CMS Hospital-Wide All-Cause Unplanned Readmission Measure: 2019 SAS Pack Software Documentation

Submitted by Yale New Haven Health Services Corporation - Center for Outcomes Research and Evaluation (YNHHSC/CORE)

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1. Introduction

This document describes the details for implementing the 2019 Hospital-Wide All-Cause Risk-Standardized Readmission Measure SAS package (SAS pack) created to produce the Centers for Medicare & Medicaid Services (CMS) 30-day risk-standardized hospital-wide readmission rates. This measure has been endorsed by the National Quality Forum. CMS publicly reports this measure on its Hospital Compare web site (www.hospitalcompare.hhs.gov).

The technical documentation for the hospital-wide readmission measure is available at www.qualitynet.org under the Hospital-Inpatient > Claims-Based Measures > Readmission Measures > Measure Methodology section. The following documents are available:

- *2019 Hospital-Wide Readmission Measure Updates and Specifications Report Version 8.0*
- *2019 HWR Readmission Measure Updates and Specifications Report: Supplemental ICD-10 Code List*
- *Hospital-Wide Readmission Technical Report (2012)*

The 2019 Hospital-Wide Readmission SAS pack is comprised of two SAS programs, one main program and one separate program containing SAS macros called from the main program. The SAS pack also needs SAS format files.

- HWR_V2019.sas
- HWR_Readmission_Macros_V2019.sas
- CC Formats.sas7bcat – one for International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9) and one for ICD-10 codes
- CCS Formats.sas7bcat – one for ICD-9 and one for ICD-10 codes

The program is designed to be run with one year of data. They require specific datasets and formats as explained in Section 3. This document provides examples of the input files and output datasets that can be expected once the program has run successfully. The format files are available by request through the CMS readmission measures mailbox: cmsreadmissionmeasures@yale.edu.

2. System Requirements

The computer system needed to run the SAS pack should meet the following hardware and software basic requirements:

- Operating System: Microsoft Windows XP Professional or later versions
- Statistical Software: SAS 9.3.0 or later versions
- Hardware: minimum 2 GB RAM and minimum 50 GB hard drive space

3. Input Data Sources

The Hospital-Wide Readmission Measure SAS pack utilizes pre-processed CMS administrative data to conduct analyses. Detailed information regarding the algorithms to produce these files

can be found in the data specifications by request through the CMS readmission measures mailbox - cmsreadmissionmeasures@yale.edu. The following data sources are used in the Hospital-Wide Readmission Measure SAS pack:

- Index Hospital Discharge File – Includes:
  - Part A data for discharges selected for inclusion in the measure for the reporting year(s) and condition of interest
  - Demographic and Fee-for-Service (FFS) enrollment information from the Medicare Enrollment Database and Denominator file

- Post-Index Hospital Discharge File – Includes:
  - Records of subsequent admissions for patients in the index discharge file
  - Part A discharge data for admissions that occurred within 90 days after the index discharge date

- Diagnosis History File (can be merged to Index Discharge File by Medicare Health Insurance Claim [HIC] number and HISTORY_CASE/CASE identifier) – Includes:
  - Records for patients with index admissions
  - Diagnosis codes selected for 365 days prior to index admission
  - Diagnoses from Part A Inpatient and Hospital Outpatient Data
  - Source code, which indicates the source file from which the diagnosis code was extracted

3.1 Index File

The variable names, data formats, and data structures in each input file must match the data standards described in the data specifications. The record unit for the Index Discharge file is at the patient discharge. Display 1 shows the SAS file data structure for the index inpatient discharge file.

Display 1. Variables and Attributes of the Index Hospital Discharge File

Variable	Type	Len	Label
ADMIT	Num	8	Admission date
ADMSOUR	Char	1	Source of admission
BENE_CLM_NUM	Char	12	Bene claim number
BENE_CLM_NUM_EQUATED	Char	12	Bene claim number equated
BILL_TYPE	Char	3	Type of a bill - concatenation of facility, bill classification and frequency
BSTATE	Char	2	Beneficiary State of Residence
DIAG1 - DIAG25	Char	7	Diagnosis code #1 - #25
DISCH	Num	8	Discharge date
DISST	Char	1	Medicare discharge status code
DVRSND01 - DVRSND25	Char	1	Diagnosis code version indicator #1 - #25
EDBVDETH	Char	1	EDB Verified DOD Switch
EDGSCD01 - EDGSCD12	Char	7	External cause of injury diagnosis code #1 -#12

