HHS-Developed Risk Adjustment Model Algorithm "Do It Yourself (DIY)" Software Instructions

Section 1343 of the Patient Protection and Affordable Care Act provides for a permanent risk adjustment program. To protect against potential effects of adverse selection, the risk adjustment program transfers funds from plans with relatively low risk enrollees to plans with relatively high risk enrollees. It generally applies to non-grandfathered individual and small group plans inside and outside Exchanges.

The HHS risk adjustment methodology is described in the HHS Notice of Benefit and Payment Parameters for 2014 final rule (78 FR 15410), which was published in the *Federal Register* on March 11, 2013. Modifications to the HHS risk adjustment methodology for the 2017 benefit year are described in the HHS Notice of Benefit and Payment Parameters for 2017 final rule (81 FR 12204), which was published in the *Federal Register* on March 8, 2016. Partial year enrollment duration factors were incorporated in the final 2017 benefit year adult risk adjustment models in the HHS Notice of Benefit and Payment Parameters for 2018 final rule (81 FR 94056), which was published in the *Federal Register* on December 22, 2016.

The methodology that HHS will use when operating a risk adjustment program on behalf of a State for the 2017 benefit year will calculate a plan average risk score for each covered plan based upon the relative risk of the plan's enrollees, and apply a payment transfer formula in order to determine risk adjustment payments and charges between plans within a risk pool within a market within a State. The risk adjustment methodology addresses three considerations: (1) the newly insured population; (2) plan metal level differences and permissible rating variation; and (3) the need for risk adjustment transfers that net to zero. The risk adjustment methodology developed by HHS for the 2017 benefit year:

- Is developed on commercial claims data for a population similar to the expected population to be risk adjusted;
- Employs the hierarchical condition category ("HCC") grouping logic used in the Medicare risk adjustment program, but with HCCs refined and selected to reflect the expected risk adjustment population;
- Establishes concurrent risk adjustment models, one for each combination of metal level (platinum, gold, silver, bronze, catastrophic) and age group (adult, child, infant);
- Results in payment transfers that net to zero within a risk pool within a market within a State;
- Adjusts payment transfers for plan metal level, geographic rating area, induced demand, premium assistance Medicaid alternative plans, and age rating, so that transfers reflect health risk and not other cost differences; and
- Transfers funds between plans within a risk pool within a market within a State.

This document provides instructions for the HHS risk adjustment models for the 2017 benefit year, with revisions from the software instructions posted on the CCIIO website on July 21, 2017.

Key Revisions in 2017:
- (July 2017 Revisions) Added the assignment of enrollment duration factors to adult enrollees with fewer than 12 months of enrollment in a benefit year. Revised Table 1 Model Membership and Section II instructions to introduce and define the enrollment duration variable added to the person level file. Revised Table 6 Additional Adult Variables and Section V of the instructions to detail how the enrollment duration variable is used to create monthly enrollment duration indicator variables for use in the adult models for the 2017 benefit year.
- (November 2017 Revisions) Revised the days enrolled used to calculate enrollment duration variable; updated Table 1 and Section II instructions.
- (November 2017 Revisions) Updated Table 2 to add 2017 CPT/HCPCS codes used for diagnosis filtering, as described in Section II. The updated Table 2 includes review of 2017 quarterly updates with effective dates through October 1, 2017. Retained the 2016 column of code information (used for historical data purposes).
- (November 2017 Revisions) Revised Table 3 to contain FY2017 and FY2018 ICD-10 diagnosis codes and FY2017 and FY2018 Medicare Code Editor (MCE) age and sex conditions. Updated ICD-10 code labels to reflect changes in FY2018. Updated CC assignments to account for new FY2018 ICD-10 codes and revised FY2017 assignments. Updated the combined set of MCE age and sex conditions to be used for Calendar Year (CY) 2017 that covers both fiscal years (FY2017 and FY2018). Revised explanatory text in Sections II and V to clarify the use of FY2017 and FY2018 ICD-10 diagnosis codes and MCE edits.
- (July 2017 Revisions) Updated Table 9 Model Factors for the 2017 benefit year (using 2012, 2013, and 2014 MarketScan data). Revised Table 9 Model Factors for the 2017 benefit year to include enrollment duration factors for the adult models.

The risk adjustment methodology consists of concurrent risk adjustment models, one for each combination of metal level (platinum, gold, silver, bronze, and catastrophic) and age group (adult, child, infant). This document provides the detailed information needed to calculate risk scores given individual diagnoses.

The model instructions are based on the methodology described in the final notice of benefit and payment parameters. Please direct questions regarding the model instructions to HHS HCC Risk Adjustment Models at hhshccraops@cms.hhs.gov. This mailbox will be used only to answer questions pertaining to operations of the HHS risk adjustment model as posted to this site. We look forward to assisting with inquiries pertaining to your risk adjustment program operations using the HHS-HCC risk adjustment models for the 2017 benefit year.

CMS has created two versions of software (SAS software and HHS-developed risk adjustment model algorithm "Do It Yourself [DIY]" software) and software instructions for issuers to use with their enrollment data to simulate their enrollee populations' 2017 benefit year risk scores within the risk adjustment model. **This software is being issued only as supplemental guidance for issuers to better understand and simulate the calculation of plan liability risk scores for their enrollees.**

This software is not a required prerequisite to submitting claims data to the EDGE server for risk adjustment, nor is it a requirement of the risk adjustment program. Furthermore, issuers should not use this software to filter their own claims prior to submitting claims data to the EDGE server. The EDGE server software may have several additional layers of operational rules. The algorithm software merely provides a simulation to calculate enrollees' risk scores.

Terminology: In this document, the abbreviations HHS-HCC and HCC are used interchangeably for Health and Human Services Hierarchical Condition Categories. The abbreviations HHS-CC and CC are used interchangeably for HHS Condition Categories. The abbreviations ICD-10 and ICD-10-CM are used interchangeably for International Classification of Diseases, 10th Revision, Clinical Modification.

I.   Introduction

The risk adjustment program transfers funds from lower than average risk plans to higher than average risk plans using a specified methodology. A risk adjustment methodology includes a risk adjustment model, a determination of plan average actuarial risk, and a calculation of payments and charges.[1] The latter two elements are referred to by HHS as the payment transfer formula. This document provides a detailed description of the HHS risk adjustment models, and enables interested parties to develop software to determine risk scores given individual diagnoses.

