

# Effect of a Patient Education Strategy on Resident Self-Efficacy and Maternal Outcomes (EDUCATE Study)

**Michelle Yanik**

University of Pittsburgh

**Andrea Pollack**

University of Pittsburgh

**Lia M. Farrell**

University of Pittsburgh

**David G. Metro**

University of Pittsburgh

**Tetsuro Sakai**

University of Pittsburgh

**Grace Lim** (✉ [limkg2@upmc.edu](mailto:limkg2@upmc.edu))

University of Pittsburgh <https://orcid.org/0000-0001-8013-0080>

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## Research article

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# Abstract

**Background** – Patient education improves treatment plan compliance and outcomes. For anesthesiology residents, patient communication is highlighted on the obstetric subspecialty rotation. However, the clinical effectiveness of patient education on patient-controlled epidural analgesia (PCEA) dose requirements is unknown. We hypothesized that patients receiving care by residents who are formally instructed on patient education for PCEA, will have lower total local anesthetic consumption and higher satisfaction.

**Methods** – A prospective, interrupted time series design was chosen. Residents participated in one of two sessions at the beginning of their two-month obstetric anesthesia rotation: 1) Education (E): residents taught how to educate patients on PCEA, followed by instructor-resident practice implementing a “teach-back” method for patient comprehension; 2) Control (C): no formal instruction on PCEA. Confidence in patient education was assessed at baseline and at the rotation end. The first 15–30 patients cared for by each resident after initiating epidural labor analgesia and PCEA were followed. Patient-level data included: total local anesthetic dose during labor, comprehension of PCEA goals, and satisfaction with childbirth experience using a validated questionnaire. The primary outcome was total local anesthetic medication consumed during labor.

**Results** – A total of 285 patients (118 cared for by residents in Group E, 167 cared for by residents in Group C) were included. Local anesthetic dose consumption was similar between groups (Group E: mean bupivacaine dose (mg),  $96.4 \pm 58.2$  vs. Group C:  $105.4 \pm 64.1$ ,  $P = 0.23$ ). Patient comprehension for PCEA goals and patient satisfaction with their childbirth experience were similar between groups. Residents in group E felt more comfortable teaching PCEA to patients by the end of their rotation (Group E self-efficacy scores: pre-rotation,  $45.7 \pm 7.5$  v. post-rotation,  $88.0 \pm 9.2$ ,  $P = 0.002$ ).

**Conclusions** – A resident teaching intervention to improve skills in patient education for PCEA did not reduce drug consumption or improve patient satisfaction, but educated residents felt more comfortable teaching patients by the end of their rotation. Teaching methods for patient education that improve not only clinician self-efficacy, but also clinical outcomes at the patient level, should be identified.

## Background

The Latin root for *doctor* is *docere*, which means *to teach*. While resident anesthesiologists as teachers to peers, students and other health professionals seems intuitively important, the ability to effectively educate patients is equally valuable. Currently, residents are evaluated by competency for, “education of patient, families, students, residents, and other health professionals<sup>1</sup>.” Yet, little guidance exists as a “gold standard” for training residents how to effectively teach patients.

Patient education is important because it improves patient outcomes, increases patient compliance with treatment plans, and reduces litigation risk<sup>2–7</sup>. Educating patients in the childbirth setting represents an ideal environment in which to teach and assess this competency for anesthesiology residents and other

learners. The childbirth setting is unique from other anesthesia-providing clinical settings, in that the initiation and management of labor epidural analgesia occurs during an exceptionally intense period for patients. It is also unique because modern labor analgesia success is dependent upon optimal utilization of patient-controlled drug delivery systems (i.e. patient controlled epidural analgesia, PCEA), rather than by the anesthesia care provider. The childbirth setting also requires that a resident or anesthesia care provider be swift at establishing and maintaining a relationship with the patient and family, so that they can effectively educate patients on the intrapartum pain management plan.

Compared to continuous epidural infusion, PCEA is known to reduce total local anesthetic dose consumption and motor blockade during labor and delivery<sup>8,9</sup>. Indeed, modern labor epidural analgesia strategies emphasize these lower total doses, because they may confer advantages such as reduced risk for instrumental vaginal delivery and for obstetric nerve palsies<sup>9-11</sup>. However, to our knowledge, no study exists on how to effectively educate patients on the appropriate use of PCEA for labor epidural analgesia.