Variable	Type	Len	Label
EVRSCD01 - EVRSCD12	Char	1	Diagnosis code version indicator #1 - #12
HICNO	Char	12	Clean xrefd ID
MBI_CLM	Char	11	Medicare Beneficiary ID at time of claim
MBI_CRNT	Char	12	Current Medicare Beneficiary ID
MDCL_REC	Char	17	Medical record number
NPI_AT	Char	10	NPI of attending physician
NPI_OP	Char	10	NPI of operating physician
POAEND01 - POAEND12	Char	1	External cause of injury POA indicator #1 - #12
POANCD1 - POANCD25	Char	1	Diagnosis code present on admission indicator #1 - #25
PROC1 - PROC25	Char	7	Procedure code #1 - #25
PVSNCD01 - PVSNCD25	Char	1	Procedure code version indicator #1 - #25
REHAB_IND	Num	8	1=Any rehabilitation revenue center code in inpatient record
TYPEADM	Char	1	Type of admission
BIRTH	Num	8	EDB date of birth
CASE	Num	4	Case number marker
CCUIND	Num	4	Coronary Care Unit indicator
COUNTY	Char	3	Beneficiary County of Residence
DDEST	Num	4	Discharge destination code
DEATH	Num	8	EDB date of death verified
DRGCD	Num	4	Diagnosis Related Group
DUAL_ELIG_DSCH	Num	8	Dual eligible status at discharge
GROUP	Num	4	Transfer bundle indicator
HISTORY_CASE	Num	4	Revised case number for merging index and history files
HSP_ENR_ON_ADMIT	Num	8	
HSP_ENR_ON_DISCH	Num	8	
HSP_ENR_PRIOR_ADMIT	Num	8	
HSP_ENR_PRIOR_DISCH	Num	8	
ICUIND	Num	4	Intensive Care Unit indicator
LOS	Num	4	Length of stay
MSCD	Num	4	Denom medicare status code
PARA	Num	4	Part A FFS enrollee at admission
PARA_B	Num	4	Part A and Part B FFS enrollee at admission
POST_FLAG	Num	8	Flag for transfers out at end of period
POSTMO	Num	4	Post-admission completeness indicator
POSTMO_A	Num	4	Post-admission completeness indicator - PTA only
POSTMOD	Num	4	Post-discharge completenes indicator
POSTMOD_A	Num	4	Post-discharge completeness indicator - PTA only
PREMO	Num	4	Pre-admission completeness indicator
PREMO_A	Num	4	Pre-admission completeness indicator - PTA only
PROCDT1 - PROCDT215	Char	8	Procedure date #1 - #25
PROVID	Char	6	Medicare provider number
PSTATE	Char	6	Medicare Provider state code
RACE	Num	4	Bene race
SEX	Char	1	Beneficiary sex from edb
TRANS	Num	8	1=stay is part of a transfer chain
TRANS_FIRST	Num	8	First stay in a transfer chain
TRANS_LAST	Num	8	Last stay in a transfer chain
TRANS_MID	Num	8	Middle stay in a transfer chain

Variable	Type	Len	Label
TXFLAG	Num	8	-1=transfer, 1=died, 0=otherwise
UNRELDMG	Num	8	Unreliable age/gender indicator
UNRELDTH	Num	8	Unreliable death indicator
UPIN_AT	Char	6	UPIN of attending physician
UPIN_OP	Char	6	UPIN of operating physician
YEAR	Char	4	Year cohort
ZIP	Char	9	Beneficiary Zipcode of Residence

3.2 Post-Index Hospital Discharge File

In order to determine whether a readmission took place, the Hospital-Wide Readmission Measure SAS pack requires inpatient claims data for up to 30 days after the index discharge date. This information is captured in a separate file that contains information similar to the Index Discharge file, although with fewer fields. The file includes inpatient claims for up to 90 days after discharge, but the software chooses those within 30 days to create the outcome indicator. Display 2 shows the SAS file structure of the Post-Index file. This file can be linked to the Index Discharge file by HIC number and CASE identifier.