This document should be viewed as a supplement to the HHS Notice of Benefit and Payment Parameters for 2017 final rule (81 FR 12204), and the 2017 benefit year methodology changes finalized in the HHS Notice of Benefit and Payment Parameters for 2018 final rule (81 FR 94056). Please note that the models described herein were finalized in these final rules.

The following is a description of the HHS risk adjustment models for the 2017 benefit year. This description includes a narrative and accompanying tables for calculating the risk scores from diagnoses in the HHS risk adjustment models. The HHS risk adjustment models calculate risk scores by summing an enrollee's factors (age/sex, HCCs, and interaction terms). This

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[1] A risk adjustment methodology also includes a data collection approach and a schedule for program operation. These elements are not discussed in this document.

description shows, in detail, how individual diagnoses are assigned to HCCs, and then allows the user to build individual risk scores from those diagnoses.

These instructions outline the steps needed to produce individual risk scores from the HHS risk adjustment models.

The HHS risk adjustment methodology includes risk adjustment models based on age, as detailed in Table 1 Model Membership. Adult scores are calculated for enrollees whose age is equal to or greater than 21 using the adult model set. Child scores are calculated for enrollees age 2 – 20 using the child model set. Infant scores are calculated for enrollees age 0 – 1 using the infant model set. Because HHS models predict plan liability, there are 5 models within each age group model set – one each for platinum, gold, silver, bronze, and for the individual market only, catastrophic plans.

The following five sections describe the algorithm for creating risk scores. Any algorithm developed to calculate risk scores should prepare the diagnosis-level file and use it to assign HCCs for each person. This is described in Section II and includes the list of acceptable CPT/HCPCS codes listed in Table 2.[2] Section III and Section IV, respectively, identify data inputted to and outputted from the risk adjustment model. Finally, Section V describes the algorithm to produce risk scores (i.e., outputs). First, the algorithm should crosswalk acceptable diagnoses to HHS Condition Categories (CCs). Then the algorithm should create HHS Hierarchical Condition Categories (HCCs) by imposing hierarchies on the HHS-CCs. For persons without claims or encounter records, zeros are assigned to all HHS-CCs and HHS-HCCs. After HHS-HCCs are created, the algorithm should compute predicted scores using the factors from the adult, child, and infant HHS risk adjustment regression models. This information is referenced in Tables 3-9.

The factors from the following regression models are used to produce risk scores:
- Adult regressions
  - Adult platinum
  - Adult gold
  - Adult silver
  - Adult bronze
  - Adult catastrophic
- Child regressions
  - Child platinum
  - Child gold
  - Child silver
  - Child bronze
  - Child catastrophic
- Infant regressions
  - Infant platinum
  - Infant gold
  - Infant silver

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[2] Definitions taken directly from the Current Procedural Terminology (CPT®) codes and the Healthcare Common Procedure Coding System (HCPCS) code set.

o Infant bronze
o Infant catastrophic

II. Creation of diagnosis-level file according to source of diagnoses allowable for risk adjustment

The diagnosis-level input file (Section III) should include ICD-10-CM diagnosis codes used for risk adjustment, listed in Table 3, ICD-10 to HHS-Condition Categories (CC) Crosswalk. The user must evaluate each claim or encounter record to determine whether the claim or record's diagnoses are included in the diagnosis file to be inputted to the algorithm or software. Encounter records normally report dates, provider or bill types, diagnoses and procedures, and other information, though they may not have payment information.

This section on the diagnosis file preparation explains how each record is evaluated to determine whether or not the record's diagnoses are to be used for CC/HCC creation. It is the user's responsibility to create the diagnosis-level file according to the filtering logic below. This document provides filtering instructions and a list of the 2016 (for historical data purposes) and 2017 CPT/HCPCS codes that define service or procedure types that identify acceptable sources of diagnoses for risk adjustment. However, the user must create the diagnosis-level file for input to the risk adjustment algorithm; the data set is <u>not</u> created by the algorithm.

NOTE: CMS stated that supplemental diagnosis codes may be submitted in certain circumstances. These instructions and the software do not address the addition of supplemental diagnosis codes. Therefore, risk score output from this software will not account for inclusion of supplemental diagnoses.

Only ICD-10-CM diagnosis codes from sources allowable for risk adjustment should be included in the diagnosis-level file. ICD-10 codes that are not listed in Table 3 may be included in the diagnosis-level file but are ignored by the algorithm.[3] The steps below provide logic to determine which diagnoses are allowable. Note that Steps 1 and 3 refer to Table 2, CPT/HCPCS Included List, which provides the 2016 and 2017 CPT/HCPCS codes used to define service or procedure types that are acceptable sources of diagnoses for risk adjustment.
- The CPT/HCPCS codes marking services with diagnoses allowable for risk adjustment are listed in column A of Table 2.
- Column B lists the short description of the CPT/HCPCS codes.
- Columns C and D, respectively, indicate whether a CPT/HCPCS code is acceptable in 2016 or 2017.
- Column E identifies applicable footnotes on the CPT/HCPCS codes.
- Notes begin on row 6534 of the Excel table with the line "Notes:" and should not be imported by any program.

The diagnosis-level input file should include diagnoses from claims/encounter records with **<u>discharge dates or through dates</u>** within the benefit year. Though the term "claim" is used in

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[3] If the user conducts fiscal year code validity checks described later in this section, only codes valid for risk adjustment will be included in the final diagnosis-level file.

the steps below, the steps apply equally to encounter records. For the EDGE server, only claims with discharge diagnoses are used for HHS risk adjustment.

