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# Miscarriage Treatment–Related Morbidities and Adverse Events in Hospitals, Ambulatory Surgery Centers, and Office-Based Settings

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**Objective:** The aim of the study was to examine whether miscarriage treatment–related morbidities and adverse events vary across facility types.

**Methods:** A retrospective cohort study compared miscarriage treatment–related morbidities and adverse events across hospitals, ambulatory surgery centers (ASCs), and office-based settings. Data on women who had miscarriage treatment between 2011 and 2014 and were continuously enrolled in their insurance plan for at least 1 year before and at least 6 weeks after treatment were obtained from a large national private insurance claims database. The main outcome was miscarriage treatment–related morbidities and adverse events occurring within 6 weeks of miscarriage treatment. Secondary outcomes were major events and infections.

**Results:** A total of 97,374 miscarriage treatments met inclusion criteria. Most (75%) were provided in hospitals, 10% ASCs, and 15% office-based settings. A total of 9.3% had miscarriage treatment–related events, 1.0% major events, and 1.5% infections. In adjusted analyses, there were fewer events in ASCs (6.5%) than office-based settings (9.4%) and hospitals (9.6%), but no significant difference between office-based settings and hospitals. There were no significant differences in major events between ASCs (0.7%) and office-based settings (0.8%), but more in hospitals (1.1%) than ASCs and office-based settings. There were fewer infections in ASCs (0.9%) than office-based settings (1.2%) and more in hospitals (1.6%) than ASCs and office-based settings. In analyses stratified by miscarriage treatment type, the difference between ASCs and office-based settings was no longer significant for miscarriages treated with procedures.

**Conclusions:** Although there seem to be slightly more events in hospitals than ASCs or office-based settings, findings do not support limiting miscarriage treatment to particular settings.

**Key Words:** miscarriage, patient safety

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For the past 30 years, the provision of many healthcare procedures has moved out of hospitals to nonhospital-based outpatient settings, including ambulatory surgery centers (ASCs) and office-based settings.<sup>1</sup> Many obstetric and gynecologic procedures, including treatments for miscarriages, are still primarily performed in hospitals.<sup>2,3</sup> Some women prefer receiving miscarriage treatment outside hospitals, and such care may cost less.<sup>4,5</sup>

Typically, patient safety has been a foremost concern when considering whether procedures should be moved to outpatient settings.<sup>6</sup> Research that directly compares patient safety between hospitals and outpatient settings has found few differences<sup>5,7,8</sup>; for induced abortion, research finds safety typically better in outpatient settings.<sup>9,10</sup> A small body of research has compared safety of different procedures across ASCs and office-based settings and has not found consistent differences.<sup>11,12</sup>

Research on safety of miscarriage treatment across facility types has been carried out primarily with small samples<sup>5</sup> and has not directly compared safety in two outpatient settings: ASCs versus office-based settings. The ASC versus office-based setting comparison is important, because some state laws require a particular gynecologic procedure—abortion—to be performed in ASCs.<sup>13</sup> Because procedures and medications used to treat miscarriage are similar to procedures and medications for abortion, evidence from comparisons of miscarriage safety across facility types is also relevant to abortion policies.

This study examines whether miscarriage treatment–related morbidities and adverse events vary across the following three facility types: hospitals, ASCs, and office-based settings.

## MATERIALS AND METHODS

### Study Design

This retrospective cohort study uses 2011–2014 data from the Truven Health MarketScan Commercial Claims and Encounters database, a database of approximately 50 million privately insured people across the United States each year, including approximately 10 million women of reproductive age, to compare miscarriage treatment–related morbidities and adverse events across the following three facility types: hospitals, ASCs, and office-based settings. This study was considered exempt by institutional review boards at authors' institutions. The exposure is procedure facility type (hospital versus ASC versus office-based setting) and the outcome is miscarriage treatment–related morbidities and adverse events.