Display 2. Variables and Attributes of the Post-Index File

Variable	Type	Len	Label
ADMIT	Num	8	Admission date
ADMSOUR	Char	1	Source of admission
BENE_CLM_NUM	Char	12	Bene claim number
BENE_CLM_NUM_EQUATED	Char	12	Bene claim number equated
BILL_TYPE	Char	3	Type of a bill - concatenation of facility, bill classification and frequency
DIAG1 - DIAG25	Char	7	Diagnosis code #1 - #25
DISCH	Num	8	Discharge date
DISST	Char	1	Medicare discharge status code
DVRSND01 - DVRSND25	Char	1	Diagnosis code version indicator #1 - #25
EDGSCD01 - EDGSCD12	Char	7	External cause of injury diagnosis code #1 -#12
EVRSCD01 - EVRSCD12	Char	1	Diagnosis code version indicator #1 - #12
HICNO	Char	12	CLEAN XREFD ID
LOS	Num	8	Length of stay
MBI_CLM	Char	11	Medicare Beneficiary ID at time of claim
MBI_CRNT	Char	12	Current Medicare Beneficiary ID
MDCL_REC	Char	17	Medical record number
POAEND01 - POAEND12	Char	1	External cause of injury POA indicator #1 - #12
PROC1 - PROC25	Char	7	Procedure code #1 - #25
PVSNCD01 - PVSNCD25	Char	1	Procedure code version indicator #1 - #25
REHAB_IND	Num	8	1=Any rehabilitation revenue center code in inpatient record
TYPEADM	Char	1	Type of admission
ADMDIFF	Num	8	Days between index discharge and claim admission
CASE	Num	4	Case number from Index Event Record
CCUIND	Num	4	Coronary Care Unit indicator
DDEST	Num	8	Discharge destination code
DRGCD	Num	8	Diagnosis Related Group
ICUIND	Num	4	Intensive Care Unit indicator

Variable	Type	Len	Label
PROCDT1 - PROCDT215	Char	8	Procedure date #1 - #25
PROVID	Char	6	Medicare provider number
YEAR	Char	4	Year cohort

3.3 Diagnosis History Files

The Diagnosis History file is used to assign comorbidities for risk adjustment, based on 12 months of claims history for the patients in the index file. These files are at the diagnosis/procedure date level and can be linked back to the index file by HICNO and CASE number by using the HICNO and HISTORY_CASE on the index file. The SOURCE field is used to determine what data repository the information came from. Display 3 shows the file layout for the diagnosis history file.

