Cost-to-Charge Ratio Files:
User Guide for Nationwide Readmissions Database (NRD) CCRs

The Healthcare Cost and Utilization Project (HCUP) Cost-to-Charge Ratio Files (CCR Files) are hospital-level files that facilitate the conversion of total charges into hospital costs (expenses) for providing care, which can be linked to HCUP inpatient databases and HCUP emergency department databases. This user guide describes the 2010-2018 CCR for Nationwide Readmissions Database (CCR-NRD) Files. Documentation for the CCR for Emergency Department (CCR-ED) Files and for other CCR for Inpatient Files is provided separately.

1. Overview of Methodology

   The CCR Files are constructed from appropriate cost centers in the hospital cost reports obtained from the Centers for Medicare and Medicaid Services (CMS) Healthcare Cost Report Information System (HCRIS). The HCUP CCR Files are annual datasets that provide hospital-specific cost-to-charge ratios based on all-payer inpatient costs for nearly every hospital in each year's NRD.

   The CCR for Inpatient Files are used to estimate the resource cost of inpatient care and its variation across hospitals and conditions. The files are designed to supplement the data elements in the HCUP inpatient databases which contain data on total charges for each hospital stay. *Charges* represent the amount a hospital billed for the case; c*osts* reflect the actual expenses incurred in the production of hospital services, such as wages, supplies, and utility costs. The charges (costs) do not reflect the specific amounts that hospitals receive in payment.

   HCUP utilizes the CMS fiscal year file, "hosp10_2018_NMRC.csv," also referred to as Prospective Payment System (PPS) records, for hospital data submitted through March 31st, approximately 18 months after the close of a fiscal year.

2. Description of CCR for NRD Files

   The HCUP CCR files provide an estimate of all-payer, inpatient cost-to-charge ratios for hospitals in the 2010-2018 NRD. The files are provided as CSV (comma-separated value) text files. Records are included for all community hospitals from the HCUP NRD that have "clean" matches with both the American Hospital Association (AHA) Annual Survey Database and the CMS hospital cost file for the corresponding fiscal year.

   The CCR for NRD files can be linked to discharge records in the NRD using the HCUP hospital identification number, HOSP_NRD, which is a unique hospital number exclusive to the NRD. The hospital identifiers (HOSP_NRD) are reassigned each year and do not link to other HCUP or to external databases or track the same hospitals across years.

   The cost of inpatient care for a discharge is estimated by multiplying TOTCHG (from the discharge record) by the cost/charge ratio, CCR_NRD. The CCR_NRD value is based on the hospital-specific all-payer inpatient cost/charge ratio (APICC) when available, or the hospital group average all-payer inpatient cost/charge ratio (GAPICC) otherwise. The APICC and GAPICC data elements are not provided.

Separate CCR for NRD files are released for each data year and should be used with the corresponding year of the NRD to ensure appropriate match of the year-specific hospital identifiers.

3. Records in the CCR-NRD Files

   For 2010-2018, the datasets contain a record for each of the hospitals (unduplicated HOSP_NRD) in the NRD:

   - 2,430 hospitals in the 2018 CCR-NRD
   - 2,454 hospitals in the 2017 CCR-NRD
   - 2,355 hospitals in the 2016 CCR-NRD
   - 2,367 hospitals in the 2015 CCR-NRD
   - 2,048 hospitals in the 2014 CCR-NRD
   - 2,006 hospitals in the 2013 CCR-NRD
   - 1,715 hospitals in the 2012 CCR-NRD
   - 1,804 hospitals in the 2011 CCR-NRD
   - 1,809 hospitals in the 2010 CCR-NRD.

   The cost-to-charge ratio in the CCR for NRD file has been modified to enhance confidentiality of the NRD. Statistical reliability of the estimates is not affected.

   Note*: The HOSP_NRD variable on the CCR CSV (comma-separated value) text file is enclosed in quotations in order to preserve leading zeros in Excel. As a result, some software applications may interpret HOSP_NRD as a character variable, which in turn would not match the numeric version of HOSP_NRD on the NRD. This data element should be loaded as numeric or converted to numeric prior to merging with the NRD.*

4. NRD-Specific Cost-to-Charge Ratio — CCR_NRD

   The cost-to-charge ratio element (CCR_NRD) is populated with the hospital-specific, all-payer inpatient cost-to-charge ratio (APICC), when available. The hospital group average CCR (GAPICC) is used to populate CCR_NRD when the APICC is not available. The construction of the all-payer inpatient and group average CCR are described in the next sections.

