Identifying Beneficiaries with Severe Maternal Morbidity in Medicaid and CHIP Administrative Data

Technical Specifications

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Contents

Tables

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I. Description

This guide provides technical specifications with a general logic for using Medicaid and Children's Health Insurance Program (CHIP) administrative data to identify beneficiaries who experienced severe maternal morbidity (SMM). SMM is an umbrella term for several unexpected labor and delivery (L&D) outcomes that have significant health consequences in the short or long term for the delivering individual. The Identifying Beneficiaries with SMM in Medicaid and CHIP Administrative Data Technical Specifications enable users to identify beneficiaries in two pregnancy-related categories:

1. Beneficiaries who had a live birth, stillbirth, or L&D with an unknown outcome during the calendar year

2. Beneficiaries with a condition or procedure indicating SMM during the calendar year

Although there is no standard list of SMM conditions or procedures,[1] the algorithm we use draws on the list of 21 conditions and procedures that the Centers for Disease Control and Prevention considers as SMM (Table 1).

These specifications are designed to use one calendar year of enrollment data. The population of interest includes female Medicaid beneficiaries ages 8 to 64[2] ever enrolled in Medicaid or CHIP in the year (fee-for-service or managed care). These specifications identify (1) beneficiaries within the population of interest who had a Medicaid-covered live birth, stillbirth, or L&D with an unknown outcome during the calendar year and (2) beneficiaries who experienced any SMM condition or procedure within six weeks (42 days) before or after their estimated delivery date (Thung and Norwitz 2010). The specifications do not impose continuous enrollment requirements (that is, contiguous months of enrollment as a recipient of Medicaid or CHIP benefits) because their purpose is to identify and produce counts of pregnant and postpartum beneficiaries covered by Medicaid and CHIP regardless of their length of enrollment. The specifications do not aim to calculate rates of pregnancy and other outcomes among the population of reproductive-age women enrolled in Medicaid. In addition, some women are eligible for Medicaid or CHIP benefits because they are pregnant and so would not have a full year of continuous enrollment in either program. Users can impose limits on continuous enrollment at their discretion.

These specifications rely on a list of procedure, revenue, and diagnosis codes to identify pregnancy and delivery-related claims. (See the accompanying documentation: "Identifying Beneficiaries with Severe Maternal Mortality (SMM): Reference Codes" for a full list of relevant codes.) After identifying relevant headers and lines on claims and creating claims-level indicator variables, users roll up to the beneficiary-level to calculate the number of beneficiaries with SMM conditions. These specifications demonstrate how to count beneficiaries with SMM during a calendar year. Each beneficiary is counted once, even if she has multiple pregnancies in the calendar year.

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[1] Creanga et al. 2014; American College of Obstetricians and Gynecologists and the Society for Maternal-Fetal Medicine 2016.

[2] The age range 8 to 64 is intentionally wider than the commonly used reproductive age range of 15 to 44 so that the specifications align with the age range for the Joint Commission National Quality Measure PC-02 (Cesarean Birth).

Severe Maternal Morbidity: Identifying Pregnant Beneficiaries in Medicaid and CHIP Administrative Data - Technical Specifications

1

Table 1. 21 SMM conditions

SMM condition or procedure
Acute myocardial infarction
Acute renal failure
Adult respiratory distress syndrome
Air and thrombotic embolism
Amniotic fluid embolism
Aneurysm
Blood transfusion
Cardiac arrest/ventricular fibrillation
Conversion of cardiac rhythm
Disseminated intravascular coagulation
Eclampsia
Heart failure/arrest during surgery or procedure
Hysterectomy
Puerperal cerebrovascular disorders
Pulmonary edema/acute heart failure
Sepsis
Severe anesthesia complications
Shock
Sickle cell disease with crisis
Temporary tracheostomy
Ventilation

Source: Centers for Disease Control and Prevention 2022.