1. Professional source of diagnosis
   a. For professional records, use diagnoses from records that have at least one line item with an acceptable CPT/HCPCS code (Table 2). If there is at least one acceptable line on the record, use all the header diagnoses. There are three possible values for CPT/HCPCS codes in columns C and D:
      i. yes = code is acceptable in that calendar year
      ii. no = code is not acceptable in that calendar year
      iii. N/A = code is not in existence in that calendar year
   b. For professional records, if a line item has an acceptable CPT/HCPCS code, use all diagnoses from the line item.
   c. If there are no acceptable service lines on the record, do not use any of the diagnoses for risk adjustment.
2. Inpatient facility source of diagnosis
   a. Use all header diagnoses from records where facility bill type code equals one of the following:
      i. 111 (inpatient admit through discharge); or
      ii. 117 (inpatient replacement of prior claim).
   b. There is no procedure screen for inpatient facility record types.
3. Outpatient facility source of diagnosis
   a. Restrict records to those with facility bill type code equal to:
      i. 131 (hospital outpatient admit though discharge); or
      ii. 137 (hospital outpatient replacement of prior claim); or
      iii. 711 (rural health clinic admit though discharge); or
      iv. 717 (rural health clinic replacement of prior claim); or
      v. 761 (community mental health center admit though discharge); or
      vi. 767 (community mental health center replacement of prior claim); or
      vii. 771 (federally qualified health center admit though discharge); or
      viii. 777 (federally qualified health center replacement of prior claim); or
      ix. 851 (critical access hospital admit though discharge); or
      x. 857 (critical access hospital replacement of prior claim).
   b. For records with at least one acceptable CPT/HCPCS code (Table 2) on a service line, use all header diagnoses. Otherwise, do not use the diagnoses for risk adjustment.

Fiscal year code validity: Section III further describes the diagnosis-level input data file. After creating that file, the user will have the variables needed to conduct fiscal year validity checks. Table 3 identifies the fiscal year(s) in which the diagnosis codes used for risk adjustment are valid. The user should check that for a given diagnosis (variable DIAG) and service date (variable DIAGNOSIS_SERVICE_DATE), the diagnosis code has a Y in the corresponding Table 3 Code Valid column. ICD-10 diagnosis codes with service dates of January 1, 2017 – September 30, 2017 should have a Y in the Code Valid in FY2017 column; otherwise, the user should exclude them. ICD-10 diagnosis codes with service dates of October 1, 2017 – December

31, 2017 should have a Y in the Code Valid in FY2018 column; otherwise, the user should exclude them.

Note on bundled claims for mother and newborn infant: In practice, some hospital claims for childbirth include both the mother's record and the newborn infant's record on the same claim (diagnoses and procedure codes). Because there are separate adult, child, and infant risk adjustment models and some of the diagnosis codes may not be distinguishable between mother and infant on bundled claims, **any bundled claims should be redefined as two separate records whenever possible (mother and infant, <u>each with a separate ID, sex, and age</u>) in order for the diagnoses to be appropriately included in the input dataset and used for appropriately calculating risk scores.**

The user will need to independently create a program to detect any bundled claims and redefine them (i.e., it is not part of these instructions). For example, a bundled claim detection program would need to identify enrollees with a claim containing the following elements:

Mother is the enrollee:
- AGE_LAST >= 2 (an age corresponding to the child or adult models; more specifically age should be appropriate for a maternity diagnosis)[4] and
- ICD-10 diagnoses corresponding to a completed pregnancy HCC (HHS-HCC 207 or 208 or 209) and
- ICD-10 diagnoses corresponding to a newborn HCC (HHS-HCC 242 or 243 or 244 or 245 or 246 or 247 or 248 or 249).

Infant is the enrollee:
- AGE_LAST = 0 (an age corresponding to the infant model; more specifically age is appropriate for a newborn diagnosis at birth) and
- ICD-10 diagnoses corresponding to a completed pregnancy HCC (HHS-HCC 207 or 208 or 209) and
- ICD-10 diagnoses corresponding to a newborn HCC (HHS-HCC 242 or 243 or 244 or 245 or 246 or 247 or 248 or 249).

See Table 3, ICD-10 to HHS-Condition Categories (CC) Crosswalk, for diagnosis codes corresponding to the completed pregnancy and newborn HCCs.

For purposes of creating the diagnosis-level input file (refer to Section III), if bundled claims will not be detected and redefined, enrollees with bundled claims should be included. If the enrollee is a female with an age appropriate for a maternity diagnosis, then the diagnoses on the bundled claim are assumed to correspond to the mother's enrollee ID. If the enrollee is age 0, then the diagnoses on the bundled claim are assumed to correspond to the infant's enrollee ID. All diagnoses on a bundled claim that could apply to either the mother or the infant (i.e., diagnoses that do not require passing an age/sex edit) are assumed to apply to the enrollee's ID. All HHS-HCCs that are valid for the mother or infant (based on diagnoses that pass or do not require

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[4] Section III of this document identifies the two age variables used in the software and specifies when each is used. Section V includes the detailed algorithm for creation of HCCs.

age/sex edits) will be used to compute the enrollee's risk score; and all diagnoses that do not pass age/sex edits (i.e., newborn diagnosis codes for the mother; pregnancy diagnosis codes for the infant) will be ignored.[5] Table 1, rows 11-20, provides an algorithm for including these enrollees.

Infants with a record in the person-level file (refer to Section III) that cannot be matched with a claim or who do not have claims will have no diagnoses in the diagnosis-level file. Infants without diagnoses will be assigned to the lowest severity category and the Age 1 maturity category for infants as detailed in Table 8, rows 122 and 129. Age 0 infants with diagnoses but who lack a newborn HCC will be assigned to the corresponding severity category and the Age 1 maturity category for infants as detailed in Table 8, rows 5-122 and 129. Male infants will also have the male demographic factor assigned. Age 0 male infants who lack a newborn HCC will have their demographic factor reassigned to Age 1.

III.   Input data files for HHS-CC/HCC variable creation

This section describes the two input data files needed to create HHS-CC and HHS-HCC grouping and regression variables—a person-level file and a diagnosis-level file. It is the responsibility of the user to create these input data files with the variables listed in this section.

Note on CSR_INDICATOR

In operations, cost-sharing reduction (CSR) plan variations and premium assistance Medicaid Alternative plans (i.e., private options) will be identified by the Health Insurance Oversight System (HIOS) variant ID. Listed below are the codes that will be used to identify the plan variation. Please note that unlike the risk adjustment software person-level CSR indicator, the HIOS variant ID is a plan-level indicator.