5. Hospital-Specific CCR — APICC

   The all-payer inpatient cost-to-charge ratio (APICC) is created by dividing the inpatient costs by the inpatient charges. APICC is used to assign CCR-NRD values and is not provided in the CCR-NRD files.

   Both of these values – costs and charges – are found on the CMS Healthcare Cost Reporting Information System (HCRIS) reports, or PPS data. APICC is populated for HCUP NRD hospitals that have a matching record in both the PPS and the AHA data. APICC is missing when there is no cost information in the PPS data or the calculated cost/charge values are considered outliers. Several adjustments are made to costs and charges before they are usable in this generalized formula, the most important being the assignment of a portion of ancillary costs to inpatient routine and acute cost centers.

6. Weighted Group Average—GAPICC

   The group average cost-to-charge ratio (GAPICC) is a weighted average for the hospitals in peer groups (defined by state, urban/rural, investor-owned/other, and bedsize), using the proportion of each hospital's beds relative to their peer group as the weight for each hospital. GAPICC is used to assign CCR-NRD values and is not provided in the CCR-NRD files.

   These averages are based on clean observations, meaning the HCUP hospitals that also have records in both the AHA Annual Survey and CMS cost data as of the March 31st date when the CMS files are acquired. These records have a matching hospital in the CMS cost report, have availability of certain completed data items in the report, and pass certain edit checks.

   Note that it is possible for group averages to be based on only one hospital in the peer group (defined by state and hospital type). The group average may be associated with a non-HCUP hospital.

7. Hospital Type for Grouping—HTYPE

   The hospital type (HTYPE) is utilized for grouping peer hospitals. Although HTYPE is not provided on the CCR for NRD file, it is helpful to know how this variable is defined to create peer groups using all hospitals within each state. Some researchers will find the information below useful with respect to replicability, and reviewers for journal articles might find this more detailed description especially valuable.

   The following are values for the HTYPE variable:

   1= investor-owned, under 100 beds
   2= investor-owned, 100 or more beds
   3= not-for-profit, rural, under 100 beds
   4= not-for-profit, rural, 100 or more beds
   5= not-for-profit, urban, under 100 beds
   6= not-for-profit, urban, 100-299 beds
   7= not-for-profit, urban, 300 or more beds

   State and local hospitals are included in the *not-for-profit categories*. *Urban* is defined as being part of a Metropolitan Statistical Area (MSA); *beds* are the total hospital beds set up (as defined in each year's AHA Annual Survey Database). *Teaching status*, which is customarily used for grouping HCUP hospitals was not assigned as a category for HTYPE; this indicator was not present on the CMS hospital cost reports and so a proxy measure of the ratio of interns and residents per bed was used. In regression analyses, the hospital group average cost ratios for large hospitals and teaching versus non-teaching hospitals were not significantly different and so only the hospital bed size was used for defining HTYPE.

8. Area Wage Index—WAGEINDEX

   The Area Wage Index is an index computed by CMS to measure the relative hospital wage level in a geographic area compared to the national average hospital wage level. It is provided on the file to allow researchers to analyze cost differences geographically or to control for price factors beyond the hospital's control. Hospital cost variation has a

0.8 elasticity with the area wage index in some AHRQ published studies, meaning that variation in the hospital cost is roughly proportional to the variation in overall hospital costs. Multivariate studies should not assume strict proportionality.

The index is computed for each urban Core-Based Statistical Area (CBSA) and then linked with the AHA data before it is added to the file. If the AHA-reported CBSA does not match the CMS hospital area, then the Area Health Resources Files (AHRF) and other hospitals in the same county are used to find a matching CBSA. All rural areas in each state are combined for a single wage index. This information is available for download from CMS. For the HCUP NRD hospitals in each year, all hospitals were matched to an area wage index using CMS files, the AHA Annual Survey Database, and the Area Health Resources File in cases where the AHA survey was incomplete.

9. Internal Validation Studies

A regression analysis of the all-payer inpatient CCR was performed in earlier years.[1] This analysis used all clean HCUP and non-HCUP records with both the American Hospital Association (AHA) Annual Survey Database and CMS data. This was a weighted OLS regression using acute medical-surgical beds as the weighting variable, with separate state constant terms. Factors leading to significant differences in the CCR were: investor-ownership, rural location, large size (more than 300 beds), and a high ratio of interns and residents per bed (top 5%). Several of the state constant terms were also significant. The results tended to validate the "peer-grouping" method used here to create weighted group averages for each HCUP record. This regression analysis is repeated each year during the CCR File production, which confirms the initial conclusions.

