of \$30 (chosen for illustrative purposes only), such staffing would require an additional 9.7 full-time equivalents and an additional salary cost of \$582,930 annually.

such circumstances, to mandate 1:1 nursing for both of the first two patients in the face of limited nursing personnel may not only be an inefficient use of resources, but may actually place the third patient in significant jeopardy. Such variations and combinations are endless, yet they reflect the realities of most labor and delivery services and will be recognized by individuals actually providing clinical care. Under these conditions, arbitrary staffing rules based on heterogeneous patient categories may negatively impact patient safety.

As outlined in ►Table 3, we estimate that the universal national adoption of recommendations for mandatory 1:1 staffing ratios for all woman receiving oxytocin would cost the U.S. health care system an additional \$1.6 billion annually, assuming that an additional 29,000 labor nurses could be found.

We acknowledge several limitations of the current study design. Outcomes data were derived from an analysis of coded discharge diagnoses. Such analyses are commonly relied upon in published series to identify various indices of neonatal and maternal morbidity including birth asphyxia and neonatal encephalopathy.<sup>17–20</sup> Although such data have generally been found to be reasonably reliable in a variety of clinical circumstances, the occurrence of occasional coding errors cannot be excluded.<sup>17–22</sup> However, the large sample size of our study population would tend to negate the impact of random coding errors on our conclusions.

Given the current capabilities of our data system, several additional neonatal outcomes of potential interest could not be analyzed on this scale and simultaneously linked to maternal oxytocin administration. Our inability to control for differences in patient acuity between facilities is another limitation, discussed at length previously. Finally, our cost analysis represents only an estimate, as outlined in ►Table 3.

In the past several years, HCA-affiliated facilities have broadly adopted patient safety education and protocols directed at the safe use of oxytocin during labor.<sup>1–5</sup> Our results must be interpreted in this context—the overall commitment of these facilities to the safe use of oxytocin may have rendered the staffing ratios for these patients less relevant.

In conclusion, we could demonstrate no evidence of improved clinical outcomes associated with the use of a 1:1 nursing ratio for women receiving oxytocin during labor. We acknowledge the limitations of our data and the theoretical possibility that future research using a more demographically detailed database might demonstrate a subgroup of women for whom such uniform staffing ratios may be beneficial. However, the imperfections of the current data must be viewed against a *complete absence* of any contradictory data demonstrating any clinical benefit of mandatory, universal 1:1 staffing ratios for women receiving oxytocin during labor. Further, our estimated economic gap analysis clearly demonstrates the magnitude of the financial impact of such recommendations, if implemented universally. Thus given our current state of knowledge, evidence-based medicine suggests that it would be inappropriate and potentially detrimental to patient safety to implement mandatory 1:1 staffing ratios for women receiving oxytocin during labor at

this time. The onus for demonstrating clinical benefit, a favorable cost–benefit ratio, and an analysis of the impact of such recommendations on those patients from whom vast resources would of necessity be diverted remains with proponents of such rules.<sup>23</sup> Given the wide variability present in almost all categories of intrapartum patients, we feel strongly that patient safety is best addressed by continuing to allow staffing decisions to be made by qualified on-site nursing and medical personnel based on individual patient acuity.

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