



Medicare Advantage Encounter Data Inpatient Hospital Analytic Approach

Centers for Medicare and Medicaid Services
Office of Enterprise Data and Analytics

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Introduction

OEDA has developed an analytic approach to analyze Medicare Advantage (MA) inpatient encounter data¹. We are using this analytical approach to allow us to include metrics related to services delivered to MA beneficiaries in our existing fee-for-service (FFS) data products. Currently, OEDA is focused on generating metrics using MA inpatient hospital encounter records² for 2016 through 2019.

This document describes the methods used to analyze and expand on certain data elements of the inpatient hospital encounter data. Specifically, it:

- Describes an algorithm that OEDA created to assign the CMS Certification Number (CCN) provider ID to inpatient hospital encounter records in order to categorize these records by hospital type. This allows us to use the MA data in a way that is consistent with how FFS inpatient hospital records are classified, and will help ensure that comparisons between FFS and MA beneficiary inpatient hospital utilization are appropriate.
- Documents the existence of possible duplicate service records in the inpatient hospital encounter header files. These records could lead to inaccurate MA encounter service counts.

We are providing this document so that researchers with access to MA Research Identifiable Files (RIFs) may better understand our analytic approach. We expect to make enhancements to our approach, and we will continue to publish updates to allow collaboration with a wide range of encounter data users. If you have specific feedback on the information provided, please contact PDAG_Data_Products@cms.hhs.gov.

CCN Assignment Algorithm

Background

The CMS Certification Number (CCN, historically referred to as OSCAR number) is a provider identifier that CMS assigns to institutional providers to classify which FFS payment system they fall under (e.g., critical access hospitals, inpatient rehab facilities). Specifically, the last four digits of the CCN indicate the facility type. For example:

- 0001-0879 = Short-Term (General and Specialty) Hospitals
- 2000-2299 = Long-Term Care Hospitals (Excluded from IPPS)
- 3025-3099 = Rehabilitation Hospitals (Excluded from IPPS)
- 4000-4499 = Psychiatric Hospitals (Excluded from IPPS)

The MA Encounter Data includes only the organizational National Provider Identifier (NPI) on encounter records. The NPI is a 10-digit unique provider identifier that health care institutional and individual providers covered by the 1996 Health Insurance Portability and Accountability Act (HIPPA) must use for administrative and financial transactions. Unlike the CCN, the NPI is intelligence-free in that the identifier does not indicate

¹ This and other encounter data files are available through the Research Data Assistance Center (ResDAC). For more information, visit <https://resdac.org/> (accessed 10/31/2022).

² Information on the inpatient hospital encounter data files can be found here: <https://resdac.org/cms-data/files/ip-encounter> (accessed 10/31/2022).

any information on provider type. While the FFS claims data also report NPI, OEDA uses the CCN to identify hospital type for FFS data products, such as the CMS Program Statistics (CPS), because the identifier is a CMS-generated identifier that categorizes hospitals in a consistent manner that is tied to FFS payment systems. The lack of CCN in MA data is one of the largest hurdles to evaluating MA encounter data inpatient hospital records by facility type in a manner consistent with FFS data analyses.

Organizational NPI Edits

Since the NPI value is used to link the CCN identifier to encounter records, the assignment algorithm first starts with ensuring the fidelity of the organizational NPI field reported on the MA encounter data. The CMS rules for the submission of institutional encounter records³ do not require plans to provide the organizational NPI directly responsible for the service represented by the encounter record when the Medicare Advantage Organization (MAO) has multiple NPIs on file for a given institution. Rather, CMS rules allow the plans to submit any NPI that they have on record as merely associated with a facility's internal MAO provider identification number. This guidance may be the reason why there are NPIs associated with individual providers reported in the organizational NPI field on the encounter record.⁴ Additionally, there are encounter records that report invalid organizational NPI values. To clean this variable, we set the invalid and individual provider NPIs to missing and then use two methods to impute a valid organizational NPI to records with nullified NPI values.

NPI Imputation Methods

With the first method, we check to see if there is a single organizational NPI within a group of encounter records with the same beneficiary ID, claim from and thru dates, and type of bill (TOB) values. This combination of values identifies a unique service and we refer to it as the four-part service key. If this condition is met, we assign this organizational NPI value to records where the NPI value was nullified because it was either invalid or associated with an individual provider.

This second imputation method generates a cartesian product of all the individual and organizational NPI combinations that exist for claims that have the same 4-part key. It then calculates the percentage of combinations where an individual NPI appears with any given organizational NPI. If an individual NPI appears with a single organizational NPI 100% of the time, that organizational NPI is imputed to records that originally had the individual NPI. This method only impacts records where only an individual NPI is reported within a group of encounter records with the same four-part key, making the first imputation method unusable.