Severe Maternal Morbidity: Identifying Pregnant Beneficiaries in Medicaid and CHIP Administrative Data - Technical Specifications

2

II. Logic overview

The technical specifications lay out an algorithm to identify beneficiaries with SMM outcomes using data from the Transformed Medicaid Statistical Information System (T-MSIS) Analytic File (TAF) Research Identifiable File (RIF), described in Table 2. At a high level, these specifications include the following steps:

Step 1:   Identify the population of interest

Steps 2-4:   Identify live birth, stillbirth, and L&D outcomes and SMM-related claims

Steps 5-7:   Roll up claims-level variables to construct beneficiary-level variables that align with the two SMM-relevant categories

For each step, the specifications provide the relevant data files needed, the logic and purpose for the step, and information about how to implement the step in the TAF RIF. The algorithm relies on the TAF annual demographic and eligibility (DE), inpatient (IP), and other services (OT) files.

Severe Maternal Morbidity: Identifying Pregnant Beneficiaries in Medicaid and CHIP Administrative Data - Technical Specifications

3

Table 2. Logic overview for identifying beneficiaries with SMM

Step	Relevant TAF RIF	Logic and purpose	Implementation using the TAF RIF
1. Identify beneficiaries in the enrollment file who qualify for inclusion in the analysis	DE file	For the analysis, identify beneficiaries in the population of interest: those who are ever enrolled in Medicaid or CHIP in the calendar year, are female, and are ages 8 to 64.	Read in the DE base file. Use the reference year (RFRNC_YR) to identify records that correspond to the calendar year of interest. Drop "dummy" records that do not contain any enrollment information about the beneficiary (MISG_ELGBLTY_DATA_IND=1). Limit to female beneficiaries (SEX_CD = F). Calculate beneficiary age (using BIRTH_DT and first day of the year); limit to ages 8 to 64.
2. Merge claims and enrollment data to create annual IP and OT files for beneficiaries in the population of interest	IP, OT, and DE files	Only retain those claims matching a beneficiary who qualifies for inclusion in the analytic population. To reduce run time, we recommend creating a table of IP and OT header records for eligible beneficiaries, restricting the claims pull to those in the population of interest.	Read in IP and OT header records for beneficiaries identified in the population of interest created in Step 1, based on MSIS identification number (MSIS_ID) and state (SUBMTG_STATE_CD). Select the most recent file version for each month using the variables IP_VRSN and OT_VRSN. Determine the months to include in each calendar year using RFRNC_YR. Include two months before and after the calendar year (that is, November and December data from the prior year and January and February data from the following year) to ensure that the analysis will be able to capture SMM occurrences within six weeks (42 days) before or after estimated delivery dates that are early or late in the calendar year. Drop records that represent payments and cannot be tied to specific services delivered to the beneficiary (CLM_TYPE_CD = 2, 4, B, D, V, X). Stack the IP and OT monthly claims files (keeping the files separate) so that all 16 months are contained in a single IP file and a single OT file. For example, 2020 IP and OT files would contain claims from 201911 through 202102). Assign a standard service begin date. In the IP File, use admission date (ADMSN_DT) to set the standard service begin date to that date. If ADMSN_DT is missing, use the maximum LINE_SRVC_BGN_DT among claim lines associated with the header. In the OT file, use the service beginning date (SRVC_BGN_DT) to set the standard service date. If SRVC_END_DT is missing, use the maximum LINE_SRVC_BGN_DT among claim lines associated with the header.
3. Join the header and line-level files	IP and OT files	Each monthly IP and OT TAF RIF consists of two files: the header-level file and the line-level file. Certain line-level data elements are required to identify claims or encounters for pregnant and postpartum beneficiaries, including revenue code (on facility claims only), and CPT or HCPCS procedure codes. Additional header-level data elements are also required to identify pregnant and postpartum beneficiaries, including diagnosis code and ICD procedure code (on inpatient facility claims only). As a result, each header-level record must be linked with its associated line-level records to evaluate whether the claim qualifies as the delivery of a pregnancy or postpartum service.	Separately for the stacked IP and OT files, link the header- and line-level files using the unique combination of MSIS ID (MSIS_ID), submitting state code (SUBMTG_STATE_CD), and claim identification number (CLM_ID).

