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### Title

Association of Facility Type With Procedural-Related Morbidities and Adverse Events Among Patients Undergoing Induced Abortions

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1 **Association of abortion facility type with procedural-related**  
2 **morbidities and adverse events among patients undergoing induced**  
3 **abortions**

4

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33

34

35

36**Key points**

37**Question:** Is there an association between the type of facility in which an  
38abortion is performed and abortion-related morbidities and adverse events?

39**Findings:** In this retrospective cohort study of 50311 induced abortions  
40among 49287 women with private health insurance, performance of the  
41abortion in an ambulatory surgery center, compared with an office-based  
42setting, was not associated with a significant difference in abortion-related  
43morbidities and adverse events (adjusted odds ratio, 0.97).

44**Meaning:** Rates of abortion-related morbidities and adverse events did not  
45significantly differ by whether the abortion was performed in an ambulatory  
46surgery center vs. an office-based setting.

47

## 48**Abstract**

### 49**Importance**

50 Multiple states have laws that require abortion facilities to meet standards of  
51 ambulatory surgery centers (ASCs). There is limited evidence regarding the  
52 occurrence of abortion-related morbidities and adverse events following  
53 abortions performed at ASCs compared with office-based settings.

### 54**Objective**

55 To compare abortion-related morbidities and adverse events at ASCs versus  
56 office-based settings.

### 57**Design, Setting, and Participants**

58 Retrospective cohort study of 49287 women continuously enrolled in US  
59 private health insurance who had 50311 induced abortions in an ASC or  
60 office-based setting January 1, 2011 - December 31, 2014. Outcomes were  
61 ascertained during the six weeks subsequent to the abortion using claims  
62 data from a large national private insurance claims database. The final  
63 follow-up date was February 11, 2015. Analyses were adjusted for age,  
64 abortion type, diabetes, hypertension, previous health care visits, year, and  
65 region.

### 66**Exposure**

67 Facility type (ASCs vs. office-based settings, including facilities such as  
68 abortion clinics, non-specialized clinics, and physician offices) in which the  
69 abortion was performed. Facility type was based on the standardized place-  
70 of-service code variable used for health care billing purposes.

## 71 **Main Outcomes and Measures**

72 The primary outcome was any abortion-related morbidity or adverse event  
73 (such as retained products of conception, abortion-related infection,  
74 hemorrhage, and uterine perforation) that received an abortion-related  
75 diagnosis or treatment code from any source of health care within six weeks  
76 of the abortion. The two secondary outcomes, both subsets of the primary  
77 outcome, were major abortion-related morbidities and adverse events (such  
78 as hemorrhages treated with a transfusion, missed ectopic pregnancies  
79 treated with surgery, and abortion-related infections that resulted in an  
80 overnight hospital admission) and abortion-related infections.

## 81 **Results**

82 Among 49287 women (mean age 28 [SD 7.31]) who had 50311 induced  
83 abortions, (23891 [47%] first-trimester aspiration, 13480 [27%] first-  
84 trimester medication, and 12940 [26%] second-trimester or later), 5660  
85 (11%) of abortions were performed in ambulatory surgery centers and 44651  
86 (89%) were performed in office-based settings. Overall, 3.33% had an  
87 abortion-related morbidity or adverse event; 0.32% had a major abortion-  
88 related morbidity or adverse event; and 0.74% had an abortion-related  
89 infection. In adjusted analyses, there was no statistically significant  
90 difference between ASCs versus office-based settings, respectively, in the  
91 rates of abortion-related morbidities or adverse events [3.25% v. 3.34%,  
92 difference -0.8%, 95% CI -0.58% - 0.43%; aOR 0.97, 95% CI 0.81 - 1.17],  
93 major morbidities or adverse events [0.26% v. 0.33%, difference -0.06%,

9495% CI -0.18% - 0.06%; aOR 0.78, 95% CI 0.45 – 1.37], or infections [0.58%  
95v. 0.77%, difference -0.16%, 95% CI -0.35% - 0.03%; aOR 0.75, 95% CI 0.52 –  
961.09].

## 97**Conclusions and Relevance**

98Among women with private health insurance who had an induced abortion,  
99performance of the abortion in an ambulatory surgery center, compared with  
100an office-based setting, was not associated with a significant difference in  
101abortion-related morbidities and adverse events. These findings, in addition  
102to individual patient and individual facility factors, may inform decisions  
103about the type of facility in which induced abortions are performed.

## 104**Introduction**

105 In June 2016, the U.S. Supreme Court ruled in *Whole Woman’s Health*  
106vs. *Hellerstedt* that Texas’s law requiring abortion facilities to meet  
107ambulatory surgery center (ASC) standards was unconstitutional.<sup>1</sup>~~Despite~~  
108this ruling, Thirteen~~eight~~ states currently enforce~~have~~ laws that require  
109licensing standards for abortions facilities that are comparable to the state’s  
110licensing standards to be performed in ASCs.<sup>2</sup> These laws include such  
111requirements as specified hall and door widths or separate procedure and  
112recovery rooms.<sup>2</sup> Many of these apply only at a specific gestational week (or  
113gestational duration), typically in the second-trimester.<sup>2</sup> Supporters of ASC  
114laws have argued that ASC requirements make abortion safer.<sup>1</sup>

115 Limited published peer-reviewed research has directly compared  
116abortion-related morbidities and adverse events across facility types. One

117study found fewer abortion-related events in clinics than hospitals<sup>3</sup> and a  
118recent review found similar rates of abortion-related events after first  
119trimester abortion procedures across study populations in different facility  
120types, including hospitals, ASCs, and office-based settings.<sup>4</sup>

121 More than 95% of induced abortions are provided in outpatient, non-  
122hospital-based settings – in abortion clinics, non-specialized clinics, or  
123physician offices.<sup>5</sup> Abortions have been performed in office-based settings,  
124including abortion clinics, non-specialized clinics, and physician offices, for  
125more than forty-five years.<sup>6</sup> ASCs developed in the 1980s to move some  
126surgeries and procedures from hospitals to non-hospital-based outpatient  
127settings.<sup>7</sup> In the 2000s, some states began passing laws that required  
128abortions to be provided in ASCs, and some abortion clinics that had been  
129office-based settings became licensed as ASCs to continue to perform  
130abortions.<sup>8</sup> There are no published national estimates of the proportion of  
131abortions performed in ASCs v. office-based settings; state-specific data  
132indicate that the minority of outpatient abortion facilities are ASCs.<sup>9,10</sup> The  
133present study used a private insurance claims database to compare  
134abortion-related morbidities and adverse events at ASCs versus office-based  
135settings.