In this study, we evaluated the effectiveness of a resident patient-teaching intervention on educational and patient outcomes. The hypothesis was that a structured, standardized teaching intervention is effective in reducing local anesthetic dose requirement during labor. We also evaluated the effect of the intervention on resident self-efficacy for teaching patients, and on patient comprehension of PCEA goals and satisfaction with clinical care.

## Methods

The study was approved by the University of Pittsburgh IRB and written informed consent was obtained from both resident and patient participants. Residents at the post-graduate year level 2 or 3 were approached and enrolled at the beginning of their two-month obstetric anesthesia subspecialty rotation, on the first orientation day prior to patient care. Residents at our institution train together in groups of 3–4 on these subspecialty rotations. Rather than randomizing each individual resident to the two study groups, which would have risked group/education contamination within each rotation time, an interrupted time series approach was taken. In this approach, standardized education on PCEA, or typical orientation without formal education on patient education for PCEA, was alternated *en bloc* every two months for a total of 8 months, or 4 rotation cycles (Fig. 1).

In the education group (Group E), immediately after enrollment, residents were given a didactic lecture covering key points for patients to understand about PCEA. The lecture was given by an attending anesthesiologist with obstetric anesthesia subspecialty training expertise and more than 5 years of clinical practice experience (GL). Residents were taught the “teach back” method<sup>12</sup>, a well-described and effective method of clinician-patient communication. The “teach-back” method of patient education has been shown to improve patient comprehension and adherence for treatment plans<sup>12</sup>. Verbal practice/role play then occurred between each resident and the instructor GL until proficiency was achieved. Proficiency was evaluated by the instructor GL and defined as 1) each major patient teaching point delivered, unprompted, by the resident; plus 2) “teach back” method consistently demonstrated by

resident at the end of patient education (“I want to be sure that I explained everything to you correctly. Can you tell me how you are going to use this button?”). Supplemental Material 1 includes all details of didactic instruction and “teach back” that was used to assess proficiency.

In the standard orientation control group (Group C), no formal teaching on PCEA was undertaken.

After the first orientation day and for the entire rotation period, patients cared for by enrolled residents were approached, enrolled, and followed by a separate investigator not involved with the education or rotation process (AP). The following endpoints were measured: total bupivacaine consumption during labor (mg), comprehension of PCEA goals, satisfaction with anesthesia care, and satisfaction with the birth experience. The validity of the local anesthetic consumption endpoint is exemplified by numerous studies that have evaluated this endpoint and its importance to obstetric outcomes; further, lower local anesthetic dose in labor has been tied to lower risk for motor block, instrumental delivery, and obstetric nerve palsies<sup>9-11,13</sup>. The patient comprehension scores were directly derived from the Group E educational intervention, in that each teaching point corresponded to a true/false question that was then completed by the patient (Supplemental Material 1). Patient satisfaction with childbirth was evaluated by the Women’s Views of Birth Labor Satisfaction Questionnaire (WOMBLSQ)<sup>14</sup> instrument. The WOMBLSQ measures maternal satisfaction with childbirth that consists of multidimensional assessments, including expectations of labor, pain relief in labor, labor environment, and sense of control in labor. It possesses good reliability and validity for these constructs. Maternal satisfaction with anesthetic care was assessed by modified Maternal Satisfaction Scale (MSS)<sup>15</sup>, a valid and reliable tool for maternal satisfaction that specifically assesses the anesthesia dimension with a 100 mm visual analogue scale.

For the resident participants, at the beginning of the rotation all residents answered the following question: “Overall, how confident are you now in educating obstetric patients on using patient-controlled epidural analgesia (PCEA)?” The question was marked with a 100 mm line, where 0 mm indicated “not confident at all” and 100 mm indicated, “the most confidence imaginable.” At the end of the rotation, residents answered the same question that self-rated their confidence in teaching patients how to use PCEA on the 100 mm visual analog scale.

Labor Analgesia.

The standard approach to labor epidural analgesia at our institution was unchanged during the study period. Typically, after confirmed loss of resistance to saline, epidural analgesia is initiated with 8 mL bupivacaine 0.083% with 2mcg/mL fentanyl. Maintenance of epidural analgesia is with bupivacaine 0.083% with 2mcg/mL fentanyl at a background rate of 8 mL per hour, with a patient demand by button (PCEA) permitted every 8 minutes equal to 8 mL of the same solution, and a total volume permitted of 24 mL per hour. Adjustments to these doses are made at the discretion of the attending anesthesiologist during evaluations made throughout labor for the need for supplemental epidural boluses.