### Data Source

The Truven Health database is a commercially available health insurance claims database often used in studies examining complications and follow-up care after health care procedures, including other gynecologic procedures.<sup>12,14,15</sup> It includes claims data for a sample of privately insured people in all U.S. states, including

demographic characteristics, health care utilization, dates of service, diagnosis codes, procedure codes, and facility type. The data represent claims from providers that have been adjudicated for payment and are obtained directly from a convenience sample of large employers and health plans that agree to participate in MarketScan. Although no attempts are made to correct or change information received from data contributors, Truven Health has an extensive quality control process to verify that the data meet criteria for quality and completeness.<sup>16</sup>

## Study Population

The study population includes all beneficiaries in this database who had a procedure or medical treatment for miscarriage between 2011 and 2014 in a hospital, ASC, or office-based setting; who were enrolled in their insurance plan for at least 1 year before the index miscarriage treatment and at least 6 weeks after the miscarriage treatment; and who were between the ages of 11 and 59 years. We identified facility types based on the standardized place-of-service code variable, which indicates setting where treatment was provided. Facility type was classified as hospital when the standardized place-of-service code variable (stdplac) equaled 21, 22, or 23 (“inpatient hospital,” “on-campus outpatient hospital,” or “emergency room hospital”), classified as ASC when stdplac equaled 24 (“ambulatory surgery center”), and office-based setting when stdplac equaled 11 (“Office”), which includes most office-based settings.<sup>17</sup>

We identified miscarriage treatments with the following Current Procedural Terminology, 4th edition codes: 59812 (procedure for incomplete miscarriage, trimester not specified), 59820 (first-trimester pregnancy loss), 59821 (second trimester pregnancy loss), 59830 (procedure for septic miscarriage, trimester not specified), and J3490 (medication treatment for miscarriage). We only included code J3490 (for misoprostol) when it was accompanied by miscarriage, early pregnancy loss, or unspecified abortion diagnosis codes. We did not include miscarriages treated with expectant management, because there is no specific treatment provided that would plausibly be influenced by facility type. We excluded ectopic pregnancies diagnosed and/or treated within 7 days of the miscarriage treatment and molar pregnancies.

## Outcome

Miscarriage treatment–related morbidities and adverse events were identified by examining and evaluating diagnoses and treatments at all health care encounters—including emergency departments (EDs), the original treatment facility, other health care sites, or pharmacy—that occurred on the day of or within 6 weeks of the index miscarriage treatment. Each index miscarriage treatment was coded as to whether a miscarriage treatment–related event occurred on the day of or within the 6 weeks subsequent to the initial treatment. Events were defined as any postmiscarriage-treatment-related morbidity or adverse event. Potential events were identified through International Classification of Diseases, 9th Revision (ICD-9) codes in primary and secondary positions, Health Care Common Procedure Coding System codes, Current Procedural Terminology, 4th edition codes, and medication codes for each health care encounter within 6 weeks of the miscarriage treatment. We used a modified version of the PAIRS Framework,<sup>18</sup> which was originally developed for first-trimester aspiration abortions, to classify miscarriage treatment–related events into one or more of 12 possible diagnoses: retained products of conception, failed abortion, hemorrhage, infection, uterine perforation, anesthesia reaction, symptomatic intrauterine material (SIM), postabortal hematometra, cervical injury, disseminated intravascular coagulation (DIC), and other/undetermined. Symptomatic intrauterine material, as defined in

the PAIRS framework,<sup>18</sup> is distressing symptoms of extended bleeding or cramping when there is no evidence of conceptus tissue. Symptomatic intrauterine material should be considered when postabortal hematometra and retained products of conception are ruled out. Using the PAIRS framework is appropriate because procedures to treat miscarriage are similar to abortion procedures and events that might occur are similar. We added retained placenta to the definition of retained products of conception and added DIC to classify additional types of events that could occur after second-trimester procedures. We also used different criteria for considering a subsequent dose of misoprostol an indication of retained products of conception or a repeat treatment; specifically, we considered subsequent doses of misoprostol after 7 days for procedures and after 14 days for medication treatment to be indications.