## 136**Methods**

### 137Study design

138 This retrospective cohort study used 2011-2014 data from the Truven  
139Health MarketScan® Commercial Claims and Encounters database to

140compare abortion-related morbidities and adverse events across two facility  
141types, ASCs and office-based settings. The University of California, San  
142Francisco Institutional Review Board considered this study exempt and thus  
143informed consent was not required. The Penn State Institutional Review  
144Board considered this study not human subjects research.

#### 145Data source

146 The Truven Health MarketScan Commercial Claims and Encounters  
147database is a commercially available health insurance claims database. It  
148includes claims data for a sample of privately-insured people in all 50 U.S.  
149states, including demographic characteristics (i.e., age and sex), health care  
150utilization, dates of service, diagnosis codes, procedure codes, and facility  
151type. The data represent claims from clinicians, hospitals, and pharmacies  
152that have been adjudicated for payment and are obtained directly from a  
153convenience sample of large employers and health plans that agree to  
154participate in MarketScan. While no attempts are made to correct or change  
155information received from the participating employers and health plans,  
156Truven Health has a quality control process to verify that the data meet  
157criteria for quality and completeness.<sup>11</sup> The database only includes data from  
158fully paid and adjudicated claims and the diagnosis and procedure codes are  
159compared to codes in effect when raw data were collected, and edited as  
160necessary.<sup>11</sup> This database has been used in other studies examining  
161complications and follow-up care after health care procedures.<sup>12,13</sup>

#### 162Study population



163 The study population included all beneficiaries in this database who  
164 were 11 years and older who had an induced abortion between January 1,  
165 2011 and December 31, 2014 in an ASC or office-based setting and who  
166 were enrolled in their insurance plan for at least one year prior to the index  
167 abortion and at least six weeks after the abortion. Current Procedural  
168 Terminology (CPT) codes used to identify abortions are listed in eTable 1.  
169 Ectopic pregnancies diagnosed and/or treated within 7 days of the abortion  
170 and molar pregnancies were excluded, as ectopic pregnancies and molar  
171 pregnancies receive different treatments than abortions and have different  
172 expected potential morbidities and adverse events.

### 173 Exposure

174 Facility type was identified based on the standardized place-of-service  
175 code variable, which indicates the setting where the service occurred.  
176 Settings in the standardized place-of-service code variable are defined by  
177 the Centers for Medicare and Medicaid Services and used across health care  
178 billing.<sup>14</sup> There are 50 different possible settings that include settings such as  
179 schools, homeless shelters, inpatient hospital, skilled nursing facilities, and  
180 others.<sup>15</sup> Facility type was classified as ASC when the standardized place-of-  
181 service code variable (stdplac) equaled 24 (“Ambulatory Surgery Center”)  
182 and office-based setting when the place-of-service code variable equaled 11  
183 (“Office”), which includes most office-based settings.<sup>15</sup> These settings  
184 included facilities such as abortion clinics, non-specialized clinics, and  
185 physician offices. Abortions performed in other settings were excluded.

## 186 Outcomes

187 The primary outcome was abortion-related morbidities and adverse  
188 events occurring within six weeks of the abortion. Secondary outcomes,  
189 which were both subsets of the primary outcome, were major abortion-  
190 related morbidities and adverse events and abortion-related infections.

191 Per methods published in a recent study of abortion-related events  
192 using billing data, abortion-related events were estimated by examining and  
193 evaluating all diagnoses and treatments at all health care encounters on the  
194 day of and within six weeks of the abortion.<sup>3</sup> Each index abortion was coded  
195 as to whether an abortion-related morbidity or adverse event occurred within  
196 the six weeks subsequent to the abortion. Events were defined as any  
197 abortion-related morbidity or adverse event that received an abortion-  
198 related diagnosis or treatment code at any care location, including  
199 emergency departments (EDs), the original abortion facility, other health  
200 care sites, or pharmacy within six weeks of an abortion. Events included  
201 those that occurred during, on the day of, or up to six weeks after the index  
202 abortion. Potential events were identified through an examination of  
203 International Classification of Diseases, 9<sup>th</sup> Revision (ICD-9) codes in either  
204 primary or secondary positions, Health Care Common Procedure Coding  
205 System (HCPCS) codes, CPT codes, and medication codes for each health  
206 care encounter within six weeks of the abortion. The PAIRS Framework<sup>16</sup>  
207 which was originally developed for first trimester aspiration abortions, was  
208 used to classify specific events into one or more specific diagnoses: retained

209products of conception, failed abortion, hemorrhage, infection, uterine  
210perforation, anesthesia reaction, symptomatic intrauterine material, post-  
211abortal hematometra, cervical injury, disseminated intravascular  
212coagulation, missed ectopic pregnancy, and other/undetermined. Retained  
213placenta was added to the definition of retained products of conception and  
214disseminated intravascular coagulation was added to account for additional  
215types of events that could occur for second-trimester or later abortions.

216Events were classified as major if they required overnight hospital admission,  
217additional surgery, or blood transfusion. All others were classified as minor.

218       Identifying abortion-related events involved the following steps. First,  
219each abortion with a subsequent ED visit, a diagnosis code indicating an  
220abortion or miscarriage complication on the day of the index abortion, a  
221subsequent health care encounter with a diagnosis code indicating an  
222abortion or miscarriage complication, or a subsequent inpatient visit was  
223individually coded by a clinically-trained reviewer who evaluated all available  
224billing data (ICD-9 and CPT codes, laboratory tests, and medications) for  
225encounters that occurred within six weeks subsequent to these abortions,  
226including on the day of the abortion. Diagnosis codes for miscarriage  
227complications were included because they seemed unlikely to be separate  
228pregnancies and, instead, were likely billing coding errors as the ICD-9 codes  
229for miscarriage complications and abortion complications only differ in one  
230number. The reviewer, blinded to abortion facility type, classified each index  
231abortion with a subsequent ED visit, a complication diagnosis code, or a

232 subsequent inpatient visit as having an abortion-related event or not and  
233 then classified each case with an abortion-related event into one or more of  
234 the 12 possible types of diagnoses. Missed ectopic pregnancies were  
235 identified through searching all encounters within six weeks and ectopic  
236 pregnancies not diagnosed or treated within seven days after the index  
237 abortion were classified as missed ectopic pregnancies.