Table 1 shows that, across the data years, between 93% and 98% of the original MA organizational NPIs and over 99% of MA institutional records in the inpatient hospital encounter data have valid NPIs. The imputation methods did not have much impact on reducing the number of invalid/individual NPIs. This result may indicate that a less restrictive percentage threshold should be used for imputation method 2. The table also shows that records with individual NPIs are driving the missing values in the edited organizational NPI

³ For additional details, download the zip file found here: <https://downloads.cms.gov/files/2017-HPMS-Q4.zip> (accessed 10/31/2022). After downloading, please refer to the subfolder labeled "2017-12-21 Memo re Encounter Data Record Submissions - NPI Submission Guidance - Frequently Asked Questions".

⁴ We identify an NPI as an organizational or individual NPI using the entity type field in the PMI NPPES tables that contain all NPIs assigned by CMS to providers.

variable, however, the number of original NPIs and encounter records associated with a missing imputed NPI value is declining over the 2016 through 2019 data periods.

Table 1. Distribution of Inpatient Hospital MA Encounter Organizational NPIs and Records, by NPI Imputation Status

NPI Imputation Status Category	2016		2017		2018		2019	
	N	Percent	N	Percent	N	Percent	N	Percent
Inpatient Hospital Organizational NPIs								
Total NPIs	13,400	100.0%	12,565	100.0%	12,680	100.0%	11,681	100.0%
Valid NPI	12,467	93.0%	12,118	96.4%	12,301	97.0%	11,451	98.0%
Original NPI	12,405	92.6%	12,040	95.8%	12,101	95.4%	11,346	97.1%
NPI Impute, no match PMI	5	0.0%	3	0.0%	4	0.0%	1	0.0%
NPI Impute, individual	57	0.4%	75	0.6%	196	1.5%	104	0.9%
Missing NPI	933	7.0%	447	3.6%	379	3.0%	230	2.0%
NPI Missing, no match PMI	5	0.0%	6	0.0%	5	0.0%	3	0.0%
NPI Missing, individual	928	6.9%	441	3.5%	374	2.9%	227	1.9%
Inpatient Hospital Encounter Records								
Total NPIs	4,271,654	100.0%	4,727,845	100.0%	5,096,909	100.0%	5,653,927	100.0%
Valid NPI	4,262,400	99.8%	4,720,759	99.9%	5,090,583	99.9%	5,643,521	99.8%
Original NPI	4,261,428	99.8%	4,719,979	99.8%	5,089,321	99.9%	5,635,932	99.7%
NPI Impute, no match PMI	843	0.0%	594	0.0%	732	0.0%	7,217	0.1%
NPI Impute, individual	129	0.0%	186	0.0%	530	0.0%	372	0.0%
Missing NPI	9,254	0.2%	7,086	0.1%	6,326	0.1%	10,406	0.2%
NPI Missing, no match PMI	7,437	0.2%	5,115	0.1%	5,219	0.1%	9,573	0.2%
NPI Missing, individual	1,817	0.0%	1,971	0.0%	1,107	0.0%	833	0.0%

SOURCE: 2016-2019 MA inpatient hospital encounter records.

One limitation of this NPI imputation method is that it does not resolve initial incorrect assignments of organizational NPIs to a particular encounter record. For example, a MAO could erroneously assign the NPI of the parent acute care hospital organization to the encounter record for an inpatient rehabilitation service instead of assigning the organizational NPI of the inpatient rehabilitation facility that performed the care. This incorrect NPI assignment could lead the algorithm discussed below to assign the wrong CCN to the inpatient rehabilitation encounter record.

NPI-CCN Crosswalk

The first step to building the CCN assignment algorithm is to construct an NPI-CCN crosswalk. The NPI-CCN crosswalk is a data set we have created to associate an organizational NPI to a CCN. We use two data sources to construct this crosswalk:

- NPI-CCN relationships found in the FFS institutional claims data (Part A and B); and

- Provider Master Index (PMI) NPI-CCN crosswalk that combines information from various CMS provider data systems.⁵

The FFS crosswalk has the advantage of capturing providers that are currently active in Medicare fee-for-service. However, it may not represent the full universe of NPI-CCN connections, particularly those that do not submit Medicare FFS claims. Using the PMI NPI-CCN crosswalk table allows us to supplement the NPI-CCN links we find in the FFS data.

To construct the NPI-CCN crosswalk from the FFS data, we collapse the Part A claims data and the Part B institutional claims data by NPI and CCN for each year of claims data between 2016 and 2019. We then concatenate the Part A and B annual data sets and further collapse the file for a given year so that there are unique combinations of NPI and CCN codes. Finally, we concatenate the annual files to create a longitudinal NPI-CCN crosswalk that contains year, NPI, and CCN data fields.

