Original Research

Wrong-Patient Orders in Obstetrics

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OBJECTIVE: To compare rates of wrong-patient orders among patients on obstetric units compared with reproductive-aged women admitted to medical–surgical units.

METHODS: This was an observational study conducted in a large health system in New York between January 1, 2016, and December 31, 2018. The primary outcome was near-miss wrong-patient orders identified using the National Quality Forum–endorsed Wrong-Patient Retract-and-Reorder measure. All electronic orders placed for eligible patients during the study period were extracted retrospectively from the health system data warehouse, and the unit of analysis was the order session (consecutive orders placed by a single clinician for a patient within 60 minutes). Multilevel logistic regression models were used to estimate odds ratios (ORs) and 95% CIs comparing the probability of retract-and-reorder events in obstetric and medical–surgical units, overall, and in subgroups defined by clinician type and order timing.

RESULTS: Overall, 1,329,463 order sessions were placed during the study period, including 676,643 obstetric order sessions (from 45,436 patients) and 652,820 medical–surgical order sessions (from 12,915 patients). The rate of 79.5 retract-and-reorder events per 100,000 order sessions in obstetric units was significantly higher than the rate in the general medical–surgical population of 42.3 per 100,000 order sessions (OR 1.98, 95% CI 1.64–2.39). The obstetric retract-and-reorder event rate was significantly higher for attending physicians and house staff compared with advanced practice clinicians. There were no significant differences in error rates between day and night shifts.

CONCLUSION: Order errors occurred more frequently on obstetric units compared with medical–surgical units. Systems strategies shown to decrease these events in other high-risk specialties should be explored in obstetrics to render safer maternity care.

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A significant proportion of severe maternal morbidity and mortality is preventable and decreasing medical errors may result in reduction of avoidable harm.[1–4] One specific type of medical error, wrong-patient orders, is an emerging challenge in the era of electronic medical records (EMRs). Although EMRs have facilitated efficiency and diminished or even eliminated certain errors, they have also introduced new potential for error via electronic patient lists and automated order sets.[5–9]

Obstetrics is a unique clinical environment because all patients are admitted with a common diagnosis–pregnancy–and have much more overlap in demographic characteristics than a typical inpatient unit given that they are all females of reproductive age. The labor and delivery environment also is

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distinct in the hospital given its dynamic tempo and unpredictable workflow. There also is the added risk of neonates typically being registered in the hospital record under the mother's name after birth. This generates abundant opportunity for errors in order placement, both between obstetric patients and between postpartum patients and their newborns.[10] These errors can, in turn, lead to patient harm by delaying execution of the order for the appropriate patient and potentially exposing another patient to an inappropriate diagnostic test, intervention, or medication.

Prior research has demonstrated that surveillance of electronic clinical data is an effective approach to identify near-miss wrong-patient orders, specifically by assessing the sequence of order placement, discontinuation, and reentry, termed the "retract-and-reorder" method.[11] The Wrong-Patient Retract-and-Reorder measure has been used in observational studies and randomized trials in other contexts to evaluate wrong-patient orders.[11–17] However, despite the specific increased risks for wrong-patient orders on perinatal units, this problem is not well-described in an obstetric population. Therefore, the objective of this study was to evaluate wrong-patient order errors in obstetrics compared with other general medical–surgical units. In addition, we evaluated whether errors were associated with practitioner type or time of day.

METHODS

This was an observational study conducted at a large, urban, integrated health system in New York City. Data were collected retrospectively over a 3-year period, from January 1, 2016, to December 31, 2018. The study included all women aged 18 years and older who were admitted to the obstetric service (labor and delivery units, antepartum units, and postpartum units) and all women aged 18–50 years who were admitted to the hospitals' general medical–surgical units during the study period. All eligible women admitted to the designated units were included in the study with no additional exclusion criteria. Data for all orders placed for eligible patients during the study period were extracted retrospectively from the health system data warehouse. The primary outcome was near-miss wrong-patient orders identified by the validated Wrong-Patient Retract-and-Reorder measure,[11] which is endorsed by the National Quality Forum.[18] The measure uses an electronic query to detect retract-and-reorder events, defined as one or more orders placed for patient A, canceled by the same clinician within 10 minutes, and reordered by the same clinician for patient B within the next 10 minutes.

