

Online Resource 1: Supplemental Tables and Figure

Validating claims-based algorithms determining pregnancy outcomes and gestational age using a linked claims-electronic medical record database

Drug Safety

Keran Moll^{1,*}, Hui Lee Wong², Kathryn Fingar¹, Shayan Hobbi³, Minya Sheng¹, Timothy A. Burrell¹, Linda O. Eckert⁴, Flor M. Munoz⁵, Bethany Baer², Azadeh Shoaibi², Steven Anderson²

¹IBM Watson Health, Cambridge, MA, USA, ²U.S. Food and Drug Administration, Center for Biologics Evaluation and Research, Silver Spring, MD, USA, ³IBM Global Business Services, Bethesda, MD, USA, ⁴University of Washington School of Medicine, Seattle, WA, USA, ⁵Baylor College of Medicine, Houston, TX, USA

*Corresponding author. Email address: kmoll@us.ibm.com

Supplemental Table 1 Clinical codes identifying pregnancy endpoints

Outcome	Code	Code definition
LB	Z370	Single live birth
	Z372	Twins, both liveborn
	Z3750	Multiple births, unspecified, all liveborn
	Z3751	Triplets, all liveborn
	Z3752	Quadruplets, all liveborn
	Z3753	Quintuplets, all liveborn
	Z3754	Sextuplets, all liveborn
	Z3759	Other multiple births, all liveborn
	O80	Encounter for full-term uncomplicated delivery
	Z373 ^a	Twins, one liveborn and one stillborn
	Z3760 ^a	Multiple births, unspecified, some liveborn
	Z3761 ^a	Triplets, some liveborn
	Z3762 ^a	Quadruplets, some liveborn
	Z3763 ^a	Quintuplets, some liveborn
	Z3764 ^a	Sextuplets, some liveborn
	Z3769 ^a	Other multiple births, some liveborn
ECT	O00	Ectopic pregnancy
	O08 ^b	Complications following ectopic and molar pregnancy
	10T20ZZ ^c	Resection of products of conception, ectopic, open approach
	10T23ZZ ^c	Resection of products of conception, ectopic, percutaneous approach
	10T24ZZ ^c	Resection of products of conception, ectopic, percutaneous endoscopic approach
	10T27ZZ ^c	Resection of products of conception, ectopic, via natural or artificial opening
	10T28ZZ ^c	Resection of products of conception, ectopic, via natural or artificial opening endoscopic
	10D27ZZ ^c	Extraction of products of conception, ectopic, via natural or artificial opening
	10D28ZZ ^c	Extraction of products of conception, ectopic, via natural or artificial opening endoscopic
	59100 ^d	Surgical treatment of ectopic pregnancy: tubal or ovarian, requiring salpingectomy and/or oophorectomy, abdominal or vaginal approach
	59120 ^d	Surgical treatment of ectopic pregnancy; tubal or ovarian, requiring salpingectomy and/or oophorectomy, abdominal or vaginal approach
	59121 ^d	Surgical treatment of ectopic pregnancy; tubal or ovarian, without salpingectomy and/or oophorectomy
	59130 ^d	Surgical treatment of ectopic pregnancy; abdominal pregnancy
	59135 ^d	Surgical treatment of ectopic pregnancy; interstitial, uterine pregnancy requiring total hysterectomy
	59136 ^d	Surgical treatment of ectopic pregnancy; interstitial, uterine pregnancy with partial resection of uterus
	59140 ^d	Surgical treatment of ectopic pregnancy; cervical, with evacuation
	59150 ^d	Laparoscopic treatment of ectopic pregnancy; without salpingectomy and/or oophorectomy
	59151 ^d	Laparoscopic treatment of ectopic pregnancy; with salpingectomy and/or oophorectomy