238 All encounters that were not individually coded within six weeks were  
239 searched to identify injection and IV antibiotics commonly used to treat  
240 abortion-related infections. All encounters within six weeks that were not  
241 individually coded were searched to identify repeat procedures (abortion,  
242 miscarriage, or dilation and curettage procedures, or additional doses of  
243 misoprostol). These repeat procedures were further classified as incomplete,  
244 failed, or other/undetermined based on diagnosis codes [See eTable 1].  
245 Abortions that were incomplete, failed, or other/undetermined were coded as  
246 events. The injection and IV antibiotics and repeat procedures were added to  
247 the individually-coded dataset.

#### 248 Control variables

249 Variables controlled for in the adjusted analyses included: abortion  
250 type (first-trimester aspiration abortion performed through 12 to 14 weeks,  
251 first-trimester medication abortion typically provided through nine weeks at  
252 the time abortions in this study were provided,<sup>17</sup> and second-trimester and  
253 later abortion performed after 12 to 14 weeks), diabetes, hypertension, age,  
254 number of previous-year outpatient health care visits, one or more inpatient

255visits in the previous year (as proxies for underlying health conditions), U.S.  
256census region, and year. In order to have more complete data on chronic  
257health condition and health care utilization variables, only women insured for  
258at least one year before their abortion were included.

#### 259*Power analysis and sample size*

260       When planning the study, 3530 induced abortions in ASCs and 15444  
261induced abortions in office-based settings in 2012 were identified in the  
262Truven Marketscan dataset. Based on assumptions that there would be a  
263similar number of abortions in each year from 2012-2014 and that about one  
264half of the abortions would meet eligibility criteria, a sample size calculation  
265for a difference in proportions indicated that there would be sufficient power  
266to detect up to a .06/100 difference (assuming 0.80 power) between the  
2672.1/100 events expected based on prior published research<sup>3</sup> versus a  
268possible 1.5/100 in ASCs. Based on Cohen's H, this would translate to a small  
269effect size.<sup>18</sup> Even when controlling for potential confounders in logistic  
270regression, this sample size would have 0.80 power to detect small effects,  
271i.e. an Odds Ratio of 0.7 to 0.74 for ASCs v. office-based settings.<sup>19</sup> Upon  
272extracting the data for 2012 through 2014 and identifying the abortions that  
273met other eligibility criteria, the ratio of abortions in ASCs to office-based  
274settings was closer to 1:7 than the 1:5 originally estimated. Prior to analyzing  
275data, an updated sample size calculation was conducted and indicated that  
276an additional year of data (2011) was needed to have sufficient power to

277detect a 0.5% difference. The final dataset had 0.80 power to detect a 0.5%  
278difference in events in ASCs v. offices, assuming 2.1/100 events in offices.

### 279Statistical analysis

280       Analysis was conducted in Stata 14.2. In regression models, any  
281abortion-related event was the main outcome and facility type the main  
282exposure variable. The first model specified for each outcome included only  
283facility type and the outcome. Then, adjusted models that simultaneously  
284added all of the potential confounders were estimated. Analysis included  
285generalized estimating equations with exchangeable correlation structure,  
286logit link, binomial distribution, and robust standard errors to account for  
287possible clustering by individuals who had more than one abortion during the  
288study. The QIC program was used to select the correlation structure.<sup>20</sup> Per *a-*  
289*priori* study plans, these analyses were repeated for major events and for  
290infections (as infections could be an event type where there might be  
291variation across procedure facility type). Then, per *a-priori* study plans,  
292subgroup analyses were conducted for any event by abortion type using  
293interaction terms, as rate of abortion-related morbidities and adverse events  
294varies by abortion type<sup>3</sup> and some laws regarding ASC requirements apply  
295specifically to second-trimester and later abortions.<sup>2</sup> Subgroup analyses were  
296re-ran with first trimester medication abortions as the reference group and  
297then with second trimester and later abortions as the reference group to get  
298interpretable odds ratios for these abortion types. Analyses for the  
299secondary outcomes and the subgroup analyses were exploratory. The post-

300estimation margins command was used to obtain adjusted incidence rates  
301and adjusted differences in incidence rates. As a supplementary analysis, a  
302series of regressions that examined the effect on the main relationship of  
303interest of adding each covariate to the model were also conducted.  
304Additionally, the QIC program<sup>20</sup> was used to compare nested models for the  
305primary outcome: those that included abortion type and those that did not.  
306Although it is not possible to determine the extent to which data are missing,  
307the analysis assumes that missing data are rare since these are adjudicated  
308billing claims used to determine payments to clinicians, hospitals, and  
309pharmacies.

310 Two prespecified sensitivity analyses that used different definitions of  
311abortion-related morbidities and adverse events were conducted. First, there  
312are considerable challenges of measuring whether an ectopic pregnancy was  
313missed based only on billing data. In particular, there is no information  
314available in billing data about whether the clinician suspected an ectopic  
315pregnancy at the time of the abortion visit and the timing of follow-up could  
316be influenced by when test results came back and when the patient was able  
317to present at a facility that provides care for ectopic pregnancies. Because,  
318the seven-day cut-off was somewhat arbitrary and could be overly  
319restrictive, the definition of missed ectopics was changed to those not  
320diagnosed or treated within 14 days. Second, additional injection or IV  
321antibiotics that are not commonly used to treat abortion-related infections  
322were present in the dataset and were added for a sensitivity analysis. A third

323sensitivity analysis was conducted *post-hoc*. This sensitivity analysis used  
324the Elixhauser Comorbidity Index<sup>21</sup> as a control variable instead of the pre-  
325specified control variables of diabetes, hypertension, number of previous  
326outpatient visits, and one or more previous inpatient visits. This analysis  
327used a binary score of  $\geq 1$  of the 30 comorbidities in the Elixhauser  
328index<sup>21,22</sup> and, in a separate analysis, used the Elixhauser Comorbidity Index  
329Readmission Score.<sup>23</sup> Statistical testing was 2-sided and used a  $p < .05$   
330significance level.