The unit of analysis was the order session, defined as a series of orders placed by a clinician for a given patient, beginning with opening the patient's order file and completed when an order is placed for another patient, or after 60 minutes, whichever occurs first. When a clinician places orders in the wrong patient's record, several individual orders may be entered and subsequently retracted together. Thus, the order session, rather than each order, represents an independent opportunity for a wrong-patient error to occur. The outcome variable was dichotomous, indicating whether each order session contained a wrong-patient retract-and-reorder event. The primary analysis was performed at the order session level, rather than at the level of the individual order, as several separate orders can be entered and canceled together. This way, the order session-level analysis reflects each distinct error occurrence.

Rates of order sessions containing retract-and-reorder events were calculated overall and by subgroups defined by ordering clinician type (attending physician, house staff physician, and advanced practice clinician) and order timing (day shift of 7 am–7 pm and night shift of 7 pm–7 am, defined according to both nursing and physician shift schedules). Results were reported as rates of retract-and-reorder events per 100,000 order sessions. Additional analyses were performed at the individual order level to ascertain granular data regarding order type.

Baseline characteristics were compared between obstetric patients and medical–surgical patients in univariable analyses using *t* test for continuous variables and Pearson chi-square test for categorical variables, as appropriate. To account for the clustering of order sessions within clinicians, odds ratios (ORs) that compared retract-and-reorder order sessions in obstetric and medical–surgical units, and in subgroups by clinician type, order type, and shift timing, were estimated in multilevel logistic regression models with indicator variables for the compared groups as fixed-effect predictors and random effects at the clinician level. The Wald test of significance was used with a 2-sided $\alpha=0.05$. For order-level analyses, an additional random effect at the order-session level was added. All analyses were performed using STATA 16.1. This study was approved by the Institutional Review Board of Columbia University Irving Medical Center.

RESULTS

There were 45,436 total obstetric patients included in the study, encompassing 676,643 total order sessions (3,186,735 total orders) and 12,915 female medical–

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Table 1. Demographic Characteristics of Participants

Characteristic	Obstetric Units (n=45,436)	Medical–Surgical Units (n=12,915)
Age (y)	32.1±5.7	36.4±9.0
Race–ethnicity*		
Non-Hispanic White	15,414 (33.9)	3,340 (25.9)
Non-Hispanic Black	3,833 (8.4)	2,503 (19.4)
Hispanic	11,598 (25.5)	3,209 (24.9)
Other†	14,591 (32.1)	3,863 (29.9)
Insurance type		
Private or commercial	27,634 (60.8)	5,759 (44.6)
Medicaid	15,803 (34.8)	4,214 (32.6)
Medicare	122 (0.3)	833 (6.5)
Self-pay	580 (1.3)	530 (4.1)
Other or unknown	1,297 (2.9)	1,579 (12.2)

Data are mean±SD or n (%).

* Race–ethnicity was extracted from the medical record, which documents the patient's self-reported race–ethnicity at the time of patient registration. It is described here as a demographic covariate to provide further information about the composition of the study population.

† Includes Asian, Pacific Islander, Native American, Middle Eastern, and self-identification of "Prefer not to say" or "Other."

surgical patients of reproductive age, involving 652,820 order sessions (2,060,268 total orders). Table 1 depicts demographics of the patient population. The obstetric order volume was comprised of 11.9% attending physician orders, 50.5% house staff orders (including residents and fellows), and 37.6% advanced practice clinician orders; the medical–surgical unit order volume consisted of 15.8% attending physician orders, 44.8% house staff orders, and 39.3% advanced practice clinician orders.

The risk of a retract-and-reorder event was significantly higher on obstetric units, with a rate of 79.5 retract-and-reorder events per 100,000 order sessions, compared with medical–surgical units at 42.3 retract-and-reorder events per 100,000 order sessions (OR 1.98, 95% CI 1.64–2.39) (Fig. 1). By clinician type, the rate of obstetric retract-and-reorder events was 127.0 per 100,000 orders for attending physicians, 119.9 per 100,000 order sessions for house staff, and 47.3 per 100,000 order sessions for advanced practice clinicians, with significantly lower retract-and-reorder event rates among advanced practice clinicians compared with attending and house staff physicians (advanced practice clinician vs attending physician OR 0.18, 95% CI 0.11–0.29; advanced practice clinician vs house staff OR 0.16, 95% CI 0.11–0.25). There were no statistically significant differences in retract-and-reorder event rate between attending physicians and house staff. Clinician type-specific retract-and-reorder event rates were significantly higher on obstetric units compared with medical–surgical units for all types, and retract-and-reorder event rates also were significantly higher for obstetric units compared with medical–surgical units regardless of time of day (Fig. 1).