Cost-Sharing Reduction (CSR) Level	HIOS Variant ID	CSR RA Factor	RA Software Person-level CSR Indicator
CSR: 94% AV Silver Plan Variation	06	1.12	1
CSR: 87% AV Silver Plan Variation	05	1.12	2
CSR: 73% AV Silver Plan Variation	04	1.00	3
CSR: Zero Cost Sharing – Platinum	02	1.00	4
CSR: Zero Cost Sharing – Gold	02	1.07	5
CSR: Zero Cost Sharing – Silver	02	1.12	6
CSR: Zero Cost Sharing – Bronze	02	1.15	7
CSR: Limited Cost Sharing – Platinum	03	1.00	8
CSR: Limited Cost Sharing – Gold	03	1.07	9
CSR: Limited Cost Sharing – Silver	03	1.12	10

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[5] This software does not flag or otherwise identify diagnoses that do not pass age/sex edits. Software users may want to create a diagnosis-level flag for bundled claims that identifies rejected diagnoses, or create a person-level flag for bundled claims that identifies enrollees with at least one rejected diagnosis submitted.

CSR: Limited Cost Sharing – Bronze	03	1.15	11
CSR: Premium Assistance Medicaid Alternative Plan w/94% AV Silver Plan	36	1.12	12
CSR: Premium Assistance Medicaid Alternative Plan w/Zero Cost Sharing - Silver	32	1.12	13
Non-CSR/unknown CSR	00	1.00	0

Note on Enrollment Duration
As introduced in the Key Revisions bullets, the 2017 adult model includes enrollment duration factors for months enrolled when less than 12 months. There are two steps involved in creating the enrollment duration indicator variables:

STEP 1: For the PERSON file, the user should create an ENROLDURATION variable for each enrollee with 12 possible values corresponding to 1-12 months based on an enrollee's total number of days enrolled in the plan in the benefit year as described below and in Table 1, rows 22-23. Although ENROLDURATION will only be used to create variables needed for the adult model, we recommend it be constructed for *all* enrollees to maintain consistency in the variables present in the PERSON file. The created ENROLDURATION variable can be ignored for enrollees in the child or infant models.

STEP 2: The monthly enrollment duration indicator variables (ED_1- ED_11) will be created only for adult enrollees by the algorithm as described in Section V and in Table 6, rows 106-116.

1. PERSON file – a person-level file of demographic and enrollment information
   a. ENROLID (or other person identification variable)
      i. character or numeric type and unique to an individual
   b. SEX
      i. one character, 1=male; 2=female
   c. DOB
      i. 8 character numeric field, provides the enrollee's date of birth
      ii. Used to calculate AGE_AT_DIAGNOSIS for MCE diagnosis code age edits
   d. AGE_LAST
      i. Age as of last day of enrollment in benefit year
      ii. Used for all risk adjustment purposes except MCE diagnosis code age edits
      iii. For infants born in the previous year but not discharged until the benefit year, users should substitute Age 0 for Age 1 in AGE_LAST.
   e. METAL
      i. Enrollee's metal level
      ii. Allowable values: platinum, gold, silver, bronze, catastrophic (only 1 of these values)
   f. CSR_INDICATOR

     i. Person-level indicator. Enrollees who qualify for cost-sharing reductions or those enrolled in premium assistance Medicaid alternative plans will be assigned CSR_INDICATOR =1-13. Non-CSR recipients will be assigned CSR_INDICATOR = 0.

       1. 1 = Enrollees in 94% AV Silver Plan Variation
       2. 2 = Enrollees in 87% AV Silver Plan Variation
       3. 3 = Enrollees in 73% AV Silver Plan Variation
       4. 4 = Enrollee in Zero Cost Sharing Plan Variation of Platinum Level QHP
       5. 5 = Enrollee in Zero Cost Sharing Plan Variation of Gold Level QHP
       6. 6 = Enrollee in Zero Cost Sharing Plan Variation of Silver Level QHP
       7. 7 = Enrollee in Zero Cost Sharing Plan Variation of Bronze Level QHP
       8. 8 = Enrollee in Limited Cost Sharing Plan Variation of Platinum Level QHP
       9. 9 = Enrollee in Limited Cost Sharing Plan Variation of Gold Level QHP
      10. 10 = Enrollee in Limited Cost Sharing Plan Variation of Silver Level QHP
      11. 11 = Enrollee in Limited Cost Sharing Plan Variation of Bronze Level QHP
      12. 12 = Enrollee in a Premium Assistance Medicaid Alternative Plan with 94% AV Silver Plan Variation
      13. 13 = Enrollee in a Premium Assistance Medicaid Alternative Plan with Zero Cost Sharing Plan Variation of Silver Level QHP
      14. 0 = Non-CSR recipient and enrollees with unknown CSR

g. ENROLDURATION

     i. Person-level enrollment duration variable. Although it is for use in adult models only, it is recommended the user create it for all enrollees for consistency in PERSON file preparation. Values will be ignored for enrollees in child or infant models.

     ii. Allowable values are 1-12 based on months enrolled in plan in benefit year as defined by days:

        1 = 1–31 days enrolled
        2 = 32–62 days enrolled
        3 = 63–92 days enrolled
        4 = 93–123 days enrolled
        5 = 124–153 days enrolled
        6 = 154–184 days enrolled
        7 = 185–214 days enrolled
        8 = 215–245 days enrolled
        9 = 246–275 days enrolled
       10 = 276–306 days enrolled
       11 = 307–335 days enrolled

12 = 336–366 days enrolled

2. DIAG file – a diagnosis-level input file of diagnoses
   a. ENROLID (or other person identification variable that must be the same as in PERSON file)[6]
      i. person identifier of character or numeric type and unique to an individual
   b. DIAG
      i. ICD-10-CM diagnosis code, 7 character field, no periods, left justified. Codes should be to the greatest level of available specificity. (Age and sex edits for diagnoses are applied in Part V, step 1 to ensure diagnoses are appropriate for the age and sex of the enrollee.) Only diagnoses from allowable sources (Part II) should be included in the diagnosis-level file.
   c. DIAGNOSIS_SERVICE_DATE
      i. 8 character numeric field, provides the date of the diagnosis
      ii. As described in Part II, this variable can be used with DIAG and Table 3 to check that a diagnosis code is valid for a given fiscal year.
   d. AGE_AT_DIAGNOSIS
      i. Age as of the diagnosis service date, calculated using DOB from PERSON file and DIAGNOSIS_SERVICE_DATE
      ii. Used only for MCE diagnosis code age edits

IV. Variables output by the algorithm

This section describes the variables that are outputted by the HHS risk adjustment model. Any software or algorithms developed from the tables output a person-level file and need to be capable of adding any person-level variables that the user wants to keep.