Outcome	Code	Code definition
	777 ^c	Ectopic pregnancy
AB	Z332	Encounter for elective termination of pregnancy
	O04	Complications following (induced) termination of pregnancy
AB	10A00ZZ ^c	Abortion of products of conception, open approach
	10A03ZZ ^c	Abortion of products of conception, percutaneous approach
	10A04ZZ ^c	Abortion of products of conception, percutaneous endoscopic approach
	10A07Z6 ^c	Abortion of products of conception, vacuum, via natural or artificial opening
	10A07ZW ^c	Abortion of products of conception, laminaria, via natural or artificial opening
	10A07ZX ^c	Abortion of products of conception, abortifacient, via natural or artificial opening
	10A07ZZ ^c	Abortion of products of conception, via natural or artificial opening
	10A08ZZ ^c	Abortion of products of conception, via natural or artificial opening, endoscopic
	01966 ^d	Anesthesia for induced abortion
	01964 ^d	Anesthesia for abortion procedures
	59840 ^d	Induced abortion by dilation and curettage
	59841 ^d	Induced abortion by dilation and evacuation
	59850 ^d	Induced abortion, by 1 or more intra-amniotic injections (amniocentesis-injections), including hospital admission and visits, delivery of fetus and secundines;
	59851 ^d	Induced abortion, by 1 or more intra-amniotic injections (amniocentesis-injections), including hospital admission and visits, delivery of fetus and secundines; with dilation and curettage and/or evacuation
	59852 ^d	Induced abortion, by 1 or more intra-amniotic injections (amniocentesis-injections), including hospital admission and visits, delivery of fetus and secundines; with hysterotomy (failed intra-amniotic injection)
	59855 ^d	Induced abortion, by 1 or more vaginal suppositories (e.g., prostaglandin) with or without cervical dilation (e.g., laminaria), including hospital admission and visits, delivery of fetus and secundines
	59856 ^d	Induced abortion, by 1 or more vaginal suppositories (e.g., prostaglandin) with or without cervical dilation (e.g., laminaria), including hospital admission and visits, delivery of fetus and secundines; with dilation and curettage and/or evacuation
	59857 ^d	Induced abortion, by 1 or more vaginal suppositories (e.g., prostaglandin) with or without cervical dilation (e.g., laminaria), including hospital admission and visits, delivery of fetus and secundines; with hysterotomy (failed medical evacuation)
	S0199 ^d	Medically induced abortion by oral ingestion of medication including all associated services and supplies (e.g., patient counseling, office visits, confirmation of pregnancy by HCG, ultrasound to confirm duration of pregnancy)
	S2260 ^d	Induced abortion, 17 to 24 weeks
	S2265 ^d	Induced abortion, 25 to 28 weeks
	S2262 ^d	Abortion for maternal indication, 25 weeks or greater
	S2266 ^d	Induced abortion, 29 to 31 weeks
	S2267 ^d	Induced abortion, 32 weeks or greater

Outcome	Code	Code definition
SA	770 ^e	Abortion with dilation and curettage, aspiration curettage or hysterotomy
	779 ^e	Abortion without dilation and curettage
	O03	Spontaneous abortion
	O021	Missed abortion
	01965 ^d	Anesthesia for missed abortion
	59812 ^{b,d}	Treatment of incomplete abortion, any trimester, completed surgically
	59820 ^d	Treatment of missed abortion, completed surgically; first trimester
	59821 ^d	Treatment of missed abortion, completed surgically; second trimester
SB	59830 ^{b,d}	Treatment of septic abortion, completed surgically
	Z371	Single stillbirth
	Z374	Twins, both stillborn
	Z377	Other multiple births, all stillborn
	O364XX0	Maternal care for intrauterine death, not applicable or unspecified
	O364XX1	Maternal care for intrauterine death, fetus 1
	O364XX2	Maternal care for intrauterine death, fetus 2
	O364XX3	Maternal care for intrauterine death, fetus 3
	O364XX4	Maternal care for intrauterine death, fetus 4
	O364XX5	Maternal care for intrauterine death, fetus 5
TRO	O364XX9	Maternal care for intrauterine death, other fetus
	O01	Hydatidiform mole
	O020	Blighted ovum and nonhydatidiform mole
	O0289	Other abnormal products of conception
	O029	Abnormal product of conception, unspecified
DELIV	59870 ^d	Evacuation and curettage of uterus for hydatidiform mole
	No code above, but has a code indicating a delivery or extraction of products of conception occurred (see codes in the supplemental Excel file)	

Unless otherwise indicated, codes refer to ICD-10-CM diagnosis codes. Service records with more than one type of outcome code on the same record were excluded.