Events were classified as major if they required overnight hospital admission, additional surgery, or blood transfusion. All others were classified as minor.

Identifying miscarriage treatment–related events involved the following. First, each miscarriage treatment with a subsequent inpatient visit was individually coded by a clinically trained reviewer who evaluated all available billing data for all encounters that occurred within 6 weeks subsequent to these miscarriage treatments. Second, the reviewer individually coded a subset of subsequent ED visits and other health care encounters with a diagnosis code indicating a miscarriage or abortion complication (ICD-9: 638.x, 634.00–634.82, 639.x, 635.00–635.82). We included subsequent diagnosis codes for abortion complications because they were unlikely to be separate pregnancies and, instead, were likely billing coding errors as ICD-9 codes for miscarriage complications and abortion complications only differ in one number. We selected the subset of subsequent ED visits and other health care encounters with miscarriage or abortion complication codes that had a treatment, medication, and/or diagnosis code we identified as possibly indicating an event. Third, we selected a five percent random sample of ED visits and health care encounters with a complications diagnosis code (that had not been included in the first selection) to ensure that we had not missed relevant cases. The reviewer then coded these random samples. Through coding of the random samples, we identified additional relevant treatments. We then pulled additional cases with subsequent ED visits and encounters with miscarriage or abortion complications diagnosis codes that had these treatments and individually coded these cases. The reviewer, blinded to index miscarriage treatment facility type, first classified each case as having a miscarriage treatment–related morbidity or adverse event or not and then classified each case with a miscarriage treatment–related event into one or more of the 12 possible event types.

Next, we searched all encounters within 6 weeks and classified ectopic pregnancies not diagnosed or treated within 7 days after the index miscarriage treatment as missed ectopics. We then searched all encounters within 6 weeks to identify injection and intravenous antibiotics commonly used to treat abortion- and miscarriage treatment–related infections. We then searched all encounters within 6 weeks to identify repeat miscarriage treatments (abortion, miscarriage, or dilation and curettage procedures, or additional doses of misoprostol). Repeat miscarriage treatments were further classified as retained products of conception, failed abortion, or other/undetermined based on diagnosis codes. We then added the injection and intravenous antibiotics and repeat procedures to the individually coded data set.

## Control Variables

Control variables included the following: miscarriage treatment type (first-trimester procedure for pregnancy loss - 59820, second-trimester procedure for pregnancy loss - 59821, procedure for

septic or incomplete miscarriage, trimester not specified - 59830 or 59812, and medication treatment - J3490 plus a relevant diagnosis code<sup>19</sup>), diabetes, hypertension, age, number of previous-year outpatient health care visits, one or more inpatient visits the previous year (as indicators of underlying health conditions), U.S. census region, and year. The reason that only women insured for at least 1 year before their miscarriage treatment were included was to have more complete data on chronic health conditions and health care utilization.

### Statistical Analysis

Analysis was conducted in Stata 14.2. We used generalized estimating equations with exchangeable correlation structure, logit link, and robust standard errors to account for possible clustering by individuals who had more than one miscarriage that was treated during our study period and controlled for potential confounders. Office-based settings were the reference group. We used the postestimation testparm command to compare odds of events in hospitals and ASCs. We used the postestimation margins command to obtain adjusted incidence rates. Per a priori study plans, we then performed these analyses for major events and infections and then conducted subgroup analyses for any event stratified by miscarriage treatment type. As a supplementary analysis, we conducted a series of regressions that examined the effect on the main relationship of interest of adding each covariate to the model.