Table 2 (*continued*)

Step	Relevant TAF RIF	Logic and purpose	Implementation using the TAF RIF
4. Identify claims for live birth, stillbirth, or L&D	IP and OT files	Identify and create a claim-level flag for live birth, stillbirth, and L&D by using diagnosis codes, procedure codes, and revenue center codes.	Using the files created in Step 3, create a binary (0/1) claim-level flag for the first category from the "Identifying Beneficiaries with Severe Maternal Morbidity (SMM): Reference Codes" list for live birth, stillbirth, and L&D. In the IP file, look for claims with any of the live birth, stillbirth, and L&D-related codes from the reference codes list in the diagnosis codes (DGNS_CD_1 to DGNS_CD_12), admitting diagnosis codes (ADMTG_DGNS_CD), procedure codes (PRCDR_CD_1 – 6), and the revenue center codes (REV_CNTR_CD). In the OT file, look for claims with any of the related diagnosis codes (DGNS_CD_1 and DGNS_CD_2) and procedure codes (LINE_PRCDR_CD) and revenue center codes (REV_CNTR_CD). If the user identifies a related claim, set the claim-level flag equal to 1 (for example, if the user identifies a code from the live birth, stillbirth, or L&D code list on a claim line, set the corresponding flag to 1 for that claim). Otherwise, set the claim-level flag equal to 0. Drop all claim-level records where all flags are equal to 0.
5. Determine estimated date of delivery for each live birth, stillbirth, or L&D event	IP and OT files	In the population of interest, the algorithm identifies beneficiaries with claims related to live birth, stillbirth, or L&D and then creates an estimated date of delivery. This date is based on the date of admission for inpatient services with claims related to live birth, stillbirth, or L&D. If there is no admission date, then the estimated date of delivery is the earliest date of service from claims in the IP file related to live birth, stillbirth, or L&D.	Stack the IP and OT claims files together. Identify beneficiaries who had one or more claims with a diagnosis code, procedure code, or revenue center code flagged in Step 4. Estimate the date of each delivery event. Use the standard service beginning date to set the date of delivery for claims with live birth, stillbirth, or L&D codes. Count all claims with live birth, stillbirth, and L&D codes that are within 90 days of one another as the same delivery event. Repeat the process for all remaining claims that are not part of the first delivery event to identify additional delivery events. Only include unique delivery dates during the measurement year (January 1 through December 31).
6. Identify claims for SMM and ensure SMM conditions are within 42 days of a delivery event	IP and OT files	Create claim-level flags for each of the 21 SMM conditions by using diagnosis codes, procedure codes, and revenue center codes among claims that are within 42 days before or after the estimated date of delivery.	Create a binary (0/1) claim-level flag for each of the 21 SMM conditions by using Code List 2 – SMM from the "Identifying Beneficiaries with Severe Maternal Morbidity (SMM): Reference Codes." If the claim has any of the diagnosis codes (DGNS_CD_1 to DGNS_CD_12 or DGNS_CD_1 and DGNS_CD_2), admitting diagnosis codes (ADMTG_DGNS_CD), procedure codes (LINE_PRCDR_CD), or revenue center codes (REV_CNTR_CD) for the relevant condition, set the claim-level flag equal to 1. Otherwise, set the claim-level flag equal to 0. Ensure SMM condition claims are no more than 42 days before or after the corresponding date of delivery for a flagged live birth, stillbirth, or L&D. claim.

Table 2 (*continued*)

Step	Relevant TAF RIF	Logic and purpose	Implementation using the TAF RIF
7. Create beneficiary-level indicator variables	IP, OT, and DE files	Roll up claims to the beneficiary level to identify and flag relevant categories for Medicaid and CHIP beneficiaries.	Roll up the two SMM claims-level flags to create annual beneficiary-level variables for the following categories: 1. Category 1: Live birth, stillbirth, or L&D. Equal to 1 if the IP or OT annual beneficiary-level flags for live birth, stillbirth, or L&D are equal to 1, otherwise set to 0. 2. Category 2: SMM. Equal to 1 if an IP or OT annual beneficiary-level flag for an SMM condition are equal to 1, otherwise set to 0.