AB elective abortion, *DELIV* delivery of unknown outcome, *ECT* ectopic pregnancy, *ICD-10-CM/PCS* International Classification of Diseases, Tenth Revision, Clinical Modification/Procedure Coding System, *LB* live birth, *SA* spontaneous abortion, *SB* stillbirth, *TRO* trophoblastic and other abnormal products of conception

^a For live births, these codes indicate there were multiple gestations, both live and stillborn; to determine pregnancy episodes, these were put on the timeline but were eventually excluded from the study.

^b Codes may introduce outcome misclassification. ICD-10-CM code O08 is classified as ectopic pregnancy, but it may be used for molar pregnancies. CPT codes 59812 and 59830 are classified as SA, but they could also be used for the treatment of elective abortion complications.

^c ICD-10-PCS procedure codes

^d Healthcare Common Procedure Coding System codes

^e Diagnosis-related groups

Supplemental Table 2 Additional information on attrition of service records

Outcome	Total service records with any code, October 1, 2015, through October 31, 2018	Number of service records after excluding those with conflicting information on records on the same day	Number of service records after limiting to women aged 12–55 years (<i>final sample size used to determine pregnancy episodes</i>)	Total pregnancy episodes after applying timeline criteria	Final number of pregnancy episodes from August 1, 2016, through October 31, 2018, after applying continuous enrollment criteria
Live birth	61,143	60,784	60,484	57,129	31,270
Stillbirth	1,222	625	620	412	212
Spontaneous abortion	16,740	15,628	15,572	7,333	4,442
Ectopic pregnancy	844	743	740	665	N/A
Elective abortion	2,018	1,716	1,700	1,405	N/A
Trophoblastic disease	2,366	1,815	1,808	925	N/A
Unknown outcome without another code above	14,951	14,951	12,413	3,771	N/A

N/A not applicable/not included in the study

Supplemental Table 3 Minimum allowable days/weeks between pregnancy outcomes

Preceding outcome	Minimum time to subsequent outcome, days (weeks)						
	LB	SB	DELIV	TRO	ECT	AB	SA
LB	182 (26)	168 (24)	168 (24)	70 (10)	70 (10)	70 (10)	56 (8)
SB	182 (26)	168 (24)	168 (24)	70 (10)	70 (10)	70 (10)	56 (8)
DELIV	182 (26)	168 (24)	168 (24)	70 (10)	70 (10)	70 (10)	56 (8)
TRO	168 (24)	154 (22)	154 (22)	56 (8)	56 (8)	56 (8)	42 (6)
ECT	168 (24)	154 (22)	154 (22)	56 (8)	56 (8)	56 (8)	42 (6)
AB	168 (24)	154 (22)	154 (22)	56 (8)	56 (8)	56 (8)	42 (6)
SA	168 (24)	154 (22)	154 (22)	56 (8)	56 (8)	56 (8)	42 (6)

AB elective abortion, *DELIV* delivery of unknown outcome, *ECT* ectopic pregnancy, *LB* live birth, *SA* spontaneous abortion, *SB* stillbirth, *TRO* trophoblastic and other abnormal products of conception

Supplemental Table 4 Prenatal windows and minimum spacing between outcomes

Outcome	Prenatal window/spacing, days (weeks)		
	Maximum pregnancy term	Minimum pregnancy term	Minimum time before subsequent pregnancy can start
LB	301 (43)	154 (22)	28 (4)
SB	301 (43)	140 (20)	28 (4)
DELIV	301 (43)	140 (20)	28 (4)
TRO	112 (16)	42 (6)	14 (2)
ECT	84 (12)	42 (6)	14 (2)
AB	168 (24)	42 (6)	14 (2)
SA	133 (19)	28 (4)	14 (2)