In 2001 an internal study was performed for two states where three different methods of calculating cost by DRG were compared (hospital-wide ratios, department-based ratios, and gross charges). The analysis concluded that hospital-wide CCRs as provided in the HCUP CCR Files, although not as accurate as department-based CCRs, are more accurate than gross charges in estimating relative cost by DRG. In 2008, 2012, and 2014, studies were conducted involving 10, 27, and 28 states respectively that provided detailed charges to HCUP in order to evaluate various methods of clustering cost centers to create adjusted cost ratios.[2] These studies produced more accurate CCRs because they use departmental CCRs as opposed to hospital-wide CCRs. Users interested in quantifying potential biases due to use of the hospital-wide CCRs should contact HCUP user support (hcup@ahrq.gov).

10. Tools for More Accurate Cost Estimates

HCUP periodically evaluates the differences in cost estimates by hospital and by cost centers (departments) and individual services.[3] There are two sets of cost adjustment factors available, for data years 2006 and 2009. The adjustment factors are contained in

[1] Refer to the References section at the end of this document.

[2] The 2008 study was an internal report not for distribution. Refer to the References section at the end of this document for the 2012 and 2014 citations.

[3] In general, department-specific CCRs are more accurate for deriving the cost of a hospital stay than hospital-wide CCRs. However, not all of the HCUP Partner organizations ask hospitals to report detailed charges for every discharge, and not all hospitals have usable CMS accounting reports.

the appendices of the following methods reports available at https://www.hcup-us.ahrq.gov/reports/methods/methods.jsp.

In general, department-specific CCRs are more accurate for deriving the cost of a hospital stay than hospital-wide CCRs. However, not all of the HCUP Partner organizations request that hospitals report detailed charges for every discharge, and not all hospitals have usable CMS accounting reports.

An initial report conducted with 2006 data (Song et al., 2008), provides adjustment factors by Clinical Classifications Software (CCS) categories and All-Patient Refined Diagnosis Related Groups (APR-DRG). The adjustment factors allow an analyst to correct cost estimates based on hospital-wide CCRs. Such adjustments will increase the estimated costs for patients in some APR-DRG and CCS categories and reduce the estimated costs for patients in other APR-DRG and CCS categories.

An updated report, conducted in 2012 (Sun et al., 2012), used a more extensive methodology to develop correction factors for 2009 data for each Medicare-Diagnosis Related Group (MS-DRG) and each CCS category. This addresses an issue with the hospital-wide CCR in that it does not account for variations among service departments in the hospital. This year's report created 13 cost-center clusters that take into account the higher markup (the inverse of CCR) for ancillary services as a whole than for routine bed-unit services. The cost-center specific and hospital-wide CCRs were applied to SID discharges for each MS-DRG or CCS category. These adjustment factors allow an analyst to correct cost estimates based on hospital-wide CCRs for the patient's MS-DRG or CCS category to get a more accurate CCR and, hence, a more accurate cost estimate.

11. Variable List

The following list summarizes the variables (and their respective labels) included in the Cost-to-Charge Ratio Files for the NRD.

Table 1. Data Elements on CCR for NRD: 2010-2018

Data Element	Description
HOSP_NRD	NRD hospital number
CCR_NRD	All-payer inpatient or Group Average CCR
WAGEINDEX	Wage Index, source CMS, edited
YEAR	Year for linking to HCUP records

References

Friedman B, De La Mare J, Andrews R, McKenzie DH. Practical options for estimating cost of hospital inpatient stays. *J Health Care Finance*. 2002 Fall;29(1):1-13.

Song, X, Friedman, B. Calculate Cost Adjustment Factors by APR-DRG and CCS Using Selected States with Detailed Charges. HCUP Methods Series Report # 2008-04. U.S. Agency for Healthcare Research and Quality. Available: http://www.hcup-us.ahrq.gov/reports/methods.jsp.

Sun Y, Friedman B. Tools for More Accurate Inpatient Cost Estimates with HCUP Databases, 2009. [Errata added October 25, 2012.] HCUP Methods Series Report # 2011-04. Online October 29, 2012. U.S. Agency for Healthcare Research and Quality. Available: http://www.hcup-us.ahrq.gov/reports/methods/methods.jsp.