ª CHIP = Children's Health Insurance Program; DE = demographic and eligibility file; IP = inpatient file; L&D = labor and delivery; OT = other services file; SMM = severe maternal morbidity; TAF RIF = T-MSIS (Transformed Medicaid Statistical Information System) Analytic File Research Identifiable File.

III. Detailed Technical Specifications

The detailed technical specifications in this section describe how the algorithm to identify beneficiaries with SMM can be applied to the TAF RIF.

1. Identify beneficiaries in the population of interest in the DE file

Conduct initial processing of the DE claims file to limit its size and to facilitate linking.

   a. Read in the DE file and use RFRNC_YR to identify records that correspond to the four-digit calendar year of interest (for example, to analyze calendar year 2020, read in data where RFRNC_YR = 2020). Select the most recent file version using the variable DE_VRSN.
   b. Keep only the DE variables that are needed for the analysis (Table 3).
   c. Remove records in which there are no eligibility data, where MISG_ELGBLTY_DATA_IND = 1, as these claim records do not contain the necessary demographic information.
   d. Limit the file to female beneficiaries, where SEX_CD = F.
   e. Calculate a beneficiary's age during the calendar year by calculating: January 1 in given year - BIRTH_DT.

Table 3. DE variables to retain

TAF RIF variable name(s)	Description
BIRTH_DT	Beneficiary's date of birth; most recent in the calendar and all prior years.
DE_VRSN	Indicator representing the iteration of the file.
MISG_ELGBLTY_DATA_IND	A flag to indicate that the person had claims for the year but no eligibility information.
MSIS_ID	A state-assigned unique identification number used to identify a Medicaid/CHIP-enrolled beneficiary.
RFRNC_YR	The year of the data file.
SEX_CD	The beneficiary's biological sex; most recent in the calendar and all prior years.
SUBMTG_STATE_CD	The numeric state code for the U.S. state, territory, or the District of Columbia that has submitted the data.

Severe Maternal Morbidity: Identifying Pregnant Beneficiaries in Medicaid and CHIP Administrative Data - Technical Specifications

7

2.   Identify claims for beneficiaries in the population of interest

Conduct initial processing of the monthly IP and OT claims files to limit their size and to facilitate linking.

a. Read in all monthly IP and OT header records for the year separately for each file, restricting the set of variables retained to those identified in Tables 4 and 5 for the most recent version of the file (based on IP_VRSN and OT_VRSN). Note that each monthly TAF consists of two files: the header-level file and the line-level file. Tables 4 and 5 note whether the variables that should be retained are located on the header file, the line file, or both files. Only read in records for beneficiaries identified in the population of interest created in Step 1, based on MSIS identification number (MSIS_ID) and state (SUBMTG_STATE_CD).

b. Include claims that fall within the two months before and after the calendar year (that is, November and December data from the prior year and January and February data from the following year, based on IP_FIL_DT and OT_FIL_DT). This ensures that the analysis will capture SMM occurrences within six weeks (42 days) before or after estimated delivery dates that are early or late in the calendar year (

c. Drop records that represent payments and cannot be tied to specific services delivered to the beneficiary (CLM_TYPE_CD = 2, 4, B, D, V, X).

d. Stack the IP and OT monthly claims files (keeping the files separate) so that all 16 months are contained in a single IP file and a single OT file. For example, a measure for the 2020 calendar year would contain claims from 201911 through 202102).

e. Assign a standard service date.

    i.   In the IP File, use admission date (ADMSN_DT) to set the standard service date to that date. If ADMSN_DT is missing, use the maximum LINE_SRVC_BGN_DT among claim lines associated with the header.

    ii. In the OT file, use the service beginning date (SRVC_BGN_DT) to set the standard service date. If SRVC_END_DT is missing, use the maximum LINE_SRVC_BGN_DT among claim lines associated with the header.