Sensitivity analyses assessed the impact of changing what was considered a miscarriage treatment–related event as well as the impact of using a different set of covariates to adjust for patient health status. The decision to conduct the first three sensitivity analyses was made before conducting main analyses. First, because of difficulties in measuring whether an ectopic was missed based on billing data, we changed the definition of missed ectopics as those not diagnosed or treated within 7 to 14 days. Second, we added

additional injection or IV antibiotics that are not commonly used to treat miscarriage treatment–related infections but were present in our data set. Third, because of the possibility that we may have underdetected retained products of conception or repeat treatments after medication treatment by using a 14-day timeframe for a second dose of misoprostol to indicate a repeat treatment, we reduced the timeframe for when we considered a subsequent dose of misoprostol to be an event, i.e., we considered a second dose of misoprostol after 7 days for a medication treatment to be an indication of retained products of conception or a repeat treatment. We conducted a fourth sensitivity analysis post hoc. This sensitivity analysis used the Elixhauser Comorbidity Index<sup>20</sup> as a control variable for patient health status instead of the prespecified control variables of diabetes, hypertension, number of previous outpatient visits, and one or more previous inpatient visits. This analysis used a binary score of 1 or more of the 30 comorbidities in the Elixhauser index<sup>20,21</sup> and, in a separate analysis, used the Elixhauser Comorbidity Index Readmission Score.<sup>22</sup>

### RESULTS

The database included 164,227 miscarriage treatments during the study period. A total of 64,350 miscarriage treatments were excluded for not meeting inclusion criteria (Fig. 1). Those with a molar (n = 1341) and/or not missed ectopic (n = 1152) pregnancy were then excluded. An additional 10 cases were excluded after individual coding, because they were determined to be live deliveries. The study cohort included 97,374 miscarriage treatments among 91,767 beneficiaries.

The mean age was 33 years; 67% were first-trimester procedures for pregnancy loss, 2% second-trimester procedures for pregnancy loss, 16% procedures for septic or incomplete miscarriages, and 16% medication treatments (Table 1). Seventy-five percent of miscarriage treatments were in hospitals, 10% in

