COMPARISON OF CESAREAN SECTION AND HYSTERECTOMY OUTCOMES BETWEEN TOPICAL POWDERED HEMOSTAT COHORTS: A RETROSPECTIVE ANALYSIS

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Background

- ❖ Powdered hemostats are used to stop continuous broad-surface oozing bleeding in patients undergoing a large variety of surgical procedures
- ❖ Powdered hemostats are commonly used in surgeries, such as cesarean section (c-section) and open hysterectomy (hysterectomy)
- ❖ Despite the availability of different powdered hemostats, including oxidized regenerated cellulose (ORC) and microporous polysaccharide (MP) options,[1] little is known about variations in outcomes among them; variations in the composition and product features of powdered hemostats, like ORC's antibacterial properties, could result in differences in outcomes

Objective

- ❖ This study aimed to compare clinical and economic outcomes among patients undergoing c-section or open hysterectomy who received either ORC or MP powdered hemostats

Methods

Overall Analysis

- ❖ Chargemaster data was obtained from the Premier Hospital Database, which represents data collected from ~20% of U.S. inpatient discharges among a representative set of private and academic hospitals[2]
- ❖ Patients who underwent c-section or hysterectomy between November 2017 and December 2018 and received a powdered hemostat (ORC or MP) were grouped into cohorts based on procedure and powdered hemostat received (either MP or ORC)
- ❖ This analysis characterized patients based on their demographic profile, comorbidities, and hospital characteristics. This analysis measured clinical and economic outcomes

Propensity Score Matching Analysis

- ❖ A propensity score matching (PSM) analysis was conducted to adjust for factors confounding the relationship between powdered hemostat use and outcomes[6]
- ❖ Propensity scores were modeled using logistic regression models to estimate a patient's likelihood of receiving ORC
  - The propensity score model included several patient and hospital characteristics, listed in Table 1; separate models were fit for each procedure
- ❖ ORC and MP patients were matched on their propensity scores; diagnostics were evaluated to ensure balance across included patient/hospital characteristics
- ❖ Upon achieving balance, patient outcomes were compared to assess differences by powdered hemostat cohort

Table 1. PSM Model Variables

Patient and Hospital Characteristics
Age
Race
Charlson comorbidity index (CCI)[3,4] [Hysterectomy Cohort Only] & Obstetric Comorbidity Index (OCI)[5] [C-section Cohort Only]
Payer Type
Obesity
Admission Type
Hospital Academic Status
Procedure Volume
Hospital Region
Primary Diagnosis (Dx), parent ICD code [Hysterectomy Cohort Only]