In order-level analysis to assess for the specific types of order errors, medication errors were found to be the largest source of wrong-patient order errors in obstetrics (Appendix 1, available online at http://links.lww.com/AOG/C355). The rate of retract-and-reorder events per 100,000 medication orders was 73.2 per 100,000 orders, compared with 5.7 per 100,000 orders for diagnostic imaging and 51.0 per 100,000 orders for all others, which include laboratory studies and nursing orders. Medication order errors were similarly the most common for medical–surgical patients (Appendix 1, http://links.lww.com/AOG/C355). Table 2 depicts order-level analysis of retract-and-reorder events by medication type. The highest obstetric retract-and-reorder event rates per 100,000 orders occurred in orders for nonoxytocin uterotonics, nifedipine, antibiotics, and tocolytics. The greatest raw number of retract-and-reorder events occurred in orders for antibiotics and opioid and nonopioid analgesics. The retract-and-reorder event rates were statistically higher for these medications in obstetric patients, though CIs are wide due to small counts.

DISCUSSION

In this population, the wrong-patient order error rate for obstetric patients was significantly higher than for nonobstetric, reproductive-aged women on medical–surgical units. In addition, wrong-patient orders in obstetrics occur more frequently among physicians (attendings and house staff) compared with advance practice clinicians.

The retract-and-reorder methodology used in this study to detect wrong-patient order errors is an automated and validated measure of wrong-patient

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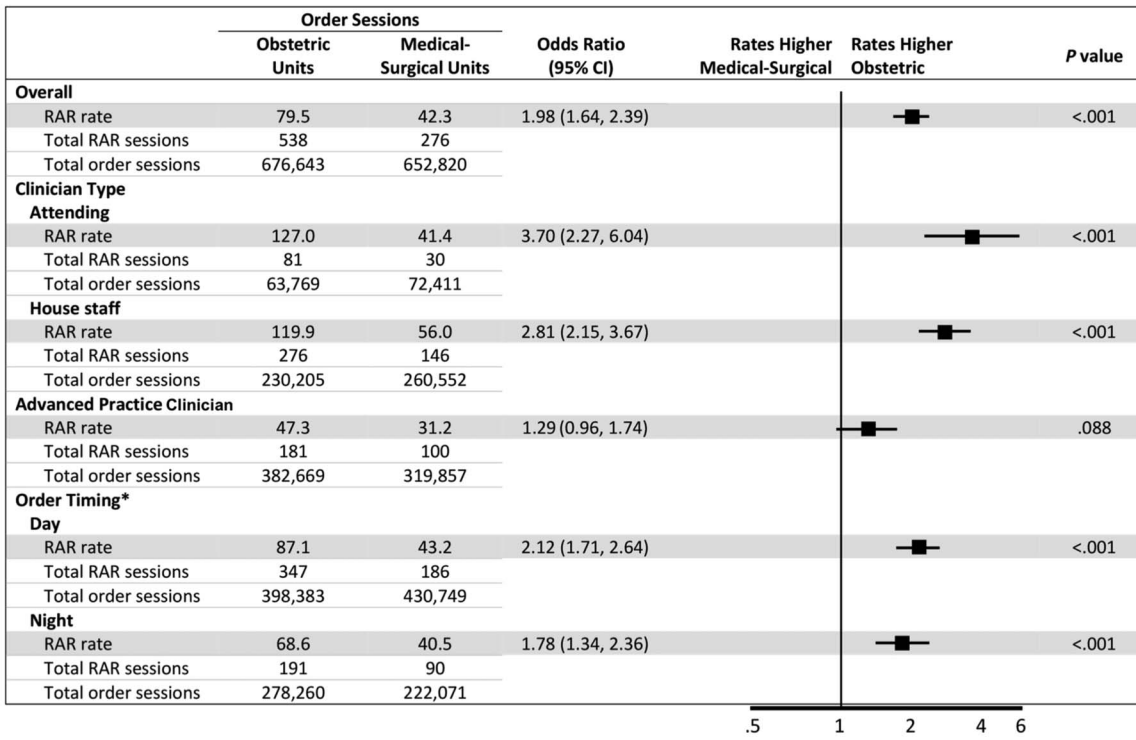

