

AIM

ALLIANCE FOR INNOVATION ON MATERNAL HEALTH

AIM Guide to Implementing the Severe Maternal Morbidity Algorithm

For use with hospital inpatient discharge data

Version: October 2026

Introduction

This guide is intended to assist analysts with the initial calculation of Severe Maternal Morbidity (SMM) using methods developed by a national workgroup with representatives from AHRQ, HRSA, CDC, and AIM.

It may be used with datasets containing ICD-10-CM diagnosis codes, ICD-10-PCS procedure codes, and MS-DRG values. Examples of appropriate data sources include electronic health records, hospital inpatient discharge records, and all-payer claims data.

There is no single "right" approach or software tool for implementing these methods. This guide uses widely understood, tool-agnostic steps. Analysts working in SAS, SPSS, R, SQL, Python, Tableau Prep, Alteryx, Informatica, or other platforms may use more efficient approaches while preserving the same record-level logic. The AIM flagging table provides standardized code-level flags that support consistent calculation across tools.

Blood products transfusion rule

- Blood products transfusion is retained as an SMM component flag.
- For the standard SMM numerator, exclude a delivery only when transfusion is the sole SMM indicator.
- A delivery with transfusion plus one or more non-transfusion SMM indicators remains included.

Table 1. Field definitions

Field	Definition
KEY	Unique discharge or record identifier.
DX	ICD-10-CM diagnosis code.
PR	ICD-10-PCS procedure code.
MS-DRG	Medicare Severity Diagnosis Related Group.

Scope of this guide

The core algorithm consists of code preparation, code matching, discharge-level flag aggregation, denominator construction, and numerator construction. Reporting-specific restrictions—such as facility type, residency, or other program requirements—should be applied and documented separately according to the applicable reporting specification.

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SMM Component and Measure Flag Variable Names and Labels

The component flags below are binary at the discharge level. A discharge may have more than one component flag.

Table 2. Alphabetical List of SMM Component Variable Names and Labels

Variable Label	Variable Name	SAS Variable Name (for reference only)
Acute Myocardial Infarction	AMI	SMM1
Acute Renal Failure	ARF	SMM3
Adult Respiratory Distress Syndrome	ARDS	SMM4
Air and thrombotic embolism	ATE	SMM17
Amniotic Fluid Embolism	AFE	SMM5
Aneurysm	ANR	SMM2
Blood products transfusion component flag	BPT	SMM18
Cardiac arrest/ventricular fibrillation	CAVF	SMM6
Conversion of cardiac rhythm	CCR	SMM7
Disseminated intravascular coagulation	DIC	SMM8
Eclampsia	ECL	SMM9
Heart failure/arrest during surgery or procedure	HFADSP	SMM10
Hysterectomy	HYST	SMM19
Puerperal cerebrovascular disorders	PCD	SMM11
Pulmonary Edema/Acute Heart Failure	PEAHF	SMM12
Sepsis	SEPS	SMM14
Severe anesthesia complications	SAC	SMM13
Shock	SHK	SMM15
Sickle cell disease with crisis	SCDWC	SMM16
Temporary tracheostomy	TT	SMM20
Ventilation	VENT	SMM21
SMM numerator including transfusion-only cases	SMMnum	n/a
SMM numerator excluding transfusion-only cases	SMMnumNoTrnsfs	n/a
SMM denominator include flag	SMMden Include	n/a
SMM denominator exclude flag	SMMden Exclude	n/a

Step 1 — Define the population

Limit the data to records meeting the core age and sex criteria:

- SEX = Female
- AGE is greater than or equal to 12 and less than or equal to 55
- Records with missing or unrecognized age or sex values do not satisfy the age/sex eligibility condition unless the reporting specification explicitly directs otherwise.

If a specific measure requires an additional patient subset—such as patients with preeclampsia or hypertensive disorders—apply and document that restriction according to the applicable reporting specification.

Step 2 — Determine whether the code arrays are wide or tall

Hospital discharge data are commonly provided in wide format, with one row per discharge and multiple diagnosis and procedure fields. The diagnosis and procedure arrays must be converted to tall format so each available code position can be matched to the AIM flagging table. Use all available primary and secondary diagnosis and procedure positions.

MS-DRG handling

- MS-DRG values are one method of identifying delivery hospitalizations for the denominator.
- MS-DRG is not an SMM numerator component.
- The single record-level MS-DRG field ordinarily does not need to be converted to tall format.

Table 3. Wide-format example

KEY	DX1	DX2	DX3	PR1	PR2	PR3
2022000001	O24410	O09293	J45909	10E0XZZ	4A1HX4Z	
2022000002	O480	Z370	Z3A40	10E0XZZ	10E0XZZ	
2022000003	O133	Z6843	Z3A40	10E0XZZ	0KQM0ZZ	
2022000004	O7589	Z6843	Z3A40	3E033VJ	10E0XZZ	10907ZC

After reshaping, each code position becomes a separate row. The example below shows the first two records; the same process is applied to every available diagnosis and procedure position.

Table 4. Tall-format example

KEY	Code Position	DX	PR
2022000001	1	O24410	10E0XZZ
2022000001	2	O09293	4A1HX4Z

KEY	Code Position	DX	PR
2022000001	3	J45909	
2022000002	1	O480	10E0XZZ
2022000002	2	Z370	10E0XZZ
2022000002	3	Z3A40	

Step 3 — Prepare the AIM flagging table and code fields

Download the current AIM SMM flagging table and record its file name, version, and review date. Worksheet names may vary by version. In the June 2026 workbook, use All DX, All PR, and All DRG.