Results

C-section

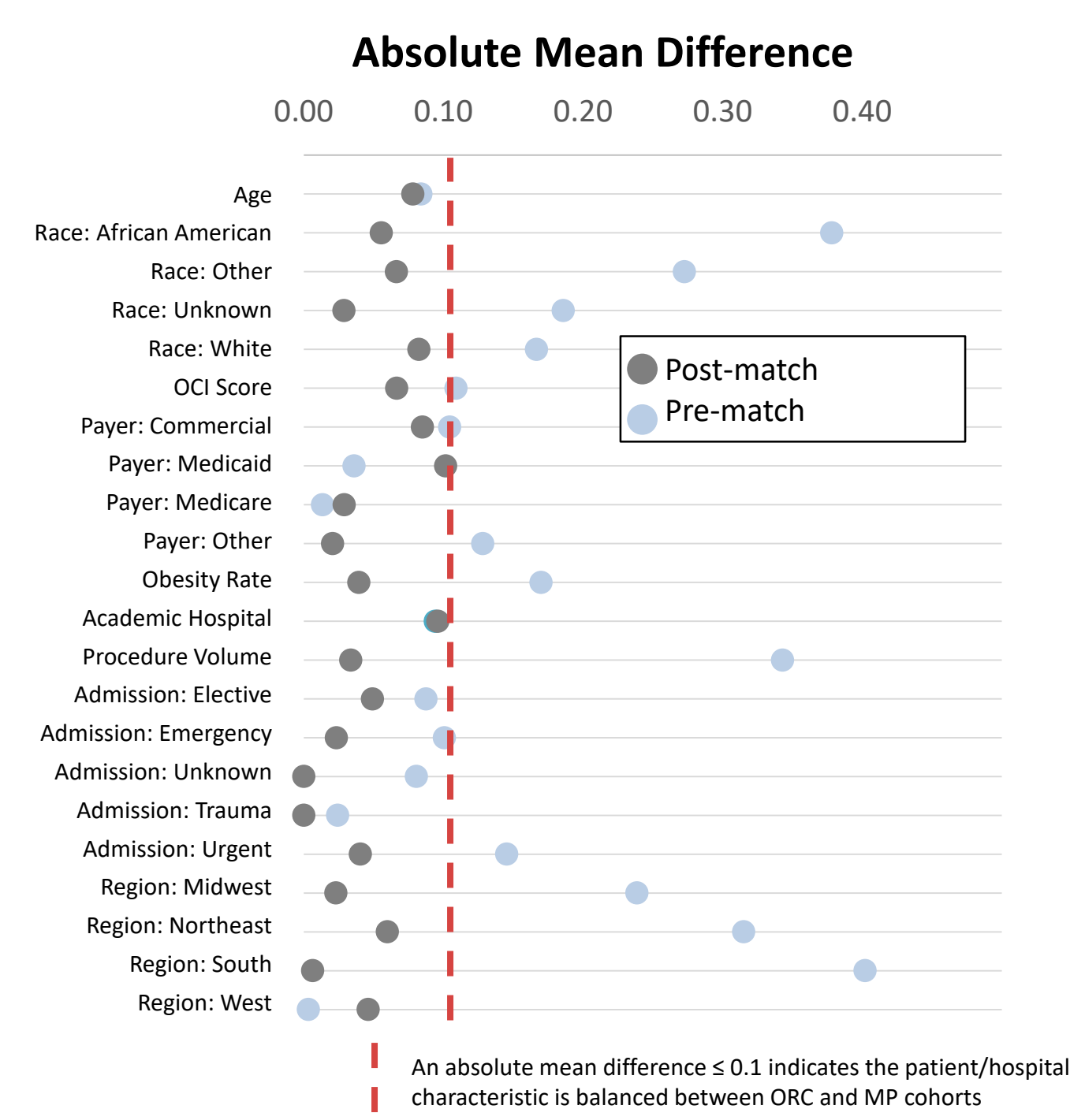*Pre-matching and Post-matching Patient Descriptive Statistics*

- ❖ Propensity score matching resulted in similar patient and hospital characteristics between ORC and MP cohorts, as shown in Table 2
- ❖ One hospital was removed from the c-section analysis because its patients would have gone unmatched and it had undue influence on the PSM model
- ❖ After removal of the hospital, 99.2% of ORC patients were matched

Table 2. C-section Descriptive Statistics

	Pre-matching				Post-matching			
	ORC		MP		ORC		MP	
	N	% / SD	N	% / SD	N	% / SD	N	% / SD
Discharges (n)	577		3,397		377		377	
Patient Characteristics								
Average Age (years)	30.4	5.7	30.7	5.6	30.2	5.4	30.6	5.6
Race								
White	255	44%	1,978	58%	249	66%	234	62%
African American	71	12%	875	26%	43	11%	51	14%
Other	240	42%	364	11%	78	21%	87	23%
Unknown	11	2%	179	5%	7	2%	5	1%
Admission Type								
Elective	295	51%	2,491	73%	293	78%	285	76%
Emergency	25	4%	146	4%	22	6%	24	6%
Trauma Center	195	34%	1	0%	0	0%	0	0%
Urgent	62	11%	748	22%	62	16%	68	18%
Unknown	0	0%	11	0%	0	0%	0	0%
Payer Distribution								
Medicare	3	1%	31	1%	3	1%	4	1%
Medicaid	336	58%	1,509	44%	161	43%	142	38%
Commercial	208	36%	1,557	46%	192	51%	208	55%
Other	30	5%	300	9%	21	6%	23	6%
Obesity Rate	154	27%	588	17%	90	24%	84	22%
Average OCI	3.7	1.7	3.6	1.8	3.7	1.7	3.8	2.0
Hospital Characteristics								
Academic Hospital	180	31%	1,450	43%	179	47%	197	52%
Hospital Geographic Region								
Midwest	38	7%	620	18%	38	10%	35	9%
Northeast	14	2%	410	12%	14	4%	20	5%
South	323	56%	2,321	68%	320	85%	319	85%
West	202	35%	46	1%	5	1%	3	1%
Average Annualized Hospital Procedure Volume	856.3	689.7	611.0	498.4	834.9	687.5	824.8	515.3