### 331**Results**

332 The database included 104,106 induced abortions during the study  
333time period. 53795 abortions were excluded due to not being in an ASC or  
334office-based setting, patients being enrolled in their insurance plan for less  
335than one year prior or six weeks subsequent to the abortion, or patients  
336having an age less than 11 years old; 216 abortions involved a molar  
337pregnancy and 765 an ectopic pregnancy diagnosed and/or treated within  
338seven days of the index abortion and were excluded. [See Figure 1] Most of  
339the 17621 abortions in the database that were not performed in an ASC or  
340office-based setting during the study time period were provided in inpatient,  
341outpatient, or emergency department hospital-based settings (n=16909).  
342The only other type of facility in which more than 1% of the 17621 abortions  
343excluded due to facility type were performed was Federally Qualified Health  
344Centers (n=297). The study cohort included 49287 patients who had 50311  
345abortions in an ASC or an office-based setting and who were continuously



346enrolled in their insurance plan for at least one year prior and at least six  
347weeks after the abortion.

348 Multiple abortions occurred in 798 patients (1822 abortions) during the  
349study time period. Of the 1822 multiple abortions, 88% of them occurred in  
350the same facility type for each abortion.

351 The mean age was 28 years [range 11 - 59 years, SD 7.3]. Of the  
35250311 included abortions, 23891 (47%) were first-trimester aspiration,  
35313480 (27%) first-trimester medication, and 12940 (26%) second-trimester  
354or later abortions. [See Table 1] 5660 (11%) of abortions were performed in  
355ASCs and 44651 (89%) performed in office-based settings. The study  
356population differed by facility type: patients in ASCs were slightly older (28.6  
357v. 28.1 years,  $p<.001$ ); more patients in ASCs had had a previous year  
358inpatient encounter (9.8% v. 8.9%,  $p=.03$ ); fewer medication abortions were  
359in ASCs (2.6% of abortions in ASCs v. 29.9% of abortions in office-based  
360settings,  $p<0.001$  for comparison of abortion type by facility type); and  
361abortions in ASCs were more common in the South and Midwest (25.1% of  
362abortions in ASCs and 12.6% of abortions in office-based settings were in the  
363South; 22.6% of abortions in ASCs and 11.5% of abortions in office-based  
364settings were in the Midwest,  $p<0.001$  for comparison of region by facility  
365type).

366 Among the 50311 abortions, 3.33% (1674) had an abortion-related  
367event; 0.32% (163) had a major event; 0.74% (374) had an abortion-related  
368infection. [See Table 2] 2.52% (603/23891) of first-trimester aspiration

369abortions, 5.42% (730/13480) of first-trimester medication abortions, and  
3702.64% (341/12940) of second-trimester or later abortions had an abortion-  
371related event. At least 0.2% or more of abortions had one or more of the  
372following types of events: retained products of conception, infection, other,  
373symptomatic intrauterine material, hemorrhage, and missed ectopic  
374pregnancy. The remaining types of events (failed abortion, disseminated  
375intravascular coagulation, hematometra, uterine perforation, anesthesia-  
376reaction, cervical injury) occurred in fewer than 0.05% of abortions or were  
377not present in the dataset. [See Table 2]

378        In unadjusted analyses examining the primary outcome, abortion-  
379related events were less common in ASCs than office-based settings (2.60%,  
38095% CI 2.21 – 3.05 in ASCs v. 3.42%, 95% CI 3.26 – 3.59 in office-based  
381settings,  $p=0.001$ ). In unadjusted analyses examining secondary outcomes,  
382there were not significant differences in major events (0.25%, 95% CI 0.15 –  
3830.42 in ASCs v. 0.33%, 95% CI 0.28 – 0.39 in office-based settings) or in  
384abortion-related infections (0.58%, 95% CI 0.41 – 0.82 in ASCs v. 0.76%, 95%  
385CI 0.69 – 0.85 in office-based settings) [See Table 2]. Unadjusted  
386associations between variables controlled for in adjusted analyses and study  
387outcomes are in eTable 2.

388        The QIC indicated that the exchangeable correlation structure was a  
389better fit for the data than the independent correlation structure (QIC of  
390307274.59 for exchangeable v. 307277.23 for independent). In adjusted  
391analyses, there were not significant differences in abortion-related events

392(the primary outcome) [aOR 0.97, 95% CI 0.81 – 1.17, adjusted incidence  
393rate 3.25% v. 3.33%, adjusted difference -0.08%, 95% CI -0.58% - 0.43%]  
394between ASCs and office-based settings [See Table 3]. Full regression results  
395including 95% CIs for adjusted incidence rates are in eTable 3. Abortion-type  
396was the only variable controlled for in the adjusted analyses that affected the  
397main association of interest between facility type and events. The model with  
398only facility type had an OR of 0.75, p-value 0.001; models with all control  
399variables other than abortion type had ORs of 0.74 or 0.75, p-value 0.001.  
400The model that included abortion type had an OR of 0.97, p-value 0.77. [See  
401eTable 4]. The QIC indicated that the model that included abortion type was  
402a better fit for the data than the model that did not include abortion type  
403(QIC of 307274.59 for model with versus 310114.09 for model without  
404abortion type).

405        There were also not significant differences in the secondary outcomes  
406of major abortion-related events [aOR 0.78, 95% CI 0.45 – 1.37, adjusted  
407incidence rate 0.26% v. 0.33%, adjusted difference -0.06%, 95% CI -0.18% -  
4080.06%] or infections by facility type [aOR 0.75, 95% CI 0.52- 1.09, adjusted  
409incidence rate 0.58% v. 0.77%, adjusted difference -0.16%, 95% CI -0.35% -  
4100.03%]. [See Table 3]

411        In unadjusted subgroup analyses by abortion type, there were not  
412significant differences across facility type in abortion-related events among  
413first-trimester aspiration abortions (events occurred in 78 out of 3630 or  
4142.15% [95% CI 1.72 – 2.68] of abortions performed in ASCs vs 525 of 20261