To construct the PMI-based NPI-CCN crosswalk, we subset the PMI Legacy ID table to records where the legacy ID type reflects IDs coming from the Online Survey Certification and Reporting (OSCAR) provider system to isolate the NPI-CCN combinations.⁶ CMS does not check the quality of the provider information stored in the PMI tables. Therefore, we applied additional checks of the NPI and CCN values in the PMI table given that the PMI table may include erroneous data or individual NPI data. Specifically, we checked that the:

- the CCN value was valid, i.e., the value consisted of CCN with 6 characters, the first 2-digits were valid state codes, the last four digits fall within ranges for facility types, and the alpha characters used in the third character are valid letters used to indicate a subunit facility⁷;
- the NPI value was not linked to an individual provider; and
- the CCN values in the PMI matched to the Provider of Services⁸ files for hospital and non-hospital facilities⁹.

We then create annual data sets of NPI-CCN combinations that were in effect for a calendar year using the legacy ID effective dates. Some PMI Legacy ID Table records did not have effective/termination dates to determine whether the NPI-CCN relationship existed in a given data year. For these records, we only kept NPI-CCN combinations that had a record status set to “Current” and deleted records with a record status of

⁵ The PMI is a suite of NPI-centered tables that combines information from various CMS provider systems. The PMI tables are only available for CMS data users. We used the PMI NPI-Legacy ID table to identify current and historical NPI-CCN links. The PMI legacy ID is sourced from the Provider Enrollment, Chain, and Ownership System (PECOS), which providers must enroll in to participate in Medicare; the National Plan and Provider Enumeration System (NPPES), which providers enroll in to receive a national provider identifier (NPI) as required by HIPAA of 1996 for use across public and private health care systems; and the National Provider Identifier Crosswalk System (NPICS), a temporary provider system that CMS implemented to ensure the continuity of claims processing during the implementation of the NPI. NPICS provides historical information NPI-legacy ID crosswalks and was ultimately replaced by PECOS.

⁶ The OSCAR system is a legacy administrative database that was used to assign organizations a CCN identifier. This system was replaced by the Certification and Survey Provider Enhanced Reporting (CASPER) and the Quality Improvement Evaluation System (QIES) in 2012. However, internal CMS data systems still refer to elements from these data bases coming from the OSCAR system.

⁷ These criteria are based on the CCN assignment rules published in the CMS State Operations Manual, Chapter 2, Certification Process, Section 2779, <https://www.cms.gov/regulations-and-guidance/guidance/manuals/downloads/som107c02.pdf> (accessed 10/31/2022).

⁸ Information on the POS file can be found here: <https://data.cms.gov/provider-characteristics/hospitals-and-other-facilities/provider-of-services-file-hospital-non-hospital-facilities> (accessed 10/31/2022).

⁹ We performed similar checks on the FFS NPI-CCN combinations and found that all FFS combinations met these criteria.

“Historical”. Table 2 documents the number of PMI NPI-CCN combinations were eliminated because they did not meet the above the criteria.

Table 2. Number of NPI-CCN Combinations Excluded from the PMI NPI-CCN Crosswalk, by Exclusion Criteria

Exclusion Criteria Categories	2016		2017		2018		2019	
	N	Percent	N	Percent	N	Percent	N	Percent
Total NPI-CCN Combinations	154,602	100.0%	154,705	100.0%	154,870	100.0%	155,032	100.0%
Excluded NPI-CCN Combinations	77,618	50.2%	77,654	50.2%	77,679	50.2%	77,686	50.1%
CCN Invalid Value	18,444	11.9%	18,442	11.9%	18,440	11.9%	18,440	11.9%
NPI Individual Provider	11,097	7.2%	11,097	7.2%	11,097	7.2%	11,097	7.2%
CCN Not Found in POS	3,834	2.5%	3,832	2.5%	3,829	2.5%	3,824	2.5%
Historical Records w/o Dates	44,243	28.6%	44,283	28.6%	44,313	28.6%	44,325	28.6%
Included NPI-CCN Combinations	76,984	49.8%	77,051	49.8%	77,191	49.8%	77,346	49.9%

SOURCE: Provider Master Index NPI-Legacy Identifier Crosswalk Table.

NOTES: The counts for NPI-CCN combinations that do not meet the criteria were applied and calculated as part of a hierarchy to make the exclusion categories mutually exclusive. This ensures that there is not double counting in the total number of combinations excluded.