SD=Standard Deviation

Hysterectomy

Pre-matching and Post-matching Patient Descriptive Statistics

- ❖ Propensity score matching resulted in similar patient and hospital characteristics between ORC and MP cohorts, as shown in Table 3
- ❖ No data points were removed from the analysis and the matching rate was 95.8%

Table 3. Hysterectomy Descriptive Statistics

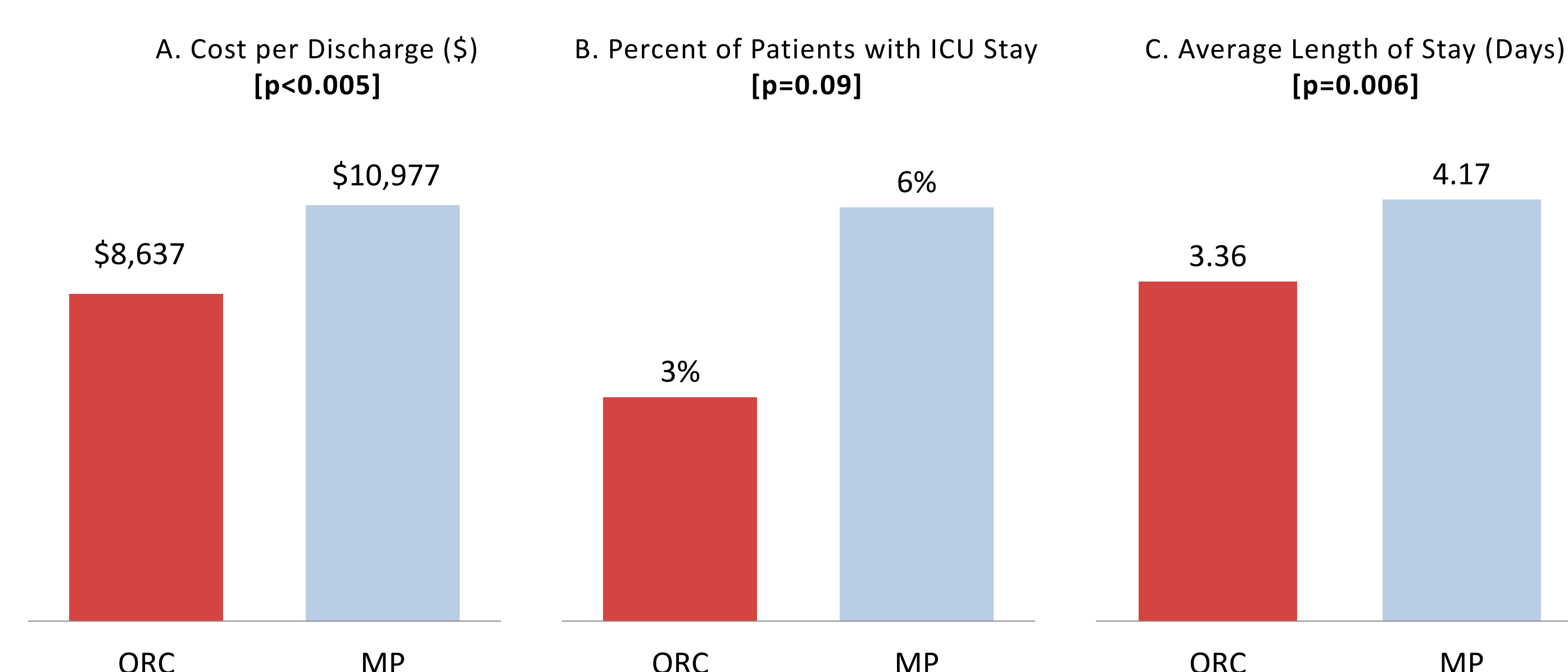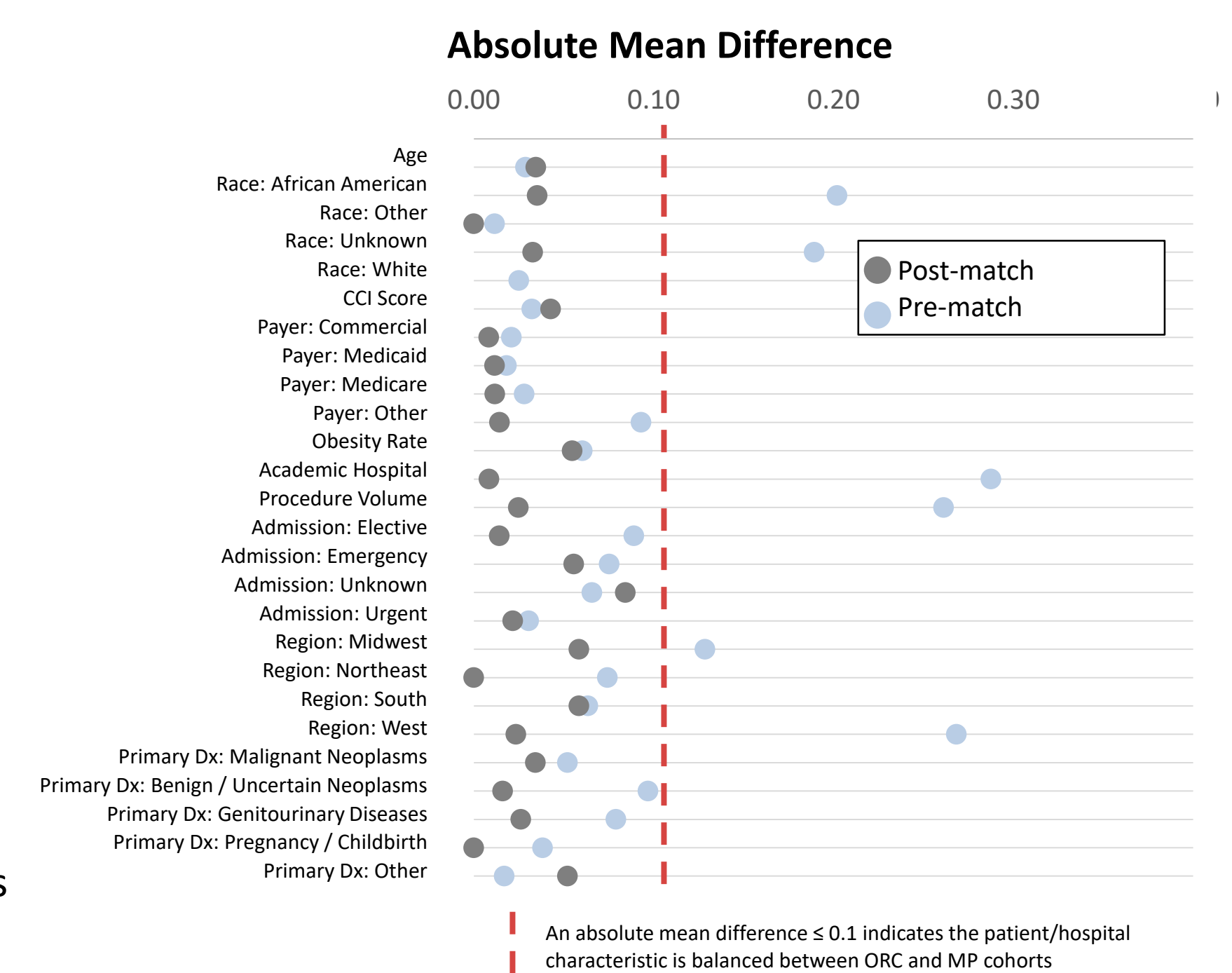|	Pre-matching				Post-matching			
	ORC		MP		ORC		MP	
	N	% / SD	N	% / SD	N	% / SD	N	% / SD
Discharges (n)	260		1,402		249		249	
Patient Characteristics								
Average Age (years)	48.2	11.3	48.6	10.8	48.2	11.5	48.6	11.1
Race								
White	175	67%	786	56%	166	67%	163	65%
African American	66	25%	485	35%	65	26%	69	28%
Other	18	7%	93	7%	17	7%	17	7%
Unknown	1	0%	38	3%	1	0%	0	0%
Admission Type								
Elective	234	90%	1297	93%	224	90%	225	90%
Emergency	15	6%	58	4%	15	6%	12	5%
Trauma Center	0	0%	0	0%	0	0%	0	0%