415 or 2.59% [95% CI 2.38 – 2.81] of abortions performed in office-based  
416 settings) or second-trimester abortions (events occurred in 53 of 1883 or  
417 2.81% [95% CI 2.16 – 3.67] of abortions performed in ASCs vs 288 of 11057  
418 or 2.60% [95% CI 2.32 – 2.92] of abortions performed in office-based  
419 settings). Among first-trimester medication abortions, the rate of abortion-  
420 related adverse events was significantly greater at ASCs, with events  
421 occurring in 16 of 147 or 10.88% [95% CI 6.74 – 17.12] of abortions  
422 performed in ASCs vs 714 of 13333 or 5.36% [95% CI 4.99 – 5.75] of  
423 abortions performed in office-based settings,  $p=0.003$ ). [See Table 2]

424 In adjusted subgroup analyses, there were not significant differences  
425 between ASCs and offices in abortion-related events for first-trimester  
426 aspiration abortion [aOR 0.84, 95% CI 0.66 – 1.07, adjusted incidence rate  
427 2.19% v. 2.59%, adjusted difference -0.38%, 95% CI -0.88% - 0.12%]. The  
428 interaction term for second-trimester and later abortion x facility type was  
429 not significant, indicating that there also was no statistical difference in  
430 events in ASCs v. offices for second trimester and later abortions, [aOR from  
431 model with second trimester and later as reference group, 1.01, 95% CI 0.75  
432 – 1.37, adjusted incidence rate 2.62% v. 2.59%, adjusted difference 0.03%,  
433 95% CI -0.70 – 0.76]. There were significant differences in odds of abortion-  
434 related events in ASCs versus office-based settings for medication abortions,  
435  $p$ -value for interaction term was 0.001, [aOR from model with first-trimester  
436 medication abortion as reference group, 2.23, 95% CI 1.30 – 3.80, adjusted

437incidence rate 11.22% v. 5.42%, adjusted difference 5.54%, 95% CI 5.12% -  
43810.56%]. [See Table 3]

439 There were no substantive differences in the sensitivity analyses using  
440different definitions of abortion-related morbidities and adverse events and  
441adjusting for comorbidities using the Elixhauser Comorbidity Index. [See  
442eTables 5, 6, 7, 8 and 9]

#### 443**Discussion**

444 In this retrospective analysis of more than 50,000 induced abortions in  
445the U.S. between 2011 and 2014, performance of abortions in ambulatory  
446surgery centers, compared with office-based settings, was not associated  
447with a significant difference in abortion-related morbidities and adverse-  
448events. The lack of a significant association between abortions performed in  
449ASCs vs office-based settings and the rates of abortion-related morbidities  
450and adverse events is consistent with the small body of literature that  
451compares the safety of other outpatient procedures across ASCs and office-  
452based settings.<sup>24</sup>

453 This study reinforced that there are low rates of abortion-related  
454morbidities and adverse events after abortion, with major events occurring in  
455only one-third of one percent of cases. This study also confirmed that there  
456are low rates of abortion-related morbidities and adverse events in both  
457ASCs and office-based settings. Although the estimate of the overall  
458abortion-related event rate was higher than a previous estimate using claims  
459data, the estimate of major events was similar<sup>3</sup>. The estimates for events

460after first-trimester aspiration abortions were higher than previous estimates  
461using claims data, but were within the range of estimates in other published  
462studies,<sup>3,4</sup> as were the estimates for second-trimester and later abortions.<sup>25-27</sup>  
463The estimates for events after medication abortions are within the range of  
464previous published estimates of events after medication abortions using  
465claims data.<sup>3</sup>

466       The study was powered to detect a 0.5% difference in any abortion-  
467related morbidities and adverse events. This difference is smaller than the  
468predetermined acceptable risk difference of 2% used in a large noninferiority  
469study comparing events after abortions performed by advance practice  
470clinicians and physicians.<sup>28</sup> In that study, the acceptable risk difference was  
471determined before the start of the study by a panel of researchers and  
472clinicians.<sup>28</sup> The upper bound of the 95% CI around the 0.1% observed  
473difference in this study was 0.6%, which is within the 2% specified as  
474clinically insignificant in that previous study. The upper bound of the 95% CIs  
475for observed differences for first-trimester aspiration and second trimester  
476and later abortions were less than 1%, which is within the 2% threshold for  
477any events. The upper bound of the 95% CI for the 0.1% observed difference  
478in major events was 0.2%, which is slightly smaller than the 0.3% difference  
479in major events defined as clinically important in a recent study.<sup>29</sup> The upper  
480bound of the 95% CI for the 0.2% observed difference in infections was 0.4%,  
481which is also not clinically important.

482        Abortion-related morbidities and adverse events appear more common  
483 among women having first-trimester medication abortions in ASCs than  
484 office-based settings. The upper bound of the difference (11%) may be  
485 clinically important. As medication abortions in ASCs were rare (only 2.6% of  
486 abortions in ASCs and 0.3% of all abortions in the sample), the significant  
487 association between facility type and abortion-related morbidities and  
488 adverse events for first trimester medication abortions should be interpreted  
489 with caution. It is possible, given that medication abortions are rarely  
490 performed in ASCs, that women who have medication abortions in ASCs may  
491 travel a long distance and may receive follow-up care at sites that may be  
492 more likely to provide an additional treatment.

493        Observational studies include the risk of unbalanced study groups,  
494 where differences are not adequately controlled in analyses. While there  
495 were some significant differences in the measured covariates across ASCs  
496 and office-based settings, the patient-level differences identified in this study  
497 were small (i.e., half a year of age, less than one percent difference in  
498 proportion with one or more inpatient encounters in the previous year). Only  
499 one of the observed covariates – abortion type – confounded the relationship  
500 between facility type and incidents [See eTable 4]. This confounding was due  
501 to first-trimester medication abortions being much more common in office-  
502 based settings and, similar to previous research,<sup>3</sup> having more incidents  
503 (more than 5%) than first-trimester aspiration and second trimester and later  
504 abortions (which had closer to 2.5%).

505 This study has strengths. First, the study used a national sample of  
506claims data from a database that is often used to examine safety of health  
507care procedures.<sup>12,13</sup> Using an insurance claims database that includes a  
508national sample allows direct comparison of abortion-related morbidities and  
509adverse events across ASCs vs. office-based settings and provides a  
510sufficiently large sample to detect differences, avoid biases associated with  
511focusing on a few facilities where practice could be unrepresentative, and  
512control for potential confounders. Second, there was little loss to follow up  
513because of the use of claims data. Claims databases are useful for examining  
514morbidities and adverse events after health care procedures (including  
515abortion) because they routinely capture health care visits and treatments  
516that occur subsequent to the procedure,<sup>3</sup> thereby increasing chances that  
517most post-procedure events will be captured in the dataset and limiting  
518biases from loss to follow-up that have been noted in other studies  
519examining abortion-related morbidities and adverse events.<sup>28</sup> Third, there  
520was a large sample of second-trimester and later abortions, which allowed  
521assessment of whether overall findings held among this subset of abortions.