Finally, we merge the FFS and PMI longitudinal NPI-CCN data sets by year, NPI, and CCN, hereafter referred to as the Master NPI-CCN crosswalk.

Table 3 provides information on the number of NPI-CCN combinations that exist on both the FFS and PMI longitudinal crosswalks, only on the FFS longitudinal crosswalk, and only on the PMI longitudinal crosswalk.

Table 3. Distribution of NPI-CCN Combinations, by Source Data Comparisons

FFS-PMI NPI-CCN Source Data Comparison Categories	2016		2017		2018		2019	
	N	Percent	N	Percent	N	Percent	N	Percent
Total	88,020	100.0%	85,937	100.0%	83,808	100.0%	81,901	100.0%
All years match	48,224	54.8%	48,288	56.2%	48,380	57.7%	48,486	59.2%
Some years match	11,223	12.8%	11,259	13.1%	11,271	13.4%	11,262	13.8%
No match = FFS Only	21	0.02%	21	0.02%	16	0.0%	11	0.01%
No match = PMI Only	11,201	12.7%	11,237	13.1%	11,254	13.4%	11,250	13.7%
No match = Both	1	0.0%	1	0.0%	1	0.0%	1	0.0%
No years match FFS Only	11,026	12.5%	8,869	10.3%	6,604	7.9%	4,550	5.6%
No years match PMI Only	17,543	19.9%	17,517	20.4%	17,549	20.9%	17,599	21.5%
No years match Both	4	0.005%	4	0.005%	4	0.005%	4	0.005%

SOURCE: 2016-2019 FFS Part A and Part B institutional claims and Provider Master Index NPI-Legacy ID Table.

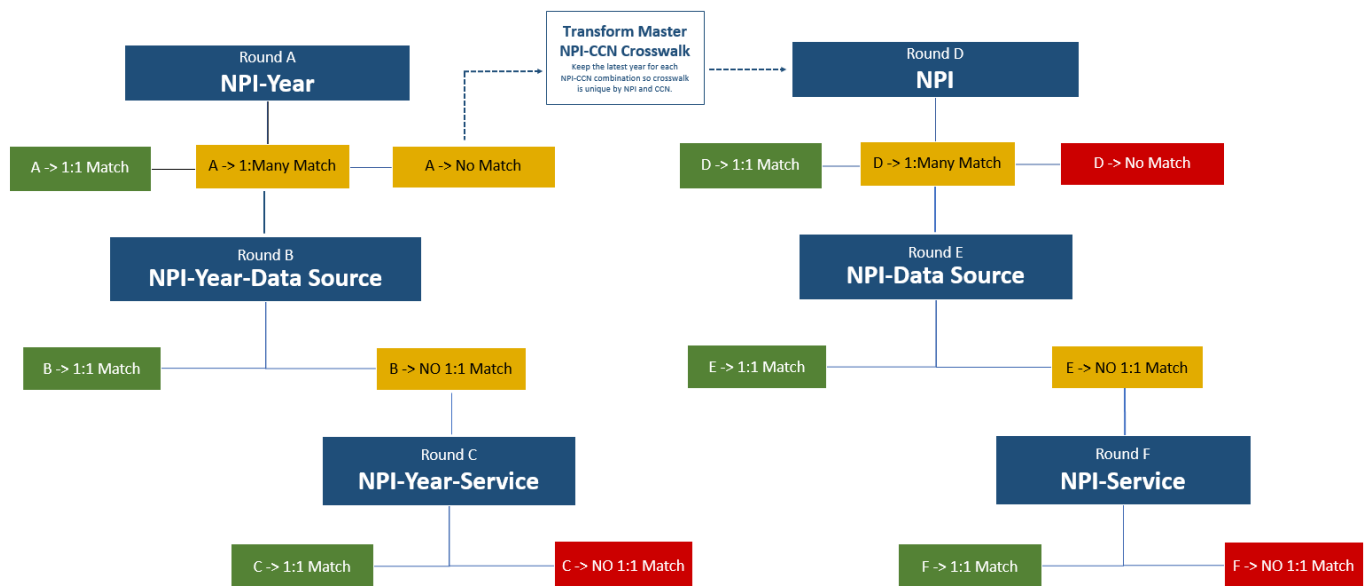
Between 68% and 73% of NPI-CCN combinations exist on both FFS and PMI source data in at least one data year, with the rate increasing over time. Those combinations where no data years match between the data source are largely driven by those NPI-CCN relationships that only appear in the PMI data.