Urgent	10	4%	46	3%	10	4%	11	4%
Unknown	1	0%	1	0%	0	0%	1	0%
Payer Distribution								
Medicare	37	14%	186	13%	35	14%	34	14%
Medicaid	38	15%	196	14%	36	14%	35	14%
Commercial	166	64%	881	63%	160	64%	161	65%
Other	19	7%	139	10%	18	7%	19	8%
Obesity Rate	72	28%	351	25%	68	27%	74	30%
Average CCI	0.8	1.6	0.8	1.6	0.8	1.7	0.9	1.7
Primary Diagnosis (Dx) Code								
Malignant Neoplasms	40	15%	190	14%	39	16%	42	17%
Benign / Uncertain Neoplasms	128	49%	758	54%	120	48%	118	47%
Genitourinary Diseases	84	32%	402	29%	82	33%	79	32%
Pregnancy / Childbirth	2	1%	16	1%	2	1%	2	1%
Other	6	2%	36	3%	6	2%	8	3%
Hospital Characteristics								
Academic Hospital	181	70%	783	56%	180	72%	181	73%
Hospital Geographic Region								
Midwest	50	19%	344	25%	50	20%	56	22%
Northeast	26	10%	173	12%	26	10%	26	10%
South	170	65%	874	62%	167	67%	160	64%
West	14	5%	11	1%	6	2%	7	3%
Average Annualized Hospital Procedure Volume	120.0	114.1	89.6	78.6	120.5	113.0	73.5	70.4