## **Statistical Analysis.**

The sample size calculation was based on prior studies using labor epidural analgesia, in which the mean and standard deviation of bupivacaine consumption per hour of labor was  $12.3 \pm 2.5$  mg.<sup>13</sup> A sample size of 103 patients in each group (103 patients cared for by residents who received teaching intervention, and 103 patients cared for by residents who were in the control group, for a total of 206 patients) would be required to detect a difference in local anesthetic consumption of 10% (1.23 mg) per hour, representing a clinically significant change in bupivacaine consumption. This difference would be detected with a power of 0.8 at an alpha = 0.05. We estimated a 15% exclusion rate for attrition. Thus, we aimed to follow the first 15–30 patients for whom each resident performed labor epidural analgesia until the total sample of 236 (at least 118 in each study group) was achieved.

The time series data was analyzed using segmented linear regression to assess changes in levels and trends of total bupivacaine dose before and after the educational initiatives, based on methods described in published literature<sup>16,17</sup>. The interrupted time series analysis controls for auto-correlated errors and adjusts for serial correlation (for example, the quality of patient care including patient education may simply improve over time). Using the total bupivacaine dose per individual patient over time, we fit a model to predict mean total bupivacaine dose using three variables: 1) Patient ID which was interpreted as the baseline trend as patients were enrolled sequentially over time, 2) Education interventions (demarcated according to patient ID/time of enrollment, binary variables), which was interpreted as a change immediately following the education intervention, and 3) Time after educational interventions, which we interpreted as the trend after the intervention. Segmented linear regression divided the time series in to pre- and post-educational segments. We then compared the changes in trends and levels of bupivacaine dose consumption before and after the introduction of education intervention. The level of significance was set at  $P < 0.05$ .

All analyses were performed using StataSE 15.0SE (StataCorp LP, 1985, College Station, TX) and Microsoft Excel (Microsoft, Inc, Redmond, WA). Continuous variables were compared by the paired or unpaired Student t-test (parametric distributions) or Mann-Whitney U test (non-parametric distributions). Categorical variables were analyzed using the chi-square or Fisher's exact test, as indicated. A  $P < 0.05$  was used to reject the null hypothesis.

## Results

A total of 285 patients (118 in Group E, 167 in Group C) enrolled and were cared for by 13 residents (6 in Group E, 7 in Group C) over the eight-month time period. Demographic and obstetric characteristics of the patient participants were not different between study groups; notably, mode of delivery (e.g., spontaneous vaginal, assisted vaginal, cesarean) was also not different between study groups (Table 1).

Table 1  
Patient demographic and obstetric characteristics compared between study groups

	<b>Educated (n = 118)</b>	<b>Control (n = 167)</b>	<b>P value</b>
Age (years)	29.2 (5.1)	28.9 (5.3)	0.69
Body mass index (kg/m <sup>2</sup> )	30.6 (5.7)	31.9 (7.0)	0.10
<b>Gravidity</b>			
1	36 [30.5]	64 [38.3]	0.26
2	37 [31.4]	41 [24.6]	
3	19 [16.1]	29 [17.4]	
4	14 [11.9]	10 [6.0]	
> 4	12 [10.2]	17 [10.2]	
<b>Parity</b>			
0	49 [41.5]	87 [52.1]	0.54
1	40 [33.9]	48 [28.7]	
2	16 [13.6]	19 [11.4]	
3	7 [5.9]	10 [6.0]	
> 3	6 [5.1]	3 [1.8]	
Estimated gestational age (weeks)	39.2 (1.5)	39.1 (1.6)	0.47
<b>Race</b>			
White	86 [72.9]	103 [87.3]	0.09
Black	19 [16.1]	26 [22.0]	
Other	11 [9.3]	30 [25.4]	
Not disclosed	2 [1.7]	8 [6.8]	
Pain score at time of epidural analgesia request (0–10 numeric rating scale)	8.3 (1.6)	8.2 (1.7)	0.77
Total epidural time (min)	465.0 (304.1)	496.1 (325.5)	0.42
<b>Mode of delivery</b>			
Induced vaginal	0 [0]	3 [1.8]	0.58
<i>Data are reported as mean (standard deviation) or frequency [percentage]</i>			