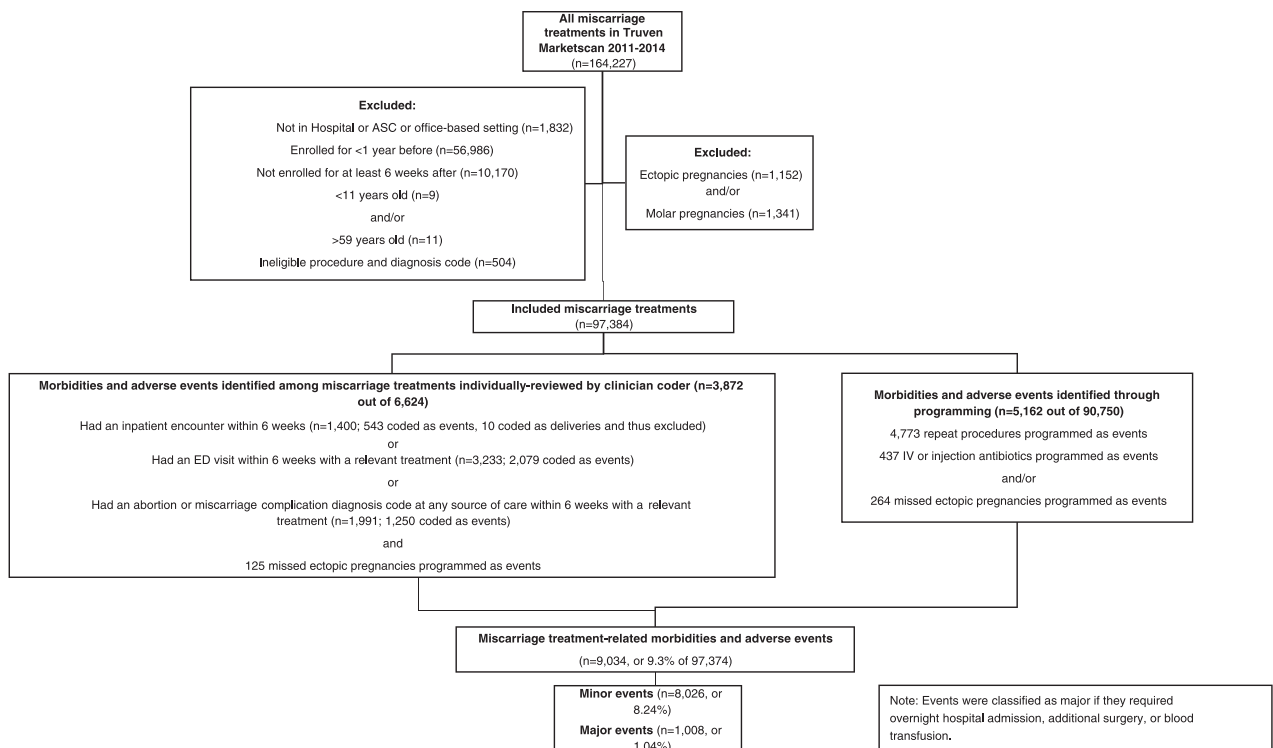


FIGURE 1. Study flow diagram.

TABLE 1. Sample Description (N = 97,374)

	Hospitals (n = 73,459)	ASCs (n = 9334)	Office-Based Settings (n = 14,581)	P
Age, mean (SD)	32.3 (6.2)	33.2 (5.8)	33.4 (6.0)	<0.001
Miscarriage treatment type, n (%)				<0.001
First-trimester procedure	50,738 (69.1%)	8107 (86.9%)	6035 (41.4%)	
Second-trimester procedure	2167 (3.0%)	85 (0.9%)	136 (0.9%)	
Incomplete or septic procedure	13,027 (17.7%)	1029 (11.0%)	1508 (10.3%)	
Medical	7527 (10.3%)	113 (1.2%)	6902 (47.3%)	
Diabetes, n (%)	3928 (5.4%)	494 (5.3%)	941 (6.5%)	<0.001
Hypertension, n (%)	4050 (5.5%)	450 (4.8%)	735 (5.0%)	0.003
≥1 previous year inpatient visits, n (%)	5891 (8.0%)	557 (6.0%)	852 (5.8%)	<0.001
Previous year outpatient visits, n (%)				<0.001
0–6	21,242 (28.9%)	2425 (26.0%)	4613 (31.6%)	
7–12	24,196 (32.9%)	2925 (31.3%)	4410 (30.2%)	
13–23	17,462 (23.8%)	2345 (25.1%)	3193 (21.9%)	
24 plus	10,559 (14.4%)	1639 (17.6%)	2365 (16.2%)	
≥1 comorbidities from Elixhauser Index, n (%)	3319 (38.3%)	28,105 (35.6%)	5436 (37.3%)	<0.001
Elixhauser Comorbidity Index readmission score, mean (SD)	2.7 (5.7)	2.4 (5.4)	2.6 (5.5)	<0.001
Year, n (%)				<0.001
2011	19,000 (25.9%)	2298 (24.6%)	3629 (24.9%)	
2012	21,752 (29.6%)	2487 (26.6%)	3998 (27.4%)	
2013	15,992 (21.8%)	2296 (24.6%)	3462 (23.7%)	
2014	16,715 (22.8%)	2253 (24.2%)	3492 (24.0%)	
Region of the country, n (%)				<0.001
Northeast	14,556 (19.8%)	1658 (17.8%)	4103 (28.1%)	
South	27,440 (37.4%)	3354 (35.9%)	3851 (26.4%)	
Midwest	17,364 (23.6%)	1630 (17.5%)	2044 (14.0%)	
West	12,142 (16.5%)	2515 (27.0%)	4289 (29.4%)	
Other	1957 (2.7%)	177 (1.9%)	294 (2.0%)	

P value for Table 1 is based on a  $\chi^2$  test for categorical and binary variables and analysis of variance for continuous variables.