The following variables can be specified:
1. Any person-level variables from the original person-level file
2. Demographic age/sex variables created by the algorithm
3. HHS-HCCs created by the algorithm
4. HHS-CCs (condition categories assigned before hierarchies are applied)
5. HHS-HCC groups and HHS-HCC interactions created by the algorithm
6. Infant model maturity categories, reassigned age/sex variables, severity level categories, and maturity by severity level interactions created by the algorithm
7. Adult model enrollment duration variables created by the algorithm
8. Score variables:
   a. Adult Models
      i. SCORE_ADULT_PLATINUM
      ii. SCORE_ADULT_GOLD
      iii. SCORE_ADULT_SILVER
      iv. SCORE_ADULT_BRONZE
      v. SCORE_ADULT_CATASTROPHIC
   b. Child Models
      i. SCORE_CHILD_PLATINUM

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[6] Please note that in operation, this information can not include personally identifiable information.

  ii. SCORE_CHILD_GOLD
  iii. SCORE_CHILD_SILVER
  iv. SCORE_CHILD_BRONZE
  v. SCORE_CHILD_CATASTROPHIC
 c. Infant Models
  i. SCORE_INFANT_PLATINUM
  ii. SCORE_INFANT_GOLD
  iii. SCORE_INFANT_SILVER
  iv. SCORE_INFANT_BRONZE
  v. SCORE_INFANT_CATASTROPHIC

9. CSR-adjusted score variables:
 a. Adult Models
  i. CSR_ADJUSTED_SCORE_ADULT_PLATINUM
  ii. CSR_ADJUSTED_SCORE_ADULT_GOLD
  iii. CSR_ADJUSTED_SCORE_ADULT_SILVER
  iv. CSR_ADJUSTED_SCORE_ADULT_BRONZE
  v. CSR_ADJUSTED_SCORE_ADULT_CATASTROPHIC
 b. Child Models
  i. CSR_ADJUSTED_SCORE_CHILD_PLATINUM
  ii. CSR_ADJUSTED_SCORE_CHILD_GOLD
  iii. CSR_ADJUSTED_SCORE_CHILD_SILVER
  iv. CSR_ADJUSTED_SCORE_CHILD_BRONZE
  v. CSR_ADJUSTED_SCORE_CHILD_CATASTROPHIC
 c. Infant Models
  i. CSR_ADJUSTED_SCORE_INFANT_PLATINUM
  ii. CSR_ADJUSTED_SCORE_INFANT_GOLD
  iii. CSR_ADJUSTED_SCORE_INFANT_SILVER
  iv. CSR_ADJUSTED_SCORE_INFANT_BRONZE
  v. CSR_ADJUSTED_SCORE_INFANT_CATASTROPHIC

10. Final unadjusted and CSR-adjusted score variables depending on the enrollee's metal level and CSR indicator, including enrollment in premium assistance Medicaid alternative plans.
 a. Adult scores
  i. SCORE_ADULT
  ii. CSR_ADJUSTED_SCORE_ADULT
 b. Child scores
  i. SCORE_CHILD
  ii. CSR_ADJUSTED_SCORE_CHILD
 c. Infant scores
  i. SCORE_INFANT
  ii. CSR_ADJUSTED_SCORE_INFANT

The user should determine which of the scores is appropriate for the enrollee depending upon the age and plan benefit design of that enrollee.

V.   Algorithm to produce output

This section describes the process by which the outputs identified in Section IV are created. The algorithm to produce risk scores can be segmented into five parts—HHS-CC and HHS-HCC creation, model variable creation, access factors table, unadjusted score calculation, and CSR-adjusted score calculation.

Step 1: HHS-CC and HHS-HCC creation. This first step should use Table 3 for HHS-CC creation and Table 4 for HHS-HCC creation.

Table 3 crosswalks ICD-10 codes to the HHS-Condition Categories (CCs) in the risk adjustment models. This table incorporates the ICD-10 Medicare Code Edits (MCEs) for age and sex, the further specified CC age and sex splits, and the creation of CCs and additional CCs.[7] Explanations of the fields in Table 3 are provided below:

- OBS (column A): Observations, numeric count from 1 to 8,283 of the code list.
- ICD10 (column B): Only ICD-10 codes assigned to HCCs in the risk adjustment models are included in this crosswalk. All other ICD-10 codes correspond to HCCs not included in the risk adjustment models and are not used to calculate risk scores.
- ICD10 Label (column C): Full ICD-10 code labels.
- Code Valid columns (columns D and E): Identifies the fiscal year(s) (column D FY2017; column E FY2018) in which the ICD-10 codes are valid. There are two possible values in columns D and E:
  - Y = Yes, code is valid ICD-10 code in that fiscal year
  - N = No, code is not valid ICD-10 code in that fiscal year; code may not yet be in existence or code was deleted in that fiscal year
- FY2017 MCE Age Condition [use AGE_AT_DIAGNOSIS] (column F), FY2018 MCE Age Condition [use AGE_AT_DIAGNOSIS] (column H), and CY2017 (FY17/FY18) MCE Age Condition [use AGE_AT_DIAGNOSIS] (column J): Checks that a person with a diagnosis code has the appropriate age for the diagnosis. The specific fiscal year versions are presented for informational purposes. The user should use the CY2017 version which covers both fiscal years (column J) to match the MCE Age Condition version being used in Operations. Conditions listed in this column are required for the CC to be assigned.
  - Newborn diagnosis: Age of 0 years
  - Pediatric diagnosis: Age range is 0-17 years inclusive
  - Maternity diagnosis: Age range is 12-55 years inclusive
  - Adult diagnosis: Age range is 15 years or older
- FY2017 MCE Sex Condition (column G), FY2018 MCE Sex Condition (column I), and CY2017 (FY17/FY18) MCE Sex Condition (column K): Checks that a person with a diagnosis code has the appropriate sex for the diagnosis. The specific fiscal year versions are presented for informational purposes. The user should use the CY2017 version which covers both fiscal years (column K) to match the MCE Sex Condition version being used in Operations. Conditions listed in this column are required for the CC to be assigned.