	<b>Educated (n = 118)</b>	<b>Control (n = 167)</b>	<b>P-value</b>
Spontaneous vaginal	105 [89.0]	143 [85.6]	
Assisted vaginal	4 [3.4]	5 [3.0]	
Intrapartum cesarean	9 [7.6]	16 [9.6]	
<i>Data are reported as mean (standard deviation) or frequency [percentage]</i>			

The primary outcome, total bupivacaine dose (mg) was not different between study groups (mean  $\pm$  standard deviation bupivacaine dose in milligrams, educated group: 96.4  $\pm$  58.2, control group: 105.4  $\pm$  64.1,  $P = 0.23$ ) (Fig. 2). Other patient-level outcomes, including PCEA goal comprehension scores, satisfaction with anesthesia scores, overall satisfaction with birth experience scores, and number of supplemental epidural doses during labor, were not different between study groups (Table 2).

Table 2  
Patient-level outcomes according to resident education group.

	<b>Educated (n = 118)</b>	<b>Control (n = 167)</b>	<b>P-value</b>
Total bupivacaine dose (mg)	96.4 (58.2)	105.4 (64.1)	0.23
Patient comprehension (percent correct)	68.4 (15.1)	63.5 (13.0)	0.14
Patient anesthesia satisfaction (mm)	78.8 (24.9)	87.5 (24.0)	0.43
Patient WOMBLSQ satisfaction (score)	85.9 (29.1)	87.5 (26.0)	0.80
Number of supplemental doses (number)	0 [1]	0 [0]	0.27
<i>WOMBLSQ, Women's Views of Birth Labour Satisfaction Questionnaire. Data are reported as mean (standard deviation) or median [interquartile range]</i>			

Resident self-efficacy scores for PCEA patient education were different between study groups. In the education group, resident self-report scores for comfort in PCEA patient education were significantly higher in the post-rotation period, compared to pre-rotation ( $P = 0.002$ ). In contrast, in the control group, resident self-report for comfort in patient education for PCEA were not different pre-rotation and post-rotation (Table 3).

Table 3  
Resident self-efficacy scores. Residents responded to the question, “Overall, how comfortable are you now in educating obstetric patients on using patient-controlled epidural analgesia (PCEA)?”

	Pre-Intervention	Post-Rotation	P-value
Educated group (n = 6)	45.7 (7.5)	88.0 (9.2)	0.002*
Control group (n = 7)	61.0 (31.0)	81.3 (10.6)	0.46
*P < 0.05			

Results of the segmented regression analysis (Fig. 3) showed that levels and trends of bupivacaine dose did not change significantly across study group epochs. The baseline trend of the first and second control periods were not significant ( $P = 0.78$  and  $P = 0.43$ , respectively). Both education period trends were not significant ( $P = 0.44$  and  $P = 0.62$ , respectively), suggesting that the education interventions did not result in significant changes in bupivacaine dose consumption.

## Discussion

This study found that although a formal teaching intervention improved resident self-efficacy for teaching patients how to use labor epidural analgesia PCEA, it did not result in reductions in local anesthetic dose consumption, patient satisfaction, or patient comprehension for PCEA. These findings support that clinician self-efficacy is insufficient to effect a change in clinical outcomes. The findings also suggest that alternative methods of patient education for labor analgesia PCEA are needed, or that existing patient education strategies are adequate to result in appropriate use of PCEA during labor. The clinical relevance of these findings is that patient-level local anesthetic consumption in labor is highly variable and appears not influenced by formal education on PCEA use by the anesthesia provider.

These findings are consistent with other educational studies suggesting that self-efficacy are insufficient to result in clinical outcomes changes<sup>18,19</sup>. In one randomized trial, increased clinician self-efficacy for asthma management did not result in increased asthma treatment plan development<sup>18</sup>. Indeed, Kirkpatrick’s Four Levels of Learning<sup>19</sup> suggests that self-efficacy is the most basic level of learning, that does not necessarily drive results. The Four Levels of Learning is a framework for categorizing outcome criteria of educational training. Learning that results from formal training programs, such as the one described in this study, can be classified into four levels of increasing influence on patient care outcomes: 1) reaction, 2) learning, 3) behavior, and 4) results. Self-efficacy – a self-belief in the ability to succeed or to accomplish a task – is at the most basic Kirkpatrick level of learning (reaction). Although we targeted an intervention aimed at level 4 (results), the intervention only resulted in a change at level 1.