AB elective abortion, *DELIV* delivery of unknown outcome, *ECT* ectopic pregnancy, *LB* live birth, *SA* spontaneous abortion, *SB* stillbirth, *TRO* trophoblastic and other abnormal products of conception

Supplemental Table 5 Diagnosis and billing codes identifying milestones of pregnancy used to infer pregnancy start dates

Code	Description
Gestational age ICD-10-CM codes	
Z3A01–42	Weeks of gestation, 1–42+
ICD-10-CM codes indicating preterm status	
O6010X0–9	Preterm labor with preterm delivery, unspecified trimester
O6012X0–9	Preterm labor second trimester with preterm delivery second trimester
O6013X0–9	Preterm labor second trimester with preterm delivery third trimester
O6014X0–9	Preterm labor third trimester with preterm delivery third trimester
O42011–9	Preterm premature rupture of membranes, onset of labor within 24 hours
O42111–9	Preterm premature rupture of membranes, onset of labor > 24 hours later
O42911–9	Preterm premature rupture of membranes, unspecified time
ICD-10-CM codes indicating full-term status	
O6020X0–9	Term delivery with preterm labor, unspecified trimester
O6022X0–9	Term delivery with preterm labor, second trimester
O6023X0–9	Term delivery with preterm labor, third trimester
O4202	Full-term premature rupture of membranes, onset of labor within 24 hours
O4292	Full-term premature rupture of membranes, unspecified time
O471	False labor at or after 37 completed weeks of gestation
O80	Encounter for full-term uncomplicated delivery
Codes indicating trimester of pregnancy	
See attachment	See the supplemental Excel file
HCPCS codes indicating procedures, scans, and tests at various times	
58321, 58322, S4035	Intrauterine insemination
58974, 58976, S4037	Embryo transfer
76801, 76802	Obstetric ultrasound <14 weeks (1 st trimester ultrasound)
76813, 76814	NT scan
59015, 76945	CVS
81420, 81507	Cell free fetal DNA
76811, 76812	Anatomic ultrasound
82950, 82951, 82952	Glucose screening test, glucose tolerance test

CVS chorionic villus sampling, *HCPCS* Healthcare Common Procedure Coding System, *ICD-10-CM* International Classification of Diseases, Tenth Revision, Clinical Modification, *NT* nuchal translucency

Supplemental Table 6 Differences in gestational ages calculated from multiple service records when there was more than one estimate available over the course of the pregnancy episode

Outcome	% of pregnancy episodes with only one gestational age estimate	% of pregnancy episodes with more than one gestational age estimate, differing by a maximum of 1 day	% of pregnancy episodes with more than one gestational age estimate, differing by a maximum of 2–6 days	% of pregnancy episodes with more than one gestational age estimate, differing by a maximum of 7+ days
Live birth	6.2	20.7	50.3	22.7
Stillbirth	18.1	17.6	34.8	29.4
Spontaneous abortion	52.4	14.7	27.9	4.9

Supplemental Table 7 SNOMED and LOINC concepts used to identify obstetric information in EMRs