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[7] The CC age and sex splits relate to how specific conditions are reclassified by age or sex within the full HHS-HCC classification. These reassignments are not related to age or sex coding guidelines.

- o Female indicates the diagnosis is only appropriate for females.
- o Male indicates the diagnosis is only appropriate for males.
- CC Age Split [use AGE_LAST] (column L): Identifies diagnosis codes whose assignments to CCs in the risk adjustment models change depending on the age of the enrollee. ICD-10 codes assigned by age to more than one CC in the risk adjustment models are listed more than once. In those cases, the age splits are mutually exclusive and enrollees are assigned to only one CC for the given diagnosis.
- CC Sex Split (column M): Identifies diagnosis codes whose assignments to CCs in the risk adjustment models change depending on the sex of the enrollee. ICD-10 codes assigned by sex to more than one CC in the risk adjustment models are listed more than once. Enrollees are assigned to only one CC for the given diagnosis.
- CC (column N): Identifies the CC in the risk adjustment models that a person with the ICD-10 code who meets the MCE conditions and CC splits is assigned.
- Additional CC (column O): Identifies the additional CC in the risk adjustment model that a person with the ICD-10 code who meets the MCE conditions and CC Age or Sex splits is assigned. Additional CCs are assigned when the ICD-10 code is assigned to more than one HCC in the risk adjustment models because it contains more than one clinical concept (such as an ICD-10 diagnosis code that encompasses both diabetes and a complication of diabetic peripheral angiopathy with gangrene).
- Footnote (column P): Identifies applicable footnotes for the ICD-10 code. Notes begin on row 8289 of the Excel table with the line "Notes:" and should not be imported by any program.

Table 4 provides the hierarchy rules to apply to the CCs to create HHS-HCCs. Explanations of the fields in Table 4 are provided below:
- OBS (column A): Observations, numeric count from 1 to 127 of HCCs in the HHS risk adjustment models.
- HCC (column B): Only HCCs in the risk adjustment models are identified. HCCs are created when hierarchies are applied to CCs.
- Set to 0 HCCs (column C): Hierarchy exclusions for each HCC are listed. Users should set the HCCs in this column to 0 when a person has the HCC listed in column B.
- HCC Label (column D): Full HCC labels.

Use Table 3 and Table 4 to create CCs and HHS-HCCs:
1. Create CC and HHS-HCC 0/1 indicator variables for each HCC in the risk adjustment models listed in Table 4 (Example: CC001, CC002, CC003, CC004, CC006, CC008 ... CC254; HHS_HCC001, HHS_HCC002 ... HHS_HCC254). Initially, set CCs and HHS-HCCs to 0 for each person.
2. If there are any acceptable diagnoses for a person, then:
   a. Perform ICD-10 Medicare Code Edits (MCEs) for age and sex (use CY2017 MCE Age Condition and MCE Sex Condition columns in Table 3). Use AGE_AT_DIAGNOSIS for applying MCE age edits.
   b. If a person meets the MCE conditions, apply CC Age Split and CC Sex Split to create CC (set to 1) using crosswalk of ICD-10 to CCs (use CC Age Split,

CC Sex Split, and CC columns in Table 3). Use AGE_LAST for CC age splits.

    c. Create additional CCs (set to 1) using Additional CC column.

3. Create HHS-HCCs after all diagnoses for a person are processed and CC variables are created using hierarchies provided in Table 4.

    a. Set HCC to 1 when corresponding CC is set to 1.

    b. Set the HCCs in column C to 0 when a person has the HCC listed in column B set to 1.

Step 2: Model variable creation.
This step should use Table 5 for demographic variable creation, Table 6 for additional adult model variables including enrollment duration, Table 7 for additional child model variables, and Table 8 for additional infant model variables.

Explanations of the fields in Tables 5-8 are provided below:
- Column A identifies the model set in which the variable is used (adult, child or infant).
- Column B identifies the variable name.
- Column C gives a variable description.
- Column D indicates if the variable is used in the model.
- Column E defines the variable creation.

Variables must be assigned values in the same order as defined in Tables 5, 6, 7, and 8. For example, in Table 6, assign a value to variable SEVERE_V3 first, then the HCC group variables, then the severe illness interactions, then the severe illness interaction groups.

Variable creation:
1. Create demographic variables needed for score calculation using Table 5.

    a. A person's age and sex are used to create 1 of 28 mutually exclusive age-sex variables (18 for adult models, 8 for child models, 2 for infant models). Use AGE_LAST.

    b. Because the infant model is computed with females as the reference group for the age-sex demographic variables, there are no separate age-sex demographic variables for females age 0 or 1. Note that if male age 0 infants are assigned to Age 1 because they lack a newborn HCC, their age/sex demographic variable will be reassigned to Age 1 using Table 8.

    c. Adult age-sex variables are listed in rows 8-25.

    d. Child age-sex variables are listed in rows 27-34.

    e. Infant age-sex variables are listed in rows 36 and 37.

2. For the adult model, create the severe illness indicator variable using Table 6.

    a. The severe illness indicator variable, SEVERE_V3, is created when an adult has at least 1 of 8 HHS-HCCs that indicate a severe illness. Rows 5-12 of column E in Table 6 identify these 8 HHS-HCCs.

        i. SEVERE_V3 is initially set to 0 for each adult and is set equal to 1 if the adult has at least 1 of the 8 HHS-HCCs.