Display 3. Variables and Attributes of the Diagnosis History File

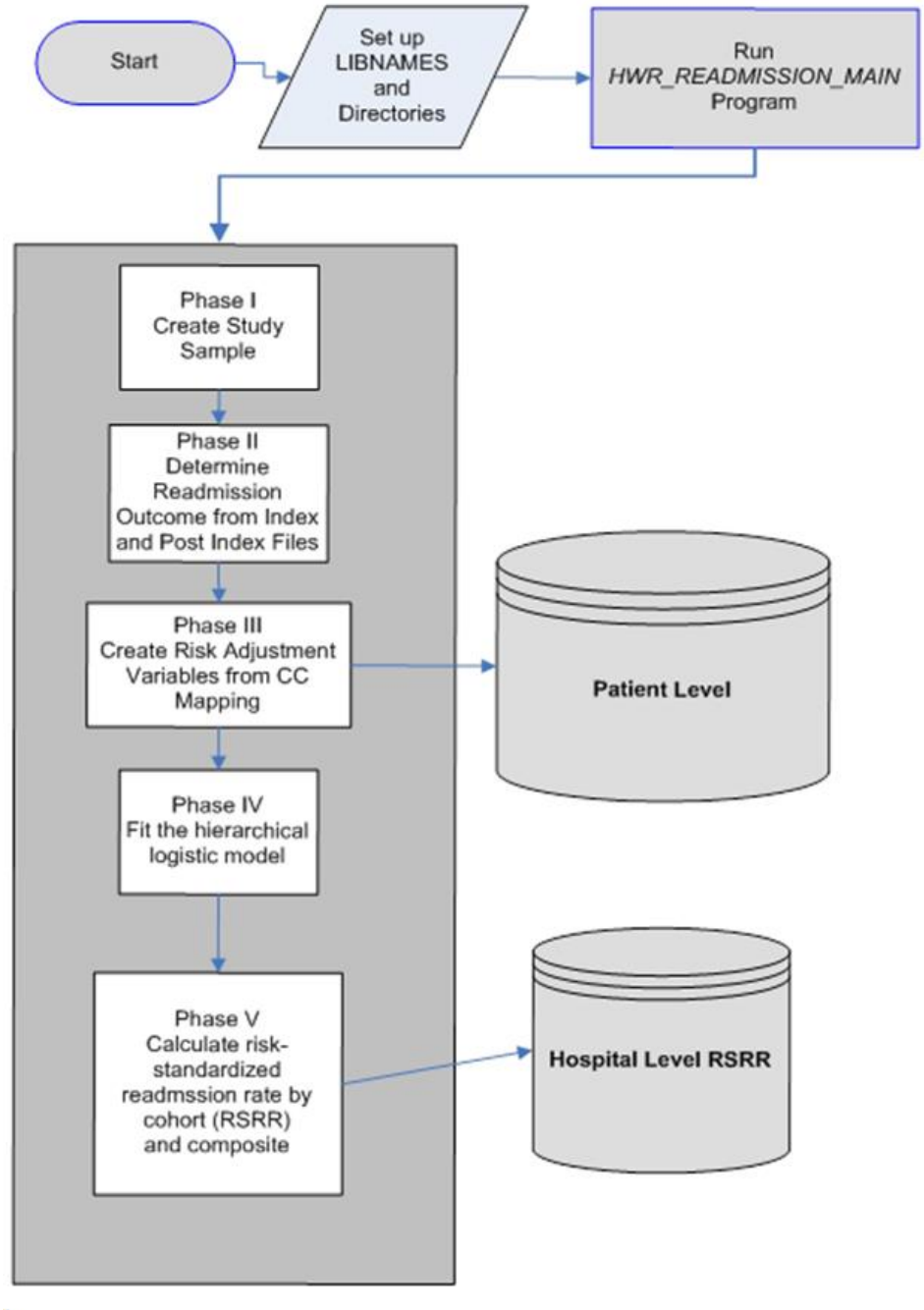
Variable	Type	Len	Label
DVRSND	Char	1	Diagnosis code version indicator
MBI_CLM	Char	11	Medicare Beneficiary ID at time of claim
MBI_CRNT	Char	12	Current Medicare Beneficiary ID
CASE	Num	4	CASE Number
DIAG	Char	7	Diagnosis code
FDATE	Num	8	Admission date (IP), Claim FROM_DT (OPD), Line First Expense Date (PTB)
HICNO	Char	12	CLEAN XREFD ID
SOURCE	Char	7	4 digit source code
TDATE	Num	8	Discharge date (IP), Claim THRU DT (OPD), Line Last Expense Date (PTB)

4. SAS Pack Structure

See Figure 1 for a flow chart displaying an overview of the programs. The first section of the SAS program is where the user can edit the SAS code. The file directories that contain the input datasets, the SAS format files for Condition Category (CC) mapping and Agency for Healthcare Research and Quality (AHRQ) Clinical Classifications Software (CCS) mapping, as well as the location of the datasets to be stored, can be modified in this section. The CC mapping is maintained by RTI International. An Excel version of the map can be found on *QualityNet*. The AHRQ CCS map description can be obtained from the following website, https://www.hcup-us.ahrq.gov/toolssoftware/ccs10/ccs10.jsp.

The next section of the SAS Pack is used for the derivation of the cohort and for the determination of the outcomes. The final dataset is used for the model development. The next section of the code is used to run the cohort data through the hierarchical model to create hospital-level results. These results are then used to create the hospital-level risk-standardized readmission rates (RSRRs) and composite HWR measure. The output is a SAS dataset called HWR_RSRR which has all cohort-level and composite measures at the provider level.