Fig. 1. Wrong-patient order sessions by clinician type and order timing: obstetric compared with medical–surgical units. *Day shift: 7:00 AM through 7:00 PM; night shift: 7:00 PM through 7:00 AM; defined according to both nursing and physician change of shift. RAR, retract-and-reorder.

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orders and has become an important tool for patient safety and health information technology research. Pioneering research in wrong-patient order errors initially evaluated the retract-and-reorder methodology by reviewing more than 9 million orders and identifying 6,800 retract-and-reorder events, averaging to 14 per day over a 1-year period.[11] This rate is substantially higher than previously described rates of wrong-patient order errors based on voluntary reporting.[19] After this methodology was published in 2013, it was endorsed by the National Quality Forum for assessing wrong-patient orders.[20] This is the first study to apply this methodology specifically to an obstetric population (based on a literature search in PubMed on January 4, 2021, using the search terms "medication error," "wrong patient order," "obstetrics," and "pregnancy").

Table 2. Wrong-Patient Order Events by Medication Type (Order-Level Analysis)

	Obstetric Units			Medical–Surgical Units			
Medication	Total Orders	RAR Events	RAR Events/ 100,000 Orders	Total Orders	RAR Events	RAR Events/ 100,000 Orders	OR (95% CI)
Antibiotics	40,100	66	164.6	40,261	11	27.3	6.03 (3.19–11.42)
Anticoagulants	20,684	17	82.2	24,402	10	41.0	2.01 (0.92–4.38)
Antihypertensives	9,146	11	120.3	17,609	12	68.2	1.77 (0.78–4.00)
Nifedipine	6,690	14	209.3	764	0	0	—
Insulin	4,828	3	62.1	16,559	6	36.2	1.72 (0.43–6.86)
Nonopioid pain medication	133,370	95	71.2	44,597	11	24.7	2.89 (1.55–5.39)
Opioid pain medication	78,270	46	58.8	84,350	16	19.0	3.10 (1.75–5.48)
Other uterotonics	2,653	4	150.8	94	0	0	—
Oxytocin	68,055	42	61.7	103	0	0	—
Tocolytics	7,487	11	146.9	7,780	4	51.4	2.86 (0.91–8.99)

RAR, retract-and-reorder; OR, odds ratio.

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Existing data from obstetric medication error research demonstrated that wrong-patient medication order errors represented 2.1% of all medication errors for obstetric inpatients.[21] However, these data relied on clinician report and, based on previous retract-and-reorder research, likely represents a significant underreporting of errors. In addition, consistent with the results of our study, the medications found to be most frequently subject to error in the obstetric population in other studies include antibiotics, opioid analgesics, tocolytics, and magnesium sulfate. The risk of administering these medications unnecessarily to an obstetric patient can be high, as can delaying administration to a patient in need of them. This study allows for further characterization of patterns of wrong-patient orders in obstetrics so that targeted interventions can be developed and implemented to reduce errors.

Implications of these findings include the imperative to develop system-level strategies to decrease wrong-patient order errors in obstetrics as a pathway to safer maternity care and reduced morbidity. Because the wrong-patient order error rate is significantly higher for obstetric patients compared with similarly aged female patients on general medical–surgical wards, this suggests a unique aspect of the obstetric clinical environment that contributes to these errors. In addition to the relative uniformity among patients in terms of sex, age, and reason for admission, the labor and delivery setting is characterized by rapid changes in patient clinical status that also can threaten a safe ordering environment and culture. Health care professionals may be required to enter urgent orders for multiple patients at the same time–such as antibiotics for chorioamnionitis, antihypertensives for severe preeclampsia, or uterotonics for hemorrhage–or may be interrupted during order entry by another obstetric emergency or imminent delivery.