Alternative explanations for the findings of this study include that the teaching intervention was ineffective, or that local anesthetic dose consumption during childbirth at our institution is already optimized. It is also worth considering that environmental or organizational factors can influence

behavior. In this way, it is possible that patients were well-educated in Group E, but that the patients from Group C were also well-educated by residents who eventually learned good patient education strategies from other senior residents or attending anesthesiologists on the rotation.

The study limitations included that we were unable to compare this educational methodology to a gold standard, as none currently exists to our knowledge. The study was also limited in that due to personnel restrictions, we were unable to observe each resident during in-situ patient care interactions, and thus cannot speak directly to adherence to appropriate patient education on PCEA (i.e. could not evaluate Kirkpatrick Level 3). Another limitation is that we were unable to account for nursing education of patients, which may have unintentionally consisted of similar points of teaching to each patient. Potential future areas of research include identifying effective patient education strategies for labor analgesia PCEA and identifying the “lowest effective total dose” of local anesthesia for a given patient in labor.

## Conclusions

In summary, we describe methods for educating resident anesthesiologists on patient education for labor epidural analgesia PCEA. The education intervention improved resident self-efficacy for patient education, but did not change patients’ local anesthetic dose requirements, satisfaction, or comprehension for PCEA. Future educational research should emphasize the impact of teaching interventions on patient care outcomes in addition to improvements in learner self-efficacy.

## Abbreviations

ID	Identification
mcg	Microgram
mL	Milliliter
MSS	Maternal Satisfaction Scale
PCEA	Patient-controlled epidural analgesia
WOMBLSQ	Women’s Views of Birth Labor Satisfaction Questionnaire

## Declarations

Ethics approval and consent to participate

This study was approved by the University of Pittsburgh IRB, PRO16070615

University of Pittsburgh Institutional Review Board

3500 Fifth Avenue, Hieber Building, Room 106

Pittsburgh, Pennsylvania, 15213 USA

Phone +1 412 383 1480 Email [askirb@pitt.edu](mailto:askirb@pitt.edu)

Consent for publication Not applicable

Availability of data and material Fully upon request

Competing interests Tetsuro Sakai is an Associate Editor

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#### Authors' contributions

MY - This author collected data, read and approved the manuscript

AP - This author collected data, read and approved the manuscript

LF – This author collected data, read and approved the manuscript

DM - This author designed the study, read and approved the manuscript

TS - This author designed the study, read and approved the manuscript

GL - This author designed the study, collected data, analyzed data, read and approved the manuscript