Figure 1. SAS Process Flow Chart



5. Output Data

The SAS pack creates four permanent output files in SAS dataset format. These files will be written to the directory the user designates in the first section of the program. The files are as follows:

1. Final master dataset – Index discharge Level (HW_readm_all.sas7bdat)
2. Final study sample – Index discharge Level (HW _readm_analysis.sas7bdat)
3. Hospital-Level RSRR (HW_readm_rsrr.sas7bdat)
4. Bootstrap results (HW_readm_rsrr_bs.sas7bdat)

The final master dataset contains all admissions in the original cohorts along with the inclusion/exclusion indicators assigned in the program. The final study sample file contains all risk adjustment variables and the readmission indicators for admissions who are included in the measure calculation. The unit of measure for this file is at the hospital discharge level. The final study sample file is further used as the primary data source for conducting the model analyses and the bootstrapping simulation. Display 4 shows a portion of this file. Please refer to the actual SAS programs to learn how the risk adjustment variables were defined.

Display 4. A Section of Output File (HW_Readm_Analysis)

RADM30	Cohort	Severe Infection (CC 1, 3-5)	Metastatic cancer/acute leukemia (CC 7)	Severe Cancer (CC 8, 9)	Diabetes mellitus (CC 15-20, 119, 120)	End-stage liver disease (CC 25, 26)
0	CARDIORESPIRATORY	0	0	0	0	0
1	MEDICINE	0	0	0	0	0
0	NEUROLOGY	0	0	0	0	0
0	MEDICINE	0	0	0	0	0
0	SURGICAL	0	0	0	0	0
0	SURGICAL	0	0	0	1	0
0	MEDICINE	0	0	0	0	0
0	CARDIORESPIRATORY	0	0	0	0	0
0	SURGICAL	0	0	0	0	0
0	SURGICAL	0	0	0	0	0
0	CARDIORESPIRATORY	0	0	0	0	0
0	NEUROLOGY	0	0	0	0	0
0	NEUROLOGY	0	0	0	0	0
0	MEDICINE	0	0	0	0	0
0	MEDICINE	0	0	0	1	0
0	SURGICAL	0	0	0	0	0
0	MEDICINE	0	0	0	0	0
0	MEDICINE	0	0	0	0	0
0	CV	0	0	0	1	0
0	CARDIORESPIRATORY	0	0	0	0	0
0	MEDICINE	0	0	0	0	0
0	MEDICINE	0	0	0	0	0
0	SURGICAL	0	0	0	1	0
0	MEDICINE	0	0	0	0	0
0	MEDICINE	0	0	0	0	0
0	SURGICAL	0	0	0	0	0
0	MEDICINE	0	0	0	0	0
0	SURGICAL	0	0	0	1	0
0	SURGICAL	0	0	0	0	0
0	MEDICINE	0	0	0	0	0
0	CARDIORESPIRATORY	0	0	0	0	0
1	MEDICINE	0	0	0	0	0

The Hospital-Level RSRR file includes the hospital identifier, total number of cases (volume), observed readmission rate (OBS), predicted readmission rate (PRED), expected readmission rate (EXP), risk-standardized readmission ratio (SRR), and risk-standardized readmission rate (RSRR) as shown in Display 5. The data contained in this file is at the hospital level and provides the point estimates of the readmission rate for each hospital.

Display 5. A Section of Hospital-Level Output File (HW_Readm_Rsrr)