Since NPIs can link to multiple CCN codes, we create additional CCN-related fields that align with the MA data source field and the taxonomy fields in the MA encounter data. Specifically, we map the CCN codes to either an inpatient hospital, SNF, home health, or other institutional category to align with the MA data source. We also map both CCN and the NPI taxonomy codes to common, broadly defined hospital type categories to see if the taxonomy can be used to resolve 1:Many NPI-CCN matches. See [Appendix A](#) for details on how CCNs and NPI taxonomy codes are mapped to common hospital type categories so that they can be used in the CCN assignment algorithm.

NPI-CCN Linkage Algorithm

Figure 1 below is a diagram that illustrates the steps we used to assign a CCN to MA inpatient hospital encounter records.

Figure 1. Diagram of MA CCN Assignment Algorithm



The algorithm starts by merging on the CCN to the encounter data by using just the data year and the NPI (Round A). Matches from this step represent NPI-CCN relationships where there is a 1:1 relationship between NPI and CCN in the master crosswalk. We have the least uncertainty of these matches since they do not require information from the MA encounter record. Figure 2 contains an example of the Round A merge where each record is assigned a CCN by matching the crosswalk using just NPI and year.

Figure 2. Round "A" Example of CCN Assignment

MA Encounter Data								Master NPI-CCN Crosswalk					
Round A								Round A					
Encounter Join Key	Year	NPI	MA Data Source	Taxonomy Service Category	Taxonomy Code	Taxonomy Description	CCN	Year	NPI	CCN Data Source	CCN Service Category	CCN	CCN Description
385565131	2016	1003000514	IP	ACUTE	282N00000X	General Acute Care Hospital	120123	2016	1003000514	IP	ACUTE	120123	Short-Term Hospitals
357011136	2017	1003000514	IP	ACUTE	282N00000X	General Acute Care Hospital	120123	2017	1003000514	IP	ACUTE	120123	Short-Term Hospitals
399394843	2018	1003000514	IP	ACUTE	282N00000X	General Acute Care Hospital	120123	2018	1003000514	IP	ACUTE	120123	Short-Term Hospitals
380295462	2019	1003000514	IP	ACUTE	282N00000X	General Acute Care Hospital	120123	2019	1003000514	IP	ACUTE	120123	Short-Term Hospitals

MA encounter records that do not have a 1:1 match to the NPI-CCN crosswalk table are then divided into two groups: 1.) those that have a 1:Many relationship between NPI and CCN; and 2.) records that have no match to the master NPI-CCN crosswalk using NPI and year. The 1:Many group is then fed into the next round of merges where we use information on the encounter bill type to uniquely assign a CCN to the record (Round B). Figure 3 shows a Round B example where the NPI has two CCNs attached to it in the crosswalk. One CCN (370139) is mapped to the inpatient hospital bill type in the NPI-CCN crosswalk's "CCN Data Source" column; the other CCN (37U139) is mapped to the skilled nursing facility bill type. We then use the bill type mappings in the crosswalk to assign the inpatient hospital CCN to the encounter records with inpatient hospital bill type.

Figure 3. Round "B" Example of CCN Assignment

MA Encounter Data								Master NPI-CCN Crosswalk					
Round B								Round B					
Encounter Join Key	Year	NPI	MA Data Source	Taxonomy Service Category	Taxonomy Code	Taxonomy Description	CCN	Year	NPI	CCN Data Source	CCN Service Category	CCN	CCN Description
337365886	2018	1003318692	IP	ACUTE	282N00000X	General Acute Care Hospital	370139	2018	1003318692	IP	ACUTE	370139	Short-Term Hospitals
324453046	2019	1003318692	IP	ACUTE	282N00000X	General Acute Care Hospital	370139	2018	1003318692	SNF	SNF	37U139	Swing Beds
								2019	1003318692	IP	ACUTE	370139	Short-Term Hospitals
								2019	1003318692	SNF	SNF	37U139	Swing Beds

For those encounter records still left without a 1:1 CCN match after Round B, the algorithm attempts to match a CCN using matched to broadly defined service categories (Round C). In this merge, we resolve 1:Many matches by assigning the CCN that matches the broadly defined service category mapped to the taxonomy reported on the encounter record. Figure 4 illustrates a Round C merge example. In this scenario, the NPI maps to CCNs that are both inpatient hospitals, but one CCN (01S007) reflects an inpatient psychiatric subunit facility (IPF) and the other CCN (010007) reflects a short-term acute care facility. The algorithm assigns the psychiatric hospital subunit CCN to the record that reports an encounter taxonomy code that maps to an IPF and the short-term acute care CCN to the record that reports an encounter taxonomy code that maps to an acute care hospital.