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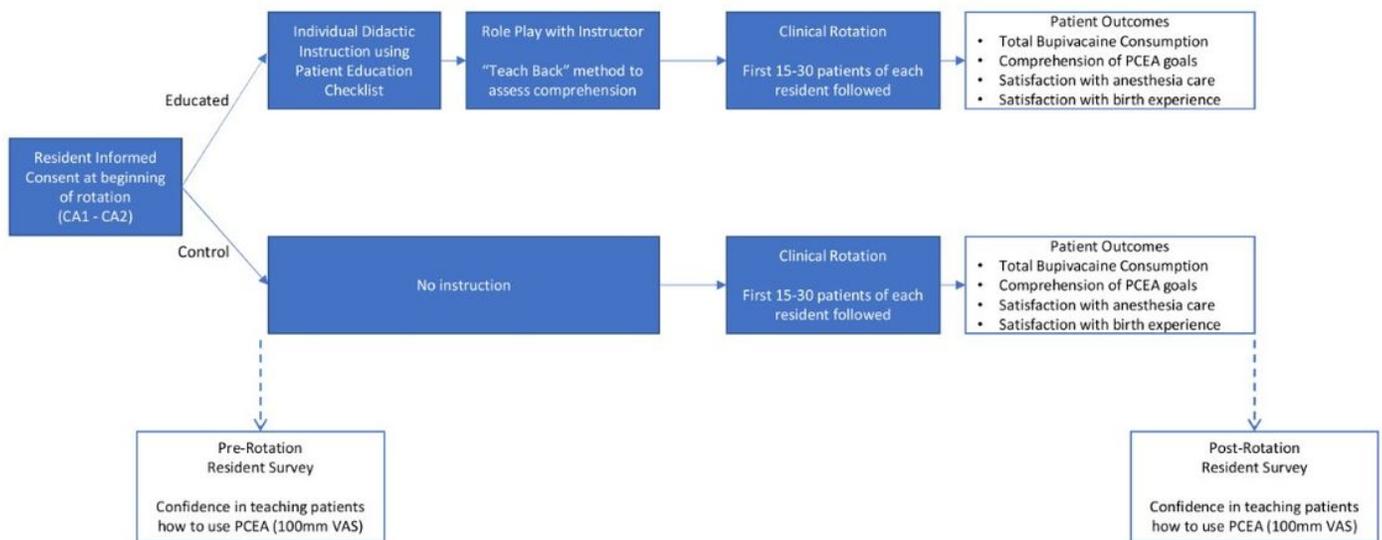
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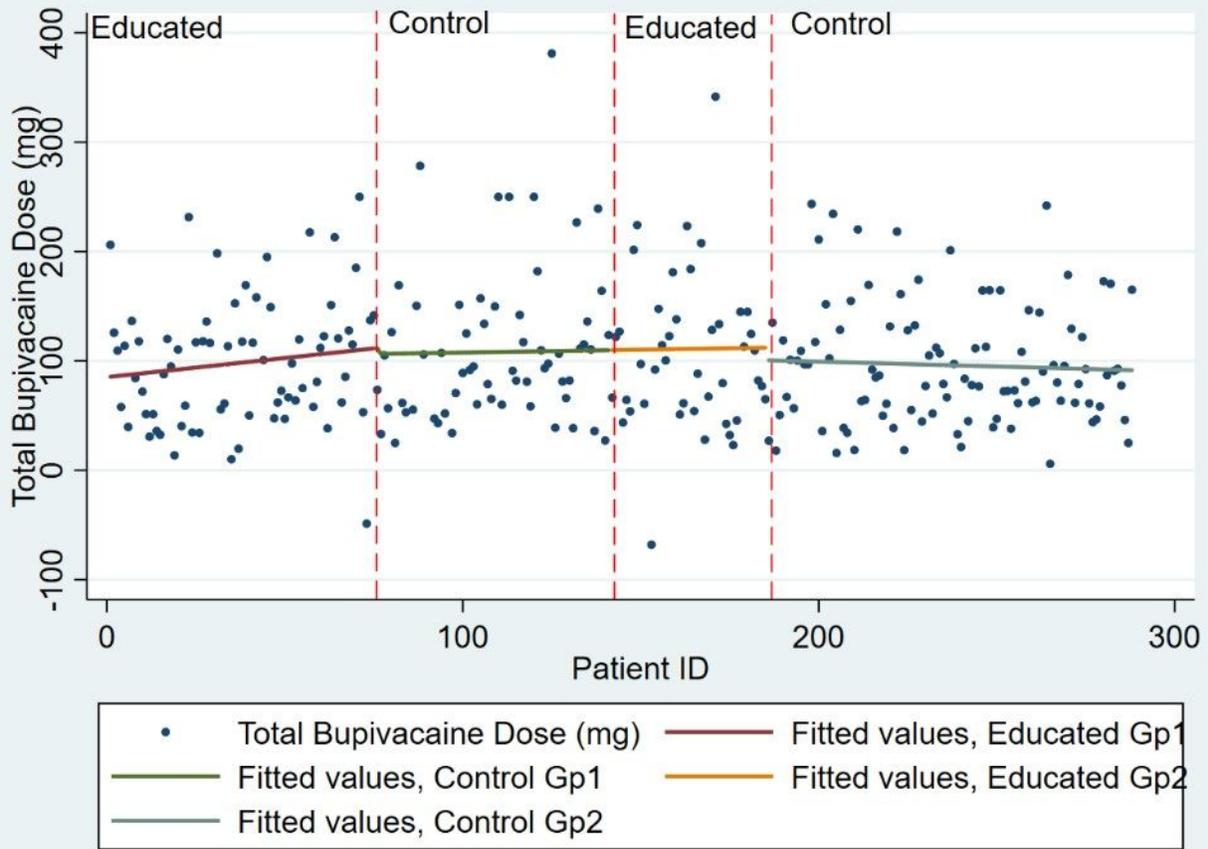
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## Figures