## 522 Limitations

523 This study has several limitations. First, while the study differentiated  
524between first and second-trimester abortions, it was not possible to know the  
525weeks' gestation at which the abortion was provided, a potential limitation  
526given that the risk of abortion-related events increases with each week  
527gestation.<sup>25,26</sup> If there were differences in timing of abortions within the first



528and second-trimesters across offices and ASCs, this could be an unmeasured  
529confounder. Second, it is not known whether the ectopic pregnancies  
530classified as missed were suspected at the index abortion visit. The approach  
531of including all ectopics diagnosed and/or treated after seven days as missed  
532was conservative. Third, by virtue of the data included in the Truven  
533Marketscan database, the study only included abortions paid for by private  
534insurance. Only about 15% of the almost one million abortions provided each  
535year in the U.S. are paid for by private insurance.<sup>5,30</sup> Thus, findings may not  
536be generalizable to all abortions in the U.S. Fourth, other potential  
537confounders, including BMI, race, previous cesarean section, were not  
538available in the database and thus could not be controlled. However, recent  
539research has not indicated associations between obesity and abortion-  
540related events, so this should partially address this concern.<sup>25</sup> Other  
541indicators of health status, such as frequency of healthcare visits, were  
542controlled for. As no anesthesia-related reactions were identified, it does not  
543appear that not being able to control for anesthesia has biased the results.  
544Fifth, the Truven Marketscan database did not include information on the  
545specific type of facility (i.e. abortion clinics, non-specialized clinics, and  
546physician offices) in which the abortions were performed. This study thus  
547was unable to assess whether abortion-related morbidities and adverse  
548events vary by whether the abortion was performed in an abortion clinic,  
549non-specialized clinic, or a physician office.

#### 550Conclusions

551 Among women with private health insurance who had an induced abortion,  
552 performance of the abortion in an ambulatory surgery center, compared with  
553 an office-based setting, was not associated with a significant difference in  
554 abortion-related morbidities and adverse events. These findings, in addition  
555 to individual patient and individual facility factors, may inform decisions  
556 about the type of facility in which induced abortions are performed.

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573

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576  
577

## 578 **References**

5791. *Whole Woman's Health v. Hellerstedt*. S. Ct. 136 S. Ct. 2292 (2016)
5802. Jones BS, Daniel S, Cloud L. State law approaches to facility regulation of  
581 abortion and other office interventions. *Am J Public Health*. 2018;108(4):486-  
582 492.

5833. Upadhyay UD, Desai S, Zlidar V, et al. Incidence of emergency department  
584 visits and complications after abortion. *Obstet Gynecol.* 2015;125(1):175-183.
5854. White K., Carroll E., Grossman D. Complications from first-trimester aspiration  
586 abortion: a systematic review of the literature. *Contraception.*  
587 2015(92(5)):422-438.
5885. Jones RK, Jerman J. Abortion incidence and service availability in the United  
589 States, 2014. *Perspect Sexual Reprod Health.* 2017;49(1):17-27.
5906. Grimes DA, Cates W, Jr., Selik RM. Abortion facilities and the risk of death.  
591 *Fam Plann Perspect.* 1981;13(1):30-32.
5927. McLemore T, Lawrence L. Plan and operation of the National Survey of  
593 Ambulatory Surgery. . *National Center for Health Statistics. Vital Health Stat.*  
594 1997;1(37).
5958. Jones BS, Weitz TA. Legal barriers to second-trimester abortion provision and  
596 public health consequences. *Am J Public Health.* 2009;99(4):623-630.
5979. Colman S, Joyce T. Regulating abortion: Impact on patients and providers in  
598 Texas. *J Policy Anal Manag.* 2011;30(4):775-797.
59910. Grossman D, Baum S, Fuentes L, et al. Change in abortion services after  
600 implementation of a restrictive law in Texas. *Contraception.* 2014;90(5):496-  
601 501.
60211. Truven Health Analytics. *The Truven Health MarketScan Databases for Health  
603 Services Researchers. Retrieved on April 16, 2018 from*  
604 [https://truvenhealth.com/portals/0/assets/2017\\_MarketScan\\_Databases\\_Health\\_Services\\_Researchers.pdf](https://truvenhealth.com/portals/0/assets/2017_MarketScan_Databases_Health_Services_Researchers.pdf). 2017.  
605
60612. Law A, McCoy M, Lynen R, et al. The prevalence of complications and  
607 healthcare costs during pregnancy. *J Med Econ.* 2015;18(7):533-541.

60813. Asemota AO, Ishii M, Brem H, Gallia GL. Comparison of complications, trends,  
609 and costs in endoscopic vs microscopic pituitary surgery: analysis from a US  
610 health claims database. *Neurosurgery*. 2017;81(3):458-472.
61114. Center for Medicare & Medicaid Services. Place of Service Codes. Retrieved  
612 on April 16, 2018 from [https://www.cms.gov/Medicare/Coding/place-of-](https://www.cms.gov/Medicare/Coding/place-of-service-codes/index.html)  
613 [service-codes/index.html](https://www.cms.gov/Medicare/Coding/place-of-service-codes/index.html). 2018.
61415. Center for Medicare & Medicaid Services. Place of Service Code Set: Place of  
615 Service Codes for Professional Claims. Retrieved on April 16, 2018 from:  
616 [https://www.cms.gov/Medicare/Coding/place-of-service-](https://www.cms.gov/Medicare/Coding/place-of-service-codes/Place_of_Service_Code_Set.html)  
617 [codes/Place\\_of\\_Service\\_Code\\_Set.html](https://www.cms.gov/Medicare/Coding/place-of-service-codes/Place_of_Service_Code_Set.html). 2016.
61816. Taylor D, Upadhyay UD, Fjerstad M, Battistelli MF, Weitz TA, Paul ME.  
619 Standardizing the classification of abortion incidents: the Procedural Abortion  
620 Incident Reporting and Surveillance (PAIRS) Framework. *Contraception*.  
621 2017;96(1):1-13.
62217. American College of Obstetricians and Gynecologists. Practice bulletin no.  
623 143: medical management of first-trimester abortion. *Obstet Gynecol*.  
624 2014;123(3):676-692.
62518. Cohen J. *Statistical Power Analysis for the Behavioral Sciences*. 2nd Edition  
626 ed. New Jersey: Lawrence Erlbaum Associates, Publishers; 1988.
62719. Hsieh FY, Bloch DA, Larsen MD. A simple method of sample size calculation  
628 for linear and logistic regression. *Stat Med*. 1998;17(14):1623-1634.
62920. Cui J. QIC program and model selection in GEE analyses. *The Stata Journal*.  
630 2007;7(2):209-222.
63121. Elixhauser A, Steiner C, Harris DR, Coffey RM. Comorbidity measures for use  
632 with administrative data. *Med Care*. 1998;36(1):8-27.