Our findings demonstrate that obstetric attending physicians and house staff had significantly higher error rates than advanced practice clinicians. In the clinical settings of this study, attending physicians and house staff are most likely to be placing orders on the labor and delivery unit and in emergency situations, whereas advanced practice clinicians are more likely to work in the triage, antepartum, and postpartum settings. The dynamic nature of the labor and delivery environment may increase the potential for wrong-patient error, especially in the event of an emergency or interruption. Similarly, house staff and attending physicians are more likely to cover multiple services simultaneously, compared with advanced practice clinicians, which may further predispose to error.

The order error rates for day and night shifts on obstetric units were similar. We evaluated for an association between errors and time of day because staffing and volume differ during the daytime and night shifts. Daytime order safety is challenged by the large volume of orders placed during the day shift, 40% more than during the night shift. Although there may be more health care professionals available during the day, the burden of this large volume of orders may itself pose a safety risk. At night, although the order volume is less, there are typically fewer physicians and advanced practice clinicians. It may be helpful to support clinicians to place orders without disturbance and to balance clinical responsibilities for all obstetric clinicians, especially house staff, to ensure adequate time and attention to enter orders safely. This can involve a mandated "no disruption" culture while orders are being placed or other safety tools to protect physicians and advanced practice clinicians from distraction and interruption. Ensuring an appropriate clinician/patient ratio, including at night when many services rely on individual residents to cross-cover multiple services, may also be critical to patient safety. In addition, it is well-known that "hand-off" periods are particularly prone to errors and patient safety risk, and it may be reasonable to develop strategies to specifically safeguard orders placed during these times.[22]

Furthermore, prior research has demonstrated that EMR modifications can reduce wrong-patient order errors.[11–13] Interventions with the potential to mitigate obstetric wrong-patient errors include requiring electronic confirmation of patient identity before signing an order, EMR-generated warnings when patients with similar names are admitted to the same unit, specific alerts for common and high-risk medications, and utilization of patient photographs in the EMR that are triggered at the time of order entry. These methods have been successful in other fields of medicine to improve safety and would likely benefit the obstetric clinical environment, as well.[23,24]

Although this study characterizes wrong-patient order errors in the obstetric population, the next step to improve patient safety is to pilot and study error reduction interventions in obstetrics. Clinical research in the form of trials evaluating the ability of EMR, personnel, and order-entry workflow modifications to reduce wrong-patient order errors are necessary. Ultimately, data-driven quality improvements in the realm of patient safety have the potential to better streamline care, promote equity, and reduce maternal morbidity and mortality.[25,26]

A key strength of this study is its description of an important and understudied patient safety challenge in obstetrics. It also included a large patient sample

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size from a diverse health system and used a validated strategy for detecting near-miss wrong-patient order errors, as opposed to clinician self-report, which has been shown to be an unreliable method for surveillance of medical errors. It is well-known that near-miss errors share the same causal pathway as errors that ultimately reach the patient. Evaluation of near-misses as a method to improve healthcare safety is a well-endorsed strategy by key patient safety organizations including the Agency for Healthcare Research and Quality, the National Academy of Medicine, and The Joint Commission.[27–29] However, the urban, academic hospital setting of this study may limit generalizability to other inpatient obstetric clinical environments. Furthermore, the Wrong-Patient Retract-and-Reorder measure captures only those near-miss errors that are intercepted by the ordering clinician within 10 minutes of placement. There are likely wrong-patient order errors, both near-misses and executed errors, that were not included. Finally, another limitation of this study is the significant differences in demographic characteristics between the obstetric and medical–surgical patient populations. Nonetheless, prior studies have not demonstrated variability in retract-and-reorder events by patient-level factors.[14]

In conclusion, wrong-patient order errors occur more frequently in obstetric units compared with medical–surgical hospital wards, suggesting that obstetric patients are uniquely vulnerable to this form of medical error. Additionally, there are significantly higher rates of obstetric wrong-patient order errors among physicians compared with advanced practice clinicians. Although the obstetric clinical environment –particularly labor and delivery–is vibrant and frequently chaotic, it is critical to establish a calm, orderly, and safe culture around order entry. This, combined with efforts to improve house staff workflow and to optimize EMR interfaces, is likely to help mitigate the threat of wrong order errors to patient care and ultimately improve maternal health and safety.

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