3. For the adult and child models – create HCC groups using Tables 6 and 7.

a. HCC groups are effectively treated as single HHS-HCCs in the models. The HCC groups are assigned variables GXX, where XX is the group number.

b. For the adult models:
   i. There are 17 adult HCC groups. The group variable names are listed in rows 14-67 of column B of Table 6.
   ii. Initially create the 17 HCC groups for adults and set to 0 for each person.
   iii. The HHS-HCCs in an HCC group are listed in column E of Table 6 starting in row 14.
   iv. A variable for an HCC group is set to equal 1 if an adult has at least one of the HHS-HCCs in a given adult HCC group.

c. For the child models:
   i. There are 17 child HCC groups. The HCC group variable names are listed in rows 5-59 of column B of Table 7.
   ii. Initially create the 17 HCC groups for children and set to 0 for each person.
   iii. The HHS-HCCs in an HCC group are found in column E of Table 7 starting in row 5.
   iv. A variable for an HCC group is set to equal 1 if a child has at least one of the HHS-HCCs in a given child HCC group.

4. For the adult models – create HHS-HCC interaction variables using Table 6.
   a. The variable SEVERE_V3 is used to create the severe illness indicator in HHS-HCC or HCC group interactions. There are 16 interactions identified in rows 71-86 of Table 6.
      i. Interaction variables are initially set to 0 for each adult.
      ii. The variable for an interaction is set to 1 if an adult has SEVERE_V3=1 and the HHS-HCC or HCC group in the interaction =1.
   b. The interactions are aggregated to create two severe illness interaction groups based on the predicted expenditures of the interactions that are in the models.
      i. Variables INT_GROUP_H and INT_GROUP_M are set to 0 for each adult.
      ii. INT_GROUP_H is set to 1 if an adult has at least 1 of the 9 high-cost interactions. The variable and interactions are found in rows 88-96 of Table 6.
      iii. INT_GROUP_M is set to 1 if an adult has at least 1 of the 7 medium-cost interactions and INT_GROUP_H is set to 0. The variable and interactions are found in rows 98-104 of Table 6.

5. For the adult models – create enrollment duration variables using Table 6.
   a. The variable ENROLDURATION is used to create the 11 mutually-exclusive (0/1) enrollment duration indicators for adult enrollees who have partial year enrollment. The variables are identified in rows 106-116 of Table 6.
      i. The enrollment duration variables ED_1–ED_11 are initially set to 0 for each adult.
      ii. An enrollment duration variable (ED_X) is set to 1 if an adult has ENROLDURATION equal to the corresponding number (X). For

example, ED_1 = 1 if ENROLDURATION = 1, ED_2 = 1 if ENROLDURATION = 2, and so on.

     iii. Enrollees who have ENROLDURATION = 12 (indicating 12-month enrollment) will have all 11 ED variables set to 0. All other adult enrollees will have exactly 1 ED variable set to 1.

6. For the infant models – create maturity and severity categories, reassign age-sex variable if needed, and create maturity by severity level interaction variables using Table 8.

    a. Table notation: Severity category and maturity category variables (which are not included in the regression, but are used to create regression interaction variables) use the "IHCC_" prefix designating them as Infant variables. Examples: IHHC_Severity5; IHCC_Extremely_Immature.

    b. Create 5 severity level category 0/1 indicator variables based on HHS-HCC flags (See Table 8, rows 5-116). Set to 1 if any of the corresponding HHS-HCC variables is set to 1.

        i. Severity Level 5 (Highest)
        ii. Severity Level 4
        iii. Severity Level 3
        iv. Severity Level 2
        v. Severity Level 1 (Lowest)

    c. Apply hierarchies so that each age 0 or age 1 infant has only a single severity level variable, the highest qualifying level, set to 1 (see Table 8, rows 118-122). Note that infants lacking any of the HHS-HCCs corresponding to severity levels are assigned to Severity Level 1 (Lowest).

    d. Create 5 maturity category 0/1 indicator variables set to 1 based on age only if age 1, and on age as well as newborn HHS-HCC flags if age 0 (see Table 8, rows 124-129). Note that age 0 infants lacking a newborn HHS-HCC (242-249) are assigned to Age 1.

        i. Age 1
        ii. Extremely Immature
        iii. Immature
        iv. Premature/Multiples
        v. Term

    e. Apply hierarchies so that that each age 0 or age 1 infant has only a single maturity variable set to 1 (see Table 8, rows 130-132).

    f. Reassign male age 0 infants lacking a newborn HHS-HCC to the Age 1 age-sex variable (see Table 8, row 134).

    g. Create 25 maturity by severity level interactions (0/1) using the 5 maturity category variables and 5 severity level category variables (see Table 8, rows 136-160). These are mutually-exclusive interactions—each infant will have only one maturity by severity level interaction set to 1.

        i. Extremely_Immature_x_Severity5
        ii. Extremely_Immature_x_Severity4
        iii. Extremely_Immature_x_Severity3
        iv. Extremely_Immature_x_Severity2
        v. Extremely_Immature_x_Severity1

vi.	Immature_x_Severity5
vii.	Immature_x_Severity4
viii.	Immature_x_Severity3
ix.	Immature_x_Severity2
x.	Immature_x_Severity1
xi.	Premature_Multiples_x_Severity5
xii.	Premature_Multiples_x_Severity4
xiii.	Premature_Multiples_x_Severity3
xiv.	Premature_Multiples_x_Severity2
xv.	Premature_Multiples_x_Severity1
xvi.	Term_x_Severity5
xvii.	Term_x_Severity4
xviii.	Term_x_Severity3
xix.	Term_x_Severity2
xx.	Term_x_Severity1
xxi.	Age1_x_Severity5
xxii.	Age1_x_Severity4
xxiii.	Age1_x_Severity3
xxiv.	Age1_x_Severity2
xxv.	Age1_x_Severity1

Step 3: Access factors in Table 9.
1. For the adult models, use adult factors in rows 4-178 for each of the metal levels (columns D-H).
2. For the child models, use child factors in rows 180-331 for each of the metal levels (columns D-H)
3. For the infant models, use infant factors in rows 333-359 for each of the metal levels (columns D-H)

Step 4: Unadjusted score calculation (using directions in Tables 6-8, variables created in Tables 5-8, and factors from Table 9).