Each worksheet contains a code column and flag columns populated with zeroes and ones. A value of 1 indicates that the code flags the corresponding component or measure field; a value of 0 indicates that it does not.

Before joining codes

- Import diagnosis and procedure codes as text or character fields.
- Preserve leading zeroes, especially in ICD-10-PCS codes.
- Use the undotted code values shown in the AIM flagging table.
- Trim surrounding spaces and standardize letters to uppercase.
- Use exact code matches rather than prefix or "starts with" matches.
- Use a left join from the discharge-code data to the corresponding AIM flagging-table worksheet.
- Replace unmatched AIM flag values with zero after each join.

Step 4 — Join the discharge codes to the AIM flagging table

Perform three code matches: DX to All DX, PR to All PR, and MS-DRG to All DRG. Use a left join so every row from the discharge data is retained. Matching codes receive the AIM flags; nonmatching codes remain in the data and their unmatched flag values are set to zero.

Table 5. Diagnosis left-join example

KEY	DX	SMMnum	AMI	ARF	ARDS
2022000001	O24410	0	0	0	0
2022000001	I2101	1	1	0	0
2022000001	J45909	0	0	0	0
2022000002	O480	0	0	0	0
2022000002	I2102	1	1	0	0
2022000002	Z3A40	0	0	0	0

Repeat the same process for the procedure array and the single MS-DRG field. Before proceeding, compare the row count before and after each join. Unexpected row multiplication usually indicates a duplicated flagging table, a nonunique join key, or an incorrectly specified match.

Step 5 — Aggregate the flags to one record per discharge

Group the joined code rows by KEY and retain the maximum value of every AIM flag. This produces one flag record per discharge. Join these discharge-level flags back to the original data only when other fields are needed for analysis or reporting.

Use MAX, not SUM

- Use the maximum value of each flag within a discharge.
- Multiple qualifying codes for the same component must still produce a binary component flag of 1.
- Summing flags can incorrectly turn a binary component into 2 or more.

Table 6. Discharge-level result example

KEY	SMMnum	AMI	ARF	ARDS
2022000001	1	1	0	0
2022000002	1	1	0	0
2022000003	1	1	0	0
2022000004	1	1	0	0

Count by distinct discharge KEY

- SMM components are not mutually exclusive.
- Count each component and overall SMM by distinct discharge KEY.
- Do not calculate overall SMM by summing component counts.

Step 6 — Construct the denominator and numerator flags

Create explicit record-level flags rather than deleting records sequentially. Retaining all discharge records makes the logic easier to validate and supports later analyses.

```
AGE_SEX_ELIGIBLE = (FEMALE = 1) AND (AGE >= 12) AND (AGE <= 55)
SMMden = AGE_SEX_ELIGIBLE AND (SMMden Include = 1) AND (SMMden Exclude = 0)
SMM including transfusion-only cases = (SMMden = 1) AND (SMMnum = 1)
SMM excluding transfusion-only cases = (SMMden = 1) AND (SMMnumNoTrnsfs = 1)
Transfusion-only case = (SMMden = 1) AND (BPT = 1) AND (SMMnumNoTrnsfs = 0)
```

Use the same final denominator for both versions of the SMM numerator. SMMden Exclude = 1 overrides SMMden Include = 1; a record carrying both flags is not in the final denominator.

Table 7. Transfusion truth table

BPT	Any non-transfusion SMM	SMMnum	SMMnumNoTrnsfs	Standard result
0	0	0	0	Not SMM
1	0	1	0	Excluded because transfusion is the sole indicator
0	1	1	1	Included
1	1	1	1	Included because another SMM indicator is present

Current method and implementation notes

- Do not apply the prior short-length-of-stay reclassification unless a current reporting specification explicitly requires it; the current FAD notes state that it is no longer applied.
- The codes shown in this guide are examples. They do not replace the current AIM flagging table.
- Revalidate the algorithm whenever the flagging table or measure specification changes.
    - AIM offers an SMM validation package with synthetic data to validate your process
- Document reporting-specific restrictions, such as facility type, residency, or other program requirements, separately from the core SMM construction.

Version control, references, and support

Version-control checklist

- Record the AIM flagging-table file name and version.
- Record the flagging-table review date.
- Record the measure specification or reporting guidance used for the analysis.
- Repeat validation whenever any of these inputs change.

Table 8. Primary references

Resource	Reference
AIM implementation guide	AIM Guide to Implementing the Severe Maternal Morbidity Algorithm. October 29, 2026.
AIM flagging table	AIM SMM Flagging Table. October 2026 version; use the current released table as the code-level source of truth.
FAD Resource Document	Maternal and Child Health Bureau. Federally Available Data Resource Document. April 16, 2026. Severe Maternal Morbidity section, pages 8–16.
FAD resource page	https://mchb.tvisdata.hrsa.gov/Home/Resources

Implementation reminder

- Preserve exact code values and leading zeroes.
- Use exact left joins and replace unmatched flags with zero.
- Aggregate with MAX by KEY.
- Exclude transfusion only when it is the sole SMM indicator.

Questions, comments, or suggestions for improvement?

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