Table 4. IP variables to retain

Variable name	Variable description
Header and line	
CLM_ID	The unique identification number for the claim.
IP_FIL_DT	Year and month of the reporting period
MSIS_ID	The encrypted state-assigned unique identification number used to identify a Medicaid/CHIP-enrolled beneficiary and any claims submitted to the system.
SUBMTG_STATE_CD	The ANSI numeric state code for the U.S. state, territory, or the District of Columbia that has submitted the data
IP_VRSN	Indicator representing the iteration of the file.
Header only	
ADMSN_DT	The date on which the recipient was admitted to a hospital.
ADMTG_DGNS_CD	ICD-10-CM admitting diagnosis code.
CLM_TYPE_CD	A code indicating what kind of payment is covered in this claim.
DGNS_CD_1 - DGNS_CD_12	ICD-10-CM code found on the claim.
PRCDR_1_CD - PRCDR_6_CD	A procedure code (CPT or HCPCS) used by the state to identify the procedures performed during the hospital stay referenced by this claim.

Severe Maternal Morbidity: Identifying Pregnant Beneficiaries in Medicaid and CHIP Administrative Data - Technical Specifications

8

Variable name	Variable description
Line only	
REV_CNTR_CD	A code that identifies a specific accommodation, ancillary service, or billing calculation.
LINE_SRVC_BGN_DT	For services received during a single encounter with a provider, the date the service covered by this claim was received

Table 5. OT variables to retain

Variable name	Variable description
Header and line	
CLM_ID	The unique identification number for the claim.
OT_FIL_DT	Year and month of the reporting period
MSIS_ID	The encrypted state-assigned unique identification number used to identify a Medicaid/CHIP-enrolled beneficiary and any claims submitted to the system.
SUBMTG_STATE_CD	The ANSI numeric state code for the U.S. state, territory, or the District of Columbia that has submitted the data.
OT_VRSN	Indicator representing the iteration of the file.
Header only	
CLM_TYPE_CD	A code indicating what kind of payment is covered in this claim.
DGNS_CD_1	Diagnosis Code 1 (Primary/Principal); ICD-10-CM code on the claim
DGNS_CD_2	Diagnosis Code 2; ICD-10-CM code on the claim.
SRVC_BGN_DT	The date the service covered by this claim began.
Line only	
LINE_PRCDR_CD	A procedure code (ICD-9, ICD-10, CPT, HCPCS, or other) used by the state to identify the procedures performed during the hospital stay referenced by this claim.
REV_CNTR_CD	A code that identifies a specific accommodation, ancillary service, or billing calculation.
LINE_SRVC_END_DT	For services received during a single encounter with a provider, the date the service covered by this claim was received

3.   Join the header- and line-level files

Link each header-level record with its associated line-level records to evaluate whether the claim qualifies as the delivery of a pregnancy or postpartum service.

   a. To link header-level records with associated line-level records, separately for the IP and OT monthly files, link the header- and line-level files using the beneficiary identifier (MSIS_ID), the submitting state code (SUBMTG_STATE_CD), and claim identification number (CLM_ID).

4.   Identify claims for live birth, stillbirth, and L&D (outcome unknown)

Identify and create claim-level flags for live birth, stillbirth, and L&D unknown by using diagnosis codes, procedure codes, and revenue center codes.

   a. Using the files created in Step 3, create a binary (0/1) claim-level flag for the first category from the "Identifying Beneficiaries with Severe Maternal Morbidity (SMM): Reference Codes" list for live birth, stillbirth, and L&D.
      i.   In the IP file, look for claims with any of the live birth, stillbirth, and L&D-related codes from the reference codes list in the diagnosis codes (DGNS_CD_1 to DGNS_CD_12), admitting diagnosis codes (ADMTG_DGNS_CD), procedure codes (LINE_PRCDR_CD), and the revenue center codes (REV_CNTR_CD).

Severe Maternal Morbidity: Identifying Pregnant Beneficiaries in Medicaid and CHIP Administrative Data - Technical Specifications

9

      ii.   In the OT file, look for claims with any of the related diagnosis codes (DGNS_CD_1 and DGNS_CD_2) and procedure codes (LINE_PRCDR_CD) from the reference codes list.

    b.   If the user identifies a related claim, set the claim-level flag equal to 1 (for example, if the user identifies a code from the live birth, stillbirth, and L&D code list on a claim line, set the corresponding flag to 1 for that claim). Otherwise, set the claim-level flag equal to 0.