Concept	Description
SNOMED clinical concepts identifying pregnancy endpoints	
2781009	Miscarriage complicated by delayed and/or excessive hemorrhage (disorder)
2989004	Complication following molar and/or ectopic pregnancy (disorder)
5191001	Surgical treatment of missed abortion of second trimester (procedure)
10763001	Therapeutic abortion by insertion of laminaria (procedure)
16607004	Missed abortion (disorder)
17369002	Miscarriage (disorder)
18391007	Elective abortion (disorder)
18489003	Surgical treatment of missed abortion of first trimester (procedure)
23667007	Term pregnancy delivered (finding)
23793007	Miscarriage without complication (disorder)
29682007	Dilation and curettage for termination of pregnancy (procedure)
34500003	Legal abortion without complication (disorder)
34614007	Miscarriage with complication (disorder)
34801009	Ectopic pregnancy (disorder)
39804004	Abnormal products of conception (disorder)
44782008	Molar pregnancy (disorder)
62688006	Surgical treatment of spontaneous abortion of any trimester (procedure)
79586000	Tubal pregnancy (disorder)
82661006	Abdominal pregnancy (disorder)
87527008	Term pregnancy (finding)
102878001	Recurrent miscarriage (disorder)
156072005	Incomplete miscarriage (disorder)
156073000	Complete miscarriage (disorder)
169826009	Single live birth (finding)
198645000	Incomplete miscarriage with delayed or excessive hemorrhage (disorder)
198650006	Incomplete miscarriage with embolism (disorder)
199050003	False labor at or after 37 completed weeks of gestation (finding)
225244002	Direct injection of sperm into cytoplasm of the oocyte (procedure)
237364002	Stillbirth (finding)
281050002	Livebirth (finding)
282020008	Premature delivery (finding)
285409006	Medical termination of pregnancy (procedure)
302080006	Finding of birth outcome (finding)
364738009	Finding of outcome of delivery (finding)
373896005	Miscarriage complicated by genital-pelvic infection (disorder)
386639001	Termination of pregnancy (procedure)
395507008	Premature infant (finding)
413338003	Incomplete miscarriage with complication (disorder)
609448007	Induced termination of pregnancy complicated by delayed and/or excessive hemorrhage (disorder)
609450004	Induced termination of pregnancy complicated by genital-pelvic infection (disorder)

Concept	Description
LOINC clinical concept identifying last menstrual period	
8665-2	Last menstrual period start date
SNOMED clinical concepts identifying gestational age	
199050003	False labor at or after 37 completed weeks of gestation (finding)
SNOMED clinical concepts identifying gestational age	
366323009	Finding of length of gestation (finding)
313180007	Gestation greater than 24 weeks (finding)
313178001	Gestation less than 24 weeks (finding)
26690008	Gestation period, 8 weeks (finding)
931004	Gestation period, 9 weeks (finding)
38039008	Gestation period, 10 weeks (finding)
50367001	Gestation period, 11 weeks (finding)
79992004	Gestation period, 12 weeks (finding)
62333002	Gestation period, 13 weeks (finding)
72846000	Gestation period, 14 weeks (finding)
6678005	Gestation period, 15 weeks (finding)
15633004	Gestation period, 16 weeks (finding)
65683006	Gestation period, 17 weeks (finding)
25026004	Gestation period, 18 weeks (finding)
54318006	Gestation period, 19 weeks (finding)
23464008	Gestation period, 20 weeks (finding)
41438001	Gestation period, 21 weeks (finding)
65035007	Gestation period, 22 weeks (finding)
86883006	Gestation period, 23 weeks (finding)
313179009	Gestation period, 24 weeks (finding)
72544005	Gestation period, 25 weeks (finding)
48688005	Gestation period, 26 weeks (finding)
46906003	Gestation period, 27 weeks (finding)
90797000	Gestation period, 28 weeks (finding)
45139008	Gestation period, 29 weeks (finding)
71355009	Gestation period, 30 weeks (finding)
64920003	Gestation period, 31 weeks (finding)
7707000	Gestation period, 32 weeks (finding)
78395001	Gestation period, 33 weeks (finding)
13763000	Gestation period, 34 weeks (finding)
84132007	Gestation period, 35 weeks (finding)
57907009	Gestation period, 36 weeks (finding)
43697006	Gestation period, 37 weeks (finding)
13798002	Gestation period, 38 weeks (finding)
80487005	Gestation period, 39 weeks (finding)
46230007	Gestation period, 40 weeks (finding)
63503002	Gestation period, 41 weeks (finding)
36428009	Gestation period, 42 weeks (finding)