Figure 4. Round "C" Example of CCN Assignment

MA Encounter Data								Master NPI-CCN Crosswalk					
Round C								Round C					
Encounter Join Key	Year	NPI	MA Data Source	Taxonomy Service Category	Taxonomy Code	Taxonomy Description	CCN	Year	NPI	CCN Data Source	CCN Service Category	CCN	CCN Description
359384435	2018	1013937705	IP	IPF	273R00000X	Psychiatric Unit	01S007	2018	1013937705	IP	IPF	01S007	Psychiatric Hospital Subunits
333037825	2018	1013937705	IP	ACUTE	282N00000X	General Acute Care Hospital	010007	2018	1013937705	IP	ACUTE	010007	Short-Term Hospitals
394189577	2019	1013937705	IP	IPF	273R00000X	Psychiatric Unit	01S007	2019	1013937705	IP	IPF	01S007	Psychiatric Hospital Subunits
393068973	2019	1013937705	IP	ACUTE	282N00000X	General Acute Care Hospital	010007	2019	1013937705	IP	ACUTE	010007	Short-Term Hospitals

The algorithm sets encounter records with no CCN match after Round C to have a missing value for the CCN variable since we cannot resolve 1:Many NPI-CCN relationships.

As Figure 1 shows, the algorithm then turns to addressing the records that did not find a match in Round A when it merges on the CCN by year and NPI. For Round D merges, we transform the NPI-CCN crosswalk by keeping the latest year for each NPI-CCN combination such that the crosswalk is unique by NPI and CCN. The algorithm then attempts to merge on the CCN to the MA encounter records by NPI only to see if the MA encounter NPI exists for any of the years in the NPI-CCN crosswalk. Figure 5 gives an example of Round D merges. In this figure, the MA encounter data for years 2016-2018 matches to the NPI-CCN crosswalk in Round A using NPI and year because there is a 1:1 NPI-CCN combination for those years in the crosswalk. However, the 2019 MA encounter record does not match to a CCN in Round A. In Round D, where the algorithm drops year and just merges by NPI using the latest NPI-CCN combination (2018), it can assign a CCN to the 2019 encounter record.

Figure 5. Round “D” Example of CCN Assignment

MA Encounter Data								Master NPI-CCN Crosswalk					
Round D								Round D					
Encounter Join Key	Year	NPI	MA Data Source	Taxonomy Service Category	Taxonomy Code	Taxonomy Description	CCN	Year	NPI	CCN Data Source	CCN Service Category	CCN	CCN Description
332986107	2016	1013906221	IP	IPPS	282N00000X	General Acute Care Hospital	050305	2016	1013906221	IP	IPPS	050305	Short-Term Hospitals
337222864	2017	1013906221	IP	IPPS	282N00000X	General Acute Care Hospital	050305	2017	1013906221	IP	IPPS	050305	Short-Term Hospitals
328047172	2018	1013906221	IP	IPPS	282N00000X	General Acute Care Hospital	050305	2018	1013906221	IP	IPPS	050305	Short-Term Hospitals
337168102	2019	1013906221	IP	IPPS	282N00000X	General Acute Care Hospital	050305						

Rounds E (merge by NPI and data source) and F (merge by NPI and service category) of the algorithm essentially repeat Rounds B and C but without using the year variable to attach the CCN to the encounter data.

Table 4 shows the results of the CCN assignment algorithm in terms of the percentage of MA inpatient hospital encounter records that are assigned a CCN and the extent to which the CCN assigned is consistent with the MA encounter inpatient hospital bill type.

Table 4. Percentage of MA Inpatient Hospital Encounter Records with CCN Assignment, by Merge Result Category

CCN Merge Result	2016		2017		2018		2019	
	N	Percent	N	Percent	N	Percent	N	Percent
Total	4,262,400	100.0%	4,720,759	100.0%	5,090,583	100.0%	5,643,521	100.0%
Match	4,096,869	96.1%	4,556,171	96.5%	4,912,140	96.5%	5,456,390	96.7%
Match, Same	4,085,597	95.9%	4,484,788	95.0%	4,839,480	95.1%	5,398,242	95.7%
Match-Round A, Same	3,809,086	89.4%	4,169,161	88.3%	4,482,092	88.0%	5,007,143	88.7%
Match-Round B, Same	135,978	3.2%	145,842	3.1%	161,037	3.2%	174,913	3.1%
Match-Round C, Same	140,298	3.3%	167,726	3.6%	194,950	3.8%	211,615	3.7%
Match-Round D, Same	235	0.01%	2,033	0.04%	1,392	0.03%	4,555	0.1%
Match-Round E, Same	--	--	3	0.00%	2	0.00%	15	0.00%
Match-Round F, Same	--	--	23	0.00%	7	0.00%	1	0.00%
Match, Different	11,272	0.3%	71,383	1.5%	72,660	1.4%	58,148	1.0%
Match-Round A, Different	10,624	0.2%	69,355	1.5%	70,560	1.4%	53,839	1.0%
Match-Round C, Different	646	0.02%	557	0.01%	443	0.01%	3,300	0.1%
Match-Round D, Different	2	0.00%	1,471	0.03%	1,657	0.03%	1,009	0.02%
No Match	165,531	3.9%	164,588	3.5%	178,443	3.5%	187,131	3.3%
No Match, 1:Many	108,511	2.5%	107,362	2.3%	111,896	2.2%	112,154	2.0%
No Match, Missing	57,020	1.3%	57,226	1.2%	66,547	1.3%	74,977	1.3%