63322. Brandi K, Morgan JR, Paasche-Orlow MK, Perkins RB, White KO. Obstetric  
634 Outcomes After Failed Hysteroscopic and Laparoscopic Sterilization  
635 Procedures. *Obstet Gynecol.* 2018;131(2):253-261.
63623. Moore BJ, White S, Washington R, Coenen N, Elixhauser A. Identifying  
637 Increased Risk of Readmission and In-hospital Mortality Using Hospital  
638 Administrative Data: The AHRQ Elixhauser Comorbidity Index. *Med Care.*  
639 2017;55(7):698-705.
64024. Berglas N, Battistelli M, Nicholson W, Sobota M, Urman R, Roberts S. The  
641 effect of facility characteristics on patient safety, patient experience, and  
642 service availability for procedures in non-hospital-affiliated outpatient  
643 settings: A systematic review. *PLoS ONE.* 2018;13(1):e0190975-e0190975.
64425. Lederle L, Steinauer JE, Montgomery A, Aksel S, Drey EA, Kerns JL. Obesity as  
645 a Risk Factor for Complications After Second-Trimester Abortion by Dilation  
646 and Evacuation. *Obstet Gynecol.* 2015;126(3):585-592.
64726. Cates W, Jr., Schulz KF, Grimes DA, Tyler CW, Jr. 1. The effect of delay and  
648 method choice on the risk of abortion morbidity. *Fam Plann Perspect.*  
649 1977;9(6):266-268, 273.
65027. Benson LS, Micks EA, Ingalls C, Prager SW. Safety of Outpatient Surgical  
651 Abortion for Obese Patients in the First and Second Trimesters. *Obstet*  
652 *Gynecol.* 2016;128(5):1065-1070.
65328. Weitz TA, Taylor D, Desai S, et al. Safety of aspiration abortion performed by  
654 nurse practitioners, certified nurse midwives, and physician assistants under  
655 a California legal waiver. *Am J Public Health.* 2013;103(3):454-461.

65629. Grossman D, Grindlay K. Safety of Medical Abortion Provided Through  
657 Telemedicine Compared With In Person. *Obstet Gynecol.* 2017;130(4):778-  
658 782.

65930. Jerman J, Jones RK, Onda T. *Characteristics of U.S. abortion patients in 2014  
660 and changes since 2008.*  
661 [https://www.guttmacher.org/sites/default/files/report\\_pdf/characteristics-us-  
662 abortion-patients-2014.pdf](https://www.guttmacher.org/sites/default/files/report_pdf/characteristics-us-abortion-patients-2014.pdf). Published May 2016. Accessed October 30, 3017.  
663 2016.

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<b>Table 1. Sample description (n=50,311 abortions)</b>				
	<b>Total (n=50,311)</b>	<b>Ambulator y surgery centers n=5,660</b>	<b>Office-based settings n=44,651</b>	<b>p-value</b>
Number of patients <sup>a</sup>	49,287	5,601	43,776	
Age in single years mean (sd), range	28.1(7.3), [11-59]	28.6(7.48), [11-59]	28.1(7.29), [11-58]	<0.001
Abortion type n(%)				<0.001
First trimester aspiration	23,891 (47.5%)	3,630 (64.1%)	20,261 (45.4%)	
First trimester medication	13,480 (26.8%)	147 (2.6%)	13,333 (29.9%)	
Second trimester and later	12,940 (25.7%)	1,883 (33.3%)	11,057 (24.8%)	
Diabetes n(%)	1,109 (2.2%)	133 (2.4%)	976 (2.2%)	0.43
Hypertension n(%)	1,960 (3.9%)	228 (4.0%)	1,732 (3.9%)	0.58
1 or more previous year Inpatient visits n(%)	4,532 (9.0%)	554(9.8%)	3978(8.9%)	0.03
Previous year outpatient visits n(%)				0.42
0-6	27,634 (54.9%)	3,085(54.5 %)	24,549 (55.0%)	
7-12	12,120 (24.1%)	1,383(24.4 %)	10,737(24.1%)	
13-23	6,923 (13.8%)	758(13.4%)	6,165(13.8%)	
>=24	3,634 (7.2%)	434(7.7%)	3,200(7.2%)	
Year of abortion n(%)				<0.001
2011	13,538 (26.9%)	1,639 (29.0%)	11,899 (26.7%)	
2012	13,808 (27.5%)	1,483(26.2 %)	12,325(27.6%)	
2013	11,119 (22.1%)	1,047 (18.5%)	10,072(22.6%)	
2014	11,846 (23.6%)	1,491(26.3 %)	10,355(23.2%)	
Region of the country n(%)				<0.001
Northeast	21,633 (43.0%)	2,081 (36.8%)	19,552 (43.8%)	
South	7,029 (14.0%)	1,418 (25.1%)	5,611 (12.6%)	
Midwest	6,390 (12.7%)	1,280 (22.6%)	5,110 (11.5%)	
West	14,290 (28.4%)	849 (15.0%)	13,441 (30.1%)	
Other	969 (1.9%)	32 (0.6%)	937 (2.1%)	

666Note: p-value for table 1. is based on a chi-square test for categorical and binary variables  
667and T test for continuous variable. Unit of analysis is abortions.