Concept	Description
7293009	Heavy-for-dates at birth regardless of gestation period (disorder)
206169007	Premature—weight 1000 g–2499 g or gestation of 28–37 weeks (disorder)
LOINC clinical concepts identifying gestational age	
11884-4	Gestational age estimated
18185-9	Gestational age
33901-0	Gestational age of fetus by amniocentesis
49051-6	Gestational age in weeks
49052-4	Gestational age in days
SNOMED clinical concepts identifying intrauterine insemination and embryo transfer	
265064001	Intrauterine artificial insemination (procedure)
57233006	Artificial insemination with sperm washing and capacitation (procedure)
58533008	Artificial insemination (procedure)
75456002	Embryo transfer (procedure)
SNOMED clinical concepts identifying first trimester scans/ultrasounds	
55052008	Diagnostic ultrasound of gravid uterus (procedure)
89343007	Ultrasound study follow-up (procedure)
169668007	Antenatal ultrasound scan 4–8 weeks (procedure)
241491007	Ultrasound scan of fetus (procedure)
425551008	Antenatal ultrasound scan for possible abnormality (procedure)
408815001	Ultrasound scan for fetal nuchal translucency (procedure)
268445003	Ultrasound scan—obstetric (procedure)
169669004	Antenatal ultrasound scan at 9–16 weeks (procedure)
169665005	Antenatal ultrasound scan abnormal (finding)
430064008	Transvaginal obstetric ultrasonography (procedure)
241493005	Ultrasound scan for fetal growth (procedure)
16310003	Diagnostic ultrasonography (procedure)
446522006	Ultrasonography in first trimester (procedure)
79966006	Ultrasonography of uterus (procedure)
370380004	Ultrasound scan finding (finding)
370379002	Antenatal ultrasound finding (finding)
SNOMED clinical concepts identifying second trimester scans/ultrasounds	
55052008	Diagnostic ultrasound of gravid uterus (procedure)
169670003	Antenatal ultrasound scan at 17–22 weeks (procedure)
307813007	Antenatal ultrasound scan at 22–40 weeks (procedure)
89343007	Ultrasound study follow-up (procedure)
241491007	Ultrasound scan of fetus (procedure)
425551008	Antenatal ultrasound scan for possible abnormality (procedure)
268445003	Ultrasound scan—obstetric (procedure)
169665005	Antenatal ultrasound scan abnormal (finding)
430064008	Transvaginal obstetric ultrasonography (procedure)
241493005	Ultrasound scan for fetal growth (procedure)
16310003	Diagnostic ultrasonography (procedure)
79966006	Ultrasonography of uterus (procedure)

Concept	Description
370380004	Ultrasound scan finding (finding)
370379002	Antenatal ultrasound finding (finding)

Obstetric visits were identified using the field specialty name equal to *Obstetrics and Gynecology Medical*. The codes presented here are those that were used in our data. A full list of pregnancy-related SNOMED and LOINC codes is shown in the supplemental Excel file (Online Resource 2).

EMR electronic medical record, *LOINC* Logical Observation Identifiers Names and Codes, *SNOMED* Systematized Nomenclature of Medicine Clinical Terms

Supplemental Table 8 Comparison of pregnancy episodes in the sample pool and those that were sampled but had insufficient data for validation