5.   Determine estimated date of delivery for each live birth, stillbirth, and L&D event

Using the claims flagged as live birth, stillbirth, and L&D, create an estimated date of delivery.

    a.   Stack the IP and OT claims files together.
    b.   Identify beneficiaries who had one or more claims with a diagnosis code, procedure code, or revenue center code related to live birth, stillbirth, or L&D in Step 4.
    c.   Estimate the date of each delivery event. Use the standard service beginning date to set the date of delivery for claims with live birth, stillbirth, or L&D codes. Count all claims with live birth, stillbirth, and L&D codes that are within 90 days of one another as the same delivery event. Repeat the process for all remaining claims that are not part of the first delivery event to identify additional delivery events.
    d.   Only include unique delivery dates during the measurement year (January 1 through December 31).

6.   Identify claims for SMM and ensure SMM conditions are within 42 days of a delivery event

Create claim-level flags for each of the 21 SMM conditions by using diagnosis codes, procedure codes, and revenue center codes and ensure claims are within 42 days before or after the estimated date of delivery estimated in step 5.

    a.   Create a binary (0/1) claim-level flag for each of the 21 SMM conditions by using Code List 2 – SMM from the "Identifying Beneficiaries with Severe Maternal Morbidity (SMM): Reference Codes." If the claim has any of the procedure codes or diagnosis codes for the relevant condition, set the claim-level flag equal to 1. Otherwise, set the claim-level flag equal to 0.
    b.   Ensure SMM condition claims are no more than 42 days before or after the corresponding date of delivery for a flagged live birth, stillbirth, or L&D. claim.

7.   Create a beneficiary-level file

Roll up claims to the beneficiary level to identify and flag the two SMM categories for Medicaid and CHIP beneficiaries.

    a.   Roll up the claims-level flags to create annual beneficiary-level variables for the following categories:

        i.   Category 1: Live birth, stillbirth, or L&D. Equal to 1 if the IP or OT annual beneficiary-level flags for live birth, stillbirth, or L&D are equal to 1; otherwise, set to 0.

        ii.   Category 2: SMM. Equal to 1 if the IP or OT annual beneficiary-level flags for SMM are equal to 1; otherwise, set to 0.

Severe Maternal Morbidity: Identifying Pregnant Beneficiaries in Medicaid and CHIP Administrative Data - Technical Specifications

10

IV. Limitations

These technical specifications have the following limitations:

- **The algorithm does not identify unique pregnancy episodes.** As a result, the algorithm should not be used to count the number of live births, stillbirths, or instances of L&D during the calendar year. The algorithm should only be used to count the number of beneficiaries in each of these categories. For instance, women who give birth twice during the calendar year (for example, in January and December) and had an SMM condition during both pregnancies will be counted only once in the category "births, stillbirths, or L&D" and once in the category "SMM." Similarly, women with a multiple birth (twins, triplets, and so on) will be counted only once in the category "births, stillbirths, or L&D," despite giving birth to more than one infant.
- **The algorithm does not identify pregnant or postpartum beneficiaries who did not receive pregnancy-related services or diagnoses during the measurement period.** This limitation is most likely to affect women who became pregnant toward the end of the calendar year or those who were early in their pregnancy during the calendar year and less likely to receive frequent prenatal services relative to women in the later stages of pregnancy.
- **Coding errors and data quality issues can affect the accuracy of the results.** The logic of the algorithm assumes that the procedure codes, diagnosis codes, and revenue codes are used correctly; however, there is evidence of coding errors and other limitations in some states' TAF RIF data. Errors in the data will result in the misclassification of beneficiaries. Further, data quality issues introduced by states during the reporting process might affect the accuracy of the results. States with serious data quality issues are not included in the final Medicaid public use file output.

Severe Maternal Morbidity: Identifying Pregnant Beneficiaries in Medicaid and CHIP Administrative Data - Technical Specifications

11

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Severe Maternal Morbidity: Identifying Pregnant Beneficiaries in Medicaid and CHIP Administrative Data - Technical Specifications

12