1. For each adult, create an adult model score for the metal level in which that adult is enrolled (corresponding to scores in Part IV).
   a. Create scores for each metal level using directions in rows 118-124 in Table 6.
      i. SCORE_ADULT_PLATINUM
      ii. SCORE_ADULT_GOLD
      iii. SCORE_ADULT_SILVER
      iv. SCORE_ADULT_BRONZE
      v. SCORE_ADULT_CATASTROPHIC
   b. The score for each of the above variables is the sum of the factors of the corresponding metal level in Table 9 for all variables set to 1 for that adult: demographic variable, any HHS-HCCs, any HCC groups, a severe illness interaction group if applicable, and an enrollment duration variable if applicable.
      i. SCORE_ADULT_PLATINUM uses factors from column D

ii. SCORE_ADULT_GOLD uses factors from column E

iii. SCORE_ADULT_SILVER uses factors from column F

iv. SCORE_ADULT_BRONZE uses factors from column G

v. SCORE_ADULT_CATASTROPHIC uses factors from column H

c. Identify the metal level in which the adult is enrolled (Table 1).

d. Create an adult model score SCORE_ADULT for the metal level in which the adult is enrolled using directions in rows 147-148 in Table 6.

2. For each child create a child model score for the metal level in which that child is enrolled (corresponding to scores in Part IV).

a. Create scores for each metal level using directions in rows 63-67 in Table 7.

i. SCORE_CHILD_PLATINUM

ii. SCORE_CHILD_GOLD

iii. SCORE_CHILD_SILVER

iv. SCORE_CHILD_BRONZE

v. SCORE_CHILD_CATASTROPHIC

b. The score for each of the above variables is the sum of the factors of the corresponding metal level in Table 9 for all variables set to 1 for that child: demographic variable, any HHS-HCCs, and any HCC groups.

i. SCORE_CHILD_PLATINUM uses factors from column D

ii. SCORE_CHILD_GOLD uses factors from column E

iii. SCORE_CHILD_SILVER uses factors from column F

iv. SCORE_CHILD_BRONZE uses factors from column G

v. SCORE_CHILD_CATASTROPHIC uses factors from column H

c. Identify the metal level in which the child is enrolled (Table 1).

d. Create a child model score SCORE_CHILD for the metal level in which the child is enrolled using directions in rows 90-91 in Table 7.

3. For each infant create an infant model score for the metal level in which that infant is enrolled (corresponding to scores in Part IV) using directions starting at row 162 of Table 8, infant variables created in Tables 5 and 8, and factors from Table 9.

a. Unadjusted infant risk score is the sum of (0/1 variable x factor) over all of the following:

i. 0/1 age-sex categories for INFANT models

ii. 0/1 maturity x severity level interactions for INFANT models

b. The unadjusted score is the sum of the factors of the corresponding metal level in Table 9 for all variables set to 1 for that infant.

i. SCORE_INFANT_PLATINUM uses factors from column D

ii. SCORE_INFANT_GOLD uses factors from column E

iii. SCORE_INFANT_SILVER uses factors from column F

iv. SCORE_INFANT_BRONZE uses factors from column G

v. SCORE_INFANT_CATASTROPHIC uses factors from column H

c. Females will have a single maturity level x severity level interaction set to 1 and that factor will be their score. Males will a have a single maturity level x severity level interaction set to 1 and a single age-sex variable set to 1; the sum of the factors for those two variables will be their score.

d. Identify the metal level in which the infant is enrolled (Table 1).

e. Create an infant model score SCORE_INFANT for the metal level in which
the infant is enrolled using directions in rows 189-190 in Table 8.

Step 5: CSR-adjusted score calculation (using instructions in Tables 6-8).

1. For each adult, create an adult model CSR-adjusted score for the metal level in which
that adult is enrolled (corresponding to CSR-adjusted scores in Part IV).
    a. Each adult will have one of the following CSR-adjusted risk scores that
corresponds to his/her metal level. CSR-adjusted scores are created using
directions in rows 126-145 in Table 6.
        i. CSR_ADJUSTED_SCORE_ADULT_PLATINUM
        ii. CSR_ADJUSTED_SCORE_ADULT_GOLD
        iii. CSR_ADJUSTED_SCORE_ADULT_SILVER
        iv. CSR_ADJUSTED_SCORE_ADULT_BRONZE
        v. CSR_ADJUSTED_SCORE_ADULT_CATASTROPHIC
    b. Identify the metal level in which the adult is enrolled (Table 1).
    c. Create an adult model score CSR_ADJUSTED_SCORE_ADULT for the
metal level in which the adult is enrolled using directions in rows 150-152 in
Table 6.
2. For each child, create a child model CSR-adjusted score for the metal level in which
that child is enrolled (corresponding to CSR-adjusted scores in Part IV).
    a. Each child will have one of the following CSR-adjusted risk scores that
corresponds to his/her metal level. CSR-adjusted scores are created using
directions in rows 69-88 in Table 7.
        i. CSR_ADJUSTED_SCORE_CHILD_PLATINUM
        ii. CSR_ADJUSTED_SCORE_CHILD_GOLD
        iii. CSR_ADJUSTED_SCORE_CHILD_SILVER
        iv. CSR_ADJUSTED_SCORE_CHILD_BRONZE
        v. CSR_ADJUSTED_SCORE_CHILD_CATASTROPHIC
    b. Identify the metal level in which the child is enrolled (Table 1).
    c. Create a child model score CSR_ADJUSTED_SCORE_CHILD for the metal
level in which the child is enrolled using directions in rows 93-95 in Table 7.
3. For each infant, create an infant model CSR-adjusted score for the metal level in
which that infant is enrolled (corresponding to CSR-adjusted scores in Part IV).
    a. Each infant will have one of the following CSR-adjusted risk scores that
corresponds to his/her metal level. CSR-adjusted scores are created using
directions in rows 168-187 in Table 8.
        i. CSR_ADJUSTED_SCORE_INFANT_PLATINUM
        ii. CSR_ADJUSTED_SCORE_INFANT_GOLD
        iii. CSR_ADJUSTED_SCORE_INFANT_SILVER
        iv. CSR_ADJUSTED_SCORE_INFANT_BRONZE
        v. CSR_ADJUSTED_SCORE_INFANT_CATASTROPHIC
    b. Identify the metal level in which the infant is enrolled (Table 1).
    c. Create an infant model score CSR_ADJUSTED_SCORE_INFANT for the
metal level in which the infant is enrolled using directions in rows 192-194 in
Table 8.

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