Characteristic	Full-term live birth			Preterm live birth			Spontaneous abortion		
	Sample pool	Sampled, insufficient data for validation	SMD	Sample pool	Sampled, insufficient data for validation	SMD	Sample pool	Sampled, insufficient data for validation	SMD
Total, No.	2,736	8	N/A	363	7	N/A	267	25	N/A
Age, years, %									
<15	0.1	0.0	-0.05	0.3	0.0	-0.07	0.0	0.0	0.00
15-17	1.6	0.0	-0.18	0.6	14.3	0.54	0.0	0.0	0.00
18-24	16.7	0.0	-0.63	14.3	14.3	0.00	17.6	12.0	-0.16
25-34	70.5	75.0	0.10	68.0	71.4	0.07	58.4	48.0	-0.21
35-44	11.1	25.0	0.37	16.0	0.0	-0.62	24.0	40.0	0.35
45+	0.0	0.0	-0.03	0.8	0.0	-0.13	0.0	0.0	0.00
Age, years, mean	28.7	30.5	0.39	29.6	25.7	-0.73	30.4	32.2	0.33
Race/ethnicity, %									
Asian	4.2	25.0	0.62	3.9	14.3	0.37	5.2	8.0	0.11
Black	8.9	0.0	-0.44	10.5	14.3	0.12	12.7	16.0	0.09
Hispanic	1.7	0.0	-0.19	1.9	0.0	-0.20	2.2	12.0	0.39
White	80.8	75.0	-0.14	78.0	71.4	-0.15	78.7	84.0	0.14
Other	7.4	0.0	-0.40	7.7	0.0	-0.41	10.5	8.0	-0.09
Multiracial	1.3	0.0	-0.16	0.8	0.0	-0.12	1.1	0.0	-0.15
Prenatal ED visit, %	31.1	0.0	-0.95	40.5	42.9	0.05	25.5	20.0	-0.13
GDM, %	18.5	0.0	-0.67	30.9	42.9	0.25	3.4	0.0	-0.26
Preeclampsia, %	3.9	12.5	0.32	24.0	28.6	0.10	0.0	0.0	0.00
C-section, %									
Primary	14.0	0.0	-0.57	26.2	14.3	-0.30	0.0	0.0	0.00
Repeat	14.4	0.0	-0.58	19.0	0.0	-0.69	0.0	0.0	0.00
GA at outcome, weeks, mean	39.0	38.9	-0.05	34.7	34.1	-0.15	10.1	8.6	-0.67

Age is the age at time of the outcome. ED visits, gestational diabetes, and preeclampsia were measured as any-listed diagnosis on any claim in the prenatal window. No stillbirths were excluded because they had insufficient data for validation.

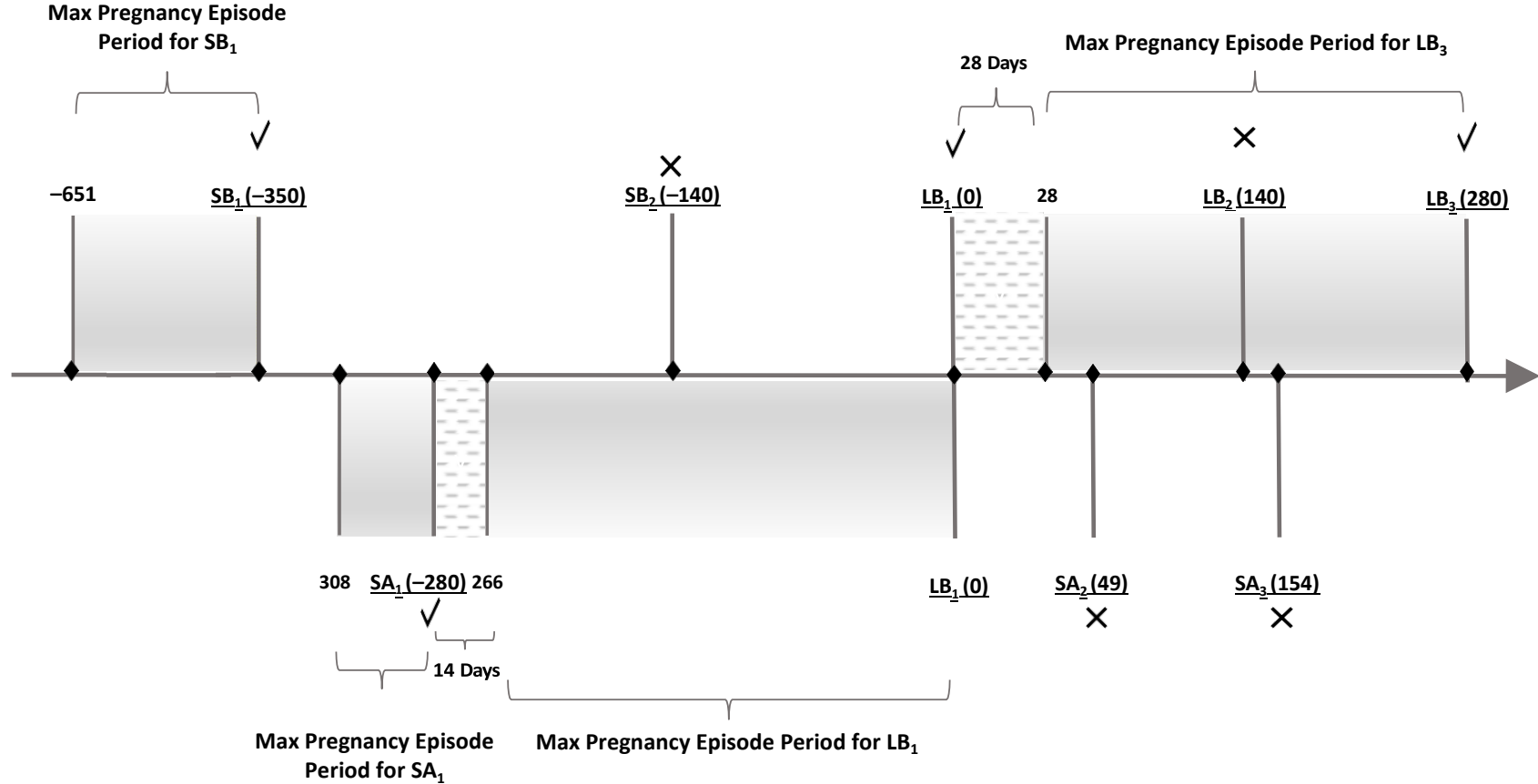
ED emergency department, GA gestational age, GDM gestational diabetes mellitus, N/A not available, SMD standardized mean difference