SD=Standard Deviation

C-section Matching Diagnostics

- ❖ Absolute mean differences shown in Figure 1 demonstrate that the cohorts were well matched, with all values falling below the 0.1 threshold indicating balance

C-section Post-match Outcomes

- ❖ Prior to matching, mean cost per discharge was $9,176 for the ORC cohort and $9,722 for the MP cohort (though differences were not significantly significant); the percent of patients with an ICU stay were 3% and 5% (p=0.05)
- ❖ Average length of stay before matching was 3.36 versus 3.45 (p=0.35), respectively for the ORC and MP cohorts
- ❖ Post-matching results are shown in Figure 2

Figure 1. C-section Matching Diagnostics

Absolute Mean Difference

An absolute mean difference ≤ 0.1 indicates the patient/hospital characteristic is balanced between ORC and MP cohorts
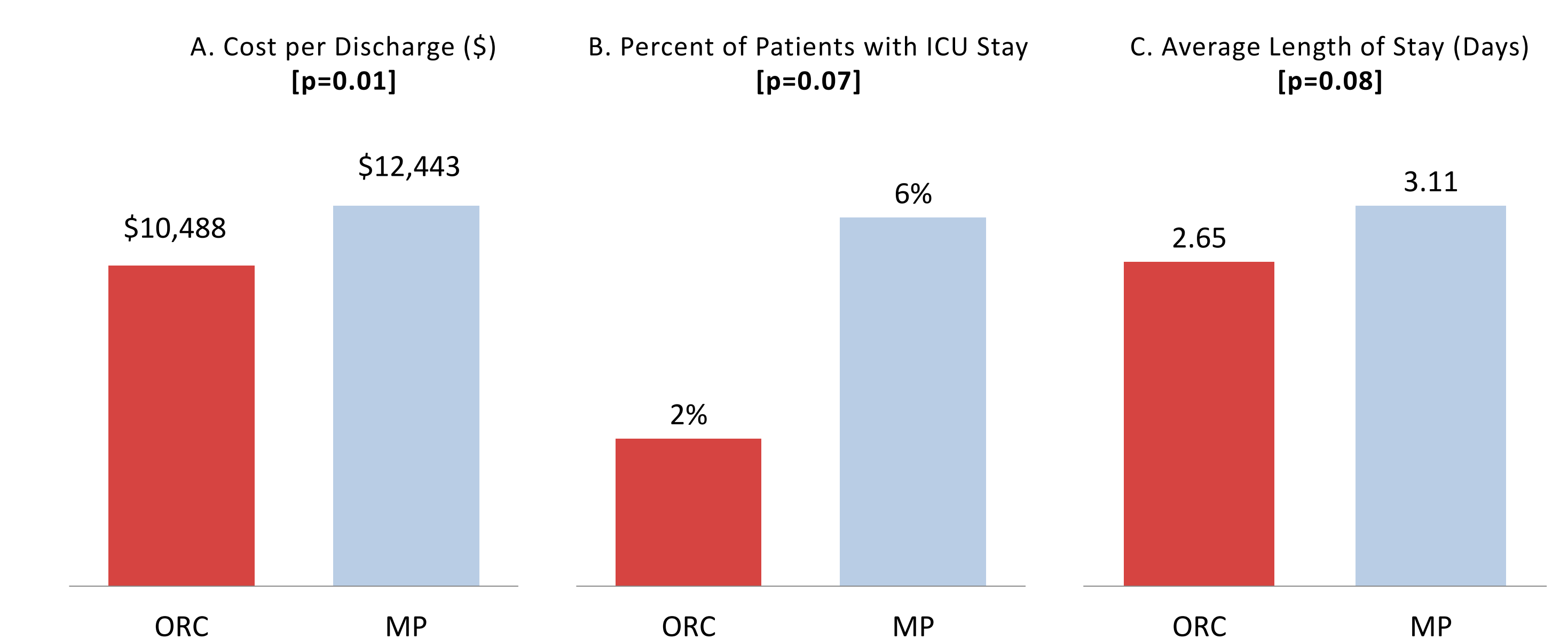
Hysterectomy Matching Diagnostics

- ❖ Absolute mean differences show that ORC and MP cohorts were well matched, as shown in Figure 3

Hysterectomy Post-match Outcomes

- ❖ Prior to matching, mean cost per discharge was $10,453 for the ORC cohort and $11,381 for the MP cohort and the percent of patients with an ICU stay were 2% and 4%, respectively; both differences were not statistically significant
- ❖ Average length of stay before matching was 2.64 versus 2.81 (p=0.32), respectively for the ORC and MP cohorts
- ❖ Post-matching results are shown in Figure 4

Figure 3. Hysterectomy Matching Diagnostics

Absolute Mean Difference

An absolute mean difference ≤ 0.1 indicates the patient/hospital characteristic is balanced between ORC and MP cohorts

Figure 2. Post-matching Outcomes

A. Cost per Discharge ($) [p<0.005]