668<sup>a</sup> The sum of patients in ambulatory surgery centers and office-based settings is greater  
669than the total number of patients because, while most patients who had more than one

670abortion had each abortion in the same facility type, a few had a subsequent abortion in a  
671different facility type.

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**Table 2. Unadjusted rates of abortion-related morbidities and adverse events (n=50,311)**

	Total (n=50,311)	Ambulator y surgery centers n=5660	Office- based settings n=44,651	p-value
Any abortion-related morbidity or adverse event (Primary outcome)	1674 (3.33%)	147 (2.60%)	1527 (3.42%)	0.001
Major abortion-related morbidity or adverse event <sup>a</sup> (Secondary outcome)	163 (0.32%)	14 (0.25%)	149 (0.33%)	0.28
<i>Any abortion-related morbidity or adverse event</i>				
First trimester aspiration	603/23,891 (2.52%)	78/3,630 (2.15%)	525/20,261 (2.59%)	0.12
First trimester medication	730/13,480 (5.42%)	16/147 (10.88%)	714/13,333 (5.36%)	0.003
Second trimester or later	341/12,940 (2.64%)	53/1,883 (2.81%)	288/11,057 (2.60%)	0.60
<b>Specific types of abortion-related morbidities and adverse events</b>				
	n, %	n, %	n, %	
retained products of conception	743 (1.48%)	46 (0.81%)	697 (1.56%)	
abortion-related infections <sup>b</sup> (secondary outcome)	374 (0.74%)	33 (0.58%)	341 (0.76%)	0.14
other or undetermined <sup>c</sup>	316 (0.63%)	49 (0.87%)	267 (0.60%)	
symptomatic intrauterine material	301 (0.60%)	28 (0.49%)	273 (0.61%)	
hemorrhage	201 (0.40%)	19 (0.34%)	182 (0.41%)	
missed ectopic pregnancy	106 (0.21%)	4 (0.07%)	102 (0.23%)	
failed abortion	15 (0.03%)	1 (0.02%)	14 (0.03%)	
disseminated intravascular coagulation	8 (0.02%)	1 (0.02%)	7 (0.02%)	
post-abortal hematometra	5 (0.01%)	0 (0.00%)	5 (0.01%)	
uterine perforation	2 (0.00%)	0 (0.00%)	2 (0.00%)	
anesthesia-reaction	0 (0.00%)	0 (0.00%)	0 (0.00%)	
cervical injury	0 (0.00%)	0 (0.00%)	0 (0.00%)	

Note: an abortion could have more than one type of abortion-related morbidity or adverse event (e.g. abortion-related infection & retained products of conception). Of the 163 major events, 90 had only one specific type of morbidity or adverse event. The remaining 73 had two or more specific types of events. Unit of analysis is abortions.

<sup>a</sup> Events were classified as major if they required overnight hospital admission, additional surgery, or blood transfusion.

<sup>b</sup> Infections were a secondary outcome of interest.

<sup>c</sup> These are primarily repeat procedures where the diagnosis could not be determined

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**Table 3. Multivariable logistic regressions of odds of events, adjusted incidence rate of events (aInc), and differences in adjusted incidence of events (aDiff) after abortion in ambulatory surgery centers vs. office-based settings among total sample and by abortion type (subgroup analyses)**

<b>Analyses among total sample</b>						
	Adjusted Incidence		aDiff [95% CI of aDiff]		aOR [95% CI]	p-value
	Ambulatory Surgery Centers	Office-based settings				
Any abortion-related morbidity or adverse event (Primary outcome)	3.25%	3.33%	-0.08% [-0.58% - 0.43%]		0.97 [0.81 - 1.17]	0.77
Major abortion-related morbidity or adverse event (Secondary outcome)	0.26%	0.33%	-0.06% [-0.18% - 0.06%]		0.78 [0.45 - 1.37]	0.39
Abortion-related infection (Secondary outcome)	0.58%	0.77%	-0.16% [-0.35% - 0.03%]		0.75 [0.52 - 1.09]	0.13
<b>Subgroup analyses</b>						
	Adjusted Incidence		aDiff [95% CI of aDiff]	Variables	aOR [95% CI]	p-value
	Ambulatory Surgery Centers	Office-based settings				
				First trimester aspiration	ref	
Any abortion-related morbidity or adverse event among first trimester aspiration abortions	2.19%	2.59%	-0.38% [-0.88% - 0.12%]	First trimester aspiration X Ambulatory surgery centers	0.84 [0.66 - 1.07]	0.16
				First trimester medication	2.16 [1.93 - 2.43]	<0.001
Any abortion-related morbidity or adverse event among first trimester medication abortions	11.22%	5.42%	5.54% [5.12% - 10.56%]	First trimester medication X Ambulatory surgery centers	2.65 [1.47 - 4.76]	0.001
				Second trimester and later	1.00 [0.86 - 1.16]	0.99
Any abortion-related morbidity or adverse event among second trimester and later abortions	2.62%	2.59%	0.03% [-0.70% - 0.76%]	Second trimester and later X Ambulatory surgery centers	1.21 [0.82 - 1.77]	0.34
Interpretation of interactions is that main effect for abortion type is the aOR or adjusted probability for that abortion type in offices						

compared to first trimester procedures in offices, facility type main effect is for first trimester procedures in ambulatory surgery centers vs. in offices, and interaction terms are whether and to what extent that type of abortion in ambulatory surgery centers differs from that type of abortion in offices

Adjusted models for total sample control for age, abortion type, diabetes, hypertension, previous year outpatient health care visits, previous year inpatient health care visits, year, and region. Office-based settings are the reference group

Full regression results are available in eTable 3

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690 Figure 1. Figure 1. Study flow diagram

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692 Footnotes for Figure 1.

693<sup>1</sup> abortions could be excluded for more than one reason

694<sup>2</sup> There are 50 different possible settings that include settings such as schools, homeless shelters, inpatient hospital, skilled nursing facilities, and others. Facility type was classified as ASC when the place-of-service code variable (stdplac) equaled 24 (“Ambulatory Surgery Center”) and office-based setting when the place-of-service code variable equaled 11 (“Office”).

698<sup>3</sup> events identified through individual review of cases with inpatient encounters, ED visits, and complication diagnosis codes were mutually exclusive.

700<sup>4</sup> events identified through programming were not mutually exclusive; i.e. an abortion could have had one or more of the programmed events. These abortions were not individually reviewed by the clinician coder

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