Medicare provider number	VOLUME	READMISSION	READM_PLAN	OBS_MED	RADM30_MED	RADM30P_MED	SRR_MED	RSRR_MED	VOLUME_MED	OBS_SURG	RADM30_SURG
	5309	760	57	0.1620635748	311	20	0.9960766014	0.167783127	1919	0.103268945	139
	2790	415	35	0.1529503106	197	17	0.9948780459	0.1675812376	1288	0.1162790698	55
	4068	606	52	0.1578947368	255	17	0.9928517593	0.1672399217	1615	0.1118335501	86
	502	72	2	0.147601476	40	2	1.0317691652	0.1737953253	271	0.1	4
	135	10	0	0.0930232558	8	0	0.9614984402	0.1619586433	86	0	0
	2688	351	31	0.1580063627	149	9	0.9942037239	0.1674676521	943	0.0977835724	75
	830	126	7	0.1466346154	61	5	1.0065208439	0.169542397	416	0.1071428571	9
	2444	340	27	0.1444906445	139	15	0.9050166706	0.1524446281	962	0.125	75
	24	1	1	0.3333333333	1	0	1.0107067982	0.1702474959	3	0	0
	2032	305	17	0.182983683	157	9	1.1213624832	0.1888867821	858	0.085106383	40
	380	50	3	0.1277777778	23	2	0.9160433553	0.1543020069	180	0.18	9
	203	31	1	0.2095238095	22	1	1.0623969965	0.1789543997	105	0.2	1
	3136	480	40	0.1843575419	165	11	1.0384041272	0.1749129448	895	0.1153136531	125
	3214	447	32	0.1600633914	202	14	0.9475826402	0.1596146102	1262	0.0997679814	86
	383	45	2	0.1144278607	23	1	0.9100750504	0.1532966818	201	0.027027027	1
	3900	542	58	0.1539923954	243	25	0.9779682074	0.1647328767	1578	0.1050620821	110
	137	19	2	0.1692307692	11	2	1.0244795764	0.1725674378	65	0	0
	5949	1015	87	0.2131661442	408	34	1.1048226349	0.1861007439	1914	0.1464943204	374
	445	59	5	0.1352459016	33	4	0.9698749634	0.1633696183	244	0.2	5
	2183	315	23	0.1570482498	166	10	0.9875610974	0.1663487415	1057	0.0798004988	32
	1039	160	9	0.1559633028	68	5	0.9938791345	0.1674129769	436	0.1134020619	22
	905	133	12	0.1510791367	63	5	0.9958053478	0.167737436	417	0.0776699029	8
	10681	1441	126	0.1576502732	577	38	0.9384287518	0.1580726927	3660	0.0976995172	344
	3366	553	36	0.1805243446	241	12	1.0797198585	0.1818723318	1335	0.1405472637	113
	199	20	4	0.099009901	10	3	0.9351139319	0.1575143312	101	0.3333333333	1
	385	69	2	0.1734693878	34	1	1.0160724029	0.1711512998	196	0	0

The bootstrap results files are for each cohort and are at the hospital-specific bootstrap iteration level. This file includes all the variables present in the hospital-level RSRR file plus an iteration variable that indicates the specific iteration during which a hospital is re-sampled. In conjunction with the RSRR data, this file can be used to classify hospitals using various approaches such as probability and 95% confidence interval (CI). It is shown in Display 6**.**

Display 6. A Section of Bootstrap Results Output File (HW_Readm_Rsrr_Bs)

PROVID	ITERATION	OBS_HWR	SRR_HWR	RSRR_HWR	VOLUME	READMISSION
	1	14.315313618	0.9963305685	15.300748173	5309	760
	1	14.896755162	1.0012214562	15.375858025	8136	1212
	1	7.4074074074	0.8176268774	12.556377719	135	10
	1	13.911620295	0.9745619379	14.966445137	4888	680
	1	4.1666666667	1.0414594786	15.993797359	24	1
	1	13.157894737	0.9823897002	15.086656865	1140	150
	1	15.270935961	1.1118991894	17.075547041	203	31
	1	15.306122449	0.9809814965	15.06503094	3136	480
	1	13.907902925	0.8854107453	13.597341357	3214	447
	1	13.897435897	0.9872233838	15.160888228	3900	542
	1	13.868613139	0.9153350172	14.056891393	137	19
	1	17.061691041	1.0056981221	15.444606631	5949	1015
	1	14.429683921	1.0314309591	15.839788382	2183	315
	1	15.399422522	0.9730019203	14.942487791	3117	480
	1	13.491246138	0.9887159825	15.183810214	10681	1441
	1	16.428995841	1.053235327	16.174640241	3366	553
	1	10.050251256	0.8472184812	13.010818937	199	20
	1	17.922077922	1.0564431717	16.223903432	385	69
	1	17.125877904	1.0252335653	15.744614385	1851	317
	1	15.113350126	1.1378766709	17.474485823	794	120

6. SAS Pack Usage

The following steps outline the procedures for running the HWR SAS pack:

1. Specify the file directories for where the input resides and where the output will be placed, including the CC map and the AHRQ CCS format library location.
2. Add the input file names and result file names in HWR_V2019.SAS (use the library prefix you created if you wish to save the files).
3. Run Program HWR_V2019.SAS.