ASCs, and 15% in office-based settings. The study population differed across facility type, with first-trimester procedures for pregnancy loss underrepresented in office-based settings versus hospitals or ASCs and procedures for septic or incomplete miscarriages overrepresented in office-based settings versus hospitals or ASCs. Miscarriages treated in hospitals and ASCs were more common in the South and Midwest.

A total of 9.3% had a miscarriage treatment-related event; 1.04% had a major event (Fig. 1; Table 2). A total of 7.0% of first-trimester procedures, 9.1% of second-trimester procedures, 9.9% of procedures for septic or incomplete miscarriages, and 18.7% of medication treatments had a miscarriage treatment-related event. A total of 6.58% had retained products of conception. Infection and hemorrhage occurred in 1.47% and 1.08%. Symptomatic intrauterine material, other/undetermined event, or missed ectopic pregnancy occurred in 0.96%, 0.59%, and 0.40%, respectively. The remaining event types occurred in less than 0.1% of cases or were not present (Table 2).

In adjusted analyses, there were fewer miscarriage treatment-related events in ASCs (6.5%) than office-based settings (9.4%) and hospitals (9.6%) ( $P < 0.001$  for both), but no statistically significant difference between office-based settings and hospitals. There was no statistically significant difference in major events between ASCs (0.7%) and office-based settings (0.8%), but there were more major events in hospitals (1.1%) than ASCs and office-based settings ( $P < 0.01$  for both) (Table 3). Miscarriage

treatment type was the only variable controlled for in the adjusted analyses that affected the main association of interest between facility type and any event or major events (Supplemental Tables 1 and 2, <http://links.lww.com/JPS/A194>; <http://links.lww.com/JPS/A195>). There were fewer infections in ASCs (0.9%) than office-based settings (1.2%,  $P < 0.05$ ) and more infections in hospitals (1.6%) than in ASCs and office-based settings ( $P < 0.001$  and  $P < 0.01$ ) (See Table 3).

In adjusted analyses stratified by miscarriage type, there were no statistically significant differences in events across ASCs and office-based settings for first-trimester procedures for pregnancy loss (5.0% and 5.6%), second-trimester procedures for pregnancy loss (7.1% and 5.8%), or incomplete or septic procedures (5.9% and 6.6%). There were fewer events after medication treatments in ASCs versus office-based settings (12.1% and 20.2%,  $P < 0.01$ ). There were more events after first-trimester procedures for pregnancy loss in hospitals (7.5%) than both ASCs and office-based settings ( $P < 0.01$  and  $P < 0.001$ ), more events after septic or incomplete procedures in hospitals (10.6%) than ASCs and office-based settings ( $P < 0.001$  for both), and fewer events after medication treatment in hospitals (17.4%) than office-based settings ( $P < 0.001$ ). There were no statistically significant differences in events after medication treatment in hospitals than ASCs or in events after second-trimester procedures across hospitals (9.6%), ASCs (7.1%), and office-based settings (5.8%).