SOURCE: 2016-2019 MA inpatient hospital encounter records.

Across all data years, approximately 96% of records are assigned a CCN. The algorithm assigns nearly all of these inpatient hospital encounter records (approximately 95%) a CCN that is an inpatient hospital facility (i.e., the “Match, Same” merge result). Approximately 89% of records are assigned a CCN in Round A where the algorithm uses NPI and year. This indicates that the vast majority of records are matched using the method with the least amount of uncertainty in terms of the match assignment, i.e., we only use the reported organizational NPI. The more data elements we need to assign the CCN, the more uncertainty is introduced into the algorithm since there may be errors in the MAO-reported data elements. For example, we have not confirmed that MAOs are accurately reporting the bill type in the encounter data and bill type is used in Rounds B and E to resolve 1:Many CCN relationships to assign a CCN to the encounter record.

There are a small percentage of records (0.3% - 1.5%) that have a CCN assigned by the algorithm, but that CCN is not an inpatient hospital facility (i.e., the “Match, Different” merge result). Preliminary analyses show that the vast majority of these records are assigned home health agency CCNs. Future refinements to the algorithm will attempt to resolve this discrepancy by evaluating whether the bill type or the NPI was incorrectly assigned.

Finally, among the encounter records with no match to the NPI-CCN crosswalk, the majority are not matched because we are unable to resolve the 1:Many relationships using the bill type or taxonomy encounter data elements. There may be opportunities in the future to improve the match rate by exploring other means for addressing 1:Many NPI-CCN relationships.

Unique Service Identification

Identifying Duplicate Service Records

According to the Medicare Advantage Encounter Data User Guide¹⁰, a single inpatient hospital base record for 2016-2019 encounter data should represent a single service. A single service is identified as the unique combination of beneficiary ID, encounter start date, encounter end date, type of bill, and organizational NPI, also known as the five-part service key. To identify the five-part service key, we use the imputed NPI variable discussed above that removes individual and invalid provider IDs from the organizational NPI column. However, even with the imputed organizational NPI variable, our preliminary analysis of the data identified a few thousand encounter records that had the same five-part service key. These duplicate records could cause analyses to overcount services when counting base records since they represent the same service. To mitigate the issue of multiple claims per five-part service key, OEDA selected the encounter record with the latest Encounter Data Processing System (EDPS) processing date in order to restore the one-to-one relationship between encounter record and five-part service key. Table 5 documents that we eliminated a small number of records that indicated duplicate services based on the 5-part service key.

Table 5. Duplicate Service Inpatient Hospital MA Encounter Records using Five-Part Service Key

Record Count Category	2016	2017	2018	2019
Original Encounter Record Count	4,279,057	4,734,194	5,099,202	5,662,306
De-duped Encounter Record Count	4,271,654	4,727,845	5,096,909	5,653,927
Encounter Records Dropped	7,403	6,349	2,293	8,379

SOURCE: 2016-2019 MA inpatient hospital encounter records.

NOTE: The de-duped encounter record count includes records where the imputed organizational NPI is invalid and therefore set to missing. These records are not included in results related to the CCN algorithm (Table 4).

Eliminating duplicate service records only serves to ensure that utilization counts are more accurate. This data edit does not resolve discrepancies across the duplicate service encounter records since we are not including any of these data elements in published reports of MA beneficiary utilization (for example, two records with the same five-part service key may contain different diagnosis code information).

Duplicate Service Record Caveats

While the above method ensures a one-to-one relationship between the five-part service key and an encounter record, it does not address encounter records that have the same beneficiary ID, start date, end date, and bill type (referred to as the four-part service key), but different organizational NPIs. In the Medicare FFS claims data, each claim corresponds to a unique combination of the four-part service key, indicating that beneficiaries cannot be served by different organizations on the same day. However, the MA inpatient hospital encounter contains several thousand examples of multiple encounters that have the same four-part

¹⁰ The user guide can be found here: <https://www2.ccwdata.org/documents/10280/19002246/ccw-medicare-encounter-data-user-guide.pdf> (accessed 10/31/2022).

key, but different organizational NPIs. Table 6 documents how many encounter records would be dropped if the data were de-duped using the four-part service key.