- ORC $8,637
- MP $10,977

B. Percent of Patients with ICU Stay [p=0.09]
- ORC 3%
- MP 6%

C. Average Length of Stay (Days) [p=0.006]
- ORC 3.36
- MP 4.17

Figure 4. Post-matching Outcomes

A. Cost per Discharge ($) [p=0.01]
- ORC $10,488
- MP $12,443

B. Percent of Patients with ICU Stay [p=0.07]
- ORC 2%
- MP 6%

C. Average Length of Stay (Days) [p=0.08]
- ORC 2.65
- MP 3.11

Discussion

- ❖ Patients who received ORC had lower average costs per discharge than patients who received MP; this held true among both c-section and hysterectomy procedures (with a difference in costs of $2,340 and $1,955, respectively). Among patients who underwent a c-section, average length of stay was lower in the ORC cohort, with the results approaching statistical significance
- ❖ Hypotheses to explain these results include that lower mean cost per discharge may be the result of shorter time to hemostasis, as animal models have shown ORC provides faster hemostasis relative to MP[1]
- ❖ Future research could evaluate differential outcomes by powdered hemostat exposure at an institution-specific level (if feasible in institutions that use both ORC and MP in similar procedures and patient populations) to more comprehensively control for hospital-related confounding
- ❖ Study limitations include: unmeasured confounding (as it is possible there are factors not captured in the data, because this is a retrospective observational study) and this study relies on accurate coding of ORC/MP exposure, patient characteristics, and reported outcomes (as is the case with all analyses of administrative data)

References

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