Supplemental Table 9 Results from sensitivity analysis

Outcome	Physician adjudicated		Percent agreement		
	Yes	No	Main analysis	Sensitivity analysis	
	No.	No.		Underestimate	Overestimate
			%	%	%
LB	185	15	100.0	92.5	100.0
FTB	92	8	97.8	90.0	98.0
PTB	93	7	62.4	58.0	65.0
SA	75	25	100.0	75.0	100.0
Stillbirth	24	0	70.8	70.8	70.8

For 40 episodes, the physician determined there was insufficient information to adjudicate the case. The underestimates assume all episodes that could not be adjudicated had negative agreement and were included in the denominator. The overestimates assume all episodes that could not be adjudicated had positive agreement and were included in the numerator and denominator.

FTB full-term live birth, *LB* live birth, *PTB* preterm live birth, *SA* spontaneous abortion, *SB* stillbirth



Supplemental Fig. 1 Hierarchical assignment of pregnancy outcomes

Illustrative process of outcome assignment on the same woman's timeline:

Live births (LBs) are assigned first, followed by stillbirths (SBs), then other outcomes on the hierarchy, and last spontaneous abortions (SAs).

1. LBs:

- First LB is placed on the timeline: LB₁.
- LB₂ is identified but excluded because it is less than 182 days apart from LB₁.
- LB₃ is then identified and determined as a valid LB because it is >182 days after LB₁—a valid outcome that is already on the timeline.

2. SBs

- a. SB₁ is identified and placed on the timeline because it is >182 days before LB₁.
- b. SB₂ is excluded because it is <182 days before LB₁.

3. SAs

- a. SA₁ is placed on the timeline because it complies with spacing rules in relation to the outcomes already on the timeline: >56 days from the previous SB₁ and >168 days prior to the subsequent LB₁.
- b. SA₂ is excluded because it is too close to LB₁ (<56 days).
- c. SA₃ is excluded because it is too close to LB₂ (<168 days).

Maximum pregnancy episode period for each outcome on the timeline is assigned according to Supplemental Table 4. An LB outcome is assigned the maximum pregnancy term (301 days) unless there is a valid preceding outcome within the time frame, in which case the maximum pregnancy episode period is adjusted. For example, SA₁ is 280 days before LB₁—the maximum pregnancy episode period for LB₁ starts 14 days after the SA₁.