**TABLE 2.** Proportion With a Miscarriage Treatment–Related Event, Unadjusted (N = 97,374)

	Hospitals	ASCs	Office-Based Settings	Total	P
Any event	9.13%	5.24%	12.62%	9.28%	<0.001
Major event	1.10%	0.60%	1.01%	1.04%	<0.001
Infection	1.54%	0.75%	1.58%	1.47%	<0.001
<i>Any event</i>					
First-trimester procedure for pregnancy loss	7.54%	5.07%	5.22%	7.01%	<0.001
Second-trimester procedure for pregnancy loss	9.37%	7.06%	5.88%	9.09%	0.313
Septic or incomplete procedure	10.70%	5.83%	6.17%	9.94%	<0.001
Medication treatment	17.06%	10.62%	20.63%	18.70%	<0.001
n, %					
Retained products of conception	6.34%	3.21%	9.96%	6410, 6.58%	
Infection	1.54%	0.75%	1.58%	1429, 1.47%	
Hemorrhage	1.11%	0.50%	1.29%	1054, 1.08%	
SIM	1.02%	0.81%	0.75%	937, 0.96%	
Other or undetermined*	0.51%	0.45%	1.04%	572, 0.59%	
Missed ectopic pregnancy	0.38%	0.30%	0.55%	389, 0.40%	
Postabortal hematometra	0.03%	0.02%	0.02%	29, 0.03%	
DIC	0.01%	0.00%	0.01%	11, 0.01%	
Failed abortion	0.00%	0.00%	0.00%	3, 0.00%	
Uterine perforation	0.00%	0.00%	0.00%	0, 0.00%	
Anesthesia reaction	0.00%	0.00%	0.00%	0, 0.00%	
Cervical injury	0.00%	0.00%	0.00%	0, 0.00%	

A case could have more than 1 type of event. Infections listed twice, in both top and bottom of table. P for Table 2 based on  $\chi^2$  tests.

\*These are primarily repeat procedures where the diagnosis could not be determined.

### Sensitivity Analyses

There were no substantive differences in sensitivity analyses that changed what was considered a miscarriage treatment–related event. One substantive difference emerged in analyses using the binary one or more comorbidities on the Elixhauser Index and the Elixhauser

Comorbidity Index Readmission Score. The difference in infections between ASCs and office-based settings was no longer statistically significant at a P < 0.05 level in either of those sensitivity analyses (results in Supplemental Tables 3–7, <http://links.lww.com/JPS/A196>; <http://links.lww.com/JPS/A197>; <http://links.lww.com/JPS/A198>, <http://links.lww.com/JPS/A199>; <http://links.lww.com/JPS/A200>).

**TABLE 3.** Adjusted Incidence Rate of Events After Miscarriage Treatment in Hospitals Versus ASCs Versus Office-Based Settings Among Total Sample and Stratified by Type of Miscarriage Treatment (N = 97,374)

	Any Event			Major Event			Infection		
	%	P	95% CI	%	P	95% CI	%	P	95% CI
Office-based	9.4%	Ref	9.0 9.8	0.8%	Ref	0.7 1.0	1.2%	Ref	1.1 1.4
ASC	6.5%	***	5.9 7.1	0.7%		0.5 0.9	0.9%	*	0.7 1.1
Hospital	9.6%	†††	9.3 9.8	1.1%	** ††	1.0 1.2	1.6%	** †††	1.5 1.7

#### Stratified models with any event as outcome

	First-trimester procedure			Second-trimester procedure			Incomplete or septic procedure			Medication treatment		
	%	P	95% CI	%	P	95% CI	%	P	95% CI	%	P	95% CI
Office-based	5.6%	Ref	5.0 6.2	5.8%	Ref	1.9 9.7	6.6%	Ref	5.3 8.0	20.2%	Ref	19.3 21.2
ASC	5.0%		4.5 5.5	7.1%		1.6 12.5	5.9%		4.4 7.4	12.1%	*	5.8 18.4
Hospital	7.5%	** †††	7.3 7.7	9.6%		8.4 10.9	10.6%	*** †††	10.1 11.1	17.4%	***	16.5 18.3

Adjusted models for total sample control for age, miscarriage treatment type, diabetes, hypertension, past year outpatient health care visits, past year inpatient health care visits, year, and region. Adjusted models stratified by miscarriage treatment type do not control for miscarriage treatment type. Analyses conducted with generalized estimating equations, with exchangeable correlation structure, logit link, and robust standard errors.

Compared with office-based setting: \*P < 0.05, \*\*P < 0.01, \*\*\*P < 0.001.

Compared with ASC: †P < 0.05, ††P < 0.01, †††P < 0.001.