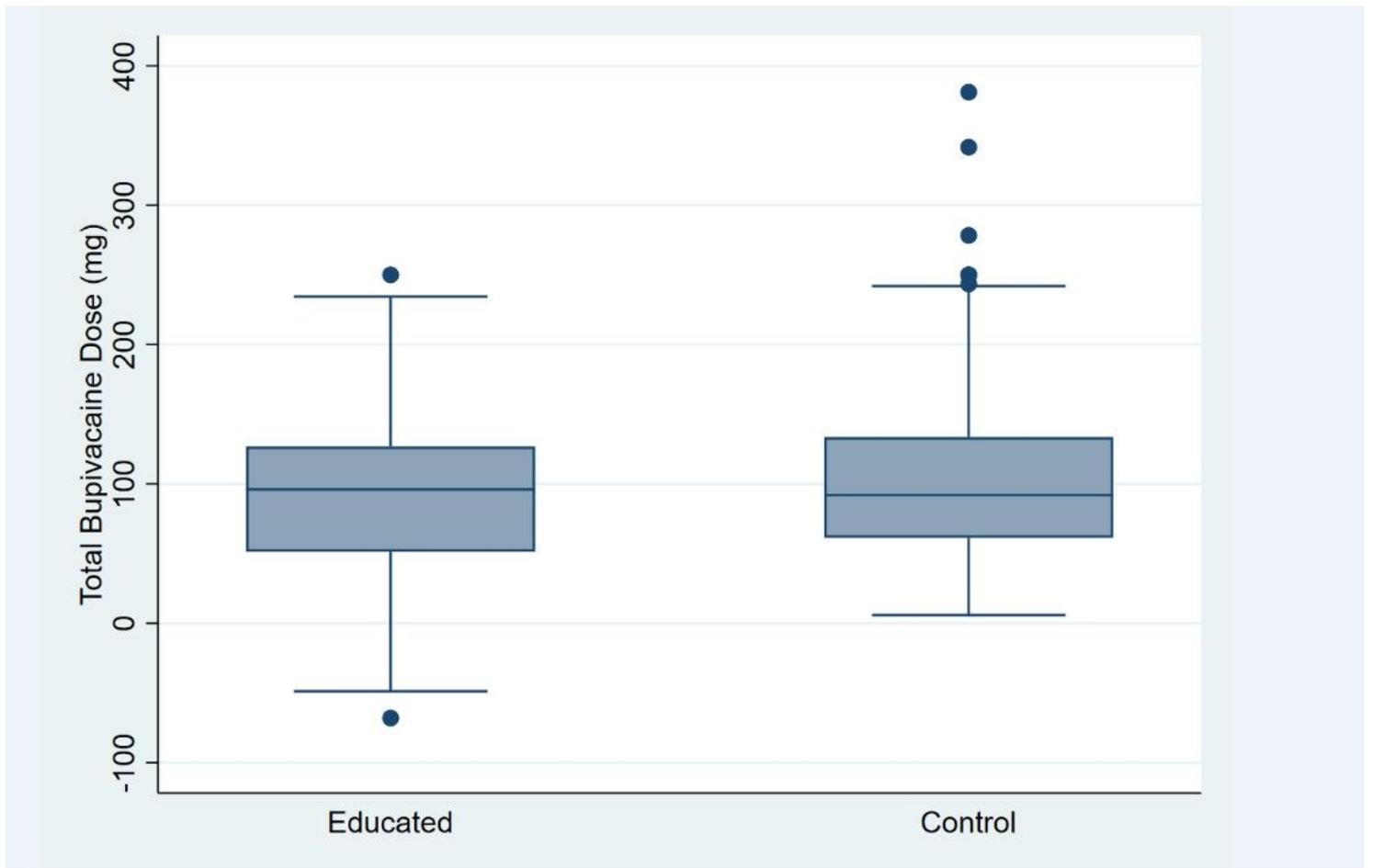
**Figure 1**

Study Flow Diagram.



**Figure 2**

Result of primary outcome, total bupivacaine dose consumption, between study groups.



**Figure 3**

Segmented regression results showing total bupivacaine dose consumption over time. A segmented regression analysis for the interrupted time series approach showed that the trends of bupivacaine dose consumption over time were unchanged across study groups/time epochs.

## Supplementary Files

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- [SuppMaterial1EDUCATEv2.pdf](#)