Table 6. Duplicate Service Inpatient Hospital MA Encounter Records using Four-Part Service Key

Record Count Category	2016	2017	2018	2019
Five-Part Key - De-duped Encounter Record Count	4,271,654	4,727,845	5,096,909	5,653,927
Four-Part Key - De-duped Encounter Record Count	4,260,988	4,714,222	5,083,025	5,638,586
Encounter Records Dropped	10,666	13,623	13,884	15,341

SOURCE: 2016-2019 MA inpatient hospital encounter records.

Appendix A: Mapping Inpatient Hospital CCN Facility and NPI Taxonomy Categories to Common Hospital Type Categories

Appendix Table A.1. Mapping Inpatient Hospital CCN Facility Categories to Common Hospital Type Categories

CCN Last 4 Digits	CCN Facility Categories	Common Hospital Type Categories
1300 - 1399	Critical Access Hospitals	Critical Access Hospital
4000 - 4499	Psychiatric Hospitals	Inpatient Psychiatric Facility
M*** ¹	Psychiatric Unit	Inpatient Psychiatric Facility
S*** ¹	Psychiatric Unit	Inpatient Psychiatric Facility
0001 - 0879	Short-Term Hospitals	Short-Term Care Hospital
0880 - 0899	ORD Demo Project Hospitals	Short-Term Care Hospital
0900 - 0999	Multiple Hospital Component-Medical Complex	Short-Term Care Hospital
3025 - 3099	Rehabilitation Hospitals	Inpatient Rehabilitation Facility
R*** ¹	Rehabilitation Unit	Inpatient Psychiatric Facility
T*** ¹	Rehabilitation Unit	Inpatient Psychiatric Facility
2000 - 2299	Long-Term Care Hospitals	Long-Term Care Hospital
1200 - 1224	Alcohol/Drug Hospitals	Other Hospital
1990 - 1999	Religious Non-Medical Hospitals	Other Hospital
3000 - 3024	Tuberculosis Hospitals	Other Hospital
3300 - 3399	Children's Hospitals	Other Hospital

SOURCE: CCN codes and facility descriptions come from the CMS State Operations Manual, Chapter 2, Certification Process, Section 2779 (<https://www.cms.gov/regulations-and-guidance/guidance/manuals/downloads/som107c02.pdf>, accessed 10/31/2022).

NOTE: ¹ These CCN digits represent ID values where the third character in the 6-digit CCN indicates a particular hospital subunit.

Appendix Table A.2. Mapping Inpatient Hospital NPI Specialty Taxonomy Categories to Common Hospital Type Categories

NPI Taxonomy Codes	NPI Taxonomy Descriptions	Common Hospital Type Categories
282NC0060X	General Acute Care Hospital Critical Access	Critical Access Hospital
283Q00000X	Psychiatric Hospital	Inpatient Psychiatric Facility
273R00000X	Psychiatric Unit	Inpatient Psychiatric Facility
281P00000X	Chronic Disease Hospital	Short-Term Care Hospital
282N00000X	General Acute Care Hospital	Short-Term Care Hospital
282NR1301X	General Acute Care Hospital Rural	Short-Term Care Hospital
282NW0100X	General Acute Care Hospital Women	Short-Term Care Hospital
286500000X	Military Hospital	Short-Term Care Hospital
2865M2000X	Military Hospital Military General Acute Care Hospital	Short-Term Care Hospital
2865X1600X	Military Hospital Military General Acute Care Hospital Operational (Transportable)	Short-Term Care Hospital
276400000X	Rehabilitation, Substance Use Disorder Unit	Short-Term Care Hospital
283X00000X	Rehabilitation Hospital	Inpatient Rehabilitation Facility
283XC2000X	Rehabilitation Hospital Children	Inpatient Rehabilitation Facility
273Y00000X	Rehabilitation Unit	Inpatient Rehabilitation Facility
282E00000X	Long Term Care Hospital	Long-Term Care Hospital
281PC2000X	Chronic Disease Hospital Children	Other Hospital
282NC2000X	General Acute Care Hospital Children	Other Hospital
282J00000X	Religious Nonmedical Health Care Institution	Other Hospital
284300000X	Special Hospital	Other Hospital

SOURCE: The NPI specialty taxonomy codes and descriptions come from the National Uniform Claim Committee (NUCC) Provider Taxonomy code set, https://www.nucc.org/images/stories/CSV/nucc_taxonomy_210.csv (accessed 10/31/2022).