## COMMENT

In this retrospective analysis of more than 90,000 miscarriages treated in the United States between 2011 and 2014, treatments for miscarriage were safe in all locations, although there were some small differences by facility type. In particular, we found that miscarriage treatment–related events were as or more likely to occur after miscarriages treated in hospitals than either outpatient setting. Though statistically significant, those differences are not clinically significant. In addition, the slightly higher rate of miscarriage treatment–related events for those who received the index treatment in hospitals could be due to patients at higher risk of an event being more likely to receive treatment in a hospital.

Our finding that miscarriage treatment safety is similar to or better in outpatient settings versus hospitals is consistent with other research, which typically finds that office-based procedures are as safe as, if not safer than, hospital-based procedures.<sup>5,7,9,10,23</sup> That we did not observe consistent differences in safety across ASCs and office-based settings is consistent with the small literature that compares safety of outpatient procedures across ASCs and office-based settings.<sup>11,12</sup>

Our estimates of miscarriage treatment–related events, including the more than 6% retained products of conception, are in the range of other estimates.<sup>24–31</sup> The rates of miscarriage treatment–related events are notably higher than published rates of abortion-related events.<sup>9,10,12,32,33</sup> One possible explanation is that there have been both government-sponsored and professional association–sponsored clinical quality improvement initiatives for abortion for more than 40 years,<sup>33–35</sup> meaning that considerable attention has been brought to ensuring and improving the safety of abortion care. This is important to emphasize, as many state laws require abortion—but not miscarriages or other procedures performed in outpatient settings—be performed in ASCs.<sup>13</sup>

Although we used a large data set, there was a small sample of second-trimester procedures (2%). The lack of statistically significant findings for second-trimester procedures across facility types may be due to the small sample. There were more events after medication treatment in office-based settings than hospitals and ASCs, although still within the range of published estimates.<sup>24–31</sup> Because medication treatment does not involve procedures performed in facilities, these findings may reflect how other aspects of care, such as patient education, follow-up, and treatments provided at follow-up, may vary across facility types.

Our study has limitations. First, we used a framework developed to classify morbidities and adverse events after induced abortion<sup>18</sup> to guide coding of miscarriage treatment–related events. As procedures and medication treatments used for abortions and to treat miscarriages are similar, this seems reasonable because there is no published framework specific to miscarriage treatment–related events. However, it is possible that we classified diagnoses or treatments as events in this context that should not be considered events and missed other relevant diagnoses or treatments. We took steps to address some differences, in particular related to additional doses of misoprostol after miscarriage treatment. One strength is that this approach allows comparison of miscarriage treatment–related event rates to abortion-related event rates. Second, we were unable to know precise weeks' gestation treatment was provided. Third, we do not know whether our classification of missed ectopic pregnancies was accurate; we chose a conservative approach by classifying all ectopics diagnosed and/or treated after seven days as missed. Fourth, we were unable to control for some potentially relevant variables; body mass index, race, and previous cesarean section were unavailable in the data set. We did not identify any anesthesia-related reactions; therefore, the inability to control for anesthesia should not bias results. Fifth, the

data come from a private insurance claims database. Findings may thus not generalize to miscarriage treatments not paid for by private insurance, such as miscarriage treatments paid for by Medicaid or miscarriage treatments for people without health insurance. In addition, there are other limitations inherent to using administrative claims databases, such as lack of detailed clinical information (e.g., medical record notes).

Our study has strengths. First, we used a national sample of claims data from a database often used to examine safety of health care procedures.<sup>12,14,15</sup> Using this database allows a sufficiently large sample to detect differences, avoid biases associated with small samples, and control for potential confounders. Second, claims databases routinely capture health care visits and treatments that occur subsequent to the procedure,<sup>10</sup> which increases the likelihood that most events are captured and limits potential biases due to loss to follow-up.

## CONCLUSIONS

Although rates of miscarriage treatment–related morbidities and adverse events vary slightly across settings, findings do not support limiting provision of miscarriage treatment to particular types of settings.

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